DEVELOPMENT AND EVALUATION OF STRATEGIES TO IMPROVE COMPLEMENTARY FEEDING IN THE CONGO

PAAN project (1991-1995)

carried out by ORSTOM and Ministry of Health of the Congo
supported by UNICEF and French Ministry for Cooperation

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Introduction

Nutritional interventions have been carried out in The Congo between 1991 and 1995 within the framework of the PAAN project *(Program for the reinforcement of nutrition activities)* which was supported by UNICEF/Congo and the French Ministry for Cooperation. It activities concerning improvement of complementary feeding comprise of three stages: (i) a situation analysis in order to identify the needs for improvement; (ii) the development and testing of food processes likely to be incorporated into strategies; (iii) the implementation and evaluation of these strategies at pilot scale level. The objective of this paper is to summarize the main results and conclusions of this experience.
The Congo is a Central African country which comprises two millions and a half inhabitants. It urbanization rate is more than 50%. The situation analysis and the implementation of strategies were performed in two pilot zones: an ancient urbanized district of Brazzaville, the capital of the Congo, and a remote rural zone, named the Kukuya plateau, located at 400 kilometers from Brazzaville and with a population of 16000 inhabitants (figure 1).

1. Situation analysis and identification of needs for improvement

The situation analysis which was performed concerned the nutritional situation of children less than two years, their feeding practices, the characteristics of their traditional gruels, their energy intake and the main features of the social and economic contexts.

1.1. Nutritional status

Anthropometric surveys showed that the prevalence of stunting was moderate in Brazzaville[1,2,3,4,5] and relatively high on the Kukuya plateau[1,2,6] where it was higher than 40% during the second year of life (table 1). In addition, the evolution of prevalence with age showed that stunting began very early, since 11 and 6 percent of children less than 6 months were already stunted in Brazzaville and on the Plateau, respectively.

1.2. Feeding practices

In both rural and urban areas, the main features of feeding practices[1,2,7,8] were (table 2):
- a quasi non-existence of exclusive breastfeeding;
- a very low predominant breastfeeding rate in particular in the rural area;
- a very early introduction of complementary foods since the median age of introduction of gruels was about 3 months and a half in Brazzaville and 2 months on the Kukuya plateau.

Furthermore, as indicated by the timely complementary feeding rate, the proportion of infants between 6 and 10 months receiving breast milk and complementary foods was quite good in both zones. But the feeding frequencies for gruels were low: in Brazzaville and on the plateau, 78% and 93%, respectively, of infants consuming gruels between 6 and 12 months received less than 3 gruels per day. Lastly, the median age for solid food introduction was very early: 6 months and a half in Brazzaville and 4 months and a half on the Kukuya plateau. Consequently, the period of gruel consumption was short (2-3 months).

1.3. Characteristics of traditional gruels

The consumed gruels were mainly prepared from a fermented maize dough in Brazzaville and from cassava on the Kukuya plateau[1,2,7,8,9].

Although inferior to the recommended value, the energy density of these gruels was only a little less than mean energy density of breast milk because of very high incorporation of sugar which constituted, on the average, more than a third of the dry matter of the gruel in Brazzaville and more than a quarter of the dry matter of the gruel on the Plateau (table 3). This high incorporation of empty calories from sugar and the low protein content of cassava on the Kukuya plateau were responsible for the very low protein content of the gruels: on the Plateau, the crude protein content of gruels on dry weight basis was less than 1 g/100g. Although it was not determined, the micronutrient content of these gruels was likely to be very low.

Gruels consumed in Brazzaville had a liquid consistency[10,11]: according to our measurement conditions, their viscosity varied between an average of 1.5 Pascal.second for 6-month old infants and an average of 2.3 Pascal.second for 10-month old infants (figure 2).

1.4. Energy intake

The relative contribution of breast milk and complementary foods to the energy intake were measured by a quantitative food consumption survey in Brazzaville in a random sample of fifty infants at 4 and 6 months[12,13].
The results showed that average breast milk intake was very low: 429 milliliters representing 270 kcal per day at 4 months and 410 milliliters corresponding to 240 kcal per day at 6 months .
At 4 months, breastmilk and gruels supplied, respectively 48% and 38% of energy intake (figure 3). The contribution of gruels increased at the detriment of breastmilk between 4 and 6 months since at 6 months breastmilk and gruels supplied, respectively, 41 % and 44% of energy intake. The average total energy intake in this rather privileged district of Brazzaville was less than the recommended energy intake recently revisited by Butte[14].

1.5. Social and economic contexts

Concerning the main characteristics of the social and economic contexts likely to influence infant feeding practices, it was brought to evidence that in Brazzaville, almost all mothers purchased ready-to-cook ingredients for gruel preparation such as imported flour or fermented maize dough, and they wished to buy easy-to-prepare nutritious infant flour[3,5,15]. But on the average, their purchasing power was low and most of them were not able to dedicate more

than the equivalent of 2 US$ a week to buy infant flours. In 1993, among households of Brazzaville comprising a 4-11 month old child, on average 14.5% of the regular weekly expenditures were allocated to the child, 81% of which was spent on food and 19% on health care[3,5]. 18% of the budget allocated to the child was used to buy gruel, while respectively 7%, 10% and 23% were used to purchase formula, other dairy products, and fish or meat. Furthermore, in regard to the changes in economic and socio-political contexts[15], part of the household budget allocated to the child decreased from 14.5% to 11.0% between 1993 and 1995.

On the Kukuya plateau, almost all mothers prepared gruels from products cultivated and processed by themselves[7]. Cultivated crops were mainly cassava, groundnut, pumpkin, beans and to a lesser extent maize. But beans were kept for sale and the only available foods for gruel preparation were cassava derived products, groundnut or pumpkin butter and some maize flour.
In addition, anthropological surveys allowed to identify some important socio-cultural constraints[1,16,17]:
- first, the total work load of mothers was so important that they had not enough time to breast feed their infant on demand and for preparing meals more than twice a day;
- second, mothers believed strongly that malnutrition was the consequence of witchcraft and was not related to quality and quantity of foods;
- third, young mothers had to take advise of their mothers-in-law and were not allowed to change feeding practices without their consent.

1.6. Needs for improvement

The main conclusions of these descriptive studies were that feeding practices have to be improved, particularly the timing of introduction and the way complementary foods were fed, and that the energy and nutrient density of complementary foods have to be increased. Consequently interventions in order to improve complementary feeding must include promotion of educational messages and technological innovations to provide children with nutritionally adequate gruels. This could be achieved by:
- the production of infant flour mixes at the level of small-scale production units in the view of selling to urban mothers;
- the transfer to rural households of simple home-based technologies for preparing improved gruel.

