Contents

Special Issue on Processed Complementary Foods in Latin America

The Food and Nutrition Bulletin encourages letters to the editor regarding issues dealt with in its contents.

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Foreword

The development of optimal nutrition among children during the first two years of life is a continuum that varies with age and results from a series of breastfeeding and complementary feeding practices and behaviours, as well as access to the appropriate mix of foods. In Latin America, almost all governments now recommend that infants be exclusively breastfed until six months of age. At this age, complementary foods need to be given, in addition to breastmilk, to ensure adequate growth and development. A recent review of the scientific knowledge of young child nutrition and feeding in developing countries highlights the difficulty of meeting the zinc and iron requirements of young children 6 to 24 months of age, even under the best of conditions [1]. One way in which to ensure that infants and toddlers receive a nutritionally complete diet is to use processed foods, fortified with these and other nutrients, to complement breastmilk and traditional foods during this nutritionally vulnerable period of development. In addition, because such foods can be produced inexpensively and require minimal time for preparation and cooking, they are likely to alleviate other economic and time-related constraints to improved child feeding The risk of food contamination may also be reduced, because the processing and packaging techniques used in production minimize contamination and the ease of preparation makes it unnecessary to store a cooked product throughout the day.

Despite the many nutritional and feeding-related advantages of processed complementary foods, their effectiveness in improving the nutritional status of infants and children at risk for malnutrition outside a research setting—as well as their sustainability—has not been clearly documented. Although such foods have often been nutritionally complete, inadequate attention has been given to their cultural acceptability and the behaviours associated with their use, as well as to issues of production, cost and financing, social marketing, and targeting and distribution. As a result, processed complementary foods have often failed to reach the poorest households, or when they have reached these households they have not been successful in improving nutritional status because breastfeeding practices and other important feeding behaviours have not been simultaneously improved.

Key features for the use of processed complementary foods in public health programmes were discussed at a technical consultation held on 17–18 March 1999 at the Pan American Health Organization and co-sponsored by Linkages, a project funded by the United States Agency for International Development (USAID). The proceedings of this consultation are included in this special issue of the *Food and Nutrition Bulletin*. The purpose of the consultation was to outline the specific elements critical to the future success of processed complementary foods and identify key gaps in our knowledge of how to use these foods to improve child nutritional status. The discussion summaries following each paper highlight some of the issues discussed and debated, but they do not necessarily indicate agreement or group consensus. Although the focus is on experiences in Latin America, it is hoped that the issues covered will also be relevant to Asia and Africa.

In general, processed complementary foods should:

» Be developed and used in the context of a broad strategy to improve early child nutrition that includes communication for behavioural change to promote key behaviours, such as exclusive breastfeeding, active feeding, and care, as well as the use of traditional foods to ensure a smooth transition to the family diet;

» Be targeted to infants and children 6 to 24 months of age, the period when they are most likely to suffer from growth retardation and when exclusive breastfeeding is no longer likely to satisfy nutritional requirements;

» Include close to 100% of the recommended intakes per daily ration for problem nutrients, such as iron and zinc; have an energy density of at least 1 kcal/g after cooking; and be of a consistency that facilitates use of a bowl and spoon by either the caregiver or the child;

» Be provided and/or marketed in accordance with the International Code of Marketing of Breast-Milk Sub-

stitutes [2] and relevant standards of the Codex Alimentarius [3].

Programmatic or operational research is needed in the following areas:

» Efficacy trials to test the effect of different formulations on micronutrient status and growth;
» Effectiveness, cost-effectiveness, and process evaluations of current public health programmes involving processed complementary foods to complement the efficacy studies currently available;
» Home preparation (dilution and mixing) and hygiene of processed complementary foods;
» The cost of social marketing of processed complementary foods, and broader strategies to improve infant and child nutrition and health.

Research as a basis for public health intervention provided the scientific foundation needed to move forward in the areas of breastfeeding and vitamin A. This level of concentrated effort and funding is needed in the area of complementary feeding. Important areas of research include such topics as the effect of different patterns of complementary feeding on breastmilk intake. Further studies are needed in which feeding frequency, food density, and the quantity of food offered are experimentally varied to determine the effect on intake, such as those by Brown et al. [1]. Further studies are also needed on the bioavailability of different mineral salts and compounds relative to specific diets, following on the findings of Cook [4], and the costs given differences in bioavailability. Also needed are studies, using a standardized protocol, to test products with respect to nutrient absorption, particularly with respect to problem nutrients.

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Potential role of processed complementary foods in the improvement of early childhood nutrition in Latin America

Kenneth H. Brown and Chessa K. Lutter

Abstract

Processed complementary foods have the potential to play an important role in the diets of infants and toddlers in Latin America. Both feeding frequency and nutrient density need to be considered when formulating recommendations on appropriate feeding practices and composition of processed foods. Unfortunately, empirical data are not yet available on the relationships among feeding practices, feeding frequency, energy density, energy intake, and intake from breastmilk that would permit appropriate public health recommendations to be made. Analyses of nutrient requirements and the nutrient contents of typical toddler foods show that it is virtually impossible to satisfy iron requirements without fortification unless there is a substantial intake of animal products. Zinc and calcium have also been identified as problem nutrients. The optimal characteristics of processed complementary foods include adequate energy density, appropriate micronutrient:energy ratios, suitably low renal solute load, appropriate viscosity for age, desirable sensory properties, resistance to microbial contamination, simple preparation techniques, and low cost.

Introduction

Processed complementary foods have the potential to play an important role in the diets of infants and toddlers in Latin America. The region is becoming increasingly urbanized (see accompanying paper by Ruel et al. [1]), and levels of female employment, disposable income, and use of purchased foodstuffs are growing in concert with urbanization. In this paper, information from the recent publication by Brown et al. [2] is reviewed, with particular focus on the potential role of processed complementary foods in Latin America. Three specific topics are addressed: the nutrients required from complementary foods by breastfed children less than two years of age, the likelihood that typical diets of children in the region will meet these requirements, and the optimal characteristics of processed complementary foods.

Complementary foods are the first foods introduced into an infant's diet in addition to breastmilk. Special transitional foods are those complementary foods that are specifically formulated to meet the particular needs of young children with respect to their nutritional requirements and neurophysiological development. These special transitional foods may be either centrally processed or prepared at home from family foods that are mashed or otherwise specially prepared for infant and toddler consumption.

There is a fairly narrow age window when special transitional foods are needed. Breastmilk alone satisfies infant nutrient needs for about the first six months of life [3, 4]. Thereafter, complementary foods are needed in addition to breastmilk to meet the nutrient requirements of infants and toddlers. By about 18 months of age, most toddlers can consume foods from the family diet.

Nutrient requirements for complementary foods

There is clear evidence from a number of studies that the more energy children obtain from sources other than breastmilk, the less breastmilk they consume [2, 3, 5]. Therefore, there is a risk that if complementary foods are promoted too actively, breastmilk intake will be reduced. On the other hand, if complementary foods are not introduced at the appropriate time in adequate amounts and quality to complement breastmilk, growth faltering is likely. At present, scientific evidence is lacking that would permit quantitative guidelines on the effects of the frequency of feeding and the energy density of complementary foods on breastmilk consumption. Such

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evidence is urgently needed so that the appropriate balance between breastmilk and complementary foods for optimal nutritional status can be established and translated into programme and policy recommendations.

The basic concept used to calculate nutrient requirements from complementary foods is simple [2]. The starting point for these calculations is current knowledge on recommended nutrient intake, which in the case of energy and protein is provided by the International Dietary Energy Consultative Group (IDECG) guidelines [6, 7]. By subtracting the amounts of energy and nutrients provided by breastmilk from these theoretical requirements, the amounts of energy and nutrients needed from complementary foods can be estimated. To obtain information on energy intake from breastmilk, 18 studies that provided data on breastmilk consumption by children of different ages and the energy content of breastmilk were summarized [2]. Table 1 shows the amount of breastmilk and the energy obtained from breastmilk for infants and young children of different age groups, and table 2 shows estimates of the amount of energy required from complementary foods. This analysis indicates an apparent minor shortfall in energy intake from breastmilk from three to five months, which is likely to be an artifact of the studies that were available for consideration. Most of the studies were from Asia, which has a high proportion of low-birthweight infants whose mean weights were less than reference median weights for each age group. Thus, it is likely that these data underestimate to some degree the intake of energy from breastmilk by infants whose weights are consistent with the expected weight-for-age. There is additional evidence from randomized, controlled trials that breastmilk alone can satisfy the needs of infants for about six months [3, 4]. After six months, it is clear that there is a substantial shortfall in the amount of energy obtained from breastmilk compared with energy requirements. This shortfall should be provided by complementary foods. The figures for the mean amounts of energy required from complementary foods can be rounded to 275 kcal for infants from 6 to 8 months, 450 kcal for infants from 9 to 11 months, and 750 kcal for children from 12 to 23 months (table 2). However, adjustment for individual children is always necessary because of the variability in energy requirements and energy intake from breastmilk at the individual level.

Although these calculations are seemingly straightforward, it must be recognized that they undoubtedly oversimplify the true situation. For example, the inter-individual variability of energy requirements is not taken into account when only the average figures are considered. Similarly, there is considerable inter-individual variability in consumption of breastmilk. There is also variability in the composition of breastmilk, particularly with regard to the concentration of certain nutrients, which in some cases is a function of maternal nutritional status. Nevertheless, despite the uncertainty imposed by these variable factors, the estimates provide a reasonable starting place for the design of centrally processed foods. As with most nutritional interventions, there is still great room for further testing to

TABLE 1. Consumption of breastmilk and mean energy obtained from breastmilk by children in developing countries according to age group[a]

	Age group (mo)				
Consumption	0–2	3–5	6–8	9–11	12–23
No. of subjects/studies	172/3	259/5	603/16	342/13	377/9
Breastmilk (g/day)	714	784	674	616	549
Energy (kcal/day)	437	474	413	379	346

a. Data from exclusively breastfed children only for infants 0–5 months old; from exclusively and partially breastfed children for those > 5 months old.
Source: ref. 2.

