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# Complementary feeding
## of young children in Africa and the Middle East

Institut de recherche pour le développement

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Geneva

# COMPLEMENTARY FEEDING OF YOUNG CHILDREN IN AFRICA AND THE MIDDLE EAST

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The Expert Consultation in Montpellier, France (28-30 November 1995) and the two workshops in Alexandria, Egypt (20-24 November 1994) and Addis Ababa, Ethiopia (12-15 December 1995) were organized jointly with ORSTOM. The Alexandria workshop was organized in collaboration with FAO, UNICEF and the Leopold Senghor French-speaking International University for African Development (Alexandria) and additional support was provided by USAID.

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# Foreword

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Interventions to prevent and significantly reduce the prevalence of malnutrition among children in developing countries traditionally focus on children aged 0 to 5 years. There is, however, a growing consensus that the greatest nutritional threat to children occurs in the period from about 6 to about 24 months of age. Morbidity and mortality rates are high because malnutrition, either directly or indirectly, plays a major role in their occurrence. This has recently been verified through the analysis, in collaboration with the World Bank, of infant mortality figures around the world. Malnutrition is an underlying cause of mortality in 54% of deaths among children below five years of age. Globally, approximately one million three hundred thousand children die every year from malnutrition. The incidence of infectious diseases, particularly diarrhoea, peaks during this period. Growth faltering appears at that time, with stunting often persisting throughout childhood.

By about six months of age all infants should be receiving appropriate complementary foods and breastfeeding should continue for up to two years or beyond. The period of complementary feeding should begin when breast milk alone no longer satisfies the nutritional requirements of the infant, which happens between the fourth and sixth month of life. The period ends when the child no longer takes the breast but eats family foods.

Numerous studies demonstrate that inappropriate complementary feeding practices — including premature or late introduction of foods other than breast milk, inadequate amounts of food, nutritionally inadequate or unsafe foods, and early cessation of breastfeeding — are important determinants of malnutrition among young children. Moreover, foods which are supposed to be complements to breast milk often become substitutes to that same milk.

It was the World Health Organization's mandate to consider complementary feeding problems. The two Regional Offices for Africa and The Eastern Mediterranean Region had the merit of gathering many countries of their respective regions in order to review infant and young child complementary feeding. The inter-country workshops held in Alexandria, Egypt, 20–24 November 1994, and in Addis Ababa, Ethiopia, 12–15 December 1995, have considered the problem from two different angles: firstly, by analysing current feeding practices during the period of complementary feeding, and secondly, by reviewing in detail complementary foods and particularly the so-called flour for infants and young children, their composition, production and use, the objective being the development of national strategies for the promotion of programmes aiming at ensuring appropriate complementary feeding of young children.

These workshops took place in a historical context which goes back to the early eighties, when WHO showed its interest in infant and young child feeding problems by first giving to breastfeeding the special attention it deserved. This era culminated in 1990 with the Innocenti Declaration on the Protection, Promotion and Support of Breastfeeding. We are now entering another phase where complementary feeding should be considered as the second important stage for the nutritional well being of children.

The Alexandria workshop, held in November 1994, gathering French-speaking countries of Africa, followed a meeting held seven years earlier in Nairobi,[1] where discussions had focused on the use of fermented products for preparing foods for infants. In Alexandria, the scope was broadened to examine complementary foods in general. In Addis Ababa, in December 1995, it was English-speaking countries' turn to discuss complementary feeding issues following a similar format. The domain is wider, however, and we should answer other basic questions in order to create the conditions for better interventions for preventing malnutrition:

- What is the optimal timing of introduction of complementary foods? Which indicators should be developed that families could use to determine when to begin providing foods in addition to breast milk?
- What is the optimal composition of complementary foods, especially in terms of micronutrient content and energy density?
- What would be appropriate in terms of feeding frequency, amounts of foods to be fed, and type of feeding utensils?
- What is the relationship between complementary feeding behaviour and sustained breastfeeding, and what are the ways to achieve optimal breastfeeding frequency and duration?
- What is the relationship between lactating mothers' health and nutritional status, breastfeeding patterns and the need to introduce complementary foods?
- What are the common social, cultural and economic constraints to optimal complementary feeding practices?

These meetings have significantly contributed to improving knowledge. Relevant recommendations have been adopted which will allow important decisions to be made at country level. These decisions should refer to the dissemination of the most up-to-date information on complementary feeding to health personnel and to the general public, as well as to producers of foods for infants and young children either at small-scale or industrial-level. In addition, the implementation of the International Code of Marketing of Breast-milk Substitutes should remain a constant concern; all efforts should be made for ensuring its effective utilization.

[1] Alnwick D, Moses S & Schmidt OG, eds (1988) Improving Young Child Feeding in Eastern and Southern Africa – Household-Level Food Technology. Proceedings of a workshop held in Nairobi, Kenya, 12-16 October 1987. Ottawa, International Development Research Center.

In a satellite meeting of the Alexandria workshop, WHO and UNICEF jointly launched the Complementary Feeding Initiative. The first step of this initiative was the preparation of a state-of-the-art review of existing knowledge on complementary feeding with the ambitious objective of answering the questions raised above.[2] The scientific updating would permit to explore new research fields and develop practical guidelines for field workers in the management of infant feeding during periods of risk. It is hoped that this initiative will naturally take place in a continuum where the meetings in Alexandria and Addis Ababa were key moments and where, at the year 2000 horizon, we should see the number of malnourished children decline significantly.

[2] K Brown, K Dewey & L Allen (1998) *Complementary feeding of young children in developing countries: a review of current scientific knowledge.* WHO/NUT/98.1. Geneva, World Health Organization.

# Outline

The inter-country workshops on complementary feeding organized by the World Health Organization's Programme of Nutrition brought together nutritionists and food scientists from many African and Middle Eastern countries. Participants discussed major scientific issues relating to infant feeding, reported on the infant-feeding situation in their countries, and described current interventions whether in households or in small-scale community-based production of complementary foods.[1]

A wealth of information was presented during the workshops which the editors have decided to assemble in a single volume together with additional scientific information and data on current practices and programmes to improve young child feeding in large areas of Africa and the Middle East.

Part one of this document deals with major scientific and technical issues: Chapter 1 summarizes the up-to-date scientific basis for complementary feeding. Chapter 2 provides an overview of current practices in Africa and the Middle East. Chapter 3 addresses the important issues of quality, safety and energy density of complementary foods. Chapter 4 presents a conceptual framework for the small-scale production of complementary foods and reviews production experiences in Africa. Chapter 5 focuses on methods and experiences of preparing complementary foods in the home. Chapter 6 considers communication tools and strategies for the promotion of appropriate feeding. Finally, chapter 7 presents a model for evaluating the nutritional impact of programmes to improve complementary feeding.

Part two describes in detail the situation relating to the feeding of infants and young children in 33 countries in Africa and the Middle East (Chapter 8) and experiences with small-scale production of complementary foods in 11 countries (Chapter 9).

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[1] Recommendations of the workshops are given in:

Trèche S, de Benoist B, Benbouzid D, Delpeuch F, Verster A, eds. *L'alimentation de complément du jeune enfant. Actes d'un atelier OMS/ORSTOM inter-pays, du 20 au 24 novembre 1994, à l'Université Senghor, Alexandrie, Egypte* [*Complementary feeding of young children. Proceedings of a joint WHO/ORSTOM intercountry workshop held at the Senghor University, Alexandria, Egypt, 20-24 November 1994*]. Paris, ORSTOM Editions, 1995.

*Complementary feeding of infants and young children.* Report of a joint WHO Regional Office for Africa/Regional Office for the Eastern Mediterranean intercountry workshop, Addis Ababa, Ethiopia, 12-15 December 1995. WHO-EM/NUT/178/E/L & WHO/AFRO/NUT96.2.

# PART I

# SCIENTIFIC AND TECHNOLOGICAL ISSUES

# Complementary feeding: a challenge to both children and mothers

Bruno de BENOIST

## 1. INTRODUCTION

During the first year of life young children experience a change of considerable nutritional importance: they progress from a milk-based liquid diet to a diversified diet based on solid foods.

This change in feeding should be part of the natural process through which infants adjust to their new extra-uterine environment. In many cases, however, this becomes a nutritional aggression that places the child in an infernal cycle of diarrhoea and malnutrition. The consequences are a negative effect on growth and psychomotor development.

This is more likely to happen if the child lives in an environment where basic foodstuffs are not easily available (too costly or unobtainable), health services are rare, hygiene is poor, mothers' nutrition education is inadequate, and they are unable to improve traditional complementary feeding practices.

The problem is how to help infants and young children adjust to a diversified diet under the best possible conditions. More precise knowledge of the various factors that play a role in this process is needed to identify the obstacles that hamper the progress of successful complementary feeding and weaning. This is exactly what our aim is: study certain aspects of complementary feeding in order to see what the main nutritional problems are and, on this basis, attempt to find a solution.

## 2. WEANING AND COMPLEMENTARY FEEDING

First of all, what is weaning? In the scientific literature, definitions of *weaning* have varied, and the term has often been misused to indicate the introduction of complementary foods. However, there is presently a consensus to define it as the complete cessation of breastfeeding. Terms such as *weaning process* and *weaning foods*, which are often found in the literature should be avoided because they imply that their purpose is the cessation of breastfeeding; *complementary feeding* and *complementary foods* should be used instead, because they convey the notion that the foods are not intended to displace or replace breast milk, but to complement it.

Moreover, all these definitions focus primarily on changes in the nature of feeding. What these approaches have in common, is that they are restrictive and do not take into account the complexity of the overall context in which complementary feeding takes place. In order to be operational, and thus lead to action, any definition of complementary feeding should cover all aspects of this issue. Complementary feeding, however, has many different components; some are universal, while others are closely dependent on social and cultural factors and thus are quite variable.

Therefore, to reflect the complexity of complementary feeding, at least five determining factors should be recognized:

- Nutritional: the nutrients supplied by breast milk have to be complemented to meet the infant's increasing nutritional needs.
- Adaptational: complementary feeding means moving from feeding based on breast milk alone, to cereal-based food in addition to breast milk.
- Sociocultural: it is a period of apprenticeship during which a child becomes acquainted with new foods whose taste and texture differ from that of breast milk.
- Psycho-emotional: complementary feeding leads to a change in the relationship between mother and child that lessens his dependence.
- Chronological: changes are gradual and take place over time.

## 3. AGE OF INTRODUCTION OF COMPLEMENTARY FOODS

The age at which complementary feeding begins varies considerably. It should occur between 4 and 6 months, although the choice of this age is not arbitrary. It is based on mechanical, physiological and nutritional arguments related to the degree of maturity of the infant.

From the mechanical point of view, an infant cannot swallow solid food before the age of 4 to 6 months because of the tongue's extrusion reflex. Around 5 to 6 months, infants begin taking things up to their mouth and at 7 months are capable of chewing. Moreover, at 4 months of age, an infant's stomach is unable to hold more than 200 ml and at 6 months 250-300 ml.

From the physiological point of view the taste function matures at around 6 months; an infant of that age can eat foods of different tastes and discover new foods that differ from mothers' milk (Schmitz and McNeisch, 1987). The capacity to absorb and digest starches and fats is sufficient in a child aged 4 to 6 months: the pancreatic amylase is active from the first month, and bile salts and the pancreatic lipase are active before the age of 3 months. Proteins are absorbed normally. Moreover, an infant's intestinal mucosa is permeable to large protein molecules that are absorbed without being broken down; this can continue for a variable period. Consequently there is a risk of allergic reactions. Until the age of 12 months, fibre is only partially digested due to the absence of colic flora — which plays a vital role in its digestion — and is, therefore, not recommended during the first 6 months of life. It is necessary to wait until 4 to 6 months before the concentration and acidification capacity of the kidneys is sufficient to ensure that excess osmotic content does not lead to the type of hypernatraemic dehydration that occurs when undiluted cows' milk is given to a young infant, especially before the age of 3 months (the high protein and salt content of cows' milk increases the osmotic level three to fourfold).

From the nutritional point of view, the concentration of nutrients in breast milk is theoretically too low to cover the needs of infants from the age of 6 months. This is more exact for energy than for protein, whose level is adequate until the end of the first year. Based on the average composition of breast milk (WHO, 1985) and estimated energy needs for infants

(FAO/WHO/UNU, 1985), approximately one litre of breast milk is required to cover the energy needs of a six-month-old baby and around 1.5 litres for a one-year-old (Table 1).

These amounts not only exceed the average daily amount of milk a woman can supply but also the amount of liquid that an infant aged 6 to 12 months can absorb in 24 hours. It should be emphasized, however, that these figures are merely indicative since they are averages subject to large intra-individual variations. For example, exclusively breastfed children at 9 months grow normally, thereby showing that beyond this age breast milk can still satisfy the nutritional needs of some children.

**Table 1**
**Energy intake from breast milk and infants' nutritional needs**

| **Age** (months) | **Energy needs** (kcal/day) | **Breast milk needed to meet energy requirements** (ml/day) |
|---|---|---|
| 1 | 458 | 654 |
| 2 | 528 | 754 |
| 3 | 593 | 847 |
| 4 | 622 | 888 |
| 5 | 700 | 1000 |
| 6 | 742 | 1060 |
| 12 | 1020 | 1457 |

*Source: based on FAO/WHO/UNU, 1985.*

## 4. MICRONUTRIENTS AND COMPLEMENTARY FEEDING

After 6 months of age, the micronutrient content of breast milk is no longer sufficient to meet an infant's entire micronutrient needs although the consequences of this are attenuated by a very high bioavailability of micronutrients from breast milk. An infant over 6 months is vulnerable to micronutrient deficiencies, namely iron, vitamin A and calcium. Children consuming an average of 500 ml of breast milk a day from 6 months onwards would barely cover 10% of their iron needs, and less than one third of their vitamin A and calcium requirements (WHO, 1989).

In addition, because of their composition, porridges that contain a mixture of cereals or tubers and pulses are especially poor in micronutrient.

One of the first measures is to enrich breast milk by giving the nursing mother micronutrient supplements, such as iron or vitamin A. However, one must bear in mind that vitamin A should be given within the first two months following delivery and not later in order to avoid any risk of teratogenicity in case of a new pregnancy. This allows the child to build up reserves that could protect him. Another measure is to vary the infant's diet by adding to the porridge one or two meals of foods that are rich in iron or in vitamin A such as fruit, dark-green leafy vegetables, and yellow pulp vegetables (Table 2).

Only a small quantity of vegetables is needed to cover vitamin A requirements. Furthermore, their addition has the advantage of providing both iron and vitamin A since the majority of vitamin A-rich vegetables are also rich in iron. These measures are particularly important for populatio groups at risk of vitamin A deficiency. Dairy products are a good source of calcium.

**Table 2**
**Examples of daily intake of foods needed to meet young children's vitamin A requirements**

| **Age** | **Carrots** (tablespoons) | **Sweet potatoes** (tablespoons) | **Dark-green leafy vegetables** (cup) |
|---|---|---|---|
| 6 to 11 months | 1½ | 1 | 1/3 |
| 12 to 23 months | 1 ½ | 1 | 1/3 |
| 2 to 6 years | 2 ½ | 1 | 1/3 |

*Source: adapted from Newman, 1992.*

## 5. BREASTFEEDING AND COMPLEMENTARY FEEDING

Complementary feeding is the gradual introduction of non-milk foods in addition to breast milk. This means that breastfeeding and complementary feeding are one process. Consequently, the promotion of breastfeeding should always be considered in combination with an improvement in complementary feeding practices and not separately as it has, up to now, been the case.

The question of the duration of complementary feeding also raises that of the duration of breastfeeding. Ideally, breastfeeding should continue until at least the age of 24 months. This is justified from a nutritional standpoint: a mother who is unable to give her child dairy and animal products every day, if she continues to breastfeed, can provide him with a minimum intake of good-quality protein and contribute to meeting the child's calcium and micronutrient needs. It is also justified from the emotional and psychological points of view: prolonged breastfeeding allows children to gradually separate from their mothers while giving them time to learn to adapt to their environment.

## 6. MOTHERS' ROLE IN COMPLEMENTARY FEEDING

Mothers should receive greater attention because they play an essential role in the complementary feeding process by: deciding when their infants will receive their first solid meal; preparing the meals and thereby determining their nutritional quality and level of hygiene; looking after their children's health; and by managing the budget with which they buy the food and, where possible, growing it themselves.

There are, however, two aspects that deserve special attention:

- Education: the higher a mother's educational level, the greater her aptitude to adopt healthy complementary feeding practices, continue breastfeeding despite social constraints, eliminate unsatisfactory food practices, and ignore the effects of harmful advice from her family, friends, or the media.

- Time: because of the demands of family and work, mothers often have little time to devote to their children. Mothers who do have spare time could vary their children's meals by cooking vegetables. They should also follow basic rules of hygiene when preparing meals, feed their children under the best possible conditions and, respecting their child's rhythm, prepare meals several times a day rather than just once. This would not only increase the number of meals, but avoid keeping food under conditions that make it prone to contamination. Nevertheless, it is important to provide children with a complementary food that is easily prepared, of high nutritional quality, based on locally available products, inexpensive, and acceptable to both mother and child.

## 7. CONCLUSION

The period of complementary feeding carries a high risk of nutritional deficiency. In recent years, considerable efforts have been made to promote breastfeeding, but the issue of complementary feeding has been left aside and has not received the importance it deserves. Its dietary aspects have, of course, been the subject of many studies which have led to the development of techniques for the production of complementary foods adapted to local conditions. In addition, they have given answers to the dilemma of porridge energy density with respect to the quantity ingested. However, these techniques are by no means widespread and respond only partly to the issues raised by complementary feeding practices.

Firstly, breastfeeding and complementary feeding are two processes that are closely linked. This link does not mean that one replaces the other, but rather complements it. Complementary foods do not replace breast milk but complement it; the term complementary foods is purposefully used to underline this role. In practice, this should be reflected in education and mobilization programmes aimed at promoting, in parallel, both breastfeeding and improved complementary feeding practices.

Secondly, the complementary feeding period corresponds to a time of great vulnerability to micronutrient deficiency. This is particularly true for the population group at risk, not only because it is living in an area where the production of fruit and vegetables rich in vitamin A and iron is limited, but because it is socially disadvantaged, irrespective of the level of local agricultural production. Recognition of the extent of micronutrient deficiency, and of the role of inappropriate complementary foods in causing it, should ensure that efforts are made to increase the intake of micronutrients, especially vitamin A and iron. This is precisely where the important nutritional role of breast milk comes into play, complemented by a variety of these foods, to which vitamin A-rich foods can be added if needed.

Finally, the health, social, economic and cultural context has a determining effect on complementary feeding practices and the nutritional quality of complementary foods. In this respect, mothers have a vital role to play because they control most of the parameters involved in the complementary feeding process. Therefore, complementary feeding is not only a challenge for children but also for mothers. It is necessary to recognize the multiple dimensions of complementary feeding practices and to take them into account when designing programmes to improve feeding practices. This will ensure that the nutritional status of the child is protected during the phase of rapid growth, and will guarantee the nutritional security that is critical to a child's health and development.

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# Complementary feeding of young children in developing countries: a review of current scientific knowledge

Djamil BENBOUZID
Bruno de BENOIST

## 1. INTRODUCTION

A joint WHO/UNICEF consultation took place from 28 to 30 November 1995 in Montpellier, France, to discuss a state-of-the-art review of complementary feeding in developing countries[1] that had been prepared by the Program in International Nutrition, Department of Nutrition of the University of California at Davis. The focus was on the appropriate age of introduction of complementary foods, the energy and nutrients required from complementary foods, caregiver behaviours and constraints, issues of safety and quality of foods and programmatic interventions to improve complementary feeding. The experts in Montpellier reached a consensus on major conclusions and were able to describe feeding recommendations. In addition, they underlined areas where additional research is needed (WHO, 1998). Most of the contents of this paper, including the tables, come from this state-of-the-art review.

**Definitions**

- The period of *complementary feeding* is the period during which other foods or liquids are provided along with breast milk.
- *Complementary foods* are defined as any non-breast milk foods given to young children during the period of complementary feeding, excluding breast-milk substitutes.
- *Transitional foods* are complementary foods specifically designed to meet the particular nutritional or physiological needs of the child.

## 2. BREASTFEEDING AND AGE OF INTRODUCTION OF COMPLEMENTARY FOODS

Exclusive breastfeeding in early life protects against infections and reduces morbidity and mortality; this effect is particularly important in environments where microbial contamination of water and foods is common. Many studies have shown that the prevalence of diarrhoea and respiratory illness are higher in infants receiving solid foods or fluids other than breast milk

[1] K Brown, K Dewey & L Allen (1998) *Complementary feeding of young children in developing countries: a review of current scientific knowledge*. WHO/NUT/98.1. Geneva, World Health Organization.

(including water, teas and non-human milk). Moreover, the negative nutritional impact of illness is reduced when the infants are exclusively breastfed. The early introduction of foods and fluids displaces breast milk, although the degree of displacement varies between studies. Therefore, avoidance of other fluids and foods during the first months of life is essential to optimize breast-milk production.

In 1992, the World Health Assembly reaffirmed that "during the first four to six months of life no food or liquid other than breast milk, not even water, is required to meet the normal infant's nutritional requirements, and that from the age of about six months infants should receive a variety of locally available and safely prepared foods [...] in addition to breast milk to meet their changing nutritional requirements" (resolution 45.34).

Given the high risk of diarrhoea associated with consumption of complementary foods in developing countries, some authors have questioned the appropriateness of introducing complementary foods from the age of four months. In terms of impact on growth, observational studies are not conclusive regarding this issue. A well-designed experimental study conducted in Honduras has shown that there is no nutritional advantage to giving complementary foods at 4 months rather than at 6 months of age.

During the Montpellier consultation, the experts stated that "time was not sufficient for full discussion and analysis of the timing of introduction of complementary foods" and that more research was needed to resolve this issue. Thus, the Consultation focused its attention on complementary feeding from the age of six months.

## 3. ENERGY REQUIRED FROM COMPLEMENTARY FOODS

### 3.1. Amount of energy

To define energy requirements from complementary foods, the amount of energy supplied by breast milk was examined in affluent and developing countries, and the mean amounts observed were subtracted from the recently revised age-specific estimates of energy requirements of infants and young children. Where studies did not measure the energy density of breast milk, a density of 0.65 kcal/g was assumed. The mean amount and range of energy required from complementary foods is tentatively set out in Table 1.

**Table 1**
**Mean amount and range of energy required from complementary foods in developing countries**

| Age (months) | 6–8 | 9–11 | 12–23 |
|---|---|---|---|
| kcal/d | 275<br>(70–470) | 450<br>(230–670) | 750<br>(490–1000) |

*Source: adapted from K Brown, K Dewey & L Allen (1998). Complementary feeding of young children in developing countries : a review of current scientific knowledge. Geneva, WHO.*

The energy required from complementary foods depends on the level of breast-milk intake, the upper and lower limit of the range given in parenthesis corresponding to requirements for infants with low (mean-2sd) or high (mean+2sd) breast-milk intakes. These ranges should not be considered as necessarily representative for all populations of developing countries because they are based on a limited number of studies. The figures should be used as general guidelines for the energy required from complementary foods, the best indicator of adequacy being the infant's growth.

### 3.2. Feeding frequency

To develop estimates of the minimally adequate energy density of complementary foods, it is necessary to take feeding frequency into account. For example, if energy density of foods is increased, energy requirements can be met with a smaller number of meals. If the number of meals is high, energy needs can be satisfied with foods of lower energy density. Thus, feeding frequency and energy density must be considered simultaneously.

Table 2 shows the calculated required energy density of complementary foods at different meal frequencies for well-nourished children with low, average or high breast-milk intakes. The clinical studies from which the estimates of Table 2 are derived were conducted in non-breastfed children.

Empirical data from non-breastfed malnourished infants indicate that greater energy intake occurs with each additional meal, regardless of energy density, but there may be diminishing returns in that as the number of meals increases, the increment in total energy intake may be progressively less. Since meal frequency may be constrained by competing demands on a mother's time, increased meal frequency may be insufficient to compensate for existing low energy density.

**Table 2**
**Calculated minimum energy density required to attain level of energy needed from complementary foods in well-nourished children by age and level of breast-milk intake**

| Minimum energy density (kcal/g) with | 6 - 8 months | | | 9 - 11 months | | | 12 - 23 months | | |
|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | a | b | c | a | b | c |
| 1 meal/d | 2.55 | 1.76 | 0.98 | 3.09 | 2.31 | 1.53 | 3.70 | 2.95 | 2.21 |
| 2 meals/d | 1.28 | 0.88 | 0.49 | 1.55 | 1.16 | 0.77 | 1.85 | 1.48 | 1.11 |
| 3 meals/d | 0.85 | 0.59 | 0.33 | 1.03 | 0.77 | 0.51 | 1.23 | 0.98 | 0.74 |
| 4 meals/d | 0.64 | 0.44 | 0.24 | 0.77 | 0.58 | 0.38 | 0.92 | 0.74 | 0.55 |

*a low breast-milk intake* *b average breast-milk intake* *c high breast-milk intake*
*Source: adapted from K Brown, K Dewey & L Allen. Ibid.*

### 3.3. Energy density

Low energy density often coexists with low nutrient density. Changes made in order to increase energy density must also take into account the potential impact on protein and micronutrient intake; addition of fat or sugar alone, for example, may increase energy intake but reduces the percentage of energy from protein and the density of most micronutrients (per energy unit) in the overall diet.

### 3.4. Flavour, aroma, consistency and variety

These may affect the intake of complementary foods. Amylase treatment can enable high energy and nutrient densities to be achieved at low viscosity. In some settings, viscosity reduction of diets of similar energy density has resulted in greater energy intakes whereas in other settings this has not been demonstrated.

### 3.5. Order of feeding

The order in which complementary foods are fed to breastfed infants (i.e. before or after nursing) does not appear to influence total daily energy intake. During infancy, however, it is advisable to breastfeed before meals to maximize breast-milk intake. In the second year of life, on the contrary, it is advisable to breastfeed after meals if intake of complementary foods is low.

## 4. DURATION OF NEED FOR TRANSITIONAL FOODS

A reanalysis of data from Peru suggests that "most children are physically capable of consuming solid foods by one year of age so there is probably a fairly narrow age window when special transitional foods may be required for physiological, such as neurological reasons, as opposed to nutritional reasons".

## 5. PROTEIN AND MICRONUTRIENTS REQUIRED FROM COMPLEMENTARY FOODS

### 5.1 General issues

During the past decade, efforts were essentially directed towards protein and energy content of complementary foods, and the improvement of energy and protein density to meet children's needs. However, micronutrients did not receive as much attention until the 1980s–1990s when the international community became aware of the importance, as a public health problem, of micronutrient deficiency all over the world, and in particular in low-income countries. For example, among the 48 countries of the African Region of WHO, 40 countries have iodine deficiency problems and 44 have vitamin A deficiency problems of public health importance.

Infants and young children, as well as pregnant women, are the most vulnerable group to micronutrient deficiencies. This explains why it is essential to examine the contribution of complementary foods to the satisfaction of children's micronutrient requirements.

Assuming that the consumption of breast milk is average, the protein density (g/100 kcal) of complementary foods is not likely to be a limiting factor in most populations. This generalization may not hold where complementary foods are based on a staple with a low protein content, such as sweet potatoes or cassava.

Breast milk will meet the essential fatty acid (EFA) requirements of exclusively breastfed infants; care should be taken to ensure that the complementary foods contain enough fat to meet EFA requirements of the infant and to facilitate absorption of fat-soluble vitamins as these foods gradually increase in the diet.

Meeting micronutrient needs from complementary foods appears to be the greatest challenge. Based on calculations, adequate amounts of certain key nutrients (iron, zinc and calcium in particular) can be covered only if animal products are consumed or if alternative strategies such as food processing, fortification and supplementation are adopted. The estimates of micronutrient density in complementary foods presented in Table 3 are based on requirements when consumption of breast milk is average.

### 5.2 Translating micronutrients into foods

For field workers, the concern is not so much the micronutrient content required in complementary foods, but rather the quantity and the nature of foods needed to meet children's micronutrient requirements. It is interesting, however, to know on which basis estimates for micronutrient requirements were calculated, to assess their reliability and be able to adjust them as needed.

**Table 3**
**Desired nutrient density of complementary foods per 100 kcal for children at 6-8 months**

| | **Recommended nutrient intake** | **Complementary foods** [a] | |
|---|---|---|---|
| | *Breastmilk and complementary foods* | *Estimated nutrient needs* | *Desired nutrient density* |
| | per day | per day | per 100 kcal |
| Protein (g) | 9.1 | 2.0 | 0.7 |
| Vitamin A (μgRE) | 350 | 13 | 5 |
| Folate (μg/d) | 32 | 0 | 0 |
| Vitamin C (mg) | 25 | 0 | 0 |
| Calcium (mg) | 525 | 336 | 125 |
| Iodine (μg) | 60 | 0 | 0 |
| Iron (mg) | | | |
| - medium bioavailability | 11.0 | 10.8 | 4.0 |
| - high bioavailability | 7.0 | 6.8 | 2.5 |

[a] *At average breast-milk intake.*
*Source: adapted from K Brown, K Dewey & L Allen. Ibid.*

The authors of the state-of-the-art review calculated the desired micronutrient composition of complementary foods, by subtracting the amount of micronutrients provided by breast milk from the estimates of micronutrient requirements. This presupposes that the requirements in micronutrients for infants and young children and the composition of breast milk are known. However,

- There are no universally accepted values for micronutrient requirements. The authors of the state-of-the-art paper used the daily reference values published by the UK Department of Health in 1991, which include various sources.
- The values for the composition of breast milk are based on data collected among well-nourished mothers from industrialized countries, with the exception of vitamin A, because of lack of data from developing countries.

To predict risk of deficiency in the mother or the infant, and from a programmatic point of view, it is useful to classify micronutrients into two groups according to the impact of maternal nutrition on their content in breast milk as shown in Table 4.

Once the micronutrient composition of complementary foods is known, the amount of micronutrients required from complementary foods, and the desired nutrient density have been determined, the next step is to translate these micronutrients into foods.

Problem nutrients were defined as those nutrients for which there was a large discrepancy between the estimates of desirable nutrient density in complementary foods, and the actual density of these nutrients in the diet of the children surveyed. Studies conducted among breastfed infants and young children in Peru and Mexico are used to illustrate this approach (Table 5).

**Table 4**
**Micronutrient classification**

| Group | | Characteristics |
|---|---|---|
| 1 | Iodine, selenium, thiamin, riboflavin, vitamin B6, vitamin B12, vitamin A | - Concentration in breast milk decreases if maternal intake or stores are low.<br>- Increasing maternal intake can rapidly restore concentration in breast milk.<br>- Low concentration in breast milk adversely affects infant development.<br>- Infant stores are low, increasing infant's dependence on an adequate supply from breast milk or complementary foods. |
| 2 | Folate, vitamin D, calcium, iron, zinc, copper | - Maternal intake has relatively little effect on their secretion in breast milk.<br>- Mother is vulnerable to further depletion during lactation. |

**Table 5**
**Mean nutrient density per 100 kcal of diets consumed by young children in Peru and Mexico compared to desired nutrient density**

| Age and place of study | 6–8 months Peru | | 9–11 months Peru | | 18–24 months Mexico | |
|---|---|---|---|---|---|---|
| | desired | observed | desired | observed | desired | observed |
| Vitamin A (μgRE) | 5.0 | 63.0 | 9.0 | 50.8 | 17.0 | 30.6 |
| Calcium (mg) | 125.0 | 83.7 | 78.0 | 64.7 | 26.0 | 56.2 |
| Iron (mg) * | 4.0 | 0.4 | 2.4 | 0.4 | 0.8 | 0.6 |
| Zinc (mg) | 0.8 | 0.4 | 0.5 | 0.4 | 0.3 | 0.4 |

* *Assuming intermediate bioavailability*
*Source: adapted from K Brown, K Dewey & L Allen. Ibid.*

The authors then calculated the amounts of various common foods that children would need to consume in order to satisfy their micronutrient requirements. Tables 6 and 7 show examples of these calculations for two problem nutrients, iron and vitamin A.

### *Iron*

As shown in Table 6, it is practically impossible to supply enough iron from unmodified complementary foods to meet iron needs at 6–11 months without an unrealistically high intake of animal products. Key iron-rich foods are liver, fish and beef; eggs are also rich in iron but its bioavailability is questionable. The quantities of food that would be needed to meet estimated iron needs are generally much higher than currently observed maximum intakes prior to 12 months in the few studies for which quantitative data were available.

In the 6–11 month group, only liver can cover the iron requirements of children (provided that two-thirds of children's energy intake comes from a single food). If estimated requirements are correct — this requires further research — other means of providing iron at this age are needed (such as fortification of transitional foods or supplementation). After the first year of life, it is theoretically possible to meet iron needs from foods such as 60–80 g/d of liver, but the practicality of this in many populations is doubtful.

### *Zinc*

It is also very difficult to meet zinc needs from unmodified foods at 6–8 months, unless there is a high intake (50–200 g/d) of liver, dried fish, cheese, milk powder or beef. At 9–13 months, zinc needs can be met by relatively high intakes of liver, fish, cheese, milk powder, beef, eggs or chicken (50–200 g/d). Again, the practicality of such intakes of animal foods in many populations is questionable.

**Table 6**
**Amounts of iron-rich foods needed to meet the iron requirements of children from complementary foods by level of iron bioavailability**

| | Age (months) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 6-8 | | | 9–11 | | | 12–23 | | |
| *A. High bioavailability* | | | | | | | | | |
| Kcal limit [a] | 180 | | | 300 | | | 500 | | |
| Required iron in complementary foods (mg/d) | 6.8 | | | 6.8 | | | 3.8 | | |
| *Candidate iron foods* [b] | | | | | | | | | |
| | **g** | **kcal** | **max g** [c] | **g** | **kcal** | **max g** [c] | **g** | **kcal** | **max g** [c] |
| Beef liver | 136 | 162 | - | 136 | 162 | 12 | 76 | 90 | 73 |
| Pork liver | 155 | 162 | - | 155 | 162 | - | 86 | 91 | 76 |
| Chicken liver | 108 | 125 | 36 | 108 | 125 | 60 | 60 | 70 | 15 |
| Egg | | | | | | | 317 | 491 | 65 |
| Fish, sardines | | | | | | | 158 | 306 | 110 |
| Fish, carp | | | | | | | 292 | 380 | 96 |
| Beef, lean | | | | | | | 253 | 319 | 103 |
| *B. Average bioavailability* | | | | | | | | | |
| Kcal limit [a] | 180 | | | 300 | | | 500 | | |
| Required iron in complementary foods (mg/d) | 10.8 | | | 10.8 | | | 5.8 | | |
| *Candidate iron foods* | | | | | | | | | |
| Beans | >kcal limit | | | >kcal limit | | | 200 | 254 | 125 |

*[a] Kcal limit = 2/3 of total average energy required from complementary foods at each age*
*[b] Candidate foods are all those that contain the required amount of nutrient in less than the kcal limit*
*[c] Max g = maximum of that food per day ever consumed by a child in Peru (6–11 months) or Mexico (12–23 months)*
*Source: adapted from K Brown, K Dewey & L Allen. Ibid.*

### *Vitamin A*

The amount of vitamin A required from complementary foods is low because the vitamin A content of breast milk is high. For children whose mothers have normal breast-milk vitamin-A concentration (at least 50 μg/l), vitamin A needs can be met by reasonable amounts of various complementary foods as shown in Table 7. The amounts of these foods needed are not generally large (1–50 g/d). However, further information is needed concerning the bioavailability of vitamin A precursors from vegetables and fruits. Where red palm oil or other precursor carotenoids are available, vitamin A needs can be readily met. In areas where vitamin A deficiency is endemic, improved vitamin A intake of the mother and/or greater intakes of vitamin A-rich complementary foods by the children are advisable. Appropriately timed supplementation of mothers and/or their infants is an alternative.

## 6. FEEDING BEHAVIOURS AND CAREGIVING ISSUES

Interventions to improve complementary feeding have not succeeded unless they have addressed behavioural factors and constraints to care.

Poor appetite is a common phenomenon which has a large impact on total energy intake. Therefore, it is important to provide caregivers with a variety of strategies for overcoming poor appetite. Caregivers should be supported in efforts to feed children effectively during illness and convalescence. Feeding recommendations that address intake during and after illness need to be included whenever complementary feeding guidelines are developed.

## 7. FOOD SAFETY AND PROCESSING

Some foods contain anti-nutritional factors. Fortunately, many of these are heat-labile. Bacterial contamination of cooked foods occurs, particularly if stored at ambient temperatures. Traditional lactic acid fermentation inhibits the growth of certain pathogenic microorganisms, including *Shigella* ssp and *Escherichia coli*, and removes some anti-nutritional factors.

Some food processing techniques may enhance nutrient bioavailability. Appropriate processing techniques must be chosen depending on the types of food and resources available. Heavy metals, pesticides, and drug residues may also contaminate foods.

## 8. INTERVENTION PROGRAMMES

The aims of programmes to improve complementary feeding can be to:

- improve child feeding practices (breastfeeding and complementary feeding)
- enhance the nutrient content of complementary foods
- ensure the microbiological and chemical safety of complementary foods.

Knowledge of child feeding practices and availability of foods is required before designing an intervention. When planning an intervention, it is necessary to examine two types of issues simultaneously: the type of foods or advice for child feeding, and the delivery systems, which will be used to reach the beneficiaries of the intervention.

**Table 7**
**Amounts of vitamin A-rich foods needed to meet vitamin A requirements from complementary foods**

| | Age (months) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 6–8 | | | 9–11 | | | 12–23 | | |
| Kcal limit [a] | 180 | | | 300 | | | 500 | | |
| Required vitamin A in complementary foods (μgRE/d) | 13 | | | 42 | | | 126 | | |
| *Candidate vitamin A foods* [b] | | | | | | | | | |
| | g | kcal | max g [c] | g | kcal | max g [c] | g | kcal | max g [c] |
| Beef liver | < 1 | < 1 | - | < 1 | < 1 | - | < 1 | < 1 | 72 |
| Pork liver | < 1 | < 1 | - | < 1 | < 1 | - | < 1 | < 1 | 76 |
| Chicken liver | < 1 | < 1 | 36 | < 1 | < 1 | 70 | 2 | 2 | 15 |
| Chillies | < 1 | < 1 | - | < 1 | < 1 | - | 3 | 9 | 13 |
| Leafy greens | < 1 | < 1 | 45 | < 1 | 1 | 12 | 17 | 5 | 10 |
| Milk, whole | 46 | 29 | 29 | 148 | 93 | - | 229 | 151 | 390 |
| Eggs | 13 | 20 | 35 | 42 | 64 | 57 | 66 | 102 | 65 |
| Cheese | 7 | 16 | 1 | 22 | 50 | 3 | 111 | 153 | 121 |
| Plantain | 2 | 2 | 6 | 5 | 6 | - | 138 | 160 | 525 |
| Tomato | 22 | 4 | 48 | 70 | 13 | 38 | 145 | 30 | 32 |
| Fish, sardines | | | | | | | 147 | 283 | 110 |
| Squash, green | | | | | | | 435 | 87 | 144 |

[a] *Kcal limit = % of total average energy required from complementary foods at each age*
[b] *Candidate foods are all those that contain the required amount of nutrient in less than the kcal limit*
[c] *Max g = maximum of that food per day ever consumed by a child in Peru (6-11 months) or Mexico (12-23 months)*
*Source: adapted from K Brown, K Dewey & L Allen. Ibid.*

Programmes can be classified in three categories:

- Production of complete food mixtures by a limited number of central processing units. Most past experiences based on central units, however, have not proven to be financially sustainable.
- Preparation of complementary foods at community level, either by the local small-scale industry or by community organizations, is an alternative approach.
- Nutrition education, the last major programme option, includes general advice on appropriate complementary feeding techniques and/or information on improved household recipes, and processing techniques. Educational messages should accompany all types of complementary feeding interventions. Dissemination through interpersonal contact has proven to be more effective than other channels.

Among the many interventions that have been conducted, results have not been consistent. Moreover, few large-scale interventions have been evaluated in terms of their nutritional impact. This is an area where major efforts are needed.

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# A review of young child feeding practices in Africa and the Middle East: need for improvement

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Marie-Claude DOP

## 1. INTRODUCTION

A review of young child feeding practices must be based on the concept of the child's diet as a process starting with the systematic introduction of significant amounts of complementary foods, and ending with the cessation of regular and substantial breastfeeding. This process is, in essence, a period of transition during which feeding practices change both qualitatively and quantitatively.

It is widely agreed that the most serious nutritional problems during this period are relevant to the following issues: breastfeeding practices; complementary feeding practices (early or late introduction of complementary foods, meal frequency, and relational aspects); and nutritional value of the diet (energy, protein, micronutrient content, and food contamination).

Therefore this process is complex and multidimensional; it is dependent on the child's age and on multiple determinants, which can be described and analysed in different ways. A discussion of necessary improvements must be based on a widely accepted set of recommendations for child feeding; an assessment of feeding practices and their determinants is needed, based on operational indicators. There must be a consensus on the definition of the indicators and the method for calculating them, as well as on the data collection techniques.

In these two areas, recommendations and indicators, the most significant progress towards standardization has been made under the aegis of WHO, particularly in 1991, with the definition of indicators for assessing breastfeeding practices (WHO, 1991).

## 2. METHODOLOGY

### 2.1. Current recommendations

The recommendations adopted in 1992, as part of the World Declaration and Plan of Action for Nutrition of the International Conference on Nutrition (WHO, 1991; WHO/FAO, 1992), form the basis for evaluating feeding practices and for estimating the need for improvement.

These recommendations are the following:

- all infants should be exclusively breastfed until 4 to 6 months of age;
- from 6 months, almost all children should receive nutritionally adequate and safe foods to complement breast milk;
- until 2 years of age and beyond, children should continue to be breastfed and receive these complementary foods;
- after weaning, children should continue to receive a healthy and nutritionally adequate diet.

## 2.2. Indicators

To date a limited number of indicators have been proposed (WHO, 1991):

- The exclusive breastfeeding rate is the proportion of infants less than 4 months receiving breast milk only, i.e. no other liquid or solid.
- The predominant breastfeeding rate is the proportion of children less than 4 months of age receiving breast milk as a predominant source of nourishment, including children receiving water, water-based drinks or fruit juice, but excluding those receiving non-human milk and food-based liquids or solids.
- The timely complementary feeding rate is the proportion of children aged 6 to 9 months receiving both breast milk and complementary foods. The quality of these foods has not been taken into account because it is difficult to measure.
- The continued breastfeeding rate at 1 year is the proportion of children aged 12 to 15 months who are breastfed.
- The continued breastfeeding rate at 2 years is the proportion of children aged 20 to 23 months who are breastfed.
- The bottle-feeding rate is the proportion of children under 12 months receiving food or beverages from a bottle.

These key indicators are presented in Annex 1 of this book. They were mainly chosen because they describe the breastfeeding practices that have the most important implications in terms of child health, particularly with reference to the Innocenti Declaration on the Protection, Promotion and Support of Breast-feeding (WHO/UNICEF, 1991). The indicators have also been selected because their computation and interpretation are straightforward. Moreover, the indicators allow the implementation of breastfeeding promotion programmes to be monitored and progress made in feeding practices to be evaluated. The indicators permit comparisons to be made within a country, over time and between areas or population groups; they are also useful for comparisons between countries and to highlight regional specificity. Beyond their focus on breastfeeding practices, the indicators provide a set of age-specific feeding guidelines for young children. The present review is based on these indicators.

A recent critique has shown that additional — potentially useful — indicators can be computed using the data that are available without any additional data collection effort (McCann et al., 1994). A few examples will illustrate the type of indicators that may be proposed to improve the assessment of complementary feeding practices and the design of programmes and messages in this area.

## 2.3. Data sources

In parallel with the WHO efforts to standardize recommendations and indicators, the Demographic and Health Surveys (DHS) represent the most important attempt to collect data systematically using standardized procedures (Sommerfelt et al., 1991). The DHS are cross-sectional surveys based on national probability samples of women 15 to 49 years of age and their children aged less than 3 or 5 years.

In addition to the questionnaires completed by the participants of the Alexandria and Addis Ababa workshops, the present review is based on the results of the DHS and, in some cases, on results of other surveys using a similar methodology, for instance the multiple indicators cluster surveys (MICS), in the following countries:[1]

Algeria (1995), Benin (1996), Botswana (1988), Burkina Faso (1993), Burundi (1987), Cameroon (1991), Côte d'Ivoire (1994), Djibouti (1995), Egypt (1995), Eritrea (1995), Ethiopia (1992), Ghana (1993), Guinea (1992), Iran (1995), Jordan (1990), Kenya (1993), Lebanon (1990), Madagascar (1992), Malawi (1992), Mali (1996), Morocco (1992), Namibia (1992), Niger (1992), Nigeria (1990), Pakistan (1995), Rwanda (1992), Senegal (1993), Togo (1988), Tunisia (1988), Uganda (1995), United Republic of Tanzania (1992), Yemen (1992), Zambia (1996) and Zimbabwe (1994).

For some countries the only source of data was the WHO Global Data Bank On Breast-feeding (WHO, 1996). Caution must be exercised when interpreting the data because the surveys were conducted between 1987 and 1996; practices may have changed since the earliest data were collected.

There are a few differences between the definition of the WHO key indicators and the format of the data presented in the DHS reports:

- The predominant breastfeeding rate, as defined by WHO includes breastfed infants who receive water or water-based liquids, excluding non-human milk, while most DHS reports only present the proportion of breastfed infants receiving plain water in addition to breast milk.
- For the computation of WHO key indicators the denominator of rates is the total number of infants, including those who are not breastfed. Some tables of DHS reports do not give the total number of infants, i.e. including the non-breastfed infants. Thus, it is impossible to compute some of the key indicators from these reports, in particular, the bottle-feeding rate as defined by WHO (number of infants less than 12 months who receive any food or liquid from a bottle).

For many African countries, Macro International Inc. has published the Africa Nutrition Chartbooks which present some of the indicators, i.e. the exclusive breastfeeding and the timely complementary feeding rates, but unfortunately do not include the bottle-feeding rate as defined by WHO.

[1] Several national surveys were conducted in 1996-97. We did not include those for which a report was not yet available (Chad, Jordan, Madagascar, Mozambique, Niger, Senegal, Tanzania and Yemen). We did not take into account the 1995 Morocco survey because sample sizes for indicators of breastfeeding practices were small.

# 3. RESULTS

## 3.1. Current WHO indicators

Exclusive breastfeeding rates vary considerably. With the exception of Ethiopia, Rwanda and Burundi, all countries are very far from the goal of exclusive breastfeeding until 4 to 6 months of age. Many countries have extremely low exclusive breastfeeding rates (Figure 1).

Rates of breastfeeding exclusively or with plain water are much higher (Figure 2). Giving water to infants in addition to breast milk is still a widespread practice and explains, in large part, the very low rates of exclusive breastfeeding in many countries. Nevertheless, the proportion of infants breastfed neither exclusively nor with water remains high, ranging approximately between 25 and 75% in three-quarters of the countries.

Among 30 countries, only 7 have a timely complementary feeding rate over 80% (Figure 3); thus improvement is also necessary in this area.

The rate of continued breastfeeding at 1 year is much more satisfactory, with 17 of 30 countries having rates of 90% or more (Figure 4). However, the rate of continued breastfeeding at 2 years exceeds 75% in only three countries; moreover, it is below 50% in 16 out of 30 countries (Figure 5).

As mentioned above, data were not available to compute the recommended rate of bottle-feeding before the age of 12 months. Figure 6 shows the rate of bottle-feeding among breastfed infants less than 4 months of age: this rate is below 5% in 10 out of 26 countries, but 4 countries have a rate above 30%.

## 3.2. Other indicators

The indicators proposed by WHO measure the proportion of infants fed according to current recommendations. They can be used to assess the progress already made towards appropriate feeding and what remains to be accomplished. However, no information on young children not fed according to recommendations is provided, especially with regard to complementary foods: before the age of 4 months, is the problem a premature introduction of complementary foods or is it the cessation of breastfeeding? Between 6 and 9 months, is it a late introduction or, once again, the cessation of breastfeeding? After 12 months, are some children still not receiving solid foods? Several simple indicators, based on the same data, could provide answers to these questions. For example, it appears that before the age of 4 months, the major problem in all countries is not the cessation of breastfeeding but the early introduction of solid foods: the proportion of infants breastfed and with solid foods is higher than 10% in 11 out of 24 countries; it is above 20% in 8 countries, and above 30% in 3 countries (Figure 7).

Between 6 and 9 months, more than 10% of infants are breastfed but receive no complement of solid foods in 21 out of 24 countries; more than 20% in 16 countries and more than 1 out of 3 in 10 countries (Figure 8). In comparison, the rate of complete cessation of breastfeeding in this age group exceeds 5%, only in 5 countries.

Between 12 and 15 months, more than 10% of children still receive no solid foods to complement breast milk in 9 out of 15 countries where the information is available (Figure 9). In 3 countries, 25% or more young children are in this situation. In most countries the proportion of children not yet receiving complementary foods is higher than the proportion fully weaned in this age group.

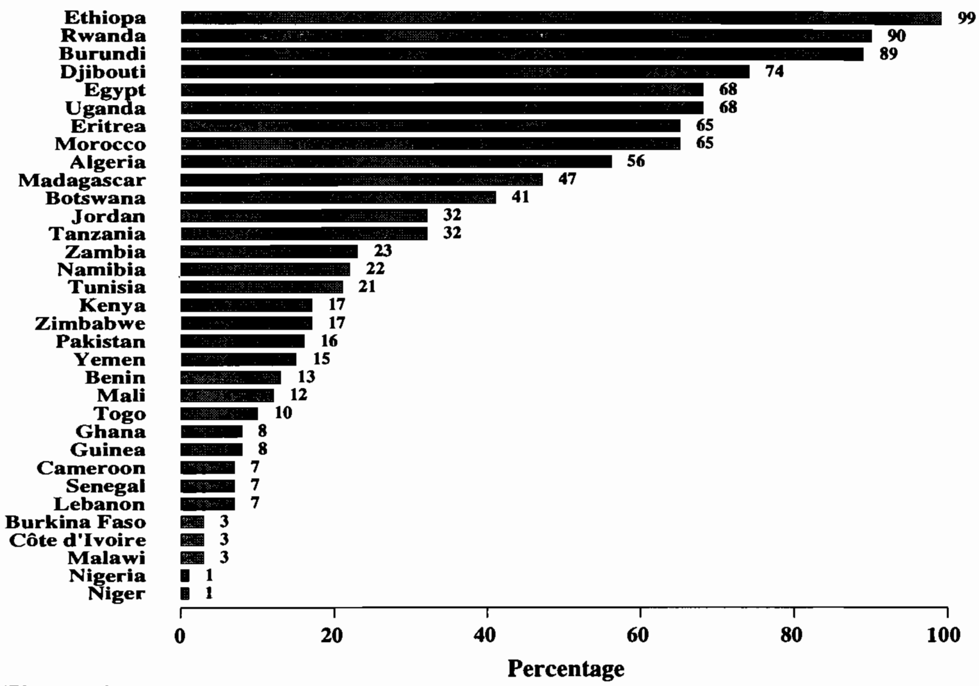


**Figure 1**
**Exclusive breastfeeding rate (infants <4 months)**

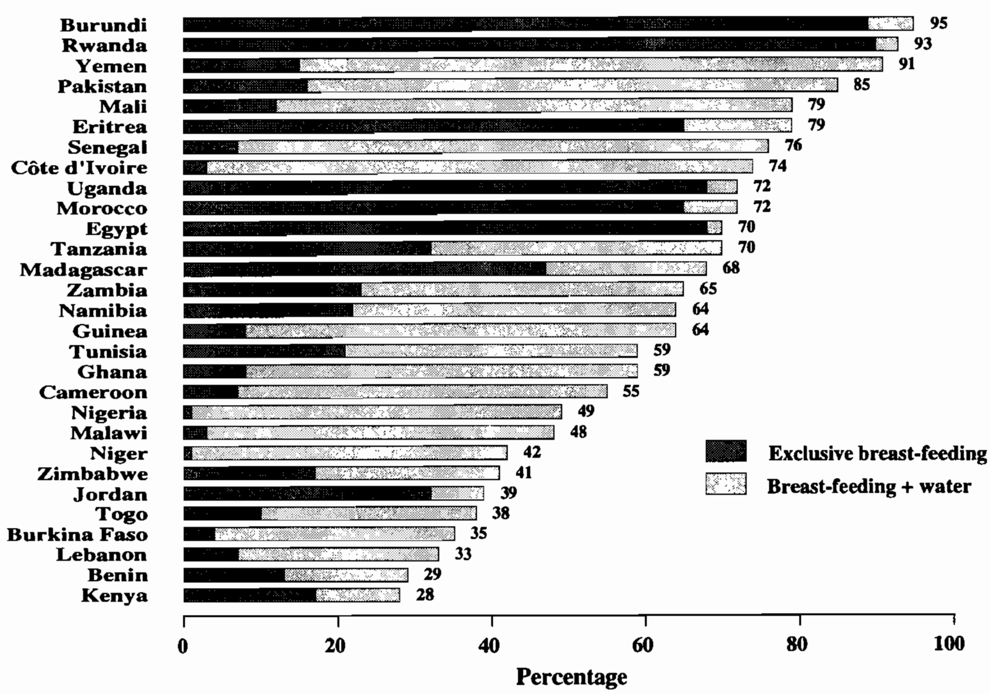


**Figure 2**
**Rate of exclusive breastfeeding and breastfeeding with water (infants <4 months)**

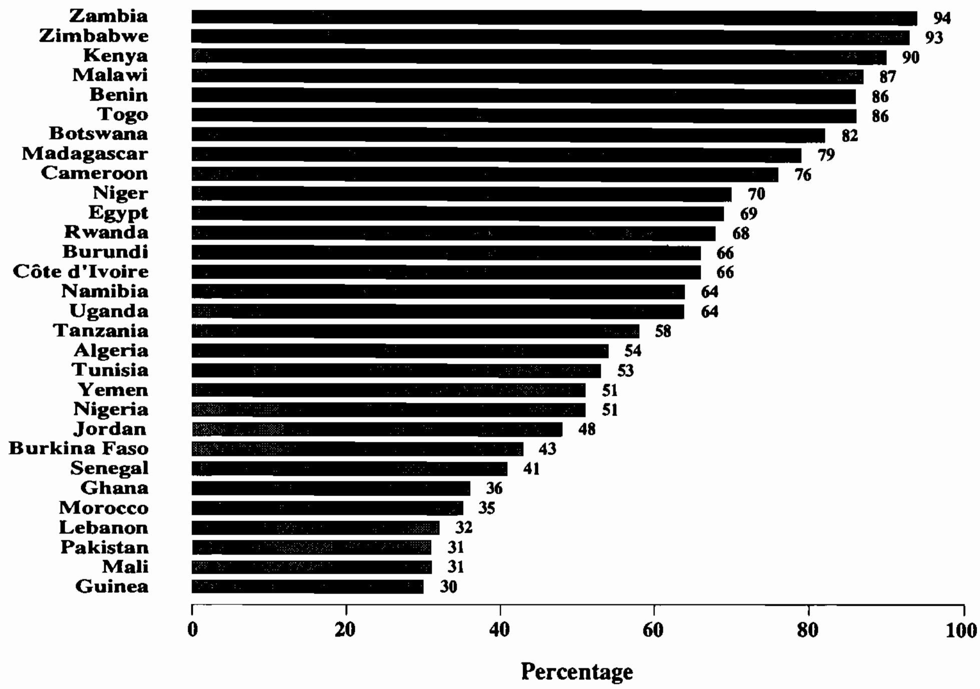


**Figure 3**
**Timely complementary feeding rate (infants 6–9 months)**

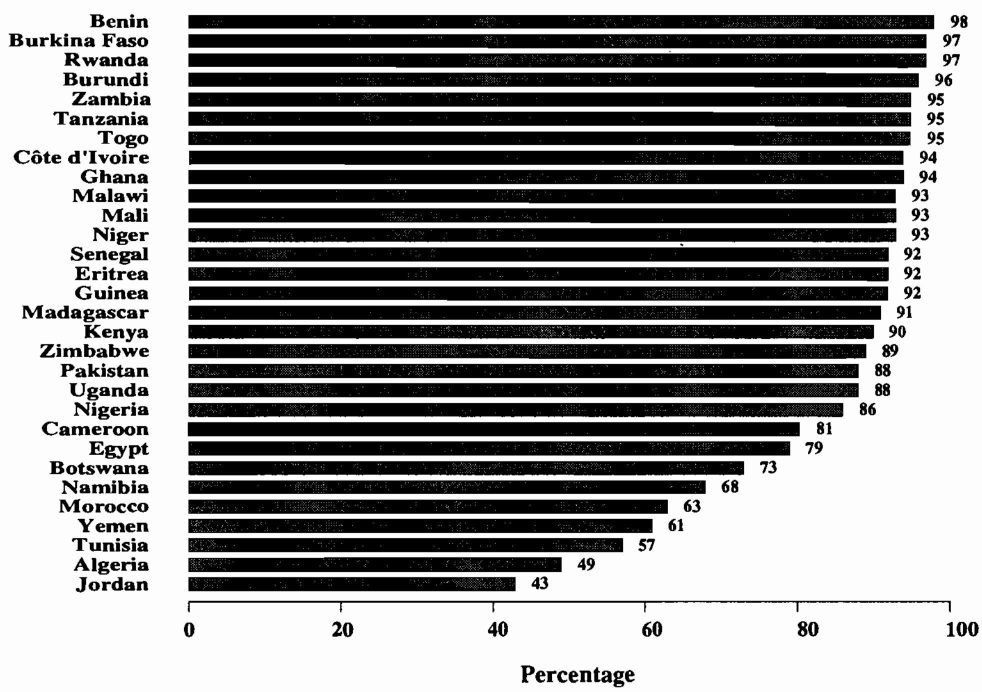


**Figure 4**
**Continued breastfeeding rate at 1 year**

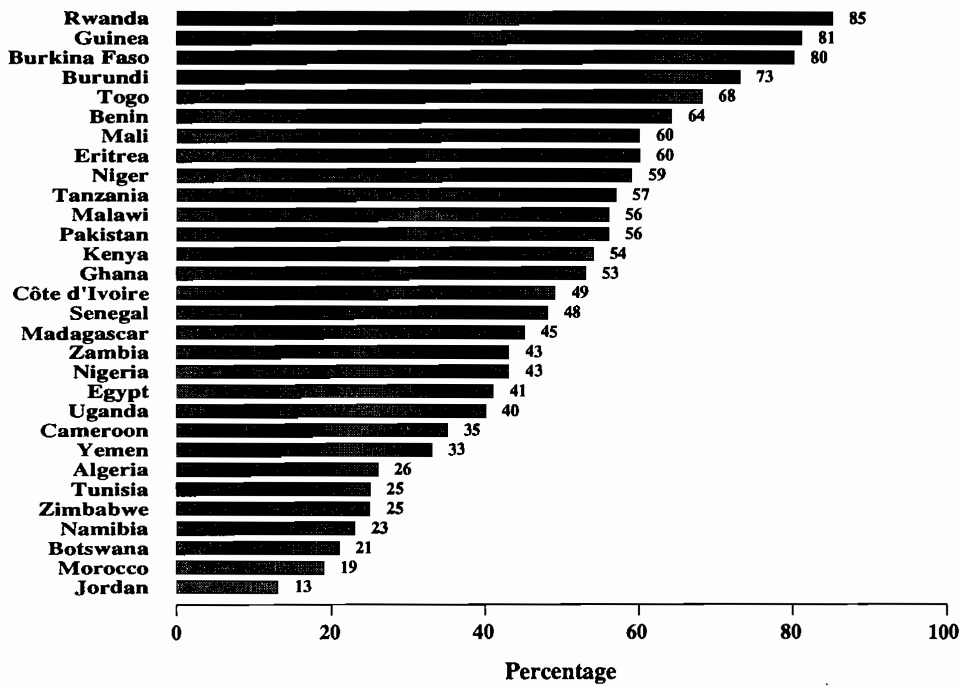


**Figure 5**
**Continued breastfeeding rate at 2 years**

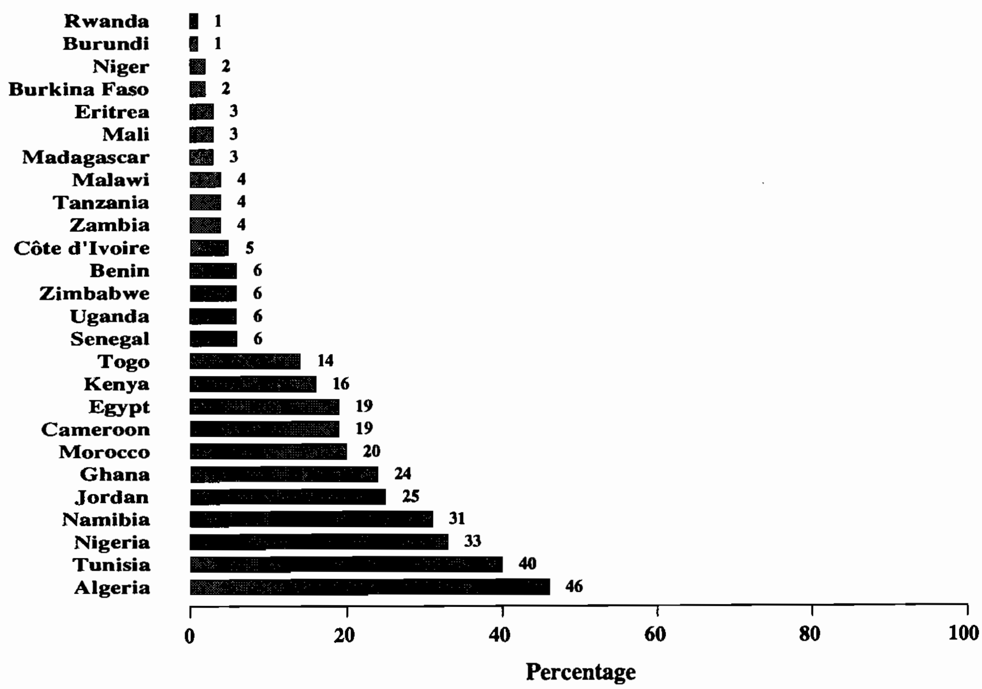


**Figure 6**
**Bottle-feeding rate (among breastfed infants <4 months)**

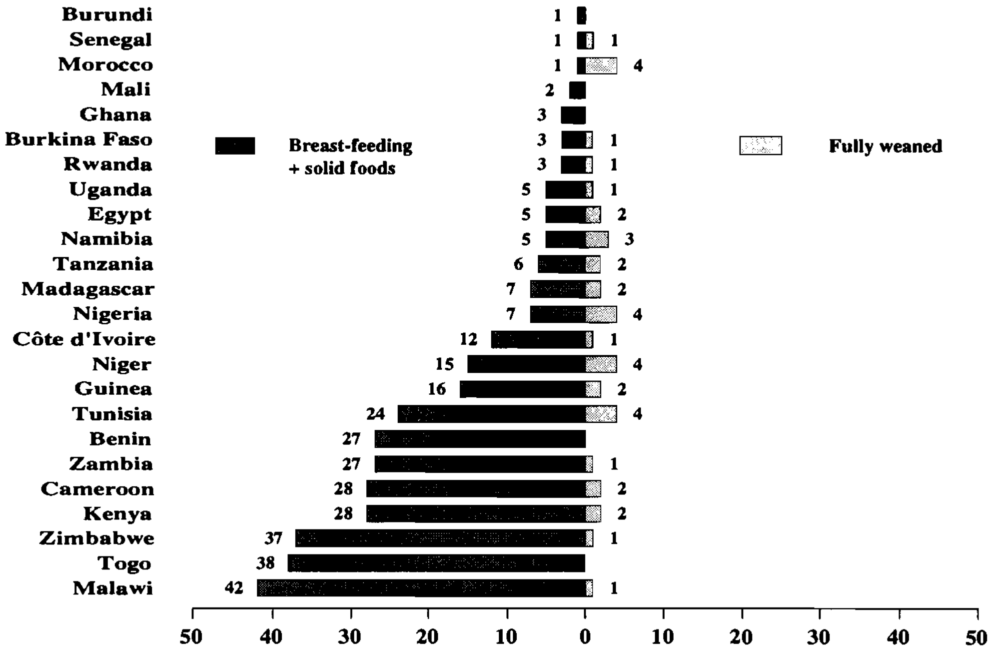


Figure 7
**Rate of breastfeeding with solid foods and percentage of infants fully weaned (infants <4 months)**

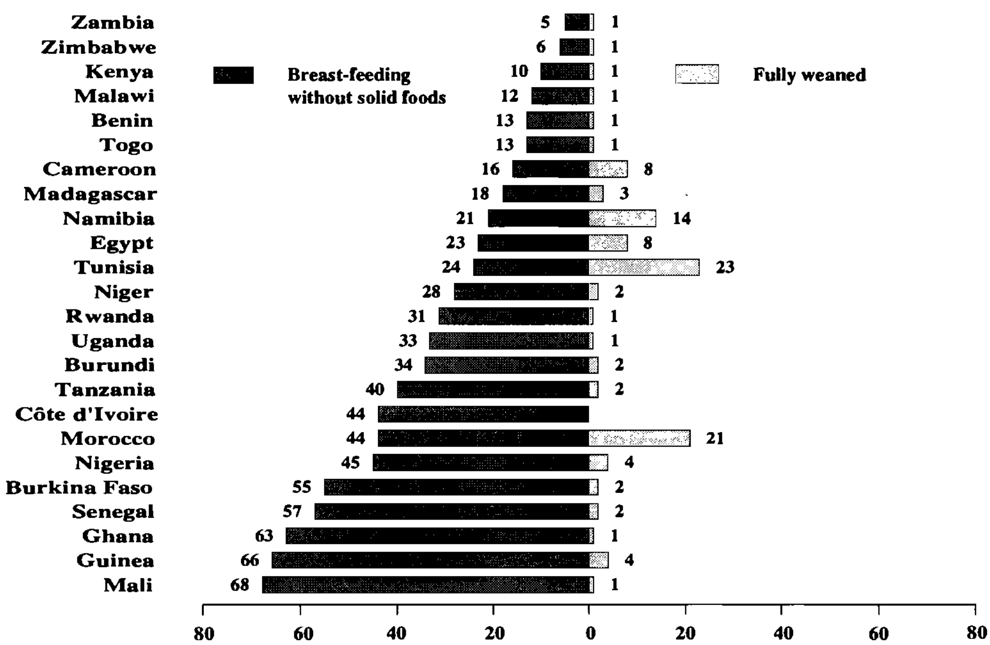


Figure 8
**Rate of breastfeeding without solid foods and percentage of infants fully weaned (infants 6–9 months)**

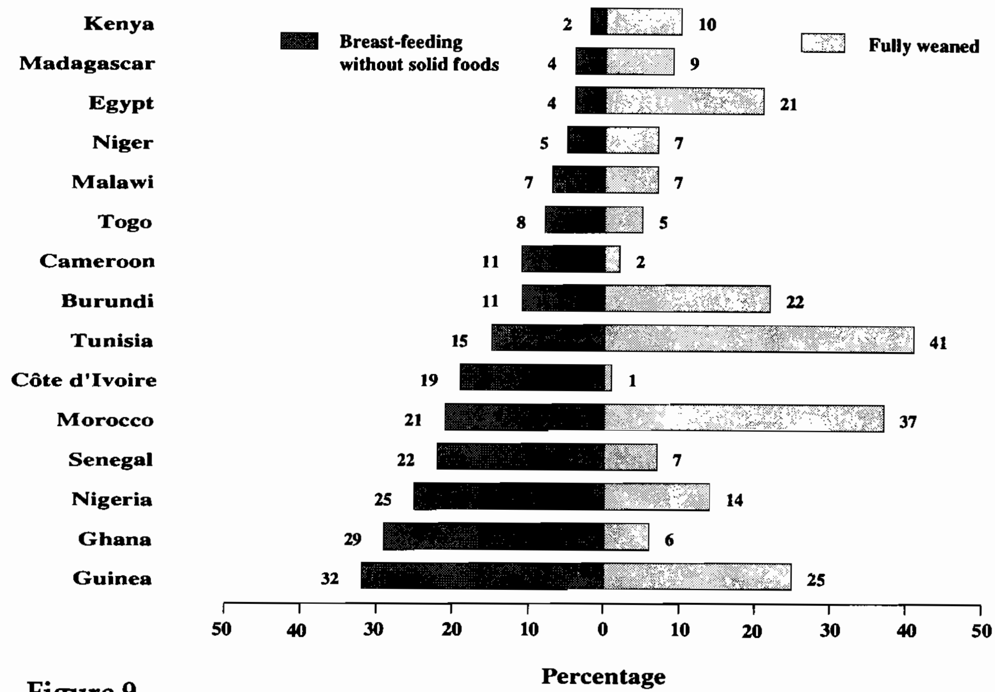


**Figure 9**
**Rate of breastfeeding without solid foods and percentage of children fully weaned (12–15 months)**

## 4. NEED FOR IMPROVEMENT

Africa remains one of the regions of the world where breastfeeding is the most widespread and lasts the longest (Perez-Escamilla, 1993). There is, however, a wide diversity in breastfeeding practices in particular and in complementary feeding practices in general, and a large number of children are fed in ways that deviate considerably from current recommendations.

Efforts are needed especially in the following areas:

- The proportion of exclusively breastfed infants at 4–6 months needs to be increased: giving water is a traditional practice — and also an accepted medical practice in many places. Consequently the exclusive breastfeeding rate is very low in many countries. Moreover, a large proportion of these infants already receive complementary foods.
- The proportion of children breastfed during the first 2 years should be increased.
- The proportion of children who receive healthy and nutritionally adequate foods to complement breast milk at the proper time, i.e. from 6 months, should be increased.

On the latter issue, we have shown that a large number of children over 6 months are still not receiving solid foods. Furthermore, the few data available show that the frequency and quality of meals are far from being adequate. Without infringing on the following presentations, the questionnaires received from the participant countries showed that:

- The mean frequency of meals is closer to 2–3 per day than the recommended 4 to 6 depending on the child's age.

- Traditional porridge, the first food given to infants, has an energy density lower — and sometimes much lower — than that of breast milk, i.e. 70 kcal/100 ml: 36 to 60 kcal for millet and sorghum porridge in Burkina, 44 to 64 kcal in Gabon, and 60 in Congo whether for cassava or maize-based porridge. The density of other nutrients and micronutrients is thus also predictably grossly inadequate.

Moreover, practically nothing is known about the amount of complementary foods that is given once complementary feeding has started: is it too large and thus disrupting breastfeeding, or too small and not meeting children's requirements? Can one depend on children's appetite regulation to avoid these two dangers?

In terms of programmes and particularly education messages, efforts made to date for the promotion of breastfeeding may not be sufficient to ensure adequate complementary feeding practices. In fact, countries with the highest rates of exclusive breastfeeding do not have the highest timely complementary feeding rates (Figure 10). Similarly, factors determining the cessation of breastfeeding or the use of bottle-feeding, which are presently better identified, are not necessarily those which also determine appropriate or inappropriate feeding practices. There is a negative correlation between the duration of breastfeeding and the level of urbanization (Figure 11) or economic development as measured by the GNP per capita. However, a similar relationship is less clear with the early (Figure 12) or the late introduction of solid foods (Figure 13).

Other cultural and social factors play a role. In Mali, Dettwyler (1986) identified fundamental beliefs pertaining to infant feeding: children do not need solid foods before the age of 8 months approximately; when children are hungry they will eat, but if they do not want to eat they must not be forced. Children know when they are hungry and when they have had enough to eat. On the contrary, in many countries most mothers consider that breast milk must be complemented very early in life. In Zinder (Niger) 40% of mothers believe that complementary foods must be given during the first 3 months, and 50% of infants in that age group have already received complementary foods (Oumarou et al., 1993).

## 5. CONCLUSION

When assessing feeding practices and when designing programmes, the focus, which is presently mainly on breastfeeding, should be shifted to encompass child feeding as a global issue. Regarding breastfeeding and complementary feeding, and as a conclusion to this tentative review, the following comments and questions are proposed for further discussion:

- The assessment of feeding practices of young children is generally inadequate; a better knowledge of mothers' current practices and their decision criteria is needed to help them improve the nutritional rationality of their decisions. In many cases, the existing information could be improved by more in-depth analyses of the available data without any additional survey or data collection effort: presenting data by types of food and age groups, bearing in mind the limitations imposed by sample sizes within age groups. In many cases, determinants and constraints to the timely introduction of complementary foods of adequate quality still need to be identified. These include: cultural beliefs, household food insecurity, availability of adequate foods, workload and allocation of time, shortcomings of the health system (lack of communication, inadequate or conflicting messages, etc.), and knowledge of hygiene.

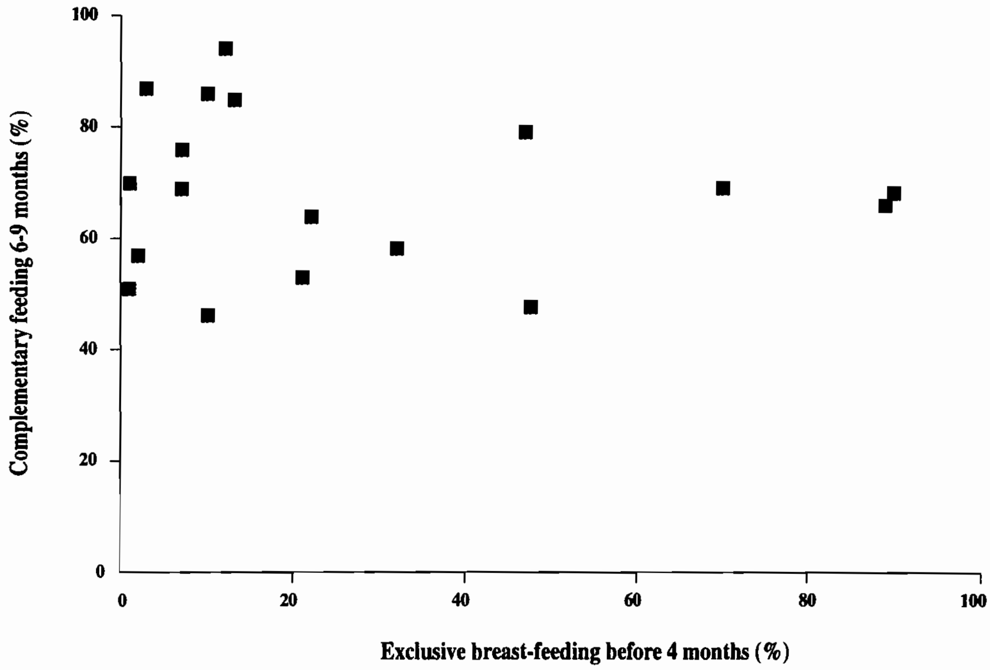


**Figure 10**
**Relationship between rate of exclusive breast-feeding (<4 months) and rate of timely complementary feeding (6–9 months) in African countries**

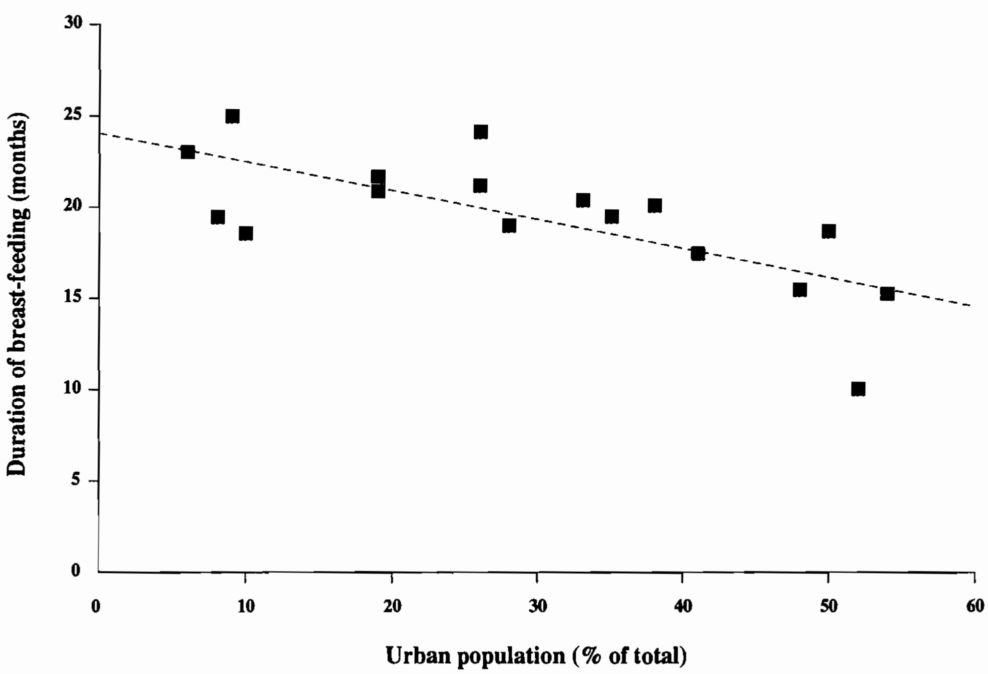


**Figure 11**
**Relationship between duration of breast-feeding and percentage of urban population in African countries**

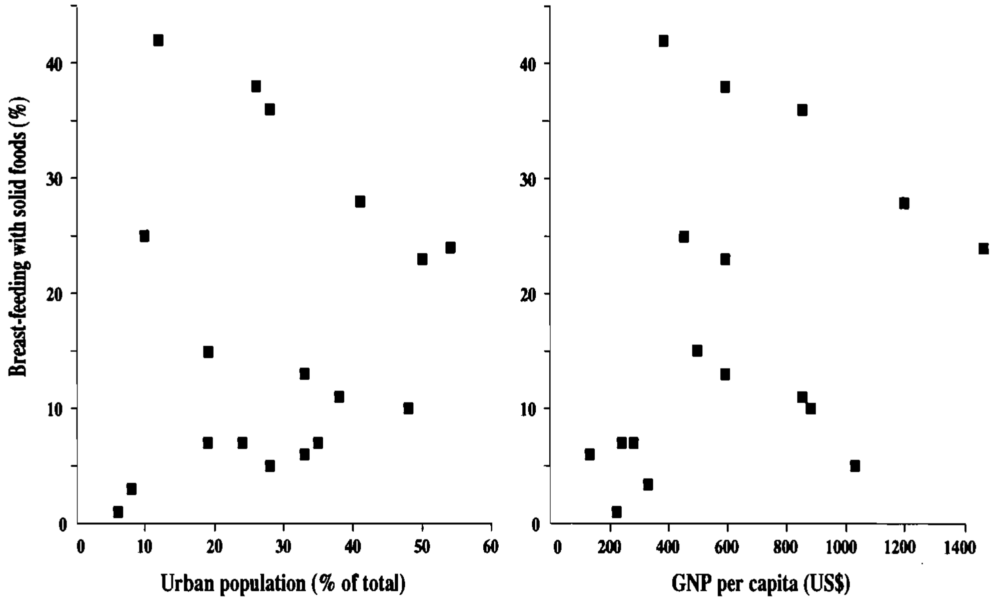


Figure 12
**Relationship between rate of breast-feeding with solid foods before 4 months and (a) percentage of urban population, (b) GNP per capita**

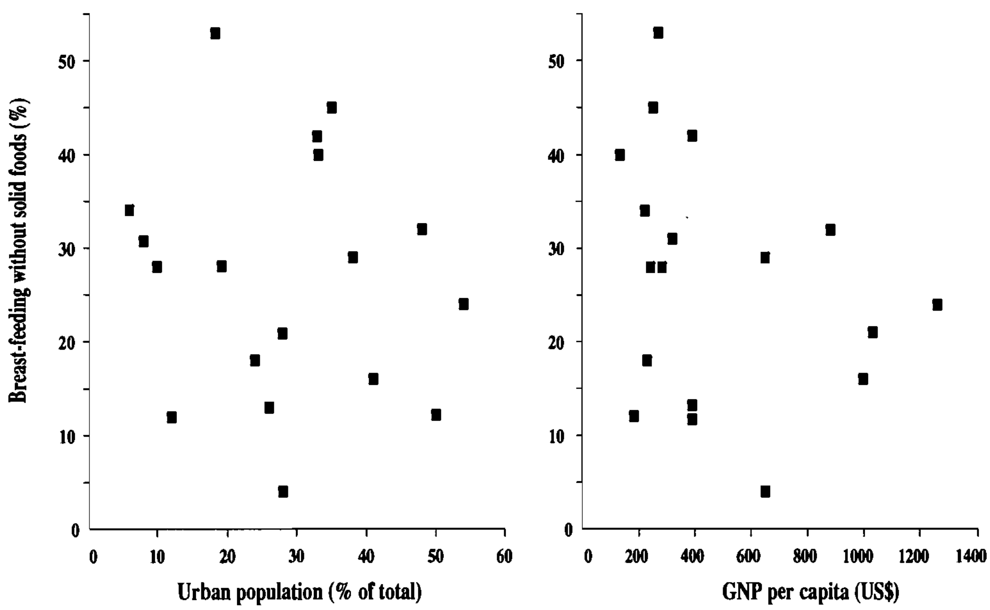


Figure 13
**Relationship between rate of breast-feeding without solid foods (6–9 months) and (a) percentage of urban population, (b) GNP per capita**

- Inappropriate practices do not affect all children; this raises the question of targeting programmes: should efforts be directed toward the general population of children or only toward target groups or individuals? Which criteria should be used for targeting? Should groups at risk of malnutrition, groups based on determinants of inappropriate practices or based on socioeconomic criteria be targeted?
- Should activities aimed at changing practices be linked to programmes for the dissemination of new foods based on innovative technologies (manufactured or made at household level)? This would provide an opportunity to take into account quality criteria, such as nutritional balance, micronutrient density, etc. When there are no processed complementary foods available, what are the alternatives for the improvement of complementary feeding of young children? Have they been tested sufficiently?
- Since the ultimate goal is to improve not only young child feeding practices, but also children's development, shouldn't programmes aimed at changing practices be integrated systematically with growth promotion activities?

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# Regional features of complementary feeding in Africa and the Middle East

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Djamil BENBOUZID

## 1. INTRODUCTION

The aim of this analysis is to highlight regional patterns of breastfeeding and complementary feeding. Where regional patterns exist, it is important to consider them when setting priorities for promotion programmes. Countries that share similar patterns of inadequate feeding practices should share their experience and expertise, to design and monitor programmes for the improvement of infant feeding. Moreover, developing programmes at regional level could strengthen countries' individual capacity for implementing and evaluating programmes.

Questionnaires on infant and young child feeding practices were sent to all the countries that participated in the workshops on complementary feeding held in Alexandria (20–24 November 1994), and in Addis Ababa (12-15 December 1995). The participating countries belong to the Eastern Mediterranean region and to the African region of WHO.

The questionnaires comprised the key indicators for assessing breastfeeding practices (WHO, 1991), plus additional questions on complementary feeding. These questions focused on the timing of introduction of complementary foods, the type, nature and composition of foods, including energy density, and the frequency of preparation and distribution. Two types of complementary foods were distinguished: first complementary foods and solid foods.

The present analysis is based on the information provided by the participants, which is presented in detail in Chapter 8 and additional sources, Demographic and Health Surveys, and the WHO Global Data Bank on Breast-feeding.[1]

There is to date no standardized format comparable to the WHO indicators of breastfeeding practices for collecting information on complementary feeding; therefore, not all countries were able to provide nationally representative data in the requested format. As a result, we included other types of information, such as data derived from surveys conducted in limited areas, and for some indicators, when no survey data were available, qualitative information given by the participants.

For the purpose of the analysis we grouped neighbouring countries, but our grouping does not reflect formal administrative divisions. Among countries of the Eastern Mediterranean region

[1] A detailed list of these references is given in Delpeuch & Dop, 1999.

of WHO we grouped the North African states on one hand, and the Middle Eastern countries with Pakistan and Yemen on the other hand. Among countries of the African region, we separated West Africa, East Africa, Central and Southern Africa.[2]

## 2. INDICATORS OF BREASTFEEDING PRACTICES

Data from nationally representative surveys were available for all the countries except for Palestine and Syria. In Congo, a rural and an urban survey were conducted at different times (Tchibindat, 1999).

### 2.1 Initiation of breastfeeding

Overall, one third of neonates of the African and Eastern Mediterranean regions are put to the breast within one hour of birth, and two-thirds within one day.

Early initiation, within the first hour of birth, is unusual. In two countries only, Malawi and Zambia, more than half of neonates are put to the breast within the first hour. Moreover, initiation within the first day is not widespread; in eight African countries, less than one in two neonates is breastfed within the first day. The practice of giving prelacteal liquids to neonates is widespread and could be a major cause of diarrhoea and early mortality.

Initiation within the first day is more common in East Africa (mean 72%) than in West Africa (mean 52%) (Figure 1). In the three Mediterranean countries for which data are available, Egypt, Jordan and Morocco, two-thirds or more of neonates are breastfed during the first day.

Promotion of early initiation is especially needed in Cameroon and Niger where less than one third of neonates are breastfed within the first day.

### 2.2 Exclusive breastfeeding rate

The mean proportion of exclusively breastfed infants is somewhat similar in both regions, with 30% in Africa and 36% in the Eastern Mediterranean.

Low exclusive breastfeeding rates are a distinctive feature of West African countries: exclusive breastfeeding rates are below 15% in all of them, and the mean rate is 7%. In some countries exclusive breastfeeding is almost exceptional (Niger and Nigeria 1%, Burkina Faso and Côte d'Ivoire 3%) (Figure 2). Low rates are also found in other parts of Africa but with no regional pattern (Malawi 3% and Cameroon 7%). Rates are much higher in East African countries (mean 55%). The highest rates, about 90%, are observed in Ethiopia, Rwanda and Burundi. In the four Southern and Central African countries, rates are intermediate (mean 22%).

Among Mediterranean countries, the distribution of rates is narrower as neither very low nor very high rates are observed. Approximately half of North African infants are exclusively breastfed (53%). In the Middle East the mean rate is lower (24%).

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[2] North Africa: Algeria, Egypt, Libya, Morocco, Tunisia. Middle East: Iran, Jordan, Lebanon, Palestine, Pakistan, Syria, Yemen. West Africa: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, Togo. East Africa: Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Rwanda, Tanzania, Uganda, Zambia. Central Africa: Cameroon, Congo. Southern Africa: Botswana, Namibia, Zimbabwe.

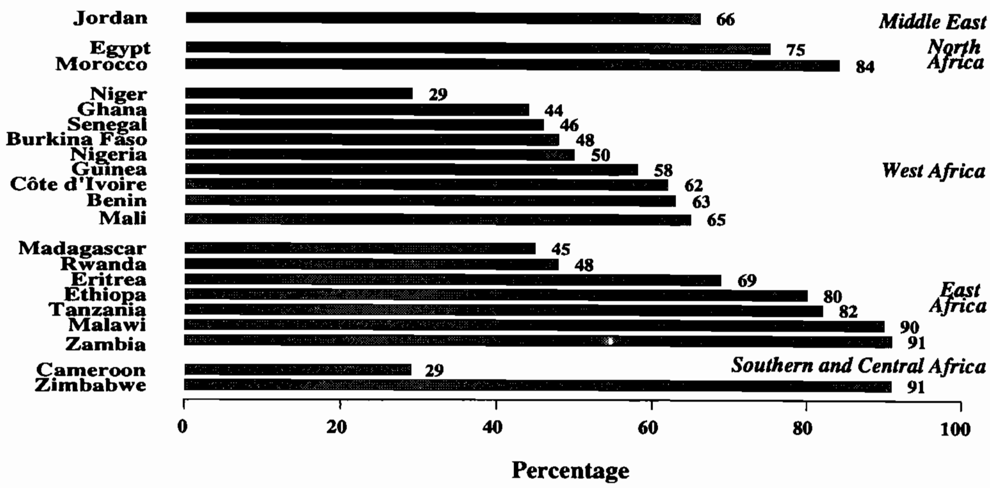


**Figure 1**
**Initiation of breastfeeding within the first day of birth**

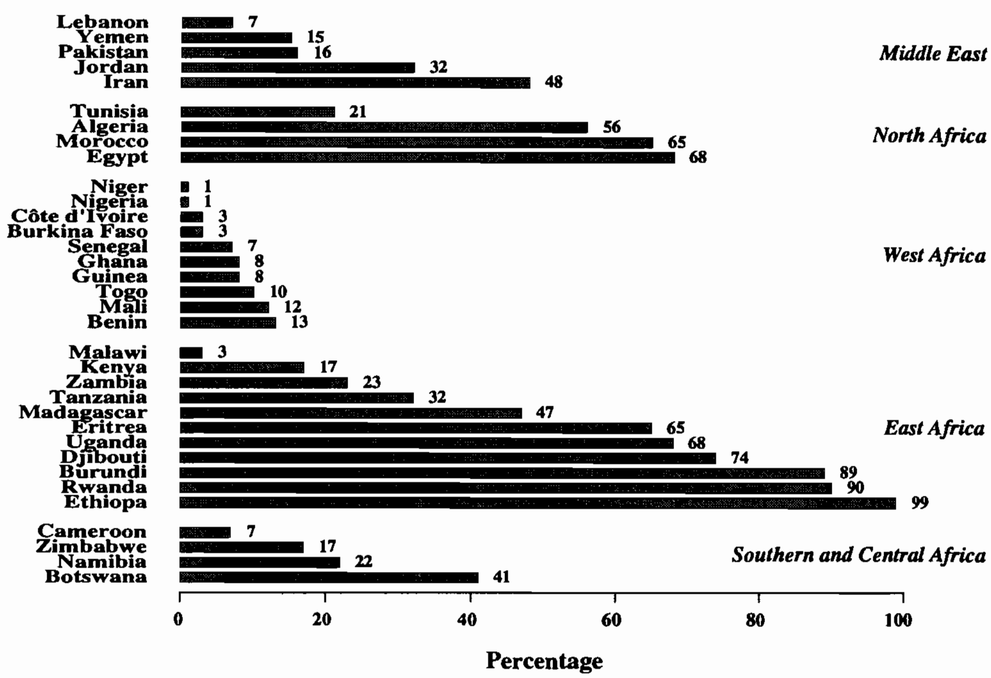


**Figure 2**
**Exclusive breastfeeding rate (infants <4 months)**

## 2.3 Rate of breastfeeding with plain water only

This indicator is used in place of the predominant breastfeeding rate — a key indicator recommended by WHO — because most DHS surveys estimate breastfeeding with plain water only (BF+W) and do not report separately breastfeeding with other water-based liquids such as juice, tea, etc. Values for this indicator are not available in Algeria, Iran, Botswana, Djibouti, and Ethiopia.

In both regions, approximately a third of infants less than 4 months are breastfed and given water (BF+W). Generally where exclusive breastfeeding is widespread, BF+W is uncommon and vice versa (Figure 3).

West African countries, whose exclusive breastfeeding rate is low, have a mean rate of BF+W of 48%, whereas in East Africa the mean rate is lower (20%). Five West African countries have rates above 50%, while the highest rate in East Africa is only 45%. Among Eastern Mediterranean countries, the rate is higher in the Middle East (mean 44%) than in North Africa (mean 16%).

Approximately two-thirds of African and Eastern Mediterranean infants less than 4 months are breastfed exclusively or with water. Some countries have both an exclusive breastfeeding rate and BF+W that are low, e.g. Benin and Kenya, where less than one-third of infants are breastfed either exclusively or with water.

## 2.4 Timely complementary feeding rate

In Africa, 65% of 6–9 month-old infants are receiving complementary foods in addition to breast milk, while only 52% receive them in the Mediterranean countries.

Marked differences are observed among regions of Africa: mean rates are high, above 70% in Eastern, Central and Southern Africa, whereas the mean rate is 54% in West Africa (Figure 4).

In five of the ten West African countries (Figure 4), less than half of the infants receive complementary foods at 6–9 months. In three countries — Guinea, Mali and Ghana — only approximately a third of infants are fed according to recommendations. In Mali, for instance, only 31% of infants are fed complementary foods, while 68% receive only water or other liquids in addition to breast milk.

In North African and Middle Eastern countries rates are also low, ranging from 30 to 70%, with the exception of Iran where almost all 6–9 month-old infants are fed complementary foods (93%).

## 2.5 Continued breastfeeding rate at one year

Two-thirds of children are breastfed beyond the first year in the Eastern Mediterranean region on average, while the mean percentage is 90% in the African region. Figure 5 illustrates the marked difference between the two regions.

In Africa, only two countries have rates below 80% (Namibia and Botswana), while in the Eastern Mediterranean region all countries have rates that are lower, except Iran (83%), and Pakistan (88%).