2. Development and testing of food processes

2.1 Development of food processes

It consisted mainly in formulating nutritionally adequate mixes using a computer program (ALICOM, developed by ORSTOM), in selecting adequate processes and techniques in particular for maize grain germination, roasting of leguminous seeds, blending of gruel ingredients and in defining conditions for using various amylase sources, in particular malted maize flour for household technologies and industrially produced amylases for cottage industry level production.
These studies led to the development of a small scale pilot unit producing an infant flour called Vitafort and recipes for home preparation of an improved gruel.

2.1.1. Infant flour production at small scale level

Vitafort[1,11,18,19,20,21], the infant flour essentially developed for urban mothers, included maize flour, soybean flour, sugar, mineral and vitamin complements as well as industrial amylases

(table 4). Minerals, vitamins and enzymes were imported from Europe. The different ingredients were in such proportions as to provide nutrients and micronutrients in agreement with the recommendations of the Codex Alimentarius for follow-up formula (CODEX STAN 156-1987).
But the main characteristic of Vitafort in regard with other locally produced infant flour was the ability to be prepared into a gruel having both a high energy density and an adequate viscosity.
The comparison of the variation of viscosity of different gruels with energy density shows that the energy density corresponding to 1.5 Pascal.second, that is to say the average viscosity of gruels consumed by Congolese infants at 6 months, is close to (figure 4):
- 40 kcal/100g of gruel prepared from maize /soybean mix without amylase and sugar;
- 60 kcal/100g of gruel prepared from maize /soybean mix with sugar but without amylase;
- 100 kcal/100g of gruel prepared from imported flour;
- 120 kcal/100g of gruel prepared from Vitafort.

Thus, the energy density of Vitafort gruel was 2 to 3 times higher than the corresponding gruels without amylase depending on the incorporation rate of sugar.

One of the main vocation of the pilot unit was to assure training of independent entrepreneurs likely to create several production units in different districts of Brazzaville or secondary towns in the country. Before the last civil disturbances, 4 or 5 units had started production.
The scale of production was deliberately limited (*≈2 tons/month, ≈3 employees)*. Selected processes and packaging were unsophisticated as shown on the flow sheet for production of the product (figure 5) and the purchase price was moderate in comparison with imported flour (≈4 times less) and traditional fermented maize dough (≈ equivalent on energy content basis).

Finally, It was planned that the promotion will be completed by health centers while commercialization will be done both by health centers and the usual marketing outlets (small shops, kiosks...).

2.1.2. Gruel preparation at household level

As maize was the only available amylase source on the Kukuya plateau, the first operation was to define the optimal conditions of germination for producing amylases[1,11,19,20,22,23,24,25]. The process was selected in order to can easily be carried out at household level (figure 6).

The second operation consisted in formulating mixes likely to supply the main nutrients and micronutrients. Taken into account the scarcity of products on the Kukuya plateau, the best mixes selected were cassava/groundnut butter or cassava/pumpkin butter.

The third step consisted in determining the rate of incorporation of malted maize flour into the former mixes. Only small amounts of malted maize flour were necessary to obtain energy dense gruel with appropriate viscosity (figure 7).

Finally, a very simple flow-sheet for the preparation of improved gruel was established (figure 8). It consisted in mixing in a pan appropriate proportions of cassava products, peanut or pumpkin butter, sugar, malted maize flour and water and cooking on low fire the pan for 5 minutes after onset of boiling.

2.2 Tests of food processes

The effect of incorporation of amylase into infant flour on energy intake was studied by carrying out two randomized controlled trials with the improved maize/soybean mix called Vitafort.

The first one was realized by Belgium colleagues at the Lwiro hospital in East Zaire[1,26]. Two groups of 74 hospitalized malnourished children less than 2 year old were fed 3 times a day with Vitafort or the usual hospital gruel. The group receiving Vitafort had energy intake from gruel 56% higher than the control group.

The second one was carried out in Brazzaville with free living infants[1,27]. Mothers of two groups of 40 infants were supplied with Vitafort or a control flour without amylase for feeding their infant from 18 to 32 weeks of age. A quantitative food consumption survey was realized at the age of 24 weeks and anthropometry was measured from 10 to 32 weeks. In addition feeding practices and morbidity were followed up weekly from the 10^{th} to the 32^{nd} weeks.
The utilization of amylase-containing gruels had no significant effects on the breast-feed frequencies and on morbidity. The mean energy density of gruels prepared by mothers was nearly two times higher with Vitafort than with the control gruel *(113 vs 61 kcal/100 g of gruel; $P<0.001$)*. Energy intake from gruels was 68 % higher per meal and 58% higher per day with Vitafort (table 5). Lastly, the mean length increment between 24 and 32 weeks was significantly higher in the Vitafort group than in the control group *(1.84 vs 1.35 cm/mo; $P<0.01$)*.

3. Implementation and evaluation of strategies

The third stage of the PAAN project consisted in the implementation and evaluation of two community level strategies taking into account characteristics of urban and rural contexts.

3.1. In Brazzaville

In the chosen district of Brazzaville, Vitafort was made available in neighborhood shops at a reasonable price[1]. A program of nutrition education and promotion of Vitafort through the integrated Health Care Centers was planned but could not be implemented because of socio-political troubles. Consequently, this urban strategy could not be evaluated so far.

3.2. In the rural zone

On the Kukuya plateau, 12 female local field-workers were selected and trained during two weeks for basic nutrition knowledge, malted maize flour and gruel preparation as well as organization of training demonstrations for mothers[1,28]. During 3 months at full-time and 21 months at part-time, these field-workers transmitted nutrition education messages and made demonstrations on the preparation of improved gruels in group meetings with mothers or during individual home visits. The target of the intervention was all women likely to participate in infant caring with a special emphasis on nursing mothers.

The scheme of the evaluation[1,6,29] comprised a process evaluation aimed at studying the penetration of the strategy among the target population, and an impact evaluation on nutritional status (figure 9). The process evaluation consisted in three successive transversal surveys in the intervention zone during which knowledge and know-how of mothers about feeding practices and new recipes were evaluated. At the same time sampling of improved gruels prepared by mothers was performed to test their energy density and protein content. The impact evaluation was performed using a controlled design with before-and-after comparison in the intervention zone and a control zone.

The process evaluation surveys realized 8, 17 and 27 months after the beginning of the intervention showed (table 6; figures 10 and 11):
- a quite satisfactory level of participation of the mothers as shown by the number of training and demonstration sessions followed by mothers of infants between 4 and 12 months;

- an improvement of their knowledge on appropriate timetable for introduction of complementary foods and on the techniques for preparing improved gruels;
- a significant delay for the age of gruel introduction which changed from to 2.6 to 3.4 months and for the age of family food introduction which changed from 4.6 to 5.9 months;
- an apparently satisfactory adoption rate of the improved gruel. But, in fact, only 33% to 71% of mothers of infants supposedly consuming improved gruels were able to show their stock of malted maize flour.