TABLE 2. Estimated mean energy required from complementary food by children in developing countries according to age group

	Age group (mo)				
Energy (kcal/day)	0–2	3–5	6–8	9–11	12–23
Total required	404	550	682	830	1,092
Obtained from breastmilk	437	474	413	379	346
Required from complementary food	0	76	269	451	746

Source: ref. 2.

ensure the ability of complementary foods to meet young children's nutritional requirements.

Recent studies have found a strong relationship between the energy density of foods provided to children, the number of meals per day, and the total daily energy intake. With increasing energy density of the diet, there was an increase in total energy consumption across the range of densities studied. At any particular energy density, when feeding frequency was greater there was greater energy intake. Therefore, both energy density and feeding frequency need to be considered when formulating recommendations on appropriate feeding practices and energy density of processed foods.

To develop quantitative guidelines for formulation of processed complementary foods, theoretical calculations must be used at present, because empirical data are not yet available on the relationships among feeding practices, feeding frequency, energy density, energy intake, and intake from breastmilk. The theoretical calculations are based on the concept of gastric capacity, which is the amount of food a child can consume at a single meal. To estimate gastric capacity, data were examined from studies in Jamaica and Peru on the amount of food consumed in controlled settings (table 3). The diets that were provided were of relatively low energy density, so the children would have tended to consume as much as they possibly could. In the Jamaica study, children consumed from 28 to 58 g per kilogram of body weight at a single meal. In Peru recovering malnourished children consumed 45 to 91 g/kg per feeding. From these data, it was conservatively concluded that almost all children can consume as much as 30 g/kg per meal, with the caveat that these studies were done under controlled conditions where the children were encouraged to eat all they could. The situation might be different under household conditions.

TABLE 3. Estimation of gastric capacity of young children

Variable	Jamaica	Peru
Body weight (kg)	4.6–8.8	5.0–9.6
Energy density of study diet (kcal/g)	0.5	0.4
Amount consumed per meal (g/kg body weight)	28–58	45–91

Source: refs. 2, 8.

It is important to ensure that the energy density of complementary foods is sufficient, so that almost all children in the population will be able to consume enough to meet their energy needs. To calculate the minimal desirable energy density, the starting point is the total energy requirement, which is then increased by two standard deviations to take into consideration the needs of virtually all children in the population. The energy intake from breastmilk is then subtracted from this figure, and the amount of energy needed from complementary foods is determined by the difference (table 4). To ensure that the figures for energy density are adequate for almost all children, the figures for breastmilk energy intake are derived from children who consume low amounts of breastmilk and who therefore have relatively high energy requirements from complementary foods. Thus, the calculations should cover the needs of even the extreme child who has relatively high energy needs from complementary foods. For the age range from six to eight months, for example, the reference breastfed infant has a functional gastric capacity of about 249 g (8 ounces) and a maximum non-breastmilk energy requirement of 635 kcal. Therefore, a child of this age can obtain all of his or her non-breastmilk energy needs in a single meal only if the energy density of the com-

TABLE 4. Steps in estimating minimum adequate energy density of complementary food, using assumed gastric capacity of 30 g/kg body weight for infants six to eight months of age with mean body weight of 8.3 kg

	Breastmilk energy intake			
Variable	High	Average	Low	None
Energy requirement (kcal)	682	682	682	682
Energy requirement + 2SD (kcal)	852	852	852	852
Energy from breastmilk (kcal)	609	413	217	0
Energy required from complementary food (kcal)	243	439	635	852
Estimated gastric capacity (g)	249	249	249	249
Minimum energy density (kcal/g)				
1 meal/d	0.98	1.76	2.55	3.42
2 meals/d	0.49	0.88	1.28	1.71
3 meals/d	0.33	0.59	0.85	1.56

Source: ref. 2.

plementary foods is at least 635 kcal/249 g (2.6 kcal/g). If two meals per day are provided, the density can be reduced by 50% (table 5).

Depending on the feeding practices employed in a particular country and the energy densities that might be achievable with the available local foods, country-specific recommendations can be formulated on the appropriate energy density and frequency of feeding of complementary foods. The suggested approach is deliberately conservative, to ensure that the foods provided are able to meet the children's energy needs, even in the most extreme situations of low breastmilk intake and high energy requirements.

Likelihood that typical diets will meet requirements

Under the usual field conditions, what might be achievable with regard to feeding frequency and energy density? The minimal suggested energy density based on the foregoing assumptions is 0.8 kcal/g of food if feeding frequency is three or more times per day in the different age groups. This level of feeding frequency was typical for most children studied in Peru and Guatemala [2]. However, the energy densities of typical home-prepared complementary foods in Peru were somewhat less (about 0.7 kcal/g) than the recommended density.

By using a similar approach to that employed for energy, the nutrient requirements from complementary foods can also be calculated for protein, vitamins, and minerals. The difference between the individual age-specific nutrient requirement and the amount provided by breastmilk is the amount that should be provided by complementary foods. In the six- to eight-month age group, only about 20% of the total protein needs must be provided by complementary foods, because breastmilk is a relatively good source of protein. The percentage of total protein required from complementary foods increases to 50% in the 12- to 23-month age group. Similarly, among children of well-nourished mothers with normal levels of vitamin A in their breastmilk, the proportion of total vitamin A requirements that needs to be provided by complementary foods is relatively small. Although some of the B vitamins are not plentiful enough in breastmilk to meet the total requirements, they are readily available in most complementary foods, with the exception of riboflavin and possibly niacin in maize-eating populations. Very little vitamin B_{12}, pyridoxine, folate, and vitamin C are needed from complementary foods, since breastmilk is quite rich in these nutrients relative to requirements. Most vitamin D requirements can be obtained from sunlight.

This analysis highlights three nutrients—calcium, iron, and zinc—whose requirements need to be provided primarily from complementary foods and whose content and availability in most complementary foods is relatively poor. The levels of iron and zinc in breastmilk are very low after the infant is about six months of age. Although breastmilk is a good source of calcium, current knowledge of requirements suggests that breastmilk provides only about half of the total calcium needs.

In general, children will consume enough food to satisfy their energy requirements. Because there is no specific appetite for vitamins and minerals, the ability of foods to satisfy all nutrient needs depends on the nutrient/energy ratio (nutrient density) of these foods. Considering the uncertainty regarding the amounts of complementary foods that a child might consume due to the inter-individual variability in both total energy needs and the amount of energy intake from breastmilk, the concept of nutrient density can be applied to evaluate the adequacy of complementary foods [2]. For example, if a child is obtaining relatively high amounts of energy from breastmilk and therefore has relatively low energy needs from complementary foods, the nutrient densities of these foods would have to be quite high, especially for nutrients like iron and zinc, which are scarce in breastmilk. By using this concept of nutrient density, a particular formulation of a complementary food can be examined with regard to its ability to provide the needs of almost all children, given the expected variation in their total intake of these foods.

Furthermore, by using the concept of nutrient density, candidate foods that have sufficient nutrient density to meet children's nutrient needs can be identified [2]. Candidate foods should be able to satisfy the requirement for a specific nutrient and can supply up to two-thirds of the total energy required from complementary foods. When the concept of candidate foods is used for infants six to eight months of age, the only food that is dense enough in iron to meet iron needs is liver, and the amount that would be needed is more than 100 g per day (table 6). In the studies in Peru, the greatest amount of liver that a child ever ate was 36 g per day. Therefore, iron requirements would be very difficult to meet from currently consumed or typical diets. Candidate zinc foods for children 12 to 23 months of age include liver, fish, some dairy products, oats, and

TABLE 5. Minimum recommended energy density of complementary foods according to age group and frequency of feeding for breastfed infants receiving low amounts of breastmilk

No. of meals/d	Energy density (kcal/g)		
	6–8 mo	9–11 mo	12–23 mo
2	1.28	1.55	1.85
3	0.85	1.03	1.23
4	0.64	0.77	0.92

Source: ref. 2.

lean beef (table 7). Candidate calcium foods are largely dairy products (table 8). Candidate vitamin A foods are liver and leafy greens (assuming standard conversion factors for bioavailability of carotenoid precursors of vitamin A in these foods) (table 9).

According to these analyses, it is virtually impossible to satisfy iron requirements without fortification of foods unless there is a substantial intake of animal products, probably an intake greater than what would be considered reasonable. Iron-deficiency anaemia remained a public health problem in the United States until infant foods were fortified with iron. Typical complementary foods are unlikely to provide enough zinc throughout infancy, particularly in six- to eight-month-old infants. Dairy products are the only candidate calcium foods. There are many candidate vitamin A foods, primarily because the vitamin A requirement from complementary foods is relatively low.

Analysis of the energy content and nutrient densities of complementary foods consumed by poor children in Peru showed that theoretical energy needs were not being met (table 10). Nutrient densities were adequate for protein on almost all days. Vitamin A density was also generally adequate, although riboflavin density was sometimes a problem. Iron, calcium, and zinc densities were never sufficient with respect to theoretical needs. On days when cow's milk was consumed as a complementary food, vitamin A and riboflavin densities were always adequate. Although the likelihood of inadequate calcium density was decreased on days when cow's milk was consumed, it was still a problem for some children. Iron and zinc densities were always less than desirable, even on days when cow's milk was consumed, because local milks were not fortified with these minerals.

TABLE 6. Daily amount of liver needed to meet iron requirements (6.8 mg) for children six to eight months of age from complementary foods[a]

Liver	Amount needed (g)	Energy (kcal)	Maximum observed consumption (g)
Beef	136	162	—
Pork	155	162	—
Chicken	108	125	36

Source: ref. 2.

a. The amount of energy supplied by foods meeting iron needs should not exceed 180 kcal/day. For eggs, sardines, fish, and lean beef, the amount sufficient to meet iron needs would supply more than this amount of energy.

TABLE 7. Candidate zinc foods

For children 9–23 mo old	To be added at 12–23 mo
Beans	Eggs
Beef liver[a]	Milk, fresh
Beef with bones	Milk, evaporated
Cheese	Chicken
Chicken liver	
Fish, dried	
Fish, fresh	
Lean beef[a]	
Milk, powdered	
Oats[a]	
Pork liver[a]	
Pork with bones[a]	
Sardines[a]	

a. Maximum grams of food documented to be consumed are greater than grams needed to satisfy requirement.

Source: ref. 2.