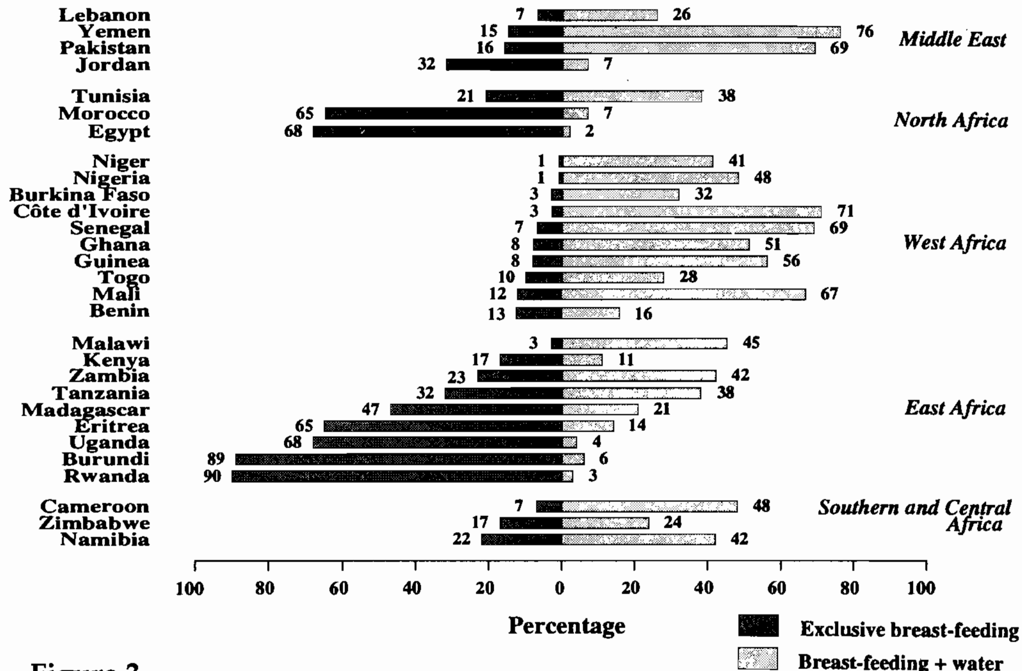


**Figure 3**
**Exclusive breastfeeding rate and rate of breastfeeding with water (infants <4 months)**

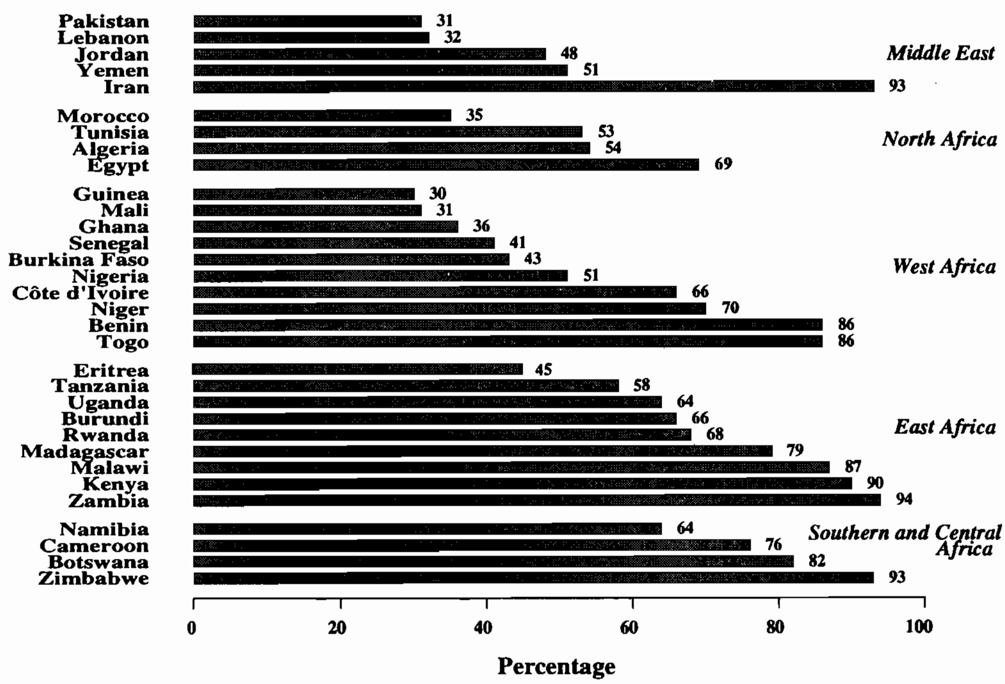


**Figure 4**
**Timely complementary feeding rate (infants 6-9 months)**

### 2.6 Continued breastfeeding rate at two years

The gap observed between the Eastern Mediterranean and the African region at one year, is less marked at two years. Less than one-third of young children are still breastfed in the Mediterranean countries (mean rate 32%) while more than half of African children are breastfed at two years (mean rate 54%).

A comparison of the median duration of breastfeeding between regions would yield similar results.[3] Although the Eastern Mediterranean and African regions differ significantly in their median duration of breastfeeding they share a common trend, that of urban and educated mothers to stop breastfeeding earlier than their rural or uneducated counterparts (Perez-Escamilla, 1993). In the many countries where urbanization is increasing this will cause a decline in the duration of breastfeeding.

### 2.7 Bottle-feeding

For many countries, the WHO indicator (percent of infants less than 12 months who are fed from a bottle) could not be calculated from DHS publications because bottle-feeding among non-breastfed infants was not reported. Therefore we present the bottle-feeding rate *among breastfed infants less than 4 months*. This indicator could underestimate the true rate of bottle-feeding because non-breastfed infants are likely to be fed from a bottle.

In the Eastern Mediterranean region, the indicator is documented in the North African countries but in only one Middle Eastern country (Jordan, 25%). Nevertheless, the data indicate that the use of bottles is much more frequent in the Mediterranean than in Africa: the mean rate is 30%, while in Africa only 9% of infants are bottle-fed on average (Figure 6).

Bottle-feeding is more common in West Africa (mean 11%) than in East Africa (mean 5%). In two countries of Africa (Nigeria and Namibia), almost one-third of breastfed infants are bottle-fed.

## 3. COMPLEMENTARY FEEDING

### 3.1 First complementary foods

First complementary foods are the first nutrient providing foods given to infants in addition to breast milk. During the WHO/UNICEF expert consultation on complementary feeding of infants and young children,[4] the term *special transitional foods* was often used to designate these foods because they are "specially prepared complementary foods designed to meet the particular nutritional and physiological needs of the infant and young child" (WHO, 1998).

Three types of foods were distinguished:

- foods prepared traditionally for infants and young children
- processed complementary foods designed for infants and young children
- nutritionally improved home-based preparations.

[3] This indicator is lacking for several Eastern Mediterranean countries and therefore is not presented.

[4] Montpellier, France 28-30 November 1995.

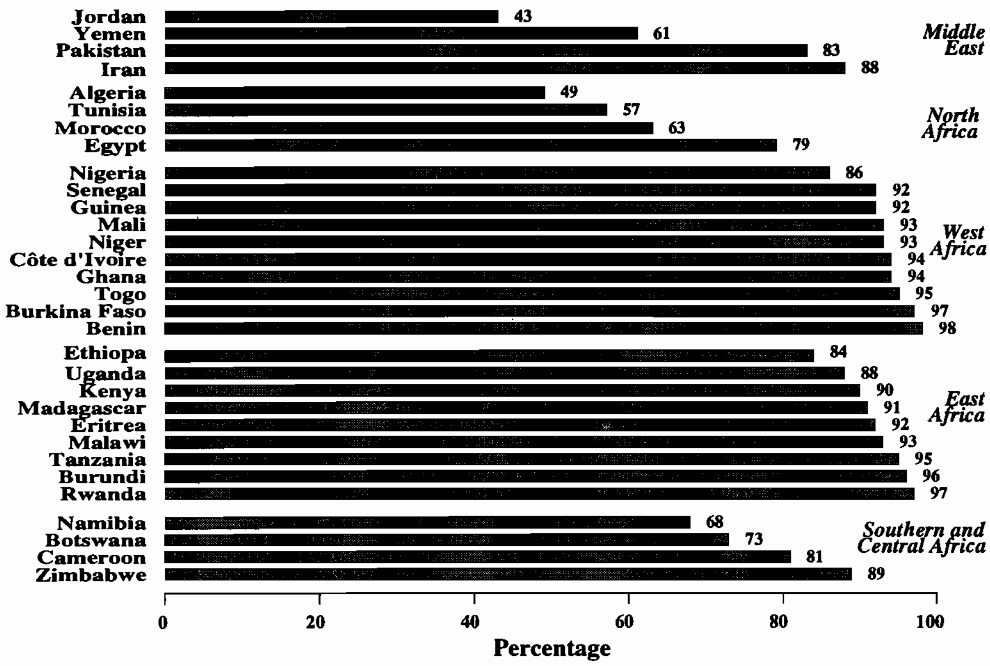


**Figure 5**
**Continued breastfeeding rate at one year (children 12–15 months)**

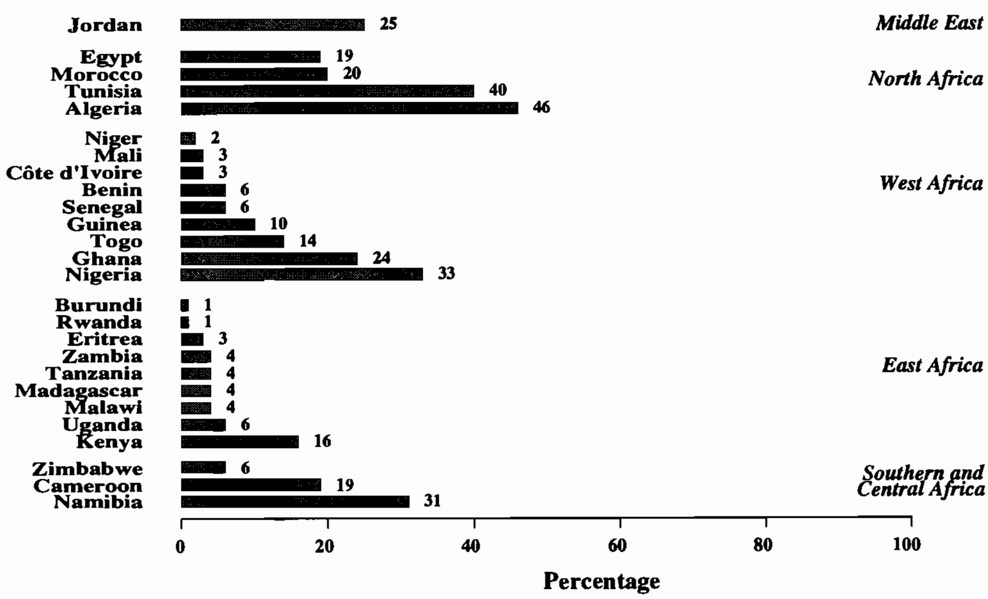


**Figure 6**
**Bottle-feeding rate (among breastfed infants <4 months)**

### *Nature and composition of first complementary foods in African countries*

*— Traditional porridge*

The first complementary food given to African infants is a thin cereal porridge. In most cases, it is made of a single cereal, maize, millet or sorghum. In Sahelian countries of West Africa, porridge is usually made from millet. In Coastal West African states, from Côte d'Ivoire to Nigeria, maize is most often used. In Nigeria imported cereals, rice and oats, are also used. In Malawi, soya bean flour is added to maize flour. In Congo, a fermented maize paste is used to make porridge in the cities, while cassava porridge is prepared in rural areas.

Other ingredients may be added, often sugar, and cows' milk, fresh or fermented in pastoral communities (Ethiopia, Kenya, Tanzania, Mali and Niger), but this is not necessarily very frequent. In many countries, groundnut paste/flour or other legume pastes are added, but the frequency of use and amounts added are not documented. Animal products are not frequently added to porridge except in Nigeria (crayfish and periwinkle powder). In Tanzania, mashed potatoes and bananas are given to infants, and in Nigeria, fruit juice, vegetable soup and mashed vegetables with palm oil.

Fermented cereal porridge is used in many countries (e.g. fermented maize porridge in Nigeria, Ghana, Congo and Botswana, and millet porridge in West Africa).

The energy density is usually low because porridges are thin: energy density ranges from 30 to 90 kcal/100 g of prepared porridge. A very low energy density, approximately 30 kcal/100g, characterizes *ogi*, the traditional cereal porridge given to Nigerian infants (Brown et al., 1988). In Congo, the median energy density of gruel is comparable to that of breast milk, 60 kcal/100g (Trèche, 1999). Because energy density is low, the density of all key nutrients is also markedly insufficient. Only the protein density of the prepared gruel is documented; it is between 0.5 and 2.5 g/100 g.

When energy dense foods are added to the porridge, e.g. oil or groundnut paste, the energy density can be higher. In Nigeria, a porridge consisting of cereal, nuts and palm oil has an energy density of 115 kcal/100 g and a protein density of 1.9 g/100 g of porridge.

As the infant grows older, the porridge is gradually thickened. Thick porridges have a high energy density because their water content is low. In Tanzania a maize and groundnut thick porridge has an energy density of 130 kcal/100 g. The actual viscosity of such a porridge has not been measured. A high viscosity may limit children's intake of porridge.

The age of cessation of porridge consumption is generally not documented, with the exception of Congo where survey data show that the median age is 5.6 months in rural areas and 8.0 months in urban areas.

*— Commercially available or distributed processed foods*

Most processed foods, produced by large industrial units or by the cottage industry, are a mixture of a cereal staple and a legume flour (groundnut, soya bean, cowpea or chickpea flour).

In Ethiopia, the centrally produced *Faffa* consists of wheat flour, defatted soy flour, dry skimmed milk and pea flour, vitamins and minerals. The protein content is 21 g/100 g of dry mix. In Eritrea, DMK is produced from wheat, chickpeas and oil. The energy density of the prepared gruel is 100 kcal/100 g of porridge. In Botswana, *Tsabana*, made from sorghum and soy, with vitamins and minerals, is distributed to all mothers of children less than three years of age. The energy density is 70 kcal/100 g of porridge and the protein content is 8 g/100 g of dry mix. The mothers are also given oil and advised to add some to the porridge to increase the energy density.

In Ghana, *Weanimix* is both a centrally produced mix and a household preparation, consisting of a roasted cereal and a legume (maize or rice, beans, groundnuts or cowpeas). The protein content is 11 g/100 g of dry mix. In Benin, *Ouando* is made from maize, sorghum and beans or soya beans. The energy density is between 40 and 70 kcal/100 g depending on how thick the porridge is. In Burkina Faso, *Misola* foods are produced by small-scale production units and by the community. They are made of millet, soya beans and groundnuts. The energy density is in the range of 60–70 kcal/100 g. In Malawi, *Likuni Phala* was introduced several decades ago. It is presently made of roasted or extruded maize and bean flour. The energy density is 79 kcal/100 g of porridge and the protein content is high: 3.2 g/100 g. In Uganda, the *Baby-soy* porridge is made of maize and soy flour with sugar. The energy density is 60 kcal/100 g.

*Bitamin* from Niger and *Vitafort* from Chad are based on a cereal, cowpea and groundnut mixture. *Musalac* from Burundi and *Sosoma* from Rwanda are made of two cereals and soya beans. *Nutrimix* and *Viten* in Togo are based on maize, sorghum and rice, with soya bean flour. The first formulation of *Vitafort* in Congo was the only food containing cassava, and *Actamine* in Morocco is the only one based on wheat (they both contain soya bean flour).

A review of experiences in the small-scale production of complementary foods in Africa is presented by Trèche (1999) in Chapter 4.

*— Improved household preparations*

In Ghana, in addition to *Weanimix*, two other preparations are promoted: *FRI-weaner,* a thick porridge made with maize, beans, groundnuts and milk; and *Tombrown,* made with roasted maize. In Benin, at Pahou, a variety of recipes are promoted for the preparation of porridge, sauces and purées.

Tanzania promotes the preparation and use of germinated cereal flour at the household level to reduce the viscosity of porridge. The energy density of a maize porridge with germinated sorghum is 100 kcal/100 g of porridge. A fermented porridge, *Togwa*, is also being experimented with.

A major constraint to the home-based preparation of improved complementary foods is the limited time mothers can devote to it. Where it is not a custom, it might be difficult for mothers to find the extra time to do it, especially in rural areas where women's workload is heavy.

### *Nature and composition of first complementary foods in Eastern Mediterranean countries*

*— Traditional foods*

In contrast with the African countries, cereal porridge is not the main first complementary food given to infants in the Eastern Mediterranean. Nonetheless, cereal porridges and puddings are used in many countries. They are rice-based in Egypt, Iran, Jordan, Pakistan, Palestine and Yemen, wheat-based in Egypt, maize-based in Egypt and Palestine, and made of other local cereals elsewhere.

Foods very often mentioned as first complementary foods are fruit juices, tea or herbal teas with bread or biscuits, vegetable soup, mashed vegetables and fruit. Dairy products, milk and yoghurt, are also frequently given to children; milk is given as a beverage with biscuits or added to porridge or pudding. In Jordan, sweetened carbonated drinks are mentioned, and there is a concern that children are receiving too much sugar. Other foods are given less often: eggs, cheese and legumes.

There is little information on the energy density of foods except in Egypt and Iran. In Egypt, *Mehalabia*, a maize starch and milk pudding with sugar, has an energy density of 130 kcal/100 g; a rice pudding is also prepared with milk and sugar. In Iran, rice based porridges or puddings are prepared with milk or sugar and almonds, with a respective energy density of 67 and 107 kcal/100 g and a protein density of 2 to 5 g/100 g.

— *Commercially available foods*

In several countries imported cereal-based foods for infants and young children are used: *Cerelac* in Egypt, Pakistan and Yemen, *Galactina* in Egypt, and *Farlac* in Pakistan.

There are several locally produced cereal foods. In Pakistan, *Farax* is an industrially prepared food made of wheat or rice. In Egypt, *Riri* is a partially pre-cooked wheat-based or rice-based food with skimmed milk and cacao.

— *Improved household preparation*

The Egyptian National Nutrition Institute has experimented and promoted several recipes for home preparation: *Arabena,* which is based on beans, chickpeas and wheat, lentils or rice; and *Sesamena*, made of wheat, lentils and sesame. Home processing techniques have been developed to improve the nutritional value of foods, through the chapati and germination techniques. Germination improves the digestibility and energy density of *Sesamena*.

### *Consumption of complementary foods before 4 months of age*

Before the age of 4 months, infants should receive no foods or liquids other than breast milk. The consumption of liquids and foods decreases infants' intake of breast milk and exposes them to pathogens. In many countries liquids other than breast milk are given to infants. Moreover, in several countries, a noticeable proportion of infants are fed complementary foods before 4 months.

Although the number of countries where this information is documented is small, the data indicate that this harmful practice is widespread: the proportion of infants fed complementary foods before 4 months is especially high in Malawi (42%), followed by Togo (38%) and Zimbabwe (37%). In Benin, Cameroon, Kenya, Tunisia, and Zambia it is near 25%.

In Congo, complementary foods are introduced very early, at 0–2 months more than one third of infants have already been given complementary foods, in urban centres as well as in rural areas. In Palestine, qualitative data indicate that a large proportion of infants are already receiving complementary foods before the age of 4 months.

### *Median age of introduction of first complementary foods*

Several African and Eastern Mediterranean countries have given estimates of the median age of introduction of first complementary foods. These must, however, be interpreted with caution as they are not the result of nationally representative surveys.

Among the few African countries that provided information, introduction is early: it varies between approximately 3 months in Malawi and Congo, and 5 months in Botswana. In the Eastern Mediterranean region, the age of introduction is somewhat later, with country medians ranging from 4 months in Jordan and Palestine, to 4.5 in Yemen, and to 6 months in Libya and Syria.

### *Preparation and distribution of first complementary foods*

This information stems from qualitative studies and the values presented are merely indicative.

*— Frequency of preparation*

In Uganda and Ghana, porridge is prepared once a day for infants between 4 and 9 months. In Nigeria, a frequency of 3.5 preparations per day is reported at 4 and 6 months. In Malawi frequency increases gradually with age from 2/d at 4 months to 3/d at 6 months, and 4/d at 9 months. In Burkina Faso, porridge is prepared for infants once or twice a day.

In the Eastern Mediterranean region, only three countries have provided some information. In Libya food is prepared once a day for 4-month-old infants, while in Palestine a mean frequency of 1.5 times/d is reported. In Pakistan, frequency is higher with 3 preparations per day.

*— Frequency of feeding*

The number of meals given to infants is generally low in African countries, e.g. in Kenya (1/d at 4 months, 2-3/d at 6 and 9 months). In Tanzania, frequency is 2–3 from 4 to 9 months, and in Botswana and Ghana, 3/d from 4 to 6 months. In Congo, at 3–5 months, approximately two thirds of infants consume two meals of porridge per day. The highest frequency is reported in Nigeria (3–4/d from 4 to 6 months, and 4–5/d at 9 months).

In the Eastern Mediterranean countries, on the contrary, the usual number of meals is higher, 3/d or more at all ages. At 9 months, frequency is 3/d in Libya and 6/d in Palestine.

### *Use of imported complementary foods*

Imported foods are more expensive than locally produced foods. In poor populations, there is a risk that infants fed imported foods will not be given sufficient amounts of these foods to satisfy their energy and nutrient requirements, because the foods are too expensive. It is difficult to estimate the importance of imported foods in comparison to locally produced complementary foods because consumption of the latter is unknown.

Data on acquisition and consumption of imported complementary foods were not available at country level. Nevertheless, the participants of the Alexandria and Addis Ababa workshops gave some indications on the level of consumption of imported foods in their country. Imported complementary foods are generally more available in the urban areas of developing countries than in rural areas.

In several Eastern Mediterranean countries, e.g. Egypt, Jordan, Lebanon, Libya and Palestine, imported cereal-based complementary foods are available, and their use is common. In Libya, it is estimated that imported foods represent approximately half of all complementary foods. Imported foods are available in Yemen but the level of consumption has not been estimated.

In most African countries and some Eastern Mediterranean countries (Pakistan), on the contrary, the use of imported foods is very limited. There are exceptions in Africa, for instance Nigeria, where more than 10% of complementary foods are imported. In the CFA Franc zone,[5] the 1994 devaluation of the currency has made imported complementary foods much more expensive, and urban mothers have reverted to using local foods (Delpeuch et al., 1996).

## 3.2 Solid complementary foods

### *Nature of solid foods in African countries*

In almost all countries, solid foods given to infants and young children are taken from the family pot. In many countries the staple of the pot is millet, cassava, yam, plantain or rice, with a sauce of legumes (beans, groundnuts) or foods of animal origin (meat, fish). Nevertheless the amount of sauce given to young children is usually small. In Tanzania, a stiff porridge is used as solid food. At 6–7 months, only a small percentage of infants are given fish, meat or eggs in Eritrea and Mali (approximately 10%), and in Benin, Tanzania, Uganda and Zimbabwe (between 15 and 20%); in Zambia 42% receive animal foods.

The variety of foods given to young children is further limited by food taboos; there is a widespread taboo on giving eggs to infants and young children. In Botswana, meat is avoided because it is believed to delay teething.

### *Nature of solid foods in Eastern Mediterranean countries*

In several countries, solid foods are prepared specially for children and a wide variety of foods are used: mashed vegetables, cereals or legumes with red meat, chicken or fish, eggs, and fruits (Egypt, Jordan and Palestine).

In some countries, children are fed solid foods mainly from the family pot (Yemen and Pakistan). Family foods can be spicy, e.g. in Pakistan. The variety of foods may be more limited when family foods are mainly based on cereals, e.g. in Yemen where staples are rice, sorghum and wheat. Bread or biscuits, with tea or dairy products, are again often mentioned. It is difficult to know how often and how much of these foods is given. Moreover, there may be large differences between rural and urban areas, as in Egypt, where complementary foods are usually not prepared specially for infants in the rural areas.

### *Median age of introduction of solid foods*

The median ages reported by the participants of the workshops show that solids are introduced earlier in Eastern Mediterranean countries than in African countries, except in Libya (median

[5] Communauté Financière Africaine (African Financial Community of French speaking countries)

12 months), but this difference could be an artefact, because the distinction between first complementary foods and solid foods is more difficult in Eastern Mediterranean countries (e.g., bread and biscuits are solid foods often used as *first complementary foods*).

In rural areas of Congo, family foods are introduced at about 6 months, i.e. at an age when infants should only be receiving their first complementary foods (Table 1).

*Number of meals of solid foods per day*

Information on the frequency of meals of solid foods was given by three Eastern Mediterranean countries, Libya and Yemen (3/day), and Palestine (3 main meals and 3 lighter meals). In African countries the number of meals of solid foods ranges from 1–2/d in Tanzania, to 2/d in Congo and Ghana, 3/d in Kenya, and 2–4/d in Nigeria.

**Table 1**
**Median age of introduction of solid foods**

| African Region | | Eastern Mediterranean Region | |
|---|---|---|---|
| **Country** | **Median** (months) | **Country** | **Median** (months) |
| Rural Congo [a] | 6.1 | Palestine | 4.0 |
| Ghana | 7.0 | Jordan | 4.5 |
| Kenya | 7.5 | Egypt | 5.0 |
| Tanzania | 7.5 | Iran | 5.0 |
| Uganda | 7.5 | Pakistan | 7.5 |
| Urban Congo [a] | 7.5 | Libya | 12.0 |
| Nigeria | 8.5 | | |

[a] *mean age*

## 4. CONCLUSION

This analysis clearly shows that distinct patterns of breastfeeding practices exist in Africa and the Middle East. Moreover, there are marked differences within regions, especially in Africa.

The two distinctive features of breastfeeding in West Africa are the low rate of early initiation, and the very low exclusive breastfeeding rate. Promotion of early initiation and of exclusive breastfeeding should be the first priorities of programmes for improving breastfeeding practices in this region.

A regional pattern is observed for the timing of introduction of complementary foods, although it is less clear-cut. In the Eastern Mediterranean region and in West Africa, introduction is generally too late, as shown by the low timely complementary feeding rates, with the exception of Iran, Benin and Togo. Rates are higher in Eastern, Central and Southern Africa — above 50% in all countries — except Eritrea. A high rate of timely complementary feeding, however, can be an indication that complementary foods are introduced too early;

this seems to be the case in several countries of Africa, e.g. Benin, Cameroon, Congo, Kenya, Malawi, Togo, Zambia, and Zimbabwe. Early complementation can cause a reduction in breast milk intake.

Feeding infants from a bottle is still uncommon in Africa, except in Nigeria and Namibia, whereas the practice is widespread in Eastern Mediterranean countries.

In Africa, the first complementary food is often a thin cereal porridge. The frequency of preparation is lower than the frequency of feeding porridge, implying that cooked porridge is stored to be served more than once during the day. The risk of microbial contamination is therefore high. Moreover, the energy density of traditionally prepared porridge is low, often lower than that of breast milk. Consequently, the nutrient density of porridge is also grossly insufficient. The frequency of feeding is generally too low to compensate for the low energy density of porridge. Quantitative data on children's intake are lacking.

The traditional porridge can be improved by the addition of locally produced energy-dense or protein-dense foods such as legumes, but more data are needed on the availability of these foods, their price and on the necessary home-based transformations, in particular whether they are labour intensive. Traditional food technologies using germination and fermentation should be studied with a view to improving and promoting them.

In some countries, important efforts have been made to promote the preparation of improved porridges, notably in Ghana and Tanzania. Many countries produce processed foods for infants and young children, but the level of production is limited in most cases. Both types of programmes — small-scale production and improved home-based preparation — need to be evaluated in terms of food quality, including their energy density, use, and impact on children's energy and nutrient intakes.

Solid foods are introduced early in the diet of African infants; the median age of introduction is less than 8 months. In almost all countries, children are fed solid foods from the family pot. The staple is very bulky, and amounts of other ingredients, such as legumes, vegetables and animal foods, are probably very small. There are again no quantitative data on young children's intake of solid foods. If the intake of porridge is maintained after solid foods are introduced, then the frequency of meals of solid foods (mean 2/d) is satisfactory. If, on the contrary, the consumption of porridge is discontinued, there is a risk that the children's energy needs will not be met.

In the more affluent Eastern Mediterranean countries, the situation of complementary feeding is very different. A wide range of foods are given in addition to porridge. Vegetables and fruit, animal foods and particularly dairy products, are often mentioned. Proper means of storing foods are more accessible than in African countries, and the risk of microbial contamination is lower. Processed foods, often imported, are more accessible. Nevertheless, some practices are inappropriate, such as the widespread habit of giving tea and bread, which could impair iron absorption. Moreover, in some countries special transitional foods are not prepared for infants traditionally, e.g. in rural Egypt, or the variety of foods is very limited, e.g. in Yemen; in these countries, the situation of complementary feeding is somewhat similar to that of the African countries.

In most Eastern Mediterranean countries, the solid foods given to young children are prepared specially for them. There is a large variety of foods and the frequency of feeding is adequate.

Nevertheless, in some countries the situation is not as favourable, as in Yemen, where children are fed a cereal staple from the family pot with insignificant amounts of other foods.

Efforts have been made in Egypt and Pakistan to produce special transitional foods. Improved household preparations have been developed and experimented with, and are currently being widely promoted in Egypt.

A standardized set of indicators for assessing complementary feeding is needed to help in designing and evaluating programmes for improving infant feeding. The development of standardized indicators is a difficult task because of the diversity of feeding practices between countries within a region, and between regions. As part of the Complementary Feeding Initiative, WHO's Nutrition Programme is committed to assisting countries in developing and field testing standardized indicators of complementary feeding.

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# Safety of complementary foods and bioavailability of nutrients

Pierre BESANÇON

## 1. INTRODUCTION

The design of complementary foods always involves a number of domestic or industrial treatments. As its main objective is to cover the nutritional requirements of young children, it is necessary to know the effect of treatments in terms of nutritional value and safety. In addition, the antinutritional factors often present in raw materials of plant origin must be eliminated or there will be a risk of losing the benefits of good product formulation.

## 2. FOOD QUALITY

### 2.1. Definitions

The quality of any food must meet the twofold objective of safety and acceptability (Figure 1). The first aim is to be able to guarantee total microbiological innocuousness, i.e. the absence of pathogenic germs. The product must also be free of toxic substances of natural origin or neoformed during treatments.

The acceptability of a food will depend to a certain extent on its organoleptic qualities (flavour, aroma, colour, texture, etc.), the quality of the services included (e.g. foods that are partially or completely ready to use) and, of course, on its economic qualities (price). All these parameters must be incorporated into the design and manufacture of a food.

Nutritional value (Figure 2) depends firstly on the composition of food or its elements as shown in food composition tables. Analysis can obviously vary to different degrees. It can go as far as assay of amino acids (especially essential amino acids); fatty acids and the balance between saturated, monounsaturated and polyunsaturated types; the different types of simple and complex carbohydrates, soluble and insoluble fibre; various minerals and vitamins; and finally secondary substances that are present in small quantities, but that may play interesting biological roles (antioxidants, protection factors, peptides, etc.).

Another important aspect in the nutritional appraisal of a food is the bioavailability of nutrients, i.e. their real potential for release during digestive processes for satisfactory absorption, and their effective metabolic use. Bioavailability depends on the physicochemical environment of the molecules, the technological processes applied, the absence of antinutritional factors, and possibly diet balance.

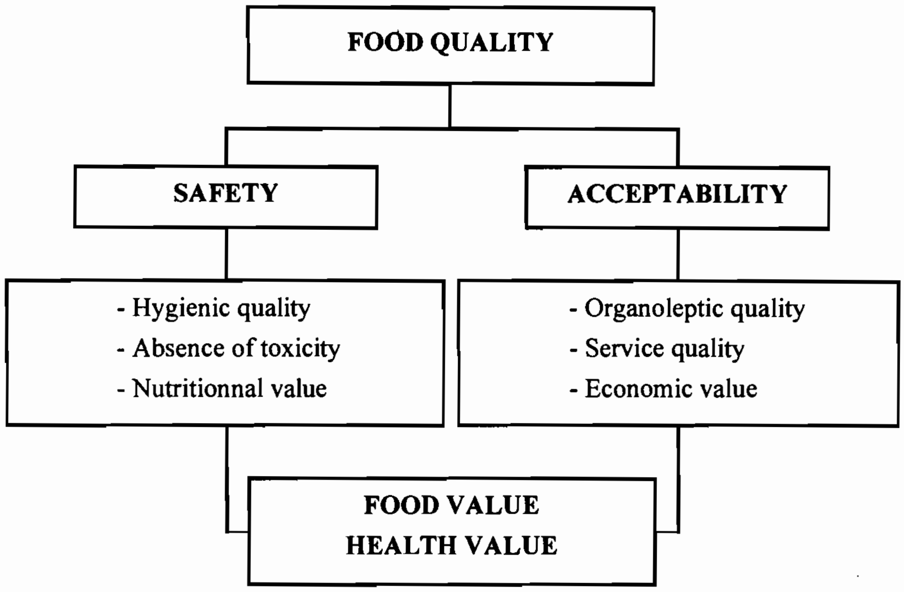


**Figure 1**
**Food quality in terms of safety and acceptability**

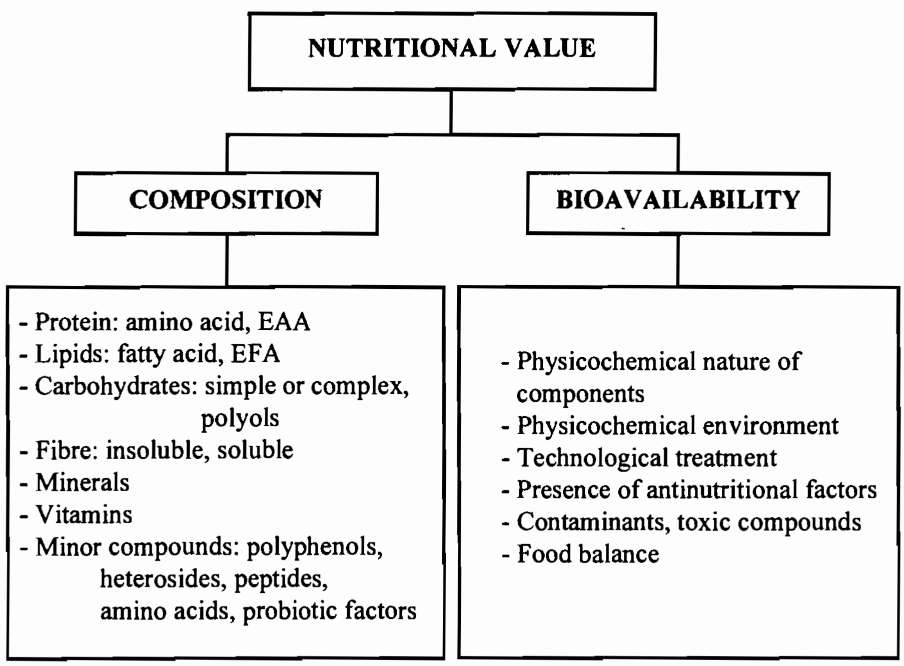


**Figure 2**
**Nutritional value of foods**

## 2.2. Quality assessment

The nutritional quality of a food is mainly assessed through chemical analysis. *In vivo* methods can be used to evaluate nutrient bioavailability. Tests on laboratory animals, and generally on young growing rats, provide an accurate evaluation of the nutritional value of foods when the tests are carried out over a short period of time, for example, over a few weeks. The classic criteria of increase in weight and digestibility (dry matter and protein) can be complemented by analysis of blood parameters, and determination of nutrient concentration in organs or in the blood.

However, these tests are cumbersome and expensive. There are alternative *in vitro* methods for evaluating bioavailability, whose results correlate fairly well with those of *in vivo* tests. Lysine, an essential amino acid that must be present in balanced quantities in the diet of young, growing children, may be rendered partially unavailable because of chemical blockage, especially following heat treatment of protein foods, and in the presence of reducing carbohydrates (glucose and lactose). In this case, overall analysis of amino acids after acid hydrolysis of the protein fraction gives the total undestroyed lysine content. The use of specific reagents that fix free amino groups (ε-NH2 lysyl residues in proteins), such as fluorodinitrobenzene (FDNB) or partial hydrolysis of protein by trypsine, gives an appraisal of available unblocked lysine that is generally well correlated with the nutritionally available lysine.

Finally, FAO and WHO experts have recommended the 'DISCO' method to assess protein quality. This combines chemical assay of the amino acid contents, calculation of the chemical index of the protein analysed in relation to a reference protein or a standard combination of amino acids and measurement of nitrogen digestibility. The result is the determination of a DISCO index which is the product of *in vivo* digestibility and of the chemical index.

Toxicological evaluation requires well-established and frequently much longer procedures. It is applied to natural toxic substances, chemical contaminants (pesticides and heavy metals), food additives, technological aids, and products neoformed during treatments. Tests on laboratory animals at increasing doses make it possible to determine the no observable effect level (NOEL); a safety factor — generally 100 — is applied to the NOEL to fix the allowable daily intake (ADI) in man. The expected level of consumption of the food is taken into account for proposing permitted levels.

# 3. TECHNOLOGICAL TREATMENTS

## 3.1. Purpose and type of treatments (Figure 3)

Domestic, artisanal or industrial treatments are applied to complementary foods for infants for various purposes:

- separation and purification of the edible fractions of the raw materials;
- improvement of conservation (pasteurisation or sterilisation);
- modification or improvement of the functional properties (solubility, viscosity, fluidity, suitability for gel formation, etc.) or nutritional features (digestibility);
- improvement of the organoleptic qualities (flavour, aroma, etc.).

Such treatments are of various kinds:

- physical treatments:
  - . heat and cold
  - . mechanical treatments: high pressure
  - . fractionation: centrifugation and filtration
  - . irradiation, microwaves, UV, gamma radiation
  - . reduction of water activity: dehydration, addition of solutes
- chemical treatments:
  - . alkaline or acid treatment
  - . oxidation or reduction
- enzymatic treatments:
  - . hydrolysis of proteins, polysaccharides and glycosides
  - . inactivation of toxic compounds
  - . synthesis.

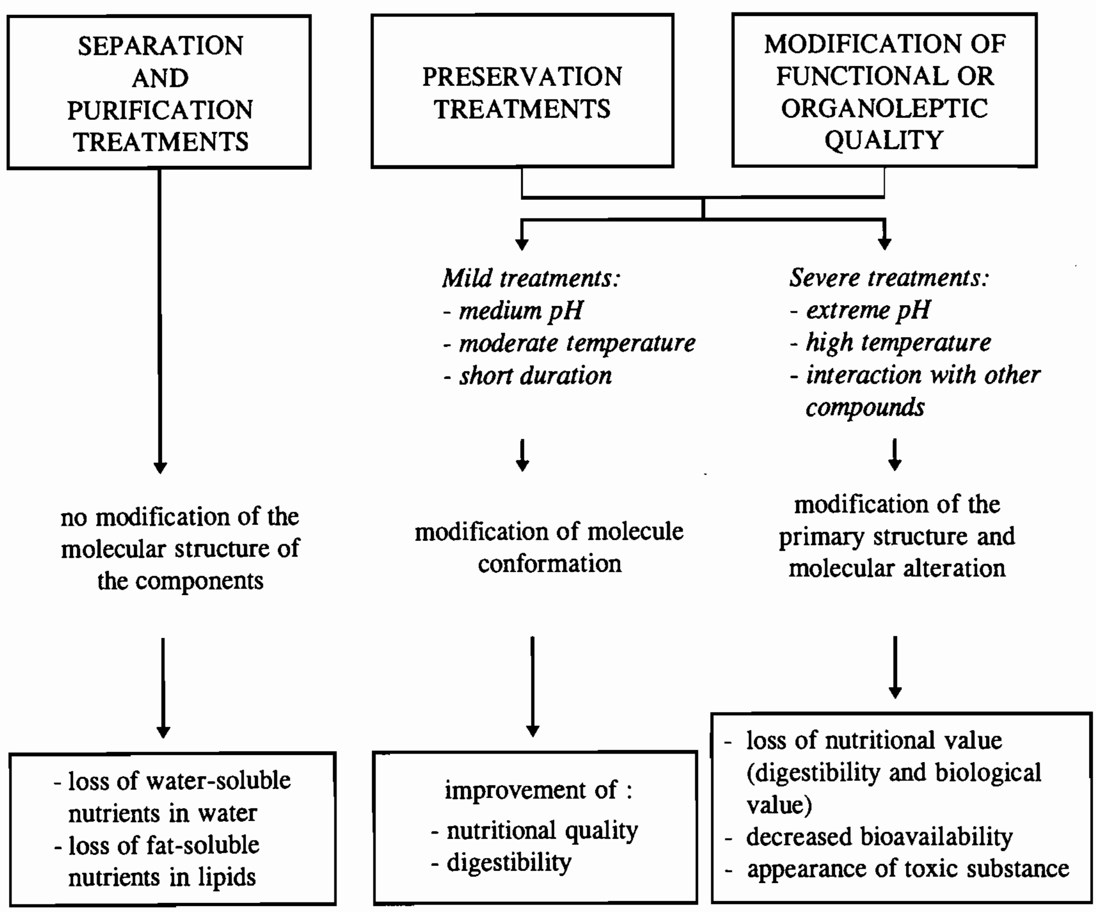


**Figure 3**
**Different types of treatment and effects on the nutritional value**

### 3.2. The effect of treatments on safety and nutritional value

Because of the diversity and especially the varying degrees of severity of treatments, the nutritional effects are diverse and can be observed at three levels:

- fairly favourable effects if treatment conditions are non-aggressive and well controlled
- a slight loss of nutritive value in moderate treatments
- severe losses and the appearance of toxic derivatives under the most severe conditions.

#### *Favourable effects*

Treatments are often aimed at improving the nutritional quality of products with low edibility in their natural state. Thus, in treatment (e.g. cooking), when only the general conformation of macromolecules (secondary, tertiary and/or quaternary structure of proteins) is changed without affecting the constituent molecules (primary structure), there tends to be an improvement in digestibility. This is due to the thermal denaturation of protein, the gelatinisation of starch, the inactivation of undesirable enzymes (lipoxygenases) and the destruction of thermolabile antinutritional factors. This is the case for the legume seeds used in numerous formulations.

#### *Unfavourable effects*

Numerous causes of loss of nutrients or reduction in bioavailability can be envisaged:

- loss of amino acids by oxidation, desamination, decarboxylation and isomerisation;
- loss of fatty acids by oxidation;
- loss of minerals and vitamins through the solubilization or elimination of parts of the plant or animal tissues which are not consumed;
- loss of vitamins by oxidation or hydrolysis;
- loss of digestibility by modification of conditions of hydrolysis and the formation of inter or intra-molecular covalent bonds;
- loss of bioavailability through the modification of nutrients at molecular level. In the most severe cases, these losses are accompanied by the production of toxic or mutagenic substances.

*— Losses by solubilisation and diffusion*

Loss of small molecules (mineral salts and hydrosoluble vitamins) is unavoidable when washing and/or cooking in water. These losses can be limited by optimising the process (particle size, water quality, duration, temperature, pH, etc.); similarly, losses of fat-soluble vitamins (carotenoids, vitamins A and E) can be substantial when fats are removed, or during oil refining processes.

*— Modifications of molecules*

Numerous fatty acids and amino acids are fragile and may be broken down. Long-chain polyunsaturated fatty acids, which include the essential fatty acids, oxidise readily. Lipid peroxides, which are formed in the presence of oxidation agents (oxygen, metals and free radicals), are considered as toxic and are themselves oxidation agents for proteins. The results can be observed at two levels: organoleptic (souring) and nutritional (loss of essential fatty acids and risk of toxicity).

Some amino acids (Table 1) are also very sensitive to certain conditions of pH, temperature, oxidation, and the presence of reducing carbohydrates (glucose, fructose and lactose), polyphenols, etc.

**Table 1**
**The sensitivity of several amino acids to various physical and chemical agents**

| | Heat | pH | Carbohydrate | Polyphenols | Oxidation |
|---|---|---|---|---|---|
| Lysine | ++ | +++ | +++++ | +++ | |
| Cysteine | ++++ | ++++ | | ++ | +++ |
| Methionine | | | | + | ++++ |
| Tryptophan | ++++ | ++ | | | ++ |
| Asparagine +Glutamine | ++++ | ++++ | | | |

— *Formation of covalent bonds*

Strong inter or intra-molecular bonds may form between proteins, within a single protein or between proteins and carbohydrates. The Maillard reaction starts with the reaction between a free amino function (lysine) and the reducing function of a carbohydrate and continues with a whole series of molecular changes and rearrangements. This is also the case of bonds of aspartyl-lysine, glutamyl-lysine, and lysino-alanine type. Lysine residues are involved in each case, leading to a decrease in digestibility, and decreased bioavailability of lysine, which is released with more difficulty or is nutritionally less accessible.

— *Neoformation of toxic compounds*

Numerous derivatives of amino acids or fatty acids may appear in the most extreme cases. They may be oxidised derivatives: malonic aldehyde from unsaturated fatty acids and oxidised sulphur amino acids such as methionine sulfoxide and methionine-sulfone. They may also be cyclic or polymerised derivatives of fatty acids, or of tryptophan, glutamic acid or creatinine. Some of these compounds (carbolines, imidazoquinoline and imidazoquinoxaline) have mutagenic properties and appear during severe heat treatment. When heated, polyunsaturated fatty acids may also be subjected to cyclisation and polymerisation phenomena, therefore producing compounds with low digestibility which are potentially toxic.

### 3.3. Heat treatment

This is probably the most common type of treatment at domestic, artisanal and industrial levels.

Heat is used in various ways:

- in cooking processes:
  - . baking, vacuum and microwave treatments
  - . extrusion-cooking
  - . shallow and deep frying
- blanching
- pasteurisation (autoclaving) and sterilisation (UHT)
- drying:
  - . evaporation
  - . vacuum and evaporation drying
  - . freeze-drying
- toasting and roasting.

The combination of time and temperature is the determinant for appraising effectiveness and/or the effects. However, three ranges of temperature can be considered, as shown in Table 2.

**Table 2**
**Nutritional effects of heat treatment**

| Temperature | Treatment | Nutritional effect |
|---|---|---|
| up to 100°C | - blanching<br>- pasteurisation<br>- cooking in water<br>- vacuum cooking<br>- microwave<br>- atomisation | - denaturation of proteins<br>- improved digestibility<br>- inactivation of antinutritional factors |
| 100 to 140°C | - sterilisation | - Maillard reaction<br>- loss of available lysine<br>- covalent bonds |
| over 140°C | - frying<br>- toasting<br>- roasting | - Maillard reaction<br>- breakdown of amino acids<br>- isomerisation, covalent bonds<br>- toxic derivatives |

The Maillard reaction itself, using a protein (mainly lysyl residues) and a reducing carbohydrate (glucose, lactose, etc.), can generally be divided into three stages as follows:

- The first, in which some reactions are reversible, produces Amadori compounds and has little effect on the nutritional value.
- The second results in the formation of colourless premelanoid intermediate compounds. There is a significant decrease in the nutritional value, and mutagenic and teratogenic compounds appear.
- The third leads to the formation of volatile, aromatic compounds, and coloured pigments with a high molecular weight which are insoluble; these are melanoidins and cannot be absorbed.

Table 3 shows the loss of nutritionally available lysine in milk powder with different types of treatment.

These results are significant. In the case of milk powder prepared under the most severe drying conditions, 25% of total lysine was destroyed and 75% of nutritionally available lysine was lost. This means that even the lysine not destroyed is rendered partially unavailable. The product subjected to the most severe processing is no longer suitable for covering the nutritional requirements of young children. Fortunately, mastery of industrial techniques makes it possible to limit such losses. It is hoped that artisanal manufacturing conditions are controlled to the same degree. Moreover, it should be noted that lysine availability is affected even at intermediate temperatures over time, e.g. when milk is kept at 60°C for several months.

## 4. ANTINUTRITIONAL FACTORS

### 4.1. General data

The raw materials, particularly of plant origin and especially legume seeds, used in the manufacture of complementary foods may include compounds with undesirable effects or antinutritional factors (ANF). Fortunately, most of them can be easily inactivated.

**Table 3**
**Lysine losses in milk powder**

| | Total lysine g/16 g N | Available lysine g/16 g N | Available/Total lysine (%) |
|---|---|---|---|
| Freeze-dried milk | 8 | 8 | 100 |
| Spray-dried milk | 8 | 8 | 100 |
| Roller-dried milk | | | |
| - moderate conditions | 7 | 5 | 70 |
| - severe conditions | 6 | 2 | 30 |

*Adapted from Mottu and Mauron, 1967.*

As shown in Table 4, these compounds belong to very different chemical moieties and have extremely varied effects. Some are ubiquitous, such as enzyme inhibitors, lectins, polyphenols, phytates, etc. Others are much more specific and are only found in a few plant species or families, such as gossypol in cotton, cyanogens in cassava, and favism factors in broad beans and several other legumes, etc. These compounds form a fairly small weight fraction of grains and seeds or different parts of the plant and analysis raises specific problems in each case. There are many treatments for removing them that depend mainly on the physicochemical nature of the compounds.

**Table 4**
**Antinutritional factors in foods**

**NITROGENOUS OR PROTEIN COMPOUNDS**
- Lectins, hemagglutinins
- Enzyme inhibitors: amylase, protease and lipase
- Peptides with biological activity
- Amino acids or derivatives : mimosine, L-DOPA, selenoaminoacid, lysinoalanine
- Lathyrogenic amino acids
- Maillard reaction products

**CARBOHYDRATES**
- Xylose
- Alpha-galactosides
- Beta-glucans

**GLYSOSIDES, HETEROSIDES**
- Cyanogens
- Favism factors: vicine
- Goitrogens: glucosinolates
- Phyto-oestrogens

**PHENOLIC COMPOUNDS**
- Chlorogenic acid
- Flavonoids
- Gossipol
- Polyphenols and tanins

**FATS**
- Cyclic, oxidised fatty acids
- Erucic acid

**PHYTATES**

**ALKALOIDS**

**MYCOTOXINS**

### 4.2. Protease inhibitors

All seeds, and especially those of legumes, contain enzyme inhibitors. The most harmful are the protease inhibitors that act on pancreatic proteolytic enzymes during digestion. They are proteins of medium molecular weight (8000 to 22 000) that specifically inhibit trypsin and/or chymotrypsin. The structure of these molecules and mechanism of inhibition are known and have been described extensively.

The effects are summarised in Table 5. It is shown nevertheless that hypertrophy of the pancreas is only observed in small species such as mouse, rat, chicken and guinea pig but not in dog, pig and calf. There is insufficient data on humans and especially on infants. It is therefore preferable to envisage a treatment for removal. Fortunately, most of these compounds are heat-labile. Autoclaving or roasting is generally sufficient for the inactivation of protease inhibitors in the seeds commonly used (kidney beans and soya beans). Wet process autoclaving for 10–20 min at 110°C is sufficient for soya beans. Verification would be required for less well known grains that may contain more heat-resistant inhibitors.

**Table 5**
**The effects of protease inhibitors**

| EFFECT | ANIMAL SPECIES |
|---|---|
| - interaction and linkage with serine proteases | affinity varies according to species |
| - pancreatic hypersecretion | rat, chicken, guinea pig |
| - pancreatic hyperplasia | rat, chicken, guinea pig |
| - growth reduction | rat, chicken, guinea pig |
| - carcinogenic potential | rat (pancreas) |
| - protective and anticarcinogenic effects | mouse, hamster |

### 4.3. Lectins

Lectins or agglutinins are found throughout the plant kingdom and in all parts of plants. They are particularly abundant (1 to 3% dry weight) in legume seeds. They are proteins with a high molecular weight and are sometimes glycosylated. They have an affinity for the glycan fraction of complex glycoconjugates such as glycoproteins. The different lectins recognize specifically the carbohydrate moieties that correspond to them.

Their antinutritional or possibly toxic effects mainly result from their ability to bind with membrane glycoproteins at the surface of the intestinal mucosa, causing decreased digestive capacity and absorption and gastro-intestinal disorders (diarrhoea and nausea). Some lectins also display cytotoxic effects. This is the case of kidney bean lectins (phyto-hemagglutinin) and of castor bean lectins. Pea, lentil and broad bean lectins are not considered to be toxic or have an antinutritional effect on growth.

The harmful effects of lectins are removed by heat treatment that is, generally, at least as severe as that used to inactivate protease inhibitors.

### 4.4. Polyphenols

This is a very varied group of more or less polymerised or condensed (tannins) phenols. Condensed polyphenols consist of polymeric proanthocyanidins that are neither hydrolysed nor absorbable. They are abundant in some cereals (sorghum) and in legume seeds.

Interactions of tannins with proteins in the food, and at the level of the intestinal mucosa in the digestive tract account for the antinutritional effects: decreased protein digestibility and blockage of lysine. However, they are also considered as having favourable antioxidative effects.

Tannin elimination is not an easy operation. Heat treatments are ineffective on condensed tannins. It is preferable not to use the parts of the plant that have the highest tannin contents.

### 4.5. Alpha-galactosides

These are oligosides found in legume seeds containing galactose, whose glycoside bonds cannot be hydrolysed by digestive enzymes in humans. Transit in the digestive tract takes them to the colon or large intestine where they are fermented by the digestive microflora, causing flatulence and diarrhoea. Alpha-galactosides can be eliminated partially by solubilisation or possibly by enzymatic pathway during germination or grain fermentation.

### 4.6. Phytates

These are phytic acid (inositolhexaphosphoric acid) salts. Phytates are present in seeds and grains, and form as much as 1 to 5% of the dry weight of some grains, but represent a very limited source of phosphorus in comparison with other forms of organic phosphorus and some mineral phosphates.

Phytates are also considered to be a factor which reduces the bioavailability of iron, calcium, manganese, cobalt, copper, and zinc cations. They also interact with proteins by forming stable bonds and can, in this respect, be considered to be potential enzyme inhibitors (amylase and proteases).

Phytates are hydrolysed with difficulty in the digestive tracts of mammals and humans, except in ruminants as there are effective enzymes in the rumen (bacterial phytases). Action of plant phytases in grains is possible but not usually under the physiological conditions of the digestive tract.

The presence of too great a quantity of phytates in the diet may cause a loss of bioavailability of phosphorus and calcium, and also of trace elements whose deficiency may be involved in anaemia.

The elimination of phytates may be possible by rendering them insoluble by chelation. An enzymatic pathway can be envisaged.

### 4.7 Enzymatic pathways for the improvement of nutritional quality

Amylases are known for improving the functional properties (viscosity) of starch products in weaning foods. Likewise, in the case of antinutritional factors that are difficult to extract, such as phytates, the use of an enzymatic pathway would appear to be reasonable and possible. Phytates can theoretically be hydrolysed by phytases found in the plant itself, present in the digestive tract of certain mammals or produced by certain microorganisms.

Strategies for the elimination of phytates are shown in Figure 4. Since physical processes are not very efficient, endogenous (plant) or exogenous (microbial) phytases can be used. In the first case, the phytasic activity of the grain itself is used either by soaking or by the initiation of germination. The second pathway uses exogenous phytases added to the medium. This can be a fermentation process during which phytase-producing microorganisms develop, which is observed during lactic fermentation. A final solution would consist of adding to the medium during soaking, for example, an enzymatic preparation containing a phytase activity rather than a microorganism. The effects of phytase-producing fungi (*Aspergillus niger, A. ficuum*), yeast (*Saccharomyces cerevisiae*), and bacteria (*Bacillus subtilis*) are known. Some of these microbial strains are already used in industry to produce other enzymatic activities.

Finally, the elimination of alpha-galactosides from legume seeds might also be possible using an enzymatic solution of this kind (microbial alpha-galactosidases).

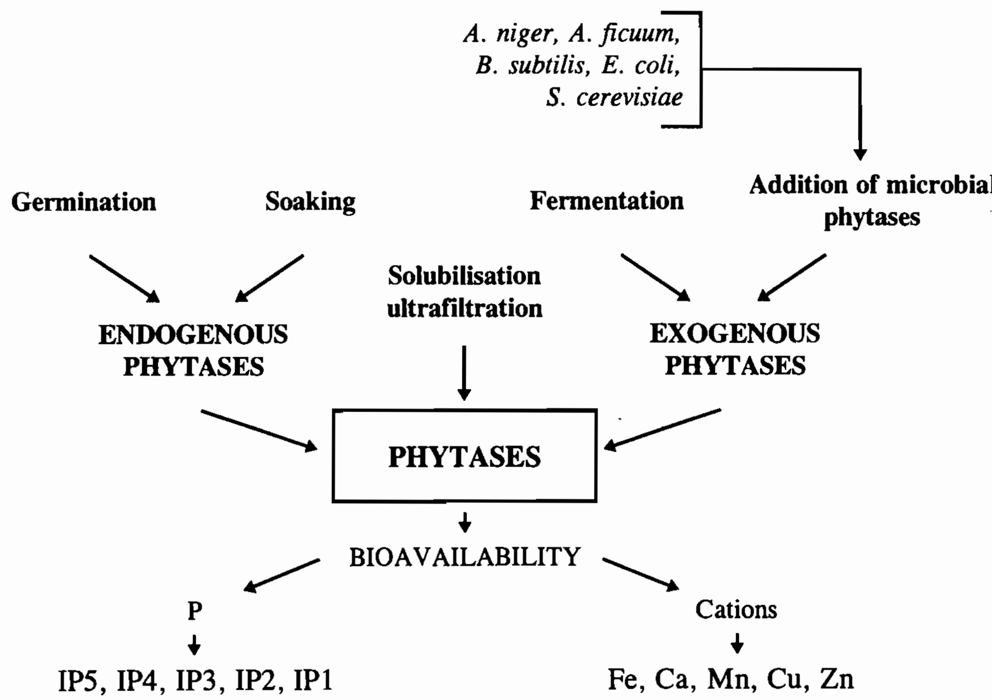


**Figure 4**
**Possible strategies for eliminating phytates**

## 5. FOOD DESIGN AND QUALITY CONTROL

The design of complementary foods might involve three main steps (Figure 5):

- Product formulation, depending on:
  - the nutritional objectives, which are to cover all or part of the requirements of young children;
  - the choice of raw material, conditioned by knowledge of the levels of available nutrients and of antinutritional factors.
- The development of treatments with the following objectives:
  - improving conservation conditions (microbial quality);
  - ensuring acceptable organoleptic qualities;
  - inactivating antinutritional factors and reducing the levels of undesirable compounds;
  - possibly improving nutritional qualities by enrichment (with minerals or vitamins) or hydrolytic operations (amylase, etc.). This stage can be completed by a trial on a laboratory animal aimed at *in vivo* validation of the technological operations chosen.
- The production (and sales) phase which, after optimisation of the formula and treatments, should integrate the potential for quality control using various parameters defined during development. This justifies the installation from the outset of a quality and risk control system (HACCP system).

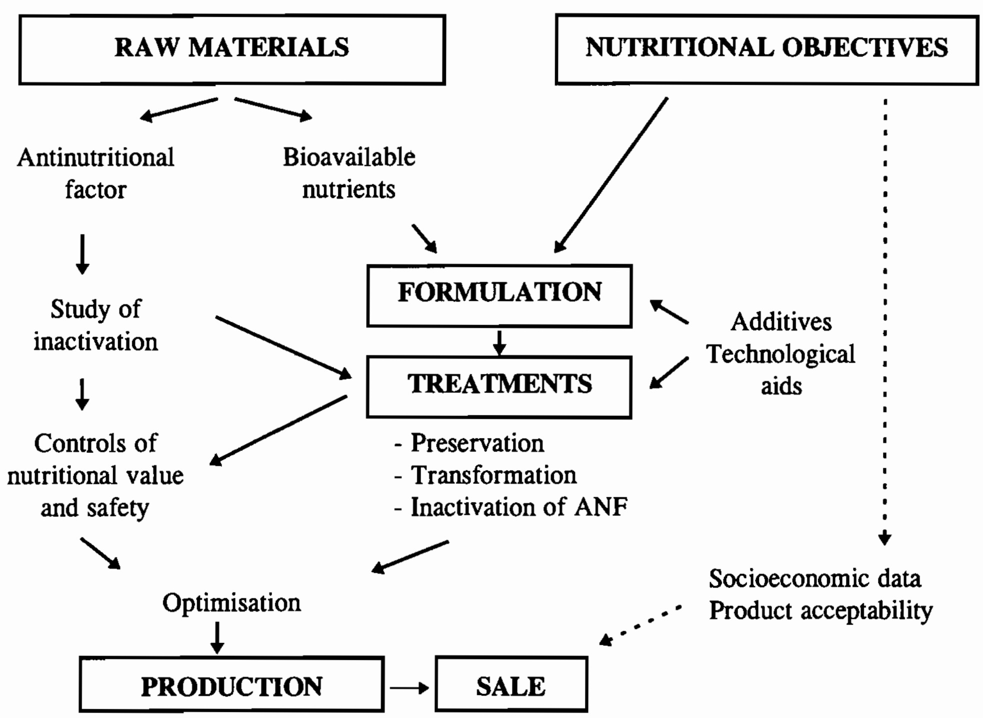


**Figure 5**
**Strategy for designing a complementary food**

The control system is to be envisaged at several levels (Figure 6):

- Process development: this involves chemical and microbiological analyses aimed at demonstrating the innocuousness of the product and its conformity with national or international standards, as well as nutritional analyses to ensure the quality required in relation to the recommended diet. These process development operations performed in accordance with good industrial practice can be performed in cooperation with research and development centres.
- Continuous quality control performed in the production unit on a continuous basis or daily using simple quality criteria.
- A system of periodic quality control by official services to check the safety, nutritional quality and sales value of the product.

It is preferable that all controls and analyses are designed in accordance with the HACCP system from the process design stage onwards.

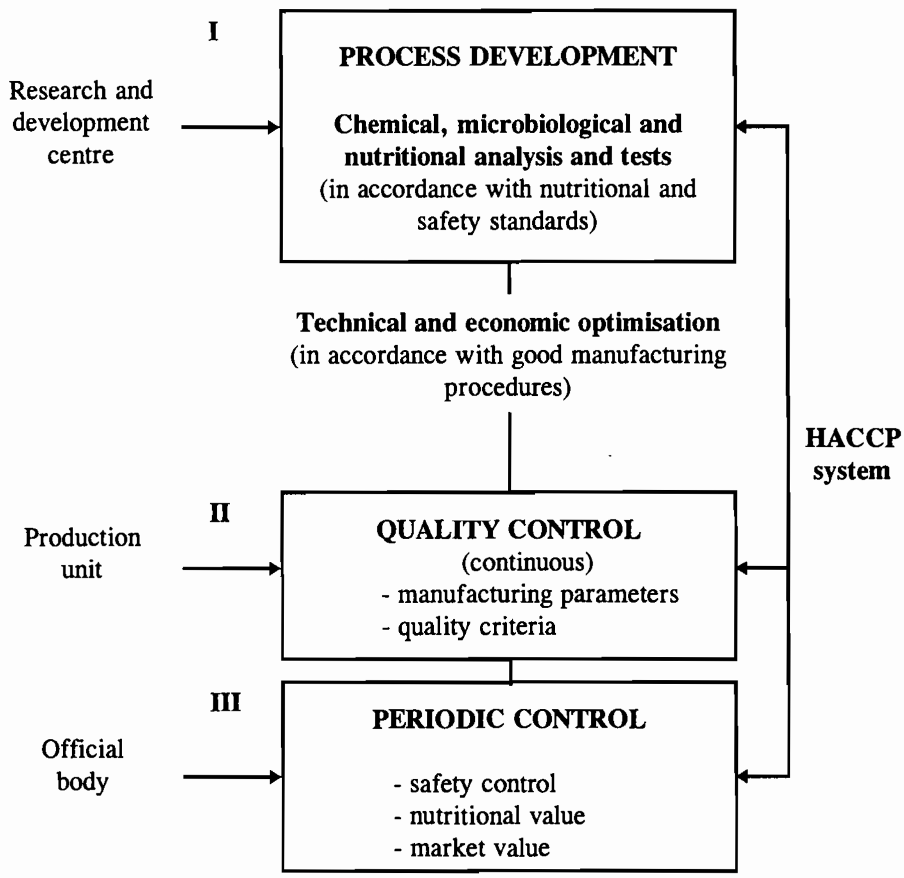


**Figure 6**
**Quality control system**

## 6. CONCLUSION

No process is ideal and many compounds considered as antinutritional can also have beneficial effects, according to the context. The solution often lies in the search for optimal conditions and for a compromise. For example, heat treatments (wet or dry processes) enhance the nutritional value and inactivate antinutritional factors, but are harmful if they are too severe and lead to a loss of bioavailability. This is well known and can be perfectly controlled; an optimal solution can only be reached through experiment and taking local socioeconomic characteristics into account, especially in developing countries. In other words, the procedure must be pragmatic and match each context and each objective.

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# Contaminated complementary food: a major risk factor for diarrhoea and associated malnutrition[1]

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## 1. INTRODUCTION

Contaminated complementary foods account for a substantial proportion of diarrhoeal diseases among infants and young children, especially in developing countries. Worldwide (excluding China) it is estimated that 1400 million episodes of diarrhoea occur annually in children under the age of 5 years. In 1990, over 3 million of such children died as a result (WHO/HST, 1992). Up to 70% of diarrhoeal episodes could be due to pathogens transmitted through food (Esrey and Feachem, 1989; Esrey, 1990). Nevertheless, the importance of food safety[2] in the prevention of diarrhoeal diseases is often overlooked or neglected. It is often observed that the strategies for prevention of diarrhoeal diseases and associated malnutrition are limited to promotion of breastfeeding or improving water supply and sanitation, neglecting the need to educate foodhandlers, particularly mothers, in food safety (Henry, 1991). Not infrequently, studies of why children suffer from diarrhoea overlook the *relevant* factors related to food safety.

The present review provides evidence that food contamination is one of the major contributors to diarrhoeal diseases and the malnutrition associated with them and that in the prevention of diarrhoeal diseases in infants and children food safety is as important as breastfeeding or provision of safe water supplies and sanitation. Every effort should be made to improve the hygiene quality of foods. Education of foodhandlers, particularly mothers, in food safety principles, through primary health care and infant feeding programmes, should be regarded as an important strategy for the prevention of diarrhoeal diseases (Tomkins, 1991).

## 2. THE PERIOD OF COMPLEMENTARY FEEDING: A CRITICAL PERIOD

Breast milk is nutritious and generally safe food for newborn infants, and exclusive breastfeeding, i.e., giving the infant no fluid or food other than breast milk, protects against diarrhoea by minimizing the infant's exposure to foodborne and waterborne pathogens. Breastfeeding may also reduce the severity of diarrhoeal illnesses and has an influential effect

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[2] This term, sometimes considered synonymous with that of "food hygiene", is defined in the Report of a Joint FAO/WHO Expert Committee on Food Safety held in Geneva in June 1983 as: "All conditions and measures that are necessary during the production, processing, storage, distribution, and preparation of food to ensure that it is safe, sound, wholesome, and fit for human consumption" (WHO, 1984).

on preventing diarrhoea-associated deaths (WHO, 1989; JHU/WHO, 1989; De Zoysa et al., 1991). However, when the infant reaches 4–6 months of age, breast milk needs to be supplemented, and later on (>2 years of age) substituted by appropriate foods until the child is gradually introduced to family food. With the introduction of complementary foods, which in many countries are prepared under unhygienic conditions, an infant, who until then has only consumed breast milk, may be exposed to infective doses of foodborne pathogens. Many studies reported that the incidence of diarrhoeal diseases is especially high after complementary feeding is initiated (Barrel and Rowland, 1979). In a study of infants and children in a Guatemalan Mayan village, Mata (1978) noted that the prevalence of many infections increased during the period of complementary feeding. Rowland and McCollum (1977) reported a particularly high incidence of diarrhoeal diseases between 7 and 18 months with a peak at 9 months of age. Similarly, Black et al. (1982a; 1982b) found that the prevalence of diarrhoea was highest during the second 6 months of life and declined with increasing age thereafter. The declining incidence of foodborne illnesses with increasing age is explained by the probable acquisition of immunity from repeated exposure to the pathogens. A review by Snyder and Merson (1982) indicated that the median incidence of diarrhoeal diseases was three to six episodes per year, the highest incidence being during the second half of infancy.

For various reasons, complementary feeding is initiated in many cultures at an even earlier age than is nutritionally necessary, i.e., 4–6 months of age. Recent surveys indicate that exclusive breastfeeding is a very infrequent practice, and water, various infusions, rice water, and similar foods are often introduced to young infants at a very early age (WHO, 1991). Consequently, contaminated complementary food may increase the risk of diarrhoeal diseases even during the very early months of life.

## 3. FOODBORNE PATHOGENS

Infants and young children are very susceptible to foodborne diseases and, if they consume contaminated foods, are likely to contract infections or intoxications leading to illness and often to death. While foodborne diseases may be caused by either chemical or biological agents, those of biological origin are of specific interest in this article, since they are responsible for a considerable proportion of diarrhoeal diseases. However, it should be noted that infants and children are also sensitive to various chemical contaminants of foodstuffs, e.g., lead, and such contamination is a major public health concern in several contries (UNEP/FAO/WHO, 1988).

Various pathogens have been identified as causing diarrhoeal diseases. Some of these include bacteria such as *Escherichia coli*, *Shigella* spp., *Salmonella* spp., *Vibrio cholerae* 01 and *Campylobacter jejuni*; protozoa such as *Giardia lamblia*, *Entamoeba histolytica*, *Cryptosporidium* spp., and also enteric viruses such as rotavirus (Black, 1980; Black et al., 1989; WHO, 1990; Gomes, 1991; Huilan, 1991). In addition, *Bacillus cereus*, *Staphylococcus aureus*, *Clostridium perfringens*, and helminths are common foodborne pathogens that cause diseases frequently accompanied by diarrhoea.

Infections due to pathogenic *E. coli* are probably the most common illnesses in developing countries and produce up to 25% of all diarrhoeal episodes. Transmission of *E. coli* has been specifically associated with complementary foods (WHO, 1990). *C. jejuni* causes 5–15% of diarrhoeas in infants worldwide. Shigellosis is a major health problem in developing countries and causes 10–15% of acute diarrhoeas in children under 5 years of age (WHO, 1990). Cholera remains an important cause of morbidity and mortality in many developing countries, mainly in Asia, Africa and, more recently, South America. Between the start of the epidemic in Peru in January 1991 and the end of May 1992, cholera has, worldwide, affected 800 000 people and killed 20 000 (WHO unpublished data, 1992). Rotavirus is more common in children aged 6–24 months and is responsible for 20% of all diarrhoea deaths among under-fives (De Zoysa and Feachem, 1985). The virus is of concern in both developing and industrialized countries. In addition, intestinal parasitic infections are prevalent worldwide and in some countries may even be more important than bacterial infections. Amoebiasis, giardiasis, cryptosporidiasis, and ascariasis are among the commonly occurring foodborne parasitic infections (WHO Expert Committe, 1987). Amoebiasis is one of the most common parasitic intestinal diseases that can be fatal (WHO Expert Committee, 1987) and a high prevalence of amoebiasis has been reported among children of complementary feeding age (Shetty, 1990; Mata, 1977).

## 4. IMPLICATIONS OF FOODBORNE DISEASES

Foodborne diseases can cause severe and/or long-lasting damage to health, including acute, watery and bloody diarrhoeas (leading to severe dehydration or ulceration), meningitis, as well as chronic diseases affecting the renal, articular, cardiovascular, respiratory, and immune systems (Archer, 1984; Davies and Gothefors, 1984; Archer and Young, 1988). One study has reported that about 2% of adults infected with an arthritogenic strain of salmonella may consequently suffer from reactive arthritis (Archer and Young, 1988). A proportion of patients, especially children, who are affected by enterohaemorrhagic *E. coli* can develop haemolytic uremic syndrome (HUS), which is characterized by acute renal failure (Gross, 1990; Taylor, 1990). However, the most serious implications of foodborne infections are their effects on nutritional status.

The association of diarrhoeal diseases and malnutrition has been the subject of extensive studies, and these have been reviewed by Tomkins and Watson (1989). Despite the complex nature of the interaction between infectious diseases and malnutrition, it is generally accepted that infectious diseases can affect children's growth once complementary feeding is initiated (Figure 1) (Mata, 1971; Mata, 1978; Rowland et al., 1988). An infectious disease can lead to a reduction in food intake owing to anorexia. In addition, in certain cultures parents may also contribute to a reduction in their child's food intake by withholding or substituting certain foods during illness (Ekanem and Akitoye, 1990). A poor food intake, aggravated by loss of nutrients from vomiting, diarrhoea, malabsorption, and fever over an extended period (persistent diarrhoea), leads to nutritional deficiencies with serious consequences for the growth and immune system of the infants and children. Thus, an infant whose resistance is suppressed becomes vulnerable to other diseases (including respiratory infections) and is subsequently caught in a vicious cycle of malnutrition and infection (Figures 2 and 3). Many infants and children do not survive under the circumstances. Annually, about 13 million children under 5 years of age die in developing countries; in the majority of cases, these deaths are due to infections and associated malnutrition (Tomkins and Watson, 1989).

There is very little evidence that any nutritional impact is caused by infection among exclusively breast-fed infants (Scrimshaw et al., 1983; Rowland et al., 1988; Tomkins and Watson, 1989). This underlines again the importance of exclusive breastfeeding for the

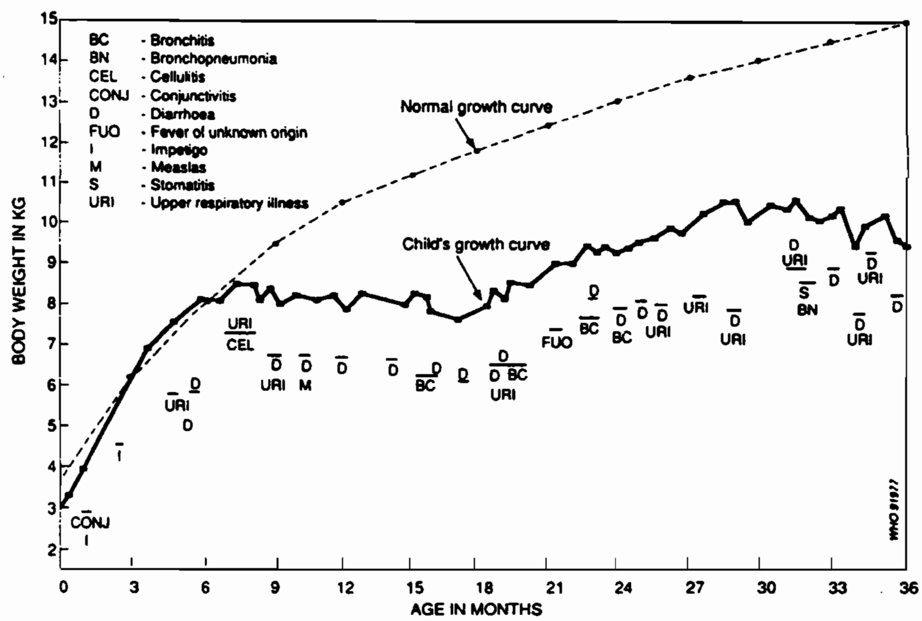


**Figure 1**

**Growth pattern of a child with frequent episodes of diarrhoea and other infections (Mata, 1971)** (The horizontal bars indicate the duration of the infectious disease)

prevention of malnutrition, particularly during the first 4-6 months of life. Breast milk compensates for the loss of water and nutrients that occurs during diarrhoea. In view of the protective effects of breast milk against diarrhoea and malnutrition, continued breastfeeding for at least 2 years is recommended (WHO, 1989; De Zoysa, 1991).

Many studies have demonstrated that infections may induce growth faltering during the complementary feeding period. In one study, for example, the relationship between morbidity and growth in the first 2 years of life among a cohort of 126 neonates was studied in a Gambian township (Rowland et al., 1988). The mean weight-for-age exceeded the National Center for Health Statistics (NCHS) standards in the first half of infancy, but there was a mean deficit of 1.2 kg by one year of age. It was estimated that diarrhoeal diseases were responsible for half this deficit — and respiratory illnesses for a quarter — and the effect of diarrhoeal diseases on growth after the onset of complementary feeding was four times that in exclusively breast-fed infants. Enterotoxigenic *E. coli* was the most common organism isolated in infants aged 6–12 months who had diarrhoea. *E. coli* from contaminated complementary foods was considered to be responsible in part, for the diarrhoea-induced weight faltering. In Keneba, Gambia, it was also demonstrated that diarrhoea was the main cause of weight faltering in children aged 6 months to 3 years (Rowland et al., 1988). Similar results have been obtained in other studies. In longitudinal studies of the effects of infectious diseases on physical growth of infants in Huascar, an underprivileged peri-urban community in Lima, the average weights during the first five-to-six months of life approximated those of the NCHS reference population; thereafter, the average weight declined relative to the reference data, and the rates of stunting and wasting increased progressively during the first year of life (Lopez et al., 1989). A study of the population of a Guatemalan village also

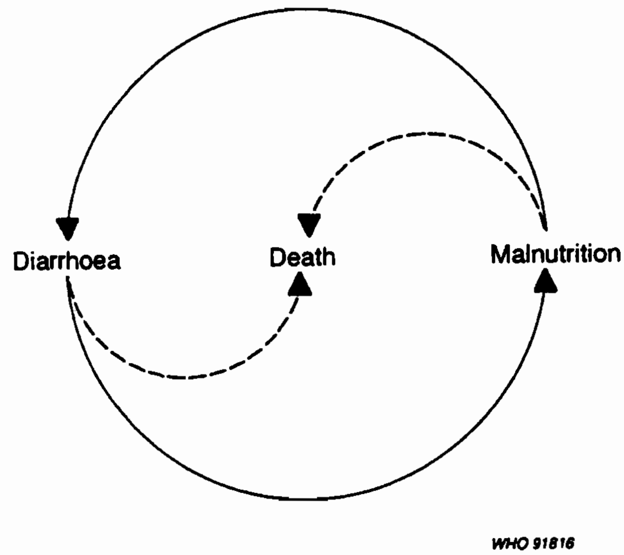


**Figure 2**
**Diarrhoea and malnutrition combine to form a vicious cycle leading to declining health status, and too often death (WHO, 1990)**

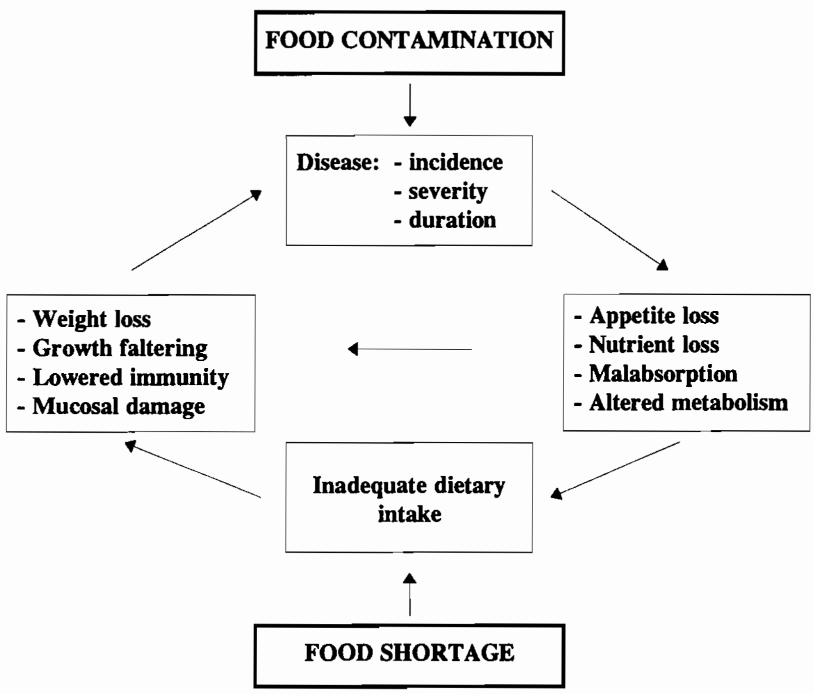


**Figure 3**
**Malnutrition and infection cycle (adapted from Tomkins and Watson, 1989)**

revealed that the incidences of infectious diseases, particularly diarrhoeal diseases, were extremely high during the complementary feeding period (6–24 months) and that infectious diseases were an important cause of weight loss, arrested height, and impaired physical growth (Mata, 1977).

Studies have also been carried out on the effect of infections and dietary intakes on children. Martorell et al. (1980) have reported a greater reduction in dietary intake during diarrhoeal illnesses than during respiratory illnesses

Many investigations indicate that of all the common childhood illnesses, only diarrhoeal diseases have a significant negative effect on growth. Studies by Martorell et al (1975a) in Guatemala suggest that children who suffered from diarrhoea for a short period exhibited a substantially greater increase in length and weight than children who were ill with diarrhoea for a longer period. In addition, children had a lower weight gain during periods of enterotoxigenic *E. coli* diarrhoea (Martorell et al., 1975b). Among rural Mexican children, an investigation of the relationship between childhood illnesses and growth increments in length and weight reported that, while upper and lower respiratory infections did not affect incremental gain in weight, a high frequency of diarrhoeal infections reduced weight gain (Condon-Paoloni et al., 1977). Village-based surveillance data from longitudinal studies in rural Bangladesh have demonstrated that, of the common illnesses, only diarrhoeal diseases had a significant inverse relationship on increase in weight (over a 2-month period) and on length (over 1 year); diarrhoeal diseases accounted for 20% of the difference in linear growth between the study children and the international reference population during the first 5 years of life (Black et al., 1984). The greatest impact on nutritional status was observed for infections caused by enterotoxigenic *E. coli* and *Shigella* ssp. Diarrhoea associated with *E. coli* constituted 30% of diarrhoeal disease episodes and affected the bimonthly weight gain. Shigellosis (prevalence, 15%) had a negative effect both on bimonthly and annual linear growth (Black et al., 1984).

Nutritional deficiency diseases, such as protein-energy malnutrition, iron deficiency anaemia, and vitamin A deficiency, have been reported in connection with foodborne parasitic infections such as giardiasis and ascariasis. For example, in one study of a 14-month-old boy in Guatemala it was noted that the child exhibited normal growth until the introduction complementary foods which started at six months of age; introduction of semi-solid foods at that time was accompanied by bouts of diarrhoea and reduced growth rate. When he received treatment, the child was found to have oedematous protein-energy malnutrition (kwashiorkor) and to be infected with *Giardia lamblia* (Solomons et al., 1990).

## 5. CONTAMINATED COMPLEMENTARY FOOD

Numerous studies have shown that complementary foods prepared under unhygienic conditions are frequently heavily contaminated with pathogenic agents and are a major risk factor in the transmission of diseases, especially diarrhoeal diseases. For example, Black et al (1981; 1982c) in Bangladesh showed that 41% of samples of food items fed to children of complementary feeding age contained *E.coli*. Milk and foods prepared separately for infants were more frequently and heavily contaminated with *E. coli* than foods prepared for adults, such as boiled rice. The level of contamination was related to the storage of complementary foods at high ambient temperatures. About half of drinking-water samples also contained *E. coli*, but colony counts were approximately 10 times lower than those in food samples. A major important finding was the correlation between the proportion of a child's food samples contaminated with *E. coli* and the number of annual episodes of diarrhoea associated with enterotoxigenic *E. coli*. Bacterial contamination of complementary foods and drinking-water has also been studied in rural Bangladesh by Henry et al (1990). Of about 900 samples of food and drinking-water that were analyzed for faecal coliforms, "wet" foods, such as milk and rice (particularly "panta bhat"), which made up a large proportion of a child's complementary feeding diet in the 6–23 month age range, contained the highest levels of faecal coliforms, while during the rainy season, when ambient temperatures increased, so did the level of contamination. These results indicate that the food was contaminated with faecal matter and thus may be a vehicle for pathogens usually transmitted via the faecal/oral route, including *Shigella* ssp. and V. *cholerae*.

Moreover, studies conducted elsewhere provide evidence for the significant contamination of complementary foods. Barrel and Rowland (1979) found that a very high proportion of the food consumed by infants and young children in a rural area of Gambia contained pathogens. In the rainy and hot season, when diarrhoeal illness is at its height, a third of the foods were contaminated immediately after their preparation with unacceptable levels of one or more pathogens, and this percentage increased to 96% of foods after 8 hours' storage. In Myanmar, food consumed by children aged 6–29 months was examined for four enteric bacterial pathogens. Of 775 samples of food tested, 505 were positive for *E. coli*, 28 for *V. cholerae* non 01, and 6 for *Salmonella* ssp., *E. coli* and *V. cholerae* non 01 were isolated from 29 and 5 drinking-water samples, respectively, from a total of 113 such samples (Khin Nwe et al., 1991). In Peru, menu items given to infants were analysed at the time of consumption; milk and food specially prepared for infants (cereals or purées) were most frequently contaminated, whereas foods eaten by an entire family, e.g., soups, stews, and fried foods, were less often contaminated. For most food items, the frequency of contamination was related to the time elapsed from initial preparation. Specific pathogens found in food included *Salmonella* ssp., *Aeromonas hydrophila*, *V. cholerae* non 01 and enterotoxigenic *E. coli* (Black et al., 1989).

Since complementary foods are frequently selected from items in adults' diet, the hygienic quality of adults' food is also of relevance. Hazard-analysis-critical-control-point (HACCP) studies[3] conducted in households in the Dominican Republic showed that cooked food products (particularly beans, rice, dried milk) if subjected to time/temperature abuse[4] contained high amounts of *B. cereus*, *S. aureus* and also faecal coliforms (Michanie et al., 1987; 1988). In Guatemala, heavy contamination with coliforms, *B. cereus* and staphylococci was found in tortillas before and after cooking (Caparelli and Mata, 1975). A total of 18% of foods in El Salvador were contaminated with *E. coli* (Soundy and Rivera, 1972). Finally, in an investigation of a large urban epidemic of cholera in Guinea, it was determined that peanut sauce supported the growth of *V. cholerae* and was the probable vehicle for transmission of the disease (St Louis et al., 1990).

[3] This is a novel approach in the prevention and control of foodborne diseases; it consists of identifying the hazards associated with the different stages of food processing/handling, assessing the related risks, and determining the operations where control procedures will be effective (Bryan, 1992).

[4] Time/temperature abuse refers to situations where the minimum time/temperature requirement to reduce the contaminant(s) to safe levels has not been respected or/and the food is stored under time/temperature conditions that permit bacterial proliferation.

## 6. IMPROPER FOOD HANDLING

The sources of food contamination are numerous: nightsoil, polluted water, flies, pests, domestic animals, unclean utensils and pots, dirty hands, and a polluted environment caused by lack of sanitation, domestic animals' droppings, dust and dirt, etc. Raw foods themselves are frequently the source of contaminants, since some foodstuffs may naturally harbour pathogenic agents or have been obtained from infected animals (Figure 4).

Unclean pots, cooking utensils, baby bottles, teats, etc. are a potential source of contamination. A study in rural Kenya showed that 44% of dishes were unsafe from a hygienic point of view (van Steenbergen et al., 1983). Hazard analyses carried out in households in the Dominican Republic reported that kitchen knives and blenders were contaminated with *Salmonella* ssp.(Michanie et al., 1987) and several studies have indicated that feeding bottles are not always effectively washed or boiled (Michanie et al., 1987, Bryan et al., 1988).

Evidence that flies contribute to the transmission of the diarrhoeal disease agents has been reviewed by Esrey (1991). Many pathogens that cause diarrhoea in humans, including *V. cholerae*, *Shigella* ssp., Campylobacter, *E. coli*, poliovirus, and *Entamoeba histolytica*, can be recovered from flies, and many pathogens can survive on the integument of flies for up to 10 days. Pathogens can also be carried in the gut of the flies and deposited on food when they regurgitate or deposit excreta. Although, Esrey (1991) was unable to conclude that they play a role in the transmission of diarrhoeal diseases, flies are a potential source of contamination of food and water. Several studies have also reported the presence of infected domestic animals in household premises (Michanie et al., 1987), presenting an additional risk factor for the contamination of food.

Touching food with contaminated hands has been the cause of many outbreaks of foodborne diseases. For those pathogens that have a low minimum infective dose and for which the human body is the main reservoir, e.g. *Shigella* ssp., *S. typhi*, contaminated hands are a particularly important risk factor. In one cholera outbreak in Guinea the contaminated rice-based meal responsible was prepared by a person who had cleaned the bed sheets and washed the body of a cholera victim, including evacuating the victim's bowel contents with enemas (St Louis et al., 1990). There are more likely to be multiple cases of cholera in families or households if the index case is a woman or a foodhandler (Roberts, 1992). Nevertheless, the washing of hands after defecation or changing infants' nappies, and prior to the preparation of food, is frequently neglected or ignored. Studying the food preparation habits of migrants living in the outskirts of Lima, Bryan et al (1988) observed that mothers did not always wash their hands after changing babies' nappies, and when they did it was often in the same pan of water used to prepare food and wash utensils. Capparelli and Mata (1975) reported that the dirty hands of women who prepared tortillas were one of the main sources of contamination of food among rural Guatemalan Indians. Also, in Lagos it was noted that out of 265 cooks only 43 washed their hands before preparing a meal (in the presence of an observer) (Ekanem et al., 1991); had no observer been present, the number would probably have been lower.

Foodstuffs such as vegetables, fruits, and seafoods can become contaminated with pathogens during cultivation. Use of untreated wastewater and nightsoil in agriculture and polluted seawater increases the risk of contamination (Geldreich and Borndner, 1971; Ercolani, 1976). Outbreaks of foodborne cholera, typhoid fever, viral hepatitis, amoebiasis, ascariasis, and fascioliasis caused by using contaminated wastewater and nightsoil are well documented (Bryan, 1977; Mara and Cairnocross, 1989).

Contamination of complementary food with faecal matter has been frequently reported, and lack of basic sanitation certainly is a contributing factor. Water used for the preparation of food itself is a source of pathogenic agents, and in rural areas, water is very often contaminated.

Some pathogens exist naturally in the environment, e.g., earth, and are consequently endogenous contaminants of food. One example is *B. cereus*, the spores of which are often found in foods, such as rice and dried milk. In the United Kingdom, it occurs in 70% of samples of uncooked rice (Rowland, 1985); if a meal based on ingredients such as rice and/or dried milk undergoes time/temperature abuse during post-preparation storage, *B. cereus* spores that may have survived the cooking process can germinate and produce toxin. Another example is provided by *Clostridium botulinum,* a natural contaminant of soil, which can therefore be present in some foodstuffs. Some foods of animals origin may harbour pathogenic bacteria or parasites, and surveys in some industrialized countries show that up to 80–100% of all poultry meat may be contaminated with campylobacter and/or salmonella (Roberts, 1990).

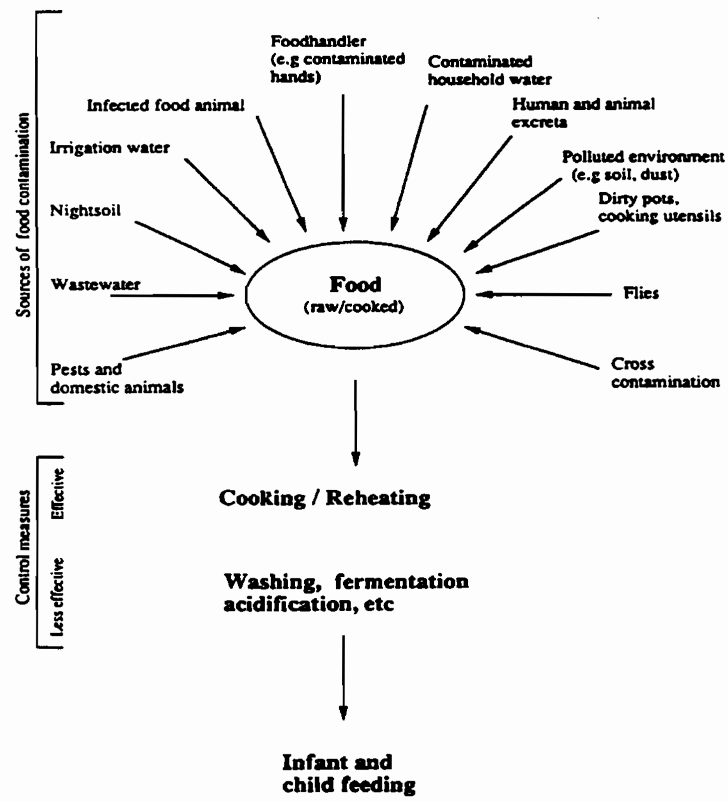


**Figure 4**
**The sources of food contamination are numerous; however, with appropriate food safety measures the hygienic quality of food for infants (including drinking-water) can be controlled**

In addition to the above-mentioned sources, there is also the imminent risk of cross-contamination during food handling. This can occur either by the direct contact between raw and cooked foods or indirectly through insects, rodents, contaminated hands, surfaces, or utensils.

Pathogenic agents can therefore contaminate food in many different ways, and at various stages in the food chain, including during the preparation of food. Under the unfavourable conditions that exist in many countries, especially in slum and rural areas, the risk of contamination of complementary foods during their preparation is even greater. However, in terms of the causes of foodborne diseases, the most critical factors are the following: the preparation of food several hours prior to consumption, combined with inadequate storage conditions; and insufficient cooking or reheating of stored food (WHO, 1984).