In an other connection, chemical analysis of improved gruels sampled at random showed that the recipe had been well understood by mothers[1]. The average energy density was 112 kcal/100 g of gruels with only 6% of gruels with an energy density less than 80 kcal/100g (figure 12).The mean crude protein content was 14 g of protein per 100g of dry matter with only 8% of gruels with a protein content less than 10g per 100g (figure 13).

Concerning the results of the impact evaluation on nutritional status[1,6], we observed a worsening of stunting in both intervention and control zones since the percentage of moderate or severe stunted infants between 4 and 27 months changed from about 31 to 38% (figure 14) and the average height-for-age Z-score from about -1.55 to -1.65 (figure 15). Thus, they were no significant positive impact of the intervention on the nutritional status of children in spite of undeniable improvements of mothers' nutritional knowledge and of the declared feeding practices.

Conclusion

In The Congo, complementary feeding has been found inadequate mainly because of a too early introduction of complementary foods, a low feeding frequency and the low energy and nutrient density of gruels.

The use of certain simple processes was able to increase the energy and probably nutrient densities of gruels and consequently the corresponding intakes from gruels[1,30].

In a remote rural zone, a strategy based on the promotion of simple nutritional messages and the transfer to mothers of improved processes for gruel preparation was able to improve nutritional knowledge of mothers and, to some extent, more appropriate feeding practices. But it did not succeed in improving nutritional status. The analysis of the data obtained during the evaluation stage is still in progress. But, here and now a combination of different factors may explain this lack of positive effect:

- the number of children having really profited by improved practices and gruels were probably less than declared by mothers and consequently insufficient to have a significant effect on the nutritional status of all the targeted children;
- the duration of the period of gruel consumption was still too short to allow a sustainable improvement of energy and nutrient intakes from gruels;
- the intervention probably did not succeed to increase micronutrient intakes sufficiently;
- lastly, in such a population inadequate feeding practices and foods may not be the limiting factors for improvement of nutritional status.

Thus, the evaluation of the strategy implemented in this rural African zone leads to the conclusion that even still more multi-disciplinary and multi-faceted approach than the one adopted is necessary to improve not only infant feeding but also their nutritional status.

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Table 1: Nutritional status of children (< 2 years)

		Brazzaville	Kukuya Plateau
Stunting (% < - 2 ET)	0-5 mo	11.6	6.6
	6-11 mo	14.4	25.1
	12-23 mo	24.1	41.6
Wasting (% < - 2 ET)	0-5 mo	1.1	0.0
	6-11 mo	5.9	2.2
	12-23 mo	10.8	8.6

Table 2: Feeding practices

	Brazzaville	Kukuya Plateau
Exclusive breastfeeding rate (% < 4 months)	1.6	1.4
Predominant breastfeeding rate (% < 4 months)	62.9	44.6
Median age at gruel introduction (months)	3.4	2.0
Timely complementary feeding rate (%; 6-9 mo)	89.7	80.5
Feeding frequency for gruel (6-11 mo; % < 3/day)	78.1	92.5
Median age at solid food introduction (months)	6.5	4.4

Table 3: Characteristics of consumed gruels

	Brazzaville	Kukuya Plateau
Main gruel ingredient	fermented maize (76%)	cassava products (95%)
Energy density (kcal / 100 g))	58	68
Mean sucrose content (g / 100 g dry matter)	36.4	27.6
Mean protein content (g / 100 g dry matter)	6.5	0.7
Viscosity (Pa.s)[(a)]:		
- at 6 months	1.5	
- at 10 months	2.3	

(a) Viscosity measurements were made using a thermostatic (45°C) HAAKE VT500 rotatory viscometer with a SV-DIN spindle at 64.5 rpm.

Table 4: Composition of Vitafort

Ingredients	**%**
Maize flour	73.8
Soybean flour	14.1
Sugar	11.0
Mineral complement	0.9
Vitamin complement	0.1
BAN 800 MG (industrially produced food grade amylase)	30 Novo units/100 g flour (375 mg/kg flour)

Table 5: Comparison of energy intakes observed with Vitafort and the control flour

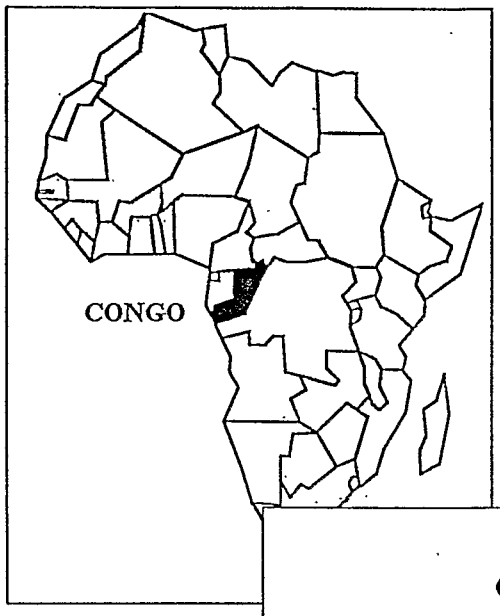
	Vitafort group		Control group		P<
	n	mean±SD	*n*	mean±SD	(1)
Per meal (kcal/kg)	*64*	15.7 ± 7.5	*73*	9.3 ± 4.9	10^{-6}
Per day(2) (kcal/kg)	*31*	31.0 ± 18.0	*33*	19.9 ± 10.3	0.05

(1) *Test de Mann-Whitney*
(2) *for infants consuming porridges prepared from experimental flour*

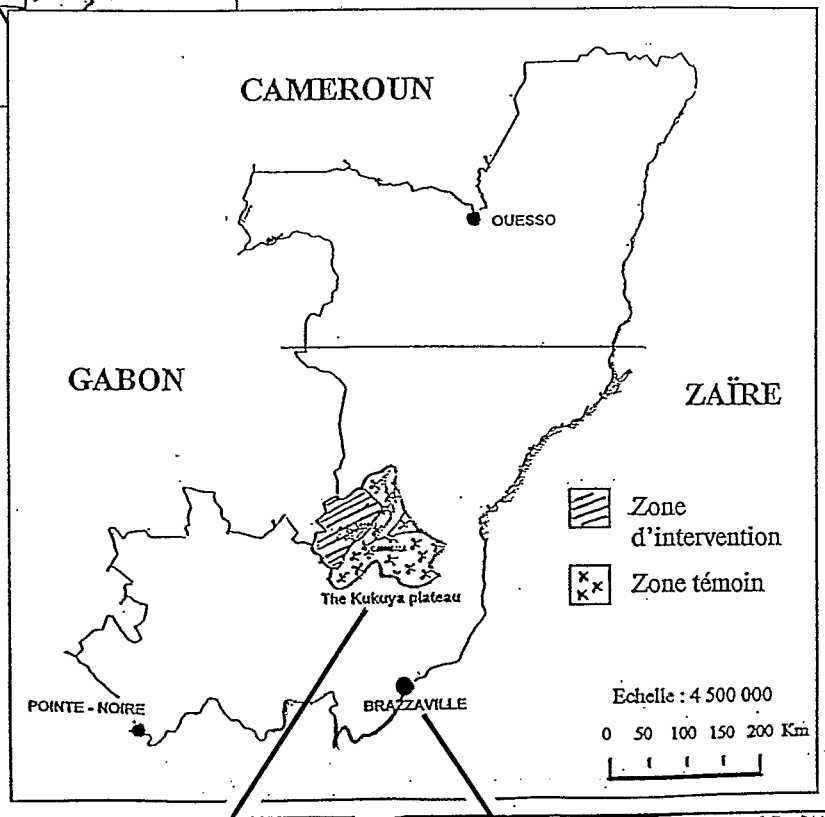
Table 6: Results of the evaluation of process *(after 8, 17 and 27 months)*

