Congo
Vitafort: flour for the preparation of energy dense gruel

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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 (μg)	240
Iodine (μg)	20
Vitamin A (IU)	1000
Vitamin D (IU)	160
Ascorbic acid (mg)	32
Thiamin (μg)	160
Riboflavin (μg)	240
Nicotinamide (mg)	1
Vitamin B6 (μg)	180
Folic acid (μg)	16
Pantothenic acid (mg)	1.2
Vitamin B12 (μg)	0.6
Vitamin K1 (μg)	16
Biotin (μg)	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.

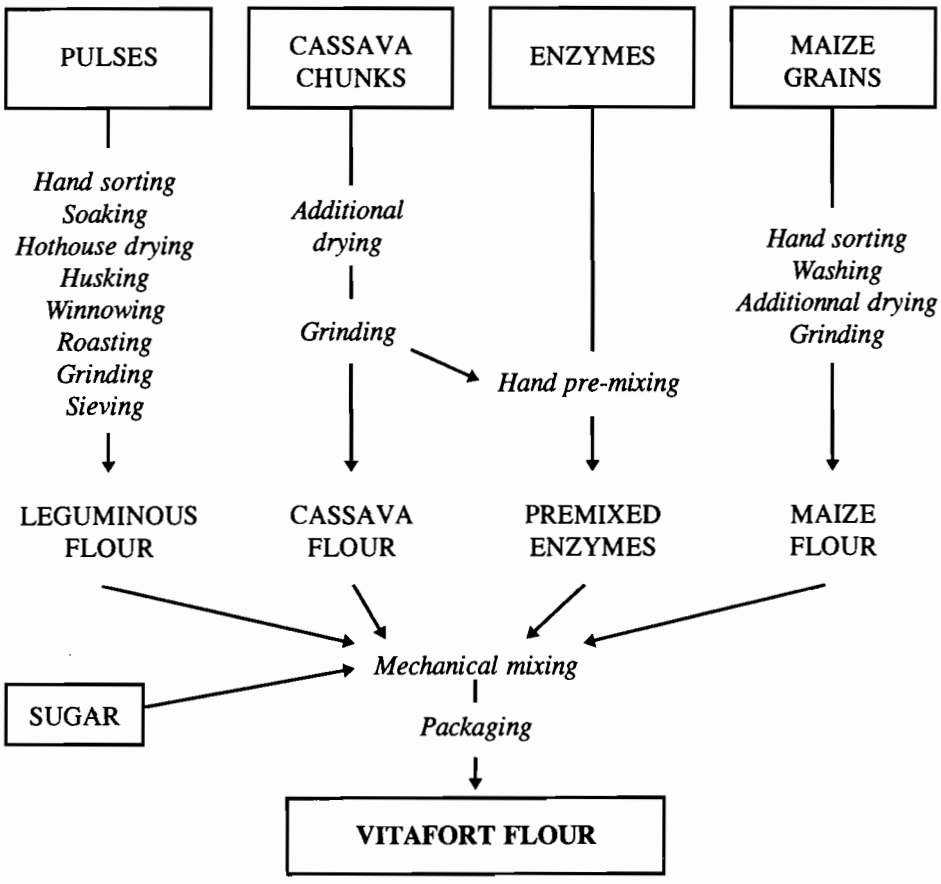

Figure 1
Flow-sheet for production of Vitafort

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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