Whatever the source of the food contamination, foodborne pathogens and some of their toxins can be destroyed by appropriate heat treatment, and adequate cooking or reheating can reduce their number to safe levels. However, contrary to popular belief, normal cooking does not necessarily eliminate all the microorganisms. In the preparation of porridge or gruels, for example, prolonged cooking is often avoided, since sustained cooking produces a food that is too glutinous and viscous for young infants to consume. Consequently, depending on the extent of the initial contamination and the duration of cooking, a number of pathogens may survive the cooking process. Many foods are a rich medium for microorganisms encouraging their growth and eventually the production of toxins. Under favourable conditions, a single bacterium can multiply to 1 million in 10 hours. Bearing in mind that the minimum infective dose of pathogens varies from a few (10 or less) to as many as $10^4$ or $10^6$, the survival of even a small number of pathogens in freshly-prepared food can become health-threatening, particularly if the food is stored at ambient temperature for several hours or overnight, as is often the case. For some microorganisms, cooked foods are an even more favourable milieu than raw foods, since cooking reduces the number of competitive flora. If food is contaminated by such a microorganism after cooking, i.e., by contaminated hands, and is then stored at inappropriate temperatures for an extended period of time ($\geq$4 hours), it is more likely to cause disease. In this context, it is important to remember that the reservoir of many pathogenic microorganisms, e.g., *S. aureus*, is the human body. The proportion of healthy humans who carry staphylococci at any one time varies from 30% to 50%, with 15–35% being persistent carriers (Bergdoll, 1989). Also, while adequate heating is effective in reducing the number of bacteria, including those that are pathogenic, certain toxins, such as those produced by staphylococci or certain strains of *B. cereus,* are heat stable and are not destroyed by cooking.

There are some traditional practices that are advantageous from the food safety point of view. For example, in many African countries it is customary to give infants fermented cereal products such as *ogi* (Nigeria), *ugi* (United Republic of Tanzania, Uganda, Kenya) and *mahewu* (South Africa, Zimbabwe) (Tomkins et al., 1988). As a result of fermentation by lactic bacteria and yeasts, the pH of the food decreases to $\leq$4.3, at which levels microorganisms associated with spoilage or disease cannot multiply. Such techniques of food preservation are not only a helpful means of preserving food, especially if fuel for cooking is in short supply or if mothers are compelled to prepare food in advance and the means for its safe storage are lacking, but also offer many nutritional benefits (Tomkins et al., 1988; Nout, 1990; King and Ashworth, 1991). Several studies carried out in Africa have demonstrated the importance of this traditional technology in controlling and improving the microbiological quality of complementary food (Mensah, 1990; Odugbemi et al., 1991). Mensah et al. (1990) showed that there were lower quantities of contaminated fermented porridge than unfermented, and that after several hours of storage the level of contamination was significantly lower in fermented porridge

In addition to some of the above-mentioned studies, there are a few others that demonstrate the relationship between contamination of complementary foods and the occurrence of diarrhoeal diseases. One such study carried out in Kenya, which shows the relationship between food contamination and diarrhoea, is worth discussing in some detail. Contamination of infant food was investigated in Kiambu, a district on the outskirts of Nairobi, where the rates of diarrhoeal diseases were low compared to other areas of the country. The level of contamination of infant food was also relatively low and in over 75% of occasions the food was eaten almost immediately after being prepared. During the period of complementary feeding, mothers took direct responsibility for feeding their infants and in most cases the food was cooked for relatively long periods. Of note is that when high levels of contamination occurred the handling of food after preparation was found to have been involved. For example, when food was cooked to high temperatures the mothers would add either cold milk or leftovers to cool it — a process that could reintroduce pathogens (Pertet et al., 1988). A correlation between contamination of complementary food and diarrhoeal diseases can also be deduced from studies of the risks associated with early introduction of complementary foods. For example, Elegbe and Ojofeitimi (1980) found a higher rate of recovery of enteric pathogens from the stools of children who were fed complementary food than from their counterparts who were exclusively breast fed. Furthermore, Gordon et al. (1963) observed that children born in spring and during the hot dry season, shortly before and at the height of diarrhoea prevalence, had the lowest death rates for diarrhoeal diseases during the first year of life. They were predominantly breast-fed at the time of major risk. Children born in autumn, with complementary feeding beginning in the hot dry season at the time of greatest risk, had the highest death rates of any cohort determined by month of birth.

Finally, it should be mentioned that there are also studies that have failed to demonstrate a clear correlation between complementary food contamination and diarrhoeal morbidity (Lloyd-Evans et al., 1984). One possible explanation for this is that food is often analyzed only for a limited number of pathogens and not for all those potentially present.

The emphasis in this review has so far been on the biological contamination of complementary foods, because of the extent and gravity of the consequences for infants and children, as well as on the role that those preparing infant foods can play. However, the chemical contamination of food also needs to be discussed, since many outbreaks of chemical intoxication have arisen as a consequence of errors made by those handling food due to their ignorance or negligence. For example, in a number of instances food has been contaminated because of unsafe packing and leakage of pesticides during storage or transport or because food was stored in containers that previously contained pesticides, but which were not adequately washed before being re-used. Also, seeds have been consumed that were intended for planting and which had been treated with fungicides; fish have been caught in ponds where rice treated with pesticide was growing; or cereals have been harvested too soon after being treated with pesticide. The problems presented by intoxication with marine biotoxin are also increasing in many parts of the world, and if seafoods constitute a part of the diet of infants and children, they too will be affected if such food is contaminated.

## 7. SOCIO-CULTURAL CONSTRAINTS

Although the risk factors for foodborne disease are well known, their prevention may be impeded or hampered by many social and cultural constraints. Social infrastructure, ignorance, incorrect beliefs and practices, taboos, poverty, insufficient food, lack of safe water and sanitation, shortage of fuel, and time are some of the many factors that aggravate the situation.

Food habits and beliefs have major implications for food safety. Unfortunately, in many societies the relationship between diarrhoea and food contamination is not understood. For instance, in Uganda some parents believe that diarrhoea is caused by false teeth (Bwengye, 1989). In Orissa, in India, 65% of mothers believe that diarrhoea is caused by casting of the evil eye, 44% by indigestion, 10% by eating "hot foods" such as mango and egg, 8% by teething, and 35% by food eaten by breastfeeding mothers; many mothers blamed their own breast milk for causing diarrhoea (Mohapatra, 1989). In many cultures, babies' stools are not considered to be dirty or contaminating (Fukumoto and Del Aguila, 1989). For example, in one community-based study of the etiology of diarrhoea in Papua New Guinea, children whose mothers did not perceive babies' faeces to be important in causing diarrhoea had a 7.4 times greater risk of having diarrhoea than children whose mothers recognized their importance. Also, the risk of contamination of food was 6.8 times greater for those children whose mothers did not recognize the importance of this route (Bukenya et al., 1990).

Many customary kitchen practices and food preferences contribute to lack of safety in food preparation. These include a predilection in some societies for raw fish and undercooked meats, the storage of perishable food at ambient temperature, and cooks' failure to wash their hands before preparing food (Abdussalam et al., 1989). Bryan et al (1988) reported that many migrants living in a settlement on the outskirts of Lima did not have a refrigerator to store their food; however, those who had refrigerators either did not know that cooked foods should be stored in them in the interval between meals or it was their usual practice not to refrigerate cooked foods. Cultural beliefs as well as taboos add to these problems. In much of Latin America, hands are thought to be "heated" by contact with pressing irons and pottery kilns or by working with "hot" substances such as mineral lime. Exposing "hot" hands to cold water is believed to cause cramps and rheumatism, so people refrain from washing them, often for many hours (Abdussalam et al., 1989).

Insufficient water is also an important reason for not washing hands or utensils properly. According to some studies, improvement in water availability has a higher impact in reducing the rate of diarrhoeal morbidity than improvements in water quality alone (Esrey, 1985). Lack of excreta disposal facilities increases the risk of contaminating food with faecal matter.

Undoubtedly, availability of time is one of the major factors that governs the feeding patterns of infants. If, in addition to caring for infants and children, mothers have to work outside the home, the greater demand on their time competes with their care/nursing capacity; in such circumstances, they do not always prepare food according to correct safety principles. Moreover, to be able to attend to their activities outside the home, some mothers may initiate complementary feeding earlier than the prescribed age of 4–6 months (Simpson-Hebert and Makil, 1985). This may lead to an increased risk of foodborne diseases.

Food preparation (cooking) can consume a great proportion of household fuel energy. In many developing countries shortage of fuelwood affects the nutritional status of rural households, particularly that of infants and children.To meet the daily nutrient requirements of infants and children (who have a small stomach), they have to be fed several times per day. When there are shortages of fuel and/or time, either for feeding or collecting fuelwood, households tend to economize on both fuel consumption and time by adopting food preparation practices that may be detrimental to the child's health. For example, it has been repeatedly observed that in order to save on fuel/time, food is prepared in quantities larger than are required for one meal — sometimes also insufficiently cooked — and is then stored until the next meal, often at ambient temperature. If there is a shortage of fuel, complementary food may be served cold or without adequate reheating. In addition to the risk of infections, insufficient cooking also causes nutritional problems since complementary foods may be less palatable or digestible; for example, some pulses contain trypsin inhibitors that prevent the absorption of proteins, but which could be destroyed with adequate cooking (Brouwer et al., 1989).

Finally, in the case of food shortage, the availability of the food is prioritized to the detriment of its quality, and safety aspects are often neglected. Sometimes ingredients are used that are not fit for consumption. Lack of some ingredients modifies the physico-chemical properties in such a way that the food (which is otherwise safe) encourages the rapid growth of microorganisms. For example, an outbreak of cholera in an African village was associated with leftover millet gruel in which the sour milk that is traditionally added had become unavailable because of drought (St Louis et al., 1990).

## 8. SIGNIFICANCE OF FOODBORNE DISEASES FOR HEALTH CARE SYSTEMS

In addition to the human suffering that foodborne diseases cause in terms of death or ill health, tremendous economic costs are incurred by health care systems and society. Episodes of diarrhoeal disease, which in some countries occur on average about 10 times per child during the first year of life, are one of the most frequent reasons for the hospitalization of children. In some areas such diseases account for 30% or more of paediatric hospitalization (Claeson and Merson, 1990). For example, in Bangladesh, diarrhoeal syndromes have been reported to account for 52% of all hospitalizations (Black et al., 1982a; Black et al., 1980); and in one study of hospitalized cases of infants and children with symptoms of intoxication in Mali, 44% of the cases were foodborne and occurred with the highest frequency among under-fives (Sidibe et al., 1991). Increasing health care costs are clearly a tremendous economic burden for many countries, particularly those with limited ressources (UNDP, 1990).

## 9. HEALTH EDUCATION IN FOOD SAFETY: A COST-EFFECTIVE INTERVENTION

To prevent the suffering of millions of children and parents, and to contribute to the breaking of the vicious cycle of disease, under-development and poverty, an urgent and cost-effective intervention is required. Currently, there is no vaccine capable of providing general protection against foodborne infections, and it is unlikely that there ever will be. Attempts are being made to develop vaccines for specific foodborne diseases such as cholera and shigellosis; however, these efforts are still at the research or experimental stage. Diarrhoeal diseases have traditionally been linked to contaminated water supply and lack of sanitation, and great efforts have been concentrated in preventing them by improving water supplies and excreta disposal facilities. A review of the impact of improved water supplies and excreta facilities in the control of diarrhoeal diseases among young children has shown that, even under the most favourable circumstances, the rate of morbidity was reduced only by 27% (Esrey, 1985). In Europe, which by and large has safe drinking-water and effective excreta disposal facilities, the incidence of foodborne diseases has increased threefold since 1984 and it is believed that in some industrialized countries such diseases affect about 10% of the population (Todd, 1989; Archer and Kvenberg, 1985; Hoogenboom-Vergedaal et al., 1987; WHO, 1992). While there are numerous reasons for this increase, outbreak of foodborne disease are almost always caused by one or more errors during the final preparation of food (Bryan, 1978; Roberts, 1982; Todd, 1983).

To prevent foodborne diseases, a multidisciplinary approach is needed. Environmental conditions need to be improved, including the provision of safe water supply and sanitation as well as the creation of the social infrastructure to permit mothers to improve their care/nursing capacity. However, such measures might take many years to achieve, and on their own will not be sufficient to prevent foodborne diseases. Foodhandlers (including all mothers) need to be educated to learn how to protect infants and children from foodborne hazards. Since the nutrition of infants and young children depends closely on the education of their mothers on food safety, this is one the most important interventions to be considered. A programme to educate mothers on food safety principles should therefore be considered to be an integral part of every primary health care system and should be incorporated into national infant feeding or food and nutrition programmes.

Experience with education programmes on other issues, such as the promotion of appropriate feeding for improving nutritional status, has shown that they are feasible and cost-effective interventions. Compared to some other interventions, the costs involved in health education are relatively low, while they produce long-lasting changes in the health-related behaviour of the target group (Ashworth and Feachem, 1985; Feachem, 1984).

In view of the worldwide dramatic increase in the incidence of foodborne diseases, immediate action to protect the most vulnerable groups of the society, i.e., infants and children, is called for. Reviews of published data on foodborne diseases show clearly that one of the most critical practices leading to increased risk of foodborne diseases is storing cooked foods at ambient temperature for several hours, and serving such foods without appropriate reheating. Therefore, as an immediate action to prevent foodborne diseases, a health education programme focusing on the problem related to time/temperature abuse should be launched, using diverse channels, including primary health care centers.

Since socio-cultural settings vary among countries, in the long term the design of health education programmes should be based on a detailed analysis of hazards associated with food habits, the social and economic situation, and the technological facilities available in the target society. Such an approach involves two types of studies. The first should be concerned with collecting socio-cultural information, for which the assistance of anthropologists or sociologists is required to investigate the customs, beliefs and rituals that lead to specific food safety problems, and to provide the socio-cultural information needed to plan an educational programme acceptable to the population. The second is the hazard analysis critical control point approach, i.e., the systematic identification of hazards at each step during the preparation of food, assessing the risks and determining the operations where control procedures will be effective. For this purpose, the expertise of food scientists is required.

In conclusion, it is clear that the prevention of diarrhoea in infants and children requires a multidisciplinary approach, including the promotion and protection of breastfeeding as well as the safe preparation and handling of complementary foods. In view of this, the education of mothers on food safety principles is one of the most important interventions in promoting the health and nutritional status of infants and children.

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# Ensuring the quality of complementary foods

Selma DOYRAN

## 1. INTRODUCTION

As the International Conference on Nutrition (ICN) made clear, not only does food have to be available in sufficient quantities, but it has to be healthy and of satisfactory nutritional quality. This is of particular importance in the case of food for young children, for whom food poisoning can have very serious effects and is an important cause of infant mortality. In addition, nutritional deficiencies seriously harm the health and development of children. Governments should include quality control, including control of the hygiene of foods, in their nutritional policies.

## 2. DIFFICULTIES ENCOUNTERED IN CARRYING OUT QUALITY CONTROL

In order to carry out effective quality control, governments have to tackle a number of problems, including the growth of the urban population, the distance between food production and consumption sites, technological developments and the globalization of trade. Furthermore, taking into account the limited resources available to governments, especially in developing countries, priorities have to be defined; for economic reasons, there is a tendency to make exports a priority, sometimes to the detriment of other controls. Nevertheless, it is essential that national authorities realize that the safety and quality of foodstuffs sold on the domestic market are important.

The poor quality of imports is a serious source of concern and many countries have had to strengthen controls in that respect. The most difficult aspect, however, is control of the quality of products manufactured domestically, for reasons of cost or due to geographical or infrastructural problems. It is much easier to inspect products grouped at the site of export or import than domestic products distributed all over the country.

Governments have become increasingly aware of the need to prevent the marketing of products that are dangerous to health or likely to mislead the consumer. In view of the complexity of food production systems, an integrated approach involving the various economic sectors is essential to ensure effective protection of consumers and make the best use of often limited resources.

During one of the last meetings of the Coordinating Committee for the Codex in Africa (FAO, 1992) and the FAO regional workshop on the management of control programmes which preceded it, the focus was on factors that would ensure the success of a quality control programme:

- the establishment of a coherent strategy for food control comprising basic legislation and regularly updated regulations;
- a clear definition of the roles of the various government bodies involved;
- coordination between the government and educational institutions, food industry and consumers at the national and local levels;
- the strengthening of control structures, including laboratories;
- identification of priority areas and measures, including foods for infants.

In this connection, the Food Policy and Nutrition Division has published a series of manuals in the Food and Nutrition Series[1] which target control authorities and are used as a reference in FAO projects. The manuals cover:

- quality control, including exports and imports
- the management of control programmes
- sampling and analysis
- microbiological analysis
- training in analysing mycotoxins
- guarantees of quality in the laboratory.

With regard to quality control in general, action depends on the type of production: large-scale manufacturing units usually have a quality control system, for example ISO 9000, and in developing countries projects currently being implemented often adopt this approach. It is the responsibility of government authorities to cooperate with industry in defining such programmes and carrying out secondary controls in factories or random sampling of finished products.

One other important aspect is labelling so as to provide fair and clear information to the consumer and, in the case of ready-to-use complementary foods, instructions on how to use the product. International standards can be used as the basis for this information:

- Codex Guidelines on Nutritional Labelling (CAC/GL 2-1985; Rev.1-1993);
- Codex General Standards for the Labelling of Prepackaged Foods (CODEX STAN 1-1985; Rev.1-1991);
- Codex General Standards for the Labelling and Claims for Prepackaged Food for Special Dietary Uses (CODEX STAN 146-1985).
- Codex recommendations on Foods for Special Dietary Uses (Including foods for infants and children) (CODEX STAN Volume 4, 2nd Edition).

[1] FAO manuals on food quality control (9 volumes). Rome, FAO (FAO Food and Nutrition Paper No. 14/1 to 14/9).

## 3. PROBLEMS CAUSED BY MYCOTOXINS

Contamination and poor quality of foods are still a serious problem and have a significant economic and nutritional impact.

In the case of complementary foods in particular, one of the major problems for the industry and control services in Africa and in tropical countries generally, is contamination due to the use of local raw materials. Mycotoxins, particularly aflatoxins, present in maize, groundnuts and some pulses constitute a serious health risk. Very high levels of contamination can lead directly to acute toxicity. FAO has published a manual on practices to prevent contamination by mycotoxins (1979) and is following up this priority issue through various activities. It has organized several regional workshops on controlling contamination which have been the subject of a number of publications. For example, the regional workshop on aflatoxins held in Cairo (1990) allowed participating countries to share experiences in controlling contamination, especially at the production level. The creation of an inter-African network on mycotoxins to allow countries to pursue their exchange of experience was initiated. It was also recommended that countries should adopt appropriate regulations.

Action is particularly important at the production level, for example, promoting awareness among farmers. If foods are not prepared industrially or in small workshops but at the family level, it is very difficult to carry out direct controls to ensure that the raw materials are not contaminated.

Another problem for control services when controlling mycotoxins is sampling; a FAO technical consultation was held in Rome in 1993, to discuss the sampling of groundnuts and maize (FAO, 1993).

A regional training course on the analysis of mycotoxins other than aflatoxins was held in Botswana in December 1994, so that action could be implemented in several countries to provide more information on other forms of contamination. The Codex Committee on Additives and Contaminants and the Codex Committee on Cereals, Pulses and Legumes are also studying these issues, both to define maximum limits and to draw up recommendations on reducing contamination at the origin.

## 4. PROBLEMS CAUSED BY MICROBIOLOGICAL CONTAMINATION

With regard to microbiological contamination, major industries carry out their own controls and apply quality assurance procedures. In such cases, control authorities have to fulfil a dual role: on the one hand, giving advice on setting up these procedures in manufacturing units and, on the other hand, answering secondary controls either to verify the functioning of self-control or the safety of the final product.

There is a trend towards the control of the manufacturing process, which generally uses the Hazard Analysis Critical Control Point (HACCP) system. Although it was first set up in large factories, it can be applied at all levels — small and medium-scale industries, and transport and retailing — because it involves general principles for a logical procedure allowing the risks of contamination to be identified and controlled.

In this connection, the Codex Committee on Food Hygiene has established guidelines for implementing the HACCP system (supplement 1-volume 1 CAC/GL 18-1993).

General food hygiene principles can also be used as the basis for ensuring hygienic production; they are currently being revised and will include a section on educating consumers about hygiene.

As far as foods for infants are concerned, there are also special hygiene provisions in the Recommended International Code of Practice for Foods for Infants and Children (CAC/RCP 21-1979).

## 5. HOW THE CODEX WORKS

Having referred several times to the Codex Standards in connection with quality controls, it is necessary to give some further details on how the Codex Alimentarius Commission works.

### 5.1 Overview

The Codex Alimentarius Commission (CAC) is composed of 150 members and was established in 1962 by FAO and WHO in order to implement the Joint FAO/WHO Food Standards programme whose aim is to protect consumer health and facilitate international trade in food. A number of special regulations and related texts have been drawn up by the CAC on foods for infants and children and this remains a priority area. The Standards constitute a reference in international trade and their importance in this regard was highlighted in the GATT Agreements on the Application of Sanitary and Phytosanitary Measures (SPS) and on Technical Barriers to Trade (TBT), which oblige member countries to respect international standards where they exist. The SPS specifically refers to the Codex (regulations and texts on protection of health).

These measures were developed in order to facilitate international trade, but they are used by many member countries as a basis for their domestic legislation. It should be noted that the Standards lay down minimum criteria and leave governments free to decide on certain areas in accordance with their situation and special needs. When legislative and food control programmes are being elaborated in different countries, FAO and WHO recommend that these international Standards be used.

Considering the problems encountered by importing countries, especially in Africa, with regard to the quality of complementary foods (and foodstuffs in general), the status of Codex Standards within the World Trade Organization (the successor to GATT) allows countries to insist that imported foods should conform to an international standard, thereby providing a certain guarantee even in the absence of any specific domestic legislation.

### 5.2 Some examples of Codex Standards for infant foods

Among the Codex Standards for foods for infants, the following relate to this subject:

***Processed Cereal-Based Foods for Infants and Children*** (CODEX STAN 74-1981)

This Standard applies to special baby foods and cereal products used to complement the diet of infants and young children. It has been regularly revised since it was first published in 1976.

The standards includes the following requirements regarding the nutritional composition of such foods:

- a minimum protein content of 15% of dry weight; the quality of proteins must not be less than 70% of that of casein;
- a minimum content of 10% of milk protein for milk biscuits;
- a maximum sodium content of 100 mg/100 g.

***Guidelines for Formulated Supplementary Foods for Older Infants and Children*** (CAC/GL 8-1991)

When discussing this Standard, developing countries expressed the wish that FAO and WHO should provide guidelines on preparing these products from locally-available raw materials. In response, the Codex Committee on Nutrition and Foods for Special Dietary Use (CCNFSDU) drew up guidelines that were adopted by the CAC in 1991. They prescribe provisions relating to the formulation of these products, defined as foods for infants during weaning, to complement or replace breast milk and other foods available in the country where the product is sold. The provisions concern nutritional requirements, processing and manufacturing techniques, hygiene rules, packaging, labelling, and instructions for use.

In order to rationalize and simplify the Standards, it was decided to combine the Standard and the aforementioned Guidelines. This text was distributed to governments for comments and review by the session of the CCNFSDU (27–31 March 1995, Bonn); it is therefore important that governments should transmit their comments and wishes in this respect.

*Other aspects*

The Codex Standards in this area also cover other aspects or products, for example, the Advisory List of Mineral Salts and Vitamin Compounds for Use in Foods for Infants and Children (CAC/GL 10-1979) and Canned Baby Foods (CODEX STAN 73-1981). All these texts can be used as a reference when defining quality criteria.

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# Techniques for increasing the energy density of gruel

Serge TRÈCHE

## 1. INTRODUCTION

Nicol (1971) in Nigeria, and Rutishauser (1974) in Uganda were the first to mention "dietary bulk" as a possible cause of protein-energy malnutrition in young children. But the need to increase the energy density of complementary foods, because of children's limited gastric capacity, especially when daily feeding frequency is low, was recognized only in the 80s following the publication of several papers by a team of Swedish researchers (Ljungqvist et al., 1981; Hellstrom et al., 1981; Brandtzaeg et al., 1981; Karlsson and Svanberg, 1982) and the work of Desikachar (1980; 1982), Gopaldas (1984) and Golpadas et al. (1986) in India. More recently, the literature on the relationship among complementary feeding, the level of energy intake and protein-energy malnutrition, emphasized that it was important to identify and promote ways of increasing the energy density of foods based on locally produced staples (Walker, 1990; Creed de Kanashiro et al., 1990; Brown, 1991; Ashworth and Draper, 1992).

## 2. WHEN IS IT APPROPRIATE TO INCREASE THE ENERGY DENSITY OF GRUEL?

Studies on infant feeding practices and on the nutritional value of traditional gruels in various African countries have demonstrated the benefits, and sometimes the necessity of improving the energy density of gruels.

To clarify our point, we will use an example, in Congo. In this country, surveys of infant feeding practices have shown that among children consuming gruel regularly, only 22% in the rural sector and 21% in Brazzaville received gruel more than twice a day (Cornu et al., 1993).

In more than 80% of cases, gruel is prepared from locally grown products, fermented maize paste *poto-poto*, or cassava flour (Trèche et al., 1992; 1993). The dry matter content of gruel taken at the time of consumption was determined in more than 300 samples; the mean dry matter content was for maize and cassava gruel, 14 and 16 g of dry matter (DM) per 100 g of gruel respectively. Given that 1 g of DM provides 4 kcal, approximately 50% of the gruels had an energy density of less than 60 kcal/100 ml (Figure 1).

During the period of gruel consumption, most Congolese children consume a gruel with an energy density of often less than 60 kcal/100 ml once or twice a day. If Central African mothers' mean breast milk output is 540 ml/day or 380 kcal, as estimated by Vis et al. (1981) in Zaïre, complementary feeding must provide a 6 month-old boy with an additional 385 kcal to meet his estimated energy needs of 765 kcal.

In order to obtain 385 kcal, children should consume 640 ml of gruel with an energy density of 60 kcal/100 ml. In fact, at this age, children cannot eat more than 150 to 200 ml of gruel per meal because of their limited gastric capacity. If the mean intake per meal is 170 ml it implies that (Figure 2):

- If children receive two meals per day, the energy density of gruel must be 120 kcal/100 ml to satisfy their energy needs.
- If the energy density of gruel does not exceed 60 kcal/100 ml, four meals per day are needed.

In a situation where breast milk intake is limited, the frequency of gruel distribution is low, and where complementary foods are made of cereals or tubers that have not been appropriately processed, gruel cannot adequately complement breast milk to cover children's energy needs. The most straightforward solution to this problem is to increase the frequency of distribution of gruel; four meals of gruel with an energy density of 60 kcal/100 ml would satisfy energy requirements. Unfortunately, studies have shown that this is not feasible for mothers who work in agriculture or as vendors.

An alternative is to increase the amount of flour, i.e. to incorporate more flour or paste in a given quantity of gruel. But measures of the viscosity of gruel used traditionally in Congo (Trèche and Giamarchi, unpublished), have shown that younger infants prefer a more liquid gruel (Figure 3). The viscosity of gruel — measured with a rotating viscosimeter, expressed in Pascal.second (Pa.s) — increases sharply with concentration, irrespective of the nature of the basic ingredient. The viscosity of gruel should not exceed 1.5 Pa.s to be acceptable to the younger children. In fact, it is impossible to prepare maize, cassava, or rice gruel with, at the same time, a concentration of more than 10 g DM/100 ml and a viscosity near 1.5 Pa.s, without special processing of the basic ingredient (Figure 4).

Other approaches can be proposed:

- reducing mothers' workload and/or improving their food consumption in order to increase their breast milk production;
- incorporating energy-dense ingredients in gruel, particularly oil, or ingredients that do not alter the consistency such as sugar.

However, experience shows that these solutions are not well accepted, either because they are not in accord with the local lifestyle or because they are too expensive.

Several studies, carried out among children over one year of age consuming two meals per day, have shown that the amount of dry matter ingested increases with the energy density of the gruel (Brown et al., 1989; Alvina et al., 1990; Sanchez-Grinan et al, 1992; Mujibur Rahman et al., 1994). Indeed increasing the energy density of gruel appears to be the most efficient way of increasing children's energy intake. This can be achieved by processing foods to alter the physicochemical properties of starch, in order to reduce the viscosity of gruel to a level that is acceptable to young children when the gruel is prepared with adequate concentrations of dry matter.

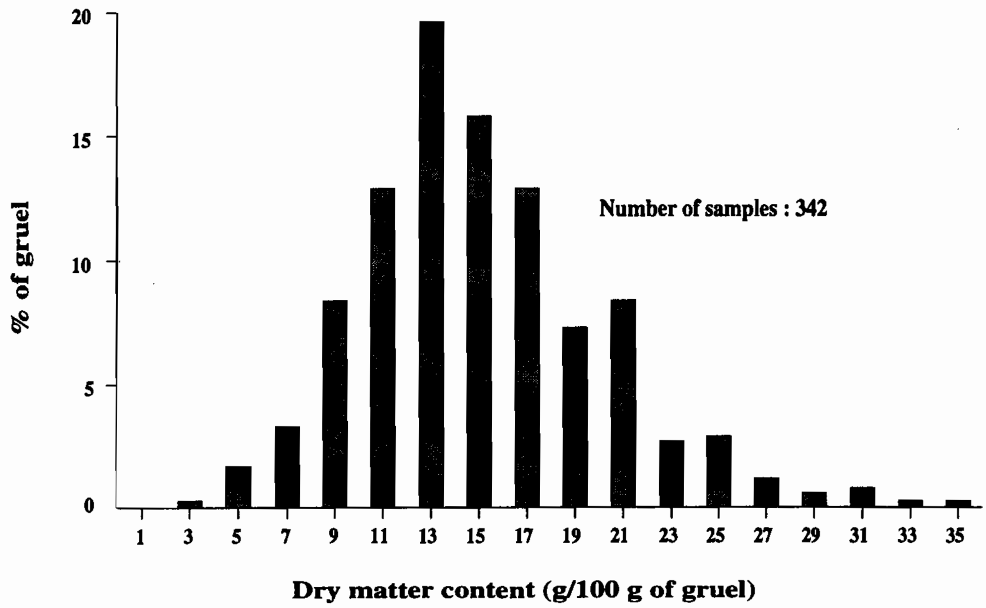


**Figure 1**
**Distribution of dry matter content of gruels consumed in rural areas of Congo**

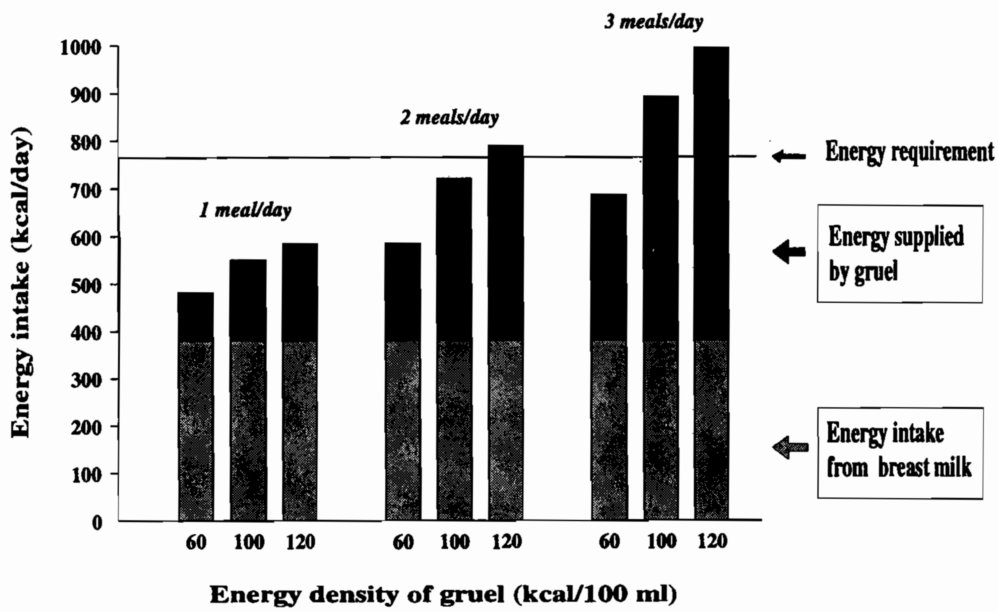


**Figure 2**
**Level of satisfaction of energy requirements of a 6-month-old boy, according to frequency of distribution and energy density of gruel**

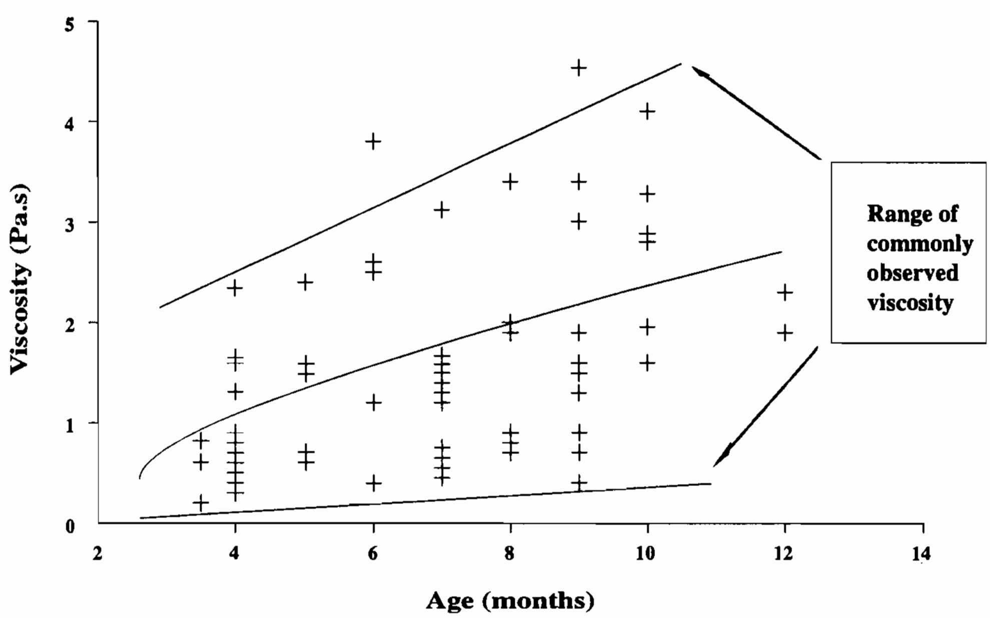


**Figure 3**
**Variation of observed viscosity of gruel according to child's age in Congo**

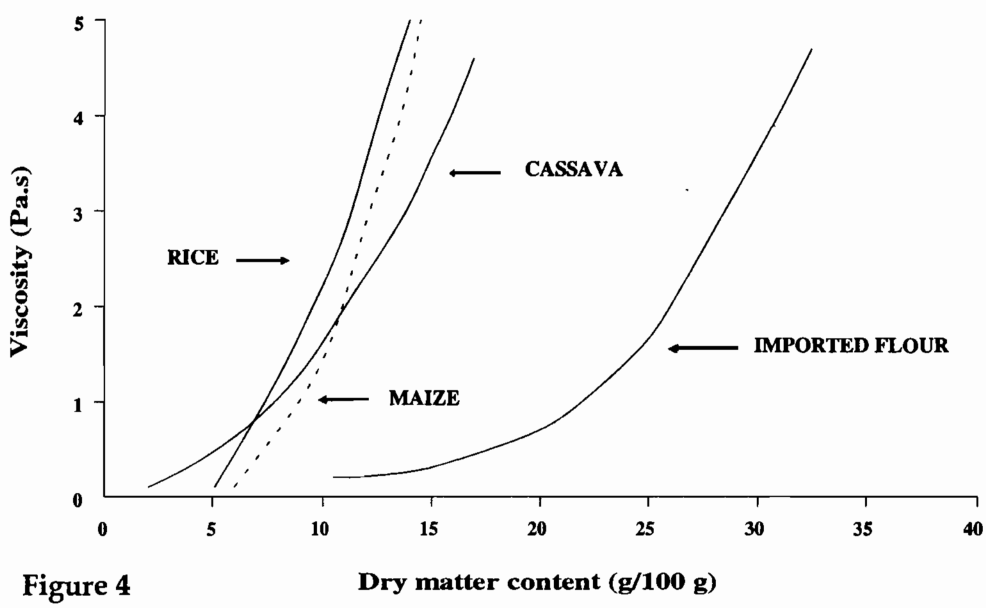


**Figure 4**
**Variation of viscosity of gruel made from various starchy foods according to dry matter content**

## 3. PROCESSES TO REDUCE THE VISCOSITY OF GRUEL

### 3.1 The options

Theoretically, there are two approaches for modifying the viscosity of preparations of starch in an aqueous medium. The first method is reticulation, which demands the addition of polar organic molecules, such as monoglycerides and fatty acids, to transform amylose from an amorphous to a compact helicoïdal form, thereby preventing the penetration of water in the molecule. The second method is depolymerisation which shortens the non-branched fragments of structural starch chains, thereby reducing their swelling capacity.

There are several techniques for obtaining depolymerisation:

- drastic hydro-thermic treatment, such as drum-drying or extrusion-cooking, which causes the starch granules to burst, and the structural chains to unfold and break;
- acid hydrolysis that dissolves preferentially the amorphous parts of starch granules by splitting the $\alpha(1\text{-}4)$ hemiacetal bonds of the amylopectin and amylose chains, thereby shortening them;
- enzymatic hydrolysis using alpha-amylase; the enzymes attack randomly non-terminal $\alpha(1\text{-}4)$ bonds, producing ramified or unramified dextrins with a degree of polymerisation that depends on the state of the substrate and hydrolysis conditions, particularly duration, pH and temperature.

Given the price of the first two methods of depolymerisation, the impossibility of implementing them at household level, and legal difficulties entailed in the use of acid hydrolysis, the most interesting option is enzymatic hydrolysis.

Several natural sources of alpha-amylase could be used:

- animal alpha-amylase: pancreas decoction, human saliva, breast milk;
- bacterial alpha-amylase produced industrially or by non-pathogenic strains developing on the substrate;
- plant alpha-amylase which are naturally present in certain plants or are produced during germination of seeds or tubers.

In most cases, to improve the energy density of gruel prepared from tropical staple foods, authors have chosen the preliminary fermentation of starch components (Tomkins et al., 1989), and the use of germinated cereal, or the addition of small amounts of amylase-rich flour made from germinated cereal (Desikachar, 1980; Brandtzaeg et al., 1981; Desikachar, 1982; Mosha and Svanberg, 1983; Gopaldas et al., 1988; Malleshi and Amla, 1989; Mosha and Lorri, 1989). The studies we have conducted show that, in addition to these sources, industrially-produced amylase can be used, particularly for incorporation into flour produced by small-scale production units (Trèche and Giamarchi, 1991; Sanogo, 1994; Trèche and Legros, 1994).

### 3.2 Effect of fermentation

In many countries, fermented cereal is used traditionally for the preparation of gruel for infants (Tomkins et al., 1989; Cornu et al., 1993): the Nigerian *ogi*; the Congolese *poto-poto*; the South-African *mahewu*; the Kenyan *uji*; the Ghanaian *kenkey*; *bogobe* from Botswana;

*nasha* in Sudan; *obusera* in Uganda; *njera* in Ethiopia; *motoho* and *leshele-shele* in Lesotho, etc. In Tanzania, the viscosity of gruel is reduced when *udaga*, a flour made from aerial fermentation of cassava roots is used, but the fermentation process is difficult to control (Hakimjee and Lindgren, 1989; Mlingi, 1989).

There are numerous advantages to fermentation; fermented products have a good acceptability and the risk of microbial contamination is reduced (Mensah et al., 1991; Svanberg et al., 1992; Lorri and Svanberg, 1994). Moreover fermentation can reduce the viscosity of gruel of low or medium dry matter content, but it has not yet been possible to obtain gruel with an energy density of more than 100 kcal/100 ml by simple fermentation.

### 3.3 Use of germinated cereals

Incorporation of increasing amounts of germinated cereal flour can drastically reduce the viscosity of gruel prepared with an adequate concentration (Figure 5); however, the amount of germinated flour that must be incorporated varies considerably according to the type of substrate: to obtain a gruel with a concentration of 30 g of DM/100 g and a viscosity of 1 Pa.s, the relative amount of germinated maize flour that must be added to rice, maize, or millet gruel is respectively 3 times, 2.5 and 2 times the amount needed in cassava gruel (Figure 6). Thus, for a given viscosity, the increase in dry matter content, and consequently in energy density, obtained with the addition of a given amount of germinated flour, is much higher for cassava gruel than for cereal-based gruels such as maize gruel (Figure 7).

Optimal conditions for the germination of sorghum and maize are the following:

- Grains are dehusked by hand, to eliminate glumes and glumellae; grains are removed from kernels.
- Grains are soaked in water at room temperature for 24 hours.
- Grains are spread on a damp fabric, protected from the direct sun, for approximately 48 hours, until 2-inch sprouts develop.
- Germinated grains are dried in the sun for 2 or 3 days.
- Sprouts are eliminated by hand.
- Desprouted grains are ground with a mortar or in a hammer-mill.

The effectiveness of germinated flour in reducing the viscosity of gruel can be evaluated by measuring the amylolytic activity (Bernfeld, 1955). There is a large inter- and intra-specific variation of this activity. For a given variety, the activity will vary depending on the treatment previously applied to the grains, in particular storage time.

The preparation of gruel with improved energy density from germinated cereal flour is theoretically possible at household level, because the basic ingredients are generally available in households. The choice of the processing methods must take into account the nature and characteristics of available foodstuffs. In Figure 8, an example is given of what was feasible in a Central African setting where the only available staple foods were cassava, groundnut and pumpkin-seed paste, and small amounts of maize (Trèche, 1994); the objective was to

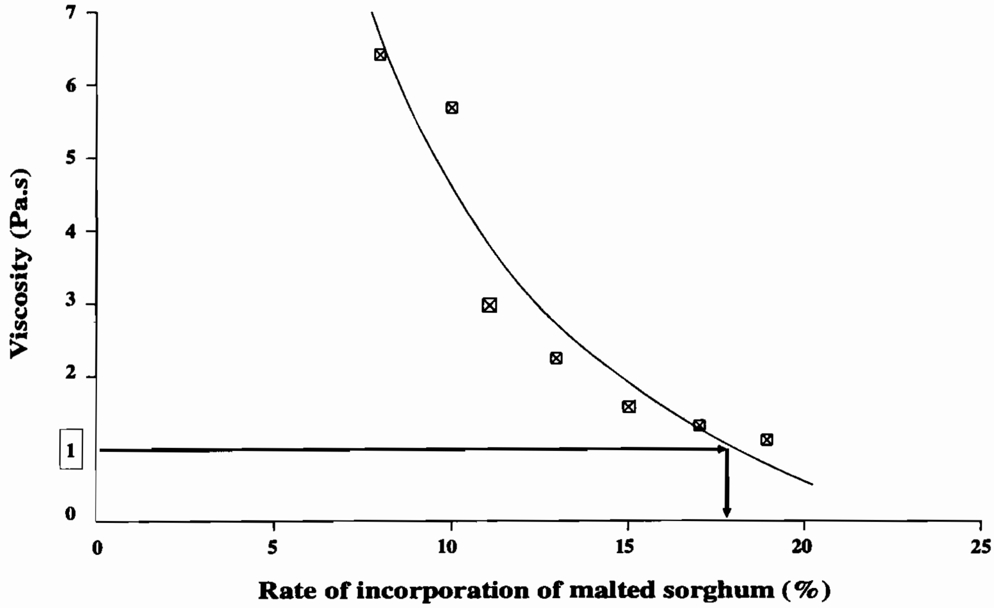


Figure 5
Effect of the addition of malted sorghum on the viscosity of cassava-based gruel prepared with a dry matter content of 30 g per 100 g of gruel

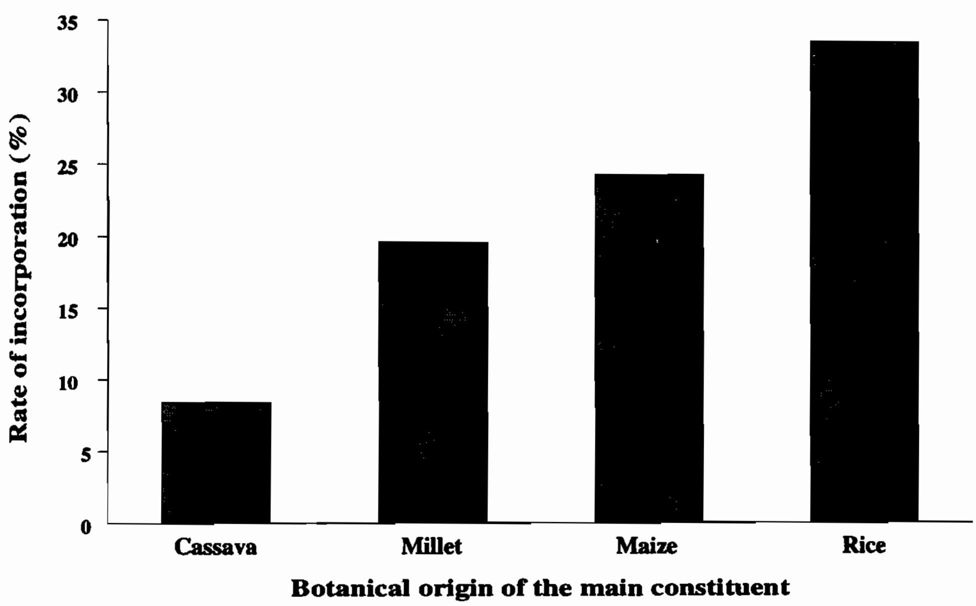


Figure 6
Rate of incorporation of germinated maize flour needed to obtain gruel viscosity of 1 Pa.s with a dry matter content of 30 g per 100 g, according to botanical origin of the main constituent

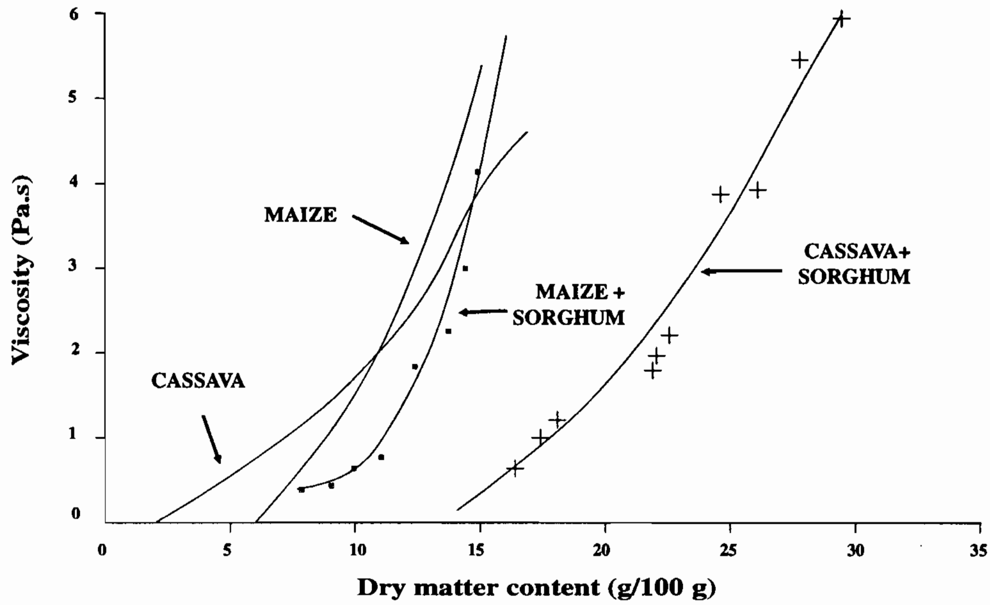


**Figure 7**
**Effect of the addition of 10% of malted sorghum flour on the viscosity of cassava and maize gruel**

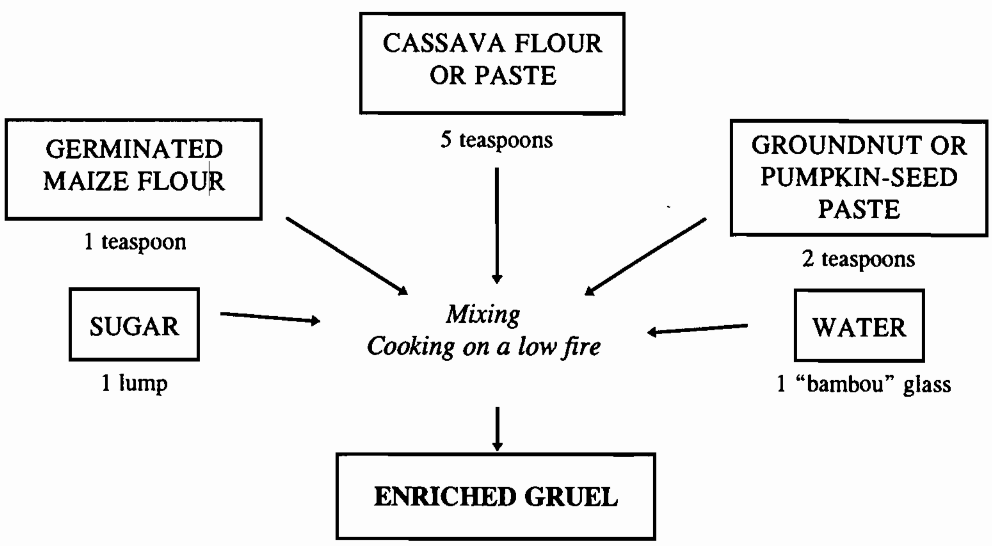


**Figure 8**
**Example of flow-sheet for preparation of an energy-dense gruel in a Central African setting**

obtain a gruel with a protein content of 10 g/100 g of DM, and a dry matter content of approximately 30 g/100 ml of gruel: the formulation is 65% of cassava paste, 32% of groundnut paste and 3% of germinated maize flour.

The preparation method is very simple: the ingredients are mixed into cold water, and heated on a low fire while stirring, boiled for 5 minutes and left to cool.

Several pilot trials have shown that these processes can be disseminated at household level. The preparation of germinated cereal flour, however, is long and households may be reluctant to prepare it. To overcome this difficulty, we have proposed other enzyme sources when flour for infants and young children is produced in small scale units.

### 3.4 Use of industrially-produced enzymes

Since imported industrial enzymes are inexpensive, we have proposed to incorporate them in flour for infants produced in small-scale units. BAN (NOVO Industries A/S), an enzyme adequate for incorporation into food, was selected after laboratory testing; the characteristics of BAN, described in Table 1, enable it to act upon structural starch molecules during the preparation of gruel by mothers. The temperature for optimal activity of the enzyme is 72°C. It is higher than the temperature of gelatinization of starch granules; they are therefore particularly susceptible to the enzyme. Moreover, boiling the gruel for a few minutes destroys the enzyme, preventing the gruel from becoming more liquid after cooling.

**Table 1**
**Characteristics of the industrial enzyme used in the Vitafort production unit**

| | |
|---|---|
| Name | BAN 800 MG (Novo Industries A/S) |
| Nature and source | Bacterial endo-amylase (Bacillus subtilis) |
| Form | Microgranule |
| Packaging | 40 Kg barrel |
| Shelf-life | 6 months at 25°C; more than a year at 5°C |
| Price | 60 US $/kg delivered in Congo |
| Absence of toxicity | Conforming with specifications recommended by FAO/WHO/JEFCA and FCC for use in food |
| Amylase activity | 800 KNU*/g |
| Optimal pH | 6.0 |
| Optimal temperature | 72°C (between 42 and 85°C activity is more than 2/3 of optimal activity) |
| Products of degradation | Dextrins with various levels of polymerisation; oligosaccharides |

* *KNU (Kilo-Unit Alpha-amylase Novo) : amount of enzyme needed to breakdown 5.26 g of soluble starch (Merck, Erg B6) per hour, using the standard Novo method.*

The viscosity of gruel can be reduced drastically with very small amounts of enzyme (Figure 9). As with germinated cereal flour, the amount of BAN needed depends on the nature of the gruel staple (Figure 10): the increase in dry matter content, and consequently in energy density resulting from the incorporation of BAN, is much higher, for a given viscosity, with cassava than with cereals such as maize.

An example of a production scheme to obtain improved energy dense flour for infants using industrial enzymes is presented in Figure 11 (Sanogo, 1994; Trèche and Legros, 1994; Trèche et al., 1995).

## 4. FACTORS INFLUENCING THE EFFICIENCY OF ENZYME-BASED PROCESSES

The efficiency of processes based on the incorporation of enzymes depends on the level of amylolytic activity of the enzyme source, the botanical origin of the gruel staple, and on other factors which must be taken into account in the development of technologies at household or cottage industry level.

### 4.1 pH of gruel

The optimal pH for alpha-amylase is slightly acid: 4.7 to 5.4 for barley malt; 6.0 for BAN. We have verified that the ability of BAN to reduce the viscosity of gruel prepared with an optimal amount of dry matter is stable at pH 5.5 to 9.0 (Figure 12). Alpha-amylase cannot be used in fermented foods whose pH is usually under 4.0.

### 4.2 Nature of other constituents of gruel

The examples described above were simple mixtures of one starch-rich flour with the enzyme source. Flours for infants usually also comprise a protein source, sugar and vitamin and mineral supplements. Depending on their nature and the amounts added, these constituents may have a variety of effects on the gruel: for example, vitamin and mineral supplements have a negligible effect on viscosity. Some ingredients increase the energy density without affecting viscosity significantly (sugar, fat), while others, such as bean flour, increase viscosity (Figure 13). Therefore, all ingredients must be taken into account when determining the amount of enzyme source that must be added to gruel.

### 4.3 Methods for preparing gruel

Preparation techniques are very important because starch is only sensitive to enzymes beyond its gelatinization temperature, i.e. above 55 to 65°C. However, beyond a certain temperature — which is source-specific — enzymes are inactivated. The efficiency of the process depends on the time active enzymes are in contact with the gelatinized starch, i.e. the time during which the flour mixed in water is maintained at a temperature between 60 and 80°C approximately, depending on the enzyme source. This time depends on the preparation technique.

The simplest technique, which we have used in the aforementioned tests under standardized heating conditions, is to mix the ingredients in cold water and heat gradually until bubbles appear on the surface, and to maintain the boil for a certain time (preparation technique A). The viscosity of gruels prepared using this technique varies slightly with the intensity of heating, i.e. how quickly the gruel is heated (Figure 14).

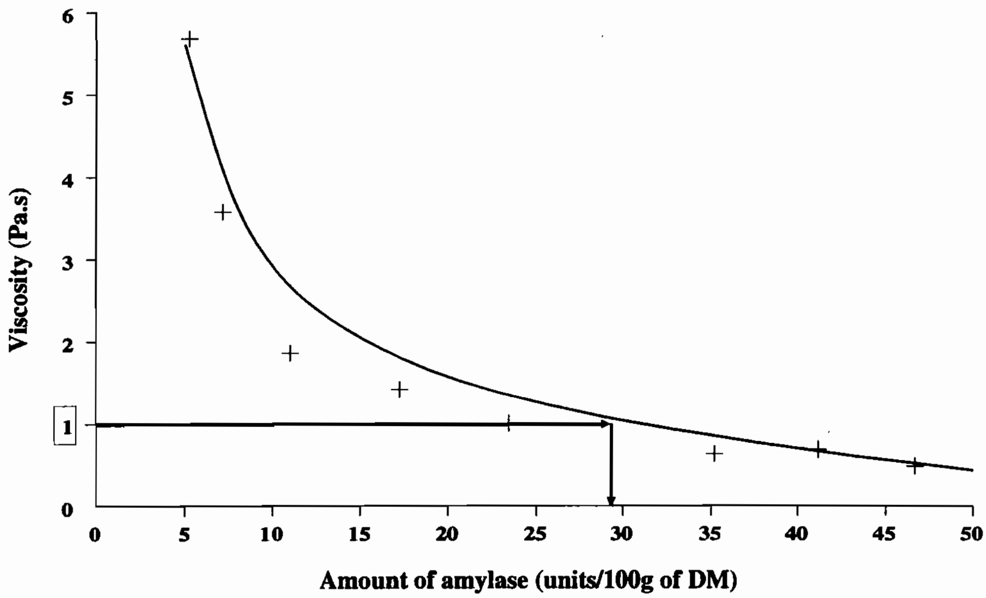


Figure 9
Effect of the addition of BAN on the viscosity of cassava gruel prepared with a dry matter content of 30 g/100 g

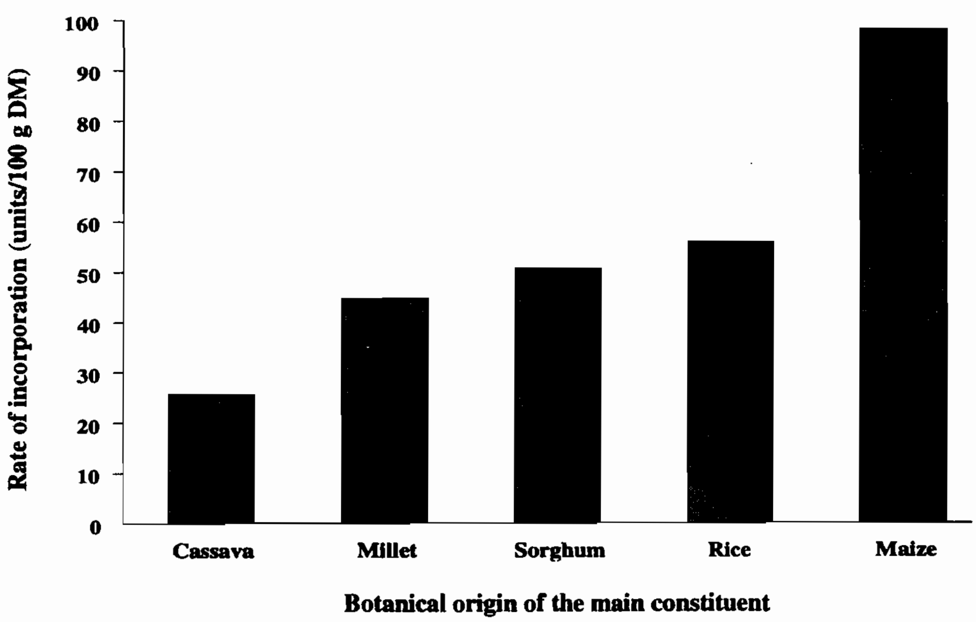


Figure 10
Effect of botanical origin of the main constituent of gruel on the amount of BAN needed to limit gruel viscosity to 1 Pa.s when prepared with a dry matter content of 30 g/100 g

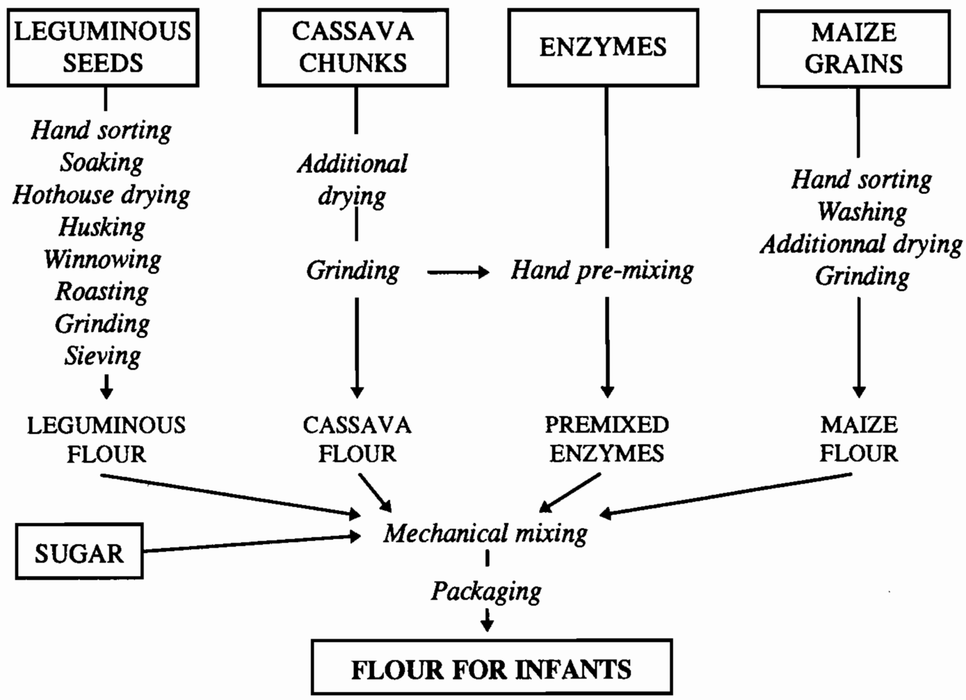


**Figure 11**
**Flow-sheet for production of maize and cassava-based flour for infants for the preparation of gruel with an improved energy density**

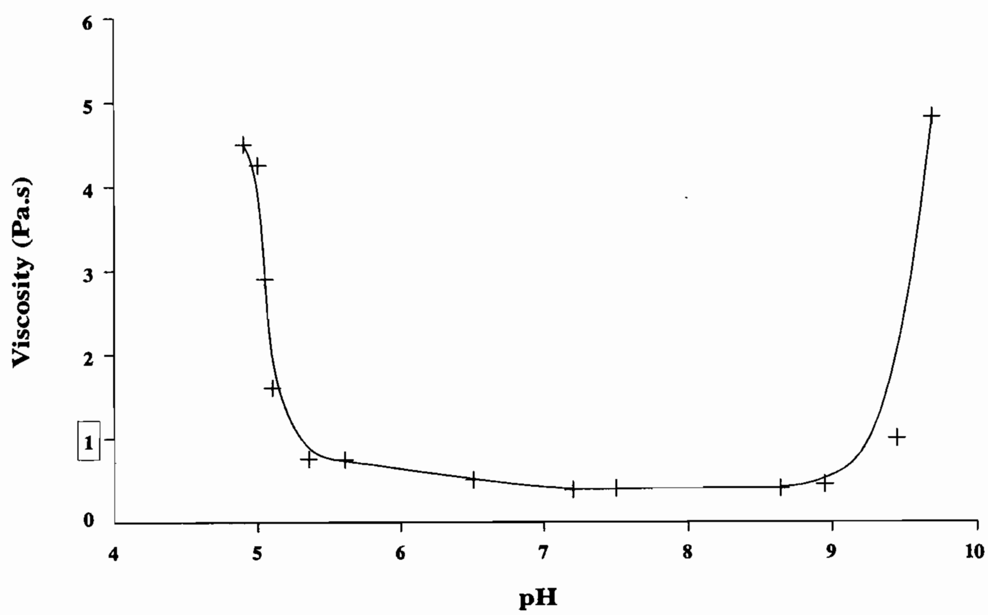


**Figure 12**
**Effect of gruel pH on the efficiency of BAN in reducing the viscosity of cassava gruel prepared with a dry matter content of 27 g/100 g**

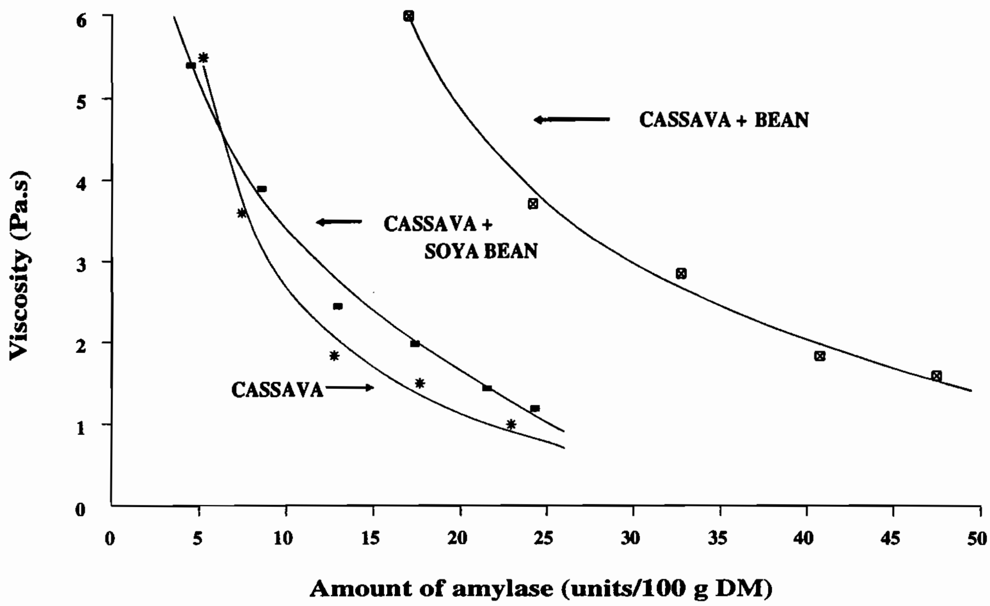


Figure 13
Effect of incorporation of BAN on the viscosity of gruel prepared with a dry matter content of 30 g/100 g, according to the nature of ingredients

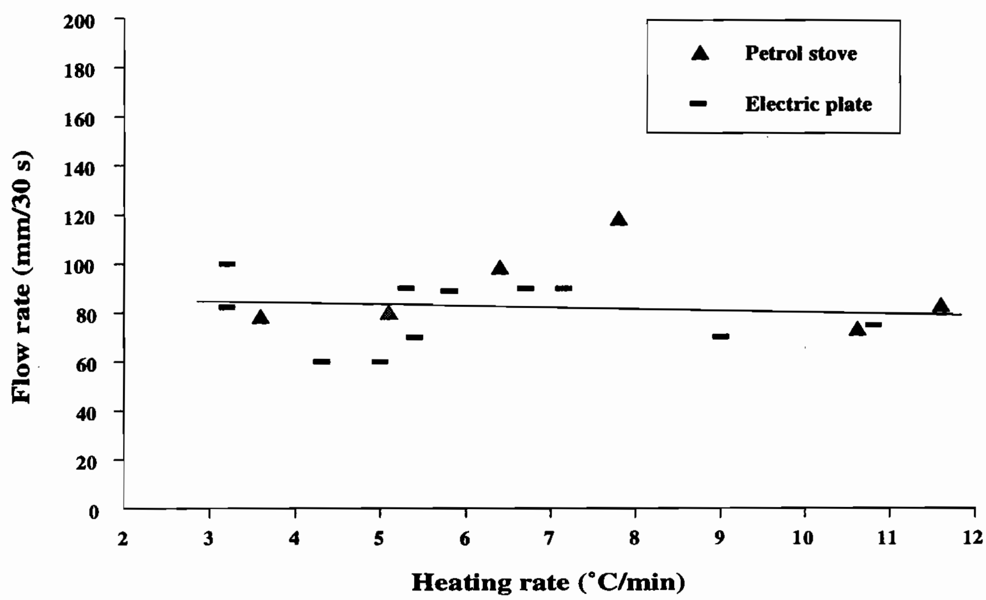


Figure 14
Effect of heating rate on the efficiency of BAN (12 units/100 g of DM) in reducing the viscosity of cassava gruel prepared with a dry matter content of 30 g/100 g

We have compared preparation technique A with two others; B consists in taking the pot off the heat source, during cooking, so that the enzymes will be active for a longer period of time; C is somewhat similar to the traditional Congolese recipe: the ingredients are mixed in a small quantity of cold water, then poured into a pot of boiling water; the pot is then left to stand off the fire for 5 minutes before cooking, so that active enzymes are in contact with the ingredients for a sufficient amount of time. Technique C is the most efficient for reducing the viscosity of the cassava-malted sorghum gruel (Table 2).

Other combinations, with other preparation techniques, could be more efficient. The choice of the enzyme source, and of the amount used, must not be separated from that of the preparation technique.

**Table 2**
**Variation of the viscosity of cassava/sorghum gruel (90/10; m/m) prepared with 30 g DM for 100 g of gruel according to preparation technique**

| | Preparation techniques | Viscosity |
|---|---|---|
| A | - Mix flour in cold water<br>- Heat progressively until bubbles appear (85°C)<br>- Maintain the boil for 5 mn | 5.38 Pa.s |
| B | - Mix flour in cold water<br>- Heat to 65°C and boil; leave to stand off the fire for 5 mn<br>- Heat progressively until bubbles appear (85°C)<br>- Maintain the boil for 5 mn | 2.47 Pa.s |
| C | - Mix flour in a small quantity of cold water, then pour into boiling water, and leave to stand off the fire for 5 mn<br>- Heat progressively until bubbles appear (85°C)<br>- Maintain the boil for 5 mn | 1.10 Pa.s |

### 4.4 Previous treatment of starch sources

Several studies have shown that particle size of cereal or tuber flour has little effect on the efficiency of the process as long as particle size is less than 0.8 mm. On the contrary, thermic treatment, such as roasting maize grains before milling, or additional drying of cassava chips on heated metallic sheets, can notably increase or decrease the susceptibility of starch to the enzyme.

## 5. PROCEDURE FOR THE DEVELOPMENT OF AN ENZYME PROCESS

The steps for the choice of an enzyme source and for the development of the process are the following, in chronological order:

- The first step is to collect data on the nutritional status and the feeding practices for infants and young children (under 2 years of age), to determine whether the energy density of gruel should be improved. Two factors are important for decision making: the nature of and frequency with which gruel is distributed.

- The second step is to formulate a gruel using locally available staple foods. The composition, when energy needs are covered, should also meet infants' and young children's nutrient requirements.
- The third step is to decide whether classic hydro-thermic processes such as extrusion-cooking and drum-drying are adequate, or whether enzymatic treatment is necessary to improve the energy density of gruel. The latter is often easier to develop and less expensive in the technological context of developing countries.
- Step four is to evaluate, at household or cottage industry level, whether the production of the flour is feasible technologically, and whether the product meets the required nutritional quality and is acceptable from an organoleptic, cultural, and economic perspective.
- The final step is to choose the most appropriate enzyme source and to determine the amount that must be incorporated.

The choice of the enzyme source will differ if the food is prepared at household level or if it is to be produced by the cottage industry.

At the cottage industry level, major constraints are the cost and the need for a constant level of quality. The cheapest source, with the most stable quality, is industrially-produced enzymes. Their only disadvantage, in developing countries, is that they must be imported, although the quantity needed is very small. Other sources can be used, such as malted barley from breweries, provided it is available at low-cost. An alternative can be the local production of germinated cereal flour, if a stable amylolytic activity can be obtained.

At household and community level, the use of malted cereal flour is the best option. Its main disadvantage is the time required for preparation. Other options could be the addition of breast milk or saliva to gruel with a high dry matter content so that amylase will reduce viscosity, or the use of other natural sources of amylase (germinated tuber flour, certain tree-barks etc).

At this stage, the amount of amylase that is needed for the type of preparation chosen can be determined: the procedure is to make gruel with the desired energy density and add increasing amounts of amylase until the desired viscosity is obtained.

The standardized measurement of viscosity is done with a rotating viscosimeter, which is an expensive device. Alternatively a flow-box can be used ("Polyvisc", Kinematica Inc.); the principle is to measure the distance covered by the flow of gruel within a given time. For a given gruel, there is a high correlation between viscosity and flow rate measured with the Polyvisc (Figure 15). Thus, this simple device can be used to measure viscosity with an acceptable reproducibility. Nevertheless, viscosity of gruel can also be estimated empirically without any special equipment in order to determine the adequate amount of enzyme source needed.

## 6. CONCLUSION

In some settings in developing countries, particularly in Africa, increasing the energy density of gruel could be an efficient and feasible way to increase infants' and young children's intake of energy and key nutrients during the period of complementary feeding. Various techniques based on natural amylase have been experimented with, although often, only at pilot-project level (e.g. in East Africa).

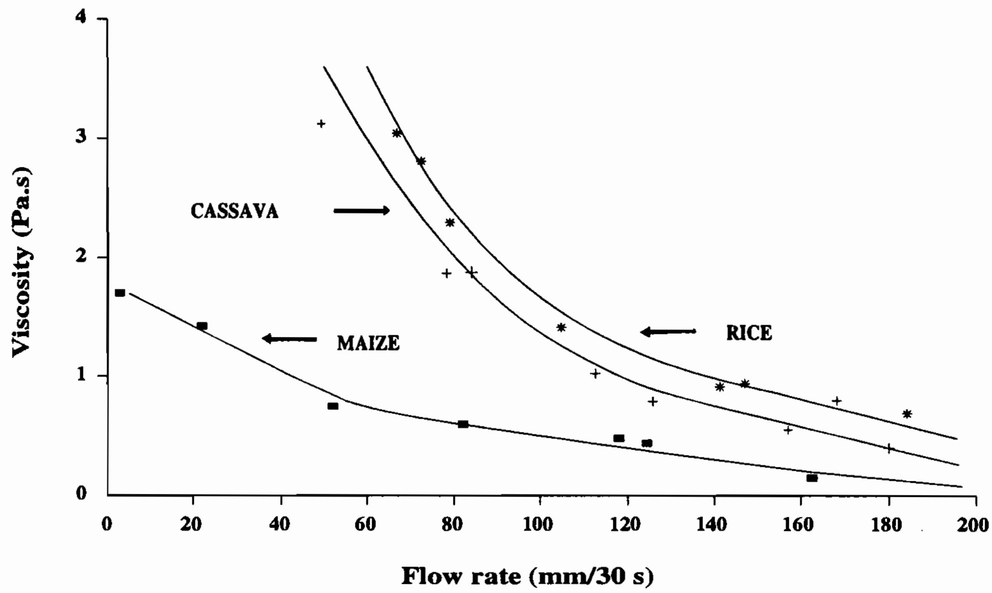


**Figure 15**
**Relationship between flow rate and viscosity of gruel prepared with a dry matter content of 30 g/100 g, after enzymatic treatment, according to the nature of the main constituent**

The preparation of malted cereal flour is time-consuming, but it is nevertheless an efficient process at the household and cottage industry levels. At the household level it is the sole feasible approach. At the level of small-scale production units, the use of industrial amylase is an efficient alternative that is both easy to implement and inexpensive.

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# Production of low-cost complementary food: from a nutrition intervention programme service to a market oriented approach

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## 1. INTRODUCTION

Since the failure in the early 1970s of large-scale sophisticated complementary food factories (like Superamine in Algeria), it took more than 10 years before a new approach was developed for local production of complementary foods. In the meantime the promotion of improved recipes for home preparation has continued, but no major breakthrough in complementary feeding practices has been achieved by this approach.

In the 1980s new projects for development of local production were started. In contrast with the approach of the 1970s, these projects focused on the development of communal processing and small-scale production units producing basic low-cost complementary foods in the form of mixtures of local cereals, legumes and oilseeds. The projects originated generally from governments, international organizations and nongovernmental organizations and were primarily aimed at providing foods to be used in nutrition intervention and food-aid programmes.

Based on the experiences in these projects a new approach has evolved. The main difference with previous approaches is the emphasis on sustainability either through the development of financially self-supporting enterprises producing for local commercial and institutional markets or through village processing with manageable support from the social sector.

## 2. THE NEED FOR COMPLEMENTARY FOODS

UNICEF (1995) estimates that as much as 50% of all children in tropical countries pass through a stage of serious malnutrition when growing up. The period of complementary feeding is particularly critical. The consequences are high morbidity and mortality as well as permanently impaired physical and intellectual development. Measures to address this situation are urgently required from a humanitarian and economic point of view (ACC/SCN, 1992).

While childhood malnutrition is generally directly related to a shortage of food in the family as a whole, the specific problem of complementary feeding is often not so much a food shortage in the family, but rather a cultural problem of intrafamily distribution and attitudes towards child care and particularly towards complementary feeding practices. Increasing poverty, overpopulation and urbanization certainly aggravate the problems encountered in availability and use of complementary foods.

Traditionally children who are beginning to take complementary foods are given only a few meals per day, made from staple food (maize or cassava) diluted with water, while nutritious side-dishes are increasingly deleted due to poverty. This food fills the stomach but will not provide enough nutrients. Energy is lacking and protein quantity and quality are low.

## 3. NUTRITION EDUCATION

In order to address the problems of child (mal)nutrition, governments, international agencies and nongovernmental organizations have for several decades implemented nutrition education programmes targeted at mothers as well as at schoolchildren and the general public. These programmes usually combine two elements.

The first element is the provision of information on general nutrition issues with an emphasis on good child feeding and weaning. This is essential, because unless the concept is accepted that children have special nutritional needs, no improvement in practical child feeding can be expected.

The second element is the practical implementation of these ideas in the actual preparation of appropriate foods. In this context, a large range of recipes based on local ingredients has been developed and mothers have been encouraged to prepare these at home.

A number of reasons inhibit mothers to actually prepare an improved complementary food at home: lack of understanding of the necessity of a special complementary food, ignorance of preparation techniques, limited seasonal availability of ingredients and in particular lack of time, fuel and money. On top of these practical difficulties, self-prepared complementary foods have often a lower prestige as compared to (imported) factory made products. As a result, this element of nutrition education programmes has often had regrettably little impact, and few mothers in developing countries actually prepare improved complementary foods at home.

In recent years new technologies like fermentation and germination have received much attention and have been tried at household level. These technologies offer interesting possibilities, particularly from a nutritional point of view. However at present they are not yet sufficiently tested in practical application. Field pilot projects to test their practical applicability and economics are urgently needed.

## 4. READY-MADE COMPLEMENTARY FOODS

The alternative to domestic preparation of complementary food is the use of ready-made products.

At present in many developing countries commercial complementary foods of excellent quality — often imported — are available. However, because of sophisticated processing, expensive packaging, extensive promotion and advertising and solid profit margins, the prices of these products are generally about 10–15 times the cost of the common staple food. This high price is beyond the purchasing power of the majority of the population, which spends already between half and three-quarters of its income on common foods. As a result only a limited high-income group can afford these products. Low(er) income groups therefore generally have hardly any access to ready-made complementary foods.

Low-cost complementary foods, locally produced from indigenous ingredients, with a price around two to three times the cost of the raw materials, will be within the reach of the lower income groups; however production of low-cost foods is presently still very limited because the need for such foods has not been translated into an effective market demand.

## 5. LOCAL PRODUCTION APPROACHES

During the past decades a large number of programmes and projects have been carried out to develop local production of affordable complementary foods for the lower and lowest income groups. These projects and programmes range from village or community level production by groups of women via small-scale production units to large-scale industrial production.

From the experiences in these programmes it has become clear that a distinction should be made between two approaches:

- low-cost production as a *service to nutrition intervention* programmes through the development of community level processing activities;
- *market-oriented production* through development of economically viable small and medium enterprises.

The principal characteristics of these approaches are shown in Tables 1a, 1b and 1c.

## 6. COMMUNITY LEVEL PROCESSING

With this approach the objective of production is primarily the direct improvement of the nutritional situation of low-income target groups. The complementary food produced is largely for self-consumption. Generation of income and employment and encouragement of local agricultural production are often expected as additional benefits. Three levels of community activities are distinguished.

Community level processing in its simplest form consists of regular (weekly) meetings of young mothers. This "feeding group" brings ingredients (cereals, pulses, oilseeds) and firewood for communal roasting. The roasted product is milled in the local commercial mill. The freshly processed complementary food is prepared and fed to the children during the meeting, and the remainder is taken home. An extension worker supports the communal activity, provides nutrition, child care and other relevant information, growth monitoring and acts as liaison with maternal and child health, family planning and other services. An example of this approach is the feeding group programme implemented at the Muona Hospital in the Chikwawa District in Malawi. The required external support for continuation of this activity is that of the extension worker.

In Turiani Hospital in Morogoro District and several other mission hospitals in the United Republic of Tanzania similar activities to those above are implemented. However here the hospitals have a mill and roasting equipment at the disposal of the "feeding group". The free milling is an additional incentive. This approach requires, besides support of an extension worker, investment for the mill and its operating costs.

**Table 1.a**
**Characteristics of approaches for production of complementary foods at different levels**

| Level of production | Incentives for consumers | Constraints |
|---|---|---|
| Household<br>(own consumption) | Nutrition awareness | Time<br>Avaibility of means<br>Energy use |
| Community<br>(own consumption) | Nutrition awareness<br>Social interaction | Management suppport<br>Investments |
| Production unit<br>(for sales) | Nutrition awareness<br>Convenience<br>Status | Purchasing power |

**Table 1.b**
**Community involvement and management needs**

| Level of production | Participation | Management requirements | Support requirements |
|---|---|---|---|
| Household | ++++ | – | ++ (c) |
| Community + village mill | +++ | + | ++ (c) |
| Community + own mill | +++ | ++ | +++ (c) |
| Production unit<br>+ social marketing | + | +++ | ++++ (i) |
| Production unit<br>+ commercial marketing | ++ | – | ++++ (i) |

(c) : continuous; (i) : initially

**Table 1.c**
**Opportunities for micronutrient fortification, quality control, energy saving and economic sustainability**

| Level of production | Micronutrient supplement | Formal quality control | Energy saving | Economic sustainability |
|---|---|---|---|---|
| Household | – | – | – | – |
| Community | – | – | +/– | +/– |
| Production unit | + | + | + | + |

The "Community Mills" projects are supported by UNICEF: these combine income generation with complementary food processing. These projects are located in villages where no commercial village mill exists. Under the project the Women's Association of the village is supplied with a mill (on an interest-free loan basis) and trained in operation and maintenance. The Association has to provide a suitable location and shelter. The mill is operated on a semi-commercial basis (recovering operating costs, salaries and depreciation) asking lower milling fees than commercial mills. The Association members operate the mill on a rotation basis and earn a salary. Its location in the village allows the milling of wet maize, which is a considerable financial saving for the customer. Once a week the young mothers of the Association gather to process complementary food together. The milling is free of charge. Sometimes additional amounts of complementary foods are processed for sale. At least once a month an extension worker has to attend the weekly complementary food processing in order to safeguard the continuity of the project. An additional duty is management support for the operation of the mill.

The income generation opportunities of this project are highly appreciated by the target group. Although the milling operation itself should be financially self-sufficient, the extension support is also indispensable in this approach.

Several specific preconditions must be met to guarantee sustainability of this approach:

- funding to provide the loans for the mills and training of extension staff and Association members;
- a strongly developed sense of community, with some management skills;
- sufficient demand for milling services;
- a well functioning extension system with adequately trained agents;
- availability of a service and repair system for the mill.

While the above approaches may very well serve the primary objective, experience shows that the expectation that the activity will continue independently, in the long term, is usually not realized. When financial and/or management support from the initiating organization is withdrawn the activity usually ceases after time.

## 7. A MARKET-ORIENTED APPROACH

The Dutch Royal Tropical Institute (KIT) has been involved since 1982 in the development of local production of complementary foods in developing countries through research and technical assistance in some 20 projects and numerous short-term consultancies. Taking into account the experience gained in these projects, KIT has developed a market-oriented approach for project development. This approach is based upon the realization that lasting improvement in (child) nutrition can be achieved only through overall and sustainable economic development of the low-income population combined with appropriate nutrition education.

The primary objective of the approach is therefore the development of financially and technically sustainable enterprises which produce complementary foods for consumers in the low(er) income market-segments (i.e. the institutional "food-aid" market and the "main" market — see Figure 1).

The principal characteristics and prerequisites for success of the KIT approach are:

- Secondary economic objectives, such as the promotion of agriculture, increasing farmers' income and generation of employment, can be achieved through the development of intensive "backward" and "forward" linkages with agricultural producers on the one hand and distributors and customers on the other.
- Product choice, production technology and organization should be adapted to local markets and the local situation.
- Provided this is justified by their comparative advantages, the emphasis should be on development of decentralized small and medium industries.
- In accordance with the market orientation of production, it is of prime importance that the management has an entrepreneurial approach and skills.
- Where useful and possible, small and medium enterprises should consider associations or other forms of cooperation to benefit from economies of scale in such activities as marketing, advertising, quality control and industrial services.
- Initial investments and operating capital should be financed through donations or development credit facilities. Such investments should be regarded as development subsidies.

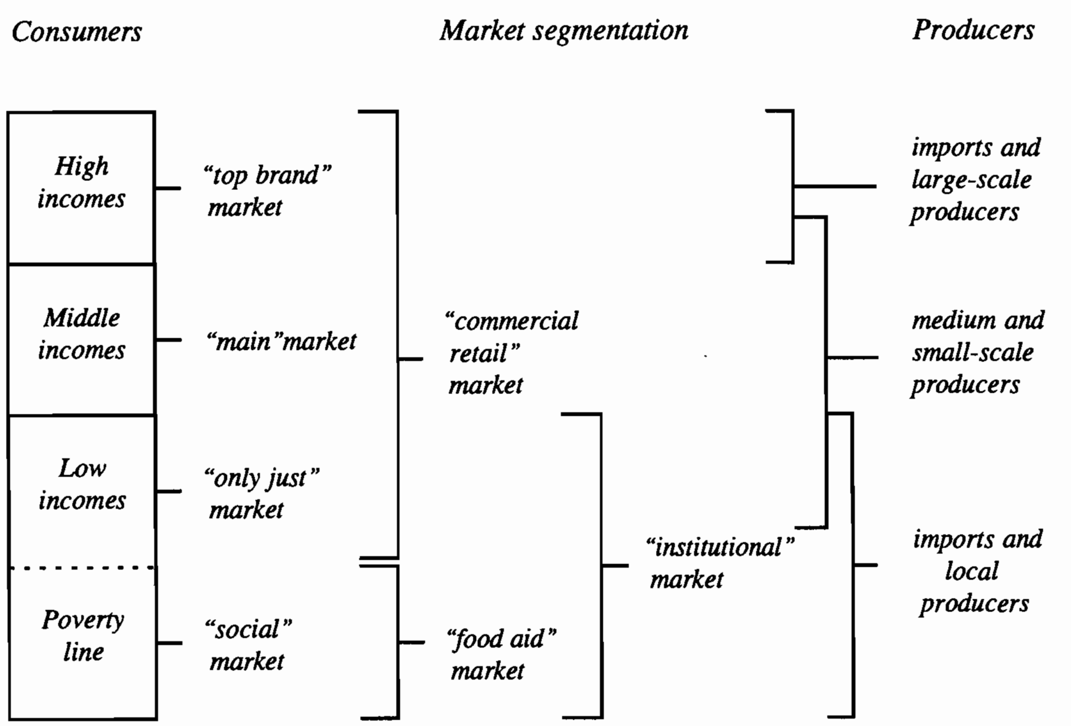


**Figure 1**
**Market-segmentation for complementary foods in developing countries**

## 8. SOCIAL MARKETING PROGRAMMES

In this market-oriented approach, the "social" objective — the combat of malnutrition — is not regarded as the direct responsibility of the enterprise but can be served through the provision of (low-cost) complementary foods to separate "social marketing" and other nutrition intervention programmes that are financed and implemented by food-aid donors, governments and/or nongovernmental organizations.

Cooperation between producers and government or nongovernmental organizations in social marketing programmes can help to introduce and popularize low-cost complementary foods and similar products among the lower-income consumers while at the same time assist in improving the nutritional situation.

In such a programme, product promotion can be incorporated at little extra cost in the ongoing nutrition education activities of the Ministry of Health or nutrition extension programmes of nongovernmental organizations. Cooperating producers would be guaranteed a market share by assigning them regions for exclusive distribution, using regular commercial distribution and marketing channels.

Examples of successful KIT-assisted social marketing programmes for locally produced complementary foods are:

- the marketing of Musalac in Burundi, through which local vendors earned an income through their retailing activities while at the same time they were trained by the project to give nutrition information to consumers thus saving time of health staff;
- the Jamaica Cereal Foods project in Jamaica, where four local nongovernmental organizations operate distribution and retail sales networks for complementary food purchased wholesale from the producing factory, Jamaica Cereal Foods Ltd., in combination with their respective nutrition education and intervention programmes.

## 9. PRODUCTS AND PRODUCT QUALITY

Complementary foods may be made from a range of cereals (maize, rice, sorghum) legumes (cowpea or others) and oilseeds (soya bean, groundnut, sesame). These mixtures can be formulated to be equivalent to a milk/cereal combination, but at a much lower ingredient cost. In order to make the product more attractive in marketing, flavours and sugar may be added.

A basic product is generally composed of 75–80% cereal, 10–15% pulses and 10% oilseed, up to 10% sugar may be added to replace cereals. Such a product will give a nutritional composition of 400 kcal/100 g, 13–14% protein and 6–7% fat, which is in compliance with the *Codex Alimentarius*, the international standard for foods and state-of-the-art views on energy density and protein content of complementary food.

The selection of ingredients will depend on nutritional criteria as well as price, acceptability and availability of raw materials. Institutional buyers such as food aid programmes, schools, hospitals may require "tailor made" products suitable for their specific clientele and methods of distribution and use.

An advantage of the small and medium scale industrial processing of complementary foods as compared to village processing is that it offers the possibility of fortifying the product(s) with micronutrients. In consultation with the World Food Programme, the vitamin-producing company Roche has developed standardized concentrates for vitamins and minerals under the name U-Mix for fortification of low-cost complementary foods. These are in line with the recommendations of the *Codex Alimentarius* and ensure that the total amounts contained in 100 g of the dry food equals at least two-thirds of the recommended dietary allowances.

Past experience and analyses have shown that products from small-scale production units can meet the bacteriological and toxicological standards for complementary foods provided attention is paid to introduce and maintain quality assurance techniques in processing.

In order to optimally use installed production capacity, it may be of interest for enterprises to diversify into production of foods produced from similar raw materials and with the same processing techniques. In this respect, production of (fortified) cereal snacks or breakfast cereals may be of interest. Such diversification can minimize the average cost of production and ensure the profitability of the enterprise.

## 10. SMALL-SCALE PRODUCTION TECHNOLOGIES

Past experience has shown that there are two processing technologies that are suitable for the local production of complementary foods at small and medium scale:

- At production levels between 50 and 500 tonnes per year a process of *roasting, mixing and milling (R&M)* can economically produce basic (non-instant) complementary foods.
- At production levels above 400–500 tonnes per year, the more sophisticated process of *extrusion* generally becomes more economical. With this technology it is also possible to produce a variety of other products such as snacks and breakfast cereals.

The roasting and milling process consists of (Figure 2) :

- *Storage* of the ingredients after bulk purchase at the appropriate time just after harvesting. This ensures the lowest possible prices. Pest protection is carried out with heat unstable or evaporative chemicals.
- *Cleaning* will ensure the quality of the final product and is done with simple winnowing screening machinery followed by hand cleaning if required;
- *Roasting* of the ingredients is the essence of the process and has the following effects:
  - it reduces the cooking time of pulses and oilseed to a few minutes only, thus saving precious time and fuel in household preparation;
  - it guarantees the safety of the product by destroying microorganisms;
  - it ensures a shelf life of about six months by inactivating the enzymes that would cause rancidity of the high fat content product;
  - it destroys antinutritional factors that are present in some unprocessed ingredients (e.g. soya beans);
  - it improves the taste and digestibility of the product;
- *Blending* of the ingredients followed by *milling* of the mixed ingredients in a ventilated hammer-mill results in a fine, smooth and properly mixed flour with a short cooking time.
- The flour can be *fortified* by mixing with a premix of vitamins and minerals if desired.

- *Packaging* is done by hand. The selection of packaging materials will depend on local availability, market requirements and distribution channels used. A simple form of packing in double polyethylene pouches with a colourful wrapper containing all the required information is appropriate, attractive, yet inexpensive and ensures a shelf life of about six months.

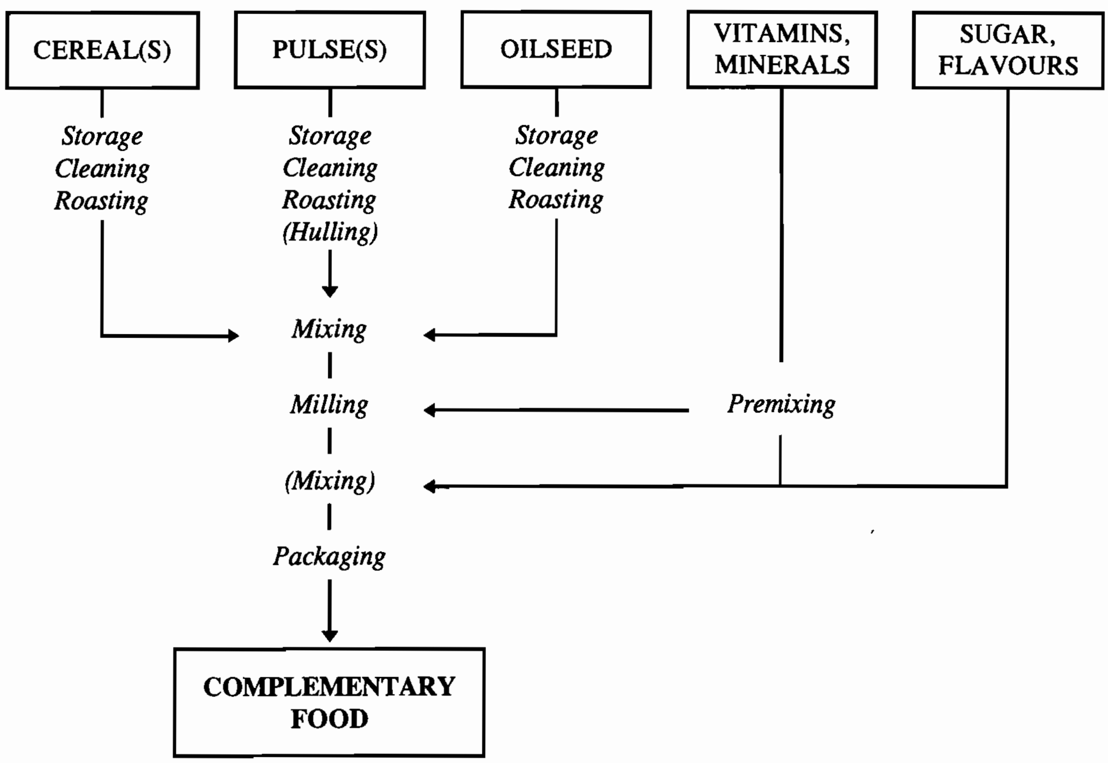


**Figure 2**
**Flow-sheet for complementary food production by roasting and milling**

The extrusion process is technically more sophisticated and requires higher investment. It consists of cleaning, pre-grinding, mixing, extrusion and cooling, milling and packaging (see Figure 3). At lower capacities internal transport would still be manual; however at higher levels, conveyors may need to be introduced.