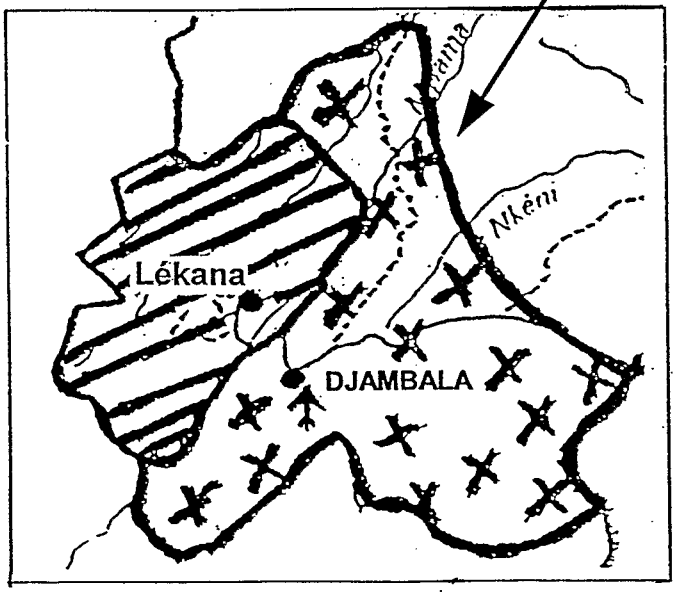
		1993	1994	1995
Number of training sessions followed	Mean	2.47	3.39	2.42
	% with 0 session	*21*	*17*	*38*
«Weaning timetable» score (/100)	Mean	58	57	54
	% with weak score	*38*	*37*	*39*
«Malted flour preparation» score (/100)	Mean	61	67	50
	% with weak score	*25*	*21*	*46*

Figure 1: Localisation of the interventions



- An ancient urbanised district of Brazzaville: *poto-poto*
- An isolated rural zone: *The kukuya plateau*





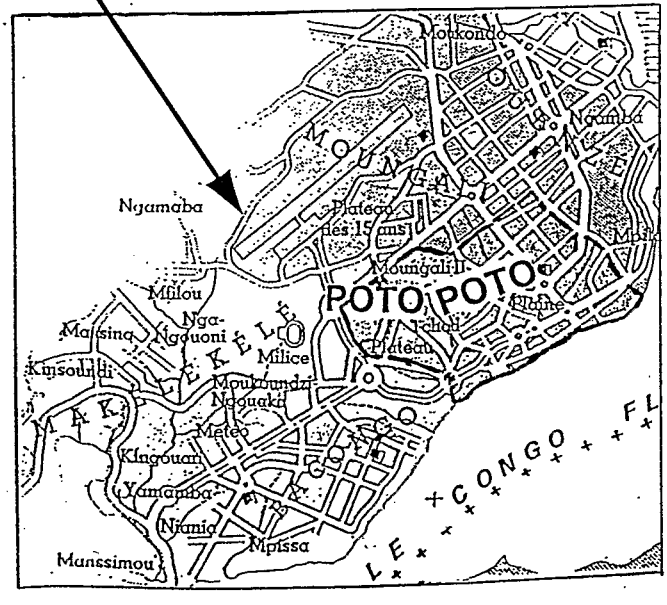


Figure 2: Variation of viscosity of gruels with infants' age

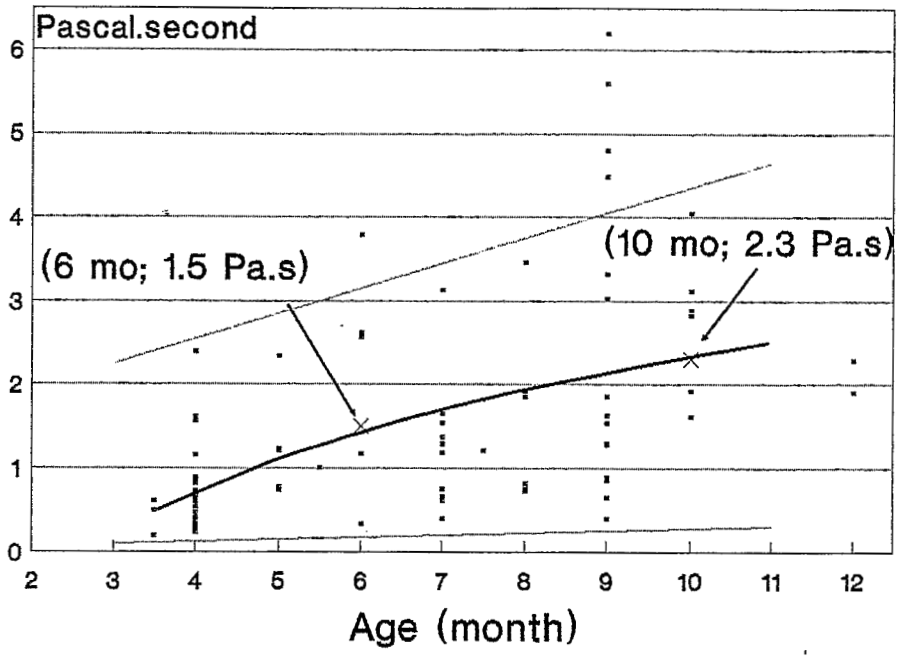
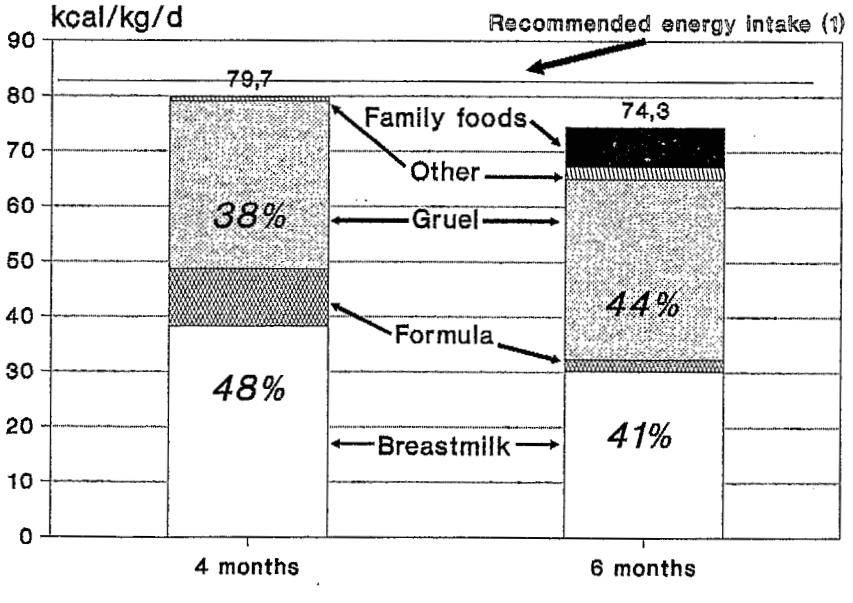