Optimal characteristics of centrally processed complementary foods

The optimal characteristics of processed complementary foods can be summarized as follows:

» Adequate energy density for age, given typical local patterns of feeding frequency. At a minimum, the energy density should be 0.8 kcal/g if children consume at least three meals per day;

» Appropriate macronutrient profile with respect to protein, carbohydrate, and fat densities, avoiding excessive amounts of sugar and unnecessary fat, as described in more detail elsewhere [2];

TABLE 8. Candidate calcium foods

For children 6–8 mo old	To be added at 9–11 mo	To be added at 12–23 mo
Cheese	Milk, fresh	Tortillas
Fish, dried		Maize dough[a]
Milk, evaporated[a]		
Milk, powdered[a]		
Sardines		

a. Maximum grams of food documented to be consumed are greater than grams needed to satisfy requirement.

Source: ref. 2.

TABLE 9. Candidate vitamin A foods

For children 6–11 mo old	To be added at 12–23 mo
Chilies	Chicken
Eggs[a]	Green squash[a]
Leafy greens[a]	Sardines[a]
Liver[a]	Maize dough[a]
Milk and cheese	Tortillas[a]
Plantains[a]	
Tomatoes[a]	

a. Maximum grams of food documented to be consumed are greater than grams needed to satisfy requirement.

Source: ref. 2.

TABLE 10. Nutrient density of non-breastmilk foods consumed by children in Huascar (Lima), Peru, according to age group

Nutrient	6–8 mo		9–11 mo		12–23 mo	
	Density[a]	% < recommended[b]	Density[a]	% < recommended[b]	Density[a]	% < recommended[b]
Protein	2.3	0	2.5	0	2.3	0
Vitamin A	10	31	13	38	34	38
Riboflavin	0.06	62	0.06	29	0.06	36
Thiamine	0.04	60	0.04	52	0.04	74
Calcium	16	87	17	83	15	73
Iron	0.53	100	0.55	100	0.55	97
Zinc	0.36	100	0.35	100	0.32	99
Energy intake (kcal/day)	117		177		422	
10th–90th percentile	12–417		26–528		159–930	

a. Median density per 100 kcal.
b. Percentage of children consuming less than the recommended nutrient density according to age, assuming average intake of breastmilk.
Source: ref. 2.

» Adequate micronutrient/energy ratios;
» Suitably low renal solute load and osmolality are not usually problematic in the age range under consideration, but diets should be analysed for these characteristics;
» Appropriate viscosity for age. Children need a semi-solid preparation until about 12 months of age;
» Desirable sensory properties;
» Processed, if necessary, to avoid the presence of anti-nutritional factors;
» Resistant to microbial contamination;
» Easy to prepare without making excessive demands on caregivers' time;
» Protective packaging;
» Low cost;
» Fun to eat.

Conclusion

Inasmuch as it is practically impossible to supply enough iron to meet infant and toddler requirements in the absence of fortification, processed complementary foods have the potential to fill this important nutrient gap. Processed complementary foods could also help meet zinc requirements, which otherwise are difficult to satisfy for infants six to eight months of age.

Research is needed on the impact of different complementary feeding regimens on the consumption of breastmilk. Such research will permit the development of appropriate programme and policy recommendations on how intakes of breastmilk and complementary foods are ideally balanced to achieve optimal nutritional status and development of infants and toddlers.

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Summary of discussion of article by Brown and Lutter

The gastric capacity of children will determine how much they eat. Empirical studies are needed in which the feeding frequency, density, and quantities offered are experimentally varied to determine the effect on intake. Empirical data on the effect of complementary feeding on breastmilk intake are also needed to ensure that our infant-feeding recommendations do not undermine breastfeeding but that children's nutrient requirements are met.

In general, energy requirements are not met for children in this age group. Children will not take in more energy than they need in order to satisfy a micronutrient requirement, and they often take in less energy than they need, particularly if their appetite is suppressed by illness, micronutrient deficiencies, unappetizing foods, or the consumption of bulky foods of low energy density. The diet needs to be considered as a whole and not in the context of a single-nutrient approach or only in terms of energy. Adding an isolated item, such as sugar or oil, will not add micronutrients and therefore will reduce the nutrient density of the diet. However, as one participant noted, oil and sugar will add energy, and many mothers will be able to make this simple change in their children's diet, whereas it may not be possible for them to increase the children's nutrient intake by animal food. Therefore, there was some disagreement about the message that we should be giving mothers. Should we encourage mothers to add oil and/or sugar to children's food to increase the energy density of the food? Or should we encourage them to feed their children animal products to increase the density of both energy and micronutrients?

The needs for some micronutrients can be met only by consuming animal products, which may not be feasible in many settings because of cultural and/or economic constraints. The other options are supplementation or fortification. It is possible to meet some micronutrient needs, such as that for vitamin A, by consuming available foods, whereas for others, such as iron and zinc, a fortified product or supplementation is needed. Breastmilk is an important source of vitamin A. The bioavailability of vitamin A from plant sources is controversial. Although vitamin A does not appear to be a problem nutrient with respect to nutrient density analysis, epidemiological analysis shows a high prevalence of vitamin A deficiency in many parts of the world. Therefore, a fair amount of focus on vitamin A is warranted. With respect to iron, there is evidence that iron-deficiency anaemia exists in this age group. Evidence of zinc deficiency is more problematic, since there are few studies that assess levels of zinc deficiency for this age group and hence there is not much evidence that zinc deficiency exists. However, diets that are low in bioavailable iron are also likely to be low in bioavailable zinc, as both nutrients are contained in similar foods.

It is important to consider the relative proportions of energy and nutrient requirements that will be provided by processed complementary foods and home-prepared foods. For the problem nutrients, it is important to ensure that almost all the requirements are provided by the processed food. However, the child should eat family foods at the same time as processed complementary foods to ensure a complete transition to the family diet at about 24 months of age.

There should be a focus on making sure that mothers are receiving adequate food, since mothers can become undernourished, which compromises their own health as well as the quality of their breastmilk. The availability of vitamins B_{12} and B_6 in breastmilk may be particularly problematic if the milk is deficient, and the effects of deficiency in infants can be irreversible.

Research as a basis for public health intervention has provided the scientific foundation needed to move forward in the areas of breastfeeding and vitamin A. This level of concentrated effort and funding is needed in the area of complementary feeding. Leadership is needed to mobilize these funds and lead this effort.

Urbanization in Latin America: Constraints and opportunities for child feeding and care

Marie T. Ruel

Abstract

The principal aim of this paper is to describe the socioeconomic context in which the topic of processed complementary feeding in Latin America should be examined. Data from CEPAL (Comisión Económica para América Latina y el Caribe) and from the Demographic Health Surveys (DHS) are used to review global trends in urban poverty and malnutrition in the region. The phenomena that are unique to urban life and that are likely to have an impact on child-care and feeding practices are reviewed using data from DHS for six Latin American countries. The issues examined include the higher levels of education and of labour force participation of urban women, the larger percentage of women who head households, and the potentially different family structure and social networks, which may affect the availability of substitute child care. Urban and rural differences in breastfeeding and complementary feeding patterns are also examined to improve our understanding of the potential constraints and opportunities for the promotion of processed complementary foods in Latin America. Programmatic issues that need to be considered in designing and targeting such interventions in largely urbanized Latin America are also discussed.

Introduction

Current estimates indicate that 47% of the world's population, some 2.9 billion people, now live in urban areas [1]. Sixty-six percent of the world's urban population lives in developing countries, and this will increase to 80% by the year 2030.* Latin America is by far the most highly urbanized region of the developing world, with 75% of the population living in urban areas, compared with a little more than a third in Africa and Asia (fig. 1). Projections indicate that by the year 2025, about 82% of Latin Americans will live in urban areas, as will more than one-half of Africans and Asians [1]. The main purpose of this paper is to set the socio-demographic context in which the issues related to processed complementary foods in Latin America should be interpreted.

Urbanization and trends in poverty and childhood malnutrition in Latin America

Poverty

A recent study using data from the World Bank and the World Health Organization (WHO) from all three regions of the world revealed that the absolute number of poor and undernourished in urban areas has been increasing over the past two decades in a number of countries, and is accounting for a greater share of overall poverty and malnutrition [2]. Using data from CEPAL (Comisión Económica para América Latina y el Caribe) [3] for Latin America, we found similar patterns of in-

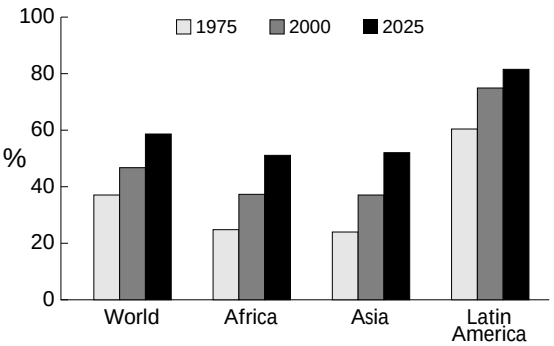

FIG. 1. Percentage of the population living in urban areas by region and by year (1975–2025). Source: ref. 1

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* The United Nations [1] follows national definitions of "urban," and these definitions vary widely. Many countries refer to population centres of about 2,000 or more inhabitants as urban areas.

creases in the share of urban poverty between the 1980s and the 1990s in 13 of the 14 countries for which data were available (fig. 2).* Similarly, the absolute numbers of urban poor were found to have increased in all countries except Chile (results not shown). Clearly, the locus of poverty is shifting from rural to urban areas in all regions of the world, including already highly urbanized Latin America.

Childhood malnutrition

The Latin American region has had an overall decline in the prevalence of childhood malnutrition since 1975 [5]. Between 1985 and 1990, there was a trend towards a reduction in the prevalence of underweight of –0.56 percentage points per year (ppy) in Middle America and the Caribbean and of –0.18 in South America [6]. The worldwide average during this period was –0.72. The second worst region was Middle America and the Caribbean, and the third was South America, both following sub-Saharan Africa, where the prevalence of underweight actually increased by 0.44 ppy during this period. Between 1990 and 1995, the rates of improvement in Latin America were negligible (–0.02 ppy for Middle America and the Caribbean and –0.1 ppy for South America) and, again, were lower than the worldwide average of –0.28 ppy.