- *Cleaning* is done in the same manner as described above. At higher production levels hand cleaning is no more possible, and suitable, more efficient cleaning equipment is required.
- *Pre-grinding* of the raw materials to grit size is done in a hammer-mill, after which the grits can be mixed before extrusion. Alternatively the individual ingredients are gritted and extruded and subsequently mixed. The choice will depend on the type of ingredients used.

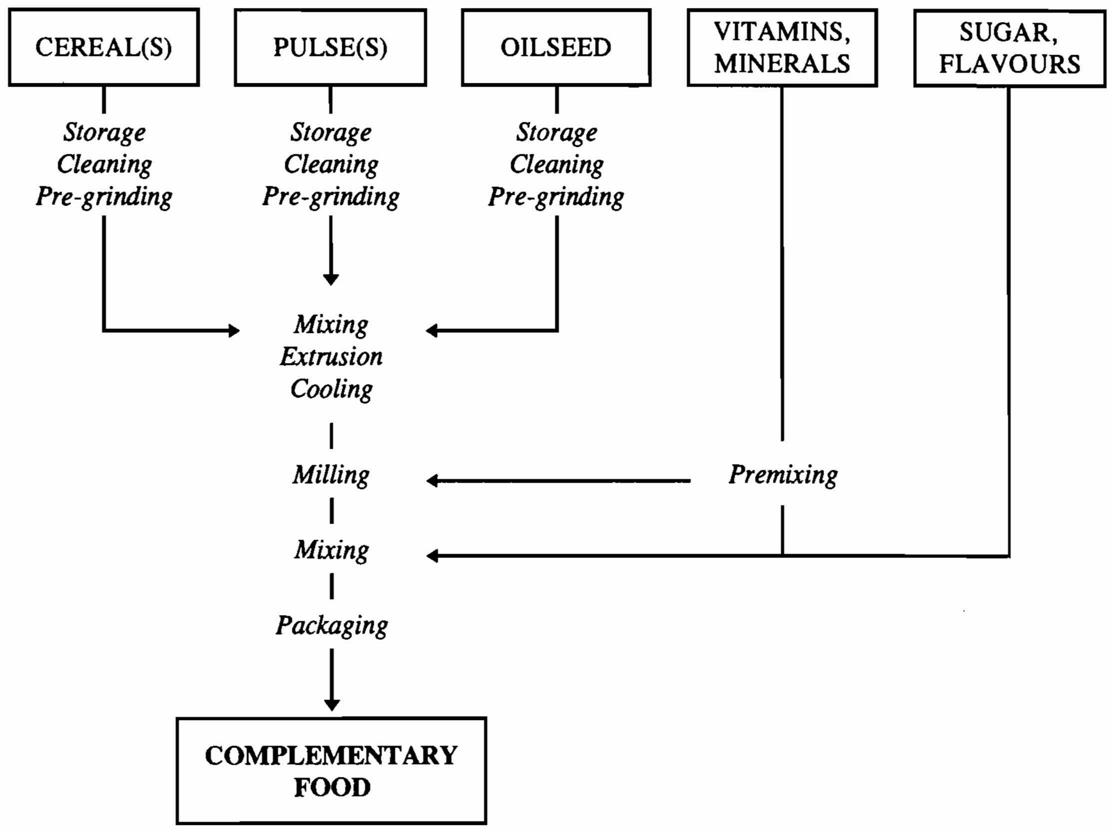


**Figure 3**
**Flow-sheet for complementary food production by extrusion**

- *Extrusion cooking* is the essential heat-processing operation which, like roasting, ensures reduced cooking time, destruction of microorganisms, inactivation of enzymes and anti-nutritional factors and enhancement of taste and digestibility. Because of the more intensive heat-treatment at a higher moisture level it is more effective than roasting and leads to a fully (or partially) pre-cooked product.
- After *cooling*, the extruded product is *milled* into a fine flour in a hammer-mill or used directly in various forms as snacks or breakfast cereals.
- Depending on the scale of production, *packing* is either done by hand or by simple machines. Because of the hygroscopic properties of the final product packaging has to be of higher standard than for roasted products. The selection of packaging materials will again depend on market requirements, required shelf life and distribution channels used.

## 11. FINANCIAL ASPECTS

The financial requirements and production costs for local complementary food production will depend largely on the local situation. However, Table 2 gives an idea of the order of magnitude and the elements to be included.

**Table 2**
**Production costs according to type of technology and production capacity**

| | Roasting and milling | | Extrusion |
|---|---|---|---|
| | **50 t/year (US$)** | **500 t/year (US$)** | **600 t/year (US$)** |
| Buildings | 40 000 | 115 000 | 115 000 |
| Machinery and equipment | 25 000 | 40 000 | 100 000 |
| Working capital | 20 000 | 90 000 | 115 000 |
| Vehicles | 15 000 | 20 000 | 25 000 |
| Total | 100 000 | 265 000 | 355 000 |
| Approximate turnover | 37 500 | 375 000 | 450 000 |
| Pay-back period (in years) | 8 | 2.5 | 2.5 |

*Note : It is assumed that production costs are US$ 0.50/kg and factory sales prices is 0.75/kg. The price of land is not included but assumed borne by project, government or industry.*

## 12. PRODUCTION COSTS AND PRICES

The experience in projects in various African countries has shown that it is generally possible to produce a basic complementary food at production costs (i.e. cost of raw materials + processing cost) of about twice the value of the raw materials. In 1995 this was equivalent to about US$ 0.5–0.6 per kilogram. With transport, distribution and marketing costs and trade margins totalling about 65%, the consumer price for these local products can be expected to be in the order of US$ 1.0 per kilogram or about three times the raw material value.

By comparison, the products from large producers or imports are commercially available at consumer prices in the order of US$ 5.0–8.0 per kilogram. Although these products are generally more sophisticated, more attractively packed and have a higher quality image, this comparison shows that local small-scale production can be highly competitive in price.

## 13. TECHNICAL ASSISTANCE

The establishment and development of local small-scale and medium-scale complementary food production enterprises generally requires financial, technical and training support in three phases:

- In the *preparation phase* there will be a need for assistance in preparing market studies, a feasibility analysis, a business plan and a marketing/advertising plan for both commercial and institutional markets;
- In the *start-up phase* there may be need for assistance in the planning, installation and commissioning of the production, the establishment of proper management and business administration structures and the implementation of the marketing plans. In this phase training of management and staff is essential;

- In the *follow-up phase* technical assistance required may include troubleshooting and further training in management, marketing and business planning. Also specialized expertise may be needed for research and product development and planning of expansion or diversification.

The actual support required will depend on local conditions and the experience, skills and entrepreneurship of the initiating parties, management and staff.

In the experience of KIT a total of some six months of specialist support over a period of three to four years was required for the establishment of an individual project.

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# Production of flour for infants and young children: a review of experiences in Africa

Serge TRÈCHE

## 1. INTRODUCTION

Based on the description of production units provided by participants in the Alexandria workshop, on data obtained previously, and on the results of additional analyses carried out in IRD laboratories, information on experiences in the production of flour for infants and young children in two North-African countries and eleven Sub-Saharan French-speaking countries was reviewed. Analysis of this information highlights both the common and the distinctive features of these experiences.

## 2. GENERAL CHARACTERISTICS OF PRODUCTION UNITS (Table 1)

The first experiences took place in Algeria (1966) and Morocco (1972). Some units have been operating for less than seven years (Vitafort in Congo, Bitamin in Niger, Vitafort in Chad, Viten in Togo).

Almost all units were set up at the initiative of government authorities, but in most cases they also received support from foreign nongovernmental organizations (Ouando in Benin, Misola in Burkina Faso, Yéolac in Guinea, Bitamin in Niger, Sosoma in Rwanda) or research organizations (Vitafort in Congo, Nutrimix in Togo). Very few units were set up as the result of private initiative (Viten in Togo, Cérévap in Zaire), but in many cases production was entrusted to the private sector (Superamine in Algeria, Actamine in Morocco, Micaf in Cape Verde); in some cases, the experiment was disseminated, and community (Misola in Burkina Faso, Musalac in Burundi) or private (Vitafort in Congo) production units were set up.

Production capacity varies greatly: smaller pilot units that are to be replicated based on an identical model produce 1–2 tonnes per month (Vitafort-Congo and Nutrimix), whereas units that produce for the country as a whole, have a capacity of more than 250 tonnes per month (Superamine, Cérévap). Several units, particularly among those with the largest capacity (Superamine, Cérévap) have ceased production.

In the majority of cases, the technical processes used before mixing are limited to dehusking, toasting or roasting and milling; in certain cases (Misola and Vitafort-Chad) this can be done without special equipment, using private dehuskers and mills located near the markets where raw materials are sold. Industrial-type units such as those producing Superamine, Ouando Superfarine or Cérévap use hydrothermic processes that provide proper pre-cooking. Vitafort-Congo is the only small-scale unit that uses a process incorporating amylase to allow the preparation of gruel with sufficient energy density.

**Table 1**
**General characteristics of production units**

| Country and name of unit | Year of launching | Origin and support | Production capacity per month | Special processes | Type of packaging | Comments |
|---|---|---|---|---|---|---|
| ALGERIA | | | | | | |
| Superamine | 1966 | State +private | 250 t | drum drying | plastic bags | ceased in 1984 |
| BENIN | | | | | | |
| Ouando community | 1977 | State +coop. | 10 t | - | plastic bags | - |
| Ouando factory | 1992 | State +NGO | 100 t | extrusion cooking | cardboard boxes | industrial |
| BURKINA FASO | | | | | | |
| Misola | 1981 | State +NGO | Variable | - | plastic bags | dissemination |
| BURUNDI | | | | | | |
| Musalac | 1984 | State +coop. | 42 t | - | plastic bags | dissemination |
| CAPE VERDE | | | | | | |
| Micaf | Project since 1986 | State +private | - | - | - | - |
| CHAD | | | | | | |
| Vitafort | 1993 | State +NGO | 10 t | - | plastic bags | - |
| CONGO | | | | | | |
| Vitafort | 1992 | State +research organism | 2 t | amylase | plastic bags | dissemination |
| GUINEA | | | | | | |
| Yéolac | 1988 | NGO | 20 t | - | plastic bags | ceased production |
| MOROCCO | | | | | | |
| Actamine | 1972 | State +private | 50 t | ? | plastic bags | - |
| NIGER | | | | | | |
| Bitamin | 1991 | State +NGO | 4 t | - | plastic bags | - |
| RWANDA | | | | | | |
| Sosoma | 1985 | NGO | 60 t | - | plastic bags | ceased production |
| TOGO | | | | | | |
| Nutrimix | 1985 | State | 1 t | - | plastic bags | - |
| Viten | 1991 | NGO | 20 t | - | plastic bags | - |
| ZAIRE | | | | | | |
| Cérévap | 1983 | Private | 250 t | extrusion cooking | aluminium bags | ceased production |

Apart from some exceptions (Ouando Superfarine), the foods are marketed in plastic bags, usually made of low-density polyethylene. Several units use two bags with labels inserted between them.

## 3. INGREDIENTS OF FLOURS FOR INFANTS (Table 2)

The main source of energy is simply local cereals, usually wheat in North Africa, millet, sorghum or maize in Sahelian countries, and maize in tropical Africa, with the exception of one of the two Vitafort-Congo formulas. Rice, usually in combination with other cereals, is used in Benin, Chad and Togo. Vitafort-Congo is the only unit that uses flour made from roots or tubers; the original formula included the incorporation of cassava flour, processed to prevent the risk of cyanide poisoning.

In all cases, protein is provided by leguminous seeds. With the exception of Superamine, elaborated almost 30 years ago, and flours for infants from some Sahelian countries (Chad and Niger), all compositions contain soya beans, sometimes in combination with groundnuts.

Almost all flours incorporate 5 to 15% of sugar. The use of milk powder has been abandoned in most present-day units. Mineral and/or vitamin supplements are only incorporated in industrial-type units (Superamine, Actamine, Cérévap) or in units that have a high level of technical supervision (Musalac and Vitafort-Congo). It should be noted that in some units salt is added (Misola).

## 4. NUTRITIONAL VALUE OF FLOURS FOR INFANTS (Table 3)

The energy content of the flours is around 400 kcal per 100 g of dry matter. Only flours that are rich in fat (Misola, Nutrimix "2ème âge" and Cérévap) have a slightly higher energy content.

Crude protein content ranges from 8.2 to 21.3 g per 100 g of dry matter. The earliest developed formulas are those with the highest protein content (Superamine, Actamine); the trend towards lower protein contents reflects progress in the knowledge of protein requirements. Flours with the lowest protein content are the so-called "1er âge" flours, in Benin and Togo (designed for infants 3–6 months).

The fibre content declared varies greatly, but this might depend on the methods used to determine it. The mineral content is low, except in flours to which mineral supplements have been added.

## 5. ENERGY DENSITY OF GRUELS (Table 4)

For some flours, IRD laboratories measured the viscosity of gruels prepared according to the method given on the label, with different levels of dry matter content. When they are prepared with a dry matter content that provides the consistency appropriate for young children (1 Pa.s for children around 5 months and 2 Pa.s for children around 8 months), all the gruels examined, with the exception of those prepared from Cérévap and Vitafort-Congo, have an energy density that is lower than that of breast milk.

**Table 2**
**Composition of flours for infants and young children**

| COUNTRY AND NAME OF UNIT | ENERGY SOURCES | PROTEIN SOURCES | ADDITION OF | | |
|---|---|---|---|---|---|
| | | | sugar | milk | mineral and/or vitamin supplements |
| ALGERIA | | | | | |
| Superamine | durum wheat: 28% | chickpeas: 38%<br>lentils: 18% | 5% | 10% | yes |
| BENIN | | | | | |
| Ouando "1er âge" | maize: 37%<br>sorghum: 37%<br>rice: 15% | | 11% | | |
| "Ouando "2ème âge | maize: 33%<br>sorghum: 33% | soya beans: 23%<br>(or beans) | 11% | | |
| BURKINA FASO | | | | | |
| Misola | pearl millet: 60% | soya beans: 20%<br>groundnuts: 10% | 9% | | salt 1% |
| BURUNDI | | | | | |
| Musalac | maize: 48%<br>sorghum: 22% | soya beans: 20% | 8% | 2% | yes |
| CAPE VERDE | | | | | |
| Micaf | wheat: 40%<br>maize: 40% | beans: 20% | | | |
| CHAD | | | | | |
| Vitafort | millet, maize, rice or sorghum 57% | cowpeas: 24%<br>groundnuts: 10% | 9% | | |
| CONGO | | | | | |
| Vitafort 1 | cassava: 43%<br>maize: 30% | soya beans: 19% | 8% | no | yes |
| Vitafort 2 | maize: 73% | soya beans: 14% | 11% | no | yes |

*"1er âge": for infants 3-6 months; "2ème âge": from 6 months*

**Table 2**
**Composition of flours for infants and young children (continued)**

| COUNTRY AND NAME OF UNIT | ENERGY SOURCES | PROTEIN SOURCES | ADDITION OF | | |
|---|---|---|---|---|---|
| | | | sugar | milk | mineral and/or vitamin supplements |
| GUINEA | | | | | |
| Yéolac | maize, sorghum | soya beans | yes | yes | |
| MOROCCO | | | | | |
| Actamine | wheat: 48% | soya beans: 16% | 15% | 20% | yes |
| NIGER | | | | | |
| Bitamin | millet: 67% | cowpeas: 20%<br>groundnuts: 10%<br>baobab fruit: 3% | | | |
| RWANDA | | | | | |
| Sosoma | sorghum, maize | soya beans | no | no | no |
| TOGO | | | | | |
| Nutrimix "1er âge" | maize: 35%<br>sorghum: 35%<br>rice: 20% | | 10% | | |
| Nutrimix "2ème âge" | maize: 60%<br>rice: 10% | soya beans: 25% | 5% | | |
| Viten "1er âge" | maize,<br>rice,<br>sorghum | | yes | | |
| Viten "2ème âge" | maize, rice | soya beans | yes | | |
| ZAIRE | | | | | |
| Cérévap | maize, wheat, oil | soya beans | yes | yes | yes |

*"1er âge": for infants 3-6 months; "2ème âge": from 6 months*

**Table 3**
**Nutrient content of flours for infants and young children (per 100 g dry matter)**

| Country and name of unit | Energy | Protein | Fat | Fibre | Calcium | Iron |
|---|---|---|---|---|---|---|
| | kcal | g | g | g | mg | mg |
| ALGERIA | | | | | | |
| Superamine | 414 | 20.9 | 4.5 | 2.1 | 390 | 15 |
| BENIN | | | | | | |
| Ouando "1er âge" | 401 | 9.9 | 3.1 | - | 6 | 13 |
| Ouando "2ème âge" | 366 | 16.0 | 4.0 | 7.0 | 29 | 9 |
| BURKINA FASO | | | | | | |
| Misola | 430 | 18.0 | 11.5 | - | - | - |
| BURUNDI | | | | | | |
| Musalac | 417 | 15.4 | 7.6 | 6.6 | 78 | 21 |
| CAPE VERDE | | | | | | |
| Micaf | 434 | 16.3 | 5.5 | - | 850 | 54 |
| CHAD | | | | | | |
| Vitafort | - | 11–13 | 5.5–8.5 | 8.0–15.0 | 32–60 | 2–5 |
| CONGO | | | | | | |
| Vitafort | - | 12.0 | 6.3 | 2.4 | 380 | 17 |
| GUINEA | | | | | | |
| Yéolac | - | 14.9 | 8.1 | 5.0 | 96 | 11 |
| MOROCCO | | | | | | |
| Actamine | 357 | 21.3 | - | - | - | - |
| NIGER | | | | | | |
| Bitamin | - | 16.2 | 8.9 | 2.2 | - | - |
| RWANDA | | | | | | |
| Sosoma | 400 | 16.5 | 7.7 | 2.2 | 6 | 7 |
| TOGO | | | | | | |
| Nutrimix 1er âge | 426 | 8.2 | 2.8 | 0.9 | 40 | - |
| Nutrimix "2ème âge" | 444 | 17.6 | 9.0 | 2.2 | 73 | - |
| Viten "1er âge" | - | 9.0 | 3.4 | 4.2 | 420 | 9 |
| Viten "2ème âge" | - | 15.5 | 7.6 | 4.4 | 450 | 9 |
| ZAIRE | | | | | | |
| Cérévap | 430 | 15.6 | 9.2 | 1.6 | 382 | 12 |

*"1er âge": for infants 3-6 months; "2ème âge": from 6 months*

**Table 4**
**Energy density of gruels**

| Country and name of unit | Energy density when prepared to a viscosity of 1 Pa.s | Energy density when prepared to a viscosity of 2 Pa.s |
|---|---|---|
| | kcal/100 ml | |
| BENIN | | |
| Ouando Superfarine "1er âge" | 41 | 55 |
| Ouando "2ème âge" | <60 | 70 |
| BURKINA FASO | | |
| Misola | 62 | 71 |
| BURUNDI | | |
| Musalac | 53 | 66 |
| CHAD | | |
| Vitafort | 50 | 66 |
| CONGO | | |
| Vitafort | 100 | 122 |
| GUINEA | | |
| Yéolac | 60 | 74 |
| NIGER | | |
| Bitamin | 46 | 56 |
| RWANDA | | |
| Sosoma | 50 | 72 |
| TOGO | | |
| Viten "1er âge" | 44 | 52 |
| Viten "2ème âge" | 54 | 60 |
| ZAIRE | | |
| Cérévap | 97 | 110 |
| CONTROL | | |
| WFP's CSB flour for infants | 44 | 58 |

*"1er âge": for infants 3-6 months; "2ème âge": from 6 months*

## 6. CONCLUSION

The units producing flour for infants that have been established in Africa over the last thirty years show important differences at several levels:

- the size of the units, with a production capacity that ranges from 1 to 250 tonnes a month;
- the technical processes used: although the majority of units simply mill, mix and package raw materials, which have sometimes been toasted or roasted, only three units produce (Ouando) or have produced (Superamine, Cérévap) instant foods;
- the nutrient contents of the flours vary, especially the protein and micronutrient contents;
- the energy density of the gruels obtained when they are prepared to the appropriate consistency differ noticeably.

On the other hand, there are a number of similarities in the type of authority that created the units, usually government bodies, and in the main ingredients used, which in the majority of cases are cereal flours, soya bean flour and sugar.

Regarding the nutritional quality of the products, the following inadequacies should be highlighted in certain foods:

- a protein content that is either too high or too low
- an excessive fibre content (cellulose + lignin > 3 g/100 g dry matter)
- an extremely low mineral content.

In addition, the energy density of gruel obtained with the majority of flours for infants is much too low, often below that of breast milk. Given the limited gastric capacity of infants and the low daily frequency of gruel distribution usually reported, this energy density does not allow gruel to adequately complement breast milk from the age of 6 months; thus, gruel does not play its role as transitional food towards a diet of solids.

Finally, it must be noted that in Benin and Togo flours for infants are proposed for feeding infants aged 3-6 months ("1er âge" flour); this is in contradiction with WHO recommendations on infant feeding and may incite mothers to introduce complementary foods too early, before the age of 4 months. Moreover, the nutritional value of these foods is much too low for children of about 6 months.

# Technology and equipment for the production of flour for infants and young children

Mémina SANOGO

## 1. INTRODUCTION

Setting up a unit to produce flour for infants and young children requires a study of the target population and its environment. It is also extremely important to consider carefully what is needed to start manufacturing the product. The choice of the most suitable technology and equipment should be part of this consideration. This is the subject of the present paper, which comprises four parts:

- choice of technology and equipment based on objectives and available resources;
- selection of the site and arrangement of premises;
- main stages of production and description of the equipment required;
- examples of techniques and equipment used in a few production units.

## 2. CHOICE OF RELEVANT TECHNOLOGY AND EQUIPMENT

This choice must be made bearing in mind the following criteria:

- Size of the market targeted and the strategy selected: is the aim to meet the needs of children in a particular district, town, region or in the country as a whole? Is the strategy based on the establishment of a high-capacity unit for the whole region, or is it to set up a number of small units located near the place of consumption?
- Financial resources available.
- Raw materials to be processed: their degree of cleanliness and quality can increase or decrease the time required to prepare them; their type (cereals, pulses) affects the method of preparation (dehusking, toasting).
- Energy source available and its cost: connection to an electric power network, cost of a generator, etc.
- Type of final product that is to be produced: flour for infants (instant or to be cooked) or an extruded product.
- Availability of equipment and maintenance capability: import or local purchase. It is preferable to choose locally manufactured equipment so that it can be repaired rapidly and spare parts can be found locally. Consideration must be given to staff training to carry out small repairs.

# 3. SELECTION OF THE PRODUCTION SITE AND ARRANGEMENT OF THE UNIT

## 3.1 Choice of site

It is preferable to set up a unit near the place of consumption, i.e. near an urban centre. This will limit the need to transport the final product and prevent deterioration due to handling. Moreover, being nearer to sales outlets makes it easier to react rapidly to demand. A unit can also be set up in health facilities in rural areas, where the need for foods for infants is often acute because of the greater prevalence of malnutrition.

A complementary food production unit can be set up in a variety of facilities, with public or private status, as is currently the case in many African countries, for example in:

- a nutritional centre such as Ouando in Benin
- a private enterprise such as the SODEPAL company in Burkina Faso (bakery)
- a women's group such as the Kasona group in Burkina Faso.

When choosing the site for the unit, the following requirements must be taken into account:

- access to water (borehole or town supply) for cleaning the raw materials and the unit, and in order to satisfy hygiene standards;
- a drain for waste water;
- a good connection to the road network to allow the loading and unloading of raw materials and final products;
- access to electric power, unless the equipment is operated with a generator or a diesel engine.

Furthermore, the unit should be located in a healthy environment, i.e. not close to sources of contamination such as waste dumps, stagnant water and dusty areas.

## 3.2 Arrangement of the premises

The premises must be large enough to facilitate the preparation, processing and packaging of the products. They must be arranged in order to limit the need for handling, and to allow the transport of raw materials and final products.

It is essential to follow the forward-moving principle, as in all food production lines; to avoid contamination, the circuit followed by the final product must never cross that of the raw materials.

A special room or area must be reserved for each operation:

- a well-ventilated storage room for the raw materials (millet, soya beans, groundnuts) measuring approximately 15 $m^2$ with no window, in order to prevent the entry of insects and dust;
- a well-ventilated storage room of around 10 $m^2$ with no window, for the semi-finished products (prepared ingredients, sugar, salt) and the bags of complementary food;
- a room for milling cereals and mixing the various ingredients (around 16 $m^2$);

- a room for weighing and packaging (15 to 20 $m^2$) with electricity, for the sealing machines;
- an office for accounting and management;
- an area for washing with a tap and running water, and a high-capacity drain; this area should be outside the premises to avoid humidity;
- an area with a raised concrete floor for drying and/or solar dryers.

Hygiene standards must be scrupulously followed at each stage of the production process: storage, processing and packaging. It is therefore necessary to:

- protect openings against animals, especially insects, and against dust with screens and mosquito nets;
- keep the premises clean by sweeping daily, and, at least once a week, cleaning the floor and walls with chlorinated water, followed by rinsing with clean water;
- dust the mill, the dehusker and other equipment regularly;
- handle the flour with ladles and spoons and do not expose it to the open air;
- avoid stagnant water;
- train the personnel in hygiene standards while monitoring their health status;
- ensure the personnel are wearing appropriate clothing for the preparation of the flour (overalls, caps, and masks for people suffering from benign respiratory illness).

## 4. STAGES OF PRODUCTION AND SUITABLE EQUIPMENT

The production of flour for infants requires several operations, shown in Table 1, which will be applied to the various raw materials (cereals, pulses, etc.); the operations include:

- storing raw materials
- processing (sorting, washing, drying, toasting, crushing, milling, and cooling)
- packaging (weighing and packaging the flour)
- storing the final product.

For example, in the case of a unit producing 1 to 2 tonnes a month it is preferable to:

- use labour rather than machines (unless the hygiene situation so requires) to avoid maintenance problems, and because this will help reduce unemployment;
- choose locally manufactured equipment as it is cheaper, easier to maintain and spare parts are available;
- make maximum use of the flexibility of the equipment, for example, by using one motor for both a dehusker and a mill.

### 4.1 Storage of raw materials

It is important to have clean, dry raw materials (cereals, pulses). Sorting and drying before storage can be very useful in preventing important losses due to mould. Drying can be done in the open air in a special area or on mats. Drying can be avoided to a certain extent, however, if the moisture content is measured upon purchase.

Immediately after delivery, the raw materials (cereals, pulses, sugar, etc.) must be stored in a dry place away from dust and insects. Storage can be done in containers or in a room reserved for this purpose with openings protected against insects.

**Table 1**
**Unit operations and equipment**

| Operation | Equipment |
|---|---|
| Sorting | Manual or electric sieve, sorting table |
| Washing | Tub |
| Drying | Solar or electric dryer, drying area |
| Toasting | Earthenware pot, toasting drum, traditional oven, roasting machine |
| Cooling | Basins |
| Weighing and mixing | Scales, mixing drum |
| Milling | Hammer mill, grindstone mill |
| Cooling | Basins |
| Weighing | Scales |
| Packaging | Electric heat-sealing machine |

## 4.2 Cleaning

Sorting and cleaning of dry raw materials eliminates stones, damaged grains, metal objects and other solids present in the grains. This stage is very often done by hand and requires a large labour force. Electric sifters or a sorting table can also be used.

Washing the grains removes dust or treatment residues, such as pesticides, that may have been used during storage. This can be done in basins or large tubs: the bottom of the tubs should have a sieve to keep the grains back. It is possible to make a tub in which 50 kg of grains can be washed at a time.

## 4.3 Drying

After washing, the grains are dried on mats, on concrete drying areas or in solar dryers. Depending on climatic conditions, drying can take three to eight hours. Electric dryers can also be used to dry soya beans (depending on the availability of power and its cost). The latter require thorough drying for roasting to be effective.

## 4.4 Dehusking

Dehusking calls for special techniques for each cereal or pulse: the envelope (pericarp) of the grain and part of the germ is removed. The pericarp is rich in indigestible cellulose fibre but it can also contain bitter tannin that may prevent the absorption of nutrients. The germ is rich in fats that cause the food to become rancid. The quality of dehusking determines the quality of the flour obtained after milling. The nutritional quality of dehusked grains varies according to the type of process used. Dehusking must allow the food to retain the maximum quantity of protein, while removing from the grain as much cellulose and fats as possible. Good dehusking is characterized by a recovery rate of 75 to 85%, a low rate of broken grain; more than 90% of the grains must have been effectively dehusked.

The equipment needed is a multipurpose dehusker (millet, sorghum, rice) or a grindstone crusher with an adjustable distance between grindstones. The mechanical process is abrasion: the grain is progressively worn from the outside towards the inside to eliminate the envelope. Among the equipment available, the following can be mentioned:

- The IDRC/PRD/RIIC model dehusker that can function continuously or intermittently. The intermittent model is used most because it allows small quantities to be processed according to need. The minimum quantity is 10 kg. This process is applied to dry grains. Dehusking is done by a series of carborundum or resinoid plates mounted on the same axis. On the large models, a ventilation system allows bran to be eliminated.
- The groundnut dehusker for which a hand-operated model exists, with an output of up to 60 kg/h. To make the best use of this machine, batches must be homogenous, grains must have a constant moisture content and be regularly fed into the machine.

### 4.5 Roasting

Roasting inactivates the antitrypsic factors in soya beans, kills bacteria, reduces humidity, and precooks the product. It can be done in hand-made ovens or ventilated electric ovens (Ouando) for soya beans, and drum roasters for groundnuts, or in earthenware pots. Cooling can done be in metal tubs with perforations at the bottom. Roasting is a delicate and important stage of production; if it is well done, it will enhance the nutritional value of the final product in comparison with the raw materials. It is also an important operation from the aspect of taste.

Improved rotary toasters comprise a drum above a heat source equipped with a rotating system for stirring. The system can be manual or driven by a motor. With this equipment soya bean grains can be roasted at 150°C for 20 to 30 minutes.

### 4.6 Weighing the ingredients

The various ingredients (cereals, pulses, milk powder, sugar, etc.) which make up the complementary food are weighed separately and mixed before milling.

### 4.7 Milling

Flour for infants requires milling to a fine dry powder for good conservation. The moisture content of the powder, as a consequence of the moisture of the grains, is decisive for the length of conservation and the taste of the final product. The drier the powder, the longer it will keep. It is, therefore, important to use equipment adapted to the milling of dry grains. An acceptable moisture content is 16%. There are two types of mill: hammer mills or crushers, and grindstone mills (Table 2).

The fineness of milling, controlled by a sieve, is important because the smaller the particle size, the better the food will be absorbed by a child. Depending on the type of mill, milling can be done two or three times successively in order to obtain the appropriate particle size. The flour is then cooled in covered basins.

Grindstone mills crush grains between two abrasive surfaces. The distance between the grindstones determines the fineness of the flour. The closer the grindstones, the finer the flour but the slower the output. The following are various types of grindstones:

- Metal grindstones consisting of crushing plates made of cast-iron, or cast-iron and steel: these are robust and inexpensive, but they may heat the flour and make a second milling necessary to obtain a powder that is sufficiently fine. In Africa, metal grindstone mills are preferred because they have many uses; the most commonly used makes are Hunt and Bentall.
- Because of the hardness of the material, grindstones made of corundum do not lose their abrasive power.
- Stone mills made of a combination of siliceous stones.

The principle of the hammer mill is to pulverize the grains by projecting them at high speed against the crushing chamber. The machine must have a motor because the speed at which the hammers rotate does not allow it to be operated by hand. Its main advantage is that it is easy and inexpensive to maintain; its most important disadvantage is that it does not deal satisfactorily with oilseeds and humid cereals. The speed of rotation of the hammers must be at least 1500 rpm; it is usually 3000 rpm for a motor of 5 to 7 hp. The output depends on a number of factors, especially the characteristics of the grille, the moisture content of grains and the power of the motor.

When choosing a mill, it is preferable to select one that is sold locally. The mill should have the following characteristics:

- simple to operate so that operators can control it easily
- easy to adjust
- easy access to parts that wear out quickly (grindstones, hammers, grilles)
- reversibility of certain parts (hammers or grindstones) to reduce operational costs
- robustness of the machinery
- good quality/price ratio.

Regarding the choice of the motor, and depending on whether a connection to the electric power network is available, the most commonly used are:

- electric motors in urban areas because they provide the most practical source of energy and are the least polluting;
- diesel or petrol motors in rural areas; diesel motors are more expensive and more complicated but are often more robust.

## 4.8 Packaging

The products are generally put into polyethylene bags manufactured locally. A minimum thickness of 0.35 mm bags is recommended when only one bag is used or 0.20 mm if there are two. Paper bags are not recommended because of the risk of humidity.

The basic equipment comprises scales and a heat-sealing machine to seal the bags. The machine is electrically operated. Several models exist, but the majority are manufactured in developed countries. Nevertheless, some hand-made machines are made locally from electric resistances.

**Table 2**
**Characteristics of the two types of mills**

| Type of equipment | Grindstone mills | Hammer mills |
|---|---|---|
| Principle | Milling by crushing | Crushing by a hammer |
| Utilization | Milling of dry or slightly humid cereals, oilseed grains (shea nut) | Milling of cereals or other dry non-oilseed products |
| Particle size of the flour | Determined by the distance between grindstones and their degree of wear | Determined by the diameter of perforations in the sieve and by the hammer rotation speed |
| | Will produce very fine flour by milling twice | Coarser flour, not possible to mill twice |
| Theoretical output (continuous operation) | 20 kg/h (belt driven)<br>200 kg/h (regular model)<br>100 kg/h for milling twice | 100 kg/h (regular model) |
| Power | Manual<br>Belt traction<br>Animal traction<br>Motor (9 to 12 hp) | Motor (5 to 10 hp) |
| Maintenance | Grindstone (resharpen/change) | Hammers (turn over, replace)<br>Sieve (replace) |
| Comments | More expensive than a hammer mill | Can be made by local craftsmen |

## 5. TECHNIQUES AND EQUIPMENT USED IN FOUR PRODUCTION UNITS

The four production units whose equipment is described in Table 3 are small-scale units producing between 1 and 2 tonnes per month — except for the Senegalese unit due to the small capacity of the equipment and to the decision to subcontract milling. For the other units milling equipment accounted for about one third of the equipment investment shown in Table 3.

**Table 3**
**Description of equipment used in four African production units**

| **Flour for infants** | **RUY XALELE** (Senegal) | **KASONA** (Burkina Faso) | **VITEN** (Togo) | **VITAFORT** (Congo) |
|---|---|---|---|---|
| Composition | Millet, cowpea, groundnuts, milk, sugar, palm oil, baobab fruit, eggs | Millet, soya beans, groundnuts, sugar, salt | Maize, rice, sorghum, cowpea, groundnuts | Cassava, maize, soya beans, sugar, enzymes |
| Monthly production | 0.4 t | 1.5 to 2.0 t | 1.0 t | 1.5 to 2.0 t |
| Equipment | Dryers<br>Heat-sealing machine | Solar dryer<br>Drying area<br>Cereal dehusker<br>Drum toaster<br>Hammer mill<br>Scales<br>Heat-sealing machine | Metal rack for drying<br>Gas ovens<br>Hammer mill<br>Disk mill<br>Motor<br>Scales<br>Foot-operated heat-sealing machine | Sorting table<br>Drying installation<br>Grindstone mill+motor<br>Hammer mill+motor<br>Mixing drum<br>100 kg scales<br>Precision scale<br>Heat-sealing and packaging machine<br>HP cleaning machine |
| Production staff | 7 | Not known | 6 | 3 to 4 |
| Investment in equipment (CFAF*) | 300 000 (1990) | 3 250 000 (1990) | 5 000 000 (1991) | 4 000 000 (1992) |

* *before the 1994 devaluation, US$ 1 ≈ CFA Francs 250*

## 6. CONCLUSION

The major technical problems encountered in operating a small-scale unit producing flour for infants are the following:

- drying of raw materials when there is little sunshine and no equipment has been provided to replace solar drying;
- milling the grains several times — necessary process to obtain a sufficiently fine particle size — leads to additional contamination and increases the temperature of the flour which is detrimental to its nutritional value;
- maintenance of the equipment.

# Creation and management of small-scale units producing flour for infants

Olivier LEGROS

## 1. INTRODUCTION

The production of flour for infants, like that of other products, must meet consumer demand. In this case, however, consumers are very special: these are infants who, although they are neither the purchasers nor the decision-makers, have their own preferences. Young children are supposed to eat porridge prepared with flour for infants for at least six months starting at 4–6 months of age. In well-off families, however, this period is usually longer whereas in the poorest families children rapidly partake of family food. The customer for such a flour is therefore an *ephemeral customer*. In an average household with four children, flour for infants is only used for four periods of 6 months during the household's life span. At any time, approximately 5% of households have a child of an age corresponding to that of porridge consumption. Thus, a small-scale production unit has an extremely *disseminated and limited clientele*.

In addition, a number of social and cultural factors that affect the choice of complementary food must be taken into account. A mother is torn between her husband, her parents, physicians, social workers, pharmacists, and shopkeepers, who all have a different opinion on the matter. Moreover, she has her own criteria for decision-making, namely, her child's reaction to the product, his growth, the frequency of diarrhoea, the taste and appearance of the product, its nutritional quality, and its price, which is often the decisive factor. The market for complementary foods is therefore a *sensitive market*.

From the producer's standpoint, there are two major constraints: firstly, *the need for profitability*, a condition for the sustainability of an enterprise; secondly, the need for operational flexibility. In other words, the goal is to create *a small-scale enterprise*, taking into account the difficult economic environment of African countries.

The challenge is therefore to create a small enterprise in a difficult market. In the majority of cases, this challenge can only be met if future producers are helped by one or several supporting organizations that will create a favourable environment. To discover their role we will follow a young entrepreneur who wishes to help solve infant feeding problems in his country.

## 2. THE PREPARATION AND CREATION STAGE

For the entrepreneur, the preparatory stage consists in answering a number of key questions.

### 2.1 What is the objective?

First of all, the entrepreneur must know what he is seeking in his enterprise. He may have several objectives: profit, creation of wealth and jobs, or simply the health of babies! In any event, he must bear in mind that an enterprise that does not earn money will die.

He must choose a basic strategy to achieve his objectives. For example, if his objective is to ensure a good income for himself and his family while helping mothers by selling a balanced and inexpensive complementary food, the strategy will be to set up a family production unit. If his objective is to use his spare time, together with volunteers, to help women in his neighbourhood, the activity will be on a different level. If the objective is to supply the domestic market, the unit will be of an industrial type.

In the present situation of African countries, *small enterprises* must be encouraged so that complementary food production is well integrated into the country's economic fabric; small enterprises are the cornerstone of economies of developing countries.

### 2.2 What is the target?

With respect to complementary foods, market surveys must be much more rigorous than for other products because nutritional and health aspects must be taken into account.

The first step is therefore to assess the nutritional status of children in order to identify needs and define the population to whom the future product will be targeted. In order to place the problem within its sociocultural context, a study of infant feeding practices is necessary. This information can often be obtained from health services, national or international organizations. Close cooperation with nutritionists is vital to find an effective solution. Once the target group has been identified, it is necessary to ensure that it is willing to buy a complementary food. The *weekly budget* the target population is prepared to spend on this food must be determined.

The producer may decide not to target the most deprived segment of the population, which is the segment most in need of the product, because its purchasing power is too low. Special solutions should be sought by government authorities or food aid organizations in order to meet the needs of this segment, perhaps through collaboration with the entrepreneur. It is impossible for a newly-created enterprise to cater for customers who are not solvent.

### 2.3 What will be the composition of the product?

As part of the market survey, the complementary foods already used by the *target population* should be listed: it is necessary to know *what* foods are being used, *how* they are used and *where* they are purchased. The assistance of sociologists and marketing consultants will be very useful in this context.

The composition of these products will guide the choice of the formula, but it is also important to take into account the availability of raw materials and technology. These two factors often condition the success of enterprises processing agricultural products.

Since consumer needs do not vary, the raw materials used must be available both in quantity and quality throughout the year. The seasonal nature of agricultural production is a factor that should be taken into account. Depending on the nature of the raw materials, some dealers permanently stock or import them and can thus supply them on a continuous basis. In some cases, it is also possible for the producer of flour for infants to stock certain raw materials himself, but this is generally costly and difficult to do during the launching stage. It is therefore necessary to choose raw materials that are *available locally*, whether produced locally or imported. Generally, the local food staple is chosen, such as for example, millet in West Africa, cassava in Central Africa, maize or rice in other regions.

The processing techniques must also be chosen with care; in some cases, studies will be needed, because inadequate techniques can be an important obstacle to the running of a production unit. For each agricultural product, the processing techniques and the equipment should be chosen in advance, and their availability assessed on site. Rural development services and nongovernmental organizations can greatly assist an entrepreneur, provide answers to his questions as well as advise him.

Once the information is collected regarding consumers' expectations, the availability and price of products, and the accessibility of available processing techniques has been evaluated, the entrepreneur and the institutions supporting him can develop one or more formulas for the complementary food. This task is primarily the responsibility of nutritionists, but it must be done in collaboration with agronomists, technicians and economists because all the above-mentioned aspects must be taken into account.

There is no obligation to produce a single formula; on the contrary, an entrepreneur should have several formulas so the composition of his product can evolve without any impact on its nutritional value. The entrepreneur may vary the proportions of ingredients, or even replace one ingredient with another according to the availability of raw materials on the market. Consumer taste should be taken into account when this is done, and customers should be informed of the changes.

## 2.4 What form of packaging should be used?

Once the content has been defined, it is necessary to decide on a container, which is just as important for the enterprise's success as the formula itself. The packaging will determine the product's appearance and is a means of communication with the customer. As is the case for agricultural raw materials, it is better to use locally available packaging. This facilitates supply and, above all, implies that stocks, and consequently financing, can be limited. The simplest packaging is a low-density polyethylene bag that can be found on site or in neighbouring countries. Depending on the target and on competing products, however, it will sometimes be necessary to use more sophisticated packaging whose supply and stock levels need to be studied with care.

## 2.5 How should production be organized?

Available technology should be studied with technicians to develop the production scheme. This scheme will determine the labour required, the machinery and tools to be installed, the quantities to be processed, etc. This is a very complex stage because other factors must also be taken into account, such as modes of supply, financing possibilities, marketing opportunities and the marketing calendar, and finally qualifications of the labour force. This stage is often called the "modelling" stage; it needs to be done in cooperation with technicians and economists, and in close contact with the supporting organization.

## 2.6 How should the price be determined?

Some experiences in Africa provide indications on the acceptable level of economic ratios for determining the purchasing price of flour for infants. These ratios are fixed to give the entrepreneur a reasonable margin of manoeuvre to deal with any unforeseen circumstances and any production or management problem:

- The threshold of profitability should be 40–50% of the anticipated production level
- The gross margin should be over 30–40% of turnover once the unit is fully operational.
- If an entrepreneur is paid according to results, this should be a minimum of 15–20% of turnover.

Occasionally, the price calculated on the basis of these ratios, plus distribution costs, exceeds the price a consumer is prepared to pay. Adjustments and modifications need to be made in the organization, investment, supply or marketing in order to bring the cost price down to a level that will maintain the profitability and ensure the sustainability of the enterprise.

## 2.7 How should the unit and its operation be financed?

An entrepreneur needs money to develop his project, set up the enterprise and make it operational once it has been launched.

### *Budget*

Drawing up investment and cash flow tables helps determine the financial needs of the entrepreneur.

The investment table presents all the investment that is needed for the creation of the unit (land, buildings, machinery and tools with their on-site delivery price). Loans taken out to cover investment should be limited because of their impact on cash-flow. A young entrepreneur can start operations by renting premises instead of building, choosing small machines and making them work longer, etc.

A cash flow table shows the estimated income and expenditure for the first three years. This covers the operation of the unit. In the first months of operation, the cash flow budget will often show expenditure in excess of income. Certain measures and steps can be taken to narrow this gap, but for the remaining amounts special financing will have to be obtained (for example, finding suppliers so as to limit stocks, obtaining delayed payment terms).

### *Financing plan*

The aim of the financing plan is to convince third parties to make a financial contribution to the creation of the unit. It should define the project clearly and show the partners already involved in the preparatory stage.

Once the plan is ready, the entrepreneur should start his campaign. The first persons contacted should be close relatives or friends, who often help in financing the preparatory stage but can also participate in setting up and operating the enterprise. Next come enterprises that may have an interest in helping to set up a small-scale unit to produce flour for infants, either because it will enhance their image or for their own operational reasons. International organizations (USAID, European Union, FAO, WFP, UNICEF, etc.) are also potential donors that should not be neglected, particularly since they may provide subsidies, i.e. non-repayable sums. Finally, banks naturally come to mind, but they should not be contacted before the other financing sources have been approached.

The case of the Dolisie production unit in Congo is interesting: 30% of the investment was in the form of a subsidy from the French Aid and Cooperation Fund, the remainder was a medium-term loan from a local bank through a line of credit granted by the Caisse Française de Développement (CFD).[1] Stocks of raw materials were financed under a German cooperation health project; this loan was repayable in kind, on the basis of a certain number of bags of flour per month for two years for nutritional rehabilitation in health centres.

## 3. LAUNCHING AND MANAGEMENT STAGE

### 3.1 Training

Working men and women are the most important asset of a small-scale industry. Therefore, training is the foundation of an enterprise; it will provide an entrepreneur and his team with the required knowledge and know-how. Training should focus on five main areas:

- technical knowledge: information on complementary feeding practices, processing of agricultural products, hygiene, machinery operation, etc.;
- management knowledge: economic information on markets, production, labour, financing and accounting rules;
- technical know-how: how to use the machines and tools, maintenance, reliable and rapid work;
- management know-how: cash flow monitoring, stocks controlling, supervising the staff and the quality of work;
- behaviour: entrepreneurial ethics, problem-solving skills, a spirit of innovation, moving ahead, motivating partners, negotiating.

Good training should focus on all five areas without neglecting any. The first two areas can be covered quite quickly with the help of technicians and management consultants at the theoretical level. The next three are more based on experience and can only be acquired through practice. It is dangerous for an entrepreneur to get into debt and launch a new activity without ever having practised it, basing himself solely on theoretical knowledge.

This underlines the need for *training units*, which should be full-scale enterprises that operate normally and profitably, and have the necessary buildings, equipment and tools, under the supervision of an experienced entrepreneur. These units receive candidates who wish to create an enterprise and gain experience by learning from the manager. The concept of training in a production unit is extremely important. It is summarized by the maxim: "a civil servant will train a civil servant, an entrepreneur will train an entrepreneur".

[1] French development fund.

In Congo, the Vitafort unit serves as a training unit. Candidates first spend one or two months with the manager of the unit and are supervised by training staff from Agricongo.[2] They are then given responsibility for managing the unit for three or four months, during which they gain practical experience and prepare their project.

### 3.2 Marketing

During his training period, the new entrepreneur must develop a marketing plan with his partners that is relevant to the target group given the approximate price of the product.

#### *Trademark and image*

The first step is to choose a name for the product. As it will reflect the product's identity, it must be chosen with care.

Meetings can be held with young mothers and fathers to make a list of names that will convey the message the enterprise wishes to communicate and reflect the composition of the product. Subsequently, a survey among the public will confirm which name meets with the greatest approval. It is important to allow consumers to express their views because they often have good ideas. As they are the ones who will buy the product, the name might as well come from them. Moreover, an idea that might meet with the approval of a small group of intellectuals may have little meaning for consumers.

The name is often much more meaningful if it is associated with an illustration, photo or drawing. An illustration is important for the presentation of the product; it should be created by a local artist, who is the only person capable of expressing images that are relevant to consumers. Through trifling details, the consumer will recognize images relevant to his/her situation, her child or what she expects of the product. The image, like the name, must evoke positive thoughts in the purchaser's mind so that he/she gives it to the child and recommends it to his/her entourage. A survey among the public showing five to ten possible images will help select the one that is preferred, in accordance with a number of fixed criteria.

After having decided on a name and an image, a model of the bag must be prepared, showing the instructions for use, the conservation time and other information in accordance with local regulations (composition, nutritional value, address of the producer, etc.). Regarding instructions for use, it is often helpful to illustrate these with drawings to enable semi-literate people to prepare the product correctly. The instructions for use, written or drawn, must be tested in order to make sure they are well understood.

#### *Distribution*

Distribution represents operations and transactions that take place once the product leaves the unit until it reaches the customer; they include transport and trade. We have seen that demand for a product is very irregular because the number of households consuming it is low. In order to reach potential customers, it is necessary either to have a large number of sales outlets, using already-existing commercial networks (markets, food stores and pharmacies), or to reach the customers in places to which they inevitably go, for example health centres and mother and child clinics. Sales through a wholesaler should be avoided because it is important to be able to control sales outlets and inform the retailers.

[2] Research institute for support of agricultural development in tropical areas.

Two distribution policies could thus be envisaged:

- sales in health centres with or without kiosks and special staff
- sales in markets, food stores and pharmacies.

In general, the product should be displayed where people are used to buying food for infants and young children.

If the product is distributed by shopkeepers, it is necessary to negotiate margins and prices in advance and reach an agreement with the retailers. Will deliveries be made to the shopkeepers or will they come to the production unit for their supplies? The simplest way is to encourage shopkeepers to come and get the product by offering an attractive price differential. Otherwise, there will be transport costs and these will have to be incorporated in the selling price to the shopkeeper. The purchase price for the public is calculated according to the usual margins. These vary according to the product and the sales outlet. Studies provide certain indications on the ways that people think and act that could be useful to entrepreneurs. In general, a shopkeeper seeks to earn a fixed profit for a given product so the greater the volume of the product he sells, the lower the margin per unit may be. Studies carried out in food shops in Brazzaville showed margins of 10 to 25% for food products and 15 to 20% for imported complementary foods. If the entrepreneur knows how many bags of competing imported complementary foods are sold per week, it is possible to determine the shopkeeper's overall margin, and negotiate with him the margin per unit of the new product, based on the number of bags the entrepreneur expects to deliver per week. The important factor is that the shopkeeper should earn the same amount, or more, with the new product as with the old one.

### *Advertising and promotion*

Once the product is in the sales outlet, the contact between the customer and the product should be encouraged, either by bringing the customer to the product (advertising) or by bringing the product to the customer (promotion). Communication should focus on the following objectives:

- publicize the existence of the product
- publicize its qualities
- convince the customer that the product is good for her child
- teach mothers how to prepare it if necessary.

It is difficult for a small enterprise to have a large advertising budget. Important media such as television, radio and newspapers are outside the scope of such an enterprise and their impact would be too great in comparison with production capacity.

The most effective solution is neighbourhood communication through posters, leaflets, and demonstration/tasting in health centres. As the clientele is ephemeral, advertising and promotion should be *ongoing*. Because the customers are widespread, communication must be *targeted* so as to reach persons concerned by the product directly. The customer must be reached in places where he or she is most likely to be found: mother and child centres, maternity homes, health centres and pharmacies.

Action can be taken at the local level to make the enterprise known and give it a good reputation without spending too much: taking part in competitions, helping schools and maternity homes, financing vaccination campaigns, etc. For the same amount of money, the impact among the public of a campaign of donations will be much more important and wide-ranging than a campaign using leaflets. Here again, important resources are required and the support of external organizations is essential for elaborating marketing strategies, designing communication tools and financing campaigns.

### 3.3 Setting up

When the entrepreneur has completed his training, collected the funds required for his project and drawn up his marketing plan, he can buy the equipment and install it on the premises; this is the moment when negotiations with suppliers come into effect and deliveries begin. If the project has been well prepared, installation should go ahead without too many problems, with the support of organizations to advise and encourage the young creator. The entrepreneur sets up his supply network, implements his marketing plan, motivates and trains his team so that product quality is above reproach from the outset.

### 3.4 Day-to-day management

Five concerns should guide an entrepreneur in day-to-day management of his production unit:

*The guarantee of constant quality*

For an enterprise producing complementary foods, quality is the most important criterion because it will ensure sustainability, and the product's reputation will be built on it. Some simple rules guarantee the quality of the product; it is up to the head of the unit to ensure that they are followed. Simple tests and analyses allow quality controls *a posteriori*; if there is a problem, the entrepreneur should approach the technicians to identify the causes and take necessary measures. Bearing this in mind, control should not be seen as a sanction but as a management tool in the same way as the accounts ledgers for cash flow. Good contacts with control officials, who are real partners, ensures that the consumer will receive a quality product.

*Encouraging and keeping up demand*

By itself or with help from its partners, a newly-created enterprise should constantly contact new households to introduce them to its product and convince them to use it for their children. It takes about two to three years to develop customer loyalty and for word of mouth to become effective so that communication can be reduced or modified. It should not be forgotten that consumers are ephemeral and that a mother who adopts the product once will only return to it two years later on average!

*Adjusting production to demand*

Organizing work in the unit so that production constantly anticipates demand is a constant concern of the head of the enterprise. Once a child has become accustomed to a particular porridge it is difficult to change it; this is why mothers insist on regular supplies at their customary sales outlet.

If supplies break down in a sales outlet, several customers whose loyalty to the product has been earned will turn towards another product with more secure supplies. An entrepreneur must therefore ensure that sales outlets are constantly supplied and that the unit has reserve stocks to meet demand. This is done through permanent contact with the sellers. On the other hand, over-production should be avoided because it is costly and may compromise quality.

*Maintaining the level of stocks*

The counterpart to regular production is a regular stock of raw materials. If one single ingredient is missing, all the production line is paralyzed. However, over-stocking means a risk of deterioration and costs a lot in immobilized funds. It is up to the head of the enterprise to monitor stocks and maintain them at an adequate level given the supply capabilities.

*Monitoring the cash flow level*

It is usually necessary to have some cash to buy raw materials. An entrepreneur must therefore follow closely the entry and exit of money, in order to maintain an ongoing balance between income and expenditure. To do this, he must learn to keep accounts in order to know his exact situation. It is then his negotiating power with customers and suppliers that will guarantee a minimum level of cash to meet current expenditure. A good financial manager makes his customers pay cash and keeps his suppliers waiting. It is sometimes difficult to follow this example, but the attempt should be made; running out of cash can be compared to running out of petrol, it means a complete halt. Many newly-created enterprises experience problems or go bankrupt because of cash flow difficulties; therefore special attention should be devoted to this factor.

### 3.5 Monthly follow-up

One does not become a good head of enterprise after just a few months' training. Apprenticeship continues throughout the launching process; it is important that a young entrepreneur be followed up by the supporting organizations that have trained him and helped him to set up. Every month, the entrepreneur should evaluate the production and operation of the unit and his financial situation in order to understand what is happening, and discuss the decisions to be taken the following month. In Congo, such a follow-up is done for a period of 6 months to a year by a group set up jointly by Agricongo and the CFD, to support creators of enterprises during the launching phase and give them a greater chance of success.

## 4. CONCLUSION

Having followed an entrepreneur all the way along the process from his original idea to the launching of the production of complementary foods, we must acknowledge that his task is arduous and fraught with difficulties. However, a small enterprise is the cornerstone on which a country's economy will be built; it must be encouraged and defended because it will lead to sustainable development.

We have seen that an entrepreneur needs a great deal of information in order to prepare his project on the one hand and, and financing, training and monitoring, on the other hand, in order to put it into effect. It is up to research and development organizations to ensure that this information is available to all those who have the courage to start an enterprise. Moreover, it is the task of such organizations, together with governments, to create a favourable environment so that such enterprises can emerge and develop.

# Germination techniques: country level experiences

Anna VERSTER

## 1. INTRODUCTION

Germination of cereal grains, also called "malting", is a technique used at household level to improve the energy density of traditional gruels. Another technique, fermentation, which is traditionally practised in many African countries, also has important advantages but does not increase the energy density of gruels (Alnwick, Moses and Schmidt, 1988). Only germination will therefore be discussed here.

The issue of the use of amylase in the production of complementary foods in small-scale production units has been discussed in Chapter 3 (Trèche, 1999). Germination and malting techniques have been promoted for use at household level in a number of countries. Two well-known country experiences are the use of amylase rich flour (ARF) in India and the use of *kimea* in Tanzania.

## 2. THE INDIAN EXPERIENCE

In India, the University of Baroda conducted several studies on the use of germinated flours. These studies have been followed by field trials to study the feasibility of these technologies at household level. Both NGO projects and nutrition rehabilitation centers have been involved in such field trials. Several of the field trials have been targeted to illiterate women in shantytowns.

Traditionally, Indian mothers prepare a thin gruel (5% flour) mixed with "jaggery" sugar and sometimes oil. The gruels prepared with amylase-rich flour are much more energy-dense: "jaggery" sugar, oil and ARF flour is added to a very thick porridge containing 30 grams of flour per 100 ml water. The process of preparation of ARF is roughly similar to that described by Trèche (1999). Great emphasis is placed in the Indian project on the importance of removing the sprouts of the germinated grain. For grinding the grain into flour, mothers rely on the commercial mills found locally.

## 3. THE TANZANIAN EXPERIENCE

In Tanzania, the Tanzania Food and Nutrition Center has been actively studying methods to increase the energy density of complementary foods, resulting in the development and promotion of *kimea*.

Traditionally children virtually everywhere in Tanzania are given a very thin gruel made from maize flour and water with a very small proportion of flour (5-8%). Other ingredients may be added, depending on their availability, price, and the time the mother has for the preparation of the food as well as her educational level. Germinated flours based on millet or sorghum, have traditionally been prepared as a first step in beer brewing. This malted flour is called *kimea* in Swahili.

In 1983, after laboratory and field studies had shown its efficacy, the use of *kimea* was promoted during the nutrition campaign, which marked the start of the UNICEF/WHO Joint Nutrition Support Programme (JNSP) in Iringa, Tanzania. Much has been written about this programme elsewhere, so this presentation will only address the use of *kimea*.

The promotion of *kimea* was one of 6 strategies aiming at improving the nutritional status of children in the Iringa region. The 6 strategies included the promotion of breast-feeding, increasing the frequency of meals, use of a mixture of ingredients, hygienic preparation of complementary foods, use of *kimea* or oil to increase energy density and ensuring that the child received enough food.

Women were shown how to prepare a very thick porridge, to let it cool and to add one spoonful of *kimea* while stirring the porridge well (Table 1). In view of the high incidence of diarrhoea, it was subsequently recommended to reheat the porridge before offering it to the child.

The preparation process of *kimea* differs in one important point from that utilized in India and Congo, in that mothers were not asked to remove the sprouts before grinding the grain into flour.

## 4. QUESTIONS RAISED BY THE EXPERIENCES OF INDIA AND TANZANIA

The experiences discussed here have been widely discussed and evaluated. Ashworth and Draper (1992) have carried out a review of these evaluations. This presentation only addresses the most salient points.

**Table 1**
**Instructions for the preparation of porridge with *kimea* in Tanzania**

1. PREPARE A THICK PORRIDGE
2. LET IT COOL
3. ADD ONE TEASPOON OF *KIMEA*
4. STIR WELL
5. WAIT UNTIL THE PORRIDGE BECOMES LIQUID
6. BRING TO A BOIL, COOL AND SERVE

### 4.1. The acceptability and sustainability of germination techniques

Both in India and in Tanzania the enthusiasm was very great during and just after the introduction campaign, but over time the number of women who continued to apply the technology fell drastically.

It was found that:

- A campaign like the one carried out in Tanzania requires considerable human and financial resources, and it was not possible to keep the momentum during the period that followed.
- Malting is a technique also used in traditional beer brewing. It has been suggested that some women associated the production of *kimea* with beer brewing and were afraid of giving their children a food that contained alcohol. This finding needs to be verified, through the use of qualitative study methods.
- The preparation of *kimea* puts an additional burden on women who are already overworked. In this context, Prof. T. Gopaldas of the University of Baroda has stated that a traditional technology is not necessarily a technology practised by each individual household. She has suggested that women could be identified who could become specialized in the preparation of malted flours and could sell these. In the Tanzanian context, the same is true in that not all women are necessarily beer brewers, accustomed to the preparation of *kimea*. One can thus think of several models to facilitate the preparation and use of ARF or *kimea*.
- It has been suggested that the cost of preparing a thick porridge is too high for some families. Prof. Gopaldas has countered this argument with the statement that cereal flour is the cheapest ingredient of the porridge, and a lot cheaper than for instance oil. A gruel containing 5% flour costs the family 2.5 p of a rupee for 100 ml, corresponding to around 20 kcal. A porridge with 30% flour would cost 15 p of a rupee per 100 ml, for around 120 kcal. The cost of adding 10 grams of oil to a gruel of 20 kcal to increase the energy density to 110 kcal/100 ml would be 40 p of a rupee for 100 ml.

### 4.2 Safety

There is a need to address the question of toxicity, especially in Tanzania where the malted grains are used together with their sprouts. This is a risk, especially in the case of sorghum, as cyanide develops in the sprouts during germination.

Studies carried out by Dada and Denby of the Institute for Natural Resource Development in the UK, on samples of *kimea* from Tanzania have, however, not detected levels of cyanide that would cause concern. Their conclusion was that the traditional process reduced the level of cyanide below the danger level.

### 4.3 Impact of germinated flours

The final question is whether the use of *kimea* or other sources of amylase has a positive impact on child growth. In this context it must be realized that there is no need for special germination techniques to obtain an amylase reaction: if the mother licks the spoon she uses to stir the porridge or if she pre-chews the food an amylase action will occur. These are things many parents all over the world already do.

It is important to study not only the content and consistency of the porridge but also to assess the nutritional impact of the efforts made. It may well be that the benefit of these technologies lies not so much or not only in increasing the energy density but in other aspects.

This point can be illustrated by a study carried out in Jamaica by Stephenson et al. (1994). In this study, three comparable groups of children were given either a thin gruel or a thick porridge or a porridge liquefied with malted flour. The children were allowed to eat "ad libitum" and the thick porridge had the same energy density as the malted porridge. The study showed no difference in the energy intake per meal between children eating the thick porridge or the malted porridge. The only difference was in the time it took to feed the child. It may well be that the main advantage of malted flours lies in the reduction of the time it takes a mother or caretaker to feed a child.

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# Nutrition education and technology transfer: a pilot intervention on the Kukuya plateau (Congo)

Abel Z. MOUKOLO, Félicité TCHIBINDAT, Serge TRÈCHE, Yves MARTIN-PREVEL, Stéphane PEZENNEC, Norbert GAMI and Yvette LOUYAT de DIBANTSA

## 1. JUSTIFICATION

In Congo, both types of protein-energy malnutrition (PEM), wasting and stunting, are prevalent. Among preschool children, the prevalence of wasting is 4%, whereas it is 21% for stunting (Cornu et al., 1990).

The national survey of the nutritional status of preschool children in Congo carried out in 1987, showed that the ecological region of the plateaux, to which the Kukuya plateau belongs (Lékana district), was highly affected by malnutrition. In 1987, the prevalence of wasting was 8.5% and that of stunting 27.5% among children aged 0–59 months.

In April 1992, the Laboratoire d'Etude sur la Nutrition et l'Alimentation (LENA)[1] of the DGRST-Orstom[2] Centre in Brazzaville conducted a new nutrition survey on the Kukuya plateau. The main objective was to identify the causes of wasting in children aged 0–59 months, determine the risk factors for PEM, and classify them by order of importance; a secondary objective was to provide basic data for designing an intervention to solve nutritional problems.

The results of the new survey confirmed the high prevalence of malnutrition previously observed, especially that of stunting (Kameli, 1992). Among the various risk factors identified, the data showed that the timing of introduction of complementary foods was inadequate, i.e. that it was not adapted to the nutritional needs and to the physiology of infants (Gami et al., 1995; Massamba et al., 1995).

[1] Laboratory of nutrition and food studies.

[2] DGRST: Department for scientific and technological research.
Orstom was renamed Institut de Recherche pour le Développement in 1999.

In addition, analyses of gruel samples prepared on the Kukuya plateau showed that it was not nutritionally adequate (Trèche et al., 1992; Cornu et al., 1993; Gami et al., 1995):

- The mean dry matter content, 15 g/100 g of gruel, corresponding to an energy density of approximately 60 kcal/100 ml, was insufficient given the low daily frequency of feeding gruel.
- The protein content was often less than 1 g/100 g of dry matter because gruel was usually made of cassava flour, sugar and water only.

The Kukuya plateau, 400 km from Brazzaville, was chosen for a nutritional intervention for a number of reasons:

- high rates of PEM and inadequate complementary feeding practices in the ecological area of the plateaux;
- human and cultural homogeneity of the Kukuya plateau, whose population density (16 000 inhabitants for the 450 km$^2$ of Lékana district, i.e. a density of 35 inhabitants/km$^2$) is much higher than the national average (Gami, 1992);
- homogeneity of agricultural production, which made it possible to propose technology that could be applied across the plateau.

## 2. DEVELOPMENT AND IMPLEMENTATION

### 2.1 Outline of the strategy

In 1991, the Ministry of Health developed two strategies to improve complementary feeding of young Congolese children (Tchibindat et al., 1993) through the Project for support of nutrition-related activities (PAAN), in collaboration with other partners including LENA and Agricongo[3].

The first strategy was mainly directed at urban areas, and was based on the production and promotion of flour for infants and young children prepared from local products (Tchibindat and Trèche, 1999).

The second, implemented as a pilot project on the Kukuya plateau, consisted of nutritional education and popularization of the household level processes shown below. This strategy had two main objectives:

- the dissemination of nutrition education messages to all women of child-bearing age in order to promote exclusive breast-feeding until 4 to 6 months, and an appropriate schedule for complementary feeding;
- the popularization of food processes to allow mothers to prepare a protein-rich and energy-dense gruel from permanently available local foods.

### 2.2 Training of village extension workers

To implement this project, we decided to enrol female extension workers selected in the target population, and trained by the research team responsible for the project. Each extension worker was responsible for one of the 12 zones of the plateau.

[3] Research institute for support of agricultural development in tropical areas.

There were eight training objectives, each one being the subject of a special module. The basic message to be conveyed to the extension worker was given in the "Aide mémoire de l'animatrice", the extension worker's handbook (Pezennec et al.,1993). Training comprised theoretical and practical stages. After acquiring basic nutritional knowledge, the extension workers should (objectives 1 to 5):

- have elementary knowledge of nutritional needs
- know how food can meet nutritional needs
- know how to meet the nutritional needs of children aged 0–2 years
- be aware of the main symptoms of malnutrition
- know how to prepare a protein-rich and energy dense gruel.

The team's approach to teaching was to build on the extension workers' previous knowledge, encourage them to participate actively and ask questions. In the second stage, training focused on organizational principles to enable workers to (objectives 6 to 8):

- be able to convey to mothers the nutritional message and teach them how to prepare the improved gruel;
- know how to organize and plan nutrition education sessions and cooking demonstrations in the zone for which they will be responsible;
- be able to evaluate their work and, in particular, identify obstacles to the dissemination of the nutritional message.

For financial reasons, it was not possible to train all the extension workers at the same time. They were divided into two groups of six. The extension workers from the zones most affected by malnutrition were trained first (January 1993), whereas those from the other six zones were trained three months later. The extension workers' work plan was divided in two phases:

- First phase: dissemination of the nutritional message and technique for preparing the enriched gruel to all women of child-bearing age in the zone. During this 3-month phase, the extension workers were asked to reach all the target population in their particular zone and were employed full time (six days per week).
- Follow-up phase: visit women in their villages (the work programme was adapted to each extension worker) in order to reinforce the action initiated during the first phase. During this phase (21 months), the extension workers worked a third of the time (around two days per week).

The 12 extension workers received a monthly salary, the equipment needed for demonstrations (cooking utensils, maize and stationery) and a bicycle for their visits, all of which were financed by the PAAN project.

### 2.3 Supervision

There were two levels of supervision: supervision by a local supervisor living on the plateau, and by members of the project team.

#### *Local supervision*

In each of the two training groups, one extension worker was chosen to coordinate the work of the others, ensure liaison with the project team, and act as local supervisor.

The local supervisor was responsible for making sure that the nutritional message and home processing techniques were correctly disseminated. For this purpose, she brought the other extension workers together twice a month and visited each one in her zone, at least once a month.

### *Supervision by the project team*

The project team supervised the work of the extension workers and local supervisors. Control visits were made towards the middle and the end of the first phase of the work plan; they took place approximately every four months in the second phase (PAAN, 1994).

During these visits, meetings with all the extension workers were organized, where they were able to describe the problems encountered, and find solutions through group discussion. The "session" and supervision records were checked and extension workers submitted questions on any unclear issue. Answers were given to any questions raised by the target women.

The team also visited extension workers in their zone during nutrition education sessions. Finally, target women were interviewed after the sessions and during visits to the villages.

## 3. TRANSFER OF TECHNOLOGY

The objective was to transfer technology to households for the preparation of protein-enriched gruel (10 g of protein per 100 g of dry matter) with a concentration of 30 g of dry matter per 100 g of gruel, providing approximately 120 kcal per 100 ml, and with a viscosity level between 1 and 1.5 Pa.s. (Trèche et al., 1991; Trèche, 1994 & 1999; Louyat de Dibantsa, 1994).

### 3.1 Ingredients

The various ingredients used to prepare the energy-dense gruel were cassava (*kifuwo*), groundnut or pumpkin paste, sugar, germinated maize flour and water (Figure 1).

### 3.2 Methods for the preparation of the three main ingredients

#### *Preparation of "Kifuwo"*

The technology used to obtain *kifuwo* is the same as the one used in the first stages of *chikwangue* preparation, the basic food staple of Congo (Trèche and Massamba, 1995):

- Retting cassava tubers for 2 to 4 days, if it is done in water, or 2 to 3 days if done underground (Gami and Trèche, 1995).
- Removing the outer skin and fibre by decantation and draining.
- Rolling the paste on a wooden board.
- Forming the paste into a large ball wrapped in leaves.
- Cooking the ball in a large pot lined with straw or creepers for ½ to ¾ hour.
- Kneading the paste after cooling on a wooden board: the centre, partly cooked, is the *kifuwo*, which is used to prepare gruel.

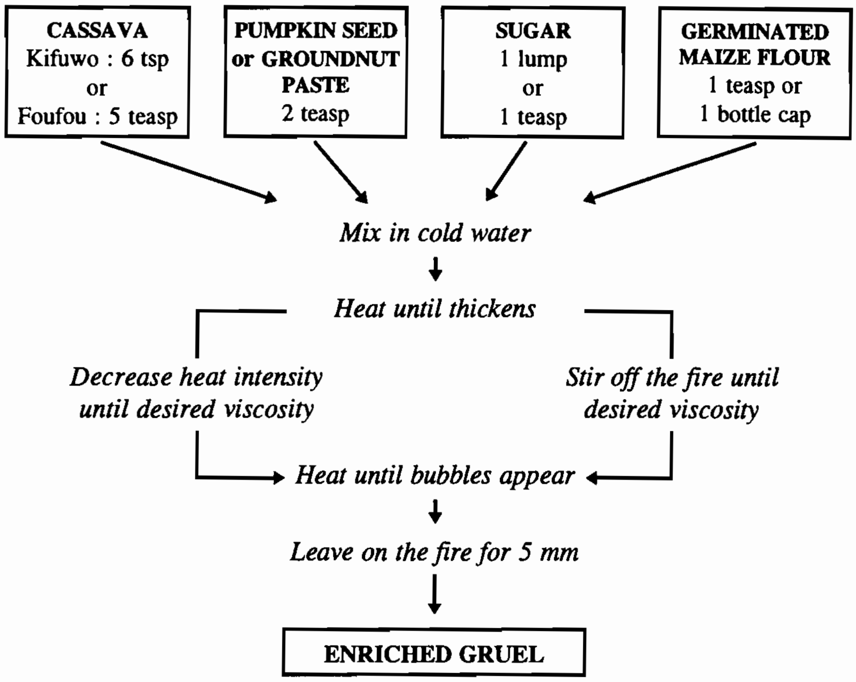


**Figure 1**
**Method for the preparation of enriched gruel**

*Preparation of germinated maize flour*

The method for preparing germinated maize flour is shown in Figure 2:

- Sorting and washing maize grains to remove those that cannot germinate.
- Soaking grains in a large amount of water for 48 hours and spreading them out on a clean moist cloth.
- Germinating at room temperature, away from the sun, until a 3-cm sprout is obtained (72 to 96 hours is required).
- Drying grains in the sun or inside the hut near the fire for three or four days.
- Removing the roots and sprouts after drying the grains.
- Crushing the grains with a mortar and then sieving if necessary.
- Storing flour in a closely sealed container away from humidity and pests.

The capacity of germinated maize flour to make gruel thinner can change depending on the variety, the duration of storage, and the method of germination; it is therefore necessary to increase or decrease the amount of germinated flour according to its characteristics and the desired consistency of the gruel.

*Preparation of groundnut and pumpkin-seed paste*

The techniques used traditionally to prepare groundnut or pumpkin paste are shown in Figure 3.

**MAIZE GRAINS**

*Sorting*
*Soaking in water for*
*2 days at room*
*Washing*
*Germination on a*
*damp fabric*

↓

**GERMINATED GRAINS**

*Drying in the sun*
*(3-7 days)*
*Removal of sprouts*
*Grinding*
*Sieving*

↓

**GERMINATED MAIZE FLOUR**

**Figure 2**
**Method for preparation of germinated maize flour (Louyat de Dibantsa, 1994)**

| PUMPKIN | GROUNDNUT |
| --- | --- |
| *Dehulling*<br>*Mild roasting*<br>*Millstone grinding* | *Dehulling*<br>*Roasting*<br>*Dehusking*<br>*Winnowing*<br>*Millstone grinding* |
| ↓ | ↓ |
| **PUMPKIN SEED PASTE** | **GROUNDNUT PASTE** |

**Figure 3**
**Traditional technology for processing pumpkin seeds and groundnuts (Louyat de Dibantsa, 1994)**

### 3.3 Method for cooking enriched gruel

The technique for cooking gruel has been adapted to customary practices of mothers on the Kukuya plateau:

- Mixing all the ingredients.
- Cooking the gruel gently or in a water-bath until bubbles appear on the surface.
- Leaving to cook for an additional 5 minutes.

## 4. EVALUATION

The operation started in January 1993. In November 1994, supervisory missions showed that the project was proceeding normally.

Evaluation of the intervention, whose design is given in detail elsewhere (Martin-Prével et al., 1999), comprised a process evaluation and an assessment of nutritional impact. The first evaluation in late 1993 showed that the nutritional message was correctly memorized and that the technology was assimilated (Louyat de Dibantsa, 1994).

## 5. CONCLUSION

One of the most important etiological factors of malnutrition on the Kukuya plateau is, undoubtedly, traditional complementary feeding practices which are inappropriate. The knowledge and attitude of mothers play an essential role in feeding practices.

The pilot intervention consisting of nutrition education and transfer of food technology was well received by the population of the Kukuya plateau. However, as with any innovation, there was some sociocultural inertia, even though the participation of extension workers originating from the plateau helped overcome some of the resistance encountered.

Behaviour change for improving the timing of complementary feeding encountered more difficulties than the adoption of the new gruel.

The sociocultural factors determining feeding practices must be taken into account to a greater extent in the future, to ensure the sustainability of technological innovation and nutrition education in this type of intervention.

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# Transfer of technology at household level: the experience of CREDESA at Pahou (Benin)

Aristide SAGBOHAN

## 1. INTRODUCTION

The Centre Régional pour le Développement et la Santé (CREDESA)[1] has been undertaking activities to promote primary health care since 1983. These activities involve research, training of health workers and services.

From the beginning, nutrition has had an important role. Nutrition activities were developed from 1986-1987 onwards, following a large study of the prevalence of protein-energy malnutrition and its determinants. The study showed a very high prevalence of acute malnutrition (10-15%), and of chronic malnutrition (25-30%) among children under five years of age. The rates are low during the first year, but gradually increase during the child's second and third years. The underlying factors are:

- poverty causing insufficient feeding and, consequently, a failure to meet energy and protein requirements;
- morbidity, primarily malaria and infections;
- bad mother-child relations;
- bad relations between spouses, and the husband consequently refusing to take part in supporting the family budget;
- lack of knowledge regarding feeding in vulnerable groups.

These observations made CREDESA aware of the need to focus on mothers' education, and to conduct development activities for agricultural production and income generation. In addition, two programmes were implemented: a programme to monitor the growth of children aged 0–5 years, and a programme for home-based nutritional rehabilitation of malnourished children.

For the implementation of these programmes, CREDESA adopted simple formulas, based on local foods, to promote improved feeding of young children.

[1] Regional centre for development and health.

## 2. METHODOLOGICAL APPROACH TO THE DEVELOPMENT OF COMPLEMENTARY FOODS

### 2.1 Surveys

The local availability of foods, and current complementary feeding practices were assessed through several surveys, including one on the determinants of protein-energy malnutrition, especially with regard to complementary feeding. The feasibility and local techniques for processing foods were also studied.

### 2.2 Development of the technology

After identifying the foods that could be used locally to feed children, CREDESA undertook the development of a technology that would preserve the nutritional value of foods. For example, simple flours and flour mixtures for preparing porridge, sauces, pastes, purées and stews were developed. The formulas were tested individually and collectively at mothers' level.

Local household measures were used to quantify the ingredients:

- the small tomato purée tin to measure flour
- tablespoons to measure liquids and oil
- the number of units of tomatoes, small fish, eggs, sweet potatoes, cassava, etc.
- the slice or piece of yam, meat, etc.
- the number of leaves, handfuls or bunches, for measuring vegetables.

The correlation between these local household units and weights allowed the estimation of the energy and protein content of the various food mixtures. A food composition table was used for the calculations, leading to the development of the complementary foods described in the next section.

## 3. COMPLEMENTARY FOODS

These are essentially porridges, sauces, pastes, purées and stews.

### 3.1 Porridge

There are two types of porridge: simple and enriched.

#### *Simple porridge*

It is prepared solely from cereals (maize, sorghum or rice) and consists of only one cereal flour. It is meant to be introduced between four and six months as a complement to breast milk. Simple porridge can be prepared with vegetable broth instead of water.

#### *Enriched porridge*

This porridge is made of a mixture of cereal flour and protein-rich foods. The protein foods are leguminous seeds (soya beans, beans, groundnuts), small dried fish, shrimps and eggs. Enriched porridge is a dual mixture of a cereal and a protein food, a triple mixture of two cereals and a protein food, or one cereal and two protein foods. It is given to children to complement breast milk from 6 months onwards, in the place of simple porridge. Table 1 shows the amounts of ingredients in household measures used in dual or triple mixtures and their weight equivalent.

**Table 1**
**Ingredients used in enriched porridge**

| Ingredients | Local measures | Weight equivalents |
|---|---|---|
| | | g |
| Cereal flour (maize, sorghum, rice) | 3 tomato purée tins | 120 |
| Bean flour | 1 tomato purée tin | 40 |
| Groundnut flour | 1 tomato purée tin | 40 |
| Fish meal | 2 tablespoons | 40 |
| Eggs | 1 large egg or 2 small | 60 |
| Soya bean flour | 1 tomato purée tin | 40 |

On the basis of this table, several mixtures can be obtained. For example:

- maize flour and soya bean flour for a dual mixture
- sorghum flour, rice flour and fish meal for a triple mixture
- maize flour, bean flour and an egg for a triple mixture.

If two different types of cereal flour are used, the mixture will be made of equal parts of the two cereal flours. The same applies to the use of two different protein foods.

The porridge is to be consumed by the child in one day. As with simple porridge, enriched porridge can be prepared with a vegetable broth. In some cases where a higher energy density is required, particularly for the rehabilitation of malnourished children, oil can be added. The quantity of oil to add depends on the energy level desired. One tablespoon of oil corresponds to 15 g.

### 3.2 Sauces and pastes

These are:

- simple fish sauces
- composite sauces made from fish and vegetables or fish enriched with leguminous seeds (soya beans, pumpkin seeds, West African locust beans, groundnuts, etc.).

Pastes often accompany the sauces and are prepared either from:

- simple or soya bean-enriched cereal flour
- root or tuber flour: cassava (gari), yam, and sweet potato
- boiled and crushed tubers.

The sauces and pastes are given to children from 6 months onwards, an age when mothers usually start to give them family food. Table 2 shows the ingredients used in a typical sauce. The pumpkin seeds can be replaced by soya bean flour or toasted groundnuts. The sauce can also be prepared without leafy vegetables.

### 3.3 Other recipes

Purées are either simple or enriched, and are based on beans or tubers (yams, sweet potatoes, cassava). Oil is always added. The ingredient used to enrich tuber purées is dried fish or eggs.

Stews are made from tubers and oil, and are always enriched with small fish, eggs or meat. Like the sauces and pastes, purées and stews are introduced from 6 months onwards. Table 2 shows the composition of a bean and a yam purée.

Cassava flour (gari), enriched with oil and fish or eggs, is introduced in children's diets during their second year.

**Table 2**
**Ingredients used to prepare sauces and purées**

| Ingredients | Local measures | Weight equivalents |
|---|---|---|
| | | g |
| **Used to prepare sauces** | | |
| Small fish or fish meal | 6 fish or 3 tablespoons | 60 |
| Crushed pumpkin seeds | 1 tomato purée tin | 40 |
| Leafy vegetables | 1 bunch | 200 |
| Palm oil | 2 tablespoons | 30 |
| Tomato | 1 medium tomato | 50 |
| Onion | 2 slices | 50 |
| Salt | 1 pinch | |
| Water | approx. ½ litre | |
| **Used to prepare bean and yam purées** | | |
| Bean purée | | |
| - dried beans | 1 tomato purée tin | 35 |
| - leafy vegetables | 1 handful | 50 |
| - fish meal | 1 tablespoon | 20 |
| - palm oil | 1 tablespoon | 15 |
| Yam purée | | |
| - yams | 1 slice | 150 |
| - palm oil | 1 tablespoon | 15 |

## 4. PROMOTION OF APPROPRIATE COMPLEMENTARY FEEDING

Promotion is done through individual and collective nutrition education sessions and cooking demonstrations.

Individual nutritional education sessions are held with mothers of children participating in the home-based nutritional rehabilitation programme. Collective sessions are held with women's groups that are set up spontaneously by the women themselves. Mothers who have seen malnourished children recover using only local foods are motivated to participate. They are eager to find out about these foods and obtain the recipes. Nutrition education sessions are held once or twice a month. Women are highly motivated to learn about the various food combinations that can be achieved with local foods. The recipes are acceptable, accessible and feasible.

## 5. NUTRITIONAL VALUE AND AVERAGE COST OF THE RECIPES

The energy and protein value of the different recipes and their cost are shown in Table 3. Mothers can give their children foods of high nutritional value at a small cost.

**Table 3**
**Nutritional value and cost of the recipes**

| **Recipes** | **Energy content** [a] | **Protein content** [a] | **Daily cost** [b] | |
|---|---|---|---|---|
| | kcal | g | CFAF | US$ |
| Simple porridge | 438 | 11 | 35 | 0.07 |
| Enriched porridge | 522-646 | 18-35 | 50 | 0.10 |
| Sauces | 700-800 | 27-49 | 75-100 | 0.15-0.20 |
| Pastes | 438 | 11 | 20 | 0.04 |
| Purées | 450-568 | 22-27 | 50 | 0.10 |

[a] *per 100 g of dry matter*
[b] *after the 1994 devaluation, US$ 1 ≈ CFA Francs 500.*

## 6. CONCLUSION

CREDESA's policy for feeding infants and young children is based on the following nutrition interventions that reach mothers and their children:

- encouraging breastfeeding for as long as possible;
- increasing local food production;
- promotion of appropriate complementary feeding of infants;
- promotion of balanced feeding through better use of local products, to diversify children's diets;

- emphasis on good knowledge of foods and combinations that meet nutritional requirements, and maintain a satisfactory nutritional status;
- promotion of good food hygiene.

The mothers compete amongst themselves in preparing the recipes proposed. They use them enthusiastically to feed their children and families appropriately.

# Introduction to education for health

Djamil BENBOUZID

There are many approaches aimed at promoting complementary feeding. Some of them will be presented in the following two papers.

First, we should agree on a common understanding of IEC (information, education, and communication), as it will provide the framework for the following papers. Activities grouped under this acronym belong to various fields that may be very different from one another. For example, education encompasses formal education, i.e. education in its broad sense, which refers to basic, in-service, and continuing education; and informal education, which is public education in general, where communication is used to convey messages. Although there is some confusion between the messages and the media, we should realize that the ultimate goal is social mobilization.

Today, terms like social marketing or social communication are widely used to attain a real social mobilization. We must avoid falling into the trap of terminology dialectic; the steps to follow in the communication planning process should lead to positive changes in feeding behaviours and practices - especially when it relates to young children during the complementary feeding period where foods other than breast milk are introduced.

In the previous papers reference was made to the importance of the complementary food users' level of education. These food users are the mothers themselves who should be, along with the fathers, the privileged audience. We will not mention the scientific and technical information that public or private economic operators need to have access to. This information needs, however, to be translated into understandable terms through appropriate labelling, and with references to standards and instructions that the public can read, whether informed or not.

To achieve the best public education in nutrition some key issues must be addressed, such as accessibility criteria and acceptability of new complementary feeding practices. It should be noted that the issues are very often of an anthropological nature, and strongly depend on the ecological, economic, and sociocultural environments. However, this does not mean that a long-term scientific observation is needed to elaborate a message targeted to a particular group.

We should tackle the problem by assuming that the "product" social communication will help us "sell" is appropriate, adequate, safe and that its use will enable the child to reach his growth potential in the best possible conditions. In other words, people need to understand that the goal is good nutritional status, and that this status is, at the same time, an indicator and an outcome of good health status.

From the analysis of feeding practices and changes that are needed, we will develop the tools for change. Such an analysis is a necessary step, particularly if we want to introduce new products, or replace inadequate or dangerous ones.

Thus, we should insist on some points which will be developed further on:

- audience: priority groups to target should be identified among the population;
- identification of elements that will cause resistance to change; they will be used for strategy development;
- elaboration of messages;
- planning media utilization;
- ensuring the sustainability of information campaigns.

Once a message has been received and understood, and has created a behavioural change, it is important to reinforce it by making it a habit. The best way to do this is, naturally, the school; studies show that the level of mothers' education has a significant impact on the household nutritional status. At the same time, nutrition education should be offered to those who have no access to school, within a time frame going far beyond the year 2000.

# Elaboration of a social communication strategy for improving complementary feeding practices

Lonna B. SHAFRITZ
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## 1. COMMUNICATION AS PART OF A COMPREHENSIVE PROGRAMME

Communication is an effective tool that has helped millions of people change their nutrition behaviour for the better. In Africa, USAID has collaborated with "improved weaning" programmes in many countries including: Burkina Faso, Cameroon, Ghana, Mali, Niger, Nigeria, Senegal, and Swaziland.

### 1.1 The complementary feeding programme: statement of the problem

As infants reach the age of 4–6 months, breast milk alone no longer provides enough nutrition for the growing child. Traditional supplements are dilute porridges made from the main staple (millet, maize or cassava) which are nutritionally inadequate and often harmful in terms of their bacterial load. If an energy dense food containing adequate levels of protein and micronutrients is not introduced at this time, the growth of children falters and the highest rates of morbidity and mortality from infections and nutritional diseases are observed.

### 1.2 The complementary feeding programme: choice of objectives

To respond to the problem, the programme should take a particular course of action:

- Encourage modification of current infant feeding behaviours associated with the introduction of complementary foods (e.g. encourage mothers to take active role in feeding 6-month-olds rather than waiting for child to demand food).
- Encourage modifications in home recipes for foods currently used for complementary feeding (e.g. add oil or sugar).
- Develop and promote new add-in products for home recipes (e.g. fried beancakes or toasted cowpea flour mix-in).
- Develop and promote new food products to be manufactured and distributed at community level.
- Develop and promote new food products to be manufactured and distributed through central supplier/distributors.

Or, any combination of the above.

In thinking about how to manage communication to support any one of these programmes, we need to begin with the understanding that in all of its breadth and range, communication is only one component of a multi-part programme that also includes research, service and product development, pricing, service delivery or product distribution, and evaluation (Figure 1).

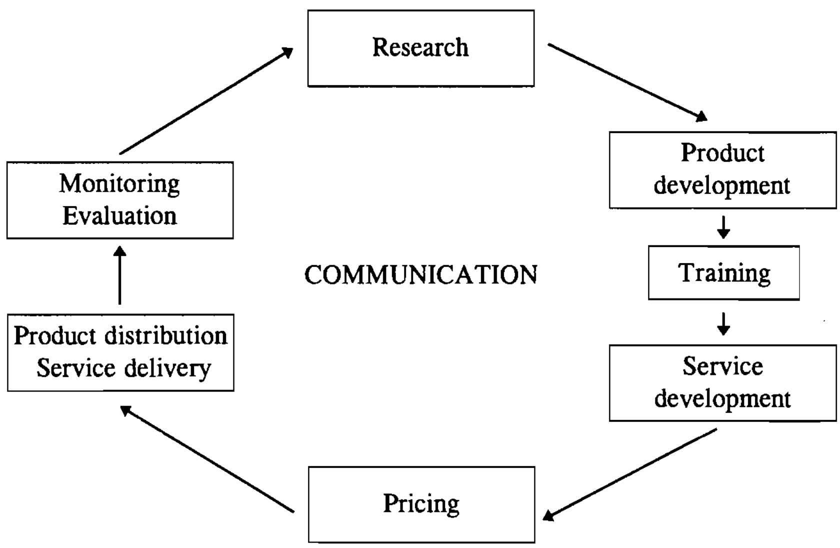


**Figure 1**
**Complementary feeding programme components**

### 1.3 Social marketing: the fundamental premise

One comprehensive and well developed framework for managing all the components of a nutrition behaviour change campaign is "social behaviour marketing" or "social marketing". Given a choice of products (or behaviours), people will choose the product (or perform the behaviour) that is most appealing for their own reasons. At the heart of social marketing is the premise that people have a continual choice among alternative behaviours that vary in the benefits they offer and the sacrifices they require. Examples of competing complementary feeding behaviours are given in Table 1.

For each alternative behaviour (e.g. spoon feeding of thick porridge vs. force-feeding of runny porridge), the consumer will weigh the perceived benefits against the costs in terms of economic assets, time, energy or psycho-social value. The objective is to guide the programme so that the behaviour endorsed is chosen by more people than the competing behaviours. How is this done?

The challenge for the programme designer is to put himself in the consumer's shoes to determine how the proposed behaviour could be more favourable than the competing alternatives. This process is built upon several stages of research conducted among the people expected to try the "new" behaviour.

**Table 1**
**Examples of competing complementary feeding behaviours**

| Desired Behaviour | Current Behaviour |
|---|---|
| Actively feeding child complementary foods at 6 months | Waiting until child feeds himself |
| Spoon feeding of thick porridge | Bottle- or force-feeding of runny porridge |
| Pounding peanuts, mashing green leaves, pouring oil, adding sugar to starchy staple | Feeding starchy staple alone |
| Buying complementary food product or ingredients | Buying anything else for same amount of money |
| Feeding complementary food 3–4 times a day | Doing anything else with the time |

At a glance, the process includes the following six steps: analysis, planning, testing, implementation, monitoring and feedback. All of these steps must be addressed in every social marketing programme and decisions must be made at each step.

## 2. DEFINING THE SOCIAL MARKETING PROGRAMME

Our goal in this section is to understand the necessary elements of a Social Marketing Programme. As discussed at the outset, there are several different options for improving complementary feeding behaviour at our disposal, including modification of behaviour or recipes and development of new products.

Following the first step in the social marketing framework, the selection of one approach over another should be based on a careful analysis of several kinds of information. USAID-supported weaning improvement programmes in several countries performed five research activities prior to formalizing their social marketing and communication strategy. These five research activities for determining complementary feeding programme approach are:

- Review existing information on feeding practices, diet and illness beliefs, and nutritional epidemiology (desk).
- Collect new cultural information to assist in the choice of candidate foods. At this time, it is important to determine the seasonal fluctuations in food availability and price (community rapid survey and focus groups).
- Formulate nutritionally adequate combinations of these foods using standard nutrition principles — consider traditional processing methods such as malting or fermenting — if appropriate (laboratory/kitchen).
- Engage mothers in developing new complementary-food recipes and practices using the food combinations and preparation techniques identified previously (community). This has been experimented in Indonesia within a project on nutrition communication for behavioural change on a fortified flour for young children and in Peru where a specially prepared food has been used during diarrhoea for nutrition rehabilitation.

- Implement household trials in which mothers are asked to prepare and feed new recipes to their children for a set period of time, and to provide feedback to the project team (community).

This assessment is the first stage of the social marketing process and it leads to setting a specific goal for the overall programme. It is only at this stage, when clear behavioural goals and programme objectives are defined, that the other programme components, shown in Figure 1, can be determined.

We will review the elements of a communication plan or "campaign". While following a defined time line, a communication campaign is not necessarily a short term event, but "an organized course of action, planned to achieve pre-defined objectives". The communication campaign plan contains answers to five key questions.