Figure 3: Contribution of breastmilk and gruels to the energy intake in Brazzaville



(1) Butte, 1996

Figure 4: Variation of viscosity of different gruels with energy density

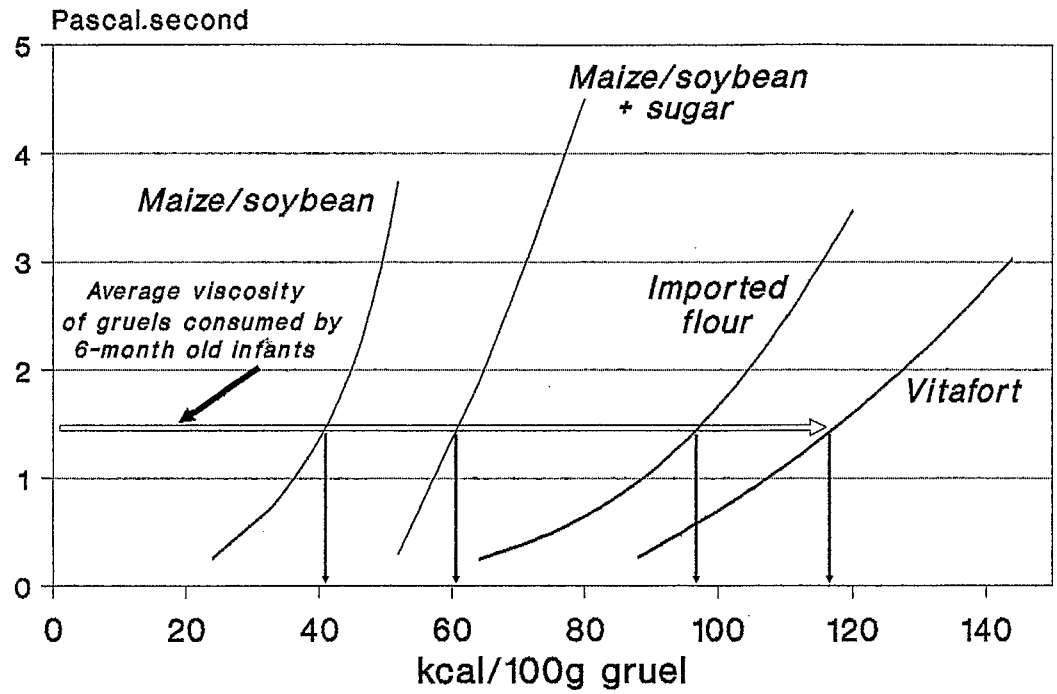


Figure 5: Flow-sheet for production of Vitafort flour

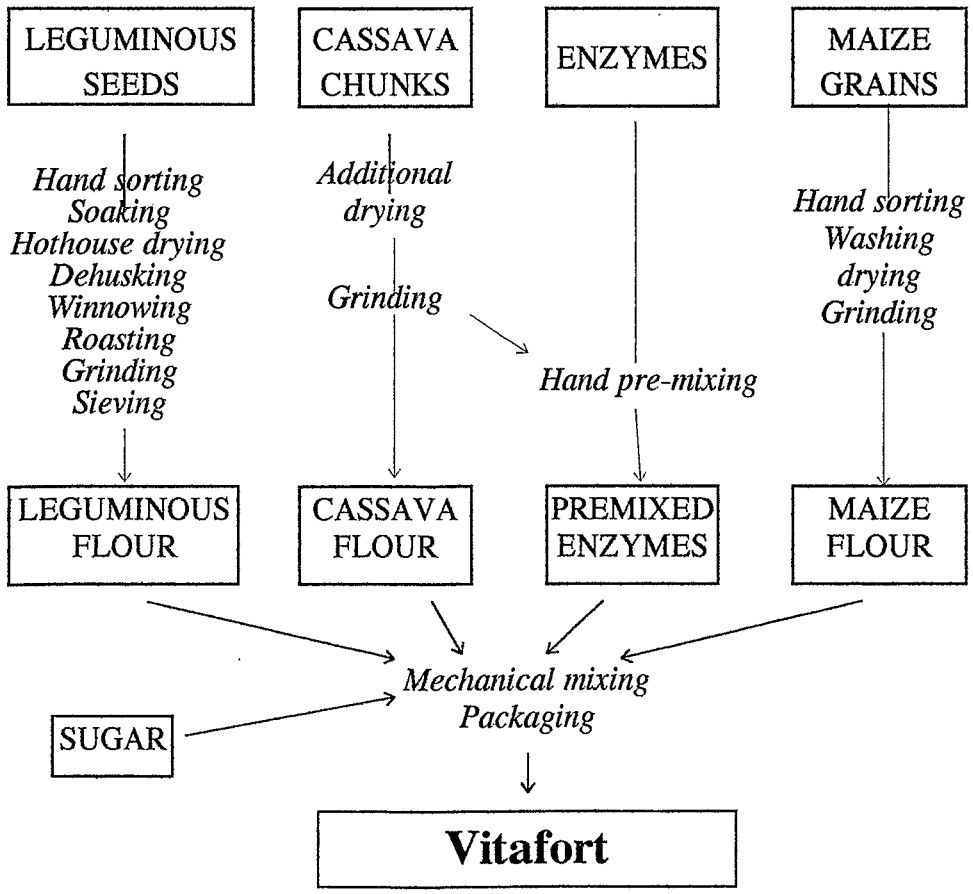


Figure 6: Flow sheet for malted maize flour production