Similar trends were documented for stunting in Middle America and the Caribbean [7], where –0.26 ppy was observed between 1980 and 1995, compared with the –0.54 average for the world. South America, on the other hand, had a greater reduction in the prevalence of stunting than the overall average, with a –0.81 ppy decrease. This raised South America to the third rank after South-East Asia and South Asia in terms of reductions in stunting prevalence during this period.

At the country level, similar patterns can be observed in Latin America. According to data from the Demographic Health Surveys (DHS) at two points in time between 1986 and 1996, the prevalence of stunting declined in all six countries, although in some cases the improvements were of small magnitude [8](fig. 3). Stunting is consistently more prevalent in rural than in urban areas, which is typical of all other regions of the developing world [9]. In Latin America, both urban and rural areas had a decrease in stunting, except for Bolivia, which showed no improvement between 1994 and 1998.

When looking at the contribution of urban malnutrition (percent underweight) to the total burden of malnutrition worldwide, Haddad et al. [2] found that for 9 of the 14 countries studied, both the share of malnutrition contributed by urban malnutrition and the absolute numbers of underweight children in urban areas have increased in recent years. This analysis was repeated for stunting using DHS data for six countries of Latin America. We found that the percentage of all stunted children who live in urban areas increased only in Colombia and the Dominican Republic between the late 1980s and the mid-1990s (fig. 4 and Annex). Brazil, Guatemala, and Peru, on the other hand, showed very slight reductions in the contribution of urban stunting to overall stunting at the national level. Relative to the number of stunted children, all six countries showed some reductions in the absolute number of stunted children in urban areas. This is in contrast to the global findings documented by Haddad et al. [2] for 14 countries but is in accordance with their findings for Brazil and Peru. The other Latin American country included in their analysis was Honduras, which showed

* Data used to derive these estimates are from CEPAL [3] for the poverty data and from CELADE (Centro Latinoamericano y Caribeño de Demografía) [4] for urban and rural population breakdowns.

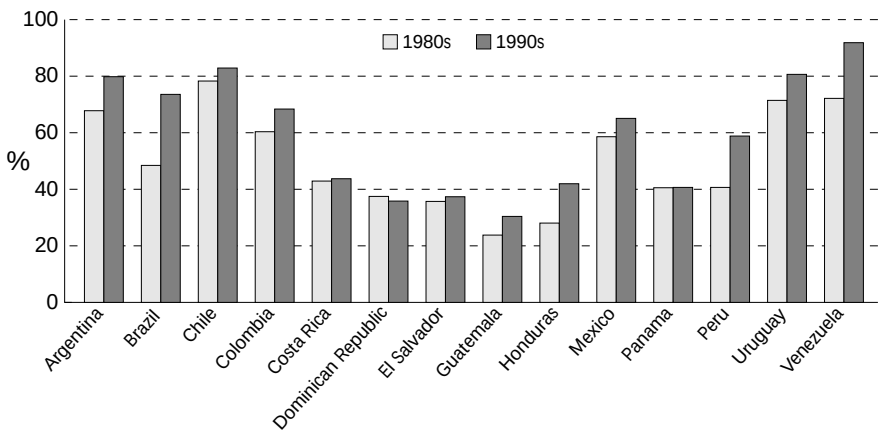

FIG. 2. Trends in share of urban poverty (percentage of all poor people who live in urban areas) in Latin America (1980–90). Source: ref. 3

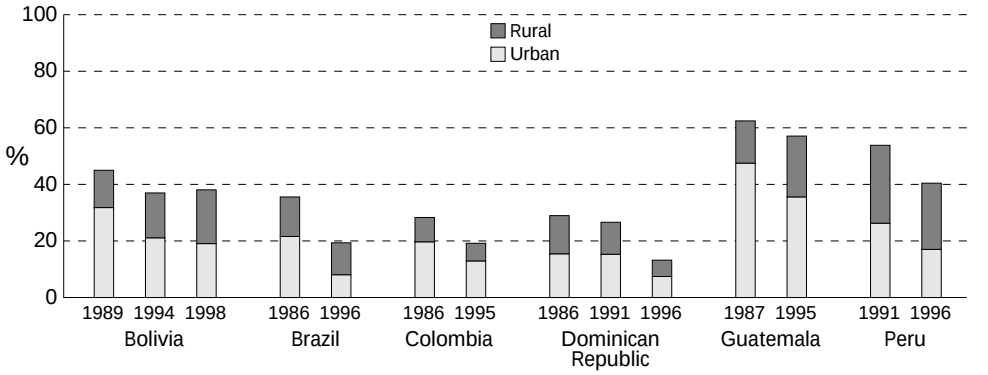

FIG. 3. Trends in prevalence of stunting (DHS data 1986–96)

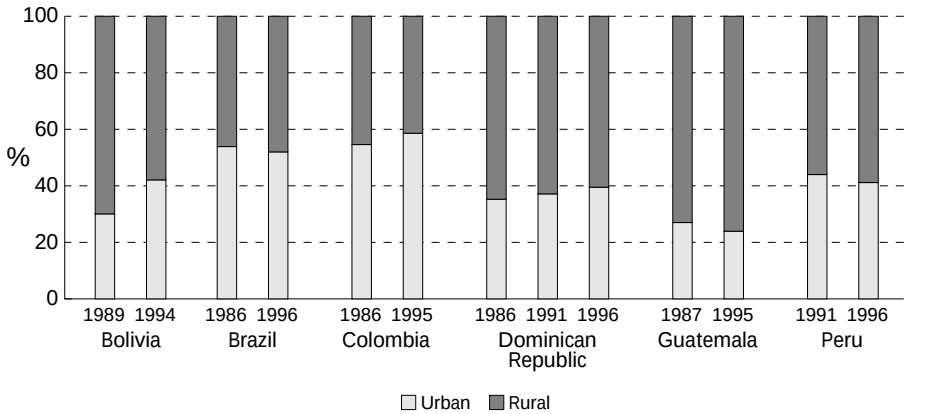

FIG. 4. Trends in the percentage of all stunted children who live in urban or rural areas in Latin America (DHS 1986–1996). Sources: DHS data [8] and ref. 4

an increase in absolute numbers of malnourished children. The authors, however, used underweight as a nutritional indicator, whereas we used stunting. Note also that the contribution of urban stunting to total stunting in Latin America is generally very high, reaching more than 50% in Brazil and Colombia and close to or greater than 40% in Bolivia, Peru, and the Dominican Republic.

Morbidity from diarrhoea

It is well recognized that morbidity from diarrhoea among pre-schoolers is similar in urban and rural areas, and is even sometimes higher in urban areas [9]. Poor environmental conditions, limited access to water and sanitary facilities, and crowding, all inherent conditions of life in urban areas, largely account for this situation. Latin America is no exception to this fact, as seen in figure 5. The prevalence of childhood diarrhoea in Latin America continues to be high, even when compared with other more deprived regions, and does not differ much between urban and rural areas. It is striking that in the Dominican Republic and Guatemala the overall prevalence of diarrhoea increased between the 1980s and the 1990s. The same is true for Bolivia between 1989 and 1994, but the data from 1998 indicate a marked improvement in that respect.

Within-urban inequities

Another important consideration when comparing urban and rural indicators of poverty and malnutrition is the fact that urban areas are highly heterogeneous and city averages mask enormous differences within areas. We have shown previously that differences in stunting prevalence between socio-economic groups within urban areas are systematically greater than within-rural differences in all three regions of the world (with Brazil the only exception) [10]. In Latin America the magnitude of these within-urban differences between socio-economic groups is between two- and four-fold larger than the within-rural differences (table 1). The differences in stunting between socio-economic groups in urban areas are also systematically larger than

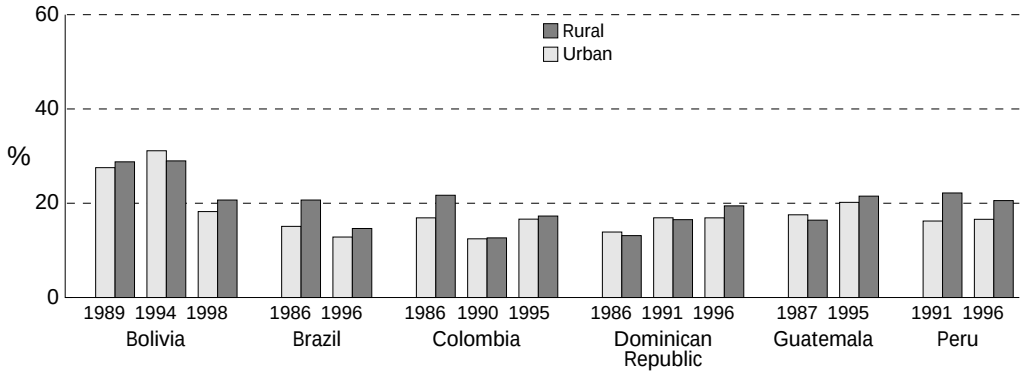

FIG. 5. Trends in prevalence of diarrhoea according to urban or rural residence (DHS data 1986–98)

TABLE 1. Odds ratios for differences in stunting between urban and rural areas and between socio-economic groups within urban and rural areas[a]

	Urban vs rural		Low vs high SES			
			Rural		Urban	
Country/year	OR	95% CI	OR	95% CI	OR	95% CI
Brazil/96	2.9	2.3–3.5	7.5	3.3–16.8	4.8	2.8–8.5
Colombia/95	1.6	1.4–2.0	1.8	1.2–2.9	4.0	2.3–6.9
Dominican Republic/91	2.2	1.8-2.7	3.5	2.2–5.5	10.2	4.6–22.3
Guatemala/95	2.4	2.2–2.6	3.3	2.7–4.0	6.9	5.2–9.3
Peru/92	3.3	3.0–3.8	2.6	2.0–3.3	9.9	6.8–14.5

Abbreviations: DHS, demographic and health survey; SES, socio-economic status; OR, odds ratio; CI, confidence interval.
a. DHS data 1991–96 [8].

the overall urban–rural differences for all countries studied in Latin America and elsewhere [10].

Summary

In summary, Latin America is highly urbanized, and the process is expected to continue in the next 25 years, although at a slower rate than in Africa and Asia. The locus of poverty and malnutrition has been gradually changing from rural to urban areas, but the prevalence of malnutrition and diarrhoeal diseases remains higher in rural areas of Latin America. The large heterogeneity found within urban areas makes city averages of social, health, and nutrition indicators misleading. The levels of poverty and malnutrition among poor urban dwellers often rival those found among the rural poor.