- What is the purpose of the communication campaign?
- To whom will the campaign be addressed?
- What message(s) will be delivered?
- What tone and manner will be used?
- What media will deliver the message(s)?

## 2.1 Purpose of the campaign

As stated earlier, the campaign's purpose is tied to, but distinct from, the overall programme goal. The overall programme goal is to introduce a new product or action but the goal of the communication campaign might be to teach, to encourage, to reassure, to frighten, to provoke, to entice, or in other ways influence or enable one of the groups of persons connected with use of the new complementary food or behaviour to perform the desired behaviour. For example, if the programme goal is to introduce an amylase-rich flour for the preparation of complementary foods, the communication goal could be to teach mothers how to prepare the flour and when to use it.

One way that programme planners decide what aspect to emphasize in their communication programme is by determining the "readiness" of the target audience to adopt the new behaviour. The behaviour adoption continuum[1] is:

Unaware of Problem

Aware, but not concerned (Problem doesn't apply to me)

Concerned, but don't know where to get information

Informed, but haven't tried yet (possibly afraid)

Tried once, not ready to totally adopt

Adopt new behaviour regularly

Willing to promote new behaviour to others.

[1] Lyra Srinivasan, world-renowned leader in Participatory Training, refers to this as a "resistance to change" continuum.

One way to think about the purpose of the communication campaign is to discover (through formative research) where most of the target audience is blocked on the adoption continuum and why — and then to think about whether a campaign can have a major impact on that behaviour. For instance, in Tanzania, in the project implemented for the promotion of the *kimea* flour, the blockage was situated in the first stages of the continuum. Complementary foods fortification was not considered by the mothers as a priority, even if the programme found a way to enrich this food.

If the target audience is constrained by a lack of appropriate skills and confidence to accept a new behaviour, mass communication (e.g. radio) may be able to do little more than direct them to an environment where they can receive the support and face-to-face counselling needed to overcome that barrier. On the other hand, if the target audience is "blocked" by a lack of appropriate concern about the issue, mass communication can dramatically address this barrier.

Therefore, the first step of planning the communication campaign is to define a specific purpose and/or objectives. These should be stated in terms of measurable results with a time frame.

For example, the objective may be to raise awareness of the new complementary food product from 0 to 40% within 12 months. Or, the objective may be to increase first trial of the endorsed behaviour from 15 to 30% within 6 months.

### 2.2. The target audience

The second strategy question requires a description of the "target audience" which should be clear and explicit rather than ambiguous and vague. It must be decided whether the message will be targeted at:

- the end user of the complementary food product or behaviour (e.g., the mother or child caretaker);
- a health provider or other intermediary (e.g. complementary food distributor);
- any individual or group that influences either of these (e.g., community leader, grandparent, father).

In many cases the behaviour change required at the household level to accept a new behaviour involves a joint decision. Therefore, during the formative research stage, it is important to examine who influences decision-making, what a mother or caretaker's authority is, and the influence of fathers and other local leaders. Selecting the correct target audience or audiences requires careful consideration. Once identified, it is important to develop vivid and specific target audience definitions (Table 2).

How many target audiences should you pursue? In many ways, this depends on the size of the programme budget. Military strategists know that limited resources have more impact when they are concentrated on one or two targets than when they are dispersed. Although it is not always easy to follow this advice, it makes sense to focus efforts where they will have the most impact.

Let's take the centre of the target as the "aiming point" — the very best possible target audience for the product or behaviour. If the media and messages selected are appropriate, the potential audience at that aiming point will receive more messages than anyone else.

What is important to notice about these segmentations is that they define the target audience in a real, living, vivid way, not only demographically but behaviourally and "psychologically" as well. Most of the information needed for this kind of segmentation comes from in-depth qualitative research.

**Table 2**
**Examples of targets**

| Vague target audience | More defined target audience |
|---|---|
| Mothers of 6–24 month-old children | First-time mothers with infants over 6 months who come to health post and seem willing to try advice |
| | Experienced mothers who have had at least one child die in the past five years following bouts of illness, particularly diarrhoea |
| | Peri-urban, working mothers who have tried one new complementary food product but stopped due to price constraints. |
| Fathers | First-time fathers who obey everything their elder brother or father tells them to do — seeking approval of the older generation and hoping to eventually be seen as a head of household |
| | Confident heads of household who are consulted for their wisdom and experience. |
| | Fathers who have lost at least one child due to illness and complications related to malnutrition. |

## 2.3. Key messages

The strongest messages include one of three key elements: barriers, consequences and benefits. Barriers could be physical barriers, emotional/psychological barriers or social/cultural barriers; benefits could be end-benefit or underlying benefits.

### *Barriers*

Barriers are obstacles or points of resistance to adoption of the product or behaviour. As described earlier, they often vary by the location of the target audience on the adoption continuum. They also vary considerably by culture, the nature of the "product" and other situational concerns. Barriers generally fall into these three categories.

### *Consequences*

Not accepting the new product or behaviour may have a variety of consequences for the target population. It is important to distinguish, again, where on the continuum the target audience falls — totally unaware of the consequences of not performing the specific feeding related behaviour, indifferent, or concerned.

Many consequence strategies use some form of fear or concern arousal — however, this is not likely to be the best choice for a complementary feeding programme. Concern or fear arousal works best when a single action change (such as getting an immunization) is required, rather than long term behaviour change, (such as feeding appropriate complementary food).

*Benefits*

Identifying the right key benefit for the communication efforts is not only important, it is a subtle task prone to misdirection.

As a first step it is extremely important to distinguish between an "attribute" of the product or behaviour and a "benefit". An attribute is a characteristic of the product or behaviour itself. In contrast, a benefit exists in the mind of the target audience. It is a perception. This is perhaps the most difficult distinction to make, however, the search for what we call the "end-benefit" or "underlying benefit" means moving beyond the obvious to identifying what is truly desired by the target audience.

What should the key message contain? Not everything all at once! If a message is to penetrate the target, it must be single-minded, sharp and clear. It must feature the most compelling benefit, barrier or consequence. Usually one key message per target audience will fit the purpose of the campaign (Table 3).

There is usually no "right" answer about which to choose, but there is usually a best choice to achieve the desired objective at a particular point in time.

### 2.4 Tone and manner

They must support the message. There are many options in selecting the tone that best conveys the message, but it's necessary to match the tone to the project's objectives. Manner or executional format, which also has numerous options, works with tone to create support for the key message (Table 4).

### 2.5 What media will deliver the message?

The key questions are: "What, where and under what circumstances will the target audience be most receptive to the message?" and "What media will deliver the message to the target at the lowest possible cost?"

When answering these questions the following issues should be considered:

- Resources: what is the available level of funds? What people and talents are available to work on the campaign? What production capabilities exist at a reasonable cost within the institution or country? Can outside capabilities be used?
- Efficiency: how many people in the target audience are likely to be reached by each of the possible media under consideration — radio, health workers, posters, and so forth. Each medium has specific benefits and disadvantages.
- Timing: will the media selection reach the target audience when they are most receptive: will it reach them when they are close to the decision point regarding the product or behaviour (e.g. place of purchase for a complementary food is critical).

Use of multiple media can be effective at reinforcing the message through exposure to more than one source. In sum, in selecting media, it's important to consider what the message does and says, the place, the timing and under what circumstances.

**Table 3**
**Examples of messages**

| Current practices | Beliefs | Desired behaviour | Message |
|---|---|---|---|
| The mother feeds her child only when he/she demands food | A child that does not ask for food is not hungry | Mothers should feed their child more frequently | Don't wait for the child to ask for food, feed him/her frequently |
| The mother feeds the child spicy family food from the $7^{th}$ day after birth | To fill his/her stomach<br>So that the child will sleep well | Mothers should breast-feed exclusively | Mothers, feed your child nothing but your own milk from the first day until 4–6 months |

**Table 4**
**Tone and manner work together to lend support to the message, giving it credibility, warmth, memorability**

| Tone | Manner |
|---|---|
| Serious | authority presenter (e.g. doctor, elderly person) |
| Factual | celebrity presenter (e.g. famous griot, singer) |
| Humorous | musical |
| Dramatic | slice of life |
| Light-hearted | testimonial |
| Empathetic | demonstration |
| Sophisticated | vignette |
| Folksy | jingle |

Examples of media commonly used for communicating nutrition messages are:

| MASS MEDIA | MEDIA FOR GROUP COMMUNICATION |
|---|---|
| radio | photographic prints |
| newspapers | flannel boards |
| posters | models |
| brochures | slides |
| flags | transparencies |
| stickers | blackboard |
| movie advertisements | video tape |
| calendars | films |
| billboards | games |
| pamphlets | wall boards |
| stamps | extension kits |
| television | drama |
| exhibits | |

Figure 2 shows possible channels for reaching the target audience through interpersonal communication.

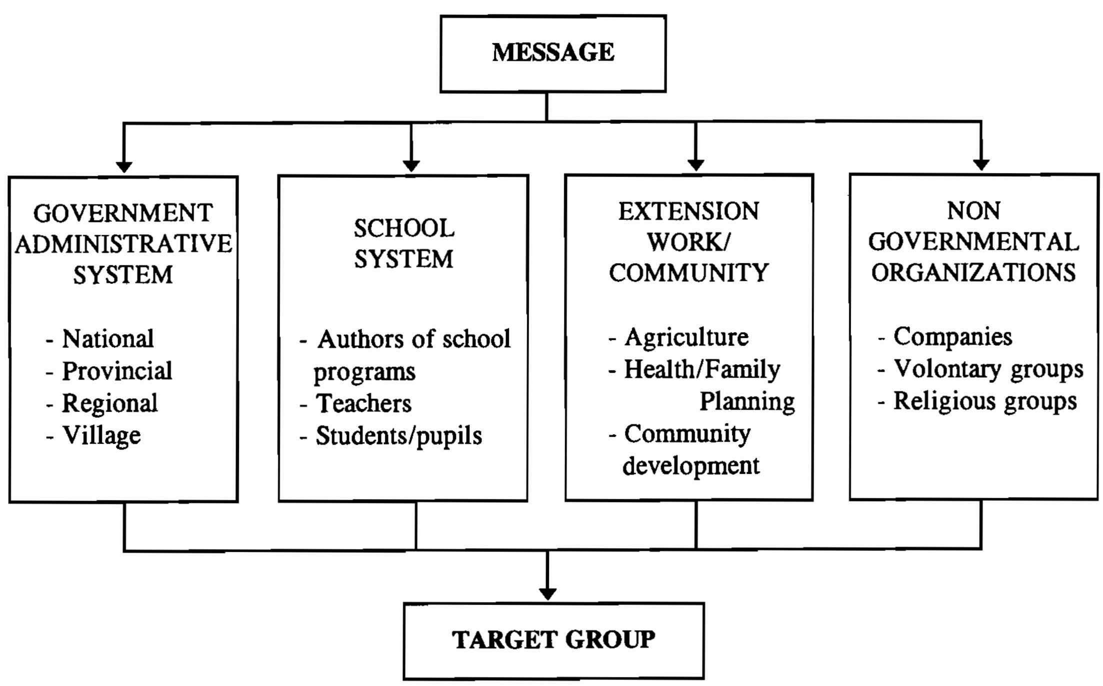


**Figure 2**
**Channels of interpersonal communication**

As an example, the experience of the Cameroon/CARE project (1989) is interesting. The goal was to change feeding practices of infants in a remote area where the prevalence of malnutrition was very high. Since radio and printed material did not reach mothers in the area, the project was implemented by community workers. They were asked to conduct a nutrition education campaign based on focus group discussions, cooking demonstrations and growth monitoring activities with individual counselling and regular visits. An impact evaluation carried out in 1989 showed that the proportion of infants who participated in growth monitoring activities in the 16 villages increased from 13 to 44% within 6 months. The number of mothers who participated in nutrition education sessions was multiplied by eight and reached 50% of all mothers. Moreover, mothers of the intervention area tended to give enriched porridge and fruits more often than those of the control area.

## 3. CONCLUSION

Before launching the communication campaign, the proposed programme should be pretested with a meaningful sample of the intended audience and necessary modifications made. A means of gathering information along the way - monitoring - should also be built in and plans made to measure impact at the end of this specific campaign which will feed back into future programmes.

How long will this process take? In fact, following a few months of intense formative research and product or behavioural trials, a team of managers can probably work out most of the answers in a few weeks.

Changing the behaviour of others is enormously complex, and no single communication tool will suffice. Different tools will be required to address different audiences and to achieve different objectives at different points in time.

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# Multimedia health promotion policies

Bernard SURUGUE

## 1. INTRODUCTION

Ethical considerations have to be taken into account when promoting choices that affect human health. There are many examples showing the negative effects of badly utilized information or lack of information in all areas of activity, but this is particularly serious when the feeding and health of young children are at stake. This is why one cannot be too careful in avoiding any deviation or inexpedient use of information. This implies awareness of declared commitment to public interest.

The task of any person responsible for health promotion is to ensure appropriate contacts between the producers of information and the consumers of that information. The promoter's role is to derive the maximum benefit from Science and Technology in order to make them available to those in need. He must implement and manage appropriate mechanisms capable of:

- facilitating the circulation of information flows
- maintaining the quality of information
- monitoring the use made of that information.

This mediation is geared by the diversity of the objectives to be achieved: the state-of-the-art knowledge on the subject to be promoted, the target audience, human, technical and financial resources, and the institutional, economic and cultural elements of the operational framework envisaged.

Implementing a multimedia promotion mechanism and initiating promotion activities are strategic steps governed by political choices and decisions. The overall mechanism presented includes four successive interdependent stages. Its aim is to help define and reactivate health promotion policies adapted to various scales of intervention.

The objective is to consider ways of implementing multimedia health promotion policies, to ensure the gradual and harmonious transition from milk-based feeding to family food for young children between 6 and 24 months of age. Multimedia means the coordinated use of all means and all appropriate aids according to the scale of intervention.

## 2. FOUR STAGES OF THE MULTIMEDIA HEALTH PROMOTION MECHANISM

### 2.1 Stage 1: identification and analysis of multimedia health promotion needs

The stage of identifying and analysing health promotion needs is similar to a market survey. The objective is to adapt the updated state of the art knowledge to the needs of the users. The goals of actions at this level are the following:

- Define and prepare the messages to be promoted.
- Ensure regular follow-up of the progress made and current status.
- Identify, together with the population groups involved, specific needs and define appropriate methods and tools able to meet them.
- Explore new methods and relevant innovative techniques likely to enhance the impact of health promotion activities.
- Identify the public's information needs through available media.
- Propose practical updated manuals for training and education.
- Mobilize human, technical and financial resources.
- Involve communication professionals to a greater degree in health promotion activities.

The state-of-the-art knowledge is in the hands of the scientific and technical community that has expertise in a particular subject, in this case experts in complementary feeding of young children. It is the core of the mechanism around which the various health promotion activities can be based. In promoting complementary feeding practices, a first step could be research.

*Promotion of research*

The scientific and technical community needs to exchange, share, and compare any information useful for improving knowledge and producing results that can be promoted among the users. The permanent establishment of a scientific and technical information system would help to speed up communication among experts.

In the area of complementary feeding there is a need for scientific and technical information on appropriate technologies for producing complementary foods, on the nutritional status of infants and young children, feeding practices, food acceptability criteria, traditional agricultural and cooking practices, and food safety. There is also a need for information on the cultural, linguistic and social criteria for the implementation of nutrition promotion programmes.

*Promotion of health education and vocational training*

Although young children aged 6 to 24 months are the final users in a campaign to promote their feeding, it is true that they have limited — but not negligible — ways of expressing or showing whether or not they are satisfied. Their mothers or caregivers are naturally the first ones to care for them and give them a balanced diet. The promotion of awareness among mothers and future mothers and the education of young girls are obvious priorities in any integrated health promotion programme that covers, *inter alia*, the promotion of breastfeeding and of complementary feeding with all its practical implications. The proposed mechanism will include promoting awareness in schools and the media, as well as among the public, especially young girls and women.

Training needs have been identified with respect to health workers, including those at the peripheral level, persons working in sectors related to agricultural and food production, cooperative groups, community leaders, educators, etc. Specific approaches can cover these needs through action affecting working conditions and vocational training.

### *Political promotion*

One priority which has been expressed is the need to integrate the most needy sectors of the population in strategies to promote complementary feeding practices and to develop mechanisms to deal with emergency situations.

By definition, health promotion strategies are intersectoral. According to the situation in each country, the implementation of strategies to promote complementary feeding practices will involve several ministries and therefore will require the identification of coordination mechanisms within each technical ministry involved.

### *Promotion of standards and guidelines*

In the first stage, it is necessary to consolidate the regulations; in other words, to reach the institutions and persons responsible for legislation, production, monitoring, marketing and promoting the recommended products and methods.

## 2.2 Stage 2: access to knowledge

Access to knowledge is a claim that can be compared to a right. It determines social and economic progress and is closely linked to the level of development in each country. Recently there has been a marked increase in access to information, including in some of the least developed countries. This is taking place in conjunction with the advance of democracy, the growing popularity of computers, office automation and the media; it is the result of telecommunications that transcend political frontiers and cultural divides. The goals at this level are the following:

- Identify sources of useful information related to the priorities defined during Stage 1.
- Select and consolidate the permanently updated mass of useful information.
- Set up networks and sites where the information can be consulted.
- Make the information sources available to the greatest possible number of persons.

## 2.3 Stage 3: multimedia production

At this stage, it is necessary to develop tools that are specifically adapted to the target groups identified. The perception of the target groups must be taken into account. Feeding habits and practices, the child's taste, cultural and religious customs, agricultural traditions, knowledge of traditional practitioners, etc. have to be respected and taken into account because to a large extent they govern the potential impact of any health promotion measure.

A spirit of creativity must be present, both in the choice of media, and in the methods of analysing and processing the content of the information. These must be at the same time effective, suitable, accessible and accepted by potential users, and coordinated according to promotional campaign logic. Actions at this level have the following objectives:

- Produce multimedia material: press releases, radio and television programmes, films, video tapes, exhibitions, posters, brochures, leaflets, databases and banks, guidelines, handbooks, etc.
- Prepare multimedia promotion campaigns.
- Encourage individual, local and domestic production.

### 2.4 Stage 4: dissemination, promotion, public relations

This stage corresponds to the launching of the activities defined in Stage 1 and developed during Stages 2 and 3. This strategic phase is determined according to the different levels of intervention envisaged: international bodies, governments (Ministries of health, education, communication, agriculture, rural development, social affairs, etc.), mayors, village chiefs, community associations, health centres, schools, etc.

The objective of this stage is to achieve the objectives identified in Stage 1 by using the prescribed tools in a multimedia approach involving the available means of communication in the circumstances: satellite networks, traditional plays, schools, local radio, etc.

## 3. PUBLIC TARGETED

In communication terms, the most relevant operational "unit" for a promotion campaign are the mothers of children aged 6 to 24 months. The infants as the beneficiaries, and the harmonious and healthy transition from milk-based feeding to family food is the object of the campaign. In order to achieve these objectives satisfactorily, various groups of intermediaries have to be taken into account *inter alia*. For example, in the case of international public bodies, Member States will be the primary intermediaries through their various governing bodies. It will then be necessary to define an ethical, legislative, scientific and technical reference framework and, subsequently, encourage Member States to identify their health promotion needs as well as ways of meeting them.

At the State level, the objective is to define and implement health promotion policies and strategies through intersectoral coordination mechanisms that involve the following: public health, social affairs, education, agriculture, rural development, communication, and decentralization. These policies must then be relayed through the various groups of intermediaries until they reach the outermost edges of the provinces in each country, that is, the general public.

Special approaches can encourage common interests among communities, for example:

- donors can coordinate the mobilization of human, technical, technological and financial resources;
- scientific and technical resources can encourage tackling new challenges;
- teachers and educators can produce more effective teaching materials;
- local authorities;
- traditional and religious authorities;
- associations, especially women's groups.

## 4. COORDINATION

The mechanism as a whole is devised to adapt the messages for different audiences. Ongoing coordination is essential, together with an assessment of the measures put into effect. The latter aspect is probably the most difficult to carry out correctly because it is not easy to measure impact in the area of communication, promotion and information. The effects of a promotion campaign may only be visible several months or even several years later, although they are always difficult to measure and *a fortiori* to quantify. The assessment aspect is shown in Figure 1 as feedback from the mechanism as a whole. Even if this function is difficult to implement, particularly useful indications can be provided through studies and surveys of samples of the relevant target group. By analysing them, it will be possible to adapt new promotion strategies as required.

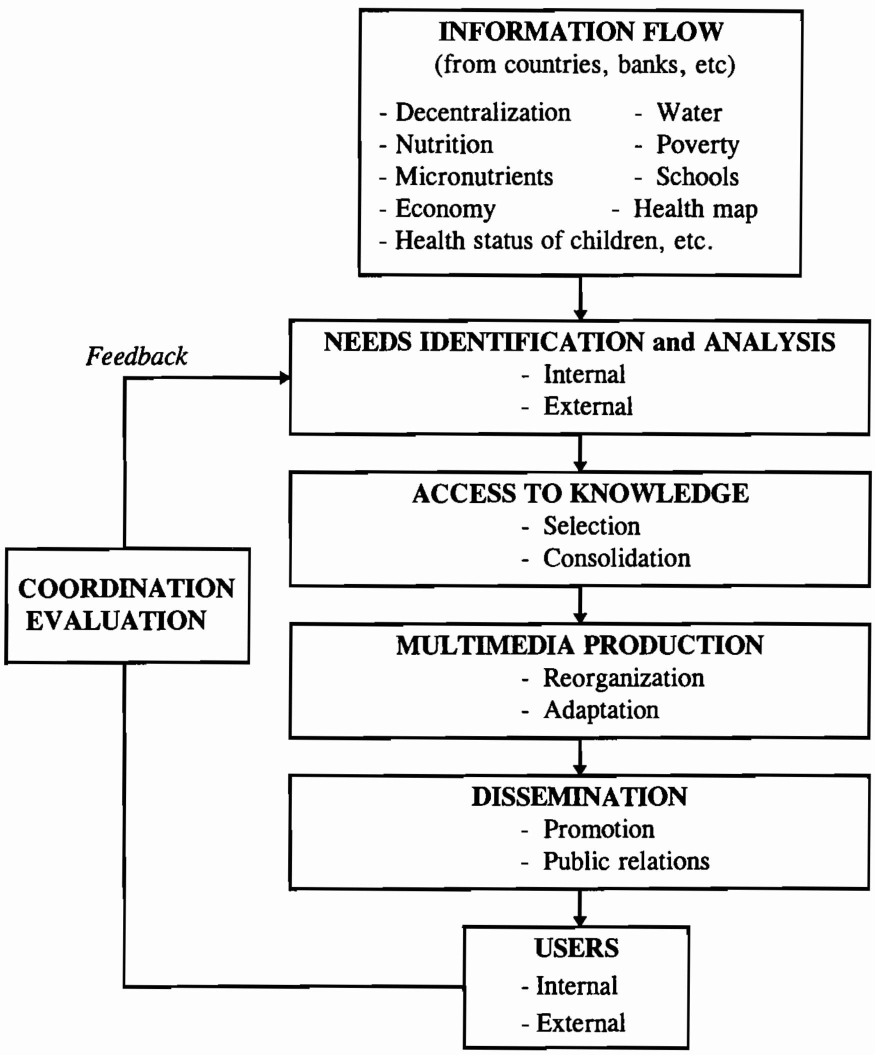


**Figure 1**
**Multimedia health promotion mechanism**

One immediate measure suggested is to set up an on-line base of factual, selective and accessible data. Such a tool would help to considerably strengthen the promotion of balanced complementary feeding practices for young children.

In the first instance, this data bank could contain scientific and technical information on the nutrient composition of products used to produce complementary foods for children aged 6 to 24 months. This type of information should be easy and quick to access for experts in each country. This basic information could then be reprocessed and completed in each country, and used by local communities where it would be widely disseminated.

If efforts are made to respond better to one of the needs of infants and young children, this initiative could combine and possibly integrate responses to other essential needs, such as malaria, measles, diarrhoeal diseases, vaccination, etc.

## 5. CONCLUSION

This rapid overview shows that there is an urgent need at all levels for multimedia health promotion in relation to complementary feeding practices. Depending on the intervention scale and on the country concerned, work should be carried out to elaborate appropriate policies on a case-by-case basis.

# Impact evaluation of a programme to improve complementary feeding practices: study design and constraints

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## 1. INTRODUCTION

The evaluation of a nutrition programme is an essential element for the orientation of future activities. Here we deal with the evaluation of the impact of a nutrition programme or, in other words, with an evaluation that seeks to measure the effects of the programme, with respect to its ultimate objective, which should be the improvement of the nutritional status of the target population. This impact evaluation must be distinguished from the process evaluation of a programme, which consists of seeing whether the programme has in fact been implemented, by measuring the outreach of the strategy among the population, identifying and analysing the main sources of resistance, etc. Naturally an impact evaluation does not, and should not, exclude the need for a process evaluation.

In the first part of this paper we will review the methodological basis for assessing impact in the area of nutrition. Interventions related to protein-energy malnutrition will be considered although the methodological principles developed are valid for impact studies of other forms of malnutrition. However, we have deliberately limited our task to cross-sectional evaluation, which is the most appropriate for assessing the impact of public health programmes. Longitudinal methods, although being more precise and more complex to implement, are directed more towards research-type evaluation.

In the second part, as an illustration, we will describe designs used in Congo to assess two strategies for the improvement of complementary feeding practices.

## 2. METHODOLOGICAL BASIS

### 2.1 General principles

The evaluation of impact of a nutrition programme cannot be simply restricted to a description of the nutritional status of the population that benefited from the intervention. It is necessary to compare the nutritional status of one or more control group(s) who may belong to another population, or be the same population before action was taken, or both types simultaneously.
This comparison must ultimately provide an answer to the following question: "*What difference, or what part of the difference between the groups, can be attributed to the*

*intervention?*" Answering this question is not easy. The degree of plausibility, with which a noted difference can be attributed to the programme, is high if potential confounding factors can be eliminated or at least if their effects can be measured and therefore taken into account in the analysis. The first and essential corollary is that the impact evaluation must be planned and designed at the same time as the programme itself.

Prior consideration is thus necessary, not only to define the study design and the variables to be used to control for confounding factors, but also to choose relevant indicators of results, determine the sample size and method of sampling, establish the budget required, etc. We shall review these aspects from a theoretical point of view, but in practice a feasibility study will, in many instances, be needed to define the conditions under which an impact evaluation can be carried out with a reasonable chance of succeeding.

## 2.2 Confounding factors

A confounding factor is any element that affects the nutritional status of the target population and which, although not part of the programme, is linked to its implementation. This is the major obstacle to be avoided, or at least kept under control, in impact evaluations.

The following is a typical example: if the programme consists of supplementary feeding of children, but participation in the programme also leads to better access to care, as far as the children's growth is concerned it will be impossible to distinguish between the effects of the supplements and of the care. The modification in access to care is thus a confounding factor when assessing the impact of supplementary feeding.

This example is particularly illustrative but, in practice, confounding factors can be much more difficult to identify. It is therefore necessary to systematically collect a certain number of variables that are known to affect nutritional status, and to examine whether their level is identical either with or without the programme. There are four main sources of confounding:

- non-comparability of the groups
- information bias
- time effects
- regression toward the mean.

### *Non-comparability of groups*

For an impact evaluation, the ideal is for the groups compared to be as similar as possible with respect to all the factors that may affect their nutritional status, the only difference being their participation in the programme. Any difference occurring between the groups can then be attributed to the programme. It is thus necessary to carefully study the comparability of the groups on the basis of potential confounding factors.

Three levels can be distinguished:

- community: health facilities, access to drinking water and electricity, and overall environment;
- family: size, income, educational level, feeding practices and all other socioeconomic variables;
- individual: age, gender, vaccination status and other health information.

In practice, the groups are never entirely comparable due to the, all too often, restricted choices of the intervention and control groups and to the ethical and political reasons that motivate this choice. Thus, it is important to know and measure the existing differences between the groups, and follow their development during the course of the programme. It is then possible to take these differences into account when analysing the results by using statistical adjustment techniques. These techniques, however, lead to a decrease in the statistical power of the comparisons, underlining therefore the need to select groups that are as comparable as possible from the outset.

Even more important is to identify and avoid any programme-related systematic cause of differences between the groups, such as for example, any self-selection phenomenon, non-random distribution of the lost to follow-up subjects or an age effect when making before-and-after comparisons. These are real confounding factors which are the source of differences between the groups; thus it will be impossible to take them into account.

### *Information bias*

This is the result of a difference that does not exist in the study groups but in the way information on each group was collected. The simple fact of using a methodology that is not strictly identical for collecting information in the different groups, different teams of researchers, or non-standardized measuring methods, is enough to create an artificial difference between the groups in the results. As a result, there will be some confounding with the effects of the intervention.

### *Time effects*

Like almost every other health phenomenon, the nutritional status of the population is subject to the effects of time (to be distinguished from the effects of age). When measures are taken at different times, it may be difficult to know whether the variations noted are related to the effect of time or to the intervention.

There are mainly two types of time effects:

- secular trend: change in the nutritional status of a population, which is usually moderate unless there are important external events (armed conflicts, for example);
- seasonal trend: cyclical change in the nutritional status, whose effects on the most vulnerable groups can be significant.

### *Regression toward the mean*

According to this phenomenon, when subjects are selected from the ends of a distribution, the value of the variable measured among these subjects tends to move spontaneously towards the central value when a second measurement is taken. The explanation of this phenomenon is that some of the individuals selected have been chosen at random, following fluctuations in the variable or mistakes in measurement. This, however, has little chance of reoccurring for the same individual in a second measurement.

It should be noted that this phenomenon is only a handicap for an impact evaluation if the programme is directed at an individual and not a population level and concerns individuals selected for extreme values of their nutritional indices.

### *Note*

In describing the various confounding factors, we have referred to cases in which these factors lead to incorrectly attributing an observed difference to the intervention. The reverse is equally possible and the confounding factor then makes it impossible to observe a difference that nevertheless exists. The risk of drawing an incorrect conclusion is just as serious in both cases.

## 2.3 Study design

The best design is a randomized double blind experiment. If well conducted, this yields the most conclusive results regarding the effects of an intervention on the nutritional status of the target population; it is then possible to exert maximum control over confounding factors. But in practice it cannot be carried out at a public health programme level. In addition, a random experiment is practically impossible for many reasons, especially ethical and political reasons, and so it is only possible to use so-called "quasi-experimental" designs.

Here we will discuss the main feasible types of design, and will briefly describe their advantages and limitations. Variations exist or could be invented for each type, but we will refer to the general principle. As we have already suggested, impact evaluation compares an intervention group with a control group. The comparison may be in space ("with vs without programme"), in time ("before-and-after"), or both at once (combined designs, which are the most effective but also the most difficult to carry out) as shown in Figure 1.

### *"With vs without programme"*

Intervention is among the "A" population. After a certain time, depending on the type of programme, the nutritional status of the target group of the "A" population is compared to that of the "B" population, which is not submitted to the intervention.

As described above, it is important that groups A and B are as comparable as possible. However, even if this level of comparability is respected for all the factors affecting nutritional status, a difference noted between the groups cannot with certainty be attributed to the programme because there is no proof that this difference did not exist prior to the study.

Another problem of this type of study design is the choice of the population sector as subject of the intervention. At this level, ethical or political constraints are often an obstacle to valid comparisons. In addition, in order to ensure comparability, it is desirable that population sectors are geographically close. The proximity of the intervention and control groups is, however, the source of the so-called "contamination" effect, i.e. the subjects in the control zone can be contaminated by the programme. This makes it difficult to identify clearly participants and non-participants in a programme. Moreover, this type of study design is the most susceptible to self-selection bias.

### *"Before-and-after"*

The nutritional status of the target group in the A population is first measured at baseline, just before the programme starts, and again after a certain time. This type of design aims at eliminating comparison problems by using the population in the programme as a control group.

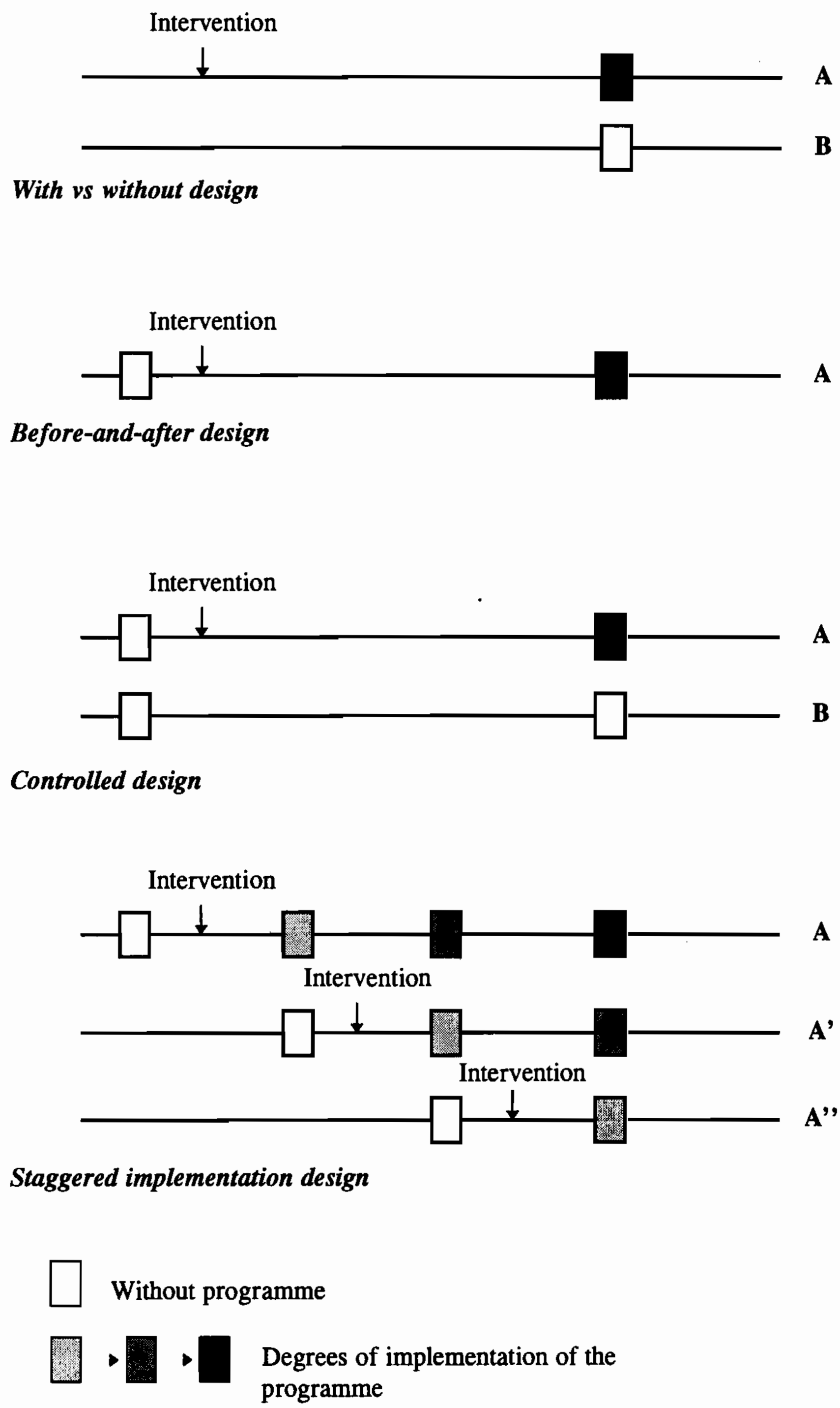


**Figure 1**
**Types of study design for impact evaluation**

This design is, however, subject to the effects of time, which can bias the study in a number of ways:

- When the trend in nutritional status is assessed for the same children before and after the programme, the age effect comes into play: for all anthropometric indicators the low values in comparison with the standard reference are more or less frequent depending on age, irrespective of any programme.
- If the programme only concerns a part of the population, generally chosen by extreme anthropometric index values, regression toward the mean occurs.
- Finally, even when evaluation concerns all age groups in the population before and after the programme, there is at least the effect of secular trend. The effect may be mitigated if the duration of the study is short. It can also be estimated indirectly (data on mortality or morbidity, or growth monitoring, vaccination rates, etc.), but such an estimate will always be partial in the absence of a control group.

### *Combination of designs*

Its objective is to make a comparison, both in terms of space and time, to avoid the disadvantages inherent in the two types.

The "controlled design" consists of measuring the nutritional status of the target population before and after the programme, both within the intervention group and the control group. The before-and-after comparison in the latter group permits an estimate of the secular trend and consequently a correction of the before-and-after comparison in the intervention group. In such a design, if the comparability of the two groups is verified before the programme begins and then checked throughout its implementation, it may be assumed that the programme is responsible for the improvement of the nutritional status. In addition, a number of confounding factors can easily be identified and their effects measured. This can sometimes be taken into account in the analysis, but it reduces the number of degrees of freedom, and so decreases the statistical power of the comparisons. This "controlled design" is methodologically the most effective. On the other hand, the choice of the population control group is difficult. In addition to the problems mentioned in connection with the simple "with vs without programme" design concerning geographical selection, it has to be recognized, at the ethical and political level, that a particular sector of the population will remain outside the programme for a certain period of time to allow the changes in the nutritional status of the intervention group to be assessed.

The "staggered implementation" design offers a compromise to the acceptability problems mentioned above. Instead of leaving a population sector without any programme for a long period of time, the programme is implemented gradually, community by community, within a more acceptable delay. This allows on the one hand a "with vs without programme" comparison and an estimate of the secular trend, on the other hand, by successively measuring those entering the programme (who are the control group) and even an estimate of the "dose-response relationship". However, the analysis is more complex and less powerful than the "controlled" design.

In addition, comparability is more difficult to achieve and to control in the successive communities. Finally, and above all, the order in which the communities are included in the study is often linked to problems of accessibility (geographic, cultural, etc.) which are probably not independent of nutritional risks. This can therefore introduce a confounding factor.

### *Note*

Until now we have considered that study designs are directed at communities. However, they can be designed for individuals, which raises additional obstacles. For example, the self-selection bias becomes much more important, and often cannot even be assessed. The problem of non-random distribution of the lost to follow-up cases also becomes difficult to control. Finally, there is an additional non-negligible source of bias related to missclassification of individuals in the study groups.

## 2.4 Outcome indicators

In the vast majority of cases, these are anthropometric indices and we will simply explain certain principles for their use in impact evaluations. Among the available indices (weight-for-age, weight-for-height, height-for-age, mid-upper-arm-circumference, etc.), the choice of an outcome indicator will depend on:

- the objectives of the programme and of the evaluation;
- the basic situation (which index is already at a low level);
- the duration of the study (with respect to the sensitivity of the indices);
- the technical and financial resources for the collection of data.

As far as the expression of the indices is concerned, one should bear the following in mind:

- growth velocities are usually more responsive to intervention than gross anthropometric indices;
- expression of indices in centiles or Z-scores is standardized on a reference population but not on age;
- the mean indices are less responsive to errors (in measurement, estimates of age, etc.), and more powerful for comparisons than the percentage of subjects below a threshold value;
- a percentage, on the other hand, is more relevant when making health policy decisions.

## 2.5 Sampling

The most important aspect is choosing the age groups for the impact evaluation. Age groups with the greatest chance of responding to the intervention should be naturally chosen, and not necessarily the whole group subject to the programme. Extending the study group beyond the sensitive age groups will weaken the evaluation and could attenuate or conceal the real effect; on the other hand, a smaller age group would be less powerful.

The sample size is another important factor. Although there are methods of calculation which can determine the number of subjects required, they will not be covered here. We would simply like to stress that such a calculation implies knowing or estimating a certain number of parameters, and making some hypotheses about the expected results. This is often an additional reason for carrying out a prior feasibility study.

The role of sample selection in the majority of confounding factors mentioned above (comparability of groups, age effects, regression toward the mean, classification errors) has to be taken into account.

### 2.6 Conclusion: choice, validity, interpretation

Any evaluation of the impact of a nutritional programme therefore requires a well prepared study design. Choices and decisions have to be made and these must be considered carefully according to the objectives of the programme, the resources available, field considerations, basic data, etc. One might decide not to go forward with the impact evaluation when it is impossible to elaborate an evaluation system that has a reasonable chance of success.

In any event, if one decides to go forward, implementation of a design that is effective *a priori* does not guarantee any conclusions that may be drawn. It will always be necessary to verify that, despite all the precautions taken, confounding factors have not slipped into the study. This is essential for interpreting the results and for the internal validity of the evaluation, i.e. for ensuring that what has been measured does actually represent the situation in the groups concerned.

The problem of external validity has to be considered, namely to what extent the conclusions of the impact evaluation may apply to other population groups. This is primarily a problem of representativeness, and it is also necessary to know whether the programme evaluated can be replicated easily for other population groups. In this connection, it should be emphasized that special management of a programme at the level of a pilot zone will limit the external validity of the evaluation.

## 3. IMPACT EVALUATION OF STRATEGIES TO IMPROVE COMPLEMENTARY FEEDING IN CONGO

In Congo, two strategies to improve complementary feeding of young children were set up in test zones: one concerned urban areas and the other rural areas. The work was initiated by the Laboratoire d'Etudes sur la Nutrition et l'Alimentation[1] of the DGRST-Orstom Centre[2] in Brazzaville, in close cooperation with the family health department, and as part of a project to support nutrition activities, financed by the French cooperation fund and administered by UNICEF.

We will not provide figures for the results of the impact evaluation (in any case it has not yet been concluded), but we will try to illustrate the various methodologic problems described in the first part.

### 3.1 Brief description of the two strategies

#### *The urban strategy*

The urban strategy is directed at families who nearly always give their infants a complementary food consisting of a commercial flour for infants. The pilot programme is based on the promotion and marketing of "Vitafort", a flour for infants and young children

[1] Laboratory of nutrition and food studies.

[2] DGRST: Department for scientific and technological research. Orstom was renamed Institut de Recherche pour le Développement in 1999.

(Tchibindat and Trèche, 1999) in Poto-poto, one of the oldest urban areas of Brazzaville. Its purchase price, for comparable nutritional quality, is three to five times less than that of imported flour for infants. Moreover, the price per unit of energy is the same as that of the fermented maize dough used locally to prepare traditional porridge. The intervention zone was defined on the basis of the limits of the health districts corresponding to two Centres de Santé Intégrés (CSI)[3] in the new Programme National de Développement Sanitaire (PNDS)[4]. The intervention strategy includes action to promote awareness of complementary feeding problems among the staff of health centres, especially those in charge of monitoring growth. This action has been duplicated with the mothers and includes the promotion of breastfeeding, information on recommended age of introduction of complementary food and on Vitafort flour.

*The rural strategy*

In the rural environment, the intervention zone comprises the Kukuya plateau, 400 km north of Brazzaville. Details of this programme are described elsewhere (Moukolo *et al.*, 1999). It is based on the training of *"nutritional education and food technology extension workers"* recruited locally, whose essential task is to act as a relay between health structures and the community. Their role includes nutrition education, mainly aimed at promoting breastfeeding and correct age at introduction of complementary food, as well as teaching food technology that allows protein-rich porridges of high energy density to be prepared from local foods.

### 3.2 Evaluation methods: study design

An identical design was chosen to evaluate these two intervention strategies in urban and rural areas and it included the following:

- A "process" evaluation, involving observation and analysis of strategy outreach among the target population. The indicators adopted related to the extent of information on the improved complementary foods proposed, their reputation, and rate of utilisation, changes in complementary feeding of young children, etc. The method used was to carry out successive cross-sectional surveys on representative samples of the population subject to the programme;
- An impact evaluation of the nutritional status of children subject to the programme. This is a "controlled" type of design as described above. For each zone of intervention (urban or rural), a control zone was defined in which characteristics that might affect nutritional status were as comparable as possible. So-called "baseline surveys" were carried out in the intervention zones and in the control zones, to assess the nutritional situation at the beginning and to study the comparability of the groups. Repeating identical surveys using an identical methodology in all the zones two years after the programme is implemented, will make it possible to assess whether the trend in the nutritional situation in the intervention zone differs from that in the control zone. Furthermore, the cross-sectional surveys carried out to evaluate the process will show whether comparability between the groups has been maintained.

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[3] Integrated health centres.

[4] National health development programme

### 3.3 Practical aspects

Once the design of the study has been established, all the problems of choice of indicators and potentially confounding variables, definition of the target population and samples, delimitation of the intervention and control zones still need to be solved.

Before reviewing these aspects, it should be pointed out that many nutritional studies have been carried out in Congo over the past five years, both in Brazzaville and in rural areas. These provided the basic data necessary to set up our programme which allowed us to limit our field surveys when carrying out our feasibility study.

*Choice of indicators*

The essential aspect of malnutrition in Congo is the fairly high prevalence of growth retardation. The main hypothesis underpinning our study is that this is to a large extent due to inappropriate complementary feeding practices and to the low energy density of porridge. It was thus logical that the main indicator of programme outcome should be the anthropometric height-for-age index. Weight is also measured to estimate the possible effects of the programme on other indicators, for example, wasting. It was the height-for-age index that was chosen, however, when calculating the number of subjects required.

As mentioned above, this index should preferably be expressed in Z-scores. The mean value of the index in the different groups and the percentage of subjects below two standard deviations will be considered simultaneously. The first index will be the most effective for comparison, while the second will make it possible to verify, together with a study of its distribution, whether the programme has benefited the most at risk subjects.

*Choice of covariates*

The prior studies available enabled us to identify the main variables, essentially of a socioeconomic nature or concerning complementary feeding practices, whose effects on the nutritional status of young children in Congo have been observed. All these variables were collected in baseline surveys in order to verify the comparability of the groups. Other potential confounding factors were also included in the study for safety's sake even though previous studies had not demonstrated their role in Congo. The same questionnaire will be duplicated for the surveys at the end of the programme and the principal variables are also being studied in surveys evaluating the process so as to verify continued comparability of the groups.

*Definition of the target population*

The target population for the programme ranges from children aged 4-9 months who either receive complementary food or partake of family food depending on their age. In view of the type of programme, however, this group has only been recommended; an analysis of the trend in complementary feeding practices during the intervention will make it possible to define more precisely what age group was actually influenced by the programme.

The target population for the impact evaluation has been chosen from a much broader range, because a growing prevalence of stunting until the age of 2 years has been observed in Congo (even if it is not possible at this stage to know whether the effects of inappropriate complementary feeding practices extend to this age). Moreover, since the proposed duration of the pilot programme is two years, the age group 4 to 27 months was chosen as the target population for the impact evaluation. The whole generation surveyed at the end of the study will therefore be concerned with the intervention. We are nevertheless aware that this choice would involve a risk of diluting the possible effects of the intervention if it was more limited in duration.

### *Delimitation of the study zones*

*— Urban strategy*

For the urban strategy, the intervention zone was defined on the basis of the integrated health centres (CSI). In Congo, the national health development plan (PNDS) envisages the conversion of dispensaries into CSI or the creation of CSI in areas where health coverage is deemed to be inadequate. One of the principles of the PNDS is that each CSI should be responsible for a health district that is carefully delimited. The population of the district is recorded and benefits from certain public health activities. It was therefore quite logical to define the study zones on the basis of the districts, and this was done with the exception of a few small clusters which differed greatly from the rest of the zone. This decision was taken because of the very small size of the population in these clusters and to preserve socioeconomic homogeneity.

The choice of CSIs for the study was governed by the following considerations:

- intervention zone sufficiently far from the control zone to limit contamination phenomena;
- districts with comparable socioeconomic levels to obtain the best possible initial comparability;
- same state of progress in implementing the PNDS, and as a corollary support for this implementation should come from the same development agency;
- avoiding interference by other nutrition research programmes also taking place in Brazzaville.

Taking into account all these considerations, the choice was very limited. Finally, two of the oldest urbanized districts of Brazzaville were chosen: Bacongo and Poto-Poto, in which the implementation of the PNDS is supported by UNICEF and where the operation of three and two CSIs respectively was planned in 1993.

*— Rural strategy*

Here, the problem is very different because the intervention zone was defined very early on. It is the Kukuya plateau, situated approximately 400 km north of Brazzaville, for which basic data on nutritional status and feeding practices were already available. The programme has been specially designed for this zone, particularly as far as food technology is concerned.

The main difficulty was choosing a study design and then a control zone. The first solution envisaged was to divide the plateau into two zones (one intervention zone and one control zone); but this turned out to be impossible for reasons of acceptance by the population and also because of the small number of people available. It was therefore decided to take the neighbouring plateau of Djambala as a control zone whose population is very similar from the ethnic standpoint. Although the proximity could be a source of contamination, but this should be negligible given the type of programme. The implementation of the PNDS, which covers the whole of Congo and could be a significant confounding factor, had fortunately been programmed for the same period for the region as a whole. However, this choice raised the sampling problems described below.

### *Sampling*

*— Sample size*

This is the first aspect to be taken into account. As data on growth retardation in the population involved in the study was available, we calculated "in reverse" in order to show, for different sample sizes, the hypotheses from results of the intervention to consider a statistically significant result (Table 1). This gives a rough idea and makes it possible to provide a rapid estimate of the chances of success of the study. Subsequently, a "straight" calculation can be made to define the size of the sample according to the hypotheses of results finally adopted. This was not done in our study, on the one hand because the hypotheses of results were not easy to make and, on the other hand, because we quickly decided to make an exhaustive study among the target population. Table 1 shows that, for example, at the intersection of the 30% column under initial prevalence and the row 500 subjects by group, the value is "-8.0". This means that if the true prevalence of stunting in the population subject to intervention is 30% at baseline and that the prevalence dropped by 8% after the programme, a figure of 500 subjects in each group will be required to show the true difference between the two population sectors compared, at the 5% threshold and with a power of 90%.

It should be understood that this does not mean that a difference of at least 8% must be noted in the samples for the study to be conclusive. It means that if the true difference (which remains unknown) between the population sectors (and not the samples) is 8%, the fluctuations in the sample mean that, with normal distribution of the variable, carrying out 100 surveys of 2 x 500 persons will statistically show a significant difference at the 5% threshold 90 times (i.e. power = 90%).

In our study, we considered that in urban areas, where the initial prevalence of stunting was estimated at 15.0%, 1500 children per group was desirable. This would show, under preset conditions, a true difference of 3.6% in the population. Taking into account that the population's involvement in the programme will certainly not be full, this would already be a satisfactory result. In rural areas, on the other hand, the initial prevalence is estimated at around 30.0% and a much higher level of participation can be expected. Under these conditions, a decrease of 8.0 to 10.0% in prevalence can be envisaged and 500 subjects per group appeared to be sufficient.

*— Inclusion/exclusion criteria*

The only criterion that appeared to be important concerns the length of residence in the designated zone. It is preferable to include in the evaluation only children who have been subject, or might have been subject, to the intervention. To do so, these children must have lived in the zone since they were born. We have nevertheless allowed for a temporary absence tolerance of 1 month before the age of 9 months, and 3 months between 9 and

27 months. Naturally, the same criteria apply to the control zone in order to maintain comparability. In rural areas, on the other hand, where the population is much less mobile, the application of this type of criterion was not seen as necessary.

— *Composing the samples*

Here, the limit was the size of the population in the study zones. In view of the problems faced in delimiting the study zones, they were necessarily of a modest size.

In urban areas, mainly for reasons of homogeneity, it was only possible to use the health districts corresponding to two CSIs in the Poto-Poto area and three CSIs in Bacongo. The population living in these zones was estimated to be around 30 000 in each area, equal to a potential of around 2000 children aged 4 to 27 months. Taking into account the high rate of exclusion foreseen, an exhaustive survey was the only way of reaching the objective fixed of 1500 children per group. The sample was therefore composed of all the children aged 4 to 27 months who met the criteria of residence in the zones. In order to be as exhaustive as possible, it was necessary to draw up plans of the districts, compound by compound, and to undertake considerable work on a census. Finally, less than 1% of the subjects could not be surveyed and less than 2% refused to participate.

**Table 1**
**Hypotheses of the necessary differences between the two groups, according to the size of the sample, in order to achieve a significant result, with a Type I error of 5% and a power of 90%**

| | | **Initial prevalence (%)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **n/group** | ***mean Z-score*** | **12.5** | **15** | **17.5** | **20** | **22.5** | **25** | **27.5** | **30** |
| 250 | *-0.38* | -7.3 | -8.1 | -8.8 | -9.3 | -9.9 | -10.4 | -10.8 | -11.2 |
| 500 | *-0.27* | -5.5 | -6.0 | -6.5 | -6.9 | -7.2 | -7.6 | -7.9 | -8.0 |
| 750 | *-0.22* | -4.5 | -5.0 | -5.4 | -5.7 | -6.0 | -6.3 | -6.5 | -6.7 |
| 1000 | *-0.19* | -4.0 | -4.3 | -4.7 | -5.0 | -5.2 | -5.5 | -5.7 | -5.8 |
| 1500 | *-0.15* | -3.3 | -3.6 | -3.9 | -4.1 | -4.3 | -4.5 | -4.6 | -4.7 |

In the intervention zone in the rural environment, i.e. the Kukuya plateau, a large-scale nutrition survey had already been carried out in April 1992. The method used had been two-stage cluster survey with a sampling fraction of 0.4. Since the total population was around 16 000, in the end just over 400 children from 4 to 27 months were included in the sample, and 25% of them came from the small town of Lékana. For obvious reasons of acceptance, it was impossible to carry out a further survey just before the programme at the beginning of 1993. We therefore had to accept this sample, slightly less than the desired figure of 500 subjects. In the control zone, also with around 16 000 inhabitants, the problem was that almost 60% of the subjects lived in the town of Djambala. Reproducing the same survey design as in the intervention zone (two-stage cluster survey) would have resulted in a sample that retained roughly 60% of "urban" subjects, which was not proportionate to the 25% in the survey on the Kukuya plateau. Hence, we had to stratify our sample according to residence in order to respect the 25-75% distribution between the "centre" and the "periphery". The two-stage cluster survey was duplicated for the town of Djambala, but for the periphery the calculation gave an estimate of a total of 350 to 400 children aged 4 to 27 months. Once again, sampling was useless and the study of children in villages outside Djambala was exhaustive.

## 3.4 Limitations

### *Evaluating a "package"*

Our study aims at evaluating the impact of a programme whose strategies have been defined according to prior analysis of the nutritional situation. The simultaneous implementation of the national health development programme (PNDS), however, obliged us to adapt the intervention planned. The evaluated impact will therefore be that of a "package" programme at the level of complementary feeding practices combined with a much broader health programme, in comparison with the impact of the health programme alone. This raises a number of problems:

- Risk of bias due to a different rate of progress of the PNDS in the zones; this is unfortunately what happened at the rural level, the Lékana plateau having received greater attention in the PNDS than the neighbouring plateau. However, we will have to wait for the final evaluation, before ascertaining whether the level of the covariates adopted was in fact altered to any significant extent in one zone compared to the other.
- Risk of diluting the effect of nutritional intervention: if the impact of the nutritional programme is less than that of the health programme, the difference in trends in the intervention and control zones may not appear with statistical significance.
- Problem of interpretation: we do not have any elements that allow us to assume the independence of the impacts, at the anthropometric level, of each of the programmes (the reverse is more likely). Consequently, any conclusion regarding the effect of the nutritional programme alone is impossible.

### *Comparability of the groups*

The initial comparability of the groups is satisfactory in urban areas even though, as expected, differences already existed in the two districts in Brazzaville. On the other hand, the difference in methodology when composing the samples in rural areas, added to the fact that the two zones were not surveyed the same year, raises a problem. Even if the analysis confirms the initial comparability of the variables which were chosen, there remains a question concerning the secular trend in the year separating the two surveys. If it was insignificant, there is no problem. But if it showed a deterioration in nutritional status, this may obfuscate the real impact of the programme. If it led to an improvement in nutritional status, on the other hand, this could exaggerate the effect of the programme. It is necessary therefore to try to estimate this secular trend.

The continued comparability of the groups during the course of the study has to be verified. At the rural level, as pointed out in the preceding paragraph, it is feared that there may be a confounding factor caused by the earlier involvement of development agencies implementing the PNDS on the Lékana plateau in comparison with the Djambala plateau. At the urban level, the situation is much worse because of the important socio-political events that have shaken the Congolese capital since the study began. These greatly hindered the progress of the programme because the production and supply of Vitafort flour were disrupted for several months. Above all, however, these events caused important population movements in both the intervention and control zones, including transfers from one district to another. The impact evaluation in urban areas therefore had to be abandoned because it would obviously not provide results that could be interpreted.

### *External validity*

At the rural level, the involvement of the various actors in the practical implementation of the nutritional programme whose impact we are trying to evaluate has been significant. If the evaluation proves conclusive, despite the possible problems of interpretation described above, it will be necessary to consider whether the programme can be replicated on a larger scale. Although the strategy assessed was designed to be integrated in the national nutrition policy, the human and financial resources utilized on a pilot scale, as well as the motivation of the participants, are often important factors in the success of a programme.

## 4. CONCLUSION

Evaluation of the impact of a nutrition programme is relatively complex from the methodological point of view and, as we have shown, constraints in the field make it even more difficult to carry out. Finally, the implementation of such a study is basically a matter of compromise between what is methodologically acceptable and what is possible in practice.

Because of the time needed to carry out the study, an impact evaluation is rarely of use to the programme itself, except when replicating the pilot intervention on a larger scale. Therefore, it is important to judge whether the type of programme evaluated improves the nutritional status of the target population. In addition, the impact evaluation is accompanied by a "process" evaluation that will provide valuable information to allow the programme to be adapted to another situation and integrated into a national policy.

Providing the resources to evaluate the impact of a programme logically appears to be essential for the further development of nutritional intervention policies. At the conclusion of a programme in the area of nutrition, however, it is only rarely that one can see to what extent the objectives fixed have been reached. This is basically due to the methodological problems of impact evaluation, its cost, and the duration of the study, which makes it vulnerable to large-scale uncontrolled modifications of the overall context.

In conclusion, two requirements are essential:

- Plan impact evaluation of a programme at the same time as the programme itself so as to define a study design that is best adapted to the special characteristics of the programme and to budgetary constraints.
- Explore and develop all the so-called "qualitative" evaluation methods which, although they cannot replace the quantitative results of an impact study, are less expensive and easier to implement.

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# PART II

# COUNTRY PRESENTATIONS

# Algeria

## 1. INTRODUCTION

In 1995, a multiple-indicators survey, "MDG Algérie 1995" was carried out by the Ministry of Health and Population (Dekkar and Bendib, 1996) with the support of UNICEF, WHO and UNFPA, to "Monitor Progress Toward the Goals of the World Summit for Children" (UNICEF, 1995).

The survey provided information on the nutritional status of children aged 0–59 months, as well as on feeding practices for those under 24 months, based on WHO indicators (WHO, 1991 & 1996b): prevalence of wasting and stunting, exclusive breastfeeding rate, timely complementary feeding rate, rates of continued breastfeeding at one and two years of age, and bottle feeding rate. A retrospective indicator, the proportion of children "ever breastfed", was also estimated.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

In 1995, the overall prevalence of wasting was 9% and was highest at 6–11 months (26%). Although the overall prevalence of stunting was only 7%, it was very high at 6–11 months (32%) and at 12–23 months (30%). Thus, malnutrition is frequent between 6 and 23 months, i.e. during the period of complementary feeding. This observation suggests that feeding practices could be one of the factors responsible for the poor nutritional status.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

The 1995 survey indicated that breastfeeding was universal in Algeria with 91% of children under one year "ever breastfed" (Table 1). There were no differences by sex, or between urban and rural sectors (Dekkar and Bendib, 1996).

In contrast with the high proportion of children "ever breastfed", the exclusive breastfeeding rate was low (56%). It was significantly higher in girls (65%) than in boys (48%). Although rates in the urban and rural sectors were 61% and 52%, respectively, the difference was not significant.[1] Analysis by type of housing conditions showed a greater contrast, from 37% for infants living in apartment buildings, to 64% for those living in slums, and to 67% for those in private houses, indicating differences in feeding practices between socioeconomic groups.

[1] The sample used for estimating feeding practices included 1631 infants and young children under 2 years of age. Approximately 20% were under 4 months. Therefore, the power of comparisons of sub-groups was low.

The timely complementary feeding rate was 54%. Although no significant differences were observed by sex, or between urban and rural sectors, they existed by type of housing: the rate was highest among children living in apartment buildings (81%), and lowest in traditional and shared houses (46%).

The continued breastfeeding rate at one year of age was 49%, for both boys and girls. Again, there were no significant differences between urban/rural sectors, but they were found in the types of housing. At 2 years of age the rate declined sharply to 26%, and the difference between the urban (20%) and rural (32%) sectors became significant. There were also large differences by type of housing.

**Table 1**
**Infant feeding practices in Algeria (MDG Algérie 1995)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 56 |
| Timely complementary feeding rate | 54 |
| Continued breastfeeding rate at 1 year | 49 |
| 2 years | 26 |
| Bottle-feeding rate | 48 |

The bottle-feeding rate was very high: 48% of children less than one year of age, had been given a bottle during the previous 24 hours. The rate was 46% under 4 months, 57% from 4 to 7 months, and 46% from 8 to 11 months. There were no significant differences by sex, between urban/rural sector or by type of housing.

## 4. CONCLUSION

Although nearly all Algerian infants are breastfed, a large percentage, over 40%, are not exclusively breastfed. The timing of introduction of complementary foods is not optimal; for many infants it is too late but the data do not indicate whether introduction is too early for some infants.The rate of continued breastfeeding at 1 year of age is lower than in most African countries, and lower than in other North African countries (57% in Tunisia and 63% in Morocco) (WHO, 1996a; Hajji, 1993). Bottle-feeding is highly prevalent in all sectors of the population but there are large differences in feeding practices between socioeconomic groups. Exclusive breastfeeding is more common in poor families and the duration of breastfeeding is longer, but complementary foods are introduced too late.

Nevertheless, some aspects of infant feeding practices have improved during the last decade: the timely complementary feeding rate has increased from 42% in 1989 and 38% in 1992, to 54% in 1995 (PAPCD, 1993; Dekkar and Bendib, 1996).

After a noticeable improvement during the 70's and 80's, the prevalence of acute protein-energy malnutrition is increasing (Kellou, 1995): the prevalence of wasting has risen from 4% in 1992 to 9% in 1995, probably as a result of the severe political and economic crisis affecting the country.

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# Benin

## 1. INTRODUCTION

In 1996, a National Demographic and Health Survey was conducted by the Institut National de la Statistique et de l'Analyse Economique[1] with the assistance of Macro International Inc. (Kodjogbé et al., 1996). The sample included 3011 children under three years of age.

## 2. MALNUTRITION AMONG CHILDREN UNDER THREE YEARS OF AGE

The survey indicated that 29% of children were underweight. Both forms of malnutrition, wasting and stunting (as defined by WHO, 1996), were found to be prevalent in Benin.

One in every four children was stunted (25%) and severe stunting affected 8% of the children. Prevalence increased gradually with age, from 9% before 6 months, to 13% before 12 months, and to over 30% during the second and third years. The level of mothers' education influenced the frequency of stunting: prevalence was twice as high among uneducated mothers (26%) as among those with a secondary or higher education (13%). Geographically, the highest prevalence was observed in the North Eastern province of Atacora (34%). Prevalence was somewhat lower among urban (21%) than among rural children (27%).

Wasting affected 15% of children under three years of age. Prevalence increased with age between 3 and 12 months, affecting a maximum of 25% of infants around one year. During the second and third year, prevalence decreased gradually to approximately 5% at 30–35 months. Mothers' education did not influence the prevalence of wasting, and urban/rural differences were small.

There were some surprising regional variations in the distribution of malnutrition in Benin: the Atacora province had the highest prevalence of stunting (34%) but the lowest prevalence of wasting (9%), while the neighbouring province of Borgou (north-west) had the highest prevalence of wasting (25%). Additional studies are needed to explain these differences.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Practically all Beninese neonates born during the three years before the survey were breastfed (97%), but initiation of breastfeeding was not early: only 24% were put to the breast within the first hour after birth, and 63% were breastfed during the first day. Delayed initiation was

[1] National institute of statistics and economic analysis, Cotonou.

more frequent in the rural sector. Educated mothers initiated breastfeeding earlier as did mothers who gave birth in a health facility.

Only 13% of infants less than 4 months were exclusively breastfed (Table 1). A comparable proportion were given breast milk and water only (16%). Whereas feeding breast-milk substitutes or non-human milk was rare, the majority of infants received water-based liquids; for example, 60% of infants were receiving non-milk liquids at 0–1 month, and before 4 months, the proportion was as high as 62%. The practice of giving water or other non-milk liquids to infants was ubiquitous and was influenced neither by residence nor by mothers' level of education.

**Table 1**
**Infant feeding practices in Benin (DHS, 1996)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 13 |
| Timely complementary feeding rate | 86 |
| Continued breastfeeding rate at 1 year | 98 |
| 2 years | 64 |
| Bottle-feeding rate [a] | 4 |

[a] *among breastfed infants*

The duration of breastfeeding was adequate — continued breastfeeding rates at one and two years of age were 98% and 64% respectively — but liquids/foods other than breast milk were introduced too early. While the median duration of breastfeeding was 22.8 months, the duration of exclusive breastfeeding was less than one month.

According to the World Health Organization (WHO, 1991) infants should not receive foods other than breast milk before the age of 4 months. In Benin, already 34% of infants were receiving cereals at 2–3 months, and 59% at 4–5 months. This was confirmed by the high timely complementary feeding rate (86%). This high rate also shows that late introduction of complementary foods was virtually unknown in Benin.

The median duration of breastfeeding was longer in the rural (23.8 months) than in the urban areas (20.3 months). It was very significantly affected by education; mothers with secondary or higher education had a median duration of only 17.4 months while mothers with no schooling breastfed for 23.3 months. The rate of bottle-feeding, before 12 months, was very low (4%).

The first complementary foods given to infants before 4 months were cereals (25%), whereas roots and tubers were given later (21% at 7-9 months). The proportion of infants receiving foods of animal origin at an early age was relatively high reaching 31% at 6–9 months.

There were regional differences in the type of complementary foods given, e.g. non-human milk, eggs/fish and tubers, which reflected differences in the availability of these foods.

Differences[2] according to mothers' level of education were small, except for non-human milk (34% of educated mothers against only 17% of other mothers) and for eggs/fish (71% of educated against 54% of uneducated mothers). Moreover, urban/rural differences observed with these foods — with a higher proportion of mothers feeding them in the urban sector — did not exceed 10%.

## 4. CONCLUSION

In Benin, although almost all infants are breastfed, some widespread feeding practices are detrimental to their health: firstly, the majority of infants receive water or water-based liquids in addition to breast milk, and secondly, complementary foods are introduced too early. Consequently, infants are exposed to pathogens and their intake of breast milk is reduced. Breastfeeding promotion and nutrition education programmes should focus on these two major problems.

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[2] In the proportion of living children less than 36 months who consumed the food during the week preceding the survey.

# Botswana

Maria S. NNYEPI

## 1. INTRODUCTION

A National Demographic and Health Survey was conducted in Botswana in 1988 (Lesetedi et al., 1989). More recently data on breasteeding practices have been collected in the context of two surveys: the Household Food Security study and the Micronutrient survey.

## 2. BREASTFEEDING PRACTICES

Breastfeeding is universal in Botswana. According to the Micronutrient survey, 95% of all infants have been breastfed. Early initiation of breastfeeding is very common: 77% of neonates were put to the breast within one hour of birth; only 16% were first breastfed within the first day, and 7% later. The reasons given by mothers for not starting breastfeeding included *inter alia*: mother's illness, nipple or breast problems, working commitments and insufficient milk output for a previous child.

In 1988, the exclusive breastfeeding rate was low (41%) because plain water was often given to infants only a few days old. At that time, the timely complementary feeding rate was high, 82% (Table 1). Rates of continued breastfeeding at one and two years were 73 % and 21%, respectively, and the mean duration of breastfeeding was 19 months.

More recently the Micronutrient survey revealed that at one month of age, 18% of infants were given plain water, 24% non-human milk, and 3% other liquids. At four months, 78% received plain water, 41% non-human milk, 87% other liquids, and 62% were already given solid foods.

The Household Food Security study found a mean duration of exclusive breastfeeding of 4.3 months. According to this study, the overall proportion of infants breastfed at 3 months was 87% at the national level, 90% in the rural areas, and 85% in the urban areas. The study showed that 55% of mothers in urban areas used infant formula in comparison with only 11% in rural areas.

## 3. COMPLEMENTARY FEEDING

### 3.1 Use of porridge

Sorghum and maize porridge, fermented or plain, are the most commonly used complementary foods for infants and young children. Sorghum and maize have a low protein content. Plain water is used to thin out the gruel, thus reducing its energy and protein density. The porridge has an energy density of about 65 kcal/100 g and a protein density of 0.5 to 2 g/100 g.

*Tsabana*, a mixture of white sorghum and soya beans, is a complementary food for infants and young children produced by the Government. At present, *Tsabana* is given to all infants and young children between 4 and 36 months of age. Beneficiaries are also given cooking oil to add to *Tsabana* porridge. The protein density of *Tsabana* porridge is higher than that of the traditional porridge. The energy density is at least 70 kcal/100 g of porridge and depends on the amount of oil mothers add during preparation.

**Table 1**
**Breastfeeding practices in Botswana (DHS, 1988)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 41 |
| Timely complementary feeding rate | 82 |
| Continued breastfeeding at 1 year | 73 |
| 2 years | 21 |

### 3.2 Frequency of feeding complementary foods

Ninety one percent of households serve infants and young children three meals a day. However, about 7% of households in rural areas serve only one meal a day, although the children can snack on leftovers at any time of the day.

### 3.3 Family foods

No study has assessed the mean age of introduction of family foods. However, infants are given mashed or overcooked food items from all the food groups from 4 to 6 months of age. Foods of animal origin are not usually given until the child has developed premolars/molars because of the belief, in some parts of the country, that early introduction of meat will delay teething.

## 4. CONCLUSION

In Botswana breastfeeding is universal, but the practice of giving water to infants is widespread. Moreover, the introduction of complementary foods is too early and the use of infant formula is common in urban centres. The Government has launched an ambitious programme of distribution of a complementary food, *Tsabana*, to ensure that all infants and young children have access to an adequate food to complement breast milk.

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# Burkina Faso

Jean Célestin SOMDA

## 1. MALNUTRITION AND DIARRHOEA AMONG PRESCHOOL CHILDREN

### 1.1 Protein-energy malnutrition (PEM)

In 1993, the Burkina Faso Demographic and Health Survey assessed the prevalence of malnutrition[1] among a nationally representative sample of 4172 children under 5 years of age (Konate et al., 1993) and reported that:

- the prevalence of stunting (chronic PEM) was 29% and that of severe stunting was 11%
- the prevalence of wasting (acute PEM) was 13% with 3% of the severe form
- the prevalence of underweight children was 30% with 8% of the severe form.

The highest prevalences were observed in the age group 6–23 months (Figure 1).

### 1.2 Specific nutritional deficiencies

*Anaemia*

A nutritional survey carried out in 9 provinces in Burkina Faso in 1987 showed that the prevalence of anaemia (haemoglobin level < 11 g/100 ml) was 70% among children under 5 years of age.

*Iodine deficiency disorders*

A number of surveys of children under 5 years of age showed the following:

- in six Sissili villages in 1989: 2.3% of visible goitre
- in Passoré in 1990 (Dr. Liliou): 11.0% of global goitre
- in Passoré and Namentenga in 1991 (MSASF/Medicus Mundi Barcelona): 64.0% of total goitre with 3.5% visible goitre.

*Vitamin A deficiency*

A survey in six provinces in 1989 showed a prevalence of night blindness of 1.14%. In the north of Burkina Faso, in 1989, a prevalence of night blindness of 2.82% was recorded with 0.18% of keratomalacia and 2.15% of Bitot spots.

### 1.3 Diarrhoeal diseases

According to a survey in 1993, the point prevalence of diarrhoeal diseases was 1.9% with an incidence of 6.8 episodes/child/year. According to the 1993 DHS, the point prevalence of diarrhoea was 20.0% for children under five years, and 32.0% for those aged 6 to 23 months.

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[1] As defined by WHO, 1996.

These relatively high levels of prevalence of under-nutrition, micronutrient deficiency, and diarrhoeal disease are partly attributable to inappropriate complementary feeding practices.

## 2. BREASTFEEDING PRACTICES

The DHS survey showed that 98% of children under 5 years of age had been breastfed ("ever breastfed"). Nevertheless, this figure conceals a number of problems because for many children the timing of breastfeeding was not optimal.

### 2.1 Delay in the initiation of breastfeeding and use of colostrum

Forty-eight percent of last-born children were put to the breast within the first day after birth and 29% within the first hour. Eighty-five percent of women in Bobo, 88% in Ouagadougou, and 78% in Ziniaré (a rural area) gave infants other substances before their first feed. The type of substance varied: plain water, hot water, sweetened water, water and lemon juice, fruit juice, formula milk, the milk of another woman, and herbal tea. In 51% of cases in Bobo and 86% in Ganzourgou (a rural area) colostrum was thrown away. In Ouagadougou, it was given to the child in 71% of the cases and in 38% in Ziniaré. The rate of refusal to give the child colostrum varies considerably between ethnic groups (Figure 2).

### 2.2 Indicators for assessing breastfeeding practices

Only 3% of children less than 4 months of age were exclusively breastfed (Figure 3), its median duration being 12 days. The rate of predominant breastfeeding was approximately 90%. The rate of breastfeeding with complementary foods was 18% at 4–5 months. The timely complementary feeding rate was 43% at the national level, 62% in Bobo and Ouagadougou, and 58% in Ziniaré. Feeding practices for children between 6 and 9 months are shown in Figure 4. The rate of continued breastfeeding was 97% at 1 year, 75% at 2 years (96% in Ganzourgou, a rural area), and 19% at 3 years. The median duration of breastfeeding was 25 months. Bottle-feeding among breastfed infants was most prevalent at the age of 2–3 months (2%) (Konate et al., 1993; Macro International Inc., 1994). The different types of feeding by age group are shown in Figures 5 and 6.

## 3. USE OF PORRIDGE

### 3.1 Age of introduction and age of cessation of feeding porridge

The mean age of introduction of porridge is 5.0 ± 2.8 months in Bobo and Ouagadougou, and 5.7 months in Ziniaré. It is difficult to pinpoint the age of cessation of porridge consumption. For example, in Ouagadougou 30% of mothers give porridge from 8 to 24 months and 23% until the child refuses to eat it. According to the DHS survey, 94% of children continue to eat porridge at 35 months.

### 3.2 Nature of porridge

*In rural areas*

The most widespread porridge is a simple gruel made of local cereal (millet, sorghum, maize). A small number of porridges are enriched with local pulses (groundnut paste and cake, African locust and bean paste), milk or dried fish powder.

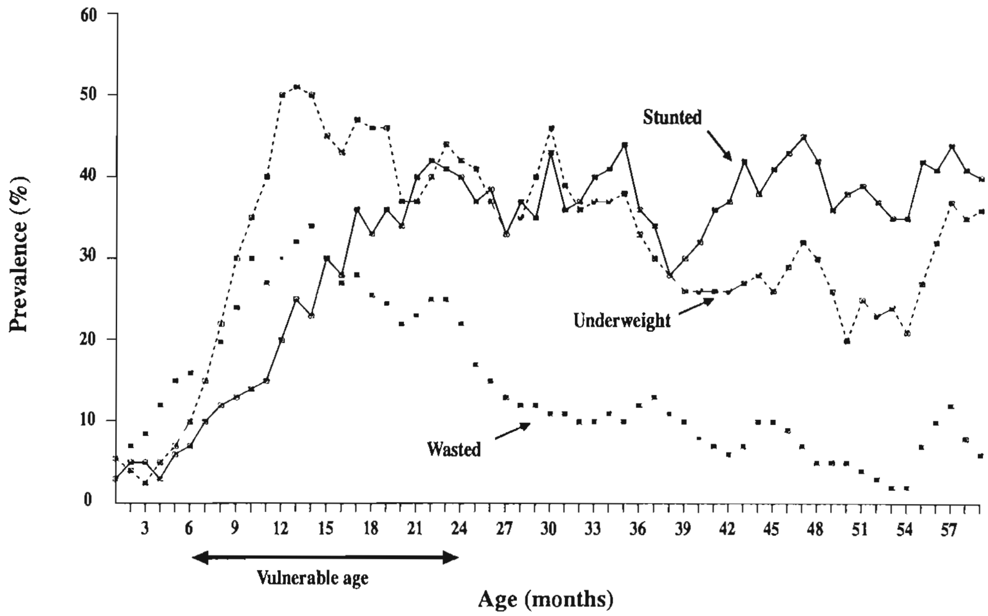


Figure 1
Prevalence of protein-energy malnutrition according to age in Burkina Faso

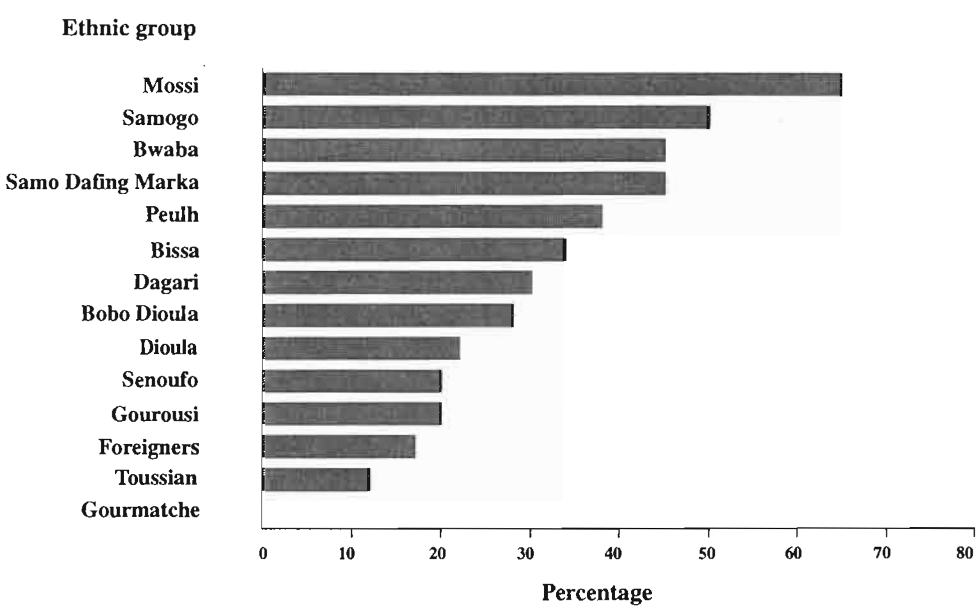


Figure 2
Rate of refusal to give colostrum according to ethnic group

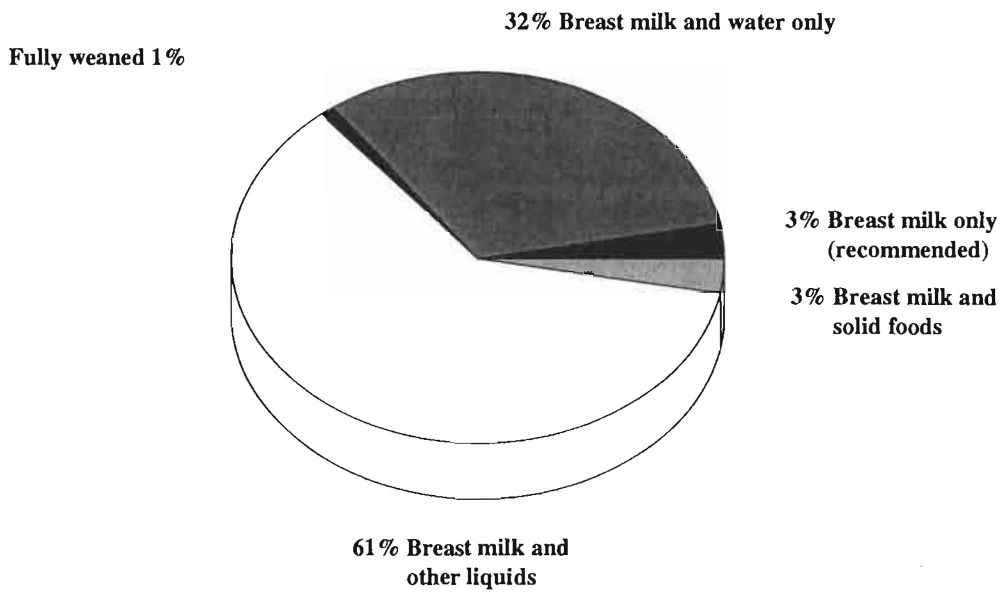


**Figure 3**
**Breastfeeding among children under 4 months in Burkina Faso**

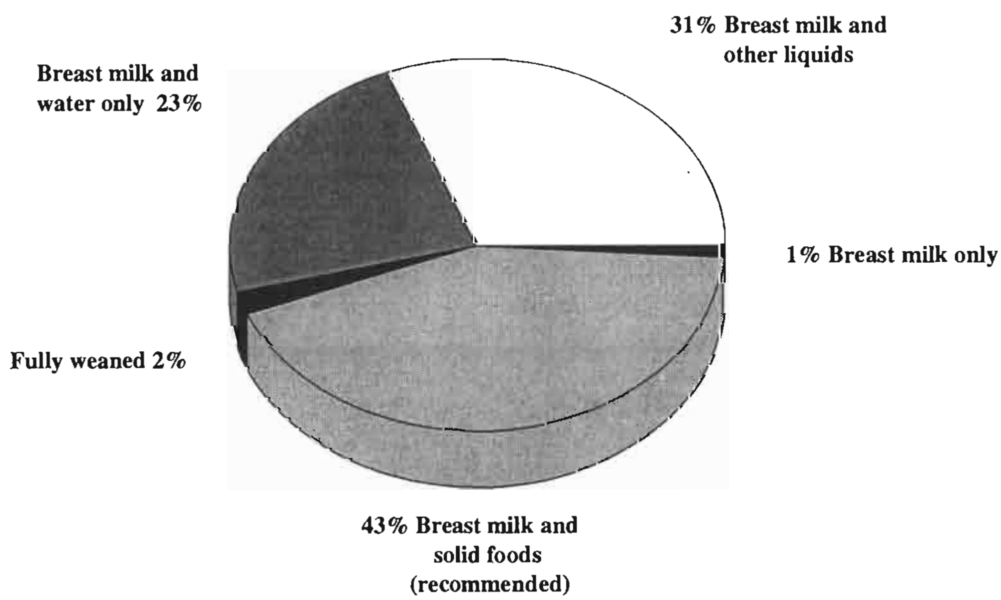


**Figure 4**
**Feeding practices among children aged 6 to 9 months in Burkina Faso**

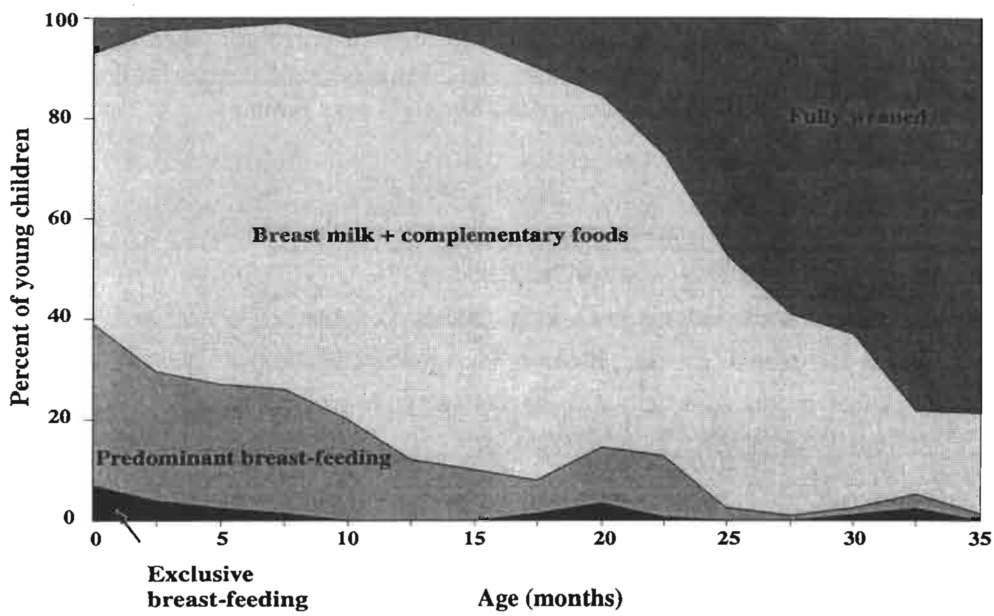


Figure 5
Feeding practices by age group in Burkina Faso

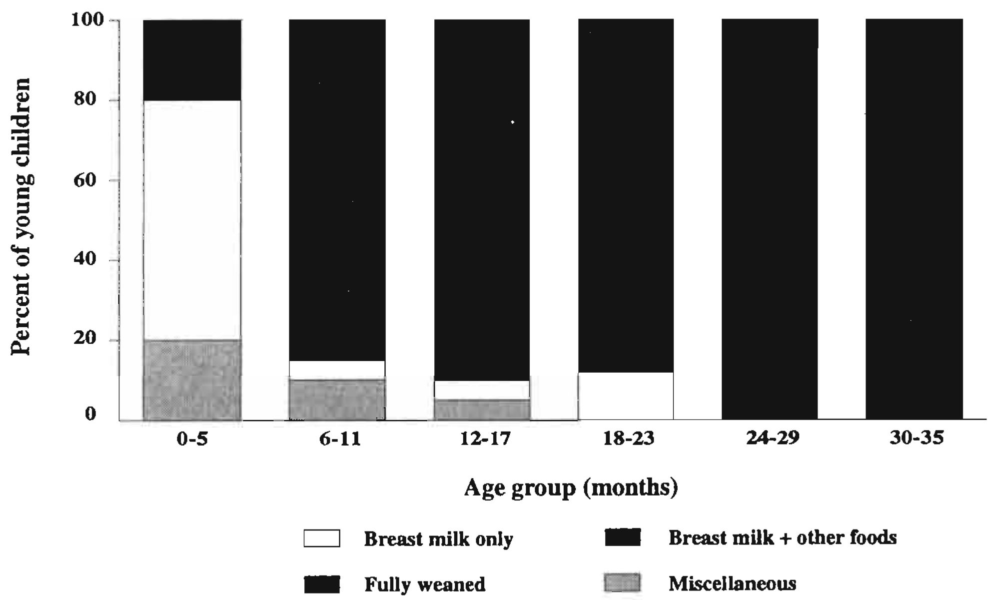


Figure 6
Breastfeeding practices among children under 3 years

In Ganzourgou, 60% of women add shea-nut butter or oil and, 53% sugar or honey. In Bazéga, African locust bean paste, meat or fish are added to 36% of porridges; shea butter or oil to 22%; and 4% of porridges are given with milk. The consumption of composite flours produced by the local cottage industry (Misola/Kasona, Den-Mugu) is very limited.

*In urban areas*

In addition to the cereals used in rural areas, the following are also found:

- fermented porridge (*koko baga*), which mothers buy
- locally-produced flour for infants and young children (Vitaline)
- imported flour for infants (Cérélac, Blédine, Phosphatine, Milupa)
- flour for infants produced locally by the cottage industry, for example Misola/Kasona, which has a market share of 7% in Ouagadougou.

### 3.3 Nutritional value of porridge and frequency of distribution

The nutritional value of porridge used in Burkina Faso is shown in Table 1.

*In rural areas*

Special preparations for children are rare; the preparation of porridge is usually dependent on that of *tô*, the family staple food (once or twice a day). The frequency of distribution of porridge varies widely from one survey to another due to methodological problems:

- in Toécé/Toudou, from 1980 to 1981, children aged 6 to 24 months received porridge from 0.84 to 3.78 times per day;
- in four provinces in Burkina Faso (Bam, Namentenga, Sanmatenga, Yatenga) in 1984 the average noted was one meal per day for children aged 3 to 5 months, 0.66 for children aged 6 to 8 months and 1.22 to 2.77 for children aged 9 to 36 months;
- in nine provinces, in 1987, three to four meals a day were the norm for children from 0 to 5 years of age.

*In urban areas*

The frequency of distribution of porridge is much higher for several reasons: the number of meals is 2–3 per day, porridge can be purchased, and preparations for infants and young children are available (enriched porridges, infant flours). In Ouagadougou in 1992, it was estimated that 9% of children received one porridge per day, 19% two and 70% three per day.

## 4. SOLID FOODS

### 4.1 In rural areas

According to the various surveys, infants start to partake of family food at the following ages:

- around 12 months in Toécé/Toudou in 1980/81;
- at the same time as porridge (between 3 to 8 months) in Bam, Namentenga, Sanmatenga and Yatenga in 1984 (in Yatenga it even started before the age of 2 months);
- between 8 and 24 months, but usually before 12 months, in nine provinces in 1987.

### 4.2 In urban areas

In Ouagadougou and Bobo in 1991, the mean age of introduction to family food was 8.3 ± 4.1 months. In Ouagadougou in 1992, it was noted that from the age of 4 to 5 months, a child was "prepared" for family food by being accustomed to the taste of the sauce; fish soup was introduced around 7 to 8 months, and tô and rice were given around 8 to 10 months.

**Table 1**
**Description and nutritional value of the porridges most frequently used in Burkina Faso**

| Type of porridge | Ingredients g/100 g | Energy density kcal/100 ml | Protein g/100 g DM | Fat g/100 g DM |
|---|---|---|---|---|
| Simple millet porridge | Millet flour | 36 | 7.0 | 1.5 |
| Misola Kasona | Toasted millet : 60<br>Toasted soya beans: 20<br>Toasted groundnuts : 10<br>Sugar : 9<br>Salt : 1 | 64 | 14.0–15.0 | 10.0–13.0 |
| Den-Mugu | Toasted millet or broken rice : 60<br>Milk powder : 30<br>Beans : 10<br>Iron sulphate : 100mg<br>Zinc sulphate : 60mg | 60 | 14.0–15.0 | 8.0–9.0 |
| Vitaline | Wheat<br>Maize<br>Skimmed milk powder<br>Groundnuts<br>Sugar<br>Vitamins<br>Minerals | 100–105 | 14.0 | 9.0 |
| Cérélac | Wheat<br>Milk powder<br>Vegetable oil<br>Sugar<br>Vitamins<br>Minerals | 100–105 | 15.5 | 9.0 |

*DM: Dry matter*

## 5. FOOD TABOOS

To our knowledge, all the studies have only touched on the problem of food taboos by simply listing them, without really trying to understand them or evaluate their nutritional impact at the population or individual levels. Food taboos are omnipresent in our societies and differ greatly from one ethno-geographical region to another; moreover, within one ethnic group there are differences from one family (or clan) to another. In general, everyone has some food taboo related to their ethnic, family or religious group, their gender, age, social status or state of health. Table 2 gives an inventory of foods forbidden to infants compiled during the Sissili study on three ethnic groups (Nouni, Mossi and Peulh).

**Table 2**
**Foods forbidden to infants**

| Energy producing foods | Building foods | Protective foods | Other |
|---|---|---|---|
| <u>Cereals and sugar products</u><br>Honey<br>*Tô*<br>Millet flour<br>Dolo<br>Biscuits<br>Sugar<br>Couscous<br><u>Tubers</u><br>Yams<br>Sweet potato<br>*Fabirama*<br><u>Fats</u><br>Shea butter | <u>Animal products</u><br>Eggs<br>Meat<br>Milk powder not boiled<br>Omelette<br>Cows' milk<br>Large amounts of meat<br>Non-ritually slau-ghtered animals<br>Dead poultry<br>Panther, Cat<br>Cayman<br>Partridge<br>Monkey<br>Chicken<br>Dog<br>Hare<br>Squirrel<br>Game<br>Pork<br><u>Plant origin</u><br>Groundnut<br>African locust bean paste<br>Voandzou beans | <u>Vegetables</u><br>Bean leaves<br><u>Fruit</u><br>Mango<br>Landolphia<br>Grapes<br>Green mango<br>African locust bean fruit | Hot pepper<br>Salt<br>Parents' totems<br>Coffee |

*Source: Initial assessment of the nutritional status of children aged 0-5 years in six villages in Sissili Province, MSAS, Worldrelief, 1989.*

The case of infants is a matter of concern because they necessarily cumulate their parents' taboos, those related to their own age group (i.e. to their stage of development), their gender and sometimes their birth rank.

In fact, these taboos are the result of the customs and thinking of the community, and relate to its understanding of health and nutritional concerns. A distinction should be made between true "taboos" on the one hand, which are ancient, immutable, and the heritage of tradition, and social beliefs on the other hand, whether right or wrong, regarging certain foods that are considered "harmful" to children. Although it is virtually impossible to change the former, the latter should be discouraged by promoting awareness and nutrition education.

It should be noted that the three traditional food groups (for producing energy, for building tissues and for protecting the body) are concerned by taboos, although there are more taboos for protein-rich foods.

In urban areas, the intermixing of ethnic groups, the relatively high level of education, and gradual westernization of food patterns have contributed to eliminating many food taboos.

## 6. CONCLUSION

A critical analysis of the different stages and components of infant feeding in Burkina Faso, shows that, despite a very high proportion of breastfeeding (98%), there is no room for complacency. Infant feeding practices are not optimal because of the many errors made at all stages of the child's development, such as:

- delayed initiation of breastfeeding at birth
- rejection of colostrum
- early or late introduction of complementary foods
- use of inappropriate complementary foods
- too few meals per day
- numerous food taboos.