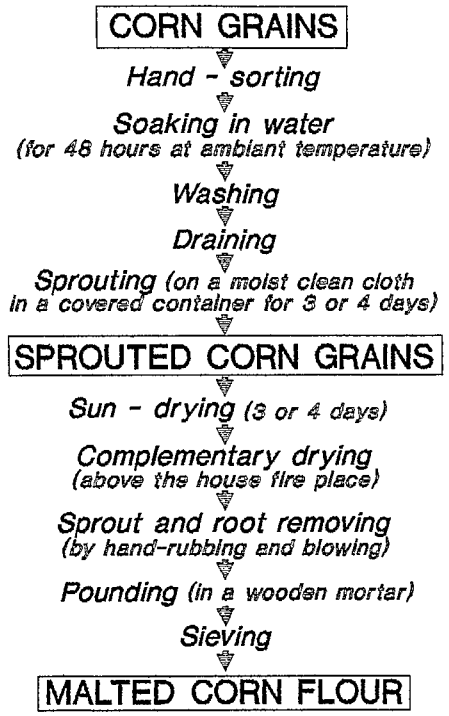


Figure 7: Determination of the incorporation rate for malted maize flour

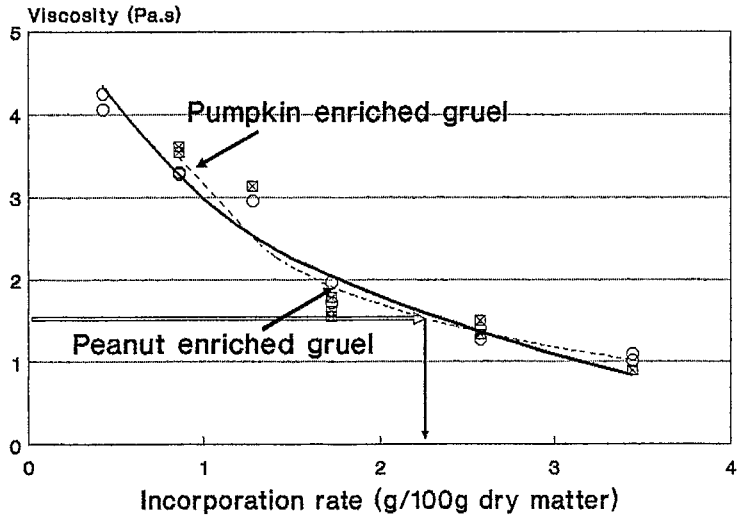


Figure 8: Preparation of the improved gruel

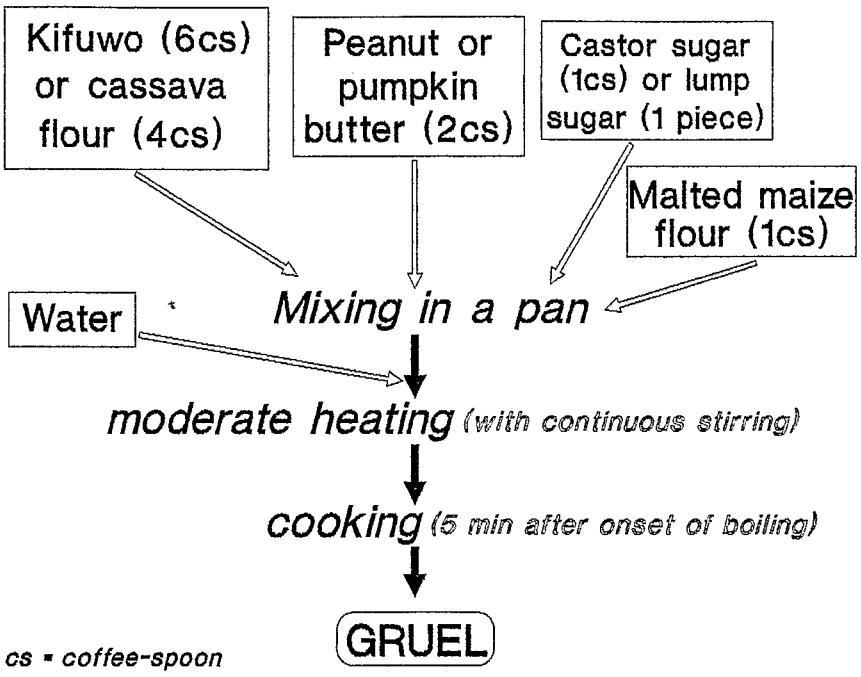


Figure 9: Scheme of the evaluation of the intervention on the Kukuya plateau

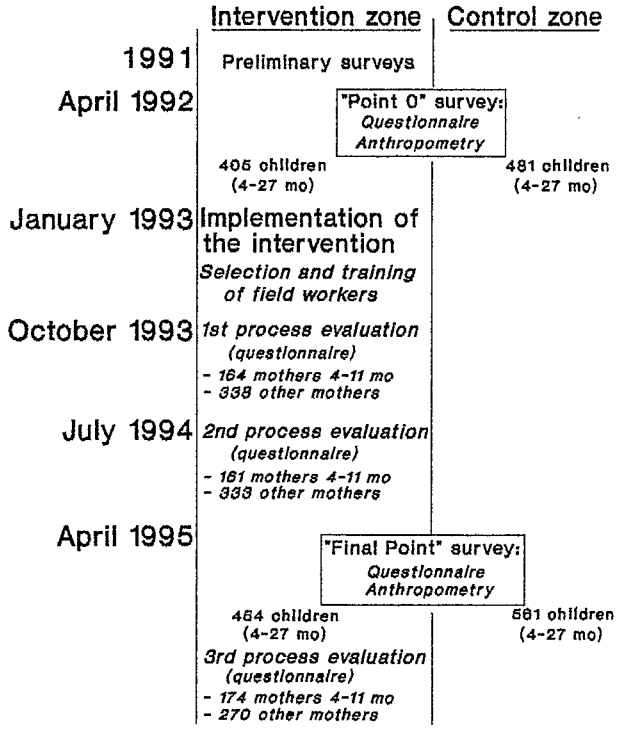