Life in urban areas

Life in urban areas is characterized by a number of phenomena that are unique to this environment and that make the provision of child care challenging. We have reviewed these characteristics of urban life previously [11] and will focus here on the specific characteristics of urban life that are most relevant for the topic of the use of processed complementary food in Latin America. These include greater dependence on cash income for food and non-food purchases, higher levels of education and greater labour force participation among women, the larger percentage of women who head households, and the potentially different family structure and social networks, which may affect the availability of child-care alternatives and support in times of crisis.

Urban dwellers are highly dependent on cash to buy food as well as to pay for all their other basic needs, such as housing, transportation, and even water. In comparison with rural people, who produce a large proportion of the food that they consume, urban dwellers must buy more of their food. In Accra, Ghana, more than 90% of the food consumed was purchased, and the rest came from intra- or inter-family transfers and gifts [12]. Food can account for up to 60% to 75% of total household expenditures among low-income urban Latin Americans [13].

This high dependence on the market for basic needs

means that urban people have to work to generate income, and usually both men and women work. Urban women may also be more likely than rural women to work because they tend to be more educated. Most employment opportunities are outside the home, and this is likely to have a great impact on mothers' ability to take care of their children and other family members. Evidence also suggests that the higher proportion of female-headed households and the smaller household sizes in urban areas reduce the household supply of alternate caregivers and result in harsher trade-offs for women between time spent in income generation (their productive role) and time spent in their reproductive, maternal, and caring roles. Employment conditions are often not flexible enough to reduce the sharpness of these trade-offs [11].

We used data from DHS for six Latin American countries to verify whether these generalizations hold true for this region. Table 2 presents urban–rural comparisons in women's work patterns and in the percentage of women who head households. Urban areas consistently have higher percentages of women-headed households, similar to overall trends in other regions [14]. For the Dominican Republic and Peru, from which data were available at two points in time, a slight decrease in the percentage of women-headed households was observed between the early and the mid-1990s in both urban and rural areas. The data also confirm that more urban than rural women work for wages and work outside the home. Close to half of all urban women worked outside the home in Brazil, Colombia, and the Dominican Republic in 1996 [8]. Interestingly, for Peru and the Dominican Republic, a large increase in the percentage of women working outside the home was observed in both urban and rural areas between 1991–1992 and 1996. This shift occurred in spite of the fact that the overall percentage of women working did not change dramatically (it even decreased in the rural Dominican Republic). In rural Peru, the percentage of women working outside the home doubled in as little as four years.

In urban areas women are usually more educated, which increases their likelihood of working and their ability to get better-paying jobs, thereby increasing the opportunity cost of their time. A comparative study of 38 DHS data sets between 1990 and 1996 showed that women are consistently more educated in urban than in rural areas in all countries and regions of the world for which data are available [15]. In some cases the urban–rural differences in measures of school attainment (median number of years of schooling) are very large. In Latin America the rural/urban ratio for years of schooling among women is about 50%, i.e., the median number of years of schooling of urban women is double that of rural women.* Guatemala has the lowest rural/urban ratio of the region (31%), indicating that the educational attainment of women in rural areas lags considerably behind that of urban women. Paraguay has the highest ratio (71%).

Patterns of child care among working mothers also differ between urban and rural areas (fig. 6). Rural mothers are consistently more likely to be the main caretakers of their children, even if they work. This is, however, the most common modality for child care only in rural areas of the Dominican Republic and Peru. The most widespread child-care arrangement for both urban and rural women in all other countries is relatives, when older siblings and other relatives are combined.** Even in urban areas, where we expected a lower access to family members because of smaller family sizes and probably fewer extended family arrangements, we found that the most common child-care alternative is

* The rural/urban ratio is calculated as follows: (median number of years of schooling in rural areas ÷ median number of years of schooling in urban areas) × 100 [15]. Thus a larger number indicates that the gap between urban and rural areas is small, and a smaller number indicates that this gap is large.

** The category "older siblings" includes both girls and boys, but hardly any boys were reported. Similarly, the category "other relatives" includes fathers, but a very low occurrence of fathers caring for children was reported.

TABLE 2. Comparison of women's work status and head of householdship between urban and rural areas[a]

	Women household heads (%)		Women working for wages (%)		Women working outside home (%)	
Country/year	Urban	Rural	Urban	Rural	Urban	Rural
Brazil/1996	20.5	11.0	62.0	56.1	48.4	42.2
Colombia/1995	26.0	18.0	58.7	45.1	46.4	27.6
Dominican Republic/1991	29.6	17.6	53.6	46.4	30.0	14.8
Dominican Republic/1996	26.1	17.0	54.3	31.3	42.5	22.3
Guatemala/1995	22.2	17.1	47.1	27.6	27.3	11.3
Peru/1992	15.5	10.4	50.6	57.3	33.2	14.0
Peru/1996	14.2	8.7	58.8	58.6	42.3	30.0

a. DHS data 1991–96 [8].

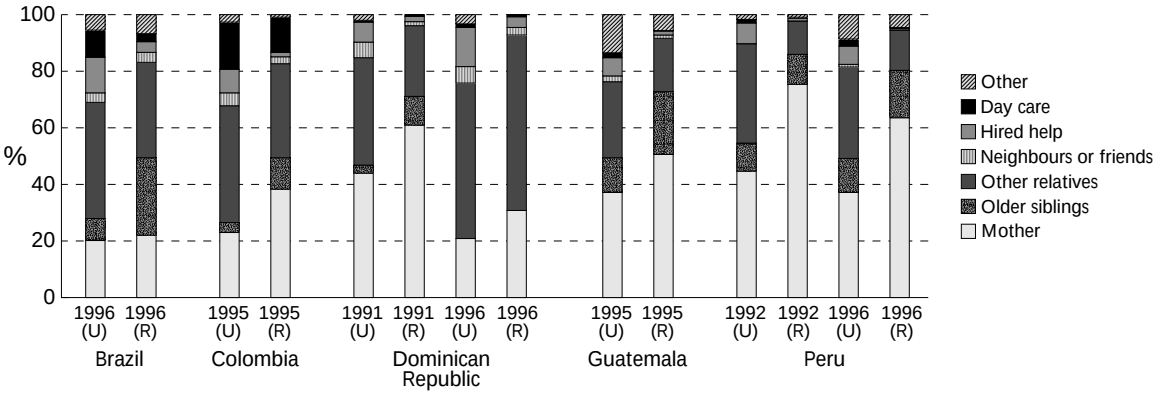

FIG. 6. Child care in urban (U) and rural (R) areas of selected Latin American countries (DHS data 1991–96)

relatives. For the Dominican Republic and Peru, from which data were available at two points in time, it is striking to observe the shifts in child-care use that occurred in this short period of four to five years. In both countries, and for both urban and rural populations, there was a large reduction in the percentage of mothers who cared for their children themselves and a large increase in the use of relatives, especially in the Dominican Republic. These changes may be related to some extent to the trends observed in women's work patterns, which also changed markedly between the two time periods, as indicated above. With increasing numbers of women working outside the home, there is an increased need for substitute caregivers, and relatives seem to be filling that role. The extensive use of older siblings, mostly girls, as substitute child caregivers raises concerns about school attendance. It is likely that women who are faced with two alternatives—leaving the children alone at home or leaving them with an older daughter—will have to deprive the older daughter of her right to school in order to protect the most vulnerable. In Latin America, however, this situation seems to be more common in rural than urban areas (fig. 6).

As expected, the use of hired help is more popular in urban than in rural areas, but overall it is not common. Institutional child care is also uncommon, even in urban areas. Brazil, Colombia, and the Dominican Republic (1996) [8] show some use of these facilities, with higher frequency of use in urban areas. It is likely that such low reported use of institutional care is due to the lack of availability of these facilities, especially in rural areas. Reports of children being locked in their homes while parents go to work in urban areas of Latin America are frequently heard and are certainly true, but this type of information cannot be captured by surveys such as the DHS.

In summary, the DHS data indicated that in comparison with rural women, Latin American urban women are more likely to head households, are more educated, are more likely to work for income, and are more likely to work outside the home. The main child-care alternative is relatives, irrespective of area of residence, followed by the mothers themselves, especially in rural areas. Older daughters often take care of their younger siblings, which may represent a threat to girls' education.

Implications for child feeding and care

The characteristics of urban life as described in the previous section are likely to have important consequences for mothers' ability to care for their children and to maintain the household. Some of the consequences may have positive effects on child and family welfare, whereas others are likely to act as constraints on the achievement of household food and nutrition security. Table 3 presents a summary of the characteristics of urban life reviewed in the previous section, along with some hypothesized positive and negative consequences for child feeding and care [16].

Urban dwellers are highly dependent on the cash economy. The generation of income may have positive effects on the household economy and allow greater access to food and more diverse diets. If the increased dietary diversity at the household level does trickle down to the child, it will provide clear benefits for growth, micronutrient status, and health status. The importance of dietary diversity for these child outcomes is well recognized [17]. A key determinant of whether or not the benefits of increased household food availability and diversity will reach the child, however, is maternal education. Evidence shows that female education is associated with greater knowledge, better child-feeding, child-care, and hygiene practices, and more effective management of resources [18–25]. Higher educational levels, on the other hand, will improve women's work opportunities and will probably increase the likelihood of their finding employment outside the home. This will lead to constraints on their time and may affect the quality of care they can provide to their children. The choice of substitute child care will be a key deter-

TABLE 3. Selected facts of urban life and their potential consequences for child feeding and care[a]

Fact[b]	Potential consequences	
	Positive	Negative
Cash economy; dependence on income	Greater access to food and other basic needs Possibly greater dietary diversity	Greater need to work and generate income to pay for food and other basic needs
Mothers better educated	Better knowledge and practices about child care, feeding, health, and nutrition Greater autonomy and control over resources Greater ability to find employment Better-paid employment opportunities	More likely to work outside the home (see potential consequences below)
Women more likely to work outside the home	Higher household income Greater control over income and other resources, which is likely to have a positive influence on income spent on child goods (health, nutrition, and schooling) Greater access to food; probably more diversity in diet	Reduced time for child care and household maintenance Greater need for alternative child-care arrangements Less time for food preparation and child feeding; possibly greater use of processed foods, street foods, and ready-to-eat foods
Greater proportion of women household heads	Greater control over income and other resources	Imperative need to work and generate income Greater vulnerability to own and dependents' illnesses Great vulnerability in the perinatal period, especially for women in the informal sector who do not have paid leave or maternity benefits
Different family structure and social networks (smaller family size, fewer extended-family arrangements, weaker social networks)	Greater independence, possibly less constrained by cultural patterns and beliefs	Possibly lower availability of substitute caregivers for children and less help with child care in general Greater vulnerability to shocks in the absence of social networks and family members to help absorb shocks

a. The approach used to derive this table is inspired by a matrix designed by Engle et al. [16].

b. These urban facts are a subselection of a larger number of phenomena listed in an extensive literature review of the constraints on food security and malnutrition in urban areas [8]. These facts will not necessarily hold true for all countries in all regions of the world, but they are generalizations of facts that have been observed widely in urban areas around the world. Many of them have been verified for Latin American countries with available data.

minant of the final impact of these opposing forces on children's welfare.