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# Burundi

## 1. INTRODUCTION

Civil unrest in the country has limited the collection of data on the nutritional status of children and on infant and young child feeding practices. The last nationally representative survey is the 1987 Demographic and Health Survey (Segamba et al, 1988). In addition, data referring to children in camp sites or feeding centers have been collected in 1995 (Ministère de la Santé Publique, 1996).

In the production of processed complementary foods, Burundi was among the leading countries in Africa with the local production of Musalac, a flour for infants and young children which was very well accepted by the population.

## 2. MALNUTRITION AMONG PRESCHOOL CHILDREN

Findings from the 1987 Demographic Health Survey showed that among children aged 3-36 months, 38% were underweight, 48% were stunted, and 6% were wasted (as defined by WHO, 1996). Prevalence of stunting was among the highest in Africa. Moreover, severe stunting was frequent, affecting 19% of children under three years of age (Segamba et al., 1988).

In 1995, a survey conducted in sites of displaced persons on a sample of 1247 children under five years of age showed that 42% were underweight, 52% were affected by stunting, and 3% by wasting (Ministère de la Santé Publique, 1996). Although prevalence of malnutrition appears somewhat higher according to this survey, the results must be interpreted with caution as they do not reflect the situation of the population of the country.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

The 1987 DHS indicated that the proportion of children "ever breastfed" was very high (97%). The practice of exclusive breastfeeding was very common, with 89% of infants under 4 months being exclusively breastfed (Table 1). In contrast with neighbouring countries such as Tanzania and Uganda, the practice of giving water to breastfed infants was not widespread (only 10% of infants under 4 months).

Burundese mothers usually breastfeed for a long time; the rate of continued breastfeeding was 96% at one year, and 73% at two years. The median duration of breastfeeding was 23.8 months.

Two-thirds of infants aged 6–9 months received complementary foods, while the remaining third, were fed only breast milk and water or other liquids. Thus, introduction of complementary foods was too late for a large proportion of Burundese infants.

Bottle-feeding was almost exceptional: among breastfed infants under 4 months, only 1% were bottle-fed (Segamba et al, 1988).

**Table 1**
**Infant feeding practices in Burundi (DHS, 1987)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 89 |
| Timely complementary feeding rate | 66 |
| Continued breastfeeding rate at 1 year | 96 |
| 2 years | 73 |

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# Cameroon

## 1. INTRODUCTION

In 1991, a Demographic and Health Survey was conducted in Cameroon (Balepa et al., 1992), which was based on a nationally representative sample of 2357 children under 5 years of age.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

In Cameroon, stunting[1] affected one in four children while only 4% were wasted. The prevalence of severe stunting was low (9%) and severe wasting was exceptional (<1%). Thus, Cameroon was one of the countries of Africa with the lowest prevalence of childhood malnutrition. Nevertheless, the proportion of children affected by malnutrition was high at certain ages: the prevalence of stunting reached 40% at 24 months (it declined after that age), while that of wasting peaked to about 10% between 18 and 22 months.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Almost all children born during the five years preceding the survey were breastfed for some period of time: the proportion "ever breastfed" was 97%.

It is not the custom to initiate breast-feeding shortly after birth; only 12% of neonates were breastfed within the first hour, whereas 70% were first breastfed on the second day after birth. The practice of giving prelacteal foods or liquids to neonates was widespread. Moreover exclusive breastfeeding was uncommon: as early as 0–1 month, 14% of infants received breast-milk substitutes, 16% other liquids, and 16% complementary foods. Consequently the exclusive breastfeeding rate, before 4 months, was low (7%) (Table 1).

Introduction of complementary foods was too early. Before the age of 4 months, 28% of infants were already receiving solid foods in addition to breast milk; at 6–9 months three-quarters of infants were receiving complementary foods. Nevertheless, a noticeable proportion, almost one in four, had not yet received complementary foods. Thus, for a large proportion of infants, introduction of complementary feeding is either too early or too late.

The median duration of breastfeeding was 17.4 months. However, there were large urban/rural differences in duration, the shortest median duration being observed in the large urban centers, Yaoundé and Douala (13.8 months). Mothers who received a secondary or

[1] As defined by WHO, 1996.

higher education breastfed for a shorter period of time (median 14.6 months) than those with primary education (17.4 months) or with no education (21.9 months) (Balépa et al, 1992).

**Table 1**
**Infant feeding practices in Cameroon (DHS, 1991)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 7 |
| Timely complementary feeding rate | 76 |
| Continued breastfeeding rate at 1 year | 81 |
| 2 years | 35 |

The use of bottle-feeding was not exceptional: 12% of infants were bottle-fed at 0–1 months. The rate of bottle-feeding among breastfed infants before 4 months was 19%, ranking fourth highest among African countries after Nigeria, Namibia, and Ghana (Macro, 1993).

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# Chad

## 1. INTRODUCTION

The population of Chad is very young: 16% are under five years of age (WFP, 1992). Unfortunately no nationwide survey of infant feeding and child nutrition has yet been conducted. However, some studies carried out in selected areas provide insights into the nutritional situation of preschool children, and infant and young child feeding practices.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

Several surveys, conducted in rural districts or in health facilities, suggest that the prevalence of malnutrition is high among under-fives.

In the district of Komra and Doba, for example, the prevalence of wasting (weight-for-height <80% of the NCHS reference) was 11% during the drought of 1984–85. Between 1986 and 1990 several surveys have shown that the prevalence of wasting (as defined by WHO, 1996) was particularly high in Sahelian areas during the pre-harvest period of food shortage: 15% in the Kanem region and 11 to 14% in the Guéra region (Trèche, 1995). In urban areas the prevalence of wasting was also high (FAO, 1991).

More recently a study conducted in a refugee camp by Action Internationale Contre la Faim[1] (AICF), a nongovernmental organization, showed that 25% of children under five years of age were wasted. The highest prevalence (approximately 30%) was observed between 6 and 29 months (Trèche, 1995).

Vitamin A deficiency is another problem of public health importance, especially in Sahelian areas of the country. In 1986, a study in a Sahelian zone reported a noticeable prevalence of clinical signs of xerophtalmia among preschool children: 2.2% of night blindness, 0.5% of Bitot spots and 0.4% of corneal scars (MDR/MSPAS, 1992).

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

To date there is no survey of infant and young child feeding practices in Chad, but some empirical information has been provided by health personnel and nutritionists working in nutritional rehabilitation centres.

In Chad, breastfeeding is universal. The duration of breastfeeding is usually 12 to 18 months, but is shorter in urban areas. Bottle-feeding is rarely practised.

[1] International action against hunger.

Porridge is introduced between 4 and 6 months (MSPAS, 1994) except in Sahelian areas where introduction, is very late, after 9 months (Trèche, 1995). Porridges are prepared with local cereals such as millet or sorghum and sometimes maize. Other ingredients can be added, e.g. groundnut, sugar and milk but it is not known whether their use is common (MSPAS, 1994). The period of feeding porridge appears to be short and children are given family foods, i.e. millet or sorghum paste very early (Trèche, 1995).

Before the devaluation of the CFA Franc, the amount of processed complementary foods imported was already low (3162 tonnes in 1993); it has declined sharply since (780 tonnes in 1994). Nevertheless, some flour for infants and young children is imported from Nigeria through informal border trade, although the volume of these imports is not known. These products are sold in pharmacies and shops catering to the well-off segment of the population but are not reaching the poorer segment most in need of complementary foods (Trèche, 1995).

In 1993, Chad started producing "Vitafort", a flour for infants and young children made locally from cereals, cowpeas, and groundnuts. It should be noted that about 90% of production was sold to AICF in 1994 for its food programme in the Kanem region; therefore, only 2% of production reached the population at large (Yomadji-Outangar, 1999).

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# Congo

Félicité TCHIBINDAT

## 1. BREASTFEEDING PRACTICES

### 1.1 Initiation of breastfeeding

In Congo, all newborn infants who are breastfed first receive colostrum; the practice of not giving colostrum to newborn children has disappeared.

Hospital surveys carried out as part of the "Baby-Friendly Hospital Initiative" showed that the time elapsed before a newborn was first breastfed varied according to hospital practice. If a mother was separated from her child at birth, this interval could be as much as 6 hours (DSF, 1994). In hospitals taking part in the Initiative, however, it was reduced to less than 30 minutes.

### 1.2 Modalities of breastfeeding

Breastfeeding is practised by all mothers of children aged 0 to 5 months in rural areas (Table 1). In urban areas, 98% of children are breastfed at birth, but 20% of them also receive formula (against 2% in rural areas).

In rural areas, over 95% of children are still breastfed at the age of 12 months and the figure reaches 88% in urban areas. From 12 months onwards, the number being breastfed drops; only 27% and 15% of infants at 18-23 months in rural and urban areas, respectively, are still breastfed.

### 1.3 Duration of breastfeeding

The mean duration of breastfeeding calculated using Ferry's method is 18.5 to 20.5 months in rural areas (Cornu et al., 1990; Tchibindat et al., 1994) and 16.4 months in urban areas (Dinga, 1991).

## 2. USE OF PORRIDGE

### 2.1 Age of introduction of porridge

Porridge is introduced at an early age, usually before 4 months (Table 2), with one-third of the children already eating porridge at 3 months. The reason given by mothers is that the child cries because he/she is hungry.

### 2.2 Age of cessation of porridge consumption

In rural areas, consumption of porridge drops sharply after 6 months. In urban areas, more than half the children between 6 and 8 months and one out of three children between 9 and 17 months were still eating porridge (Table 2).

The mean age of cessation of porridge consumption is 5.6 months in rural areas (Tchibindat et al., 1994) and 8.0 months in urban areas (Dinga, 1991).

### 2.3 Nature of porridge

*Origin of porridge*

In 1990, over 80% of the porridge consumed by children under 24 months of age was prepared from local products (Table 3). Imported porridges were only consumed in 12% of cases in rural areas and 19% in urban areas. The majority of local porridges were prepared from fermented maize paste and, in rural areas, from cassava-based products.

**Table 1**
**Prevalence of breastfeeding in Congo**
***(% of mothers who declared breastfeeding their child during the previous 24 hours)***

| Age (months) | Rural areas (1987) | | Urban areas (1990) | |
|---|---|---|---|---|
| | % | number of mothers | % | number of mothers |
| 0–2 | 100 | 141 | – | – |
| 3–5 | 100 | 145 | – | – |
| 6–8 | 98 | 128 | 93 | 136 |
| 9–11 | 95 | 137 | 88 | 119 |
| 12–17 | 80 | 278 | 61 | 251 |
| 18–23 | 27 | 248 | 15 | 188 |

*Source: Cornu et al., 1993.*

**Table 2**
**Prevalence of consumption of porridge in Congo**
***(% of mothers who declared they had given porridge to their child during the past 24 hours)***

| Age (months) | Rural areas (1987) | | Urban areas (1990) | |
|---|---|---|---|---|
| | % | number of mothers | % | number of mothers |
| 0–2 | 31 | 141 | 13 | 47 |
| 3–5 | 45 | 144 | 61 | 150 |
| 6–8 | 17 | 127 | 58 | 139 |
| 9–11 | 7 | 133 | 35 | 119 |
| 12–17 | 2 | 270 | 32 | 253 |
| 18–23 | 4 | 237 | 19 | 188 |

*Source: Cornu et al., 1993.*

Since 1992, flour for infants and young children has been produced locally, for example, Vitafort in Brazzaville (Tchibindat and Trèche, 1999) and household preparations of energy-dense porridge on the Kukuya plateau (Moukolo et al., 1999); being new, their consumption is still limited.

### *Ingredients used in local porridge*

In addition to the basic ingredient (maize or cassava), mothers often add sugar (73% in urban areas and 50% in rural areas) and to a lesser extent milk (50% in urban and 22% in rural areas) (Table 4). They sometimes add groundnut, pumpkin-seed paste, or vegetables.

### *Methods of preparation of local porridges*

Maize porridge is made from fermented maize paste called *poto-poto* (Bouvier, 1992). The paste is mixed into a small amount of cold water, then poured into boiling water and allowed to cook for a few minutes until the desired consistency is reached.

Cassava porridge is made from cassava flour (in 53% of cases) or a wet product consisting of a precooked or raw fibreless drained paste (47% of cases). In 90% of cases, the paste is mixed in cold water, then poured into boiling water or heated in a water-bath (Trèche and Massamba, 1991; Trèche et al., 1992).

**Table 3**
**Types of porridge consumed in Congo by children under 2 years of age (%)**

| Main ingredients | Rural areas | Brazzaville |
|---|---|---|
| Imported flour for infants | 12 | 19 |
| Local products, including: | 89 | 81 |
| - maize | 47 | 78 |
| - cassava | 22 | 1 |
| - other | 19 | 2 |

*Source: Trèche et al., 1992.*

**Table 4**
**Ingredients used in local porridge**
***(% of porridges prepared using the ingredients indicated)***

| Ingredients | Rural areas | Brazzaville |
|---|---|---|
| Basic products | | |
| - flour | 2 | 1 |
| - fermented paste | 98 | 99 |
| Additional ingredients: | | |
| - sugar | 50 | 73 |
| - milk | 22 | 50 |
| - other | 16 | 6 |

*Source: Trèche and Massamba, 1991.*

Vitafort porridge is prepared by mixing one measure of water to one measure of flour. The mixture is heated on a low fire for 10 to 15 minutes (Tchibindat and Trèche, 1995).

The energy-dense porridge prepared on the Kukuya plateau is made from pre-cooked fibreless drained cassava paste mixed with germinated maize flour and groundnut, or pumpkin-seed paste and sugar. The mixture is stirred in water and cooked on a low fire for 10 to 15 minutes (Louyat de Dibantsa, 1994; Moukolo et al., 1999).

### *Nutritional value of local porridges*

The mean concentration of traditional porridge prepared from *poto-poto* or cassava is 15.1 g of dry matter (DM) per 100 ml of porridge, corresponding to an energy density of around 60 kcal per 100 g of porridge (Trèche et al., 1992). The mean concentration of new porridges, such as Vitafort and the Kukuya plateau porridge, in contrast, exceeds 30.0 g DM per 100 g of porridge, resulting in an energy density of around 120 kcal per 100 g of porridge. The crude protein content of local flour used in traditional porridge varies between 1.0 to 7.5 g per 100 g DM; the figure for new porridges is over 10.0 g per 100 g of dry matter (Table 5).

**Table 5**
**Overall composition of various porridges used in Congo**

| | ***Poto-poto*** | **Cassava** | **Vitafort** | **Kukuya porridge** |
|---|---|---|---|---|
| Dry matter (g/100 g porridge) | 15.1 | 15.1 | 34.0 | 33.0 |
| Energy density (kcal/100 g) | 60 | 60 | 125 | 122 |
| Protein (g/100 g DM) | 7.5 | 1.1 | 13.6 | 10.0 |
| Fat (g/100 g DM) | 3.0 | – | 7.1 | – |
| Fibre (g/100 g DM) | 0.8 | 2.1 | 2.6 | – |

*DM: Dry matter*
*Source: Trèche et al., 1992*

## 2.4 Modalities of distribution

The mean frequency of porridge consumption is two meals per day. A frequency of three meals of porridge per day is mainly observed among children under 9 months in rural areas (Table 6).

When children eat porridge once a day, it is usually in the morning or afternoon in rural areas and in the morning in urban areas. When it is eaten twice a day, consumption takes place in the morning and evening (Table 7).

## 2.5 Level of satisfaction of energy requirements

Traditional porridges with a mean energy density of 60 kcal per 100 g of porridge are generally eaten twice a day. The requirements of a child of 6 months can be estimated at 780 kcal/day.

According to studies by Vis et al. (1981), mothers in Central Africa can produce an average of 543 ml of milk per day, supplying around 380 kcal. Complementary feeding (in this case *porridge*) must therefore provide the 6-month-old child with around 400 kcal/day. On average, a child consuming two meals of porridge a day will absorb 340 ml (approximately 170 ml of porridge per meal, considering his stomach capacity), supplying around 204 kcal. Therefore, approximately 200 kcal are lacking to meet the child's needs; this deficit represents 25% of energy needs (Trèche, 1991).

It is precisely to solve this problem that new porridges such as Vitafort or the one introduced on the Kukuya plateau have been developed by Orstom,[1] produced by Agricongo[2] (in the case of Vitafort) and transferred at household level by the Ministry of Health.

**Table 6**
**Daily frequency of consumption of porridge in Congo among regular porridge consumers (% of children)**

| Age (months) | Rural areas (1987) | | | Urban areas (1990) | | |
|---|---|---|---|---|---|---|
| | 1/day | 2/day | 3/day | 1/day | 2/day | 3/day |
| 0–2 | 20 | 55 | 25 | 57 | 33 | 10 |
| 3–5 | 14 | 65 | 22 | 23 | 56 | 21 |
| 6–8 | 18 | 49 | 33 | 43 | 43 | 15 |
| 9–11 | 42 | 47 | 11 | 38 | 50 | 12 |
| 12–23 | 37 | 56 | 7 | 72 | 25 | 3 |

*Source: Cornu et al., 1993.*

**Table 7**
**Time of consumption of porridge**
***(% of mothers who gave porridge the previous day at the time indicated)***

| Time of day | Rural areas (1989) | Urban areas (1990) |
|---|---|---|
| Once a day | | |
| - morning | 34 | 66 |
| - midday | 20 | 7 |
| - afternoon | 4 | 17 |
| - evening | 6 | 10 |
| Twice a day or more | | |
| - morning | 52 | 79 |
| - midday | 35 | 25 |
| - afternoon | 24 | 20 |
| - evening | 65 | 76 |

*Source: Cornu et al., 1993.*

1 Orstom was renamed Institut de Recherche pour le Développement in 1999.
2 Research institute for support of agricultural development in tropical areas.

## 3. SOLID FOODS

### 3.1 Age of introduction of the different types of foods

Family food is introduced earlier in rural areas (18% of infants aged 3–5 months) than in urban areas (9%) (Table 8). The mean age at which family food is introduced is 7.5 months in urban areas (Dinga, 1991) and 6.1 months in rural areas (Tchibindat et al., 1994).

In rural areas, starch, in particular from cassava in its various forms, is introduced early (18% of children under 6 months). This is in fact a real meal because animal protein is consumed at the same time (16%) (Table 9).

In urban areas, starches are introduced somewhat later and in more varied forms. In the morning, an urban infant mainly eats wheat in the form of bread or doughnuts, and at midday has cassava as his meal staple.

### 3.2 Frequency of meals according to age

Once a child partakes of the family meal, the number of meals in addition to breast milk varies little with age. On average, a child receives two meals per day in addition to breast milk (Table 10). In rural areas, however, almost 30% of children only receive one meal per day in addition to breast milk, which is clearly not enough to cover their energy requirements.

### 3.3 Modalities of distribution

In rural areas, family food is eaten either in the morning (64% of children), or in the evening; in urban areas, it is mostly eaten at midday (97% of children) (Table 11). These variations underline two different lifestyles: women working in agriculture go to the fields in the morning and only come back at night so the family eats in the morning and evening, whereas in urban areas the family meal is at midday.

**Table 8**
**Prevalence of consumption of family food according to age**
***(% of mothers who declared they had given family food to their child during the previous 24 hours)***

| Age (months) | Rural areas (1987) | | Urban areas (1990) | |
|---|---|---|---|---|
| | % | number of children | % | number of children |
| 0–2 | 3 | 130 | 2 | 51 |
| 3–5 | 18 | 212 | 9 | 150 |
| 6–8 | 72 | 82 | 61 | 138 |
| 9–11 | 8 | 133 | 83 | 119 |
| 12–23 | 97 | 507 | 91 | 440 |

*Sources: Cornu et al., 1990; Dinga, 1991.*

## 4. FOOD TABOOS

Only around 30% of children are affected by food taboos. As shown in Table 12, these concern mainly meat (30%), and freshwater fish (28%) (Tchibindat et al., 1994). Poultry is forbidden in order to prevent seizures and epilepsy; snake meat would dehydrate the skin (Dinga, 1991). Palm oil is also mentioned as a food taboo, especially for pregnant and nursing mothers in order to prevent respiratory infections (bronchitis), and for children suffering from bronchitis or coughs.

**Table 9**
**Prevalence of consumption of various types of food according to age (%)**

| | Age group (months) | | | |
|---|---|---|---|---|
| **Type of food** | **0-5** | **6-11** | **12-17** | **18-23** |
| *Number of children* | | | | |
| *- urban areas* | *197* | *261* | *251* | *192* |
| *- rural areas* | *285* | *260* | *270* | *237* |
| Starches | | | | |
| - urban areas | 7 | 64 | 81 | 86 |
| - rural areas | 18 | 69 | 86 | 92 |
| Animal protein | | | | |
| - urban areas | 7 | 64 | 83 | 84 |
| - rural areas | 16 | 64 | 74 | 74 |
| Pulses | | | | |
| - urban areas | – | 1 | 3 | 5 |
| - rural areas | 3 | 7 | 10 | 24 |

*Sources: Cornu et al., 1990; Dinga, 1991.*

**Table 10**
**Number of family meals in addition to breast milk**
***(% of mothers who had given their child family food the previous day per number of meals)***

| | Number of meals/day | | |
|---|---|---|---|
| | **1** | **2** | **3** |
| Rural areas | 29 | 63 | 9 |
| Urban areas | 25 | 72 | 3 |

*Source: Cornu et al, 1993.*

**Table 11**
**Frequency of consumption of family food according to the time of day**
***(% of mothers who declared they had given their child family food the previous day at the time indicated)***

| Time of day | Rural areas (1989) (n = 506) | Urban areas (1990) (n = 602) |
|---|---|---|
| Morning | 64 | 52 |
| Midday | 52 | 97 |
| Afternoon | 12 | – |
| Evening | 84 | 78 |

*Source: Cornu et al, 1993.*

**Table 12**
**Types of food forbidden to preschool children**
***(% of children affected by a taboo against the foods indicated)***

| Foods | % | number |
|---|---|---|
| Tubers and starchy fruits | 3 | 20 |
| Leaves and vegetables | 21 | 131 |
| Raw and cooked vegetables | 3 | 17 |
| Nuts and seeds | 4 | 23 |
| Fruits | 3 | 17 |
| Meat | 30 | 185 |
| Fish | 28 | 176 |
| Eggs | 2 | 10 |
| Fats and oils | 4 | 24 |
| Other | 2 | 13 |
| **Total** | **100** | **616** |

*Source: Tchibindat et al., 1994.*

## 5. CONCLUSION

A study of infant feeding practices in Congo shows the following:

- Breastfeeding is the rule but, in urban areas, mixed feeding is increasingly practised.
- Porridge is introduced early at a time when children's physiology does not allow them to use it and its consumption competes with breast milk.

- Family food is introduced early and the introduction of this food coincides with the cessation of porridge consumption, which no longer plays its transitional role towards solid feeding.
- The nutritional value of traditional porridge is poor and the low frequency of consumption per day does not allow porridge to provide a satisfactory complement to breast milk.
- The frequency of meals in addition to breast milk is not sufficient to meet the child's nutritional requirements.

These features of infant feeding practices explain the high level of protein-energy malnutrition in Congo; in rural areas, 28% of preschool children suffer from stunting and 6% from wasting (as defined by WHO, 1996).

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# Côte d'Ivoire

## 1. INTRODUCTION

A Demographic and Health survey was conducted in Côte d'Ivoire in 1994 by the Institut National de la Statistique with the assistance of Macro International Inc. (Sombo et al., 1995). The survey provides nationally representative data on feeding practices and nutrition of children under three years of age.

## 2. MALNUTRITION AMONG CHILDREN UNDER THREE YEARS OF AGE

According to the survey, 24% of children under three years of age were underweight. While the prevalence of wasting[1] was low (8%), and severe wasting was rare (1%), the prevalence of stunting was noticeable (24%) and severe stunting was not exceptional (8%).

The prevalence of stunting increased with age; it more than doubled between 6–11 months (13%) and 12-23 months (31%). It affected more than a third of children between two and three years of age.There were large differences in prevalence between the urban sector (15%) and the rural areas (29%); the lowest prevalence of stunting was observed in the capital, Abidjan (11%), where severe stunting was rare (2%). The prevalence of stunting was lower among children of educated mothers (13%) than among those of uneducated mothers (27%). Sex of the child, birth order and birth interval had a more limited influence on the prevalence of stunting (Sombo et al., 1995).

The age distribution of wasting was different. The prevalence of wasting increased with age until 12–23 months, reaching a maximum of 13%, and decreased thereafter to 5% at 24–35 months. Prevalence was lower among infants of educated mothers but the differences were smaller than with stunting. Surprisingly, the highest prevalence of wasting among urban areas was found in the capital, Abidjan (10%). The Savane Rurale was the rural region of Côte d'Ivoire with the highest prevalence (12%).

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Almost all children born during the three years preceding the survey were breastfed: the proportion "ever breastfed" was 98%. Although breastfeeding was universal, initiation was not early; only 62% were breastfed within the first day, and 43% within the first hour after birth.

[1] As defined by WHO, 1996.

Ivoirian mothers usually did not breastfeed exclusively. The practice of giving water or water-based liquids was highly prevalent (97% of breastfed infants less than one month). The exclusive breastfeeding rate was consequently very low (3 %) (Table 1).

As early as 2–3 months, 20% of infants were given complementary foods. The proportion increased to 40% at 4–5 months. Although complementary feeding started too early for a high proportion of infants, for others it was introduced too late, the timely complementary feeding rate being 66%. At 12–13 months, 19% of young children were still not receiving complementary foods.

**Table 1**
**Infant feeding practices in Côte d'Ivoire (DHS, 1994)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 3 |
| Timely complementary feeding rate | 66 |
| Continued breastfeeding rate at 1 year | 94 |
| 2 years | 49 |
| Bottle-feeding rate [a] | 3 |

[a] *among breastfed infants*

Breastfeeding beyond the first year was common; the median duration was 20.3 months. The shortest duration was found among mothers living in Abidjan (17.9 months) whereas in rural areas the median was 21.3 months. Mothers with secondary or higher education breastfed for only 16.6 months.

Bottle-feeding was infrequent in Côte d'Ivoire: only 3% of breastfed infants less than 12 months were bottle-fed.

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# Djibouti

## 1. INTRODUCTION

The population of Djibouti is approximately 570 000 inhabitants, two-thirds of which live in the capital. In 1995, the Ministry of Public Health conducted a survey of nutrition and risk factors for cardiovascular diseases, with the support of WHO (Ministère de la Santé Publique et des Affaires Sociales, 1995). The survey provides information on the nutritional status and feeding practices for children under five years of age. The size of the sample was nevertheless small (n=305 children) and precluded a breakdown by age for some indicators.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

Thirty-one percent of children were stunted,[1] and 14% were wasted. The prevalence of severe stunting was 14% and that of severe wasting 4%. Compared to an earlier survey carried in 1990, prevalence of malnutrition has not declined (Ministère de la Santé, 1990).

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Before the age of 4 months, 74% of infants were breastfed, 3% were bottle-fed and 22% were mixed-fed, i.e. were given the breast and the bottle. At 6–9 months, 20% of infants were still breastfed, 13% were solely bottle-fed, and 20% were mixed-fed.

Only approximately 35% of mothers said they breastfed for more than a year. There were differences between ethnic groups for the duration of breastfeeding: the Afar and Somali breastfed for a longer time than the Arab group. Reasons given for interrupting breastfeeding were an insufficient milk yield (34%), taboos (24%), and work (6%), but in many cases no reason was specified.

Mothers started introducing complementary foods between 4 and 6 months of age. At 4 months, approximately 30% of infants were receiving foods, and at 5 months, 62%. Foods given to infants and young children under five years of age were mostly family foods. The number of mothers who bought imported processed complementary foods was very low (1%).

In summary, infant and young child feeding practices in Djibouti are characterised by the frequent use of bottle-feeding and a short duration of breastfeeding. The timing of introduction of complementary foods is appropriate, but the quality of complementary foods may not be adequate as very few mothers reported giving special transitional foods to their child.

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[1] As defined by WHO, 1996.

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# Egypt

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## 1. INTRODUCTION

Weaning has been defined as the manner in which a child is accustomed to the loss of its mother's milk.[1] However, the word covers many different situations. Sometimes it is used to signify the complete cessation of breast-feeding, or it means complementary feeding when breast milk no longer provides the protein or energy that is necessary for an infant's harmonious development (Whitehead, 1985).

Recommendations and practices concerning complementary foods for infants vary greatly from country to country. Before 1920, complementary foods were rarely recommended for children under one year. The first supplements introduced into the diet were cod liver oil to prevent rickets and orange juice against scurvy. During the following half century, it was recommended that cereals, together with mashed fruit and vegetables, should be given around 6 months of age. After that, a wide variety of baby foods became available and were introduced into the infant's diet at an increasingly early stage.

From then on, the aim of introducing complementary foods was to:

- provide energy, iron, vitamins and possibly other elements
- prepare children for a more varied diet
- prevent deficiencies in minerals.

Breastfeeding is important not only for the satisfactory development and health of an infant, but also because of its effect on fertility and birth spacing.

In Egypt, infants are of normal birth weight and lactation is generally satisfactory for the first four months and in some cases, six months of life. Beyond this point the nutrients supplied by breast milk alone become increasingly insufficient to satisfy the needs of a growing infant. Children begin to move away from reference growth curves. At this age many mothers are not aware of how best to feed their infants. Moderate chronic malnutrition develops as complementary foods are introduced late and often with home-made preparations of low nutrient content. Developing nutritionally adequate low-cost complementary foods and educating the mothers about what, when and how to feed their children are the best measures to combat the multifactorial problem of malnutrition.

[1] Webster, International Dictionary, Vol III, 1989.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

Table 1 presents the prevalence of stunting, wasting and the proportion of children under five years of age who were underweight according to the Egypt DHS surveys of 1992 and 1995. Between the two surveys, the prevalence of wasting and the proportion of children underweight have increased slightly (<3%). The increase in the prevalence of stunting, i.e. chronic malnutrition, is more marked, almost 6% for stunting and approximately 4% for severe stunting.

**Table 1**
**Malnutrition[a] among children under five years of age in Egypt (DHS, 1992 & 1995)**

| | Stunting | | Severe stunting | | Wasting | | Severe wasting | | Underweight | | Severely underweight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 |
| **Age (months)** | | | | | | % | | | | | | |
| <6 | 6 | 7 | 3 | 1 | 2 | 5 | <1 | 2 | 2 | 3 | 0 | <1 |
| 6–11 | 17 | 28 | 7 | 12 | 5 | 10 | 1 | 3 | 11 | 22 | 2 | 6 |
| 12–23 | 36 | 30 | 12 | 18 | 5 | 6 | 1 | 2 | 15 | 19 | 3 | 5 |
| 24–35 | 28 | 35 | 12 | 18 | 3 | 3 | 1 | 1 | 12 | 13 | 3 | 3 |
| 36–47 | 24 | 38 | 10 | 18 | 3 | 3 | <1 | 1 | 6 | 11 | 1 | 2 |
| 48–59 | 21 | 22 | 6 | 6 | 2 | 3 | <1 | 1 | 6 | 10 | 1 | 1 |
| All children | 24 | 30 | 9 | 13 | 3 | 5 | 1 | 1 | 9 | 12 | 2 | 3 |

[a] *As defined in "Catalogue of Health Indicators"(WHO, 1996)*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 3.1 Breastfeeding

All the studies carried out in Egypt over the past decade, especially the Egyptian Fertility Survey in 1980 and the Egyptian Demographic Health Survey in 1988, show that breastfeeding is universal among Egyptian women. The data collected in the 1992 and 1995 Demographic and Health Surveys confirm this. Among children born in the five years preceding the survey, the proportion "ever breastfed" was 95% (El-Zanaty et al., 1993; 1996).

#### *Initiation of breastfeeding*

In 1992, one-quarter of children were put to the breast within one hour of birth and 64% within the first day. In 1995, percentages had increased to 41 and 75% (Table 2). For rural upper Egypt, only 53% were breastfed during the first day. Rural mothers believe that colostrum is harmful to the child. Urban populations are more aware of the importance of early initiation of breastfeeding.

### *Breastfeeding status*

In 1992, 60% of infants below two months of age and 50% at 2-3 months received only breast milk. In 1995, these figures had increased to 76% and 60%, which represents a considerable improvement (Table 3). The exclusive breastfeeding rate (before 4 months) has increased from 54% in 1992, to 68% in 1995. Infant formula was seldom given to breast-fed infants below three months (4%) whereas it was more common to give non-human milk (10%), and other liquids (21%).

### *Median duration of breastfeeding*

In 1995, the median duration of breastfeeding was 18.9 months (Table 4). The early introduction of supplements is related to the short duration of exclusive breastfeeding (1.6 months in 1992), but in 1995 exclusive breastfeeding was much longer (around 3 months). Rural children were breastfed for a longer period than urban children.

**Table 2**
**Initiation of breastfeeding and proportion of children "ever breastfed" in Egypt (DHS, 1995)**

| | Male | Female | Urban | Rural | National |
|---|---|---|---|---|---|
| | | | % | | |
| Ever breastfed | 96 | 95 | 94 | 95 | 95 |
| Initiation of breastfeeding | | | | | |
| - within one hour of birth | 40 | 42 | 43 | 40 | 41 |
| - within one day of birth | 74 | 76 | 81 | 71 | 75 |

**Table 3**
**Distribution of infants by breastfeeding status in Egypt[a] (DHS, 1992 & 1995)**

| Age (months) | Exclusively breastfed | | Not breastfed | | Breastfed and given | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Water | | Supplements | |
| | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 |
| | | | | % | | | | |
| <2 | 60 | 78 | 2 | 1 | 1 | 1 | 38 | 21 |
| 2-3 | 50 | 60 | 4 | 2 | 2 | 3 | 45 | 35 |
| 4-5 | 29 | 31 | 4 | 3 | 7 | 6 | 60 | 60 |
| 6-7 | 15 | 11 | 6 | 6 | 11 | 7 | 67 | 76 |
| 8-9 | 4 | 4 | 14 | 10 | 5 | 6 | 78 | 81 |
| 10-11 | 4 | 2 | 14 | 13 | 6 | 5 | 77 | 80 |
| 12-13 | 4 | 1 | 20 | 19 | 4 | 2 | 72 | 79 |

[a] *Breastfeeding status refers to preceding 24 hours*

### *Bottle-feeding*

In Egypt, the majority of children are not bottle-fed. However, nearly one-fifth of breastfed infants below eight months of age were given a bottle with a nipple on the day before the interview (El-Zanaty et al., 1993 & 1995).

**Table 4**
**Median duration of breastfeeding in Egypt (DHS, 1992 & 1995)**

| | Male | Female | Urban | Rural | National |
|---|---|---|---|---|---|
| | | | months | | |
| **DHS 1992** | | | | | |
| Breastfeeding | 19.2 | 18.9 | 18.2 | 19.7 | 18.9 |
| Exclusive breastfeeding | 1.7 | 1.8 | 0.7 | 2.5 | 1.6 |
| **DHS 1995** | | | | | |
| Breastfeeding | 19.9 | 18.2 | 17.9 | 19.5 | 18.9 |
| Exclusive breastfeeding | 3.1 | 3.1 | 2.4 | 2.6 | 2.9 |

## 4. COMPLEMENTARY FEEDING

### 4.1 Age of introduction of complementary foods

Solid or semi-solids and mashed foods started to be introduced into the diet at the age of 4–5 months (36% of breastfed infants received some), and at 6–7 months (71%) (Table 5). Nearly 25% of breastfed infants were not receiving solid or mashed foods at 12–15 months in 1992, but the percentage had declined to 7% in 1995. Better educated mothers introduce complementary foods in their child's diet sooner than less educated mothers.

### 4.2 Types of complementary foods

In developing countries such as Egypt, complementary foods are mainly flour-based: rice, starches, biscuits, bread, potatoes and sweet potatoes. Protein foods are consumed in insufficient quantities, particularly those of animal origin: milk, cheese, eggs, and meat. Industrially-prepared foods are only consumed by a minority.

Home-prepared cereals in the form of wheat and rice, are used by nearly 40% of either rural or urban populations (Table 6). Starch pudding *Mehalabia* is also used by a higher percentage of mothers in urban than in rural areas. Almost all infants receive infusions such as anise water, caraway, fenugreek, and tea.

With regard to socioeconomic status the following can be mentioned:

- Mothers of the high-income group usually offer various types of complementary foods whether commercial or home-made. These are usually yoghurt, fruit juice, vegetable soup, cereals, and biscuits introduced early during the period of complementary feeding.

- Mothers of the low-income group are accustomed to giving limited types of foods before one year of age. These are diluted fresh animal milk, milk powder, rice or starch water, potatoes, mashed beans, and cheese.

**Table 5**
**Breast-feeding and complementary feeding in Egypt (DHS, 1992 & 1995)**

| Age (months) | Infant formula | | Non-human milk | | Other liquids | | Solid or mashed foods | | Using bottle | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 | 1992 | 1995 |
| | | | | | % | | | | | |
| <2 | 2 | 1 | 13 | 9 | 33 | 16 | <1 | 2 | 16 | 16 |
| 2–3 | 8 | 6 | 15 | 11 | 35 | 24 | 4 | 8 | 21 | 22 |
| 4–5 | 17 | 14 | 27 | 28 | 33 | 42 | 34 | 36 | 21 | 23 |
| 6–7 | 19 | 16 | 31 | 32 | 43 | 47 | 46 | 71 | 17 | 16 |
| 12–13 | 19 | 8 | 34 | 46 | 52 | 54 | 74 | 93 | 8 | 12 |
| 18–19 | 17 | 5 | 47 | 40 | 58 | 61 | 87 | 96 | 4 | 5 |

**Table 6**
**Percentage of infants less than six months fed various complementary foods in Egypt (DHS, 1992)**

| Food | Urban | Rural | National |
|---|---|---|---|
| | | % | |
| Water and sugar[a] | 31 | 100 | 66 |
| Cereal and cereal products | 43 | 37 | 40 |
| Starches | 12 | 7 | 9 |
| Fats and oils | – | 1 | – |
| Eggs | 6 | 1 | 3 |
| Milk and dairy products | 46 | 18 | 32 |
| Legumes | 13 | 5 | 9 |
| Vegetables | 4 | 2 | 3 |
| Soft drinks | – | 5 | – |
| Fruit juice | 3 | – | – |
| Tea | 3 | 2 | 2 |
| Not complemented | 57 | 70 | 63 |

[a] *Feeding infants with water and sugar is a custom in rural areas of Egypt.*

The youngest mothers are the first to vary their children's diet. Children whose mothers are under 20 years of age start receiving complementary foods one month earlier than those of mothers aged 40–49 years. This is perhaps due to the young mothers' higher level of education, and consequently to a greater awareness than older mothers of the need to vary the child's diet as soon as possible after the first 4–6 months.

The place of residence and the educational level of the mothers also affect the average age of introduction of solid foods, and the average delay between the initiation of complementary feeding and definitive weaning. The values of these two indicators are higher, on the one hand, in rural areas than in urban areas and, on the other hand, for illiterate mothers compared to those with a high level of education. It can therefore be concluded that modernization goes hand in hand with the early introduction of complementary foods.

A wide variety of foods is given to children in the 18–24 months age group as shown in Table 7. Non-human milk and dairy products, biscuits, and family food are usually given to children rather than specially prepared foods or ready-made foods for young children.

Egypt has considerable experience, going back over 20 years, in using inexpensive complementary foods for the nutritional rehabilitation of children. These foods rich in plant proteins are prepared locally either at home (for example, *Sesamena* and *Arabena*) or industrially (Supramine). In Egypt, introducing complementary foods using local products is more appropriate and more acceptable culturally because of its economic advantages for the family, community, and society.

**Table 7**
**Percentage of urban children consuming various food items at 18–24 months in Egypt (DHS, 1992)**

| Food item | Percentage |
|---|---|
| *Energy foods* | |
| Cereals and cereal products | 100 |
| Sweets (sesame cake) | 8 |
| Potato and sweet potato | 46 |
| Starches | 8 |
| Sugar | 90 |
| Fats and oils | 25 |
| *Protein foods* | |
| Milk and dairy products | 54 |
| Eggs | 8 |
| Meat or chicken | 18 |
| Legumes (beans, lentils) | 23 |
| Fish | – |
| *Protective foods* | |
| Vegetables | 31 |
| Fruit or juices | 8 |
| Special baby food "Supramine" | 28 |

### 4.3 Adequacy of child diet during the complementary feeding period

The major problem concerning complementary foods prepared at home is their low energy density, which should be increased to take into account the small capacity of the infant's stomach (generally 3% of body weight, i.e. 200 to 300 ml during that period). At the same time, the diet should be balanced in order to meet the infant's energy requirements. Although cereals and some vegetables contain large quantities of starch, they become gelatinous when cooked and produce a thick sticky paste if they are not diluted with water.

The high level of viscosity of semi-liquid or semi-solid complementary foods limits the children's intakes. This problem is usually resolved in Egypt by adding oil or sugar (or both) to foods to improve their energy density without increasing viscosity, or by adding 1% of pure malt to dilute the thick gruel.

Almost 55% of children and their families do not satisfy the recommended dietary allowance (RDA) for energy and almost one-third do not satisfy the RDA for protein, especially in low socioeconomic groups. Some children receive less than 100% of the RDA although there is enough food in the familiy. This group represents 25% of the families. It is in this group that nutrition education would have full benefit as food availability is not a problem in the household. The families that give more to their children than they consume are a minority (14%). One of the main factors that causes inadequacy of child diet is that this diet is mostly the family's diet. Even the gruel specially prepared for the child from cereals or legumes becomes bulky and of high viscosity, and the mother resorts to more dilution to keep it semi-solid thus lowering the energy and nutrient density.

Even though national surveys show that breastfeeding is strongly established in Egypt, the practice of early introduction of complementary foods could harm the nutritional status of children and lessen their natural immunity as a result of insufficient consumption of breast milk.

### 4.4 Development of low-cost complementary foods

The development of low-cost complementary foods has been tested and proved successful in the management of child malnutrition. *Arabena 2*, composed of broad beans, chickpeas and wheat flour, and *Sesamena*, composed of 60% wheat flour, 30% lentils and 10% hulled sesame, were the most interesting food mixes.

An attempt to use a simple low-cost technology for home-processing of complementary foods has also been carried out by the Nutrition Institute. Germination of the previously mentioned formula increased significantly the PER and NPU when compared to the ungerminated formula. The complementary foods which were developed are popularized through national nutrition education programmes all over Egypt, initiated by the staff of the Nutrition Institute.

## 5. REASONS FOR DEFINITIVE WEANING AND MODALITIES

The most common reasons for definitve weaning are subsequent pregnancy in rural and urban areas, 34% and 26%, respectively, and the child being considered old enough, 31% and 14% respectively. In urban high-income groups the most common causes are insufficient milk (3%) and the use of contraceptive pills (27%). Insufficient milk production was suggested to be caused by psychological factors associated with urbanization and modern lifestyle.

In the Arab world, it is generally thought that breastfeeding should be terminated abruptly. It is true that real weaning is somewhat sudden and, as a result, can cause emotional distress and psychological trauma. The most common practice is to smother the nipple with bitter substances made from aloes, quinine, castor oil or even pepper in order to give the breast a disagreeable taste. Rapid weaning is the most common practice in rural areas, especially in Upper Egypt, and among illiterate mothers. While 72% of infants were weaned abruptly in rural areas, the figure was 64% in urban areas. Women aged 40 to 49, women in rural areas and in Upper Egypt, and those who went to school but did not obtain a diploma, are the mothers who breastfed the longest (24 months or more).

## 6. CONCLUSION

For infants, the period when complementary foods are introduced is the most crucial of their lives. This is mainly due to the lower level of maternal antibodies after the first 6 months, the child's vulnerability to surrounding sources of infection during this period, as well as to traditional complementary foods that have a low energy density and are often prepared and kept in unhygienic conditions.

Egypt adheres to the International Code of Marketing of Breast-milk Substitutes, which is now legalised as a national code. Almost all Egyptian children are breastfed for some period of time. Three-quarters of infants are breastfed within one day of birth. Exclusive breastfeeding is common but not universal among children under four months of age. The majority of children are breastfed on demand, and are not fed with a bottle. The median duration of breastfeeding is 19 months, with rural children being breastfed for a somewhat longer period.

Feeding infants with water and sugar is customary in many rural areas. Solid or mushy foods begin to be introduced into a child's diet by the age of 4 months. The proportion of children receiving solid or mushy foods increases rapidly to 71% among those aged 6–7 months. By categories of complementary food used in Egypt, milk, portions from the family pot and preparations such as biscuits are given to nearly 70%, whereas specially prepared foods for infants constitute only about 20% of complementary foods. Type and regularity of complements given are greatly affected by the socioeconomic status of the family. The majority of rural children or children of urban low economic status get diets that are smaller, less energy dense, and with a lower protein–energy ratio than their families.

The most common reason for definitive weaning in rural areas are subsequent pregnancy and child being old enough, while in urban areas insufficient milk production and contraceptive pills are the predominant causes. Late abrupt weaning is practised more often in rural than in urban areas.

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# Eritrea

Alganesh ADHANOM

## 1. INTRODUCTION

Eritrea is a newly independent country and lacks basic data in all sectors, particularly the health sector. However, in recent years a number of regional and national surveys have been conducted, in cooperation with NGOs and United Nations agencies in the field of nutrition and health. The 1993 Health and Nutrition survey, conducted by the Ministry of Health with the assistance of UNICEF, assessed the prevalence of malnutrition and micronutrient deficiencies among women and children under five years of age (UNICEF, 1994). The 1995 Eritrea Demographic and Health Survey provides nationally representative information on young child feeding practices and child nutrition from 0 to 35 months (National Statistics Office, 1997).

## 2. MALNUTRITION AMONG CHILDREN UNDER THREE YEARS OF AGE

In 1995, stunting[1] affected 38% of children under three years of age, while 16% were wasted. The prevalence of severe stunting, was one of the highest in Africa (18%). Stunting was more frequent in the rural (41%) than in the urban areas (29%). Children born after a long birth interval were less likely to become stunted, as well as children of mothers with secondary or higher education. Wasting, on the contrary, was less affected by these factors. The prevalence of stunting increased progressively with age, from birth to 35 months (at 24-35 months it was as high as 57%). The prevalence of wasting reached a maximum between 15 and 18 months (25%) and declined thereafter (National Statistics Office, 1997).

The Health and Nutrition survey found that 55% of infants under one year of age were anaemic (UNICEF, 1994). Moreover, the nutritional status of pregnant and lactating mothers was very inadequate.

## 3. INFANT AND YOUNG CHILDREN FEEDING PRACTICES

Breastfeeding is nearly universal in Eritrea: 98% of children born during the three years preceding the survey were breastfed. A majority of neonates were breastfed within the first day of life (69%), but only 48% were put to the breast within the first hour. Neonates were not fed colostrum because mothers did not know of its values.

The exclusive breastfeeding rate was high (65%) but the practice of giving water in addition to breast milk was not infrequent before the age of 4 months (14%) (Table 1). Approximately 6% of breastfed infants less than 4 months also received non-human milk.

[1] As defined by WHO, 1996.

From the age of 6 months, breast milk alone is no longer sufficient and infants should receive complementary foods. In Eritrea, at 6–9 months, only 45% of infants were fed complementary foods, and 15% were still exclusively breastfed (Macro International Inc., 1997). This is an indication that complementary foods were introduced too late. Moreover, the foods were often inadequate both in quantity and quality. Cereal products were consumed by 30% of infants aged 6–9 months, whereas animal products were given to only 12%. Consumption of animal products was infrequent at all ages; they were given to 20–30% of children between 10 and 29 months.

The rate of continued breastfeeding at one and two years was 92% and 60% respectively (Table 1). The median duration of breastfeeding was 22 months at the national level, but was somewhat shorter, 19.7 months, in the urban areas. There were variations between regions; the shortest median duration was observed in the Southern Red Sea (14.8 months); in other zones it varied between 20 and 23 months. Mothers usually stopped breastfeeding when they were ill and/or pregnant. Uneducated mothers tended to breastfeed longer (22.6 months) than those with secondary or higher education (17.0 months). Although the practice of giving liquids other than breast milk to infants, such as water, juice, tea, and non-human milk was common, the rate of bottle-feeding among breastfed infants under 4 months remained very low (3%).

**Table 1**
**Infant feeding practices in Eritrea (DHS, 1995)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 65 |
| Continued breastfeeding rate at 1 year | 92 |
| 2 years | 60 |
| Timely complementary feeding rate | 45 |

## 4. NATIONAL POLICIES FOR IMPROVING CHILDHOOD NUTRITION AND FEEDING

With regard to nutrition education activities at community level, the Nutrition unit of the Ministry of Health conducts training sessions, workshops and seminars for the training of health workers who train other health workers in the provinces. The health workers train mothers and concerned individuals at all levels of the health system down to the community. In April 1995, training of trainers for advocacy and promotion of breastfeeding was conducted and, in June 1995, the Baby Friendly Hospital Initiative was implemented at national level, and later in July at provincial level. From mid-November to mid-December 1995 international assessors evaluated 45 health centres and hospitals for the BFHI.

The World Food Programme supports the Ministry of Health's efforts to reduce infant and child mortality and morbidity, and to strengthen the preventive health care programme through the promotion of integrated health and nutrition activities and the local production of "DMK", a complementary food made of wheat, chickpeas and oil.

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# Ethiopia

Frew TEKABE

## 1. INTRODUCTION

In 1992, a National Rural Survey of young child feeding practices and nutrition was conducted by the Central Statistical Authority (1993). Unfortunately, no survey has been carried out recently in the urban areas, and most of the information presented here is relevant to the rural sector of the country only.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

Ethiopia is one of the countries of Africa with the highest prevalence of stunting among under-fives (64%). Prevalence exceeds 50% in all age groups from 6 to 59 months. The prevalence of wasting, on the contrary, is low (8%). It peaks at 12-23 months (12%) and decreases to 7% thereafter (Table 1).

**Table 1**
**Malnutrition[a] among children in rural Ethiopia (National Rural Survey, 1992)**

| Age (months) | Stunting | Wasting | Underweight |
|---|---|---|---|
| 6–11 | 57 | 6 | 40 |
| 12–23 | 73 | 12 | 55 |
| 24–35 | 64 | 7 | 50 |
| 36–59 | 62 | 7 | 45 |
| All children | 64 | 8 | 48 |

[a] *As defined in "Catalogue of Health Indicators" (WHO, 1996)*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Breastfeeding is universal in Ethiopia. The proportion of young children "ever breastfed" was near 100% in the rural areas (Central Statistical Authority, 1993).

Only about one third of neonates were put to the breast within the first hour, but initiation was rarely delayed until the second day (20%). Prelacteal feeds such as butter, warm water with sugar, and non-human milk have been reported. The practice of feeding butter to the neonate was very common in many rural areas; it was especially frequent in the North Shewa and North Gonder regions (more than 80% of neonates).

The exclusive breastfeeding rate of rural areas was the highest in Africa (99%), with a median duration of 7.1 months. Almost three quarters of infants aged 6 months were still exclusively breastfed. This shows that introduction of complementary foods was too late for the majority of infants. The timely complementary feeding rate (at 6–9 months) was only approximately 30%. At 12 months, 22% of infants had still not yet received any complementary foods.

The rate of continued breastfeeding at one year of age was approximately 84%. The median duration was 25.3 months, varying among the different regions between 19.7 months (Borena) and 29 months (South Gonder).

## 4. COMPLEMENTARY FOODS

The most common complementary foods were cows' milk, where it was available, and a cereal porridge *Atmit*. Maize flour, and roasted barley flour and sugar, were also used for making porridge. A large industrial plant produces *Faffa*, a complementary food made of wheat flour, defatted soya, skim milk powder and pea flour with vitamins and minerals. The protein content of *Faffa* is 21 g/100 g of dry weight.

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# Ghana

Evelyn LAMPTEY

## 1. INTRODUCTION

Child survival during the first years of life is greatly affected by the child's birth weight, breastfeeding patterns, and the ability of mothers to initiate and carry out safe complementary feeding practices.

In Ghana infants grow very well during the first six months of life because they are fully breastfed. However, after 6 months growth begins to falter. This is primarily because breast milk alone cannot sustain rapid growth and has to be complemented.

The period of complementary feeding has been identified as the most critical because of:

- the untimely introduction of complementary foods
- the low energy and protein density of traditional complementary foods, and the fact that most mothers give them without a protein source.

In the past, efforts to address this problem included the education of the general public, particularly mothers, on the addition of protein-rich foods such as groundnuts, milk or fish powder to their children's porridge, the institution of supplementary feeding programmes in health institutions throughout the country, and the import of cereal-based complementary foods.

In spite of all those efforts, the prevalence of malnutrition is still high in preschool children; in 1993, 28% of children under 3 years of age were underweight, and 26% were stunted.[1] Moreover, the prevalence of wasting among children under 3 years of age has increased from 8% in 1988 to 12% in 1993. It reached a maximum of almost 30% at 23 months, while at 21 months nearly half of Ghanaian children were stunted (Macro International Inc., 1993 & 1995).

The National Nutrition Conference of 1974 stated that complementary foods were urgently needed, especially a mixture that could be made by mothers at home. The Conference further recommended that the whole question of complementary foods should be examined carefully and urgently by the Government. In 1981, the Joint FAO/WHO/OAU Regional Food and Nutrition Commission for Africa and the Ghana Government assessed the nutrition situation in the country and strongly recommended the development of low cost but nutritious complementary foods made from local ingredients. As a follow-up to these recommendations the Joint Commission and the Nutrition Division developed *Weanimix*, a cereal/legume product which contains more protein than the traditional porridge.

[1] As defined by WHO, 1996.

## 2. BREASTFEEDING PRACTICES

### 2.1 Prelacteal feeding

According to the 1989 survey on Improving Young Child Feeding Practices, all neonates, with rare exceptions, were given something before the first breastfeed. The type of foods given, and reasons for giving them are presented in Table 1.

### 2.2 Initiation of breastfeeding

The 1993 Ghana Demographic and Health Survey (GDHS) showed that a large proportion of neonates was not breastfed during the first day of life (Table 2) (Macro International Inc., 1995).

Colostrum was given to 50% of neonates. The resistance against feeding colostrum was strongest in the northern part of the country, where only one mother out of 28 said she fed colostrum because the baby was hungry. Some mothers in the coastal and forest areas, as well as those in the north, discard colostrum because they believe that it is "bad milk" that will harm the baby. Mothers who gave colostrum said they gave it because it was "part of breast milk".

### 2.3 Modalities of breastfeeding

According to the five nationally representative surveys conducted in the country,[2] over 90% of mothers breastfed their babies. The most recent Ghana DHS showed that 97% of infants and young children born during the last 5 years were breastfed.

Although breastfeeding is universal in Ghana, the exclusive breastfeeding rate was only 8% in 1993. Nevertheless, it had increased since 1988, when it was as low as 2%. Mothers often gave water in addition to breast milk to infants under 4 months (51%).

Results from the survey on Improving Young Child Feeding Practices showed that infants under 4 months were breastfed on demand. Mothers offered the breast anytime the baby cried, sometimes reporting as many as 20 feeds per day. Water was also given several times a day, sometimes before breastfeeding, because mothers felt the infant needed water or was thirsty.

The mean duration of breastfeeding by type of feeding is given in Table 3. On average, Ghanaian mothers practised predominant breastfeeding for a period of approximately 6 months. Between 1979/80 and 1988 no significant change in the duration of predominant breastfeeding was observed, but between 1988 and 1993 there was a slight increase (Table 3). However, the entire duration of breastfeeding (including the period of complementation) rose from a mean of 15.1 months in 1979/80 to 20.4 months in 1988, and 22.0 in 1993, leading to a subsequent increase in the duration of complementary feeding. In 1993, the rate of continued breastfeeding was 94% at 1 year, and 53% at 2 years. Efforts to support breastfeeding have had quite an impact over the years, leading to a noticeable increase, both in the duration of predominant breastfeeding and complementary feeding.

[2] 1979/80 Ghana Fertility Survey (GFS); 1988 Ghana Demographic and Health Survey (GDHS, 1988); 1987/88 Ghana Living Standards Survey (GLSS); 1989 Survey on Improving Young Child Feeding Practices; 1993 Ghana Demographic and Health Survey (GDHS, 1993).

In 1988, the rate of bottle-feeding among children under 4 months was very high (53%), but declined very significantly to 24% in 1993.

## 3. COMPLEMENTARY FEEDING

### 3.1 Introduction of porridge

Although children 4–6 months were fed on demand many times a day, they were also given other liquids or foods. Water was given, as well as a thin porridge made from maize or millet, which was fed about 1–5 times a day. According to mothers, the most common reason for complementing the diet was that breast milk alone did not satisfy the baby (the baby cried after breastfeeding or did not sleep well at night).

**Table 1**
**Reasons for giving prelacteal foods**

| Type | Reasons |
|---|---|
| Water | "customary" to do so to welcome baby |
| Glucose Water | baby is crying/hungry |
| Evaporated Milk | baby's "throat is dry" |

**Table 2**
**Time elapsed between delivery and the first breastfeed**

| Characteristic | Among last-born children percentage who started breastfeeding | | |
|---|---|---|---|
| | within 1 hour of birth | within 1 day of birth | No. of children |
| Urban | 18.2 | 50.4 | 581 |
| Rural | 14.5 | 41.5 | 1446 |

**Table 3**
**Mean duration of breastfeeding by type (in months)**

| Type | GFS 1979/80 | GLSS 1987/88 | GDHS 1988 | GDHS 1993 |
|---|---|---|---|---|
| Predominant breastfeeding [a] | 5.2 | - | 5.0 | 8.0 |
| Complemented | 9.9 | - | 15.4 | 14.0 |
| Entire Duration [b] | 15.1 | 17.0 | 20.4 | 22.0 |

[a] *predominant breastfeeding: refers to feeding on breast milk/water only.*
[b] *based on mothers whose penultimate child survived for at least 12 months.*

Some mothers were complementing as early as the second week of life. In 1993, 3% of infants less than 4 months were already receiving complementary foods. Only approximately one child out of three was fed according to WHO recommendations between 6 and 9 months of age (WHO, 1991): the rate of timely complementary feeding was 36%. Moreover, 63% of children 6–9 months were not yet complemented, with 20% receiving breast milk only or breast milk and water, and 43% breast milk and other liquids. Since 1988, there was a twofold increase in the proportion receiving breast milk and other liquids.

### 3.2 Cessation of porridge consumption

In Ghana there is no specific age at which mothers cease feeding their children porridge. The frequency of feeding porridge may be reduced when solid food is given.

### 3.3 Nature of porridge

The traditional practice is to give plain maize or millet porridge (these cereals are available locally). The porridge is watery and may be served plain or with sugar and, less frequently, with milk. A legume paste may also be added. In the north, shea butter or, more rarely, fish powder is added.

One of the intervention measures which has been instituted to promote infant nutrition is the production of a cereal legume composite flour called *Weanimix*. It is composed of four parts of cereal to one part of legume. This product contains more protein than the traditional porridge. Ingredients for preparation of *Weanimix* are cereals (maize, millet or sorghum) and legumes (cowpeas, groundnuts or both). For instance, to make *Weanimix* from maize, white beans, and groundnuts, the method of preparation is the following:

- Clean the ingredients (i.e. remove stones, bad grains).
- Measure with a measuring cup:
  - 4 cups maize
  - ½ cup white beans
  - ½ cup groundnuts
- Roast each lightly (groundnut should be roasted to brown); peel groundnuts.
- Mix roasted maize with roasted beans and groundnuts thoroughly.
- Take mix to a maize milling machine and mill two or more times to a smooth powder.
- Leave it to cool and then put powder into polythene bags and store in a tin with a tight lid.

### 3.4 Other porridges

There are several other types of porridge fed to infants; *plain akasa* (prepared from fermented maize dough), *Tombrown* (from roasted maize) and *FRIweaner* (a flour made from maize, beans, groundnuts and milk). Their methods of preparation are somewhat similar to that of *Weanimix*:

#### *Plain akasa*

- Soak maize for 2 days.
- Wash and send to the mill on the third day.

- Mix the flour with a little water and allow to ferment overnight.
- Use the fermented dough to make the porridge (this same method is used for millet or sorghum porridge).

*Tombrown*

- Roast maize to light brown colour.
- Send the roasted maize to the mill and use the flour for the preparation of porridge. (Note that there is no addition of beans or groundnut).

*FRIweaner*

- Mix one cup of *FRIweaner* with one and a half cups of cold water to prepare slurry.
- Stir into one cup of boiling water.
- Cook for 5 min.
- Add sugar and salt to taste.

The mean nutrient contents of *FRIweaner* are shown in table 4.

**Table 4**
**Nutrient content of *FRIweaner***

| Nutrients | per 100 g dry meal |
|---|---|
| Moisture (g) | 4.6 |
| Energy (kcal) | 413 |
| Protein (g) | 18 |
| Fat (g) | 9 |
| Calcium (mg) | 220 |
| Phosphorous (mg) | 239 |
| Iron (mg) | 9 |

### 3.5 Modalities of distribution of porridge

*Daily frequency of preparation*

Porridge is usually prepared once a day and stored for subsequent feeding.

*Daily frequency of distribution*

From 4-6 months, porridge may be fed 1 to 5 times a day. During the second half of the first year, porridge is still fed to infants although the frequency of distribution is reduced. Between 19 and 24 months porridge is fed at least once a day in addition to the solid foods given.

### 3.6 Solid foods

On average mothers start feeding solid foods from the age of 7 months, although quite a few may start a little earlier, i.e. around 4 months, or as late as 18 months.

Common foods fed to young children are prepared from cereals (*banku*, *akple*, *tuo zaafi* which are stiff porridges of maize or guinea maize served with vegetables or green leafy sauces). In forest areas boiled tubers mashed with *kontomire* (cocoyam leaves) stew may be fed. Rice and vegetable sauce may also be given. Fish is generally not served between the ages of 7 and 11 months but is fed, although in very small quantities, from 12–18 months.

### *Frequency of feeding solid foods*

The frequency of feeding solid foods and the quality of meals are low; moreover, the quantity of food given tends to be small. Solid foods are served 1–3 times a day from 7–11 months and more commonly twice a day. Young children are normally fed by their mothers; the porridge is given by spoon or cup, and the solids by hand.

Children 12–18 months are fed the same type of solid foods with a frequency of 1–4 times a day. The amount of sauce accompanying the staples is small.

Between 19–24 months solid foods are given 1–3 times a day, more commonly twice. Some children are fed by their mothers while others eat by themselves with other children.

### *Patterns of intra-household distribution of food*

In the typical Ghanaian home the men are served first. The women and girls of the household eat from one shared bowl, while all children eat together. Where there are children below the age of 12 months, they are fed by their mothers from their own plates. However, boys and girls from the same household are served separately.

## 4. FOOD TABOOS

Food taboos have not been studied with regard to complementary feeding of infants and young children. Some foods such as fish, beans, *gari* and meat are not given to infants because mothers think children cannot chew or digest them. But eggs are avoided in certain parts of the country because it is believed that children who eat eggs will become thieves.

## 5. CONCLUSION

In Ghana, infant and young child feeding practices are often inappropriate. The major problems are:

- strong cultural beliefs against the use of colostrum especially in the northern part of the country;
- strong belief in the need for babies to drink water even when fed on the breast only;
- lack of confidence in adequacy of breast milk leading to early introduction of complementary feeding;
- universal practice of bottle feeding;
- too early or too late introduction of complementary foods;
- poor quality of traditional complementary foods.

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# Guinea

## 1. INTRODUCTION

Two nationally representative surveys of infant feeding practices were conducted in Guinea: in 1992, a Demographic and Health Survey (Keita et al, 1994), and, more recently, in 1996, a Multiple Indicators Survey (Keita et al, 1996).

The DHS survey provides information on feeding practices of children under 5 years of age, whereas in the Multiple Indicators Survey mothers were interviewed about feeding of children under the age of two years. Unfortunately, the reports do not present information on the nutritional status of young children.

## 2. INFANT AND YOUNG CHILD FEEDING PRACTICES

Breastfeeding is universal in Guinea. In 1992, almost all infants were breastfed: the proportion of children under 5 years "ever breastfed " was 93%. Nevertheless, initiation of breastfeeding was not early, as only 38% of last-born infants were put to the breast within the first hour of birth. Moreover, initiation was often delayed until the second day (42% of neonates) (Keita, 1994).

Exclusive breastfeeding is not a custom in Guinea and its rate was low (8%) (Table 1). The practice of giving water or other water-based liquids was very common. Before the age of 2 months, 63% of infants were already receiving plain water. The median duration of breastfeeding either exclusive or with plain water was only 4 months (Keita, 1994).

**Table 1**
**Infant feeding practices in Guinea (DHS, 1992)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 8 |
| Timely complementary feeding rate | 31 |
| Continued breastfeeding rate at 1 year | 92 |
| Bottle-feeding rate [a] | 9 |

[a] *according to the MIS survey (Keita et al., 1996)*

The rate of continued breastfeeding at one year was 92%. Overall the median duration of breastfeeding was 23.5 months. Mothers from rural areas breastfed longer (24.6 months) than urban mothers (21.4 months). Mothers with secondary or higher education stopped breastfeeding earlier (21.6 months) than other mothers (23.7 months).

Although liquids other than breast milk were given too early, the introduction of complementary foods was too late: at 6-9 months, only 31% were receiving complementary foods (Keita, 1994). The first complementary food is usually a rice or *acha*[1] based porridge.

Bottle-feeding is not widespread in Guinea; the rate was 9% among breastfed infants less than 12 months (Keita et al, 1996). Although the rate had not changed noticeably since 1992 at the country level, more urban mothers were using bottles: the rate was 13% in Conakry, whereas it was only 7% in the rural sector.

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[1] Digitaria spp.

# Islamic Republic of Iran

Zahra ABDOLLAHI

## 1. INTRODUCTION

Two nationally representative surveys of child nutrition and infant feeding practices were conducted in Iran: the National Survey in 1991, and the Multiple Indicators Cluster Survey in 1995 (Ministry of Health, 1991 & 1995).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

The prevalence of malnutrition observed during the 1995 survey is shown in Table 1.

**Table 1**
**Malnutrition[a] among children under five years of age in Iran (MICS, 1995)**

| | Stunting | Wasting | Underweight |
|---|---|---|---|
| | | % | |
| Male | 25 | 6 | 15 |
| Female | 18 | 7 | 16 |
| Urban | 12 | 8 | 13 |
| Rural | 25 | 6 | 19 |
| All children | 19 | 7 | 16 |

[a] *As defined in "Catalogue of Health Indicators" WHO, 1996.*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 3.1 Breastfeeding

Although almost all infants were breastfed for some period of time — the proportion " ever breastfed " was 95% — initiation of breastfeeding was often delayed: only 21% of neonates were put to the breast within two hours of birth (14% in the urban sector, 30% in rural areas). Nevertheless, 81% of the infants were fed colostrum.

In 1995, the exclusive breastfeeding rate was 48% (39% in urban and 54% in rural areas). About 31% of infants were given water in addition to breast milk. Most mothers breastfed into the second year. Rates of continued breastfeeding at one and two years were 88% and 41% respectively. The mean duration of breastfeeding was 20.5 months.

### 3.2 Complementary feeding

The timely complementary feeding rate was 93% at national level, 96% in urban centres, and 89% in rural areas (Ministry of Health, 1995). As shown in Table 2, complementary foods were introduced too early both in the urban and rural sectors.

**Table 2**
**Percentage of children receiving complementary foods by age in Iran (Ministry of Health, 1991)**

| Age (months) | Urban | Rural | National |
|---|---|---|---|
| 0–1 | 11 | 21 | 15 |
| 2–5 | 64 | 51 | 58 |
| 6–11 | 99 | 92 | 96 |

The most common foods for infants between 2 and 5 months were juice, bread, tea, and cereals. Between 6 and 11 months infants were given the following: juice, family food, soup, bread, and tea. Main ingredients, energy density and protein and fat contents of some typical Iranian complementary foods are shown in Table 3.

**Table 3**
**Composition and nutrient content of complementary foods in Iran**

| Types | Ingredients | Energy density kcal/100 g | Protein g/100 g | Fat g/100 g |
|---|---|---|---|---|
| Pudding (*fereny*) | Rice flour<br>Sugar<br>Milk | 107 | 3–5g | 1 |
| *Shir berenge* | Rice<br>Milk | 67 | 2–5 | 2–5 |
| *Harireh badam* | Almonds<br>Rice flour<br>Sugar | 60 | 3–5 | 2–5 |

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# Jordan

Abdel Monim SALLAJ

## 1. INTRODUCTION

Two nationally representative surveys of child nutrition and infant feeding were conducted in Jordan: the first was a Demographic and Health Survey conducted in 1990 (Zou'bi et al, 1992), while the second was a survey carried out in 1991 by the Ministry of Health and UNICEF (1993).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

The 1991 survey used a stratified clustered multistage design covering a large representative sample of Jordanian children below five years of age (n=8113) from all eight governorates (Ministry of Health, 1993). The prevalence of malnutrition was low, as only 9% of children were underweight, 16% were stunted and 2% were wasted.[1] The level of malnutrition was very similar to the DHS estimates (Zou'bi et al, 1992). In particular, both surveys found that stunting was more prevalent in rural areas (27%) than in urban (16%) (Zou'bi et al, 1992).

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 3.1 Breastfeeding

According to the 1991 survey, 93% of children born during the preceding five years were breast-fed, but only 74% were breastfed for more than 4 months. Most newborn infants were given colostrum (86%), but only 60% were put to the breast within 6 hours of birth.

Supplementing breast milk with other liquids like herbal teas, sugar or glucose water was very common among mothers (Ministry of Health, 1993). The 1990 DHS indicated that the exclusive breastfeeding rate was 32%.

The median duration of breastfeeding was 12 months at national level, 13 months for rural areas and 12 months for the urban sector.

Almost 50% of children were bottle-fed at one stage of their lives, the average age for introducing breast-milk substitutes being 3.7 months. A bottle was given to two in ten infants at 0–1 month, and the rate of bottle-feeding before the age of 12 months was 31%. A good proportion of mothers, 20%, used a diluted formula for their children. Diluted formulae are among the major causes of bottle-fed children's failure to thrive. Only 73% of mothers used boiled water for preparing formula (Zou'bi et al, 1992).

[1] As defined by WHO, 1996.

### 3.2 Timing of introduction of complementary foods

Introduction of complementary food was very early for 23% of children (Table 1). Supplementary foods were given to children as early as the first month whether they were breastfed or not; for example, 13% of infants aged 2–3 months received complementary foods (Zou'bi et al, 1992). Many foods, such as bread, eggs, legumes, rice, and yoghurt, were introduced earlier than recommended. Consumption of caffeinated beverages like tea and soda was high, and many mothers regarded them as nutritive foods.

Infants were given commercially canned foods between 4 and 6 months of age. Sugar consumption was very high among children; sugar was added to milk, water, tea, and juice.

The majority of children were fed a diet composed of a variety of items from all food groups. A few mothers served raw eggs to their children regularly. This is a bad habit that can cause a nutritional hazard called egg-white injury due to deficiency of biotin, as well as increase the risk of salmonellosis contamination. The majority of children were introduced to family foods at the age of 7 months.

**Table 1**
**Percentage of infants receiving complementary foods by age in Jordan (Ministry of Health, 1993)**

| Age (months) | % |
|---|---|
| 0–3 | 23 |
| 4–5 | 54 |
| >6 | 23 |

### 3.3 Description of complementary foods

Almost 60% of children were given special transitional foods at one stage of their life. Processed cereals were the main foods given to them. The timing of introduction of the various food groups was the following:

- dairy products: yoghurt and *labaneh* were introduced on average at 5 months;
- fruits and vegetables: fresh fruit juice was mostly introduced at an ideal age, i.e. 5 months, and was given 3 times a week as a source of vitamin C;
- red and white meat was given twice a week from the age of 7 months. Chicken was introduced at 6 months, i.e. earlier than recommended, and a large proportion of children consumed it twice a week;
- eggs: soft and hard-boiled eggs were consumed 3–4 times per week;
- bread was given one month earlier than recommended and almost every day;
- pasta, cereals, and grains were given once or twice a week. Rice, in the form of powdered rice, was introduced first, and was mainly given as early as the second month;
- legumes: lentils with broad beans, followed by chickpeas were consumed twice a week;
- potatoes were introduced between 4–6 months and served 2–3 times a week;

**Table 2**
**Recommended and actual age of introduction of complementary foods in Jordan (Ministry of Health, 1993)**

| Type of food | Actual age of introduction | Recommended age of introduction |
|---|---|---|
| | months | |
| Yoghurt and *labaneh* | 5 | 6 |
| Fruits | 5 | 5 |
| Vegetables | 5 | 4 |
| Cereals and grains | 6 | 5–6 |
| Rice | 6 | 5–6 |
| Pasta | 6 | 5–6 |
| Rice pudding | 2 | 6 |
| Custard | 5 | 6 |
| Red meat | 6 | 7–9 |
| Chicken | 6 | 7–9 |
| Egg yolk | 5 | 6 |
| Whole eggs | 5 | 7–9 |
| Bread/biscuits/cake | 6 | 7–9 |
| Legumes | 6 | 8 |

- biscuits, crackers, and cakes were the children's favourite foods and were consumed between 4 and 7 times a week;
- custard pudding and cream caramel were given from the age of 5 months, 2–3 times a week;
- beverages: carbonated beverages were given mostly with snacks to some infants older than 4 months; water was given every day to most infants from the first months;
- honey, jam, and marmalade were given about 4 times a week;
- family food was introduced regularly from 6 months of age.

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# Lebanon

Moustafa ITANI

## 1. INTRODUCTION

For many years no survey of infant and young child nutrition and feeding practices was carried out because of the civil war in Lebanon. Two surveys, however, conducted in 1990 and 1993 provide some information which is presented here (Deeb and Jabbour, 1990; PAPCD, 1993).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

The Pan Arab Project for Child Development survey showed that the prevalence of malnutrition[1] was low in Lebanon (PAPCD, 1993). The proportion of children classified as underweight was only 3%. Stunting affected 12% of under-fives, and wasting only 3%.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

The survey conducted in 1990 with the support of UNICEF indicated that the large majority of Lebanese infants were breastfed for some period of time: the proportion "ever breastfed" was 90% (Deeb and Jabbour, 1990).

The practice of exclusive breastfeeding, however, was rare (Table 1). Moreover, the mean duration of breastfeeding was short (9 months).

The main feature of infant feeding in Lebanon was the high rate of bottle-feeding. Almost three-quarters of infants less than 12 months were bottle-fed (WHO, 1996a).

**Table 1**
**Infant feeding practices in Lebanon (UNICEF, 1990)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 7 |
| Timely complementary feeding rate | 32 |
| Bottle-feeding rate | 73 |

[1] As defined by WHO (1996b).

## REFERENCES

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# Libyan Arab Jamahiriya

Fawzi Bashir AL BADRI

## 1. INTRODUCTION

A Pan Arab Project for Child Development survey conducted in 1995 provides information on feeding practices and nutrition of children under five years of age (PAPCD, 1997).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

The overall prevalence of malnutrition was low (Table 1). Only 5% of children under five years were underweight. The prevalence of stunting, however, was 15% and was higher in the rural sector. The prevalence of wasting was low. Stunting affected more boys (16%) than girls (14%), but there were no differences by sex for wasting and percent of children underweight.

**Table 1**
**Malnutrition[a] among children under five years of age in Libya (PAP Child survey, 1995)**

| | Stunting | Severe Stunting | Wasting | Severe wasting | Underweight | Severely Underweight |
|---|---|---|---|---|---|---|
| | | | | % | | |
| Urban | 14 | 4 | 3 | <1 | 4 | 1 |
| Rural | 18 | 5 | 3 | 1 | 6 | 1 |
| All children | 15 | 5 | 3 | <1 | 5 | 1 |

[a] *As defined in "Catalogue of Health Indicators" (WHO, 1996)*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 3.1 Breastfeeding

Approximately 96% of the neonates have been breastfed for some period of time. The mean duration of breastfeeding was 11 months. In rural areas 55% of children were exclusively breastfed compared to 51% in cities.

### 3.1 Complementary feeding

Breastfeeding is usually complemented with mashed vegetables and fruits from the age of 4-5 months.

Soft complementary foods are prepared from cereals, pulses and mashed fruits, and vegetables. The foods are produced locally or come from imported canned and packaged products. Children are sharing the family pot around 12 months of age. At this age the meal frequency is three times a day.

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# Madagascar

## 1. INTRODUCTION

Two Demographic and Health Surveys were conducted in Madagascar by the Centre de Recherches sur l'Environnement:[1] the first in 1992, and the second in 1997 (CNRE, 1993). The results of the second DHS are not yet available.

The 1992 DHS survey provides information on nutrition and breast-feeding practices for children under five years.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

In Madagascar, more than one child out of three was underweight (39%) before the age of five years. The prevalence of stunting[2] was one of the highest in Africa (51%), and severe stunting was frequent (24%). The prevalence of wasting, on the contrary, was moderate (5%) and severe wasting was exceptional (less than 1%).

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Breastfeeding is universal in Madagascar. The proportion of children "ever breastfed" was 97%. Early initiation of breastfeeding was infrequent: only 6% of neonates were put to the breast within the first hour of birth. Moreover, approximately 55% were not given the breast before the second day of life (CNRE, 1993).

Approximately half of the infants under 4 months were exclusively breastfed, 21% were given water, and 22% other liquids in addition to breast milk (Macro International Inc., 1993) (Table 1).

The timing of introduction of complementary foods was generally appropriate; mothers started introducing them at 4–5 months (46% of infants). However, a small proportion of infants were given foods too early (10% at 2-3 months) (CNRE, 1993). The timely complementary feeding rate was high (Table 1). Nevertheless, about 20% of infants aged 6–9 months were still not receiving complementary foods at an age when breast milk is no longer sufficient to meet their energy and nutrient requirements.

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[1] Madagascar national research centre for the environment.
[2] As defined by WHO, 1996.

**Table 1**
**Infant feeding practices in Madagascar (DHS, 1992)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 47 |
| Timely complementary feeding rate | 79 |
| Continued breastfeeding rate at 1 year | 91 |
| 2 years | 45 |
| Bottle-feeding rate | 3 |

Bottle-feeding was very unusual: less than 5% of infants were bottle-fed in all age groups.

Almost all mothers breastfed into the second year as shown by the high continued breastfeeding rate at one year (Table 1). The median duration of breastfeeding was 19.4 months (CNRE, 1993).

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# Malawi

Henry J. MDEBWE

## 1. INTRODUCTION

Malnutrition continues to undermine the health, physical and mental development of Malawian preschool children. The 1992 Demographic and Health Survey showed that 49% of children under five years of age were stunted,[1] 27% were underweight, and 5% were wasted (Macro International Inc., 1994). Micronutrient deficiencies of vitamin A, iron, folate, and iodine were also prevalent in this age group throughout the country.

One of the immediate causes of the poor nutritional status is the inappropriate child feeding practices, which are underlined by widespread maternal illiteracy, poor extension services on complementary foods and proper feeding practices, and poverty among the majority of Malawian households.

## 2. BREASTFEEDING

### 2.1 Initiation of breastfeeding

Initiation of breastfeeding is universal among Malawian mothers. A recent Baby Friendly Hospital Initiative (BFHI) assessment has shown that the timing of initiation of breastfeeding varies from within 30 minutes after delivery, to over 24 hours depending on the condition of the mother as well as clinical knowledge of lactation management among the maternity staff.

The practice of giving prelacteal foods during the first few hours/days after birth exists in a few cultural groups and hospitals in Malawi. Documented prelacteal foods include plain water, glucose solution, and plain raw porridge known as *dawale*. Whether practised in a village or hospital setting, prelacteal feeding delays initiation of breastfeeding significantly. According to the DHS, 90% of neonates were put to the breast within the first day of birth. Though not properly documented, it is feared that a few communities, especially those in the Shire valley discard colostrum, as mothers believe that it is harmful to their infant's health.

### 2.2 Modalities of breastfeeding

About 97% of Malawian mothers breastfeed for varying duration (National Statistical Office, 1994). However, exclusive breastfeeding is uncommon, and only 5% of children under 2 months of age were fed breast milk alone. Before the age of 4 months, the exclusive breastfeeding rate was 3%. Moreover, 45% of infants were receiving water in addition to

[1] As defined by WHO, 1996.

breast milk (Macro International Inc., 1994).

Changing this trend is an uphill extension battle, for it is widely believed among both health workers and communities that an infant cannot thrive on breast milk alone for 4–6 months after birth. This is further exacerbated by a mandatory three-month maternity leave among working class mothers in the private sector, and lower industrial groups in the civil service. There are virtually no breastfeeding facilities in most offices and work places. Hence, the majority of working class mothers breastfeed during the evening, at night and early in the morning, and infant formula and other food supplements are fed to their infants by their caretakers during working hours.

According to the DHS, rates of continued breastfeeding at 1 and 2 years of age were 93% and 56% respectively. The median duration of breastfeeding was 21.2 months (National Statistical Office, 1994).

The proportion of children who were not breastfed was low (less than 2%), in all age groups during the first year. Among breastfed infants, 4% of infants under 4 months were also bottle-fed (Macro International Inc., 1994).

## 3. COMPLEMENTARY FOODS

### 3.1 Age of introduction

The rate of timely complementary feeding was high (87%), but introduction of complementary foods was much too early; 25% of infants aged 0–1 months, and 60% of infants at 2–3 months were already receiving "solid or mushy" foods (National Statistical Office, 1994).

### 3.2 Consumption of porridge

The 1992 DHS is the only survey regarding age of introduction of complementary foods among Malawian children, but unfortunately porridge was not specifically mentioned in this survey. Porridge is introduced as early as one month of age in a few communities, depending on the cultural beliefs. Cereals, roots, and tubers are given to a majority of infants before six months of age. Pulses, vegetables, and animal protein are introduced after six months.

No study regarding the age of cessation of porridge consumption has been conducted in Malawi.

#### *Nature of porridge*

A traditional complementary porridge is usually prepared from plain white maize flour or whole grain maize flour. In the early months of an infant's life, the porridge is prepared thin and is gradually thickened, as the infant grows older. An energy and nutrient dense complementary food known as *Likuni Phala,* was introduced in the 1960s. Its recipe has changed over the years due to difficulty with its shelf life. The industry has finally settled for a 4:1 ratio of roasted or extruded maize and bean flours.

#### *Modalities of distribution*

So far, there has been no study on the frequency of preparation and distribution of porridge in a typical day among either urban or rural children. Frequency of distribution ranges from at least two to five times per day; it probably varies, however, between urban and rural areas, lower income and higher income groups, and between literate (educated) and illiterate mothers. It is noteworthy that factors such as fuel scarcity, busy schedules of the mothers, etc. are likely to affect the frequency of porridge preparation and distribution. Nevertheless, more research is needed on the age of introduction of porridge, the age of cessation of porridge consumption and on the modalities of distribution.

### 3.3 Consumption of solid foods

#### *Age of introduction*

There could be inter- and intra-household variation in the age at which solid foods are introduced to infants. Infants who show more interest in food when adults are having a family meal, are more likely to be introduced to solid foods early in life than those who do not show marked interest.

#### *Frequency of meals according to age*

This is an area that requires further research. In most households meals are prepared twice a day and a child partakes of the meal along with the rest of the family members.

## 4. FOOD TABOOS

Malawian communities, like most African communities, have taboos that interfere with food intake of all age groups. There are many taboos associated with breast-feeding and complementary feeding, but the following are frequently mentioned:

- Breast milk expression: it is believed that infants will be cursed and hence suffer many misfortunes in their adulthood if their mother's breast milk drops on the ground. This belief is still held strongly in some rural areas of the country and tends to interfere with the advice on expression of breast milk as promoted by the BFHI.
- Consumption of eggs: there has been a belief in the past that children who were fed eggs became thieves in their adulthood. This belief still prevails in some remote communities in the country.

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# Mali

## 1. INTRODUCTION

Two Demographic and Health Surveys were conducted in Mali, the first in 1987 (Traoré et al, 1989) and the second in 1995–96 (CPS, 1996). Information on feeding practices was collected and anthropometric measures were taken among a representative sample of children under 3 years of age; therefore, trends in feeding and nutrition of infants and young children could be assessed over almost a decade.

## 2. MALNUTRITION AMONG CHILDREN UNDER THREE YEARS OF AGE

In 1987, 24% of children were stunted, and 11% were wasted. The main risk factors for stunting were short birth intervals (<2 years) and rural residence. The prevalence of wasting reached a maximum at 12-15 months (approximately 16%) while stunting continued to increase sharply to reach 40% at about 22 months (Macro International Inc., 1993).

As shown in Table 1, the nutrition situation in 1995–96 had deteriorated since the previous survey in 1987 (Macro International Inc., 1996). This is not a methodological artefact as methodologies were comparable: in 1995–96, 33% of children were stunted and 25% were wasted. The prevalence of wasting has more than doubled, but the increase in stunting is also significant (38%). The increase in the prevalence of malnutrition could be a consequence of the long-lasting Malian economic crisis affecting food security and access to health care.

**Table 1**
**Malnutrition[a] among children 3–35 months of age in Mali (DHS, 1987 & 1996)**

| Year of survey | Stunting | Wasting | Underweight |
|---|---|---|---|
| | | % | |
| 1987 | 24 | 11 | 31 |
| 1996 | 33 | 25 | 44 |

[a] *As defined in "Catalogue of Health Indicators" (WHO, 1996)*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

During the first Mali DHS, only a limited number of indicators were documented (exclusive breastfeeding rate, breastfeeding with plain water, timely complementary feeding rate), and therefore trends in feeding practices were only estimated for these indicators (Traoré et al, 1989; Macro International Inc., 1993).

Although breastfeeding is universal in Mali — 95% of children born during the three years before the survey were breastfed — initiation of breastfeeding is usually not early (CPS, 1996). Only 65% of neonates were breast-fed within the first day of life and 10% within the first hour. Mothers with secondary or higher education were more likely to breastfeed their child very early (17% breastfed within the first hour).

Exclusive breastfeeding is uncommon in Mali because most mothers give water to their infant. The exclusive breastfeeding rate was only 10% in 1987, and it has not progressed significantly, with a rate of 12% in 1996 (Table 1). The proportion of infants less than 4 months receiving water in addition to breast milk has remained stable between the two surveys, (about 66%). In 1996, the median duration of exclusive breastfeeding was 1.5 months (CPS, 1996).

**Table 2**
**Infant feeding practices in Mali (DHS, 1995-96)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 12 |
| Timely complementary feeding rate | 31 |
| Continued breastfeeding rate at 1 year | 93 |
| 2 years | 60 |
| Bottle-feeding rate [a] | 3 |

[a] *among breastfed infants*

Nevertheless, mothers breastfeed for a long time; in 1996, the rates of continued breastfeeding at one and two years of age were 93% and 60% respectively (CPS, 1996). Moreover, the median duration of breastfeeding, 21.6 months, had not changed since 1987 (Traoré et al, 1989; CPS, 1996).

In Mali, introduction of complementary feeding is too late for a majority of infants. In 1987, only 46% of infants aged 6–9 months were receiving complementary foods (Macro International Inc., 1993). Furthermore, the proportion has decreased to 31% between the two surveys, representing a 30% reduction in the timely complementary feeding rate over less than a decade (Macro International Inc., 1996).

First complementary foods are usually cereals. At 10–11 months, 57% of infants were fed cereals, and 26% animal foods (fish, meat or eggs).

The rate of bottle-feeding among breastfed infants less than 12 months was low (3%), and the use of breast-milk substitutes was infrequent (less than 7% in all age groups) (CPS, 1996).

## 4. CONCLUSION

Although practically all mothers breastfeed and the duration of breastfeeding is satisfactory, some very common feeding practices are detrimental to young children's health, such as early introduction of liquids other than breast milk, and late introduction of complementary foods. Moreover, over almost a decade, both the nutritional status of young children and feeding practices have deteriorated, and urgent action is needed to reverse this trend.

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# Morocco

## 1. INTRODUCTION

In 1992, a National Demographic and Health survey was conducted by the Ministry of Public Health (Hajji, 1993). It was followed, 3 years later, by a new survey, "Enquête de Panel sur la Population et la Santé" (Ministère de la Santé Publique, 1995). Both surveys provide information on feeding practices and nutrition of infants and young children under five years of age but the sample of the 1995 survey was smaller.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

According to the 1992 DHS, the proportion of children underweight was 9% and there was virtually no wasting[1] (2%).

In contrast, the prevalence of stunting was high, 23%, although it had slightly declined from 29% in 1987. In 1992, however, the prevalence of severe stunting was still important (8%). Stunting affected both sexes similarly. Prevalence increased regularly with age, from 4% before 6 months, to 9% at 6–11 months, reaching 20% before 18 months. The highest level was seen at 2 years of age (29%). Subsequently, prevalence remained above 20% until five years of age. Poor maternal education and high birth-rank were risk factors for stunting. Geographically, the highest prevalence was observed in the southern region of Morocco.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

In Morocco, breastfeeding is universal. In 1992, 95% of children under five years of age had been breastfed for some period of time. In 1995, the proportion "ever breastfed" was comparable (96%).

Early initiation was common in 1992; among last-born children, 84% were put to the breast within the first day of life, and 49% within the first hour of birth. The situation was very similar in 1995, where it was 81% and 41% respectively. Early initiation was especially common in rural areas, among uneducated mothers and among mothers who gave birth at home.

In 1992, the exclusive breastfeeding rate was 65%, and was one of the highest in North Africa (Table 1). The practice of giving water in addition to breast milk was infrequent (7% before 4 months). Nevertheless, at 4–5 months, other liquids and non-human milk were given to 36% and 28% of infants, respectively.

[1] As defined by WHO, 1996.

Exclusive breastfeeding was much more common in the rural than in the urban sector (70% and 36% respectively). Educated mothers were less likely to breastfeed exclusively than those who never went to school.

It is impossible to assess with certainty the trend in exclusive breast-feeding from the findings of the 1995 survey because the sample size for infants under 4 months was too small (Ministère de la Santé Publique, 1995).

In 1992, continued breastfeeding rates were 63% at one year, and 19% at two years. The median duration of breastfeeding was 15.5 months. In 1995, the rates were 57% and 20%, respectively, and the median duration was slightly shorter (14.6 months).

**Table 1**
**Infant feeding practices in Morocco (DHS, 1992)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 65 |
| Timely complementary feeding rate | 46 |
| Continued breastfeeding rate at 1 year | 63 |
| 2 years | 19 |
| Bottle-feeding rate [a] | 17 |

[a] *among breastfed infants*

At about 6 months, according to WHO recommendations (WHO, 1991), all infants should receive complementary foods. In 1992, the timely complementary feeding rate was only 46%, while 5% of infants aged 6–9 months were receiving formula, and 28% non-human milk. Complementary foods were generally introduced too late; at 4–5 months only 22% of breastfed infants were given porridge or solids. Moreover, at 10–11 months, about one third of breastfed infants were still not receiving such foods and were only fed a milk-based diet (Hajji, 1993). In 1995, the situation was very similar (Ministère de la Santé Publique, 1995).

In 1992, the rate of bottle-feeding before 12 months among breastfed infants was high (Table 1). Before 4 months, bottle-feeding was more than twice as frequent in the urban (39%) as in the rural sector (15%). Bottle-feeding was correlated with the level of education; 63% of mothers with secondary or college education were bottle-feeding compared to only 17% among their uneducated counterparts.

Bottle-feeding seems to be increasing quickly, but the trend must be interpreted with caution, because of the small sample size of the 1995 survey. At 2–3 months, 35% of infants were bottle-fed in 1995, whereas only 23% were in 1992 (MSP, 1995; Hajji, 1993).

## 4. CONCLUSION

Until recently, infant and young child feeding practices in Morocco were characterised by a satisfactory exclusive breastfeeding rate, and an intermediate duration of breastfeeding. This situation, however, is changing quickly, as the practice of bottle-feeding is, for example, becoming increasingly common. Exclusive breastfeeding, and the duration of breastfeeding could be declining as well. These trends in infant feeding are strongly associated with education and urban residence. Therefore, breastfeeding promotion programmes are urgently needed to reverse this trend. Priorities are the training of health personnel in appropriate child feeding practices, and nutrition education in schools.

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# Niger

## 1. INTRODUCTION

In 1992, the Ministry of Finance and Planning conducted a National Health and Demographic Survey in Niger, in collaboration with the Ministries of Public Health and Social Development, and with the assistance of Macro International Inc. The survey provides nationally representative information on nutrition and feeding of infants and young children (Adamou and Barrère, 1993).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

The survey showed that 37% of preschool children were underweight. The prevalence of stunting was 33% and that of wasting 16% (Macro International Inc., 1993).

There was virtually no stunting before 6 months. Afterwards the prevalence increased sharply, reaching a maximum of 47% at 24-35 months. Prevalence remained high in the 36–47 month age group, and decreased to 38% at 48–59 months. Stunting affected both sexes similarly. It was more prevalent in rural (34%) than in urban areas (26%). Moreover, prevalence was much lower in Niamey, the capital (19%), than in other towns (29%). There were also large differences between regions, with the Niamey region having the lowest prevalence (19%), and the Maradi region the highest (43%). Prevalence was lower among children of educated mothers (Adamou & Barrère, 1993).