Figure 10: Evolution of the median age of introduction of complementary foods

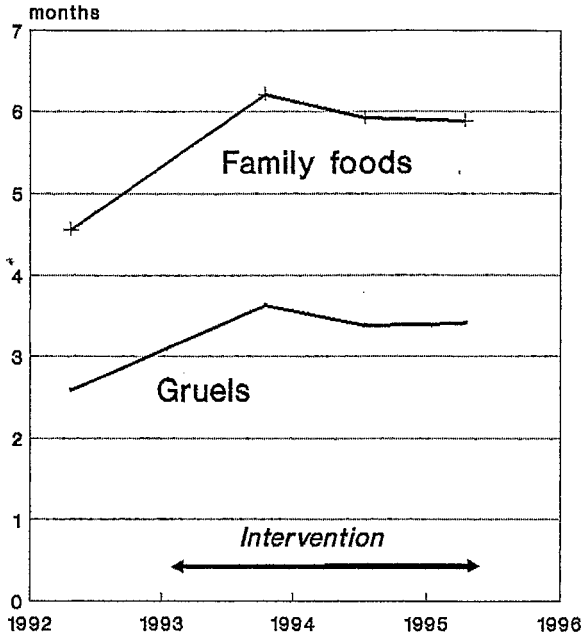


Figure 11: Declared nature of the last gruel consumed in fonction of the year

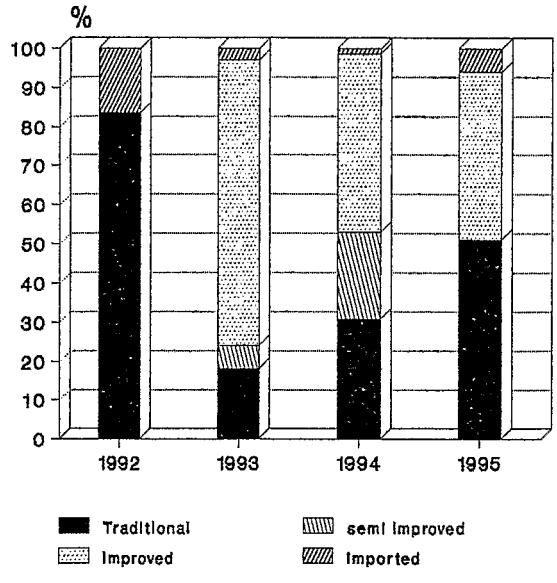


Figure 12: Energy density distribution of home-made cassava-based gruels

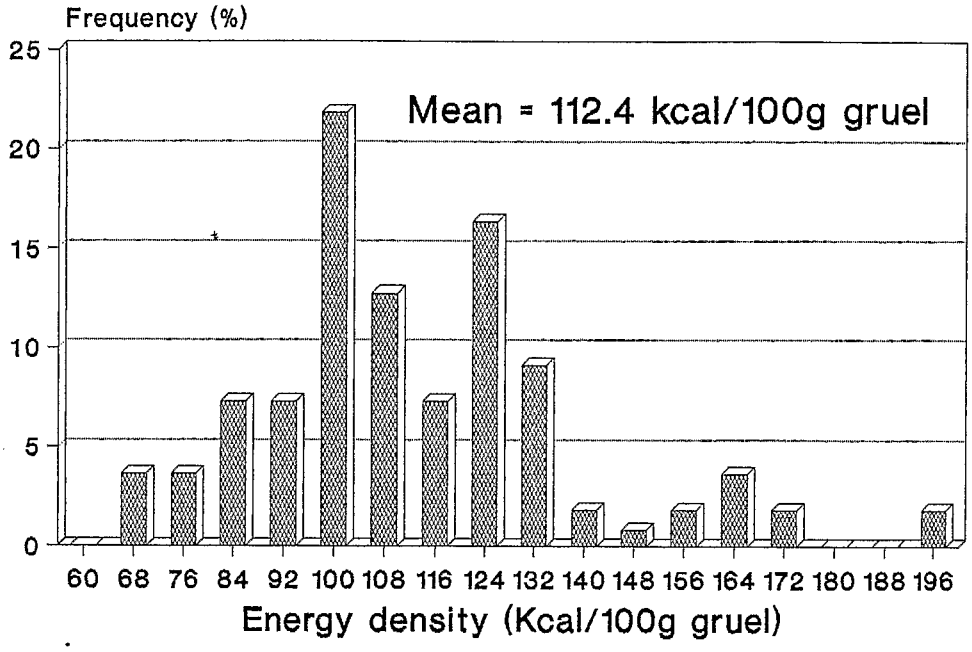
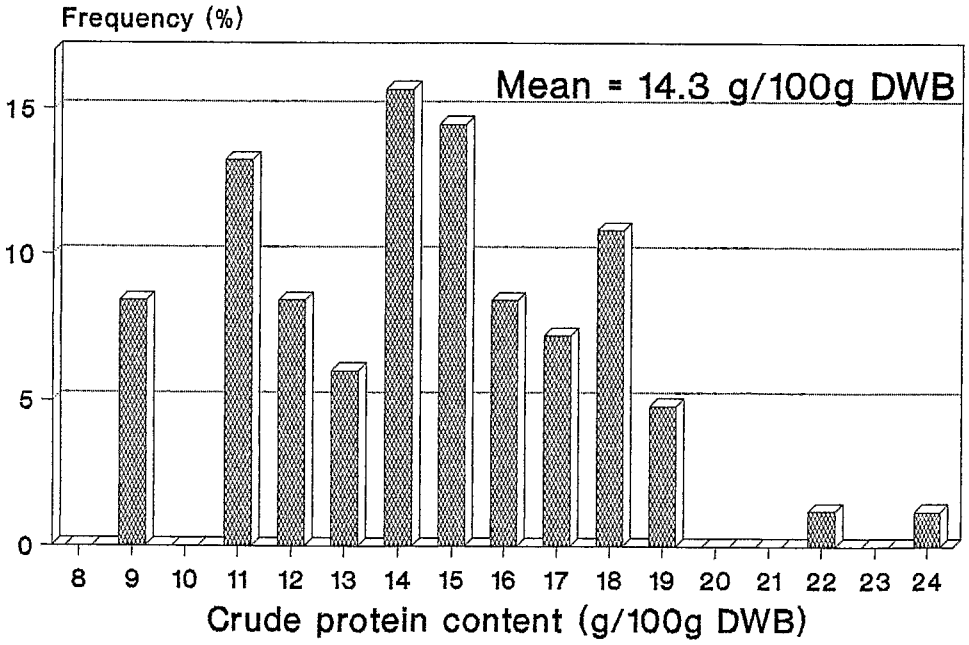