Maternal time constraints usually result in shifts in dietary patterns. With more cash and less time, mothers tend to buy more processed and ready-to-eat foods, as opposed to the traditional complementary foods, which often require long processing and cooking times. Evidence supports the argument that shifts in consumption of processed and prepared foods are largely driven by the opportunity cost of women's time [11]. In Sri Lanka, for example, the value of the time of the primary woman in the household had a positive effect on bread consumption and a negative effect on rice consumption, which requires longer preparation and cooking times [26].

In many countries, street foods constitute a large component of urban households' food budget [27]. Research shows that street foods and processed foods are not necessarily more expensive than traditional home-prepared staple foods, especially when the time and resources needed to prepare them are factored in [27]. In northern Brazil, traditional foods were found to be more expensive in urban than in rural areas, whereas the opposite was true for processed foods [28]. This provided an incentive for urban dwellers to shift away from traditional foods and to substitute processed foods. The main health concerns with processed foods are their often high contents of fat, cholesterol, and refined sugar and their low fibre content; street foods may carry the additional health hazard of contamination. Research suggests that although street foods are often contaminated, they do not appear to be worse

than the foods sold in restaurants in the same neighbourhoods [27].

Again, the overall impact of these changes on children's nutrition and health is difficult to predict. The important point is that urban dwellers in Latin America already buy a variety of processed and special imported foods for their children, and hence the demand for these types of products already exists.

Data from the DHS surveys were again used to shed light on these questions and, more specifically, to look at the patterns of breastfeeding and complementary feeding in urban areas of Latin America and document whether they are different from those observed in rural areas.

Breastfeeding

The greatest threat of urbanization and maternal employment to child care is its potential negative impact on breastfeeding practices. It is generally believed that urban mothers are less likely to initiate breastfeeding and are more likely to wean earlier if they do breastfeed. Our previous analysis of DHS data [9] showed that in Latin America, as in most other regions, the percentage of children ever breastfed tends to be lower in urban areas, but the pattern is not fully consistent and differences are generally small. Urban mothers were actually found to initiate breastfeeding at a surprisingly high rate (greater than 90%). A low occurrence of exclusive breastfeeding, on the other hand, is of concern for both urban and rural areas, but it is particularly uncommon in urban areas. The median duration of breastfeeding (exclusive or non-exclusive) is also typically shorter in urban areas (up to four to six months) than in rural areas [9].

Figures 7 and 8 show differences between urban and rural areas in breastfeeding practices for infants from birth to six months of age in Brazil and Guatemala, respectively. Because of space limitations, data from only these countries are presented. Brazil was selected because it has the highest percentage of urban population among the six countries (78%) and has a high percentage of women working outside the home in urban areas. Guatemala was selected because it is the least urbanized and has the highest prevalence of stunting and the lowest percentage of women working away from home. Of the six countries studied, Brazil has the highest percentage of mothers not breastfeeding, even between zero and four months of age (approximately 20% in urban and 14% in rural areas). In Peru and Guatemala, however, breastfeeding is almost universal in the first four months of life, even in urban areas. In Colombia milk-based complements are extensively used, irrespective of area of residence, and even solid foods are offered to more than 10% of infants between birth and four months of age. Exclusive breastfeeding is extremely uncommon in Colombia and is actually slightly higher in urban than in rural areas. Mothers in Colombia, however, continue to breastfeed beyond four months of age at a higher rate than in Brazil. There is a huge drop in breastfeeding beyond four months postpartum in Brazil (close to 45% of urban mothers and 35% of rural mothers stop breastfeeding by this time). Guatemala and Peru are doing much better: more than 85% of urban Guatemalan mothers and up to 94% of urban Peruvian mothers are still breastfeeding at four to six months postpartum. In rural areas of both countries, the percentage of mothers still breastfeeding at that age is greater than 95%. Peru is striking for its high prevalence of exclusive breastfeeding compared with the other countries: up to 60% in the first four months in urban areas and 73% in rural areas. Milk-based complements are much less popular in Guatemala and Peru than in Brazil and Colombia, but they are consistently more commonly used in urban than in rural areas. Mothers in Guatemala make extensive use of water-based liquids in the first four months of life, a strongly entrenched cultural pattern.

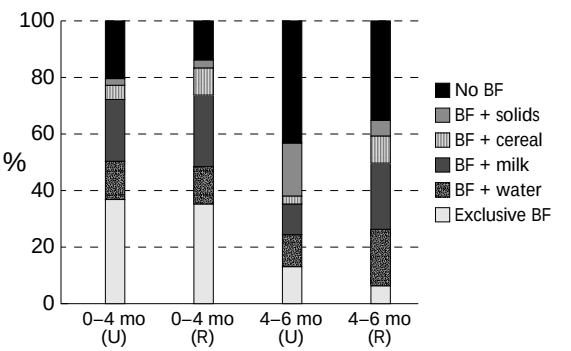

FIG. 7. Breastfeeding (BF) practices in urban (U) and rural (R) areas of Brazil in the first six months of life (DHS data 1996)

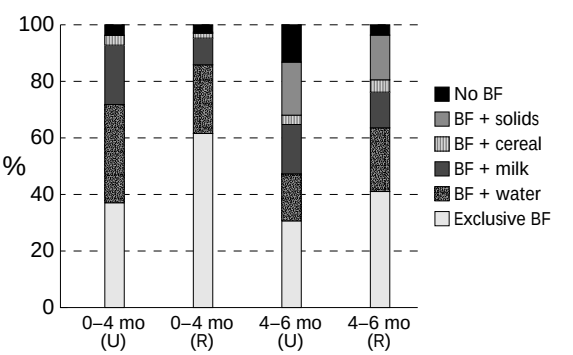

FIG. 8. Breastfeeding (BF) practices in urban (U) and rural (R) areas of Guatemala in the first six months of life (DHS data 1995)

Complementary feeding practices

Many recent DHS data sets contain useful information on complementary feeding practices [8]. Among the variables are whether the mother gave different liquids and solid foods on the previous day, and how many times in the previous week she gave the child food from various food groups. We are currently in the process of using some of these variables to create a child-feeding index to do comparative analyses by urban and rural areas for different regions of the world. However, here we focus only on a few of the key differences that are emerging between urban and rural areas of Latin America. Table 4 summarizes the main findings for children six months of age and older. The results show a clear pattern of more extensive use of powdered milk, infant formula, eggs, fish, poultry, and meat in urban than in rural areas. In Guatemala the differences are more than threefold for powdered milk and close to twofold for meat. Powdered milk is used more frequently than infant formula in all settings. When the data are analysed according to age group for three-month intervals, the differences in intake of animal foods between urban and rural areas are usually larger at younger ages (results not shown). For example, large differences are found among the 6- to 9-month and the 9- to 12-month groups, especially for the egg, fish, or poultry group and the meat.

Patterns similar to those shown in table 4 are found from examination of the number of times mothers gave their children food from these same categories during the preceding seven days. Consistently larger percentages of rural than urban mothers reported not having given their children any food from the meat group or from the egg, fish, or poultry group during the previous week. Again, these differences were more striking at younger ages. This is probably related to cultural beliefs that discourage the use of animal products in children's diets at young ages. The consistent pattern of lower intake of animal products by children in rural areas throughout the pre-school years, however, is likely to be a reflection of greater food insecurity and lower maternal education in rural areas, among other things.

Differences in growth (height-for-age Z scores; HAZ) between urban and rural areas were also examined with the use of the DHS data from these six countries, to characterize the pattern of growth differences between the two areas and the specific times at which these differences are found. Figure 9 presents data from Guatemala to illustrate the nature of the differences discussed. Interestingly, we find that in most countries, urban and rural infants have very similar growth curves up to six months of age. It is only at this age that differences in mean HAZ become noticeable, and these differences continue to intensify to reach a maximum gap at approximately 18 months of age. This pattern was surprisingly consistent across countries, and as expected, the largest urban–rural differences after six months of age were found in Guatemala and Peru, which have the highest prevalences of stunting overall. In Guatemala children were born with some degree of stunting: the mean HAZ at birth was close to −0.5 in both urban and rural areas. In Peru urban children were

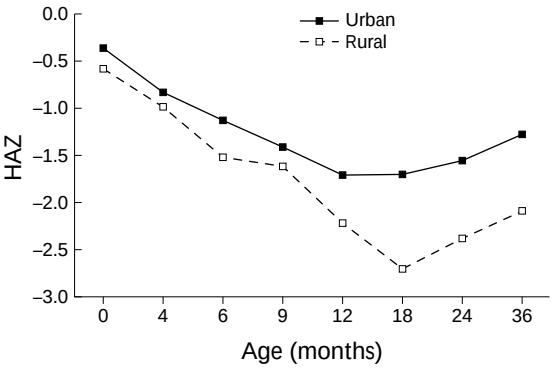

FIG. 9. Urban/rural differences in mean HAZ by age in Guatemala (DHS data 1995)

TABLE 4. Urban–rural differences in intake of animal foods in the past 24 hours by Latin American children aged six months and older[a]

	Powdered or canned milk		Formula		Fresh milk		Eggs, fish, or poultry		Meat	
Country/year	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Brazil/1996	8.3	11.9[b]	31.9	21.4	48.5	47.5	55.2	48.2[b]	59.1	48.9[b]
Colombia/1995	33.5	21.8[b]	11.7	3.4[b]	53.9	52.1	73.3	62.4	62.8	59.6[b]
Dominican Republic/1996	75.3	55.0[b]	4.5	1.5[b]	9.2	20.1[b]	NA[c]	NA	NA	NA
Guatemala/1995	46.7	14.8[b]	5.8	4.0[b]	14.7	11.9	64.6	53.0[b]	43.7	26.4[b]
Peru/1996	18.2	18.1	2.1	1.4[b]	14.2	21.2[b]	69.6	47.1[b]	31.2	29.6

a. DHS data 1991–96 [8].
b. Statistically significant ($p < .05$, t test).
c. No information available.

born with an average HAZ close to 0, whereas the rural children already had a deficit of approximately 0.4 score at birth.