In contrast with stunting, wasting was prevalent at a younger age; 6% of infants less than 6 months were wasted. Afterwards, prevalence increased rapidly to a maximum of 33% at 12-23 months, and declined to 7% at 48-59 months. Differences between the urban and rural areas were smaller than for stunting (5%), and there was practically no difference between Niamey and other towns (less than 1%). There were differences between regions, and according to mothers' level of education, but they were smaller than for stunting (Adamou & Barrère, 1993).

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

In Niger, breastfeeding is universal: 98% of neonates born during the five years preceding the survey have been breastfed for some period of time. Nevertheless, initiation was very often delayed; at the national level only 20% of last-born neonates were put to the breast within the first hour after birth, and 29% within the first day. There were, however, marked differences between rural and urban areas. In Niamey, early initiation was common (51% within one hour and 68% within the first day), whereas in rural areas, only approximately one in four neonates was breastfed during the first day (27%). Delayed initiation was a traditional practice of the *haoussa* ethnic group. In rural areas, prelacteal foods — herbal tea, water or cows' milk — are likely to be contaminated, and the practice of delayed initiation is probably an important cause of diarrhoea and early mortality. Educated mothers, and mothers giving birth in a health facility were more likely to start breastfeeding early. Educational programmes targeted to rural mothers and traditional birth-attendants should therefore be a priority.

Exclusive breastfeeding was very rare; before 4 months only 1% of infants were exclusively breastfed (Table 1). The practice of giving water or other liquids to breastfed infants was common: 41% of infants less than 4 months were given water in addition to breast milk, and 38% other liquids including non-human milk. The use of formula was nevertheless rare (2% before 4 months) (Adamou & Barrère, 1993).

**Table 1**
**Infant feeding practices in Niger (DHS, 1992)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 1 |
| Timely complementary feeding rate | 70 |
| Continued breastfeeding rate at 1 year | 93 |
| 2 years | 59 |
| Bottle-feeding [a] | 3 |

[a] *among breastfed infants*

The median duration of breastfeeding was 20.9 months. Differences between urban and rural areas were small (21.2 in rural areas, 20.7 in Niamey and 18.9 in other towns). The level of education had only a small influence on the duration of breastfeeding.

Overall, the practice of bottle-feeding was infrequent (3% of breastfed infants less than 12 months). In the urban sector, however, it is becoming increasingly common (the rate was 19% in Niamey and 11% in other cities).

The timely complementary feeding rate was 70% (Macro International Inc., 1993). In Niger, complementary foods are introduced either too early or too late: 15% of breastfed infants were receiving solids at an age when they should be exclusively breastfed (under 4 months), while 28% were not yet receiving complementary foods when breast milk alone is no longer sufficient (at 6–9 months).

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# Nigeria

Iyabo Aina LEWIS

## 1. INTRODUCTION

In 1990, a Nigerian Demographic and Health Survey was carried out by the Federal Office of Statistics with the Federal Ministry of Health, in collaboration with WHO and UNICEF (Federal Office of Statistics, 1992). A national sample of 299 clusters was randomly selected. Approximately 9000 households were interviewed. The DHS provides information on the nutritional status of children under 5 years of age, and on breastfeeding practices at the national, urban and rural levels.

Additional data on breastfeeding and complementary foods for infants and children were derived from surveys conducted in a few communities and in selected districts/local government areas; these surveys were carried out by tertiary institutions, health workers in State Ministries of Health, the Federal Ministry of Health, including the National Primary Health Development Agency, and international agencies such as UNICEF.

## 2. PREVALENCE OF MALNUTRITION AND NATIONAL POLICIES TO COMBAT MALNUTRITION

Protein-energy malnutrition is a problem of public health importance in Nigeria with a high prevalence due to the deteriorating economic situation in the country. The proportion of under-fives who were underweight was 34%. The prevalence of wasting was 9% and that of stunting was 43% (Macro International Inc., 1993).

In order to reduce the high prevalence of malnutrition, Nigeria has adopted several measures:

- The government has implemented the International Code of Marketing of Breast-milk Substitutes (WHA, 1981).
- Hospitals, clinics and maternity units are encouraged to adopt the "Ten steps to successful breastfeeding" (WHO, 1989). This is achieved through the Baby Friendly Hospital Initiative (BFHI) programme. Presently, there is a nation-wide programme to train more Baby Friendly hospitals.
- Health workers and volunteers are trained on growth monitoring and promotion so that every child under 5 years of age may be weighed regularly and nutritional rehabilitation may be instituted when the child is underweight. Growth monitoring and promotion is an ongoing national programme in Nigeria.
- Information, education and communication on use of available foodstuffs in various communities for the preparation of complementary foods for infants and young children.

Use of imported cereals is discouraged, while mothers and health workers are educated in the preparation of foods using cereals (maize, millet/sorghum, *acha*, rice, wheat), legumes (soy beans, cowpeas, groundnuts, melon seeds, other nuts), fruits, leafy vegetables, animal protein (crayfish, fish, periwinkles, dairy products such as *fura*, *nono*, and meat and poultry products), as well as root tubers (yam, potatoes, cassava).

Nigeria is an agricultural country; foodstuffs are produced on a large scale. In the northern parts of the country, livestock and poultry products are widely raised, and so are legumes, cereals, tubers, and green leafy vegetables. The southern part of the country is noted for large scale cultivation of root tubers, leafy vegetables, fruits, cereals and poultry. Raising of livestock is not organised on a large scale as it is in the savannah areas of the northern states. Communities in bordering sea areas benefit from fish, shrimps, crabs, periwinkles, and other sea food. However, consumption of these foodstuffs is influenced by a variety of factors such as custom, culture, socioeconomic status and knowledge of their influence on health. Moreover, some staple foodstuffs are peculiar to certain ethnic groups.

## 3. BREASTFEEDING PRACTICES

### 3.1 Initiation of breastfeeding

In 1990, 50% of neonates were put to the breast within the first day, and 33% within the first hour. Presently many babies receive colostrum and are put on the breast immediately after birth, thanks to nutrition education in the media, and training programmes on BFHI in rural and urban centres.

### 3.2 Modalities of breastfeeding

Practically all Nigerian infants are breastfed for some period of time: the proportion "ever breastfed" was 97% in 1990. Exclusive breastfeeding, however, was uncommon; only 1% of infants under 4 months were exclusively breastfed, whereas 48% received water in addition to breastmilk (Macro International Inc., 1993). Through the BFHI programme, which is continuously disseminating information to rural and urban communities on exclusive breastfeeding, more mothers are now breastfeeding exclusively than before, particularly mothers who do not go out to work. The majority of mothers have access to information, education and communication on breastfeeding.

Working mothers in cities leave their children with nannies, house helps, grannies, or in day care centres. As few mothers express breastmilk to feed the baby while away at work, fluids (water, *Ribena*, etc.) are usually offered to the child until the mother comes back home to breastfeed.

In 1990, the continued breastfeeding rates at 1 and 2 years were 86 and 43% respectively, and the median duration of breastfeeding was 19.5 months.

Mothers who were housewives, petty traders or who were self-employed breastfed on demand while mothers who went out to work breastfed less than six times a day. Duration of breastfeeding was shorter in the latter group (often only 9 to 12 months).

The practice of bottle-feeding was perceived as a status symbol and was widespread in both the rural and urban areas. Before the age of 12 months, 31% of infants were bottle-fed (Federal Office of Statistics, 1992).

## 4. INTRODUCTION OF COMPLEMENTARY FOODS

In 1990, the timely complementary feeding rate was 51% (Macro International Inc., 1993). Hence, almost one child out of two was not fed according to WHO recommendations (WHO, 1991). Some infants were given solid or mushy foods too early (13% of breastfed infants aged 2-3 months), but a large proportion of infants started receiving complementary foods too late (approximately 35% were still not fed these foods at 10–11 months) (Federal Office of Statistics, 1992).

### 4.1 Utilisation of porridge

By the age of 4–5 months infants are given complementary foods in the form of porridge. Very few mothers used porridge prepared from imported foods due to their cost, and because of improved knowledge of nutrition. A majority of children consumed porridge prepared from locally available foodstuffs such as cereals (maize, millet, oats, *acha*, rice), legumes (beans, nuts), tubers (yam, potatoes, cassava), animal protein (crayfish powder, broth, dairy products), fruit juices, and mashed vegetables mixed with palm oil.

Consumption of porridge ceased by the age of 10–11 months when the child was introduced to the solid family diet. The frequency of feeding porridge was 3–4 times per day at 4 months, and 4–5 times from the age of 9 months.

### 4.2 Nature of first complementary foods

Complementary foods for children aged 4–9 months have a low energy density. They are made from locally produced foodstuffs and are mainly prepared at the household level. A variety of dishes are given to infants and young children. Feeding practices differ between the northern and southern regions of Nigeria.

*Southern regions of Nigeria*

The diet of children 4–6 months, and 7–11 months, are both prepared from:

- milled maize with crayfish and palm oil
- milled maize with powdered groundnut
- milled maize with egg yolk and palm oil
- fruit juice (orange, mashed banana, pineapple)
- milled maize with soy bean powder (cooked together)
- milled maize with bone marrow and tomatoes
- cooked maize paste, boneless fish and okra soup containing palm oil and some pepper
- boiled cassava flour (*koro*) with crayfish powder and palm oil
- milled maize, dehulled beans and roasted baby fish (all cooked into a semi-solid porridge)
- milled maize or millet with palm oil.

*Northern regions*

- milled maize or millet with crayfish powder and palm oil
- milled maize with fermented milk (*wara*)
- milled maize or millet with groundnut powder

- milled millet with fresh cows' milk
- fruit juice (mango, oranges).

The method of preparation for each of these meals is cooking the ingredients separately and then mixing them together. The food is fluid or semi-solid. The child is served 3–4 times a day, either with a spoon or a feeding bottle, while he continues to be breastfed.

### 4.3 Nutritive value

Complementary feeding is a mixed diet consisting mostly of cereals, legumes, fruits, vegetables, minimal amounts of animal protein and tubers; consequently it is rich in protein, carbohydrates, fats/oils, vitamins and minerals. Nutrient contents vary depending on the recipe. Cereals contain 6–10 g of protein/100g of dry meal. When mixed with legumes the amino acids complement each other.

The quantity of porridge prepared is such as to last for 24 hours. Fresh porridge is prepared on the following day, using stored and well preserved ingredients.

### 4.4 Solid foods

By the age of 10 months, the child is introduced to solid foods and then gradually fed with the family diet. The nature of solid foods varies from one group to another as the staple foods available in the community make up the recipe: ingredients can be cereals, tubers, legumes, animal products, fruits and vegetables. The frequency of feeding solid foods is 2–4 times per day. Legumes are consumed by three quarters of the children from the age of 9 months, but meat or fish is only given to one third of the children.

Recipes for solid foods for southern regions (children 10-18 months ):
- *eba* (cassava paste) with vegetable soup and meat
- yam porridge (soft) with crayfish or fish, green leafy vegetables and palm oil
- milled maize (semi-solid) with bone marrow and tomatoes
- cooked beans with crayfish powder and palm oil
- milled maize with bean soup and spices (pepper)
- bean pudding
- mashed cocoyam with boneless fish and green leafy vegetables
- *foofoo* (cassava product) with okra soup with boneless fish or *ogbono* soup with boneless fish and meat
- rice with meat/fish stew
- beans and plantain with pepper and palm oil
- fruit juices (oranges, pineapple, papaya)
- yam flour with vegetable soup and fish/meat.

Recipes for northern regions (for children 10–18 months):
- fermented cows' milk with millet drink
- coagulated cows' milk with potato and poultry product
- mashed yam with groundnut oil

- beans with rice
- *tuwo* (maize, rice or millet pudding)
- *gari* soaked in water (cassava) with groundnut cake and sugar
- fruits in season (mango, banana, papaya, sugar cane).

### 4.5 Food taboos linked to complementary foods for infants and young children

Many factors influence directly or indirectly the consumption of nutritious foods by infants and young children. In some Nigerian cultures, it is believed that a newborn who was given colostrum will develop serious health problems later in life. Hence, colostrum is expressed and discarded. A lactating mother should not have sexual relationship with her husband because of the belief that semen finds its way to breastmilk. It is believed that such "contaminated breast milk" affects the child's growth and development.

Other beliefs exist, for instance:

- A child fed on a diet consisting of meat, fish or eggs tends to like that diet and may be tempted to steal when that food is not offered to him. So it is better not to give such diets at all.
- Foods that are produced with chemical fertilisers have a negative influence on the child's health. Children are predisposed to eczema (*Ela*), hence, vegetables and poultry products are not offered to them.
- Animal proteins can cause obesity in the child and are better avoided.
- Some foods of animal origin predispose the child to excessive salivation, diarrhoea and haemorrhoids.

Presently in Nigeria, growth monitoring and promotion is ongoing in health facilities and communities. It involves regular monthly weighing of the child from birth until the age of 5 years in order to recognize and manage malnutrition. Management essentially consists of nutrition education and food demonstrations. Health workers and volunteers have been trained to implement growth monitoring. It is through nutrition education that most of the taboos and beliefs will gradually die a natural death.

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# Pakistan

Aysha A. RIFFAT

## 1. INTRODUCTION

The 1990–91 Demographic and Health Survey is the most comprehensive national survey of nutrition and feeding of young children conducted in Pakistan (Tauseef and Ayub, 1992). In addition, a more recent Multiple Indicators Cluster Survey provides information on key indicators of breastfeeding practices (Ministry of Health, 1996).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

The prevalence of malnutrition estimated during the 1990-91 Demographic and Health Survey is shown in Table 1.

**Table 1**
**Malnutrition[a] among children under five years of age in Pakistan (DHS, 1990-91)**

| | Stunting | Severe Stunting | Wasting | Severe wasting | Underweight | Severely Underweight |
|---|---|---|---|---|---|---|
| | | | | % | | |
| Male | 51 | 21 | 10 | 2 | 41 | 14 |
| Female | 49 | 30 | 8 | 1 | 40 | 13 |
| All children | 50 | 30 | 9 | 2 | 40 | 14 |

[a] *As defined in "Catalogue of Health Indicators" (WHO, 1996)*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 3.1 Breastfeeding

#### *Initiation of breastfeeding*

Breastfeeding is universal in Pakistan. According to the DHS survey, the proportion of children "ever breastfed" was 94% and did not vary with the sex of the child or the mother's residence (urban vs rural). Prelacteal feeds were common; almost one-third of neonates received liquids or foods before being put to the breast. Water, honey or *ghutti* were predominant, followed by rose water, *araq* or sugar. Initiation of breastfeeding was often delayed for more than one day as shown in Table 2.

### *Modalities of breastfeeding*

Although almost all infants were breastfed, the rate of exclusive breastfeeding was only 25% in 1990-91; it further declined to 16% in 1995 (Ministry of Health, 1996). The practice of giving water or other liquids to infants was common (Table 3).

**Table 2**
**Initiation of breastfeeding in Pakistan (DHS, 1990-91)**

| | Percentage of children ever breastfed | Percentage of children breastfed | |
|---|---|---|---|
| | | within 1 hour of birth | within 1 day of birth |
| Male | 93 | 8 | 26 |
| Female | 94 | 9 | 26 |
| Urban | 92 | 6 | 29 |
| Rural | 94 | 9 | 25 |
| All children | 94 | 9 | 26 |

**Table 3**
**Modalities of breastfeeding in Pakistan (DHS, 1990-91)**

| | Percentage of living children who were | | | |
|---|---|---|---|---|
| | Not breastfed | Exclusively breastfed | Breastfed and receiving | |
| | | | plain water only | supplements |
| 0–1 | 4 | 27 | 12 | 57 |
| 2–3 | 3 | 24 | 10 | 63 |
| 4–5 | 7 | 18 | 12 | 64 |
| 6–7 | 12 | 16 | 13 | 59 |
| 8–9 | 49 | 12 | 21 | 59 |
| 10–11 | 18 | 8 | 9 | 65 |
| 12–13 | 14 | 5 | 9 | 72 |
| --- | | | | |
| 22–23 | 53 | 2 | 4 | 41 |

*Breastfeeding duration*

Most mothers breastfeed into the second year. According to the 1995 survey the continued breastfeeding rate was 83% at one year, and 56% at two years (Ministry of Health, 1996). Girls were breastfed for a longer period than boys, and urban mothers stopped breastfeeding earlier than their rural counterparts (Table 4).

**Table 4**
**Duration of breastfeeding in Pakistan (DHS, 1990-91)**

| | Median duration of any breastfeeding |
|---|---|
| | months |
| Male | 18.3 |
| Female | 21.1 |
| Urban | 14.8 |
| Rural | 21.0 |
| Total | 19.9 |

## 3.2 Complementary feeding practices

*Age of introduction*

In Pakistan, introduction of complementary foods is generally late (Table 5). In 1995, the timely complementary feeding rate was only 31% (Ministry of Health, 1996).

**Table 5**
**Complementary feeding and bottle-feeding of breastfed infants in Pakistan (DHS, 1990-91)**

| | Among breastfed children percentage receiving | | | | |
|---|---|---|---|---|---|
| Age (months) | Infant formula | Other milk | Other liquids | Solid/mushy foods | Bottle with a nipple |
| 0-1 | <1 | 23 | 51 | <1 | 17 |
| 2-3 | 1 | 32 | 51 | 6 | 31 |
| 4-5 | 3 | 33 | 55 | 11 | 29 |
| 6-7 | 3 | 36 | 48 | 30 | 26 |
| 12-13 | <1 | 46 | 32 | 57 | 19 |
| --- | | | | | |
| 22-23 | 4 | 38 | 40 | 78 | 7 |
| --- | | | | | |
| 24-25 | 4 | 43 | 56 | 83 | 24 |

Solid and mushy foods do not become an important part of the diet until after six months of age. Almost all children are given these before they complete their third year of life. Nevertheless, according to the mothers' reports, a substantial proportion of breastfed children were not receiving solid or mushy foods even after they reached their second birthday.

Bottle-feeding is increasingly common. In 1995, the bottle-feeding rate had reached 27% among infants less than 12 months (Ministry of Health, 1996).

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# Palestine

Raghda AL SHAWA

## 1. INTRODUCTION

For a long time the general situation prevailing in Palestine did not allow surveys of childhood nutrition and infant feeding practices to be conducted. Nevertheless, a survey of infant feeding was carried out in Jerusalem by UNICEF (1993) and the nutritional status of under-fives was assessed in the Gaza Strip by Terre des Hommes, a nongovernmental organization (Kumar, 1995).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

In 1995, the proportion of children underweight was 15% in the Gaza Strip. Stunting, as defined by WHO (1996), affected 14% of under-fives and wasting 6% (Kumar, 1995). The prevalence of both severe stunting and severe wasting were very low, 4% and 2% respectively.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 3.1 Breastfeeding practices

#### *Initiation of breastfeeding*

All neonates were fed colostrum. Among the low-birth-weight neonates and those who were delivered by caesarean section, however, only half were fed colostrum (UNICEF, 1993). Approximately 70% of infants delivered normally were put to the breast within 6 hours of birth. The proportion was much lower among other neonates; 17% among those who were born by caesarean section and 36% among the small-for-gestational-age. Prelacteal foods were commonly given to newborn infants. For instance, 64% received glucose water and 27% non-human milk or diluted milk. These were given by spoon, syringe or bottle.

#### *Patterns of breastfeeding*

The rate of breastfeeding declined very quickly with age. Between 0 and 4 months of age, it dropped from 98% to 86%. At 6 months it had further dropped to 76%. This trend was general, but there were some differences between the sectors. At the age of one year, more than half of the infants were breastfed (60%).

The rate of exclusive breastfeeding was 51% (Table 1). Infants were breastfed on demand. It was the routine to give the breast when the child cried or within 2–3 hours from the last feed.

Bottle-feeding was common (49%) and was usually given following a schedule. Complementary foods were added to the bottle.

**Table 1**
**Infant feeding practices in Palestine (UNICEF survey, 1993)**

| WHO key indicators | % of children |
|---|---|
| Breastfeeding rate | 51 |
| Timely complementary feeding rate | 41 |
| Continued breastfeeding rate at 1 year | 60 |
| Bottle-feeding rate | 49 |

### 3.2 Complementary feeding

*Age of introduction of complementary foods*

The rate of timely complementary feeding was 41%. Table 2 gives the percentage of children below 4 months of age who receive foods too "early", and those above 6 months who received foods, including water and liquids, too "late" (Abed Yahia, unpublished data).

*First complementary foods*

Usually mothers or grandmothers prepare the complementary foods for the whole day; prepared foods are easily kept as most homes have refrigerators. From observation it is possible to say that both ready-made and home-made meals are sometimes given to the same child. This depends on the availability of the foodstuff and time of meal, as well as on what the mother sees as correct infant feeding, especially when she is bombarded by different messages from all different angles. This issue needs special attention with more programmes on infant and young children feeding, where education, support of mothers and legislation for the marketing of breast-milk substitutes, form an integral part.

Complementary foods include rice pudding, *mehalabia* (starch cooked with milk), vegetables, meat, chicken and added oil or fat after one year of age. Ready-made cooked imported foods are popular and mothers know about their nutritional value. Similarly it is easy to calculate the energy density and nutrient composition of cereals, corn flour and other flours. For home-made foods, standards for calculating their energy density are not available. However, mothers are aware of the nutritional value of meat, eggs, and yoghurt, as well as vegetables and fruits. Beans are not popular because families are aware of favism.

Normally, between 10 months and 14 months children are fed with the family. The food is prepared once a day, but it is often freshly prepared when complementary foods are given more than once. Unfortunately, feeding techniques are not well documented.

*Solid complementary foods, i.e. the "family pot"*

Usually, children are introduced to family foods slowly around the age of 9 to 12 months: vegetables, chicken soup, rice, yoghurt, minced meat, potatoes, and beans are given first;

bread, eggs, cereals, corn flour, and full cream have already become part of the infant's diet; fruit is introduced before the age of one year.

The child is offered 3 full meals, 2 snacks, and a light supper before going to bed. This pattern is a loose frame, which can vary somewhat from region to region. There are, of course, individual variations between children.

**Table 2**
**Percentage of children below four months of age, "early", and children above six months, "late", receiving various foods and water**

| Foods | Urban (Rimal) | Rural (Jabalia) |
|---|---|---|
| Water | | |
| - early | 61.1 | 34.8 |
| - late | 38.9 | 62.2 |
| Juice | | |
| - early | 25.5 | 15.2 |
| - late | 64.5 | 60.0 |
| Tea | | |
| - early | 13.9 | 37.1 |
| - late | 63.5 | 53.6 |
| Cereals | | |
| - early | 81.8 | 64.8 |
| - late | 9.1 | 15.6 |
| Fruits | | |
| - early | 73.8 | 58.7 |
| - late | 16.6 | 27.9 |
| Vegetables | | |
| - early | 48.0 | 45.1 |
| - late | 39.2 | 37.7 |
| Eggs | | |
| - early | 44.4 | 49.2 |
| - late | 42.1 | 35.9 |
| Meat | | |
| - early | 3.5 | 3.5 |
| - late | 56.1 | 60.4 |

## 4. CONCLUSION

At country level, almost all mothers initiated breastfeeding, but the duration of breastfeeding was short. Introduction of complementary foods was too early and bottle-feeding was common. Solid foods were introduced either too early or too late.

There were some variations between the different sectors, but the decline in breastfeeding was similar. The highest bottle-feeding rate was found in camps.

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# Rwanda

## 1. INTRODUCTION

A nationally representative survey of childhood nutrition and infant feeding practices was conducted in 1992 (Barrère et al, 1994). Rwanda has successfully experimented with the small-scale production of complementary foods, such as Sosoma flour made from sorghum, maize and soya beans (Mukamurenzi, 1999). However, the civil war has had a very negative impact on the nutritional status of children and has disrupted the production of flour for infants and young children (Engelhard, 1995).

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

In 1992, approximately one-third of Rwandese children were underweight (Table 1). The prevalence of stunting was one of the highest in Africa (49%), while only 4% of children were wasted. Moreover, severe stunting was frequent (21%).

The prevalence of stunting increased progressively with age, reaching 61% at 48-59 months. The main risk factors were the mother's level of education and residence: prevalence was much lower among mothers with secondary or higher education (29%) or living in urban centres (33%).

**Table 1**
**Malnutrition among children under five years of age in Rwanda [a] (DHS, 1992)**

| | Stunting | Severe stunting | Wasting | Severe wasting | Underweight | Severely underweight |
|---|---|---|---|---|---|---|
| | | | | % | | |
| Male | 50 | 22 | 4 | 1 | 29 | 6 |
| Female | 47 | 20 | 3 | 1 | 30 | 6 |
| Urban | 33 | 14 | 4 | 1 | 18 | 3 |
| Rural | 49 | 21 | 4 | 1 | 30 | 6 |
| All children | 49 | 21 | 4 | 1 | 29 | 6 |

[a] *As defined in " Catalogue of Health Indicators " ( WHO, 1996)*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Breastfeeding prevalence was very high, as 97% of neonates had been breastfed for some period of time. However, initiation was often delayed; only 18% of infants were breastfed during the first hour after delivery, and 48% within the first day.

Exclusive breastfeeding is very common in Rwanda. The practice of giving water or other liquids in addition to breast milk was rare before the age of 6 months (Table 2), and consequently, the exclusive breastfeeding rate was 90% among infants less than 4 months. The median duration of exclusive breastfeeding was one of the highest in Africa (5.4 months).

Rwandese mothers often breastfeed for more than two years, the median duration of breastfeeding being 27.9 months, and also one of the highest in the continent. Educated mothers and those who gave birth in a hospital stopped breastfeeding earlier.

Bottle-feeding is very uncommon in Rwanda: only 2% of breast-fed infants under 12 months were fed from a bottle.

As shown in Table 2, mothers usually did not start introducing complementary foods before the age of 4 months. At 4–5 months, only 17% of infants were receiving solid or mushy foods.

The timely complementary feeding rate was high (68%), but approximately one-third of infants were not yet receiving complementary foods at 6–9 months. Thus, introduction of complementary feeding was too late for a large proportion of Rwandese infants.

**Table 2**
**Percentage of breastfed infants receiving foods or solids in Rwanda (DHS, 1992)**

| Age | Supplements | | | Use bottle with |
|---|---|---|---|---|
| (months) | Other milks | Other liquids | Solids/porridge | a nipple |
| | | | % | |
| 0–1 | 2.9 | 1.7 | 2.2 | 0.0 |
| 2–3 | 3.5 | 1.9 | 4.5 | 1.3 |
| 4–5 | 10.2 | 7.9 | 17.1 | 3.8 |
| 6–7 | 9.9 | 19.9 | 57.2 | 2.3 |
| 8–9 | 10.6 | 29.4 | 79.4 | 1.6 |
| 10–11 | 17.0 | 28.8 | 93.4 | 3.0 |
| 12–13 | 12.4 | 30.3 | 92.3 | 1.6 |

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# Syrian Arab Republic

Mousa SHAMIA

## 1. INTRODUCTION

A national survey of maternal and child health was conducted in Syria in 1992–93 (Ministry of Health, 1994). Unfortunately, this survey provides only limited information on breastfeeding and complementary feeding practices. Nevertheless, some information gathered in the context of the implementation of nutrition programmes is presented here.

A prevalence of 27% of stunting[1] and 8% of wasting were found among children below two years of age. This could be due to inadequate timing of introduction of complementary foods and early cessation of breastfeeding.

## 2. INFANT AND YOUNG CHILD FEEDING PRACTICES

Breastfeeding is universal in Syria. The proportion of children "ever breastfed" was high (92%) and was slightly higher in the rural areas (93%) compared to the urban centres (90%) (Ministry of Health, 1994).

A programme for the promotion of breastfeeding started in 1985, and changes in attitudes and practices of mothers have been observed during the implementation of this programme.

Presently, the proportion of infants who are breastfed is 92% at 3 months, 87% at 6 months, and 18% at 18 months. The median duration of breastfeeding is 14 months; it is somewhat shorter in urban centres (13 months).

Major reasons given by mothers for stopping to breastfeed were an insufficient milk production when the infant was 1-3 months old, and a new pregnancy when the infant was 3–9 months old.

From the age of 6 months, mothers feed their infants carbohydrate-rich foods such as bread with tea.

## 3. CONCLUSION

The following recommendations have been made. Mothers have been encouraged to:

- Breastfeed their children until 24 months.
- Start giving complementary foods from four to six months.
- Introduce solids at the age of six months.
- Get training in order to be able to monitor the growth of their children.

[1] As defined by WHO, 1996.

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# Togo

## 1. INTRODUCTION

Two nationally representative surveys providing information on young child feeding practices and nutrition were conducted in Togo: a Demographic and Health Survey in 1988, which collected information among infants and young children under three years of age (Agounké et al., 1989), and a Multiple Indicators Cluster Survey in 1995 among young children under five years of age (UNICEF, 1996).

## 2. MALNUTRITION AMONG INFANTS AND YOUNG CHILDREN

In 1988, 26% of children under three years of age were underweight (Macro International Inc., 1993). In 1995, the situation had not improved noticeably, and the proportion underweight was still 22%.[1] In 1988, the most common form of malnutrition was stunting, i.e. chronic malnutrition, with a prevalence of 31% under three years, while the prevalence of wasting was low (6%). In 1995, the prevalence of stunting increased to 42% among children under three years of age. The trend in wasting could not be estimated because the MICS report did not present information on this indicator (UNICEF, 1996).

Among children under five years of age, there were large differences in the proportion underweight between urban and rural areas, as well as between regions; prevalence was much lower in the urban sector (14%) than in the rural areas (26%) (UNICEF, 1996).

Similarly, the prevalence of stunting among under-fives was higher in the rural (51%) than in the urban areas (38%) (UNICEF, 1996). There were marked regional differences: in 1988, the lowest prevalence was found in the Maritime region, and the highest in the nothernmost region of the Savannes. In 1995, prevalence had increased in all the regions, but the situation was especially severe in the Savannes where it reached 68%.

Prevalence was slightly higher among boys (50%) than among girls under five years of age (43%). It increased with age, from 28% at 6–11 months to a maximum of 55% between 36 to 47 months. Long birth intervals and mothers' education were associated with a lower prevalence of stunting.

The situation of children in the Savannes region, which was a matter of concern 10 years ago, is deteriorating quickly. In 1988, approximately one in two children under three years of age was stunted, and 7 years later in 1995, the proportion exceeds two-thirds of under-fives. Action is urgently needed to reverse this trend.

[1] For children under five years of age, prevalence was 23%.

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

Breastfeeding is universal in Togo. All infants aged less than 12 months were breastfed (Agounké et al., 1989). In 1988, exclusive breastfeeding was infrequent, as shown by the low exclusive breastfeeding rate (10%), because the practice of giving water and other liquids to breastfed infants was common (28% and 24% respectively) (Table 1). Moreover, 38% of infants under 4 months were already receiving complementary foods (Agounké et al, 1989).

The timely complementary feeding rate estimated in 1995 was very low (25%) and differed considerably from that estimated by the 1988 DHS (86%) (Agounké et al., 1989). This could be due to methodological differences between the two surveys.

Most Togolese mothers breastfeed beyond the first year: in 1988, continued breastfeeding rates at one and two years of age were 95% and 68% respectively (WHO, 1996). The rate of bottle-feeding among breastfed infants less than 4 months was 14% (Macro International Inc., 1993). According to the 1995 survey, only 6% of infants under 12 months were fed with a bottle (UNICEF, 1996).

**Table 1**
**Infant feeding practices in Togo (DHS, 1988)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 10 |
| Timely complementary feeding rate | 86 |
| Continued breastfeeding rate at 1 year | 95 |
| 2 years | 68 |

Traditionally, maize, millet or sorghum porridge is given to infants as a first complementary food. Togo produces two complementary foods, Nutrimix and Viten, based on cereals (maize, sorghum, and rice) and oilseeds (soya beans).

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# Uganda

B. Ursula WANGWE

## 1. INTRODUCTION

Two DHS surveys were conducted in Uganda: the first in 1989, and the second in 1995 (Statistics Department, 1989 & 1996).

## 2. MALNUTRITION AMONG CHILDREN UNDER THREE YEARS OF AGE

The prevalence of malnutrition assessed during the two DHS surveys is shown in Table 1. Prevalence of stunting has declined significantly between the surveys, while that of wasting has increased markedly.

There were large urban/rural differences in the prevalence of stunting (23% and 40% respectively) but not in the prevalence of wasting (Statistics Department, 1996).

**Table 1**
**Malnutrition[a] among children under three years in Uganda (DHS, 1989 & 1995)**

| Year of survey | Stunting | Wasting | Underweight |
|---|---|---|---|
| | | % | |
| 1989 | 44 | 2 | 25 |
| 1995 | 36 | 6 | 27 |

*[a] As defined in " Catalogue of Health Indicators " ( WHO, 1996)*

## 2. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 2.1 Breastfeeding

#### *Initiation of breastfeeding*

Initiation of breast-feeding is universal in Uganda. Almost all women expect to breastfeed their babies as a cultural norm. Results of a secondary in-depth analysis of the 1989 DHS data showed that 98% of mothers initiated breastfeeding regardless of residence, region or sociodemographic group. This figure was the same in the 1995 DHS survey.

The practice of giving prelacteal feeds during the first few days after birth is quite common among both urban and rural communities. This can delay the timing of the first breastfeed for 2–3 days. Common prelacteal feeds include plain water, sugar solution, glucose solution or diluted cows' milk.

A very large majority of neonates, however, were put to the breast within the first day of birth (87%), and more than half (51%) were given the breast within the first hour (Statistics Department, 1996).

Most mothers give colostrum to their newborn, and only in a few communities do they regard it as harmful and refuse to feed it to their newborn. In some communities there is a traditional belief that colostrum washes out the newborn's stomach.

### *Modalities of breastfeeding*

Once lactation is well established, many mothers practise exclusive breastfeeding for varying periods of time. Studies have shown that there is a widely held perception among both health workers and the community that many women are unable to produce sufficient breast milk to satisfy their infant beyond 2–3 months postpartum.

Exclusive breastfeeding rates were high in 1989 as well as in 1995, 70% and 68% respectively (Macro International Inc., 1993 & 1996). In 1995, 27% of breastfed infants under 4 months were given water or other liquids, and 5% were given solid foods. The median duration of exclusive breastfeeding was about 3 months.

The maximum duration of breastfeeding extends to well over two years and children are mostly breastfed on demand. In 1995, the median duration of breastfeeding was 19.5 months. Rural children were breastfed longer (19.9 months) than urban children (16.9 months).

Bottle-feeding is not widespread: among breastfed infants under 4 months, the rate of bottle-feeding was 6% (Statistics Department, 1996).

## 2.2 Complementary feeding

### *Types of complementary foods*

Cultural, social and economic factors play a role in determining the age of introduction of fluids and foods other than breast milk. The timely complementary feeding rate was 69% in 1989 and 64% in 1995. For as much as one-third of infants aged 6-9 months, introduction of complementary foods was too late.

According to the 1995 survey the use of infant formula was negligible as mothers seemed to prefer giving other milk and liquids rather than infant formula (Table 2). Cereals in the form of porridge, tubers, and plantains were commonly given, starting at the age of 6–7 months.

### *Nature of porridge*

One of the most popular complementary foods given to infants as their first complementary food is thin cereal porridge. It can be made from either maize flour, millet flour or sorghum flour. Cows' milk may be added to the porridge, or the cereal flour can be mixed with soya flour. Few analytical studies have been carried out on the porridge to determine its energy density and nutrient content. However, some calculated results indicate that the plain maize porridge has 12 g of protein per 100 g of dry mix, and an energy density of 71 kcal per 100 g of prepared porridge.

**Table 2**
**Percentage of breastfed infants receiving foods or liquids in Uganda (DHS, 1995)**

| Age (months) | Breast milk only | Infant formula | Other milk | Other liquid | Meat poultry fish egg | Grain flour cereal | Tubers plantain | Using bottle with a nipple |
|---|---|---|---|---|---|---|---|---|
| | | | | | % | | | |
| 0–1 | 77 | 1 | 14 | 3 | 0 | 1 | 0 | 3 |
| 2–3 | 65 | 2 | 18 | 11 | 0 | 3 | 1 | 7 |
| 4–5 | 37 | 2 | 29 | 30 | 5 | 8 | 5 | 10 |
| 6–7 | 19 | 2 | 32 | 44 | 18 | 23 | 24 | 5 |
| 8–9 | 9 | 3 | 38 | 44 | 24 | 35 | 46 | 11 |
| 10–11 | 6 | 2 | 31 | 51 | 31 | 40 | 49 | 9 |
| 12–13 | 2 | 4 | 30 | 51 | 33 | 45 | 66 | 9 |

The *Baby soya* porridge, which is commercially produced, has a protein content of 21 g per 100 g of dry mix as indicated on the package.

Porridge for feeding young children is often prepared once a day, due to fuel scarcity as well as the busy work-schedule of mothers that may keep them away from home for a number of hours. The porridge is prepared in sufficient quantities to last for 12 hours and is warmed up whenever needed for infant feeding.

The feeding timetable for infants in most cases is not restricted, and infants may be fed the porridge as often as they feel hungry. However, for the ages 4–6 months this may be four or more times a day, in addition to breast milk. Older infants 9 months and above may be fed porridge three or four times in addition to breast milk and other food.

### *Solid foods*

Age of introduction varies, as shown in Table 2, starting at about 6 months. The proportion of infants receiving meat, poultry, fish and eggs, rose from 5% at 4–5 months, to more than 30% at 10–11 months (Statistics Department, 1996). Cereals may be given mixed with any legume or protein food that the family eats. From the age of 56 months, the infant may be given a meal based on a tuber, root or plantain, preferably with legumes and foods of animal origin.

Complementary foods are fed to infants during family mealtime, in other words, twice a day. Mothers rarely prepare separate solid foods especially for their infant.

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# United Republic of Tanzania

Rose KINGAMKONO

## 1. INTRODUCTION

Malnutrition is today, the most widespread problem affecting young children in Tanzania. Combined with infection it is the major cause of death and is responsible for retarded growth and development of many children.

Data on breastfeeding practices and children's nutritional status were collected during two Demographic and Health Surveys: the first in 1991–92, and the second in 1996 (Bureau of Statistics, 1992 & 1997). In addition, several smaller studies conducted in the 80's and 90's, provide information on feeding practices by employment and income group in the urban and rural sectors, and among particular population groups such as pastoral communities.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

In 1992, 29% of under-fives were underweight, 43% were stunted and 6% were wasted. In 1996, the level of malnutrition was very similar with 31%, 43%, and 7% for underweight, stunted, and wasted children respectively. The prevalence of stunting was one of the highest in Africa along with Burundi and Uganda (Macro International Inc., 1993).

The level of protein-energy malnutrition (PEM) is relatively low during the first 6 months of life, but increases rapidly, peaking between 1–2 years of age. The ultimate manifestation of this problem is unacceptably high infant and young child mortality rates, which stand at 137 and 231 per thousand live births respectively. About 10% of child deaths are attributable to severe PEM. A combination of disease and PEM accounts for 50% of all deaths.

Adequate breastfeeding, combined with timely and proper complementary feeding, is important in ensuring that infants and young children become strong and healthy adults.

## 3. BREASTFEEDING PRACTICES

### 3.1 Initiation of breastfeeding

At national level, 82% of neonates receive colostrum, and percentages are very similar in the urban and rural areas. Neonates stay close to their mothers, especially in government hospitals, allowing for early initiation of breastfeeding. Initiation was very early, within the first hour of life, for 59% of neonates. The proportion breastfed within the first day was 88% (Bureau of Statistics, 1997). In some regions, along the coast and in a part of central Tanzania, breastfeeding initiation is delayed longer. A study by Mgaza and Bantje (personal communication) showed that high-income mothers delayed initiation longer than low-income mothers. Neonates were given prelacteal foods such as glucose, gripe or plain water and/or formula. This practice was much more common in private hospitals/health facilities where high-income mothers deliver.

Social, economic and cultural pressures in the community result in delayed initiation of breastfeeding, throwing away colostrum and giving infants prelacteal foods and water.

### 3.2 Modalities of breastfeeding

Since all the WHO key indicators of breastfeeding from the 1996 DHS have not yet been published, only the 1992 figures are shown in Table 1, and the more recent figures are given in the text where available.

**Table 1**
**Infant feeding practices in Tanzania (DHS, 1991-92)**

| WHO key indicators | % of children |
|---|---|
| Exclusive breastfeeding rate | 32 |
| Timely complementary feeding rate | 58 |
| Continued breastfeeding rate at 1 year | 95 |
| 2 years | 57 |
| Bottle-feeding rate [a] | 5 |

[a] *among breastfed infants*

Breastfeeding is universal in Tanzania, both in urban and rural areas. The proportion of children "ever breastfed" was 97%. Infants were breastfed on demand.

In 1996, at national level, 40% of infants less than four months were exclusively breastfed, i.e. were fed according to WHO recommendations, while 23% were given breast milk and plain water (Bureau of Statistics, 1997). Although the exclusive breastfeeding rate is still not satisfactory, it has improved significantly since 1992 when it was as low as 32%. In parallel, the practice of giving plain water in addition to breast milk has decreased from 38%.

The continued breastfeeding rates at 1 and 2 years of age, 94% and 53% respectively in 1996, have not changed since 1992. The median duration of breastfeeding was also unchanged (21.2 months in 1992, and 21.5 in 1996). Overall the median duration was very similar in the rural and urban sectors of the country.

The bottle-feeding rate among breastfed infants less than 12 months, which was low in 1992 (Table 1), increased significantly to 9% in 1996 (Bureau of Statistics, 1992 & 1997).

Results of smaller surveys showed differences in breastfeeding practices between low and high-income groups, employed and unemployed mothers, urban and rural dwellers, as well as pastoral and non-pastoral communities.

In urban areas, there were noticeable differences between the low and high-income mothers in the duration of breastfeeding. Mothers from the low-income segment prolonged breastfeeding more than mothers from the high-income group. According to Mgaza and Bantje, 11% of the low-income mothers had stopped breastfeeding when the infant was below one year of age, compared to 70% in the high-income mothers. At 24 months, the corresponding proportion was 76% and 98% respectively. Shorter breastfeeding duration was particularly common in women of Asian origin and in those who considered themselves modern.

In rural areas, prolonged coexistence of breastfeeding and complementary feeding is typical. Unless in a very rapid succession of pregnancies, there is no tendency towards abrupt weaning. Mothers continue to breastfeed until the child desists by itself, the milk dries up or the mother becomes pregnant.

Aggressive marketing of infant foods and of the bottle endangers breastfeeding, especially in urban areas where using such foods and feeding bottles is regarded as modern. Although the rate of bottle-feeding was low at national level, some studies done in the early 80s in three large towns showed that bottle-feeding was more common among the employed, and those in the medium-income and high-income groups.

## 4. COMPLEMENTARY FEEDING

### 4.1 Age of introduction of porridge

According to the 1992 DHS, 6% of infants were already receiving complementary foods before 4 months. The timely complementary feeding rate (among infants 6–9 months) was 58%, while 40% of children were not yet complemented at that age (Macro International Inc., 1993).

The age of introduction of porridge varies from, as early as one month, to later than six months. In urban areas infants start consuming porridge between 3–4 months and in rural areas, between 4–6 months.

The smaller surveys showed that socioeconomic differences were particularly striking in urban areas, where at one month, 40% of the high-income people started introducing complementary foods compared with 20% of the low-income group. In both income groups employed mothers initiated complementary feeding earlier that unemployed women. This was noticeable at the age of three months when employed mothers went back to work after their three-month maternity leave. At this age, over 75% of employed mothers were already giving their infants complementary foods against 49% of the unemployed mothers. Before the age of six months all infants of employed mothers were complemented, while about 3% of infants of unemployed mothers, and 8% of infants from the high-income group were not yet receiving complementary foods.

In the rural areas, differences are not as clear between the different groups; however pastoral communities delayed complementing their infants (except cows' milk) more than rural non-pastoral groups: before six months, 25% of infants from pastoral communities were complemented while the proportion was 60% in the non-pastoral communities (Table 2).

### 4.2 Cessation of porridge consumption

There is no particular age for ceasing to consume porridge. Usually infants start to consume a thin porridge, which is gradually replaced with thick porridge as the child grows older and learns to chew. This usually happens at twelve months of age when young children are getting most of their meals from the family pot. However, the thin porridge continues to be served as breakfast for the child and the rest of the family, especially in rural areas.

### 4.3 Introduction of solid foods

There are no data at national level. The smaller surveys show that solid foods appear in the infant's diet as early as 4 months. The mean age for introduction of solids is about 6–9 months.

In towns, at 4 months, 9% of infants were already receiving solid foods; 30% started receiving them at six months, and 73% at 9 months. In the pastoral communities introduction of solids was delayed longer than in non-pastoral communities.

**Table 2**
**Complementary feeding practices in Tanzania**

| | DHS 1991/1992 | Some isolated studies done in the 80s/90s | |
|---|---|---|---|
| **Food groups** | **National** | **Rural non-pastoral communities** | **Rural pastoral communities** |
| Percent of children who consumed solids: | | | |
| 2-3 months | 9 | – | 0 |
| 4-5 months | 30 | 60 | 25 |
| 8-9 months | 73 | 100 | 100 |
| Percent of children who consumed pulses: | | | |
| <4 months | - | 4 | <1 |
| <6 months | - | - | <1 |
| <9 months | - | 20 | <1 |
| Percent of children who consumed meat or fish: | | | |
| <4 months | - | <1 | – |
| <6 months | - | <1 | – |
| <9 months | - | <1 | 2 |

### 4.4 Nature of complementary foods and modalities of distribution

In rural areas porridge is prepared from local staples, mainly cereals, mashed potatoes or bananas. Sugar, milk, or soups of beans, meat or vegetables may be added where available. Foods prepared specifically for infants and young children are single mixes of a thin cereal porridge unless the child feeds from the family pot. Pulses are very rare and appear in the infant's diet after six months of age, only in non-pastoral communities. Meat and fish are another rare ingredient in the infant's diet. They appear only at nine months or later, specifically in pastoral communities (Table 2). In towns, flour for infants such as Cerelac and Farex, although available, are expensive to the majority and are, therefore, rarely used.

The number of meals of solid foods is about 1–2 per day. The thick porridge, although energy and protein dense (> 100 kcal and 2 g of protein per 100 g of porridge), is often difficult to digest, and is therefore poorly utilized by the fragile digestive system of the young infant (Table 3). On the other hand, the thin plain porridge provides only about 20–60 kcal per 100 g of food and feeding frequency is only 2–3 times a day. Given their small feeding capacity per meal (100–150 g) at 4–6 months, children can only consume 20–90 kcal from thin porridge per meal.

Moreover, these foods are often prepared, stored, and fed to the infant under inadequate sanitary conditions causing frequent diarrhoea in young children. There is also a problem of insufficient dietary therapy during and immediately after illnesses, due to difficulties in feeding sick children or because of withholding foods and drinks especially during diarrhoea.

**Table 3**
**Composition of various types of prepared porridge in Tanzania**

| Type | Composition | Energy density (kcal/100g) | Protein content (g/100g) |
|---|---|---|---|
| Stiff porridge | maize flour + water | 114–149 | 2.5-3.7 |
| Thin plain maize | maize flour + water | 28–60 | 1.3–1.7 |
| Thin porridge +groundnut flour | maize flour + groundnut flour + water | 90 | 1.3 |
| Amylase ("power flour") maize porridge | maize flour + germinated cereal flour | 96 | 2.5 |

## 5. ONGOING ACTIVITIES TO IMPROVE INFANT FEEDING

Tanzania has launched several activities towards improving infant and young child feeding which include:

- Development of home-made complementary food mixtures with improved nutritional quality using locally available foodstuffs.
- Development and production of five regional complementary-food manuals based on country zones. The manuals are used by extension workers in their respective regions to impart knowledge about proper feeding practices and preparation of improved complementary foods. Along with these, several materials for information, education and communication have been developed.

- Development of a low cost industrial-based complementary food mixture called *LISHA*.
- Studies on the use of power flour (germinated cereal flour) to reduce dietary bulk in conventional complementary foods. Good results have been obtained. Promotion of this technology for child feeding has been done in the Joint UNICEF/WHO Nutrition Support Programme (JNSP — famous throughout the world) in the Iringa region, and in the Child Survival Protection and Development project areas, through nutritional campaigns, seminars, demonstrations, and radio programmes.
- Studies on the use of fermented porridge, *togwa*, for child feeding are also in progress. So far, laboratory studies have shown that *togwa* is another potential complementary food. Apart from the improved nutritional quality, it also has the ability to inhibit the growth of enteropathogens in the porridge, thus possibly reducing the incidence of diarrhoea among young children. *Togwa* keeps, allowing for several meals to be served from the same preparation.

Currently the National Consultative Committee, chaired by the Ministry of Health and coordinated by the Tanzania Food and Nutrition Centre (TFNC), is responsible for the coordination of activities on infant and young child nutrition. A 5-year National Programme is also in place. Under this committee, some activities have taken place.

They include:

- Activities aimed at protecting, supporting and promoting successful breastfeeding such as:
  - adoption and translation of the International Code of Marketing of Breast-milk Substitutes into a national law;
  - adoption of the 10 steps for successful breastfeeding;
  - advocacy for hospitals to become mother-baby friendly (so far 22 hospitals have been trained);
  - training of health workers on lactation management;
  - establishment of hospital-based support groups in trained hospitals.
- Development of training modules on breastfeeding management and proper complementary feeding.
- Continuing basic and operational research towards improving complementary foods.
- Advocacy on use of germination and fermentation technologies in child feeding.
- Advocacy on use of improved home-made complementary foods and good complementary feeding practices.
- Distribution of information, communication and educational materials.

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# Yemen

Khaled AL GINDARI

## 1. INTRODUCTION

Breastfeeding is the safest and the most important natural method for infant growth. However, at present, the picture of breastfeeding in some developing countries in general is gloomy. With increased awareness about the importance of breastfeeding, its practice is on the increase in developed countries while in developing countries it is on the decline. Breastfeeding is affected by several factors such as mothers' education, age, working status, family size and income, race and geographic region.

Nearly all of the Yemeni mothers have a positive attitude toward breastfeeding, feeling that it should be carried on for two years as the Quran enjoins. In Yemeni culture fear, anger or sickness of the mother is believed to make breast milk unsuitable for the infant, but these beliefs are strongest in traditional parts of the society.

## 2. MALNUTRITION AMONG CHILDREN UNDER FIVE YEARS OF AGE

The latest information available, collected in 1996, does not provide figures for the prevalence of wasting, but comparisons can be made for the other indicators of malnutrition with results of the previous Demographic and Health Survey of 1991–92 (Ministry of Health, 1996; Central Statistical Organization, 1994). Results are summarized in Table 1.

**Table 1**
**Malnutrition[a] among children under five years in Yemen (DHS, 1992; Ministry of Health, 1996)**

| | Stunting | | Underweight | |
|---|---|---|---|---|
| Percent of children | 1992 | 1996 | 1992 | 1996 |
| Male | 39 | 42 | 30 | 41 |
| Female | 49 | 36 | 30 | 37 |
| Urban | - | 29 | - | 31 |
| Rural | - | 44 | - | 43 |
| All children | 44 | 39 | 30 | 39 |

[a] *As defined in "Catalogue of Health Indicators" (WHO, 1996)*

## 3. INFANT AND YOUNG CHILD FEEDING PRACTICES

### 3.1 Breastfeeding

*Initiation of breastfeeding*

In the first few hours after delivery neonates are given water, boiled water, honey, butterfat or cows' milk cream. These are administered by fingertip, or using a piece of cotton, or a feeding bottle.

The survey conducted in 1992 in urban and rural areas of Sanaa and Aden governorates showed that 93% of urban, and 90% of rural mothers fed colostrum to their babies. This reflects the general belief, knowledge and practices of mothers of these two areas. Furthermore, most of the small-scale studies conducted in various parts of the Republic of Yemen indicate that breastfeeding is initiated on the first day after delivery. The percentage ranged between 73% and 98% in northern and southern governorates (Bagenholm et al., 1987).

The remaining percentage of mothers delayed breastfeeding initiation until the third day after delivery, because they believe that colostrum is polluted by their pregnancy, and sometimes is not regarded as real milk.

*Breastfeeding patterns*

Prevalence of breastfeeding represents only one facet of the nutritional, health and fertility aspect in the Republic of Yemen. During the first three months 93% of mothers breastfeed their infants. The percentage declines to 81% between three and five months; there is a further decline after six months; and after 12 months the percentage is 35%.

Breastfeeding patterns are different in urban and rural areas. The overall prevalence of breastfeeding is higher in rural (87%) than in urban areas. However, in the first three months the percentage is slightly higher in urban areas than in rural. Moreover, 42% of urban mothers stop breastfeeding their babies after three months from delivery, compared to 29% of rural mothers, for many reasons such as going back to work or use of contraceptive pills.

In the Republic of Yemen a majority of mothers (94%) breastfed their infants on demand (only 4% on both demand and schedule) and both breasts were given for 30 minutes or more during a feed. There was no difference in rural and urban areas for this practice.

*Breastfeeding duration*

The median duration of breastfeeding was 16.8 months (Central Statistical Organization, 1994). It varied only moderately with mother's age and showed no discernible pattern. The median duration of breastfeeding varied between rural and urban areas, and between regions, respectively. Medians were lowest for women in the southern and eastern governorates (13.4) and in urban areas (13.7).

Percentage of breastfeeding at six months was 24% in urban areas, while it was 32% in rural areas. Breastfeeding duration was shortest among young city women and for last-born children, indicating that the current trend is away from extended breastfeeding.

### *Bottle-feeding*

Feeding bottles were unknown before the 1962 Revolution, but cheap plastic bottles became available and increasingly common by 1971. At that time, the feeding bottle was viewed as a symbol of modernity. In 1979, the market was booming with artificial baby foods, with 30 brands of infant formulae available (plus about 30 brands of full-cream powder and 7 evaporated milks), showing appealing pictures of smiling babies on the packages. The 1991-92 DHS found that the use of bottle with a nipple was quite popular in Yemen. Presently, the majority of infants appear to be bottle-fed, and feeding bottles can be purchased in the smallest shops, even in remote villages. More than half (52%) of Yemeni children under five years have been bottle-fed for some period of time (Central Statistical Organization, 1994). The prevalence of bottle-feeding was higher in urban areas and in the southern and eastern governorates (around two-thirds of the children), than in rural areas or the northern and western governorates (almost half). Half of the children whose mothers had no formal education were bottle-fed.

## 3.2 Complementary feeding

### *Use of soft complementary foods*

In the Republic of Yemen, it is common practice to give soft complementary foods at an early age (Table 2). The type of complementary foods and the age at which they are given depends on tradition and social customs; grandmothers and other elderly women have an influence on complementary feeding patterns. The age of starting soft complementary foods varies from one place to another. Forty-five percent of infants under three months of age receive soft foods in urban areas, while a lower percentage do in rural areas. Around two-thirds of children at three months are given other liquids in urban areas, while only one-quarter receive juice, sugar water, rice water or herbal drinks in rural areas. It is very common to introduce imported baby foods (such as Cerelac) at an early age.

Biscuits and artificial products, usually with milk or boiled water, were mostly introduced as complementary foods at less than three months of age. Biscuits ranked first as a suitable food.

**Table 2**
**Age of introduction and type of complementary food (DHS, 1991-92)**

| Type of food | Age of child when complementary foods were introduced (months) | | | | | |
|---|---|---|---|---|---|---|
| | **0-3** | **4-6** | **7-11** | **12-17** | **18-23** | **24-59** |
| | % of children under five years | | | | | |
| Powdered milk | 31.2 | 7.6 | 2.6 | 1.8 | 0.3 | 0.2 |
| Animal milk | 14.6 | 4.7 | 1.4 | 1.7 | 0.3 | 0.4 |
| Solid or mushy food | 7.2 | 30.1 | 17.4 | 8.9 | 0.9 | 0.9 |

About 30–50% of the urban infants aged 3–12 months receive commercial baby foods as their first complementary food, as well as biscuits mixed with liquid. They are fed either by spoon or feeding bottle. Rural mothers have not been influenced by this modern feeding practice yet.

When the children are old enough to eat by themselves, they are gradually introduced to the family diet, without any restriction or addition.

### *Use of solid complementary foods*

Traditional family foods vary greatly from one part of the country to another. The most common family foods are offered to the child — grain dishes being the most popular— such as rice, *assed* (a thick porridge made from sorghum or wheat mixed with boiled water), *hareesh* (a thick wheat or corn flour, butter-fat and honey porridge) and *mattet* (a thin gruel made with soured skimmed milk, grain flour and spices). Another family food offered is *shabiza* (a soft porridge made from locally available ground grains, legumes flours, ghee and sometimes milk, boiled water and sugar), which is still used in various regions of the country and is fed to older children as well as adults. Usually, health workers still encourage mothers to feed their infants with *shabiza* from the age of six or seven months.

Eggs, fruit and vegetables are mostly introduced at the age of three to six months, while in southern areas, fish is used more by mothers to feed their infants. Legumes are introduced as complementary foods mostly in the age group of three to six months and more by mothers from Aden.

Children who share the family pot eat three times a day, regardless of their age. Lunch is considered to be the main meal. Solid foods are considered as being good if they are soft, light, easy to swallow and digest, and not too strongly spiced or hard to chew. The belief that light foods are best for infants sometimes leads to over-diluting milk powder to make it "more suitable".

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# Algeria
# Production and marketing of Superamine

Jean Paul GRANGAUD
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## 1. INTRODUCTION

In 1963, a nutritional rehabilitation centre in Algiers successfully used a preparation made of wheat and pulses; this incited a group of experts, led by Raoult and Buffa, to persuade the Algerian Government to undertake the industrial production of a protein-rich food for infants.

## 2. COMPOSITION AND NUTRITIONAL VALUE

Superamine was first produced on an industrial scale in 1969 by the Société Nationale des Semoules, Pâtes et Couscous,[1] initially in Blida and later in Sétif. The ingredients are shown in Table 1.

The durum wheat and chickpea flour were pre-steamed and poured over a cylinder, in a "pasta-type" process, to produce a very fine flour (Buffa, 1967a). Then, the skimmed milk, sucrose, and mineral and vitamin supplements were added.

From 1967 to 1969, Superamine was analysed by the Central Food and Nutrition Institute in Utrecht; its nutrient content is shown in Table 2. In addition, repeated analyses by the Pasteur Institute in Algiers have shown that Superamine was devoid of toxic products or microbiological contamination.

**Table 1**
**Composition of Superamine**

| Ingredients | per 100 kg |
|---|---|
| Durum wheat flour (kg) | 28 |
| Chickpea flour (kg) | 38 |
| Lentil flour (kg) | 18 |
| Skimmed milk (kg) | 10 |
| Sucrose (kg) | 5 |
| Vitamin A (IU) | 2 500 000 |
| Vitamin D3 (IU) | 400 000 |
| Vitamin B2 (mg) | 800 |
| Calcium carbonate (g) | 500 |

[1] National semolina, pasta and couscous company.

## 3. METHODS OF PREPARATION

The methods recommended for preparing Superamine depend on the age of the child and whether it is intended as an exclusive food for malnourished children. The methods are summarized in Table 3 (Raoult, 1970). Superamine is diluted in warm water and boiled for 3 to 5 minutes.

Clinical trials of Superamine carried out since 1966 in Algerian paediatric services show that it is readily accepted by children and that a satisfactory weight gain is obtained.

**Table 2**
**Nutrient content of Superamine produced from 1967 to 1969**

| Nutrients | per 100 g |
|---|---|
| Energy (kcal) | 414 |
| Protein (NPU=70) (g) | 20.9 |
| Fat (g) | 4.5 |
| Total CHO (g) | 58.0 |
| Digestible CHO (g) | 54.0 |
| Cellulose (g) | 1.2 |
| Ash (g) | 0.09 |
| Water (g) | 7.5 |
| Calcium (mg) | 400 |
| Phosphorous (mg) | 400 |
| Potassium (mg) | 900 |
| Magnesium (mg) | 140 |
| Iron (mg) | 14.5 |
| Vitamin A (IU) | 2600 |
| Vitamin D3 (IU) | 400 |
| Vitamin B1 (mg) | 0.45 |
| Vitamin B2 (mg) | 0.87 |

## 4. PRODUCTION TREND

During the first year, production was 800 tonnes, rising to 1200 tonnes and subsequently to 3000 tonnes following the creation of a new production unit in Sétif. In 1976, the production of Superamine had stabilized. This experience was cited as an example and it was suggested that the process be extended to the production of pasta and couscous for human consumption, to obtain protein-rich foods for adults. At the same time, the Ministry of Agriculture proposed a programme to enhance the production of pulses. There were, however, two drawbacks: on the one hand, the unattractive presentation of the food in plastic bags and, on the other hand, the fact that certain batches were contaminated by salmonella.

The very low purchasing price (DA 0.80[2] per bag), considerably lower than the production cost (DA 2.40), was the source of much comment regarding its advantages (affordability) and disadvantages (depreciation). Despite the positive results, production of Superamine was halted in 1984 for a number of reasons:

- Firstly, far from increasing, the production of pulses stagnated and later dropped. Algeria was therefore obliged to import 75% of the ingredients. The same occurred for durum wheat and even skimmed milk, whose supply by the World Food Programme was stopped in 1990. These constraints had an impact on the regularity of production.
- Secondly, the decision to subsidize Superamine reduced the company's profit, even though it received compensation from the State. Consequently, the company preferred producing pasta and couscous, as the production equipment and personnel were the same as those required to produce the complementary food. This versatility of the production line, initially deemed to be an advantage in terms of flexibility (Buffa, 1967b), was a disadvantage for the production of Superamine.
- Thirdly, the contamination caused by the absence of qualified personnel contributed to breakdowns in the marketing circuit.
- Finally, the Ministry of Trade's authorization for the sale of an imported normoproteic food, ready to use and presented in a much more attractive package as well, encouraged consumers to turn towards this new food.

**Table 3**
**Recommendations for use of Superamine**

| Age (months) | Number of meals of porridge/day | Amount of Superamine per meal (g) | Amount of Superamine per meal (number of level tablespoons) | Amount of water or broth per meal ($cm^3$) |
|---|---|---|---|---|
| **In addition to breast milk** | | | | |
| 3–5 | 1 | 30 | 3 | 150 |
| 6–7 | 2 | 50 | 5 | 180 |
| 8–10 | 3 | 50 | 5 | 200 |
| 11–30 | 3 | 60 | 6 | 200 |
| **Used exclusively** | | | | |
| 3–5 | 5 | 20 | 2 | 150 |
| 6–7 | 4 | 30 | 3 | 180/200 |
| 8–10 | 4 | 40 | 4 | 200 |
| 11–15 | 4 | 50 | 5 | 200 |
| 16–30 | 4 | 60 | 6 | 200 |

[2] In 1984, US$ ≈ 4.98 DA.

## 5. FUTURE PROSPECTS

Although Superamine disappeared a decade ago, many health workers and consumers would like to see it manufactured again; more so, because the economic crisis that is affecting Algeria since 1985 following the collapse of oil prices, carries a risk of re-emergence of serious forms of protein-energy malnutrition, which had practically disappeared in the 1980s (Kellou, 1995).

Before deciding to resume production of this food, it is necessary to make sure there is a potential market and that basic ingredients are available. From a practical standpoint, the relative advantages of developing household preparations should be compared to those of producing an industrial food within the framework of a development project integrating agricultural production and processing industries.

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# Benin
# Ouando flours for young children: marketing and targeting methods

Robert Z. METOHOUE

## 1. INTRODUCTION

Benin's experience in the area of complementary foods for infants and young children began in the early 1970s as part of a programme to alleviate hunger and malnutrition. Studies carried out at that time demonstrated the existence of malnutrition in Benin and highlighted the major causes. One of these was the traditional infant feeding practice of giving children a porridge of low energy and protein density.

To solve this problem, complementary foods were developed at the Centre Horticole et Nutritionnel de Ouando (CHNO) ;[1] two types of foods were developed based on local agricultural products (cereals, pulses):

- a flour for infants, composed of maize, sorghum, rice and sugar, for ages 3 to 6 months
- a flour for the next age group, i.e. from 6 months, composed of maize, sorghum, beans, groundnuts and sugar, or maize, sorghum, soya beans and sugar.

The manufacturing process is very simple and uses a Beninese food technology. It comprises the following operations: cleaning, sorting and washing, toasting, mixing, milling, and packaging.

## 2. HISTORY OF THE OUANDO EXPERIMENT

The Ouando experiment went through five stages.

### 2.1 Promotion of the techniques throughout Benin

The techniques were promoted especially among the most disadvantaged sectors of the population. The aim was to encourage mothers to prepare their children's food themselves according to the CHNO formula.

[1] Ouando horticultural and nutritional centre. It was established in 1963 under the programme to fight hunger in Benin. It is situated in Porto Novo, Benin's administrative capital, in a suburb called Ouando. It is an extension service of the Direction de l'Alimentation et de la Nutrition Appliquée (DANA: department of food and applied nutrition) which is a specialized department of the Ministry of Rural Development responsible for promoting nutrition.

## 2.2 Establishment of a small-scale production unit

It was necessary to set up such a unit to provide a processed food to mothers who did not have time to prepare food for their children because of their work. The foods produced were also to be used to rehabilitate malnourished children attending the CHNO as part of its nutrition monitoring activities.

## 2.3 Improvement of the manufacturing process

To meet the increasing demand and respond to the population's expectations, the manufacturing process was improved. The unit was equipped with semi-industrial machinery with the support of the Royal Institute of Tropical Medicine in Amsterdam (KIT, Netherlands). This new equipment made it possible to produce around 100 tonnes annually from 1984 onwards.

## 2.4 Evaluation of the experiment

The evaluation planned by the CHNO was carried out by the Centre International de l'Enfance (CIE)[2] and the Ecole Nationale Supérieure des Industries Agricoles et Alimentaires (ENSIAA)[3], with financing from the French Aid and Cooperation Fund. It highlighted shortcomings and proposed improvements in the presentation and the nutritional quality of the products, in particular their protein and micronutrient contents.

## 2.5 Establishment of the Superfarine factory in Ouando

This factory was financed by the Italian Government through a nongovernmental organization from Naples, the Third World Lay Group. The original formulae were improved and the technology is now based on extrusion-cooking. With this new factory, production has increased from 100 tonnes to 150 tonnes annually.

# 3. ACCEPTABILITY

In general, consumers appreciate Ouando foods. The 1985 CIE evaluation showed that 82% of mothers did not experience refusal by their children when the food was introduced or when it was consumed regularly. Of the remaining 18%, some mothers mentioned digestive problems related to use of the foods: diarrhoea, vomiting, regurgitation, constipation, and nausea. These problems could be explained by inadequate cooking or by mothers' inappropriate feeding practices.

Acceptance of the product by the population depends on several factors. Some of the most important in the Ouando experiment were:

- The choice of technological processes: the manufacturing scheme is simple and takes into account the target population's food habits; toasting, for example, not only improves the food safety of the product and destroys anti-nutritional factors, but also gives a taste and aroma consumers are familiar with.
- The adequate nutritional value, especially protein and energy content.

[2] International children's centre. Paris, France.

[3] National college of agricultural and food industries. Massy, France.

- Information for mothers: in the beginning some mothers tended to consider Ouando as a medicine for children suffering from malnutrition, but this view changed following awareness campaigns, focus group discussions and advice from health workers.
- Easy use: the method for preparing Ouando porridge is almost identical to that of traditional porridge and it is easy to make.

It is clear that the good acceptance of Ouando foods is the result of several factors, the choice of the manufacturing process, the quality of the product and the information system.

## 4. MARKETING

Complementary foods cannot be promoted without an appropriate marketing policy. To describe the Beninese experience in this area, we will present data on the purchase price and distribution networks.

### 4.1 Purchase price

In the beginning, the foods were subsidised because it was felt that they were needed by the most disadvantaged segments of the population. The subsidy was in the form of State payment of part of the operating costs (payroll, water and energy costs). Currently, however, there is a trend towards setting prices that do not aim at profit but allow the manufacturer to be independent and, in the long term, to make a profit. Price trends from 1977 to 1994 are shown in Table 1.

### 4.2 Distribution networks

Many institutional structures involved in development have activities that promote the distribution of Ouando foods. These include medical facilities, social welfare centres, and the Centre d'Action Régional pour le Développement Rural (CARDER)[4] and are sometimes also sales outlets for the products.

In the beginning, the flours were distributed only in areas close to the production zones (Cotonou and Porto Novo). As the food was promoted, sales outlets were gradually established in other areas. Currently, there are around 200 outlets nationwide, 120 of which are in Cotonou alone.

There are three categories of retailers (Table 2):

- Health facilities (health centres, maternity wards, hospitals); in the beginning, the foods were only sold in these outlets, but today there are many other retailers and sales through this institutional channel are continually decreasing.
- Pharmacies and pharmaceutical stores sell around 40% of production; this distribution network helps enhance the food's image and reduce the volume of complementary food imported.
- Other retailers such as supermarkets, kiosks, grocery stores and door-to-door salesmen sell almost 50% of production.

[4] Regional centre for rural development, Benin.

The unit has a vehicle equipped for distributing the products. The driver is the delivery man; he delivers to Cotonou (3 times a week), Porto Novo (twice a week) and to inner Benin within a radius of 100 km (once a month or every two months).

Deliveries to distant areas (North Benin, Parakou, Natitingou) are made by train or public transport. Measures are being taken to set up outlets in areas that are difficult to reach.

**Table 1**
**Trend in the purchase price of Ouando flours since 1977 (CFA Francs[a] per 500 g packet)**

| Period | Type [b] | Wholesale price | Retail price |
|---|---|---|---|
| 1977–1980 | "1er âge" | 160 | 180 |
| | "2ème âge" | 180 | 200 |
| 1980–1989 | "1er âge" | 180 | 200 |
| | "2ème âge" | 200 | 225 |
| 1989–1993 | "1er âge" | 180 | 200 |
| | "2ème âge" | 200 | 250 |
| 1993–1994 | "1er âge" | 400 | 440 |
| | "2ème âge" | 300 | 340 |
| June 1994 | "1er âge" | 480 | 525 |
| | "2ème âge" | 360 | 400 |

[a] *Before the 1994 devaluation, US$ 1 ≈ CFA Francs 250*
[b] *"1er âge" for infants aged 3–6 months; "2ème âge" for infants from 6 months*

**Table 2**
**Amounts of Ouando distributed by various retailers in 1993**

| Retailers | | "1er âge" [a] | "2ème âge" [a] | Total |
|---|---|---|---|---|
| Health centres | kg | 1300 | 12 901 | 14 201 |
| | % | 10.3 | 13.8 | 13.4 |
| Pharmacies | kg | 6451 | 35 267 | 41 718 |
| | % | 51.0 | 37.7 | 39.3 |
| Other retailers | kg | 4902 | 45 433 | 50 335 |
| | % | 38.7 | 48.5 | 47.4 |
| Total | kg | 12 653 | 93 601 | 106 254 |
| | % | 100.0 | 100.0 | 100.0 |

[a] *"1er âge" for infants aged 3–6 months; "2ème âge" for infants from 6 months*

## 5. MEASURES TAKEN TO REACH TARGET GROUPS

It was difficult to state categorically that Ouando flours were being used by the targeted rural population when the experiment began. In 1985, evaluation by the CIE showed that only 15% of users belonged to this population segment. In 1993, less than 14% of the production was marketed outside the provinces of Oueme (Porto Novo) and Atlantique (Cotonou) (Table 3). Although action has been taken to make prices accessible, the purchasing power in rural areas is so low that it is difficult for many families to buy Ouando complementary foods.

**Table 3**
**Amount of Ouando distributed in 1993 by province**

| Region | | "1er âge" [a] | "2ème âge" [a] | Total |
|---|---|---|---|---|
| Oueme | kg | 2376 | 13 982 | 16 358 |
| (Porto Novo) | % | 18.8 | 14.9 | 15.4 |
| Atlantique | kg | 8589 | 66 597 | 75 186 |
| (Cotonou) | % | 67.9 | 71.1 | 70.8 |
| Mono | kg | 333 | 5358 | 5691 |
| (Lokossa) | % | 2.6 | 5.7 | 5.4 |
| Zou | kg | 964 | 3964 | 4928 |
| (Abomey) | % | 7.6 | 4.2 | 4.6 |
| Borgou | kg | 231 | 3000 | 3231 |
| (Parakou) | % | 1.8 | 3.2 | 3.0 |
| Atacora | kg | 160 | 700 | 860 |
| (Natitingou) | % | 1.3 | 0.7 | 0.8 |
| Total | kg | 12 653 | 93 601 | 106 254 |
| | % | 100.0 | 100.0 | 100.0 |

[a] *"1er âge" for infants aged 3-6 months; "2ème âge" for infants from 6 months*

This situation was taken into account and the following action was undertaken:

- sales outlets were gradually opened in all areas of Benin to make the products available to all those who can buy it;
- recipes were disseminated for household preparation of enriched complementary foods;
- nutrition education was intensified so that all available resources were used to improve feeding practices.

# Burkina Faso
# Misola flours for young children[1]

Simone SOUBEIGA

Misola is a high protein and high-energy food designed to fight malnutrition. It has been produced in Burkina Faso since 1982, from cereals and leguminous seeds grown in the sub-Sahelian region (millet, soya beans, and groundnuts).

## 1. BACKGROUND

The Misola story started in response to a need, not a theoretical decision: when the supply of complementary foods to the Nutritional rehabilitation and education centre (CREN) at Fada N'Gourma hospital by International Aid ceased in 1981, the paediatric team was forced to find an alternative. The team attempted to answer the following questions:

*What could be done?*

Use what was available to develop a formula for a complementary food that would replace the foods donated to prevent and cure malnutrition, and ensure that such a breakdown would not happen again.

*What was available?*

- a CREN in a public hospital
- a coordinator devoted to her job
- a provincial health director willing to take action
- jobless mothers waiting for their children to grow
- cooking utensils in the CREN
- a market and shopkeepers in town
- a small amount of financial aid from the NGO "Frères des hommes".

*Who would do what?*

To set up the production unit (PU) it was necessary to define the role, and use the competence, of each and every person, to observe, encourage and develop what worked best, and give each participant his/her equal share of responsibility. The CREN coordinator used the first few months to develop an energy and protein food formula effective in treating malnutrition, consistent with local food practices, with the best possible digestibility, and using local agricultural resources as much as possible.

[1] The presentation given at the Alexandria workshop was complemented with a paper entitled "L'aventure Misola" [The Misola adventure] presented by Dr. F. Laurent at the WHO/AFRO Workshop *"Les Bouillies de Sevrage en Afrique Centrale"* [*Weaning gruel in Central Africa*]. Brazzaville, Congo, May 21-24, 1991.

The CREN provided the premises and the basic equipment as well as more specific equipment (dryers, toasting drums). The provincial health directors were very motivated to produce a local food and they supported the project at the government health department. The women provided their skills and labour. The nongovernmental organization providing support participated in the research (elaborating the formula, developing appropriate technology) and helped finance the minor equipment, assays, and the follow-up consultations.

The Misola story could begin. The first PU would lead to the creation of others, each designed and operating slightly differently according to local circumstances. To date, however, the project remains on a small scale and its nutritional impact is very limited.

## 2. INGREDIENTS AND NUTRITIONAL VALUE

With a balanced content of vitamins, protein, carbohydrate, fat, and minerals, Misola is a complementary food designed to prevent malnutrition. In the beginning, in November 1982, the composition was the following: millet, soya beans, milk, groundnuts, plus supplements (iron, vitamin complex). Problems were encountered with milk and vitamins, and these ingredients were consequently withdrawn; the current formula uses only local products such as millet, soya beans, groundnuts, sugar and a little salt.

The composition of Misola is based on a cereal/leguminous seed combination to obtain a balanced amino acid content, similar to that of animal protein. The cereal, finger millet, provides carbohydrates and protein; leguminous seeds, i.e. groundnuts and soya beans, are rich in protein and fat and help increase the energy density of the food and provide unsaturated fatty acids.

Annual production is 5 tonnes. Misola comes in 220 g and 500 g packets; it is sold for CFA Francs[2] 225 per 500 g packet (compared with CFAF 400 per 400 g for imported foods of the Cérélac type).

The main formulas currently prepared are shown in Tables 1 and 2; their nutritional value is given in Table 3. Bacteriological analyses carried out in the nutrition laboratory of the Family Health Department have sometimes shown an unacceptable level of contamination (Table 4). The advantages of Misola over other complementary foods are low cost, easy preparation and a taste which is readily accepted by children. After preparation, Misola can be enriched with orange, lemon or tomato juice, baobab fruit flour, fish or meat as it is a balanced food that contains vitamins, protein, carbohydrates, fat, and minerals.

## 3. ORGANIZATION OF THE PRODUCTION UNIT AND PROCESSING TECHNIQUES

### 3.1 Design of production units

The small-scale production units can be designed according to several models:

- a "compact" plan that limits costs, but the whole unit must be built in one stage;
- a "divided" plan in which the different production processes are housed in separate buildings. This model allows future growth, provided there is a large enclosed area.

The design in Figure 1 shows a production unit built in Toma, Sourou province, Burkina Faso.

[2] Before the 1994 devaluation, US\$ 1 ≈ CFA Francs 250; after devaluation, US\$ 1 ≈ CFA Francs 500.

**Table 1**
**Composition of Misola flours from the main production units (per 100 g)**

| Ingredients | Misola | Misopa | Den-Mugu |
|---|---|---|---|
| Millet (g) | 60 | 58 | 60 |
| Soya beans (g) | 20 | 23 | – |
| Groundnuts (g) | 10 | – | – |
| Beans (g) | – | – | 10 |
| Milk powder (g) | – | 30 | – |
| Sugar (g) | 9 | 5 | – |
| Baobab fruit (g) | – | 3 | – |
| Salt (g) | – | 1 | – |
| Iron sulphate (mg) | – | – | 100 |
| Zinc sulphate (mg) | – | – | 60 |

**Table 2**
**Recipe of Misola flour prepared in the community**

| Ingredients | Volume |
|---|---|
| Toasted millet | 3 parts |
| Toasted soya beans | 1 part |
| Toasted groundnuts | ½ part |
| Sugar | ¼ part |
| Salt | to taste |

### 3.2 Processing techniques

Toasting the ingredients increases their digestibility and gives the porridge a taste that even malnourished and anorexic children like. The use of local foods facilitates the transition to traditional family foods. Vitamin C and beta-carotene (provitamin A) can be added after cooking in the form of fresh fruit juice.

The production of Misola is easily mastered because it uses traditional manual techniques. The production method is adapted to three socioeconomic contexts:

- The food produced in regional small-scale production units is for sale. The units are well equipped (as regards weighing of ingredients and packaging) and produce a high-quality flour of standard composition. The units are profit-oriented.
- At the community level, in health centres, mothers who have helped produce the food can take home the amount needed by their child until the next session. The technology is simplified, ingredients are measured by volume and only traditional cooking utensils are used.
- Teaching how to make Misola porridge is part of nutrition education, as well as learning to prepare enriched porridges such as those used in some SMI or CREN.

**Table 3**
**Biochemical composition of Misola flours (per 100 g[a])**

| Components | Fada | Sect.30 | Zabré | Dori | Toma | Den-Mugu | |
|---|---|---|---|---|---|---|---|
| | | | | | | Ban Fora | Kou |
| Protein (g) | 13-15 | 16 | 13-15 | 15 | 15 | 14 | 15 |
| Fat (g) | 12-13 | 10-12 | 13 | 14 | 13 | 8 | 9 |
| Starch (g) | 52 | 51 | 49 | – | - | – | – |
| Sugar (g) | 11 | 11 | 13 | – | – | – | – |
| CHO (g) | 63 | 62-63 | 62 | 63 | 63 | 67 | 68 |
| Energy (kcal) | 430 | 412-428 | 421-426 | 436 | 430 | 400 | 409 |
| Minerals (g) | 2 | 2-3 | 3 | 2 | 2 | 2 | 2 |
| Water (g) | 8 | 7 | 8 | 6 | 7 | 8 | 6 |
| Aflatoxin (mg/kg) | 0.001 | 0.001 | – | – | – | – | – |
| Lysine (mg/16gN) | 4.57 | 4.93 | – | – | – | – | – |

[a] *Unless otherwise stated*

*N.B. The analyses were carried out by the nutrition laboratory of the Family Health Department (DSF-Burkina Faso) and the Laboratoire Agro-vétérinaire of Rouen (France)*

**Table 4**
**Bacteriological analysis of Misola flours**

| Germs identified | Fada | Zabré | Dori | Kou | Toma |
|---|---|---|---|---|---|
| | | | *(germ count per g)* | | |
| Salmonella | 0 | 0 | 0 | 0 | 0 |
| Coliforms | 1800 | 1800 | 1800 | 0 | 0 |
| *Escherichia coli* | – | – | – | | 80 |
| Staphylococcus | 1320 | 1100 | 950 | 0 | 0 |
| Yeast/mould | 50 | 80 | 64 | 0 | 22 |
| *Bacillus cereus* | 0 | 0 | 0 | 0 | 0 |
| *Clostridium welchii* | 0 | 0 | 0 | 0 | 0 |
| *Clostridium botulinum* | 0 | 0 | 0 | 0 | 0 |
| Faecal streptococcus | 0 | 0 | 0 | 0 | 0 |
| Pseudomonas | 0 | 0 | 0 | 0 | 0 |
| Proteus | 0 | 0 | 0 | | 0 |
| Total germ count | 2080 | 3500 | 2320 | 300 | 300 |

### 3.3 Storage

If Misola is not stored properly, it can become infested with insects (weevils) or can be destroyed by mice and cockroaches. It can be a source of diarrhoea in children. Therefore, storage of raw materials (millet, soya beans, groundnuts) and of finished products is subject to various controls.

Inside the PU, the following precautions are taken: washing of hands, sifting flour in specific dishes, cooling under cover before packaging, air-tight heat-sealing of packets, and storage in hermetically-sealed cylinders.

If the food is prepared and stored under satisfactory conditions, it can be kept for six months and sometimes more.

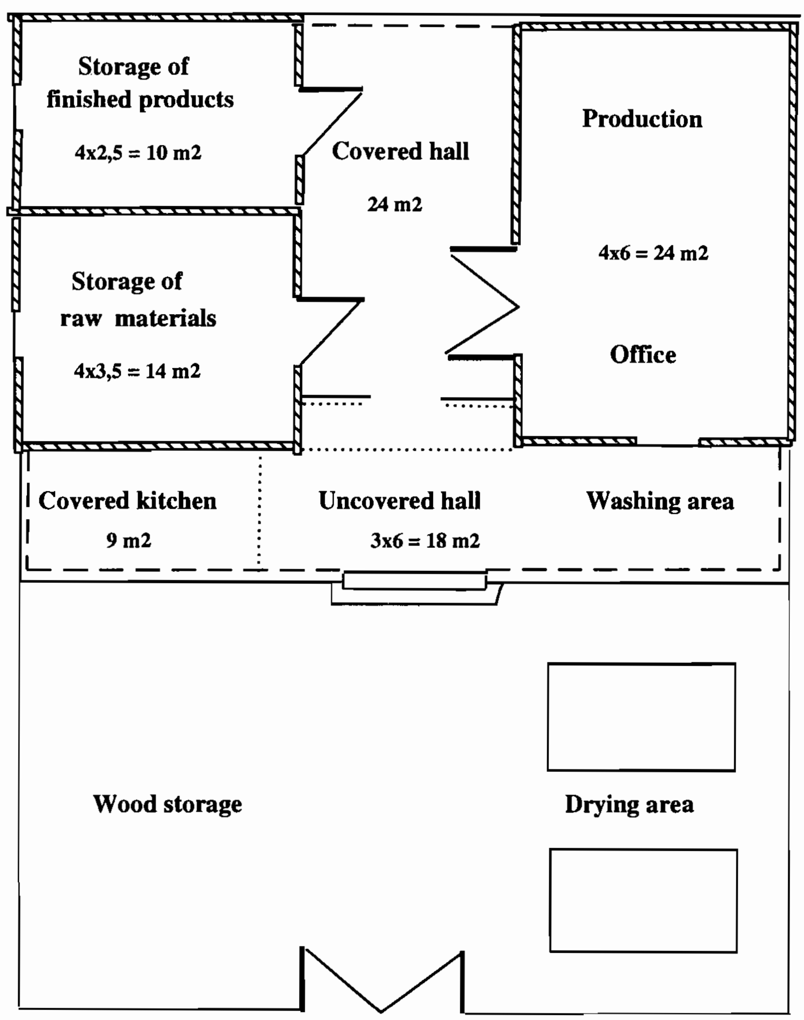


**Figure 1**
**Plan of the unit built in Toma (Sourou province)**

# 4. INSTITUTIONAL FRAMEWORK AND ACTIVITIES WITHIN THE MISOLA PROGRAMME

## 4.1 Institutional framework

The production units are decentralized and operate independently, ideally with the concurrent support of:

- the local health authority responsible for supervising the PU and identifying the target group, so that Misola is integrated in a public health project to combat malnutrition;
- the women's association responsible for producing and marketing the flour for infants with the additional goal of generating profit for the women's project;
- a nongovernmental organization which invests in the project.

Community production operates in the same way, but in a less stringent manner.

In Burkina Faso, production of Misola is part of the Plan of Action for the production and popularization of complementary foods, made from local products defined by the Ministry of Health and Social Action and the Department of Family Health (DSF). It receives active support and a financial contribution from UNICEF.

In Mali, the physician in charge of the Tenenkou circle has managed the project since 1993. Coordination is done in France by the CFDAM and the Diafarabé-France association, which follow up the various PUs in liaison with the Ministry of Health and UNICEF in the country concerned, and with the NGOs providing support. Follow-up consultations are regularly done in the PUs.

## 4.2 Activities carried out in the Fada N'Gourma unit

In the Fada N'Gourma unit, the following activities are routinely carried out:

- training of staff in techniques for producing Misola-type complementary foods;
- production of Misola foods;
- local sale of Misola in the Fada N'Gourma district;
- supply of Misola to 30 health posts in Gourma and the provinces of Gnagna and Tapoa and to pharmacies in Ouagadougou.

## 4.3 Training of technical staff

The Misola unit in Fada is the national training centre in Misola production techniques. It has trained the following production teams: Pô (1983), Zabré (1987), Diabo (1987), sector 30 of Ouagadougou (1989), Tenkodogo (1989), Toma (1989), Kouritenga (1989), Pal la Biig Yidgri association, Bam (1993, 1994) and Diafarabé in Mali (1992).

# 5. LESSONS TO BE DRAWN FROM THE MISOLA EXPERIENCE

Operation of the four major PUs provides answers to five key issues that determine whether this type of experience, based on small-scale production units with a low level of financial investment, can play a role in Public Health and move beyond the experimental stage.

### 5.1 How to ensure that production units can control supplies and production

Misola is composed of raw materials that are available throughout the year — as a result the production of soya beans was increased — and are inexpensive at harvest time. Building up stocks is recommended.

The responsibility for purchasing raw materials and for production are entrusted to the women in charge of PUs, since they are used to doing this for their families.

The processing techniques, based on traditional methods, have gradually been improved and made more efficient; time is saved by reducing and simplifying the number of production stages, energy is saved and wastage is decreased. The equipment is simple and no breakdown stops the women's work.

The equipment was purchased locally so it is easy to replace: there is no special equipment, and consequently no technological dependence. Usually, the town mill is used or the women's group owns a mill.

Supply and production are more reliable when they are shared among women or entrusted to a women's group. The women's groups collaborating in PUs are usually competent at finding active women who can help to find the best suppliers and promote sales.

The proximity of producers of raw materials to the distribution sites facilitates, supply and distribution, and helps reduce costs.

### 5.2 How to organize the production unit

Eight years' experience has resulted in the organization of a tripartite structure: a health facility, a women's group and a supporting NGO. All PUs are supported by the Ministry of Health and its Department of Family Health, or by bodies such as UNICEF Burkina and an association (Misola advisory group), which acts as a technical adviser and coordinator of supporting NGOs *inter alia*.

The specificity of Misola PUs is that they work within health facilities. This collaboration is a major advantage to obtain an impact on public health. This system:

- facilitates access to target groups;
- raises the health personnel's awareness of the importance of nutrition for children's health;
- promotes the food as a product that can lead to good health and "cure malnutrition";
- gives complementary foods access to the network of distribution of medicines, vaccines etc.

The collaboration of a women's group in a PU has several advantages:

- it "privatizes" the production tool by giving women a financial interest in production;
- it benefits from the women's knowledge and permanent presence;
- it benefits from their practical common sense once they have mastered the processing techniques;
- it makes women in the group aware of the importance of their childrens' nutrition.

The collaboration of a supporting NGO is a source of financial aid. This collaboration is often linked to other parts of a development project and thus allows the PU to be integrated into a broader framework.

The creation of a network bringing together the PUs is necessary to ensure a coherence between the public health objective and the means (small-scale production, women's groups).The network is coordinated by the Department of Family Health, UNICEF and the Misola advisory group.

### 5.3 How to organize small-scale production units to make them economically viable

The repayment of large-scale investment, such as that required to build the plant, is not the goal of this type of project. On the other hand, self-financing of operating costs and, if possible, self-financing of reinvestment and growth should be achieved.

To determine the profitability threshold of a PU, the following method can be used:

- Calculate the cost price of the gross raw materials needed to manufacture 1 kg of flour.
- Determine a reasonable purchase price that will make the product accessible to the greatest possible number in terms of public health (it should be equivalent to two or three times the cost of the raw materials).
- Calculate the recurrent costs (wages, rental, water, transport, electricity, reinvestment, losses and unexpected costs).
- The minimum sales needed for the economic balance of a small-scale PU can be calculated by dividing the amount of the recurrent production costs by the margin earned from each kg sold. For example, in 1991, the figures for the PU at Fada N'Gourma were the following:
  - cost price of raw materials: CFA Francs 230/kg;
  - purchase price: CFA Francs 500/kg;
  - i.e. a gross margin of CFA Francs 270/kg;
  - recurrent costs were CFA Francs 90 000 a month, so the minimum quantity to be sold per month was 333 kg.

The need for strict management demands keeping careful accounts of purchases, stocks, production and sales, and not offering the complementary food to the needy; instead, institutions whose role is to help the needy should be encouraged to purchase the product for them.

Everyday accounting can be entrusted to the women's group responsible for milling. This group has an interest in seeing production increase — as this will provide jobs for women — and in promoting the use of flour for infants by the mothers belonging to it. Management is supervised by the physician of the province where the PU is located or by the person in charge of the women's group.

Integration of the PUs in health facilities will reduce costs considerably (energy, maintenance of premises etc.), and even in some cases payment of wages. In turn, the health services have a credible — although not sufficient — tool to combat malnutrition.

The remaining problem is investment. PUs created until now have used premises loaned by the health services or built by the supporting NGO. Therefore, it was possible to start operations rapidly and adapt production to market capacity, and to increase it gradually. If these facilities are not available, it is necessary to find some land and financing to build the unit. However, if the health services or the women's group refuse to loan premises, it can be a sign that they disagree with the public health objective of the PU, or are not interested in the project; this would cause the project to fail. If there is a real determination to set up a PU, it is usually possible to find premises, however modest they may be in the beginning.

Investment in the production equipment was taken care of totally or partly by the supporting NGO. UNICEF Burkina also made a large contribution toward supporting and equipping the units.

### 5.4 How to reach the target groups and improve children's nutritional status

Reaching the target groups is probably the most difficult problem, much more difficult than reaching the population that can afford the product, and this problem has so far limited the extension of the project. Collaboration with health services is necessary in this respect, even for profit-oriented PUs. This collaboration will help achieve the following objectives:

- reinforce the public health objective of the project and integrate nutrition as part of prevention;
- increase awareness of child nutrition among health workers (through training sessions);
- use the network created for the distribution and sale of drugs, for the product;
- promote programmes to combat malnutrition in the same way as vaccination programmes;
- organize awareness campaigns to encourage mothers to use complementary foods from 4 to 6 months onwards.

Setting up a PU in a health centre will strengthen the health-nutrition link. The dissemination of PUs throughout the country facilitates distribution to the most accessible target groups. Another way of reaching target groups is to set up "village community production units".

### 5.5 How to guarantee the quality of the flour

It is necessary, but not sufficient, for an infant to eat enough. The food must also have an adequate nutritional value. It is thus important to be able to guarantee the quality of the product, i.e. the stability of the formula, the absence of toxicity (aflatoxin) and proper storage, and to meet international standards for such foods. This quality requirement is an essential criterion to capture and keep the loyalty of the clientele, but also for credibility with national and international organizations likely to buy the complementary food for their programmes to fight malnutrition.

It is obvious that this type of PU cannot undertake industrial-type quality control, with comprehensive and systematic analyses of samples of flour and adjustment of the formula at the end of the production line when needed. Therefore, special care must be taken when preparing the product regarding:

- hygiene requirements;
- a strict control of the production process (sensitive areas are sorting the grains and toasting);
- careful measurement of the ingredients to be mixed;
- the quality of packaging.

An ongoing strict control of the production process, if possible complemented by quarterly analyses (nutrient and aflatoxin contents; and bacteriological control), are the only guarantee of quality.

Monitoring quality is the task of the person in charge of the PU. Biological controls are the responsibility of the nutrition services. The high cost of quality control cannot be supported by the PU budget. The involvement of the analytical laboratory of the Ministry of Health or of other laboratories may call for additional financing by the supporting NGO.