Figure 13: Crude protein content distribution of home-made cassava-based gruels



DWB: Dry weight basis

Figure 14: Evolution of the prevalence of stunting during the intervention

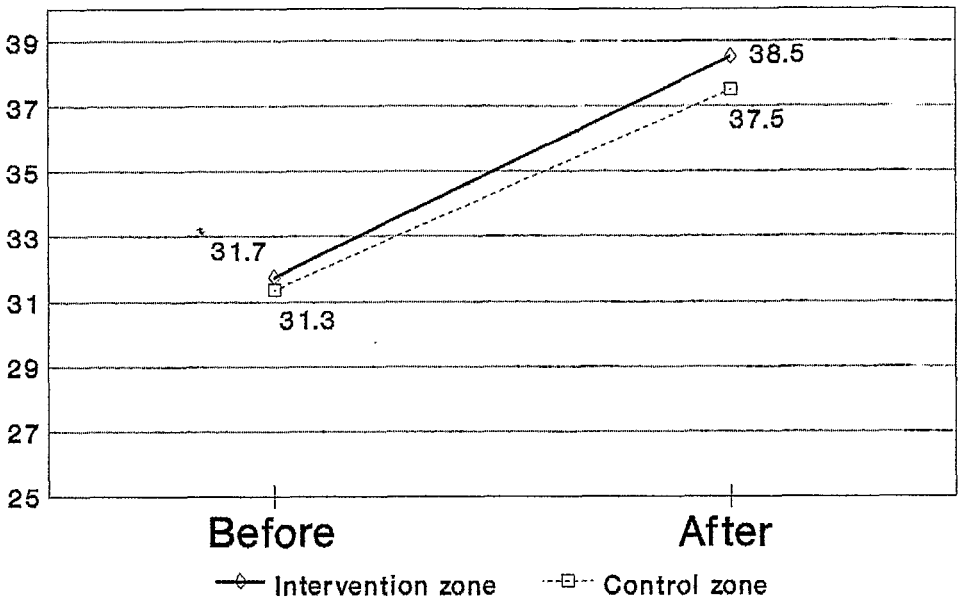
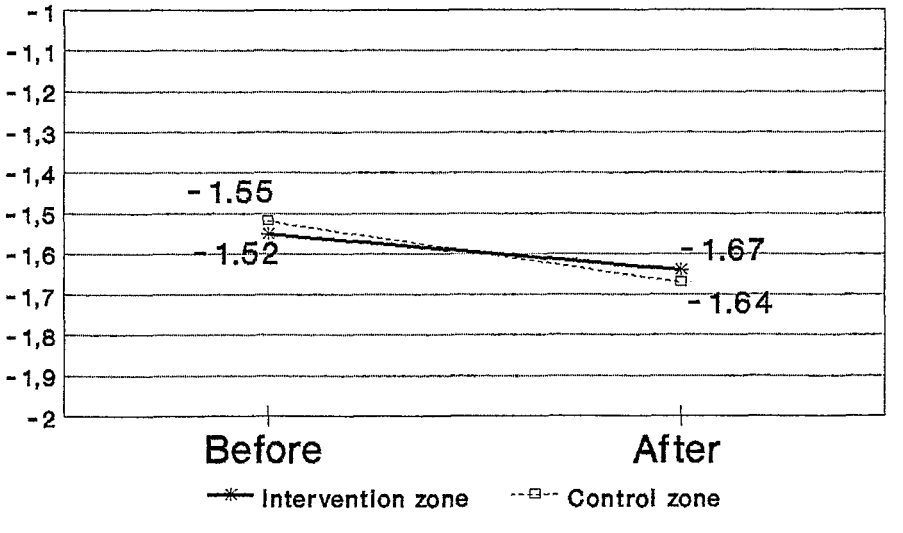


Figure 15: Evolution of the mean height-for-age Z-Score during the intervention



DEVELOPMENT AND EVALUATION OF STRATEGIES TO IMPROVE COMPLEMENTARY FEEDING IN THE CONGO

by Serge Trèche (ORSTOM/Montpellier)

Abstract

A program was carried out between 1991 and 1995 within the framework of the PAAN project *(Program for the reinforcement of nutrition activities supported by UNICEF and the French Ministry for cooperation)* in order to improve infant feeding. The situation analysis and the implementation of strategies were performed in two pilot zones: an ancient urbanized district of Brazzaville, the capital of the Congo, and a remote rural zone named, the Kukuya plateau with a population of 16000 inhabitants.

Situation analysis and identification of needs for improvement

The prevalence of stunting was relatively high on the Plateau area and moderate in Brazzaville (respectively, 41% and 24% <-2 Z-scores for the 12-23-mo old children). In both rural and urban areas, the main features of complementary feeding were too early introduction of complementary foods, low feeding frequency; low energy and nutrient density of the traditional gruels.
In Brazzaville, almost all mothers purchased ready-to-cook ingredients for gruel preparation such as fermented maize dough or imported flour. On the Kukuya plateau, where some important socio-cultural constraints were identified *(total work load of mothers, role of witchcraft and influence of mothers-in-law)*, mothers prepared gruels from products cultivated and processed by themselves.
In such contexts, interventions in order to improve complementary feeding had to include promotion of educational messages and technological innovations to provide children with nutritionally adequate gruels.

Development and testing of food processes

Studies were carried out to define the conditions for using various amylase sources in order to reduce the viscosity of energy dense (120 kcal/100 ml) improved gruel and to formulate infant mixes from local foodstuffs. These studies led to the development of *(i)* a small scale pilot unit producing Vitafort, an infant flour mix (maize, soybean, sugar, industrial amylase and a mineral and vitamin supplement) for urban mothers, and *(ii)* recipes for rural household preparations of gruel based on fermented cassava, pumpkin or peanut butter, germinated maize flour and sugar.
Two controlled trials were carried out using gruel prepared from Vitafort. In Lwiro (Ex-Zaire) hospitalized children (< 2 ys of age) receiving Vitafort had energy intakes 56% higher than those consuming the usual hospital gruel. In Brazzaville, from the age of 17 weeks until 32 weeks, households of two groups of 40 free-living infants were supplied with Vitafort or a control flour without amylase. When prepared by mothers, the mean energy density of the gruels was 113 and 61 kcal/100g for Vitafort and the control gruel, respectively. At the age of 6 months, energy intake from gruels was 68 % higher per meal and 58% higher per day with Vitafort. The mean 24-32-week length increment was higher in the group consuming Vitafort *(1.81 vs 1.35 cm/mo)*.

Implementation and evaluation of strategies

In Brazzaville, Vitafort was made available in neighborhood shops at a reasonable price. A programme of nutrition education promoting an appropriate use of Vitafort through the Integrated Health Care Centers was planned but could not be implemented because of socio-political troubles.
On the Plateau, the intervention was a package comprising nutrition education and the transfer to mothers of simple processing techniques to prepare the above mentioned improved gruel. Twelve female local field-workers were trained to visit the villages and teach the mothers more appropriate ways of feeding infants and young children, and how to prepare the energy dense gruels.
Process evaluations carried out on the Plateau 8, 17 and 27 months after the beginning of the intervention showed a high level of participation of the mothers, an improvement of their knowledge of appropriate complementary feeding practices, and a good knowledge of the recipe for the preparation of the improved gruel. The age of introduction of gruel and family foods was significantly delayed. But the impact evaluation, performed two years after the beginning of the intervention, showed no significant effect on the nutritional status of the target children in the intervention zone compared to a control area.

Conclusion

The evaluation of the strategy implemented in the rural African zone leads to the conclusion that even still more multi-disciplinary and multi-faceted approach than the one adopted is necessary to improve not only infant feeding but also nutritional status.