The differences in dietary patterns, and specifically in dietary diversity described above, may explain, at least in part, the characteristic differences in growth patterns observed between urban and rural areas. It appears that the introduction of nutritious semi-solid and solid foods in the diets of rural children is constrained and that dietary diversity starts to be a problem in rural areas as early as six months of age. At 18 months of age, the cumulative effect of poor complementary feeding is evidenced by significantly poorer nutritional status among rural children.

Another main difference between urban and rural areas is the extensive use of baby bottles among urban populations. Again, for Peru and Guatemala, the differences are approximately twofold (an average of 50% in urban, compared with 25% in rural areas) (results not shown). The Dominican Republic has the highest rate of use of baby bottles: 89% in urban and 82% in rural areas. Brazil and Colombia are also high users of baby bottles: 61% and 64% in urban areas, respectively, and 52% and 54% in rural areas.

Summary

These findings highlight the fact that rural children in Latin America are still worse off in terms of growth and dietary diversity than their urban peers. Much work needs to be done to improve complementary feeding in both areas, but the low intake of animal products by rural children is a problem that calls for immediate attention. Improving breastfeeding patterns, such as exclusive breastfeeding, continued breastfeeding beyond four to six months of age and avoidance of baby bottles, however, are key concerns for urban areas. Although dietary diversity appears to be greater in urban areas, the limited data available in DHS surveys do not allow a complete analysis of other important dietary concerns of young children, such as nutrient density of foods and micronutrient adequacy [29]. Clearly, a lot of effort still needs to be invested in interventions to optimize breastfeeding and child-feeding practices in Latin America.

Programmatic implications for processed complementary foods

The characterization of the current situation in Latin America calls for optimism regarding the potential for processed complementary foods to respond to existing demand and to be successful, particularly in urban areas. Urban women already buy a variety of foods for their young children, and the need for convenience and time saving appears to strongly motivate their food choices. Because of the great availability of a variety of foods in the urban market, urban consumers (especially those of low income) also tend to be more price-sensitive than rural consumers and to switch between substitute foods more easily [28]. Hence, the cost of processed complementary foods will be a key determinant of acceptability that must be taken into account in the design and marketing of these products. Unfortunately, we do not have information on the proportion of total household expenditures that families currently allocate to feeding young children, either when they use the family diet or when they use special complementary foods. This type of information, disaggregated according to socio-economic group, would be of great value for planning interventions to promote the use of processed complementary foods.

The next question is: Besides low cost, what will it take for families to buy the products and to feed them to their children? As indicated above, urban mothers seem to be amenable to purchasing a variety of foods for their children, but convenience and ease of preparation are keys to acceptability. For the same price, ready-to-eat products (to which only water or another liquid needs to be added) are more likely to be successful than products that require boiling water and that take time to cook. In Guatemala City, for example, ready-to-eat imported cereals served with milk have become a popular breakfast food offered to young children and are largely replacing the traditional hot porridges and the hot, cooked, cereal-based *atole* drinks (personal observation). With ready-to-eat products, however, food safety becomes an issue. Fortified cereals that require adding cold water, for example, increase the risk of contamination if mothers use untreated water. Limited storage and refrigeration facilities are other factors that need to be taken into account when designing the products. The ability to prepare small, child-sized portions will also reduce the risk of contamination during storage and the chances that mothers will re-feed poorly stored food to children at later times.

Frequency of feeding is another constraint for busy urban working women. As reviewed by Brown [29], young infants need to be fed four or more times a day. The need to fulfil this recommendation further strengthens the case for processed complementary foods that are quickly and easily prepared.

Another set of key questions that arises when designing interventions for urban areas is: Who should be targeted, and how and where should they be targeted? In an urban environment where up to half of all mothers work outside the home for extended hours, and often for at least six days a week, it is not clear who is mainly responsible for child-feeding decisions and hence who should be targeted by the marketing and education campaigns. Should schoolgirls, grandmothers, or other groups of women be targeted? Should efforts be directed to institutional day-care centres?

Answers to these questions should be obtained through context-specific analyses before decisions about intervention design and targeting can be made. From the information reviewed above for Latin America, young girls, grandmothers, and other female relatives are the most popular caregivers, along with mothers themselves. Again, how can these women be targeted and where? Our experience in Guatemala City is that working urban women are extremely difficult to find at home, even on Sundays. For this reason, the workplace might be more suitable than the home for targeting interventions. Large factories, for instance, often host large numbers of mothers, as do the market areas. The usual vehicles for nutrition and health interventions—health centres and community centres—have restricted hours of operation and thus would not be appropriate for reaching working women. Churches in some areas should be considered, especially in communities where attendance is high. Schools are likely to be an excellent choice, and young girls should be targeted before they drop out of school. This would prepare them for their potential role as substitute caretakers and their future roles as mothers and grandmothers. Thailand recently conducted a successful school-based nutrition education campaign targeted to 10- to 13-year-old girls [30].

In summary, the potential for interventions using processed complementary foods in Latin America is great, particularly in urban areas where more than 75% of the population currently lives. The elements necessary for success and impact already exist. With effective marketing strategies and well-targeted education and behavioural change interventions, processed complementary foods in Latin America have the potential to have a significant impact on children's nutrition and health.

Annex

Changes in urban and rural prevalence of stunting and in the contribution of urban stunting to total stunting in six countries of Latin America[a]

			Urban			Rural			Total	
Country	DHS yr	Population yr[b]	No. children 0–59 mo	% stunted	No. stunted	No. children 0–59 mo	% stunted	No. stunted	No. stunted	% urban/ total stunted
Bolivia	1989	1990	519,334	32	163,590	498,594	45	224,367	387,957	42
	1994	1995	639,975	21	134,394	501,172	37	183,429	317,823	42
Brazil	1986	1985	11,586,947	21	2,468,019	6,071,889	35	2,137,305	4,605,324	54
	1996	1995	11,762,784	8	917,497	4,461,274	19	847,642	1,765,139	52
Colombia	1986	1985	2,691,600	19	519,479	1,545,049	28	429,524	949,003	55
	1995	1995	3,234,185	13	404,273	1,517,010	19	289,749	694,022	58
Dominican Republic	1986	1985	436,180	15	65,863	441,405	28	123,593	189,456	35
	1991	1990	485,790	15	70,925	462,782	26	121,712	192,637	37
	1996	1995	521,007	7	36,470	434,210	13	57,316	93,786	39
Guatemala	1987	1985	452,323	47	213,496	951,839	62	591,092	804,588	27
	1995	1995	560,993	35	198,030	1,131,924	56	633,877	831,907	24
Peru	1991/92	1990	1,785,903	26	462,549	1,198,977	49	592,194	1,054,743	44
	1996	1995	1,837,122	16	299,451	1,065,213	41	432,476	731,927	41

a. DHS data [8].
b. Estimates for numbers of children 0–59 months of age in urban and rural areas are from CELADE [4].

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Summary of discussion of article by Ruel

An important issue to consider is quality control at the level of the household, including the correct mixing and sanitary preparation of complementary foods, in conditions of poverty and severe household constraints. How will programme managers ensure that mothers and families with severe economic constraints properly prepare these foods? Mixing instructions often call for adding boiling water to complementary food and/or cooking the food for five minutes, which adds to the work and time requirements.

Urbanization has potentially negative impacts on diet and complementary feeding practices. In a semi-urban Mexican community, soft drinks are one of the top three sources of energy among 9- to 18-month-olds, whereas only four years ago they received traditional *atole*, bean broth, and tortillas. Excessive intake of certain foods should be discouraged in areas with access to the commercial market.

One study by the International Food Policy Research Institute showed that infant formula products are widely purchased even though they are expensive. Recent studies showed that the promotion of breastmilk substitutes in violation of the International Code of Marketing of Breast-Milk Substitutes continues, although in more subtle ways, and is of concern.

Although women in rural areas work, often this work has some flexibility that allows time for child care and feeding. In contrast, in urban areas women are often away from their children for 10 or more hours a day and do not have the same opportunities to interact with and feed their children.

Changing patterns of female education must also be considered. This generation of mothers has far more years of formal education than their mothers did. In Brazil the largest increases in exclusive breastfeeding were found in urban areas, and there are many opportunities for women in urban areas to respond to health messages in ways that improve child feeding and care.

Institutional care (day care and pre-schools) of infants and young children, though representing a small proportion of overall child care, can be expected to increase as more women seek employment in urban settings. In Ecuador and Guatemala, there are no provisions for special feeding of children under two years of age who are cared for in institutions. Day-care centres are popular programmes among some of the First Ladies in Latin America, and children receive food at these centres. Sometimes mothers who care for these children are given money to buy food. Menus are posted in the centres, but there are no special foods for children under two years of age. Processed complementary foods have a particularly important role in the diets of infants and young children who spend a good part of their time in institutionalized care.

Complementary feeding, the Code, and the Codex

David Clark and Roger Shrimpton

Abstract

The principal international instruments regulating the composition and marketing of processed complementary foods are the International Code of Marketing of Breast-Milk Substitutes, adopted by the World Health Assembly in 1981, subsequent relevant World Health Assembly Resolutions, and the Codex Alimentarius Standards for Canned Baby Foods and for Processed Cereal-Based Foods for Infants and Children. The Code and Resolutions emphasize the use of a variety of locally available foods in addition to breastmilk in ensuring a balanced diet for infants from around the age of six months. Complementary foods should not be marketed in ways that interfere with breastfeeding, and governments should support education for parents in the appropriate feeding of infants.