The financial impossibility of ensuring scientific control of this hand-made complementary food has, unfortunately, been used by an institution in the past as a pretext for not buying it for its programme to combat the effects of drought in Burkina Faso in 1991, and to buy imported foodstuffs instead; another organization, in the interest of using local resources, ordered 12 tonnes of Misola as part of the same campaign. International political commitment is also necessary to allow for this type of PU to operate.

# Burundi
# Musalac processed complementary food

Jean Baptiste NSAVYIMANA

## 1. ORIGIN OF MUSALAC

Musaga is a zone in the district of Bujumbura with a population of around 60 000 inhabitants. It is increasingly inhabited by middle-class civil servants as part of the Supervision of social housing and land planning project (Ecosat) implemented by the Government in order to improve living conditions following a cholera epidemic in 1978. The Musaga Health Centre, inaugurated in 1984, was created with the same objective; it was designed as a primary health care centre, in conformity with the recommendations of the Alma Ata Declaration (1978).

In order to reinforce the sectoral health policy, it was decided to involve the population in managing their own health. Therefore during the first year, the population was called on to elect a health council to assist in planning and implementing primary health care.

At its first meeting, the health council was asked to visit the people it represented to identify priority health problems. Discussion at its second meeting underlined the importance given by the population to the following problems:

- the lack of financial resources, which makes health care inaccessible to the population
- malnutrition.

As far as malnutrition is concerned, a survey of 340 children aged 0 to 5 years who attended the Centre for different types of consultation showed that 10% of them had a weight-for-height index that was below 80% the NCHS reference. In addition, many clinical cases of malnutrition were noted in the course of general consultations at the Centre. There was therefore a real problem and urgent action was required.

In order to respond to the first problem, namely, the lack of financial resources for health care, the health council prepared a sickness insurance card that was universally affordable. The project was rapidly taken up by the Government and extended to the country as a whole. Today, all the non-wage earning population (not belonging to a mutual fund) can contribute an annual sum of 500 FBu[1] for a sickness insurance card that provides free health care in public health centres and hospitals.

With regard to malnutrition, the health council decided to set up a nutrition project with the following objectives:

- provide a flour for the preparation of porridge with sufficient nutritional value to rehabilitate malnourished children and to prevent malnutrition in general;

[1] in 1989, US$ 1 ≈ FBu 160.

- improve the population's socioeconomic situation by promoting the growing of crops (especially soya beans) under contracts that guarantee prices to both parties, by setting up a production unit, and consequently creating jobs, and by promoting the consumption of highly nutritious products through cooking demonstrations, nutrition education, advertising and marketing;
- use the surpluses earned to assist in the development of a self-financing health care scheme for the population;
- develop other foods based on local products and on the experience gained;
- encourage cooperation among various groups and institutions involved in feeding and food production, through the exchange of ideas and experience and through mutual assistance in supplying basic products.

The flour for infants and young children called "Musalac" was created in accordance with these objectives and a consumer policy was elaborated. As Musalac is one of the activities carried out by the Musaga Health Centre, its objectives are primarily related to social and health aspects, but for reasons of viability certain market principles have to be taken into account.

## 2. PRODUCTION AND MARKETING OF MUSALAC

### 2.1 Composition and nutritional value

The composition of Musalac is given in Table 1 and its nutrient content in Table 2.

A very simple technology, which is familiar to all Burundi people, is used to prepare the food: cleaning when dry, washing, toasting, and milling. The various ingredients are mixed carefully.

In January 1985, production was 40 kg/month and in 1990 it reached 40 tonnes/month.

The digestibility of the proteins is 71%, with a chemical score of 90; the limiting amino acid is lysine.

The composition shows clearly that Musalac is a high-energy and high-protein food. It is wholly appropriate for children of any age. For reasons of digestibility, however, it cannot be given to children under 6 months.

The bacteriological and mycological analyses carried out show that it is a safe product that meets international standards.

### 2.2 Marketing

Musalac is the subject of a commercial policy to make it accessible to the population as a whole by improving *inter alia*:

- its geographical availability by setting up a distribution network (wholesalers, retailers etc.) and by increasing the number of production units in the various regions of Burundi. At present, five independent units have a franchise agreement with the Musaga unit; buildings are now ready for two more units and they should start production soon;
- its affordability by means of a social financing policy to ensure that the consumer price of Musalac remains stable. It is 12 times less costly than similar imported products, even though it is not subsidized;
- its cultural acceptability.

**Table 1**
**Composition of Musalac**

| Ingredients | % |
|---|---|
| Maize | 48 |
| Sorghum | 22 |
| Soya beans | 20 |
| Sugar | 8 |
| Skimmed milk | 2 |

**Table 2**
**Nutrient content of Musalac**

| Nutrients | per 100 g |
|---|---|
| Energy (kcal) | 417 |
| Water (g) | 7 |
| Protein (g) | 14 |
| Lipids (g) | 8 |
| Fibre (g) | 2 |
| Ash (g) | 2 |

## 3. THE ADVANTAGES OF THE MUSALAC PROJECT

### 3.1 Introduction of innovation

Musalac was the very first semi-industrial unit producing complementary food in Burundi. It marked the beginning of the industrialization of food production through the processing of local agricultural products.

In addition, it led to the development of the production of soya beans, which had only previously been grown on a small scale and had not been used to any significant extent as a food in Burundi. At the end of 1989, it became necessary to import soya beans from Uganda; since then, a campaign to promote awareness among cooperatives and regional development associations has been carried out and soya beans can now be found easily on local markets. Their export will only be envisaged once domestic demand has been satisfied.

### 3.2 Integration in the health sector and social organization

Musalac was created in recognition of a problem that affected the population. Moreover the production unit is an integral part of the health centre's activities; its objectives are thus naturally related to society and health.

In creating Musalac, we wanted to produce a complementary food of sufficient nutritional value to rehabilitate malnourished children and prevent malnutrition in general. Secondly, Musalac was used to promote the growing and consumption of nutrient-rich crops through cooking demonstrations and nutrition education.

In order to convey educational messages on primary health care, the following measures were implemented:

- distribution of a cartoon strip
- development of cassette tapes with Musalac songs and health messages
- use of illustrations and posters during health education sessions.

Furthermore, the Musalac programme has made a model latrine Musatrine, with a special "flap trap" that offers protection from odors and flies.

In 1990, these innovations resulted in the award of the "*World Health Organization Prize for health education within the framework of primary health care*" and in 1991 the *Liguria Prize* in Rome.

Musalac also has a social impact:

- As part of its social programme, Musalac has set up kiosks near health centres and provides free cups of Musalac porridge to all children who come for a consultation. Six health centres and the paediatric service of the reference hospital in Bujumbura (Prince Regent Charles Hospital) receive support.
- The units in inner Burundi are not kept by traders but by associations: handicapped persons with the support of nuns, cooperatives, hospitals.
- It has been agreed with these associations that the net profit, after costs have been deducted, will be used to develop primary health care in their respective districts. The ways in which these sums are to be used must be discussed jointly by the management council of the production unit and the district authorities.

### 3.3 Sociocultural integration

The product easily became part of the population's feeding habits because it is made from local products and the Burundis are used to eating porridge. Promotion of the production of soya beans has been facilitated by the fact that they grow like beans, the basic foodstuff in Burundi.

More than 50% of the building materials and the equipment used in the production units disseminated all over Burundi, which are working under a Musalac licence, are of local origin.

### 3.4 Technical and economic viability

The satellite production units quickly master the technology because it is simple and all the Burundi people are familiar with it (cleaning, toasting, milling). In all the production units quality control is regularly carried out by local institutions (agricultural college).

From a financial point of view, the Musalac production unit was set up at a very difficult time. For a long time (three to four years) it experienced considerable cash-flow problems because it did not have a rolling fund to allow for the building up of stocks of raw materials, to deal with maintenance problems, and to renew machinery or renovate buildings and vehicles.

Nevertheless, the unit has been able to operate with bank loans and production is continually increasing. From a small-scale production of 40 kg/month in the beginning (January 1985), it reached 40 tonnes/month in 1990.

At the national level, it should be noted that since the launching of Musalac in 1985, the product has had an important impact on Burundi's economy: in 1986, imports of food for infants amounted to over 30 million FBu; this figure gradually dropped and was less than 10 million FBu in 1988.

The shortage of flour in Burundi in 1988 was attenuated by the existence of Musalac, which was adopted by the majority of families. Moreover, if one compares the price (150 FBu/kg) and the nutritional value, Musalac is the most appropriate food for children and adults.

Musalac played an important role in feeding schoolchildren and the victims of the events that recently affected Burundi. This was done within the UNICEF and WFP framework of action.

## 4. CONCLUSION

Ultimately, Musalac is an example of a project that has been carried out with small resources but has achieved, and surpassed, the original objectives. We now propose to diversify production if the necessary human and technical resources can be mobilized rapidly.

# Cape Verde
# Micaf flour for young children

Eugenio VERA CRUZ

## 1. REASONS WHY CAPE VERDE NEEDS COMPLEMENTARY FOODS

For over 15 years, the Cape Verde islands have suffered the effects of a virtually unending drought. One of the most serious consequences of the drought has been the increase in the number of cases of malnutrition among the population, especially among vulnerable groups such as young children, pregnant women, and lactating mothers. Around 16% of Cape Verde's population (334 000 inhabitants) is under 5 years of age. It is estimated that more than one-third of these children are chronically malnourished.

In 1985, agricultural production in Cape Verde only satisfied 4% of the country's food needs. Although the major part of the food deficit is met by international food aid, this is marketed through a national supply; only a small proportion is devoted to improving the nutritional status of children, and none at all is in a form that is specifically adapted to the needs of infants.

Food for children is mainly channelled by a World Food Programme project through the Ministry of Health, Labour and Social Affairs. The Ministry has two important services to assist vulnerable groups:

- A network of maternal and child health and family planning centres (MCH/FP) in all the islands and in the majority of "*concelhos* " (administrative districts). These centres regularly monitor the nutritional status of young children, particularly their rate of growth. Pregnant mothers are weighed and also sometimes primary-school children. The MCH/FP centres distribute food aid to malnourished children.
- Social services under the department of social affairs distribute food aid to families with low resources.

There is good cooperation between the social services and the MCH/FP centres. Facilities able to distribute complementary foods and monitor nutrition have already been set up in Cape Verde.

## 2. PROJECT TO PRODUCE MICAF FLOUR

### 2.1 Characteristics of MICAF

Todate, MICAF flour has only been produced on a small scale in the MCH/FP centre at Mindelo. It is a mixture of toasted pulses and cereals ground into a flour. The respective proportions of the ingredients are given in Table 1.

Toasting helps prolong conservation, improves digestibility and reduces the amount of water needed to prepare the porridge.

On average, 100 g of flour provides 400 kcal and 15 g of proteins of high biological value. The presence of vitamins (thiamine and riboflavin) and iron is important. The nutrient composition is given in Table 2.

**Table 1**
**Composition of Micaf**

| Ingredients | % |
|---|---|
| Maize | 40 |
| Wheat | 40 |
| Beans | 20 |

**Table 2**
**Nutrient content of Micaf**

| Nutrients | per 100 g |
|---|---|
| Carbohydrates (g) | 72 |
| Protein (g) | 15 |
| Lipids (g) | 5 |
| Ash (g) | 2.5 |
| Iron (mg) | 50 |
| Calcium (mg) | 800 |
| Vitamin B1 (mg) | 0.330 |
| Vitamin B2 (mg) | 0.170 |
| Carotene (mg) | 0.033 |

## 2.2 The MICAF project

After a first outline of the project was presented in mid-1985, the MCH/FP carried out acceptance tests and decided on the following formula for the product called MICAF: maize 40%, "*cabecinha*" 40%, beans 20%.

The WFP agreed to supply some of the raw materials. The Minister of State for Cooperation and Planning unequivocally decided that the "*Fabrica de Massas Alimenticias*" (FAMA) — a pasta factory and a parastatal body — should implement the programme. Within the framework of the project, FAMA is a subcontractor appointed by the Government to produce MICAF.

In March 1986, FAMA, with the help of an experienced consultant from Afrique Industrie Conseil et Promotion (AICP)[1] and the MCH/FP at Mindelo elaborated a document containing a report of the feasibility study and plans for building, machinery, and production.

The production line also includes the possibility of roasting coffee and maize (to produce *camoca*, which is greatly appreciated in Cape Verde). The marketing of these products would allow the equipment to be used full-time and would thus ensure the profitability of the large-scale investment required to produce a high-quality flour for infants. The project therefore forms part of a broader project to extend the operations of FAMA.

## 3. OUTLOOK

Mothers in Cape Verde usually prepare porridge as a complementary food for their children and introduce it between 3 and 6 months. In most cases, however, the porridge is prepared solely from maize flour and a "custard" powder that has little nutritional value. The production and distribution of a complementary food made of enriched flour as part of this project should therefore result in a significant improvement of the nutritional status of young children in Cape Verde. The food could also be prepared as a supplementary food for pregnant women and nursing mothers and for other vulnerable groups (the aged, under-nourished sick persons etc.).

This project therefore forms part of the efforts deployed by the United Nations system in general, and WHO in particular, to combat the immediate negative effects of the drought in Africa and provide a way of ensuring rehabilitation of the food and nutritional status of vulnerable groups in Cape Verde by the year 2000.

It will also help to diversify Cape Verde's food industry and reduce imports of commercial flour for infants and young children, which constitute a large part of food imports.

The installation of the equipment has been completed and the quality control laboratory has been set up. Industrial production has been tested.

Since 1997, Micaf has been produced by the MCH Unit of the Health District on the island of San Vincente. It is distributed by MCH/FP centres and is sold at a price that is much lower than that of a commercial food with equivalent nutritional value. The production — 500 kg per month — is distributed on the island and Micaf is consumed by people of all ages.

[1] African industry counselling and promotion.

# Chad
# Vitafort: a food made from local products

Oscar YOMADJI-OUTANGAR

## 1. HISTORY AND OBJECTIVES

Chad is situated in the heart of Africa and covers an area of 1 284 000 $km^2$. In April 1993, the population was 6 288 261. It is one of the poorest countries on the continent due to its land-locked situation, several years of civil war and persistent drought; this situation has had a negative impact on the social and health structures and has contributed to the deterioration of living standards of vulnerable groups.

Several surveys have shown that the most common nutritional problems are protein-energy malnutrition (with widespread prevalence of wasting among preschool children after 6 months), iron-deficiency anaemia, vitamin A deficiency and endemic goitre. Mortality is highest during "weaning". Moreover, more than 80% of malnourished children admitted in the Nutritional rehabilitation and education centre (CREN) are between 6 months and 2 years of age.

There has been no study of breastfeeding practices in Chad. Porridge, the first complementary food given to infants, is mainly prepared from local products; the most common ingredients are maize, millet, groundnuts, lemon, milk, and sugar; rice and beans are rarely used.

In the CREN, the duration of treatment of acute malnutrition is three months; mothers are involved so that they can continue treatment at home and thus prevent a relapse; however, going to the CREN daily is an important constraint for mothers who are obliged to look after their families.

With this in mind, we considered producing a semi-industrial food for infants to improve children's nutritional status. In 1993, a group of women, with the support of Médecins Sans Frontières from Belgium (MSF-B) and the Centre National de Nutrition et de Technologie Alimentaire (CNNTA)[1] started to produce an enriched complementary food called "Vitafort". The main objectives of this production were to:

- provide mothers with an affordable food to prepare a porridge of adequate nutritional value for the rehabilitation of malnourished children and the prevention of malnutrition in general;
- improve the socioeconomic situation of the Chadian population by encouraging the production and consumption of crops (cereals and pulses);
- promote awareness of appropriate complementary feeding techniques among mothers.

[1] National nutrition and food technology centre. N'djamena, Chad.

## 2. INGREDIENTS AND TECHNOLOGY

### 2.1 Choice of ingredients

Ingredients must meet the following criteria:

- be adapted to the nutritional requirements of young children
- be produced locally and available all year round
- be readily accepted from a cultural point of view.

In Chad, the foods that meet these criteria are cereals, pulses (beans, cowpeas) and oilseeds (groundnuts, sesame, pumpkin seeds). The cereals that are used are white sorghum, red sorghum, millet, maize or rice. These are local products available all year; they are purchased on the market in quantities that vary according to availability and are then stored in 100 kg sacks.

### 2.2 Production scheme

The method of production is shown in Figure 1. The stages are: sorting, husking, winnowing, drying, milling, sieving, roasting, and mixing. For red sorghum, the only operation before milling is cleaning.

- Sorting is done by hand and eliminates debris from panicles or ears. Husking of millet, maize, rice and white sorghum is done by machine; red sorghum is not husked.
- After washing, ingredients are dried at room temperature; the duration of the drying process depends on the type of cereal and sunshine.
- Each ingredient is milled separately and then sieved.
- The flours are roasted separately, rather than the grain as is usually done in other units producing flours for infants; the reason for this is to reduce moisture and viscosity, destroy bacteria and insects and allow a good taste to develop. Flour is toasted in an aluminium pot, constantly stirred with a wooden spatula. After roasting, flour is sieved again.
- The various ingredients are then mixed in the following proportions to produce "Vitafort": cereals (57.2%), cowpeas (23.8%), groundnuts (9.5%), sugar (9.5%). It is particularly difficult to mix the groundnut paste with the other ingredients: this is done by putting through a sieve the appropriate quantities of groundnut paste and the other pre-mixed ingredients.
- The product is packed in 100 g polyethylene bags for sale to individuals or in airtight bags containing several kilograms for food aid programmes.

### 2.3 Equipment

The mechanical equipment, made in India but bought in Ndjamena, mainly consisted of a husker and two mills driven by three diesel engines; this equipment frequently breaks down so husking and milling are often done in machines at the market. The rest of the equipment consists of aluminium pots and household heat-sealing equipment.

A vertical mixer recently imported from France has not yet been used. A pick-up truck belonging to MSF-B is currently being used to transport raw materials and to deliver the finished products.

## 2.4 Cost price structure

The cost price structure, calculated for an average production of 5.5 tonnes a month (from May to December 1994), is shown in Table 1.

The average cost of raw materials for the various formulas has been calculated on the basis of average losses during processing (22% for cowpea; 28% for millet; 40% for maize; 16% for groundnuts; 35% for sorghum; 0% for rice and sugar).

**Table 1**
**Breakdown of cost price of Vitafort (per kg)**

| Item | CFAF [a] | % |
|---|---|---|
| Average cost of raw materials | 340 | 54.1 |
| Husking and milling | 14 | 2.2 |
| Firewood | 9 | 1.4 |
| Operating costs | 89 | 14.2 |
| Small-scale investment | 18 | 2.9 |
| Rental of premises | 36 | 5.7 |
| Payroll | 103 | 16.4 |
| Miscellaneous | 19 | 3.0 |
| **Total** | 628 | 100.0 |

[a] *After the 1994 devaluation, US$ 1 ≈ CFA Francs 500.*

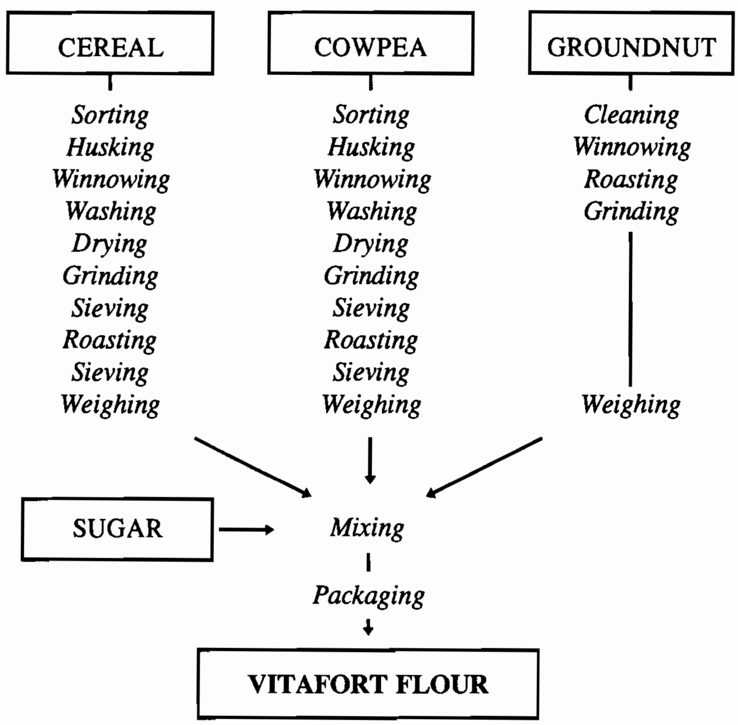


**Figure 1**
**Flow-chart for production of Vitafort**

The husking and milling costs correspond to the cost of processing raw materials on the market because the husker and mills in the unit were not operational during this period.

Operating costs include water supply, electricity, purchase of consumables (detergent, paper etc.), and the cost of the plastic packets (CFAF 8 per 100 g packet) purchased from a manufacturer in Douala (Cameroon). The monthly rental for the premises in which the unit is temporarily installed is CFAF 200 000.

Between ten and twenty employees were hired depending on the season. The monthly wages are CFAF 25 000 to 45 000 depending on the number of hours worked (the employees divide amongst themselves CFAF 100 per kg sold). In 1994, the employees were supervised by a paid member of the staff of MSF-B. During this period, the purchase price was set at CFAF 750 per kg. The difference between the purchase price and the cost of the product just covered the investment and some expenses borne by MSF-B during the period (wages of the manager, equipment etc.).

## 3. NUTRITIONAL QUALITY

The nutrient content of the five Vitafort complementary foods is shown in Table 2.

**Table 2**
**Nutrient content of the 5 Vitafort flours (per 100 g dry matter [a])**

| Nutrients | Rice | Red sorghum | White sorghum | Maize | Millet |
|---|---|---|---|---|---|
| Dry matter (g) (per 100g of flour) | 92.9 | 94.4 | 93.1 | 92.8 | 92.7 |
| Protein (g) | 11.5 | 13.0 | 13.7 | 11.5 | 13.4 |
| Fat (g) | 5.6 | 7.0 | 6.9 | 5.5 | 8.5 |
| Fibre (g) | 8.6 | 15.0 | 13.9 | 8.1 | 10.5 |
| Ash (g) | 1.2 | 2.1 | 1.7 | 1.2 | 2.2 |
| Phosphorous (mg) | 172 | 238 | 209 | 161 | 216 |
| Potassium (mg) | 387 | 614 | 575 | 377 | 571 |
| Calcium (mg) | 32 | 60 | 38 | 34 | 32 |
| Magnesium (mg) | 65 | 138 | 107 | 59 | 97 |
| Iron (mg) | 1.99 | 4.77 | 3.00 | 1.94 | 4.53 |
| Copper (μg) | 0.43 | 0.95 | 0.53 | 0.43 | 0.86 |
| Zinc (μg) | 1.98 | 2.86 | 2.68 | 2.05 | 3.23 |

[a] *Unless otherwise stated.*

## 4. MARKETING

From May to December 1994, production was 44.6 tonnes, i.e. an average of 5.58 tonnes per month, with a range of 3.7 to 10 tonnes depending on orders. Ninety percent of production was sold to the nongovernmental organization Action Internationale Contre la Faim (AICF) for its emergency programme in Kanem. Only 1.7% of production was sold to individuals, the remainder being sold to other institutions for food aid programmes.

Vitafort was sold for CFAF 750 per kg irrespective of the packaging. For retail sale, the product was in a 100 g heat-sealed plastic packet. Vitafort bought from the unit by organizations for food distribution programmes was usually packed in 7 to 20 kg plastic bags which were simply sewn at the top. The contents were identified by small duplicated papers stuck on to the bags showing the ingredients and the use-by date. For retail sale, an explanatory sheet without any illustrations was placed within the packet in the food.

The use-by date is arbitrarily set at three months because of the risk that groundnut paste will become rancid, but no study of the shelf-life has yet been undertaken.

## 5. FUTURE PROSPECTS

Despite a significant level of production during the past eight months (an average of 5.5 tonnes per month) and a good acceptance of the foods, a number of problems have been identified in the unit:

- the lack of an official statute and manager
- installation in premises temporarily rented and made available by MSF
- 90% of the product is sold to one NGO for its food aid programme
- the low energy density of the porridge
- an excessive cost price
- the need to set up quality control
- the need to improve the processes and equipment.

At the end of 1994, officials from CNNTA, who supervised the unit in collaboration with MSF-B, asked WHO to send an expert to make proposals to improve the operation and production of the Vitafort unit to ensure that it becomes sustainable.

# Congo
# Vitafort: flour for the preparation of energy dense gruel

Félicité TCHIBINDAT
Serge TRÈCHE

## 1. INTRODUCTION

Surveys of infant feeding practices and nutrition in Congo (Cornu et al., 1990 & 1993; Trèche et al., 1992) have shown that some practices, particularly the early introduction and poor nutritional quality of complementary foods, were the major determinants of the nutritional status of children during the period of complementary feeding. The Vitafort small-scale production unit is the result of efforts made since late 1990 by the Department of Family Health (DSF) of the Congolese Ministry of Health, in collaboration with nutrition researchers from Orstom[1] and the Congolese DGRST,[2] together with engineers from Agricongo,[3] to improve complementary foods in Congo.

Based on laboratory studies (Giamarchi and Trèche, 1995), researchers from Orstom proposed compositions and technological processes that use local products to produce complementary foods with a balanced nutrient composition. Gruel with a high energy density can be prepared with these foods. Agricongo's technicians and economists carried out a feasibility study. As a result they designed a model for a small-scale production unit that could be replicated rapidly. The model was proposed in May 1991 during a seminar on weaning gruels in Central Africa, organized jointly by the Congolese Ministry of Health and Social Affairs, Orstom, Agricongo, UNICEF and the WHO Regional Office for Africa. After the seminar the Department of Family Health encouraged the creation of a pilot unit within the context of the Project for the support of nutrition-related activities (PAAN), financed through the French cooperation fund and UNICEF. The name Vitafort was chosen following a market survey in 1992. Activities of the pilot unit were placed under the control of the consultative committee (CC) for the PAAN project. The CC comprises all the individuals who helped set up the unit, and acts as the management committee.

The objective of this collaboration among researchers, technicians, donors, and beneficiaries is to provide a complementary food for the greatest possible number of children, in order to contribute efficiently to reducing the prevalence of protein-energy malnutrition. Given the infant feeding practices observed in Congo, particularly the low daily meal frequency (Trèche

[1] Orstom was renamed Institut de Recherche pour le Développement in 1999.
[2] Department for scientific and technological research.
[3] Research institute for support of agricultural development in tropical areas.

et al., 1992; Cornu et al., 1993), gruel prepared from Vitafort flour should have an energy density and key nutrient content to complement the energy and nutrient intakes from breast milk with two meals of gruel per day, from the age of 4-6 months to 8-9 months.

## 2. INGREDIENTS AND NUTRITIONAL QUALITY

### 2.1 Ingredients

Vitafort necessarily contains:

- a main energy source based on flour or a mixture of flours, made from starchy foods (cassava, maize etc.);
- a protein source composed of a flour made from pulses (soya beans etc.);
- a moderate quantity of sugar so that children do not develop a taste for sweet foods too soon;
- a source of alpha-amylase able to hydrolyse starch sufficiently during cooking to limit its swelling and to reduce the viscosity of the gruel. Until now, BAN 800 MG, an amylase , produced industrially for the food industry by the Novo-Nordisk company, has been used (Trèche, 1999; Giamarchi & Trèche, 1995). The composition of Vitafort is shown in Table 1.

From 1993 onwards, the formula was enriched with minerals and vitamins by including 0.9% of a mineral complex, and 0.1% of a vitamin complex made in France from food grade industrial products according to recommendations made by the management committee. Acceptance trials had shown that mothers often found that Vitafort gruel had a strong taste of cassava, was too bitter and not sweet enough. Therefore a formula without cassava and with 11% sugar was produced. This food is preferred by urban mothers who are used to giving their children a gruel based on fermented maize paste. The new composition is given in Table 2.

In rural areas, cassava flour was maintained in the composition because mothers are used to giving gruels based on retted cassava flour or paste.

### 2.2 Nutritional quality

The type and quantities of the various ingredients used can vary according to feeding habits, availability and cost of raw materials. The nutritional quality of the foods should meet the standards set by the consultative committee for the PAAN project and adopted by the Congolese Ministry of Health. These standards are the following:

*Micro-biological quality*

- total coliforms.............. less than $10^3$ per g flour
- *Escherichia coli*............ less than 10 per g flour
- salmonella .................. less than 1 per 25 g flour
- *Aspergillus flavus*.......... absence
- mycotoxin................... absence

### *Particle size*

The flour for infants must not contain particles exceeding 500 micrometres.

### *Nutrient content*

The nutrient content is given in Table 3, expressed per 100 g of dry matter. In addition, Vitafort flours for infants may include the indication "*Enriched with minerals or vitamins*" if the minimum content reaches the values presented in Table 4 for minerals and vitamins.

**Table 1**
**Composition of Vitafort marketed from 1992 to 1993**

| Ingredients | (%) [a] |
|---|---|
| Cassava flour | 43.4 |
| Maize flour | 30.0 |
| Soya bean flour | 18.6 |
| Sugar | 8.0 |
| BAN 800 MG | 28 Novo units/100 g flour (or 350 mg/kg flour) |

[a] *Unless otherwise stated.*

**Table 2**
**Composition of Vitafort marketed since the end of 1993**

| Ingredients | (%) [a] |
|---|---|
| Maize flour | 73.8 |
| Soya bean flour | 14.1 |
| Sugar | 11.0 |
| Mineral supplement | 0.9 |
| Vitamin supplement | 0.1 |
| BAN 800 MG | 30 Novo units/100 g flour (or 375 mg/kg flour) |

[a] *Unless otherwise stated.*

### *Energy density*

After being prepared according to instructions given on the bag, the gruel should reach an energy density near 120 kcal/100 ml (between 100 and 140 kcal/100 ml), while remaining sufficiently fluid to be well accepted by children. This energy density, which is twice that of traditional gruel, is necessary to ensure that gruel can adequately complement the intake of breast milk of children aged 4 to 9 months when it is given twice a day.

**Table 3**
**Nutrient content of Vitafort**

| Nutrients | | per 100 g of dry matter [a] |
|---|---|---|
| Water (per 100g of flour) (g) | | < 8.0 |
| Fibre (cellulose + lignin) (g) | | < 3.0 |
| Sucrose (g) | | < 12.0 |
| Fat (g) | | > 4.0 |
| Linoleic acid (g) | | > 1.2 |
| Crude protein content (g) | | 10.5–16.0 |
| Amino acids: | Histidin (mg) | > 40 |
| | Isoleucine (mg) | > 248 |
| | Leucine (mg) | > 720 |
| | Lysine (mg) | > 388 |
| | Sulphur amino acids (mg) | > 160 |
| | Phenylalanine + Tyrosine (mg) | > 560 |
| | Tryptophan (mg) | > 40 |
| | Threonine (mg) | > 432 |
| | Valine (mg) | > 400 |

[a] *Unless otherwise stated.*

**Table 4**
**Minimum mineral and vitamin contents required to mention *"Enriched with minerals and vitamins"***

| Nutrients | per 100 g of dry matter [a] |
|---|---|
| Calcium (mg) | 360 |
| Iron (mg) | 16 |
| Zinc (mg) | 2 |
| Copper ($\mu$g) | 240 |
| Iodine ($\mu$g) | 20 |
| Vitamin A (IU) | 1000 |
| Vitamin D (IU) | 160 |
| Ascorbic acid (mg) | 32 |
| Thiamin ($\mu$g) | 160 |
| Riboflavin ($\mu$g) | 240 |
| Nicotinamide (mg) | 1 |
| Vitamin B6 ($\mu$g) | 180 |
| Folic acid ($\mu$g) | 16 |
| Pantothenic acid (mg) | 1.2 |
| Vitamin B12 ($\mu$g) | 0.6 |
| Vitamin K1 ($\mu$g) | 16 |
| Biotin ($\mu$g) | 6 |
| Vitamin E (per g linoleic acid) (IU) | 0.7 |

[a] *Unless otherwise stated.*

## 3. PROCESSING METHODS

The types of treatment applied to the raw materials (pulses, maize grains) or semi-processed products (cassava) in the production unit can be grouped as follows:

- treatment to enhance the bacteriological quality of the foods (sorting, washing, additional drying, roasting);
- treatment to eliminate toxic compounds and reduce anti-nutritional activities, e.g. roasting;
- treatment to reduce the amount of fibre (dehusking/dehulling and winnowing );
- treatment to obtain a homogenous product (grinding, sieving, pre-mixing and mixing);
- packaging (packing into bags, labelling, heat-sealing).

The flow-sheet for the production of Vitafort is shown in Figure 1. In urban production units, the operations for preparing cassava have been eliminated.

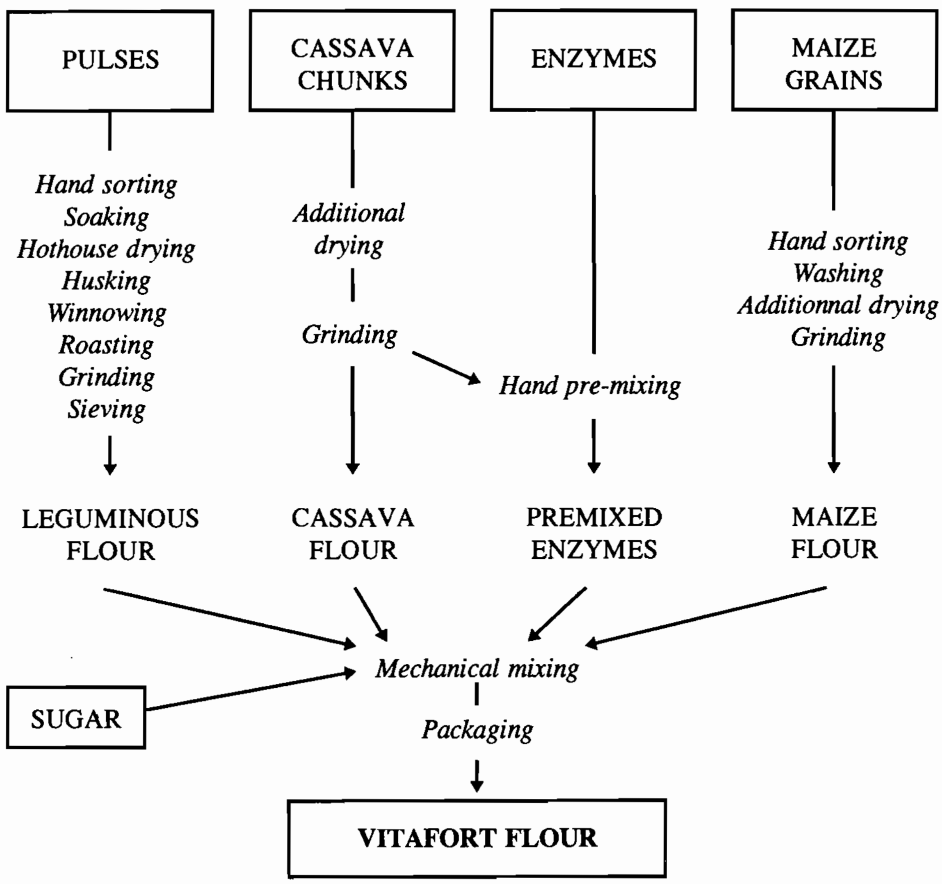


**Figure 1**
**Flow-sheet for production of Vitafort**

Cassava is sent to the unit in the form of chunks dried in the sun in the traditional way. These are prepared from roots that have been retted for at least three days to eliminate almost all the cyanide compounds (to a total cyanide content $< 15$ ppm) and have a residual moisture content of around 14%; thus, additional hothouse drying or drying in racks above the roasting machine is necessary. The tubers are then ground in a hammer mill with a sieve of mesh size 0.8 mm (output 350 kg/hour).

Maize is purchased from traders after undergoing a quality control (absence of insects or damaged grains; moisture not exceeding 15%) and comes either from inner Congo or Zaïre. It is stored until use. The grains are then sorted by hand, washed and mildly roasted (20 mn at 120°C) to bring their moisture content down to under 8%. They are then spread out for a last sorting during which they cool and finish drying before they are fed into a hammer mill with a sieve of mesh size 0.5 mm (output 350 kg/hour).

Soya beans come from producers from inner Congo. Like maize grains, they are checked and stored until use. Processing starts with hand sorting, soaking during which the beans that rise to the surface are eliminated, and hothouse drying. The outer skin is removed by putting the beans through a grindstone mill. This is followed by hand winnowing. Finally, the beans are roasted (30 mn over 120°C) before being put through a hammer mill with a sieve of mesh size 0.5 mm.

Enzymes are purchased from the firm Novo Nordisk S.A. in 40 kg containers and stocked in a cold store. During the week prior to use, they are carefully premixed with the cassava or maize flour using precision scales (50 g of enzymes to 5 kg of flour). This premixture is incorporated in the desired quantity in the Vitafort flour (33.5 and 38.5 g of amylase per 100 kg of finished product, respectively in flour with or without cassava).

The various ingredients (maize and soya bean flour, the enzyme premixture and, where appropriate, cassava flour, mineral and vitamin supplements) are blended in a hand-operated mixing drum that can process 50 kg of flour at a time. Vitafort is then hand-packed in transparent 50 micron polyethylene bags. The amount per bag is measured with a measuring jug.

The package consists of two identical plastic bags, one inside the other; two labels are placed between the bags showing the name, logo and information concerning the Vitafort production unit, the characteristics of the product and how it should be prepared. The two bags are then heat sealed.

The weight of the bags has been fixed at 250 g, which allows 3 to 5 days' use at a reasonable price (CFAF 180 and CFAF 275 per bag respectively before and after the devaluation[4]).

The choice of the name and logo was particularly difficult: those proposed by the management committee and mothers during sessions were tested in a random sample of mothers in Brazzaville. Given the large number of local languages, it appeared preferable to choose a French-sounding name; for a majority of mothers, high vitamin content was the most important quality of a gruel and it was difficult to avoid using a name that implied the presence of vitamins in the flour. The management committee emphasized concepts of energy, strength and vitality and a compromise was reached with the name "Vitafort" and the

[4] Before the 1994 devaluation : US$ 1 ≈ CFA Francs 250 / after devaluation US$ 1 ≈ CFA Francs 500.

slogan *"energy for babies"*. A survey showed that the name, and the logo showing a chubby baby, were overwhelmingly endorsed by mothers.

## 4. EQUIPMENT AND ORGANIZATION OF THE PRODUCTION UNIT

### 4.1 Equipment

The equipment of the production unit mainly consists of tables for sorting, drying installations, a mixing drum, a heat-sealing device, a 100 kg scale, precision scales, furniture, and a diesel engine that drives a hammer mill by means of a long propeller shaft, a carborendum mill and a roasting machine. The building has four rooms for the machines, a storage, packing and rest room.

The grindstone and hammer-mills, heat-sealing machine, weighing machine and scales have all been imported. The sorting table, drying installations, roasting machine and mixing drum, have, however, been made locally.

The roasting machine consists of a halved metal drum placed above a wood fire. Metal blades driven by an engine (rotating at 6 rpm) turn the grains over (output: 40 kg/h). Racks placed above the roasting machine inside a hood allow the heat generated by roasting to be used to dry cassava tubers thoroughly.

The mixing drum is a specially adapted aluminium barrel (with entry flap and inside fluting) placed on a stand with metal bars welded to the sides so that the main axis angle is 45°. The appliance is rotated by hand with a handle; 25 kg of flour can be mixed in 10 minutes.

### 4.2 Operation

This type of unit can operate with three or four people: the manager, who deals mainly with supplies of raw materials, planning production and marketing the product, two workers who carry out the manual (washing, packing) and mechanized operations and a temporary aid for sorting.

The work schedule of the two workers for processing 45 kg of cassava, 18 kg of maize and 21 kg of soya beans can be broken down as follows:

- sorting the grain ............ 1½ hours
- roasting ........................ ½ hour
- milling ......................... ½ hour
- mixing ......................... ½ hour
- packaging ..................... 3 hours

The Vitafort production plant is a training unit; it is managed successively by candidates for the management of other installations. After training in the technical, hygiene and management aspects, each candidate starts by following the operation of the unit managed by his predecessor; he is then entrusted with responsibility for the unit for a period of 4 to 6 months. During this time, he is free to choose his employees. He pays the unit's management committee a rent that corresponds to the amount of loan repayments he will have to reimburse once he has set up his own unit. At the end of the trial period, the management committee helps the young entrepreneur, if he so wishes, to prepare a loan application to be submitted to potential donors.

### 4.3 Economic results

The overall value of all the installations, before the devaluation of the CFA Franc, was slightly over CFAF 6 000 000. The level of investment is consistent with the size of the unit and the amount a small entrepreneur is able to repay.

Variable overhead costs are that of the basic ingredients (69.8%), the plastic bags and labels (24.0%), temporary labour (4.4%) and fuel (1.8%). They represent around 73.0% of total costs and in 1993 amounted to CFAF 666 000 per month. The cost of incorporating enzymes imported from Europe only represents 1.4% of variable overhead costs and 1.1% of total costs.

Fixed overhead costs were CFAF 236 000 per month in 1993; this included the structural cost of the unit and labour costs. Repayment of investment and financial costs were around CFAF 136 000 per month, monthly labour costs for the two qualified workers were CFAF 100 000. The ratio of fixed costs to total costs (27.0%) is reasonable for this size of unit. The entrepreneur is self-employed and his salary is not included in the labour costs.

Monthly turnover depends solely on the sale of 250 g bags at the wholesale price of CFAF 140 and CFAF 225 per bag, respectively, before and after the currency devaluation. Once the unit is running, the monthly production is 8 000 bags, which corresponds to the needs of approximately 800 children between 4 and 9 months consuming Vitafort gruel as the only complement to breast milk.

In 1993, when the unit was operating normally, the cost price of a bag of Vitafort, including all costs, was CFAF 113. The wholesale price was CFAF 140 per bag; the profit per bag was CFAF 27, i.e. around 20% of the purchase price. For total production, the monthly profit was CFAF 214 000. This covers the entrepreneur's income, and savings for future investment and for replacing equipment.

## 5. CURRENT RESULTS

The strategy to improve complementary feeding by marketing a low-cost flour for the preparation of energy-dense gruel was implemented in two phases:

- Following an agreement between the Congolese Ministry of Health and Agricongo, a pilot unit was set up with the dual aim of producing Vitafort flour and of training young entrepreneurs to set up other production units.
- Vitafort flour for infants was promoted through the usual marketing outlets (small shops, kiosks) and through integrated health centres.

Despite serious disturbances due to socio-political problems in Congo since mid-1993, four entrepreneurs trained at the pilot unit opened up units at the beginning of 1995: one in Brazzaville, another in Dolisie, the third largest town in Congo, and two in Bouansa (a small town situated on the railway linking Brazzaville and Pointe Noire).

The production and marketing of Vitafort is nevertheless facing problems:

- poor sales in the usual marketing outlets;
- a delay in promoting Vitafort in health centres, because the rehabilitation programme of the maternal and child health centres (SMI) into integrated health centres (CSI) was held-up;

- a high purchase price in comparison with the purchasing power of many families, because of the cost of raw materials and their transport, and a steep increase in the cost of some ingredients (particularly sugar) after the currency devaluation;
- the competition from the composite flours (cereals/pulses) produced locally without any form of treatment to enhance energy density, and sold at slightly lower price.

In 1994, eight CSIs were operating in Brazzaville. In March 1995, ten members of the staff of these CSIs were trained to participate in the programmes to promote breastfeeding, improve complementary feeding and monitor growth. The German cooperation agency (GTZ), responsible for these CSIs, has signed an agreement with entrepreneurs in Brazzaville and Dolisie for the supply of Vitafort. This agreement which guarantees the entrepreneurs an outlet for Vitafort in eight CSIs in Brazzaville and two in Dolisie, is a significant encouragement for them. During the starting-up phase, each CSI will receive 100 bags of Vitafort for demonstrations and sale to mothers. The CSIs will then finance the purchase of bags of Vitafort (CFAF 250 each), which will be resold to mothers at CFAF 275. The centre will make a profit of CFAF 25 per bag, which will be used to buy Vitafort for demonstrations and nutritional rehabilitation.

## 6. CONCLUSION

Promoting awareness among mothers in the integrated health centres, as part of monitoring and growth promotion activities, represents an important element in the strategy for making Vitafort available to the greatest number of children. The objective is to change infant feeding habits that are detrimental to children, especially the very early introduction and cessation of feeding gruel. To be successful in changing behaviour, however, intervention is needed at several levels: knowledge, know-how, self-esteem, cultural background, etc. It is a multidisciplinary process that is necessarily long and fraught with problems. The delay in promoting Vitafort in the integrated health centres has been the major limiting factor.

The Vitafort production unit is different from other units manufacturing flour for infants in Africa, because it is supervised by a management committee composed of health service officials, development agents and researchers, and because of its threefold role: training of entrepreneurs; popularization of Vitafort and of the Ministry of Health's quality label, which entrepreneurs can use once they have set up a unit; support for pilot studies to improve and diversify products.

The economic profitability of the model unit set up under the Vitafort project is not an end in itself; it is simply one of the necessary conditions for pursuing the main objective, which is to make available a complementary food of high nutritional value to the greatest number of children.

Another characteristic of the Vitafort project is the importance given to improving the energy density of gruel, to compensate for the low daily frequency of distribution.

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# Morocco
# The Actamine programme, 1972–1993

Mimoun AOURAGHE

## 1. INTRODUCTION

Protein-energy malnutrition is a very serious nutritional problem for young children. Either alone or in combination with infections, it results in the death of several thousand children each year.

As part of the programme to alleviate malnutrition, the nutritional rehabilitation of malnourished children is based on family food, nutrition education of the population, and distribution of a complementary food. Since it was first conceived, the project for the distribution of a complementary food has been through several important stages.

## 2. HISTORY OF THE PROJECT

### 2.1 Prior to 1972

The Moroccan Ministry of Public Health has devoted special attention to nutritional problems. Prior to the 1970s, there was a nutrition unit working alongside the rural and urban prevention units. This unit especially concentrated on improving the population's diet through the promotion of fish consumption and the production of fishmeal. The unit also considered opening nutritional rehabilitation centres.

These actions motivated the Ministry of Public Health to:

- carry out a nationwide survey, in 1971, of the nutritional status of children under 4 years of age (ENNE 71) to assess the prevalence of malnutrition in Morocco;
- focus nutritional actions on children;
- restructure the nutrition unit;
- produce a protein-rich complementary food.

### 2.2 Period from 1972 to 1986

In view of the high prevalence of malnutrition brought to light by ENNE 71 (46% of children under 4 years were malnourished), the Government set up an interministerial committee on feeding and nutrition (CIAN) in 1972 to develop a national food policy and coordinate action in this field.

At the same time, within the framework of a joint Moroccan Government/UNICEF project, the Ministry of Public Health became involved in the production of a pre-cooked complementary food based on locally grown products. This food, intended to prevent and treat protein-energy malnutrition, was called ACTAMINE 5. The caloric value of Actamine was 415 kcal/100 g (dry product) and the protein content was 20.5 g/100 g; the ingredients and formula are shown in Table 1.

The responsibility for manufacturing and marketing Actamine was entrusted to the Société d'Exploitation des Produits Oléagineux (SEPO)[1] under agreements between the Ministry of Public Health and SEPO, and the Ministry and UNICEF. The latter organization contributed US$ 758 000 towards the installation of the manufacturing plant.

The price of Actamine was fixed at DH 4.5/kg.[2] The product was only actually launched in 1977. The Ministry of Public Health was SEPO's major client, but only purchased 100 to 200 tonnes up to 1980. Although its nutritional value was higher, Actamine competed with imported products that benefited from widespread advertising and were already well established on the domestic market. Because of these problems, the food was gradually withdrawn from public sale.

In 1978, at the request of the Ministry of Public Health, SEPO modified the composition of Actamine, replacing the chickpea and lentil flour by soya bean flour. The new formula had a caloric value of 357 kcal/100 g and a protein content of 21.1 g/100 g (Table 2).

In order to resume the production of Actamine, a number of meetings were held with the parties involved and it was decided that:

- The price of Actamine to government bodies would be DH 5.50.
- Ministries with a social role should help to promote the consumption of Actamine, should specify their needs, and include these in their budget.
- A joint authorization by the Ministry of Trade and the Ministry of Public Health would be required for imports of complementary foods.

As a result of these decisions, SEPO started to produce Actamine again, despite a number of problems related to customs administration.

### 2.3 Period from 1987 to 1993

Within the framework of the Programme Alimentaire Compensatoire (PAC)[3] PL 480, Title II, and in order to mitigate the effects of structural adjustment on the most disadvantaged sectors of the population, USAID and Catholic Relief Services donated to the Ministry of Public Health a large quantity of milk that allowed the production of 2600 tonnes of Actamine during the period 1987–1990.

The milk was given to SEPO and the company manufactured Actamine in exchange for the local value of the donated milk. This permitted the widespread distribution of the product in all of Morocco's provinces and departments.

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[1] Oilseed products processing company.

[2] 1977: US$ 1 ≈ DH 4.50; 1986: US$ 1 ≈ DH 9.10; 1989: US$ 1 ≈ DH 8.49.

[3] Compensatory food programme

**Table 1**
**Composition of Actamine (1972)**

| Ingredients | % |
|---|---|
| Wheat flour | 28.0 |
| Chickpea flour | 38.0 |
| Lentil flour | 19.0 |
| Skimmed milk powder | 10.0 |
| Sucrose | 5.0 |
| Calcium carbonate | 0.4 |
| Vitamin complex and flavouring | 0.2 |

**Table 2**
**New composition of Actamine (1978)**

| Ingredients | % |
|---|---|
| Wheat flour | 48.0 |
| Soya bean flour | 16.0 |
| Skimmed milk | 20.0 |
| Sucrose | 15.4 |
| Calcium carbonate | 0.4 |
| Vitamin complex and flavouring | 0.2 |

The increase in the production of Actamine (from 230 tonnes annually in 1987 to 638 tonnes in 1988) created serious problems of management, storage and conservation of the product that led to the deterioration of around 50 tonnes in 1989.

The following measures were taken to improve the quality of the product and the management at the production level and in distribution sites:

- New packaging for Actamine.
- Indication of the batch number, date of manufacture and detailed composition on each packet.
- Improvement of storage conditions by:
  - rearranging storage premises;
  - acquiring 425 metal shelves;
  - purchasing insecticide (K-Otrhine) and protective equipment (gloves, helmets and goggles);
  - developing accounting documents for the management of Actamine.

In 1991, new strategies to alleviate malnutrition, defined at the 1990 Workshop on Nutrition and Child Development held in Marrakesh, were implemented. The introduction of new indices for identifying malnutrition, particularly the weight-for-height index, improved the targeting of genuinely malnourished children. Following delays in implementation, the distribution of Actamine within the framework of the PAC was extended until 1993.

### 2.4 Period from 1993 to 1994

After the end of the PAC, the distribution of Actamine continued, but its purchase was included in the budget of the Ministry of Public Health. However, the funds allocated only permitted the purchase of 159 tonnes of Actamine at a cost of DH 18.86/kg. This quantity only covered 35 to 40% of the needs of genuinely malnourished children under the age of 5 years.

## 3. SCREENING AND REHABILITATION OF MALNOURISHED CHILDREN

### 3.1 New strategy for identifying malnourished children

Until 1990, screening for malnutrition was solely based on the weight-for-age index recorded on the child's growth-monitoring card. It was only in 1991 that the weight-for-height index was introduced to improve targeting of children requiring rehabilitation. Equipping health facilities with the Thinness Wall Chart made the analysis of the index easier, and enabled the health personnel to assess and monitor children's nutritional status.

Between 1983 and 1991 the number of children identified as malnourished using the weight-for-age index had increased from 99 250 to 170 220. When screening based on weight-for-height began the number of children identified as malnourished dropped to 73 893 in 1992 and 57 798 in 1993. This new screening strategy implemented at the SMI[4] level improved targeting of children who are genuinely malnourished and require nutritional rehabilitation.

### 3.2 Trend in the number of children receiving Actamine and amount consumed

The number of children receiving Actamine depends firstly on the number of malnourished children identified and, secondly, on the availability of the food in the particular province or department. This explains the fluctuations noted from 1977 to 1993 in the amount of Actamine consumed annually in the different provinces, the number of children receiving it and the mean amount of Actamine consumed by each child (Figure 1).

Following the introduction of the new strategies to alleviate malnutrition (1991), there was a sharp decrease in the number of children receiving Actamine. The decrease in the average amount of Actamine consumed per child in 1992 and 1993 corresponds to the use of leftover Actamine purchased under the PAC, which should have ended in 1990 but was extended until 1993.

## 4. EVALUATION OF THE ACTAMINE PROGRAMME

The programme for distribution of Actamine was the subject of a number of studies to analyse trends and assess the product's importance for beneficiaries. Studies dealing with the identification of malnourished children showed that, although the equipment and information for monitoring children's growth were available and the majority of the personnel of SMI

[4] Maternal and child health centre.


**Figure 1**
**Trend in the average amount of Actamine consumed annually per child between 1977 and 1993**

centres had been trained, the new screening strategy was not well mastered. This indicated that the personnel needed more training within the ongoing educational programme. Nevertheless, since the introduction in 1991 of the new anthropometric index for identifying malnutrition, the management of the Actamine programme has improved: the children receiving it are those who indeed need rehabilitation, i.e. malnourished or at risk.

# Niger
# Bitamin processed complementary food

Haoua MOUSTAPHA IBRAHIM

## 1. ORIGIN AND OBJECTIVE OF THE PROJECT

Bitamin is a complementary food made in Niger. It was developed by Caritas, a nongovernmental organization, with the support of the Ministry of Public Health, Caritas Neerlandica and the Royal Institute of Tropical Medicine in Amsterdam, to solve the acute problem of complementary feeding and thereby decrease the high rate of malnutrition in Niger.

The food is designed for infants and young children over 6 months and is adapted for the period of complementary feeding.

The project objectives are to:

- Contribute to improving the food situation of under-nourished children below 36 months of age among groups that are medically and socioeconomically disadvantaged, by producing a complementary food adapted to local feeding habits and tastes, which can be prepared at home at a cost lower than that of imported products.
- Create a certain number of jobs for the disabled.
- Set up, in the long term, a financially independent production unit.

## 2. COMPOSITION AND NUTRITIONNAL VALUE

The composition of the complementary food was defined on the basis of a proposal made by the Ministry of Public Health. The composition and the method of preparation are such that mothers can prepare it themselves at home when they no longer receive the ready-made product. Moreover, it can be used as a staple in demonstrations carried out within the national nutrition education programme.

Bitamin is made of millet (67%), cowpeas (20%), groundnuts (10%) and baobab fruit (3%). The nutrient content is shown in Table 1. The energy content is 406 kcal/100 g of flour. It undergoes regular bacteriological checks in Niamey and physicochemical analyses in Amsterdam.

## 3. PRODUCTION SCHEME

The process for the production of Bitamin, which was launched in 1991, has been developed by the Royal Institute of Tropical Medicine in Amsterdam:

- During the first stage, raw materials are sieved and sifted to eliminate the impurities (if necessary, they are also washed and dried); some of the millet is dehusked (around 30%). All the ingredients are toasted, and then cooled before being temporarily stored.
- During the second stage, materials poor in lipids are mixed in the desired proportions and pre-milled in a hammer mill. The groundnuts are then added and the mixture is finely milled in a grindstone mill.
- After cooling, the product is packed in 500 g plastic packets and stored pending distribution.

**Table 1**
**Nutrient content of Bitamin**

| Nutrients | per 100 g |
|---|---|
| Protein (g) | 15.4 |
| Fat (g) | 8.5 |
| CHO (g) | 67.0 |
| Ash (g) | 2.0 |
| Fibre (g) | 2.1 |
| Water (g) | 5.0 |

## 4. MARKETING

The factory's production capacity is 4 tonnes per month. Production varies according to the quantities remaining unsold. The flour is grey in colour and packets are yellow or white.

Unfortunately, the product is not well known and distribution is weak. The quantities sold can sometimes drop to less than one tonne per month. Although production of Bitamin started in 1991, Niger still has the highest rate of malnutrition among countries in this subregion.

# Rwanda
# Sosoma processed complementary food

Edith MUKAMURENZI

## 1. ORIGIN AND OBJECTIVES OF SOSOMA

The name Sosoma is derived from the three main ingredients it is made from (sorghum, soya beans, maize), and is produced by DUHAMIC-ADRI, a food production unit in Kigali. ADRI[1] is an association set up in July 1985 on the initiative of Rwandans who wished to help their fellow farmers and to support their struggle for self-development.

In many cases the aim of food processing is to utilize temporary surpluses and treat them with a view to conservation; this is not the case for Sosoma. In Rwanda, production of sorghum, maize, and particularly soya beans, does not meet the population's needs and there are no surpluses. Sosoma is produced for purely nutritional reasons: to give young children a food mixture whose nutritional value is higher than that of each of the elements it is composed of.

In Rwanda, mothers often confuse complementary feeding and weaning. The choice of complementary foods is governed more by their consistency than their nutritional value, the key element being the gradual appearance of teeth. For example, mashed plantain bananas are given to children with few teeth and whole bananas to those who have more teeth. Mothers sometimes give their children porridge, but they rarely think of adding an egg or milk; the consistency of the porridge is adapted to children who are not yet able to chew, but their nutritional value is insufficient.

## 2. NUTRITIONAL VALUE OF SOSOMA

Sosoma is rich in nutrients, especially high-quality proteins. Table 1 compares the nutrient content of Sosoma and of other simple sorghum, soya bean and maize flours. The biological value of the proteins in Sosoma (91) is higher than that of meat (76) and milk (82). The calcium content is low, but additional calcium can be obtained from breast milk and other foods.

## 3. PRODUCTION PLAN

The production plan for Sosoma is shown in Figure 1.

Two types of complementary food are produced which differ by their particle size obtained after milling:

- a very fine complementary food bearing the indication "Sosoma 2 mixture" on the packet, which can be given to children from 4 months onwards;
- an ordinary complementary food bearing the indication "Sosoma mixture", which can be given to children from 12 months onwards.

In the beginning, the unit produced 400 kg/day, but recently this has increased to 3 tonnes/day.

[1] Action for integrated rural development.

**Table 1**
**Comparison of the nutrient content of Sosoma and of its constituent flours**

| Nutrients (per 100g) | Simple flour | | | Compound flour |
|---|---|---|---|---|
| | Sorghum | Maize | Soya beans | Sosoma |
| Energy (kcal) | 345 | 357 | 405 | 364 |
| Protein (g) | 10.7 | 8.6 | 33.7 | 15.0 |
| Lipids (g) | 3.2 | 4.3 | 17.9 | 7.0 |
| Water (g) | 10.1 | 11.8 | 9.5 | 10.0 |
| Cellulose (g) | 2.4 | 1.4 | 4.7 | 2.0 |
| Calcium (mg) | 26 | 6 | 183 | 51 |
| Iron (mg) | 10.6 | 2.8 | 6.1 | 6.0 |
| Vitamin B1 ($\mu$g) | 340 | 360 | 710 | 431 |
| Vitamin PP ($\mu$g) | 3.30 | 1.4 | 2.0 | 2.1 |

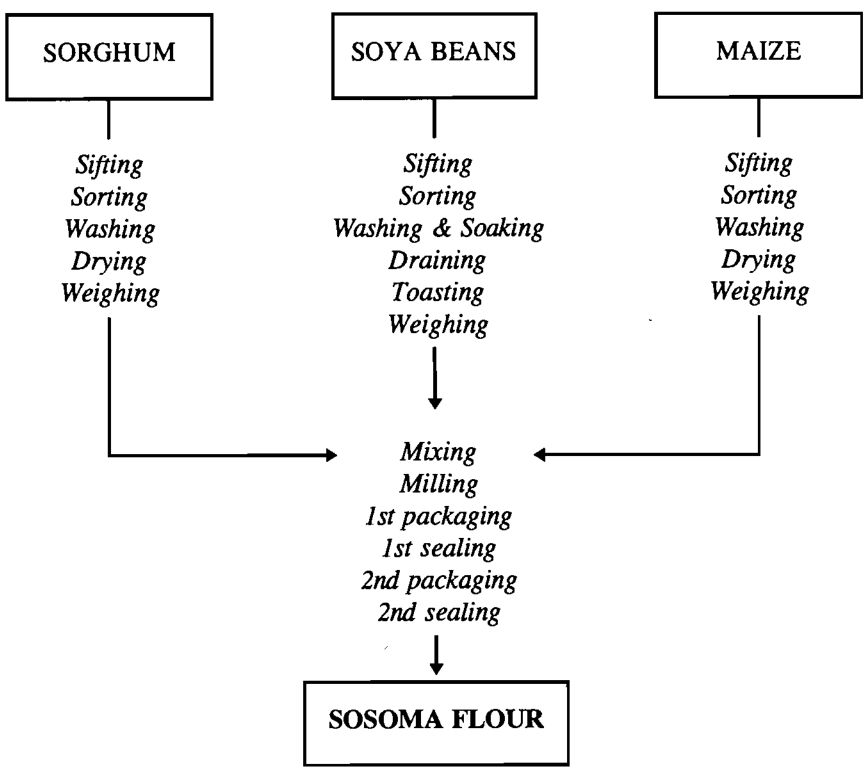


**Figure 1**
**Production plan for Sosoma complementary foods**

## 4. PREPARATION AND ACCEPTABILITY OF THE PORRIDGE

Mothers do not find it difficult to prepare Sosoma as a porridge because preparation is similar to that of other cereal flours commonly used in Rwanda (sorghum, maize, wheat, finger millet).

To prepare Sosoma porridge, one needs Sosoma flour, sugar and water. It is prepared as follows:

- take a measuring utensil (cup, glass)
- put 3 measures of water in a pan
- boil the water
- mix one measure of flour in one measure of water
- pour this mixture onto the boiling water and mix with a spatula
- leave to boil for a few minutes
- add the sugar and mix
- leave to cool and serve.

Sosoma is primarily for the preparation of porridge, but it can be used to make cakes and biscuits or to enrich sauces.

In the beginning, Sosoma received a fair amount of criticism because some consumers would have preferred it to be salty while others wanted it to be sweet. However, as production spread throughout the country, Sosoma became more appreciated, as reflected by an increase in demand.

# Togo
# Nutrimix production unit

Kodjo D. AGBO
Abdou Rahmane AGBERE

## 1. BACKGROUND

In developing countries, the diet of children from birth to 4–5 years remains a major concern to governments, because of the increasingly unsatisfactory trend in nutritional indicators. For the first 5 to 6 months an infant develops on breast milk alone if feeding practices are adequate. Subsequently, however, infants need complementary food to cover their growing nutritional requirements.

Traditionally, complementary foods have little nutritional value and either consist of diluted parts of the main family food (maize or cassava gruel) or simple millet, sorghum or maize porridge with or without sugar. In order to make up for this inadequacy, complementary foods based on local products and consistent with consumer habits have been developed in many countries since the 1970s.

In Togo, research was undertaken in 1985 by the Institut de Nutrition et de Technologie Alimentaire (INTA)[1] of the Ministry of Rural Development. As a result "Nutrimix", a complementary food based on local ingredients was formulated. It comes in two forms:

- Nutrimix "1er âge" for infants aged 3–6 months;
- Nutrimix "2ème âge" for infants over 6 months.

The production process is semi-industrial and comprises four basic stages: cleaning, toasting, milling, and packaging. The finished product is used to make porridge and must be cooked for 10–15 minutes.

After acceptability trials carried out in social and health centres in Lomé by the Mother and Child Department of the Ministry of Health yielded positive results, the INTA and the Ministry of Health and Social Affairs were motivated to promote Nutrimix among health workers, midwives, nurses, educators, counsellors and women's groups using two complementary strategies:

- production and promotional sales in Lomé;
- popularization of recipes at the national level through nutrition training seminars focusing on the feeding of infants and young children.

[1] Nutrition and food technology institute.

This promotional action was effective, and as a result:

- Nutrimix is well known and is recommended to mothers by the appropriate services, paediatricians, maternal and child health centres.
- The foods are used by families throughout Togo and, particularly, by women taking part in monitoring and growth promotion programmes carried out by the health authorities and nongovernmental organizations (CRS, CONGAT/ICB etc.).
- Private production has been undertaken in Lomé (VITEN, SOMEL) and inland (PALUJIED in Dapaong, SOUKKOTH foods for infants in Kpalimé).

## 2. INGREDIENTS, PROCESSING TECHNIQUES AND METHODS FOR PREPARING PORRIDGE

### 2.1 Ingredients

The original formulas used seven ingredients: maize, sorghum, rice, cowpeas, groundnuts, soya beans, and sugar. Three types of foods were prepared from mixtures of these ingredients and subsequently underwent acceptance trials:

- Nutrimix "1er âge" composed of maize, sorghum, rice and sugar;
- Nutrimix "2ème âge": a mixture of maize, rice, cowpeas, groundnuts and sugar or a mixture of maize, rice, soya beans and sugar.

Based on the trial results and because of technical problems (with milling of the product containing sugar, and conservation of the product with cowpeas and groundnuts), the formulas were modified; the final composition of the products is shown in Table 1.

The cereals (maize, sorghum and rice) are used for their caloric content; soya beans for proteins and for their effect on energy density because of their high fat content. Sugar should be added according to taste when serving the porridge.

Raw materials such as maize, sorghum and rice are usually purchased monthly on Lomé markets by the person in charge of the production unit. A stock of soya beans for at least six months is built up in the production zones (Centrale and Savannes regions); two women wholesalers or the seed farm in Sotouboua are in charge of delivering the supplies.

**Table 1**
**Composition of Nutrimix**

| Ingredients | "1er âge" [a] (%) | "2ème âge" [a] (%) |
|---|---|---|
| Maize | 42 | 63 |
| Sorghum | 42 | - |
| Rice | 16 | 11 |
| Soya beans | - | 26 |

[a] *"1er âge" for infants aged 3-6 months; "2ème âge" from 6 months*

## 2.2 Techniques utilized

The Nutrimix production unit is semi-industrial; the production scheme for the two foods is given in Figures 1 and 2. The ingredients are processed separately, then weighed and mixed in the required proportions before being crushed and milled.

Sorting/sifting is done by hand on sorting tables or in sifting basins: this operation eliminates dust, plant debris, mouldy grains, stones and grains of other varieties.

The ingredients are washed in water in a basin to eliminate any impurities. A container with a specially adapted mesh is used for filtration; maize is only washed if it has been treated during storage.

The ingredients are dried in open air on drying tables of a type commonly used in the region. These consist of two grilles held in a wooden frame resting on four metal feet: the iron bottom grille supports a nylon upper grille with a smaller mesh. The length of the drying process depends on the amount of sunshine and the size of the grains treated: the ingredients are usually dry after four to eight hours.

The grains are toasted in two Convectomat® electric ovens with a preset roasting programme (200°C for 5 to 8 minutes depending on the product). This operation is particularly important because it:

- improves the hygienic quality of the products by destroying insects, larvae and bacteria
- inactivates anti-nutritional factors such as the anti-trypsin factor
- increases the product's digestibility
- reduces the cooking time of the finished product.

The grains are rapidly cooled for a few minutes in a KIT electric cooler developed by the Royal Institute of Tropical Medicine in Amsterdam (Netherlands).

The unit has both hammer and grindstone mills. If there is a lot of work, however, the grindstone mill in another unit is also used. Milling takes place in two stages:

- Crushing of the mixture of toasted grains in the hammer mill.
- Milling of the crushed mixture to a fine powder in the mill with metal grindstones in two, three or even five operations if the grindstones become blunt.

The flours are then cooled in covered basins placed in a clean part of the unit. They are packed in hermetically heat-sealed polyethylene bags. The inside bag is filled with the food using a special ladle and then weighed (500 g) on a 1 kg household scale. Labels identifying the two types of food are placed between the inside and outside bags; they show the use-by date (length of conservation is six months) and the address of INTA. This labelling is incomplete because it does not give the composition or the recipe for preparation.

## 2.3 Method for preparing the porridge

The method for preparing the porridge is similar to that commonly used by mothers. The recommended proportions of water and flour are as follows:

- 50 g to 550 ml water for Nutrimix "1^er^ âge" (3–6 months)
- 50 g to 450 ml water for Nutrimix "2^ème^ âge" (over six months).

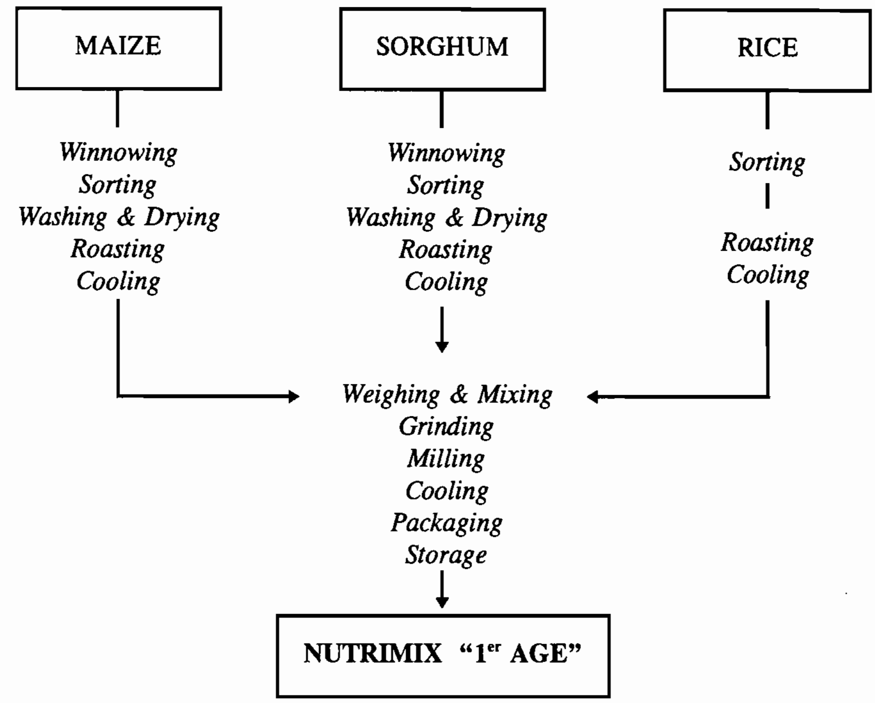


**Figure 1**
**Flow-chart for production of Nutrimix "1$^{er}$ âge"**

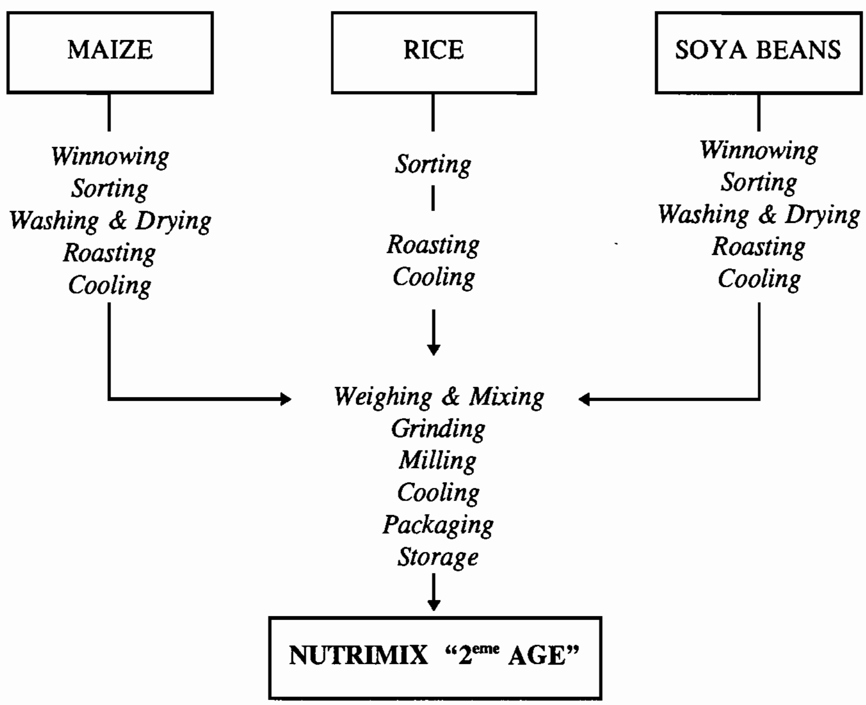


**Figure 2**
**Flow-chart for production of Nutrimix "2$^{ème}$ âge"**

Preparation consists of dissolving the flour in 150 ml of water, then pouring this mixture into a suitable container (saucepan or pot) containing the remaining quantity of water (300 to 400 ml) which has already been boiled. The mixture is stirred carefully with a wooden spatula or spoon and left to boil for 10–15 minutes. Sugar is added to taste and the porridge is served with a spoon after being cooled.

It should be emphasized that no survey has been carried out to see if mothers are following these instructions for use.

## 3. NUTRITIONAL QUALITY

### 3.1 Nutrient content

The nutrient content of Nutrimix currently produced is shown in Table 2. A more comprehensive determination of the composition of the formulas has not been possible due to a lack of financial resources. However, results of previous analyses of similar types of complementary foods which included 10% sugar, show that significant mineral and vitamin deficiencies might be occuring.

**Table 2**
**Nutrient content of Nutrimix**

| | "1er âge" [a] | "2ème âge" [a] |
|---|---|---|
| **Nutrients** | **per 100 g** | |
| Energy (kcal) | 402 | 423 |
| Water (g) | 1.7 | 2.4 |
| Protein (g) | 8.2 | 16.8 |
| Fat (g) | 2.8 | 8.6 |
| Total CHO (g) | 86.1 | 69.7 |
| Ash (g) | 1.2 | 2.5 |

[a] *"1er âge" for infants aged 3–6 months; "2ème âge" from 6 months*

### 3.2 Energy density of the porridge

Presently this parameter is not available. The energy density of porridge prepared from Nutrimix flour is, however, probably lower than that recommended by WHO (120 kcal per 100 ml of porridge) taking into account the nature of the ingredients and the techniques used.

### 3.3 Food safety

In addition to microbiological control of the foods before acceptance trials were carried out, hygienic measures have been taken at various levels to avoid contamination:

- daily cleaning of the premises, the machinery and the utensils used to produce the foods
- cleanliness of the handlers
- visual checks during sorting, drying and roasting
- covering of the basins during cooling

### 3.4 Acceptability

The trials carried out show that the foods are well accepted. Feedback from social and health centres showed that women preferred Nutrimix to other similar foods for infants sold in Togo.

## 4. PRODUCTION AND MARKETING

The unit is supervised and directed by a management committee and employs:

- four state employees, including the person in charge of production, two assistants and a sales manager at the Institute;
- two temporary employees, including the miller, covered by the overall budget;
- four temporary employees: a two-person team rotates every two weeks.

The production capacity corresponds to that of a unit designed for research. For the promotional sales option, the unit has been organized to produce a maximum of 250 kg/day. The unit can, nevertheless, exceed this figure by increasing the number of temporary employees if there is a special order for emergency supplies. The production trend from 1990 to 1993 is shown in Table 3.

**Table 3**
**Production of Nutrimix from 1990 to 1993 (kg)**

| Year | "1er âge" [a] | "2ème âge" [a] | Total |
|---|---|---|---|
| 1990 | 2826 | 4838 | 7664 |
| 1991 | 2254 | 3792 | 6048 |
| 1992 | 1481 | 2490 | 3971 |
| 1993 | 1872 | 2877 | 4749 |

[a] *"1er âge" for infants aged 3–6 months; "2ème âge" from 6 months*

There was a slow-down in production in 1992 and 1993, due to socio-political events in Togo. In 1994, however, there was a satisfying upturn following the devaluation of the CFA Franc.[2]

Marketing was done by the social and health centres which promoted complementary foods. Nutrimix was also sold in INTA premises during international fairs in Lomé, agricultural fairs and exhibitions, World Food Days organized each year and scientific days organized by the scientific research department. Since 1994, however, the products have also been available in pharmacies to meet consumer demand.

The prices fixed by the Institute are well below the cost of production (prices for a bag of 500 g of Nutrimix "1er âge" and Nutrimix "2ème âge" were CFAF 200 and 225, respectively,

[2] Before the 1994 devaluation, US$ 1 ≈ CFA Francs 250 / after devaluation, US$ 1 ≈ CFA Francs 500.

before devaluation in January 1994, and CFAF 300 and 325 after the devaluation). In fact, despite increases due to the devaluation, prices do not reach those recommended in the study "Potential for extension of a network producing composite flour in Togo: foods for infants" carried out in 1989 (recommended prices were CFAF 480 and 500 respectively for Nutrimix "1er âge" and Nutrimix "2ème âge").

The first action to be taken at production level will be to produce only one enriched complementary food for use from 6 months onwards, in order to conform with WHO/UNICEF recommendations on exclusive breastfeeding up to the age of about 6 months.

## 5. ECONOMIC RESULTS

The unit and its equipment cost CFAF 12 200 000 (in 1985 and 1986). The financing came from the State's investment and equipment budget. Costs such as wages, water and electricity are not included in the price, in order to keep prices at a socially affordable level.

Income mainly comes from sales of Nutrimix. The results in terms of financial profitability have not yet been determined. In calculating profitability, however, the training of extension workers to popularize the complementary foods, which are an important social product, must be taken into account.

## 6. PERSPECTIVES

At this stage in the unit's activities, Nutrimix is selling well, but the unit is experiencing problems with the organization of production and marketing. INTA will have to solve these problems in collaboration with private promoters. The latter will benefit from the results of our research and services, particularly for developing production technology and quality control. Promoters who are already operational could form groups in order to benefit from this support.

# Togo
# Viten production unit

Kodjo C. PLETH-SUKA

## 1. BACKGROUND

The lack of well-balanced local foods on the domestic market, the high cost of imported complementary foods, and low income — aggravated by the recent devaluation of the CFA Franc[1] — justify providing the most vulnerable groups, especially children and pregnant women, with local complementary foods with a vitamin, nutrient and trace element composition that are equivalent to that of imported products.

"Viten" cereal and legume complementary foods, developed and produced by the Association de Jeunes Diplômés Créateurs (AJDC),[2] are the result of the nutrition programme of Entreprenariat Développement Environnement Nutrition (EDEN),[3] a nongovernmental organization sponsoring the AJDC. The preliminary phase of elaboration and improvement of Viten, under the responsibility of two of us,[4] took place from 1987 to 1989.

The period from 1990 to 1994 saw the launching of the production and distribution phase. This phase of EDEN's nutrition programme received financial support from the World Bank in the amount of CFAF 5 851 184 and technical support from UNIDO in the course of two consultations which resulted in the establishment of a management system, the definition of formulas consistent with the Codex Alimentarius and the grouping of production at one site. This phase also received institutional support from WHO which helped to improve the quality of Viten foods: the fibre content was decreased, the protein content was increased (from 9 to 12%), a mineral and vitamin complex was added and the viscosity and caloric density of porridge prepared from Viten foods were improved.

## 2. INGREDIENTS, PRODUCTION TECHNIQUES AND METHODS FOR PREPARING PORRIDGE

### 2.1 Ingredients

Local products such as soya beans, rice, maize, and sorghum are used. Sometimes imported rice is used instead of local rice since the latter is too expensive. The ingredients used in Viten's various formulas differ to suit different feeding habits.

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[1] Before the 1994 devaluation, US$ 1 ≈ CFA Francs 250; after devaluation, US$ 1 ≈ CFA Francs 500.

[2] Association of young graduate inventors.

[3] Environment nutrition development enterprises.

[4] Richard Akwei and Kodjo Pleth-Suka.

## 2.2 Production techniques

The production scheme for Viten complementary foods complies with quality standards, and is made up of the following operations:

- Storage of raw materials (maize, soya beans, sorghum and rice);
- Washing of maize, soya beans and sorghum;
- Roasting (maize, soya beans, sorghum and rice);
- Storage of roasted products;
- Grinding and mixing;
- Packaging either in 500 g polyethylene bags with a label placed between the two bags for Viten products sold in pharmacies and health institutions, or in 25 kg jute sacks or boxes containing 500 g bags with the name of the donor when the food is used for food aid programmes;
- Storage of finished products.

## 2.3 Methods for preparing the porridge

There are two possible ways of preparing porridge: a direct method and a simple method.

The direct method consists of boiling water, dissolving the Viten flour in a small quantity of warm water so as to prevent lumps, pouring this mixture into the boiling water, and boiling for a maximum of five minutes.

The simple method consists of boiling water for 10 minutes, adding this water to the Viten flour and mixing before letting it cool to the desired temperature.

# 3. NUTRITIONAL VALUE

Two formulas are sold: Viten 1 for children between 3 and 6 months; Viten 2 for children over 6 months. The nutrient composition of Viten 1 and 2 are shown in Table 1.

# 4. ORGANIZATION OF PRODUCTION AND MARKETING

The unit's equipment consists of a disk mill, a hammer mill, two gas burners, plastic basins with volumes of 40 and 60 litres, aluminium basins, ten scales with a capacity of 5 kg, one scale with a capacity of 500 kg for checking the weight of raw materials, a heat-sealing machine for plastic bags, dosing spoons, two production tables (measuring 1.2 m x 2.4 m x 1.2 m) and three production boards (measuring 0.7 m x 1m x 0.8 m). Since the beginning of the project, EDEN has invested a total of CFAF 10 000 000 for the Viten component of its nutrition programme.

The capacity of the Viten production unit is 300 kg/day; it can be increased to a maximum of 800 kg/day on demand. Although it is a small-scale industry, it is consistent with standards of hygiene of the products. The employees are versatile so that production does not suffer from the absence of any particular person.

Viten is marketed by a team of three people under the responsibility of a physician. This team is paid by a commission on sales. Viten's major clients are pharmacies, social centres, hospitals and dispensaries, which buy it wholesale and retail it. In 1994, after the devaluation of the CFAF, Viten 1 and Viten 2 were sold at the wholesale price of CFAF 350 and 375 respectively.

As an integral part of EDEN's nutrition programme, Viten has benefited from fiscal advantages granted to EDEN as a nongovernmental organization. In 1995, Viten will become a private company, independent of EDEN, and will therefore lose these fiscal advantages.

**Table 1**
**Nutrient content of Viten**

| | "1er âge" [a] | "2ème âge" [a] |
|---|---|---|
| **Nutrients** | **per 100 g** | |
| Energy (kcal) | 385 | 400 |
| Protein (g) | 12 | 16 |
| Calcium (mg) | 420 | 450 |
| Phosphorous (mg) | 300 | 380 |
| Potassium (mg) | 350 | 700 |
| Iron (mg) | 9 | 9 |
| Copper (mg) | 1 | 1 |
| Zinc (mg) | 8 | 8 |
| Iodine ($\mu$g) | 100 | 100 |
| Vitamin A (IU) | 1300 | 1300 |
| Vitamin D (IU) | 50 | 50 |
| Vitamin E (IU) | 8 | 8 |
| Vitamin C (mg) | 60 | 60 |
| Vitamin B1 (mg) | 0.8 | 0.8 |
| Vitamin B2 (mg) | 0.8 | 0.8 |
| Vitamin B6 (mg) | 0.5 | 0.5 |
| Vitamin B12 ($\mu$g) | 1.5 | 1.5 |
| Niacin (mg) | 10 | 10 |
| Folic acid ($\mu$g) | 125 | 125 |
| Pantothenic acid (mg) | 2.5 | 2.5 |

[a] *"1er âge" for infants aged 3–6 months; "2ème âge" from 6 months*

## 5. FUTURE PROSPECTS

Like other small or medium-size companies, Viten will have to evolve from a cottage industry unit to a semi-industrial plant fully mastering processing techniques. This development implies a commercial approach to distribution, the goal being to sell the whole production and even to supply the market with zero stock. Viten needs to acquire more efficient equipment — which will require more investment — and to collaborate with research institutions.

For the moment, EDEN has informal relations with the Ecole Nationale Supérieure d'Ingénieurs (ENSI)[5] of the University of Benin in Togo as regards technical problems. It also has relations with the Department of Nutrition and Food Sciences of Legon University in Ghana for questions concerning nutrition. In addition, it collaborates with a women's group in central Togo which will soon start producing foods for infants, and is assisting the U.CO.DAL. company of Mali to create a production unit for complementary foods. EDEN remains open to any cooperation that will help it to improve the quality of its complementary foods, as well as of other foods prepared from local agricultural products.

[5] National engineering college.

# Annex 1

# Indicators for assessing breastfeeding practices at household level[1]

The key indicators for assessing breastfeeding practices are a set of standardized measures for assessing infant and young child feeding and evaluating the progress of promotional programmes. They are derived from interviews at household level and are based on current status data, i.e. on feeding practices during the 24 hours preceding the survey.

## 1. KEY INDICATORS FOR ASSESSING BREASTFEEDING PRACTICES

**Exclusive breastfeeding rate:**

Proportion of infants less than 4 months who are exclusively breastfed:

$$\frac{\text{Infants less than 4 months } (<120 \text{ days}) \text{ who were exclusively breastfed in the last 24 hours}}{\text{All infants less than 4 months of age}}$$

**Predominant breastfeeding rate:**

Proportion of infants less than 4 months who are predominantly breastfed:

$$\frac{\text{Infants less than 4 months } (<120 \text{ days}) \text{ who were predominantly breastfed in the last 24 hours}}{\text{All infants less than 4 months of age}}$$

**Timely complementary feeding rate:**

Proportion of infants aged 6-9 months who are receiving breast milk and complementary foods:

$$\frac{\text{Infants 6-9 months (180-299 days) of age who received complementary foods in addition to breast milk in the last 24 hours}}{\text{All infants 6-9 months of age}}$$

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[1] Adapted from: Indicators for assessing breast-feeding practices. Report of an Informal Meeting 11-12 June 1991.WHO/CDD/SER/91.14. Geneva, World Health Organization.

**Continued breastfeeding rate (1 year):**

Proportion of children 12-15 months who are breastfeeding:

$$\frac{\text{Children 12-15 months of age who were breastfed in the last 24 hours}}{\text{All infants 12-15 months of age}}$$

**Continued breastfeeding rate (2 years):**

Proportion of children 20-23 months who are breastfeeding:

$$\frac{\text{Children 20-23 months of age who were breastfed in the last 24 hours}}{\text{All children 20-23 months}}$$

**Bottle-feeding rate :**

Proportion of infants less than 12 months of age who are receiving any food or drink from a bottle:

$$\frac{\text{Infants less than 12 months (< 366 days) of age who were bottle-fed in the last 24 hours}}{\text{All infants less than 12 months of age}}$$

## 2. RECOMMANDATIONS FOR INFANT AND YOUNG CHILD FEEDING

"All infants should be fed exclusively on breast milk from birth to 4-6 months of age: the inference of this statement is that 100% of infants up to exact age 4 months (< 120 days) should be exclusively breastfed.

In order to meet their nutritional requirements, complementary foods should be introduced to the majority of infants during a transitional period lasting 2 months (that is, during the fifth and sixth months of life). Thus, nearly all infants older than exact age 6 months should be receiving complementary foods in addition to breast milk.

Children should be breastfed for at least one year and preferably for up to 2 years of age or beyond."

## 3. DEFINITION OF INFANT FEEDING CATEGORIES

The categories of infant feeding, such as exclusive and predominant breastfeeding, complementary feeding, and bottle-feeding, are defined in Table 1.

**Table 1**
**Criteria for inclusion in infant feeding categories**

| Category of infant feeding | Requires that the infant receive | Allows the infant to receive | Does not allow the infant to receive |
|---|---|---|---|
| Exclusive breastfeeding | Breast milk (including milk expressed or from wet nurse) | Drops, syrups (vitamins, minerals, medicines) | Anything else |
| Predominant breastfeeding | Breast milk as the predominant source of nourishment | Liquids (water and water-based drinks, fruit juice, ORS), ritual fluids and drops or syrups | Anything else (in particular, non-human milk, food-based fluids) |
| Complementary feeding | Breast milk and solid or semi-solid foods | Any food or liquid including non-human milk | |
| Breastfeeding | Breast milk | Any food or liquid including non-human milk | |
| Bottle-feeding | Any liquid or semi-solid food from a bottle with nipple/teat | Any food or liquid including non-human milk<br>Also allows breast milk by bottle | |

# Annex 2

# The joint WHO/UNICEF Complementary feeding initiative: Research for appropriate action January 1995

1. Interventions to prevent and significantly reduce malnutrition of children in developing countries for many years have focused on children aged 0–5 years. There is, however, a growing consensus that the greatest nutritional threat to children occurs in the period from about 6 to about 24 months of age. Infectious disease rates, particularly that of diarrhoea, peak during this period, and the process of growth failure begins, with stunting persisting throughout childhood.

2. Malnutrition in infants and young children is the result of a complex of societal, household and individual factors. Access by all family members to nutritionally adequate and safe food, availability and use of health services and a sound environment are important underlying factors that have been the focus of numerous field interventions for improving the nutritional status of children. It is increasingly clear, however, that a greater reduction in childhood malnutrition can be achieved in many settings by improving the care provided to those in the highly vulnerable 6–24 month age-group, particularly where feeding practices are concerned. Studies suggest that caring practices and feeding behaviour have significant effects on child growth.

3. By about six months of age all infants should be receiving appropriate complementary foods, and breastfeeding should continue for up to two years of age or beyond. The period of *complementary feeding* should begin when breast milk alone no longer satisfies the nutritional requirements of the infant. Numerous studies demonstrate that inappropriate complementary feeding practices — including premature or late introduction of foods other than breast milk, inadequate amounts of nutritionally adequate and safe food, and early cessation of breastfeeding — are important determinants of malnutrition among young children.

4. A wide range of interventions is supported by governments, international development agencies and nongovernmental groups to improve complementary feeding practices. These are frequently based on locally available foods, whether prepared in the home or through large-scale production and marketing schemes. Nevertheless, many of these interventions have a weak scientific base. Indeed, answers to a number of fundamental questions about appropriate complementary feeding are urgently needed as a basis for reducing malnutrition by increasing the impact of existing interventions and developing new ones. Among the many questions requiring careful consideration are the following:

4.1 optimal timing of introduction of complementary foods, including development of indicators that families can easily use to determine when to begin providing foods in addition to breast milk;

4.2 optimal composition of complementary foods, including special attention to micronutrient content and energy density, food components that may inhibit the bioavailability of certain nutrients and techniques that minimise contamination by microorganisms;

4.3 appropriate feeding frequency, amount of foods to be fed, and type of feeding ustensils;

4.4 the relationship between complementary feeding behaviour and sustained breastfeeding, and ways to achieve optimal breastfeeding frequency and duration;

4.5 the relationship between maternal health and nutritional status, breastfeeding patterns and complementary feeding practices;

4.6 common social, cultural and economic constraints to optimal complementary feeding practices.

5. WHO and UNICEF have begun an initiative to address the need for programme-oriented research in this important area. The two organizations, assisted by others, are collaborating with the University of California at Davis in preparing a state-of-the-art review of existing information on complementary feeding, which should be completed by June 1995. A technical consultation of qualified experts is expected to take place in September 1995 to reach consensus on (a) suitable programmatic recommendations based on existing information, and (b) a practical, action-oriented research agenda to deal with priority issues that will help ensure optimal feeding practices. A small steering committee, composed initially of WHO, UNICEF and the nutrition research community, will guide this process while spearheading the fund-raising effort to support the applied research agenda.

6. An important product of this initiative will be scientifically sound guidelines for use by field practitioners in planning and implementing activities to improve child feeding practices, thereby reducing child malnutrition and related morbidity and mortality. An important body of research with extensive practical applicability for future interventions will be generated as a result.

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Inappropriate complementary feeding practices are a major contributing factor to malnutrition, morbidity and mortality of infants and young children in developing countries. In Africa and the Middle East, the most common inadequate practices are an inappropriate age of introduction of complementary foods, bacterial contamination, a low energy and nutrient density of complementary foods, and a frequency of feeding that is insufficient to fulfil the children's needs.

In response to these problems, the World Health Organization's Department of Nutrition for Health and Development convened two inter-country workshops where nutritionists, food scientists and health professionals from more than 30 countries of Africa and the Middle East shared their knowledge of infant feeding practices and their experience of interventions whether in households or in small-scale production of complementary foods.

The editors assembled this information in a single document together with additional scientific information and recent data on current feeding practices from a large part of Africa and the Middle East. The document provides an overview of the multiple dimensions of interventions for improving infant feeding, ranging from nutritional aspects, to production and management issues, and social communication strategies.

It is organized in two parts. Part one deals with major scientific and technical issues: Chapter 1 summarizes the up-to-date scientific basis for complementary feeding. Chapter 2 provides an overview of current practices in Africa and the Middle East. Chapter 3 addresses the important issues of quality, safety and energy density of complementary foods. Chapter 4 presents a conceptual framework for the small-scale production of complementary foods and reviews production experiences in Africa. Chapter 5 focuses on methods and experiences of preparing complementary foods in the home. Chapter 6 considers communication tools and strategies for the promotion of appropriate feeding. Finally, Chapter 7 presents a model for evaluating the nutritional impact of programmes to improve complementary feeding.

Part two describes in detail the situation relating to the feeding of infants and young children in 33 countries in Africa and the Middle East (Chapter 8) and experiences with small-scale production of complementary foods in 11 countries (Chapter 9).