Introduction

We will examine the history and framework of the international regulations and standards within which complementary foods should be manufactured and marketed. This paper will examine the treatment of complementary feeding in:

» The Joint World Health Organization (WHO)/ UNICEF Meeting on Infant and Young Child Feeding [1]
» The International Code of Marketing of Breast-Milk Substitutes
» Subsequent relevant World Health Assembly Resolutions
» Codex Alimentarius Standards for Canned Baby Foods [2] and for Processed Cereal-Based Foods for Infants and Children [3]

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Joint WHO/UNICEF Meeting on Infant and Young Child Feeding, Geneva, October 1979

In 1979 the term "weaning foods" was still in vogue. This term is no longer used, since weaning implies a reduction in and eventual cessation of breastfeeding, whereas the foods with which we are concerned are intended to complement continued breastfeeding up to the age of two years or beyond.

Paragraph 8 of the Statement on Infant and Young Child Feeding [4] adopted at the meeting specifies that:

> The period of weaning from the breast is a critical stage which often results in malnutrition and disease if the child does not have a diet that is adequate in quantity and quality, hygienically prepared and culturally, socially and economically acceptable.

An entire section of the recommendations dealt with "promotion and support of appropriate and timely complementary feeding (weaning) practices with the use of local food resources"[4]. This section emphasized that:

> Foods that are locally available in the home can be made suitable for weaning, and their use should be strongly emphasized in health, education and agricultural extension programmes. Foods traditionally given to infants and young children in some populations are often deficient in nutritional value and hygiene, and need to be improved in various ways. Mothers need guidance to improve these traditional foods through combinations with other foods available to them locally. Countries should determine the need for subsidizing weaning foods or otherwise helping to ensure their availability to low-income groups.

There was also an emphasis on the need for government support for educating mothers in the proper feeding of children, and it was recognized that:

> All food aid programmes in this area should take cognizance of the local food content and habits, and not create a situation of dependency and should be careful not to compete with breastfeeding and local food production [4].

There was emphasis during the meeting on the need for the regulation of the marketing and distribution of both breastmilk substitutes and complementary foods. It was stated, for example, that products unsuitable for use alone as complementary foods, such as sweetened condensed milk, cornstarch, cassava flour, and cereal flours, should not be packaged, labelled, advertised, or otherwise promoted in ways that suggest they should be used as a complement or substitute for breastmilk. In addition, there was a warning against the advertising of complementary foods in ways that undermine breastfeeding. However, the negotiations around the drafting of the International Code focused on breastmilk substitutes, feeding bottles, and teats, and dealt only to a very limited extent with the regulation of the marketing of complementary foods.

International Code of Marketing of Breast-Milk Substitutes (1981)

The preamble to the International Code of Marketing of Breast-Milk Substitutes (1981) [5] emphasizes the importance of local foods in complementary feeding practices:

> Convinced that it is important for infants to receive appropriate complementary foods…and that every effort should be made to use locally available foods; and convinced, nevertheless, that such complementary foods should not be used as breast-milk substitutes….

The responsibility of governments, through their educational systems and other social services, to promote the appropriate use of complementary foods is also stressed. So how is the marketing of complementary foods dealt with in the provisions of the Code? In terms of Article 2:

> The Code applies to the marketing, and practices related thereto, of the following products: breast-milk substitutes, including infant formula; other milk products, foods and beverages, including bottle-fed complementary foods, when marketed or otherwise represented to be suitable, with or without modification, for use as a partial or total replacement of breast-milk; feeding bottles and teats.
>
> The Code defines complementary food as any food, whether manufactured or locally prepared, suitable as a complement to breast-milk or to infant formula, when either becomes insufficient to satisfy the nutritional requirements of the infant.

So the Code does apply to "foods" when they are represented as suitable as a replacement for breastmilk. How does this work in practice? If infants should be exclusively breastfed for about six months, any other food or drink given to a child during this period will actually replace breastmilk and should be viewed as a breastmilk substitute. Water, fruit juices, teas, biscuits, soft foods, and cereals advertised or promoted for use before the age of about six months are hence covered by the Code, and any such advertising or promotion is a violation of the Code.

Many of the violations found in the independent monitoring project carried out by the Interagency Group on Breastfeeding Monitoring, published as "Cracking the Code" in January 1997 [6], involved the inappropriate marketing of complementary foods. Indeed, there has been increasing concern among breastfeeding advocates that as greater efforts are made to restrict the advertising of infant formula, more efforts will be spent on the promotion of complementary foods as a means of getting the company name to the mother as early as possible, building her confidence in the brand name. Why else do so many companies provide newly delivered mothers with free samples of products that will not be necessary until several months later? In areas of high illiteracy, where many mothers will be unable to read the recommended age of introduction on the sample, does not the provision of the sample itself represent the product as suitable for feeding a newborn, and hence as a breastmilk substitute?

Another area of concern is the promotion of commercially produced complementary foods as the only way to feed infants. A recent study in Pakistan revealed promotional materials in a health service that detail the necessary components in a child's diet and then state:

> It is impossible to achieve this balance with traditional foods. Start giving your baby the rich food [brand name] from today [7].

This obviously goes against recommendations of the World Health Assembly, which has consistently stressed the importance of local foods. In the report to the Forty-First World Health Assembly (1988)[8], it is stated in relation to complementary foods that:

> 96. Industrially prepared food products, which were suitable as part of a mixed diet to complement breastmilk in order to satisfy the nutritional requirements of the infant, might be a convenience under certain circumstances. They provide an option for some mothers who had both the means to buy them and the knowledge and facilities to prepare and feed them safely to their children. However, it was clear that a balanced diet for the vast majority of the world's infants from around the age of six months could and should be effectively and economically ensured by using a variety of locally available foods in addition to breastmilk.

Subsequent relevant World Health Assembly Resolutions

Every second year, the World Health Assembly revisits issues of infant and young child feeding and, when considered necessary, adopts a Resolution to clarify or augment the provisions of the International Code. Since

the Code itself was adopted by a Resolution, these subsequent Resolutions have the same status as the Code.

> Resolution WHA 37.30 of 1984 [9] urges continued action by Member States, WHO, non-governmental organizations and all interested parties to put into effect measures to improve infant and young child feeding, with particular emphasis on the use of foods of local origin.

Having noted that many products unsuitable for infant feeding were being promoted for that purpose in many parts of the world, and that some infant foods were being promoted for use at too early an age, with potentially detrimental effects on the health of infants and young children, the Assembly requested that Member States examine the problem of the promotion and use of unsuitable foods and ways of promoting the appropriate use of infant foods.

In 1986, with Resolution WHA 39.28 [10], the Assembly stressed that any food or drink given before complementary feeding is nutritionally required can interfere with the initiation and maintenance of breastfeeding and therefore should not be promoted or encouraged for use by infants during this period.

The Assembly also noted that:

> The practice being introduced in some countries of providing infants with specially formulated milks (so-called "follow-up milks") is not necessary.

Reference has been made to the report presented to the Assembly in 1988, and the Resolution adopted that year emphasized the need to develop recommendations regarding diet, including timely complementary feeding and appropriate weaning practices, which are appropriate to national circumstances.

Resolution WHA 45.34 of 1992 [11] reaffirmed that from the age of about six months infants should begin to receive a variety of locally available and safely prepared foods rich in energy, in addition to breastmilk, to meet their changing nutritional requirements. In 1994 Resolution WHA 47.5 [12] again emphasized continued breastfeeding and frequent feeding with safe and adequate amounts of local foods.

The most recent Resolution to deal with this issue was WHA49.15 of 1996 [13], which urges Member States "to ensure that complementary foods are not marketed for or used in ways that undermine exclusive and sustained breast-feeding."

Again the World Health Assembly reinforced the idea that no food or drink products should be advertised for use by infants during the period of exclusive breastfeeding. But how does one prevent products being marketed in ways that interfere with sustained breastfeeding? One approach is to prohibit or regulate, through national legislation, the marketing of all infant drinks and foods up to the age of two years. This is the approach adopted recently by the Government of Pakistan in draft legislation to implement the Code. In Guatemala the Rules for the Marketing of Breastmilk Substitutes of 1987 [14] also regulate the promotion of complementary foods, whereas in Brazil the Regulation for Marketing of Infant Foods, Resolution CNS No. 31, 1992 [15], provides that the promotion of "supplementary foods" must include a warning that the product should not be used to feed infants during the first six months of life, except under the guidance of a doctor or nutritionist.

Codex standards for foods for special dietary uses (including foods for infants and children)

The Codex Alimentarius Commission is the body responsible for carrying out the Joint Food and Agriculture Organization/World Health Organization (FAO/WHO) Food Standards Programme. Established in 1962 by FAO and WHO, the programme is intended to protect the health of consumers and facilitate international trade in foods. However, given the fact that few developing nations have been able to afford to be represented at the frequent Committee meetings, and the high level of industry representation on the delegations of industrialized countries, the work of the Commission has come under criticism. It is felt that by influencing the Codex Standards, there has been an attempt to dilute the scope and application of the International Code, despite the fact that the World Health Assembly in 1981 [16] requested the FAO/WHO Codex Alimentarius Commission to consider what action it might take to support the implementation of the International Code.

A good example of how the Code can be undermined is the case of follow-on formula. This is a product that some see as having been developed to get around the provisions of the Code. Manufacturers often argue that the Code applies only to infant formula. Infant formula, by definition, is a breastmilk substitute formulated to satisfy the normal nutritional requirements of infants up to four to six months of age. Hence, it is argued, a formula for infants over the age of six months is not an infant formula and is not subject to the prohibition on advertising imposed by the Code. However, it is still a breastmilk substitute, since infants should ideally be breastfed up to two years or beyond. Any milk product given in that period will replace or substitute for breastmilk, and thus still falls within the scope of the Code. Despite this reasoning, the Codex Standard for Follow-up Formula contains the "Additional Requirement" that "the products covered by this standard are not breastmilk substitutes and shall not be presented as such," providing industry with an opportunity to point to an international standard that would appear to justify their continued advertising of follow-on formula.

There are two standards dealing with complementary foods: the Codex Standard for Canned Baby Foods

and the Codex Standard for Processed Cereal-Based Foods for Infants and Children. The Codex Standard for Canned Baby Foods was adopted in 1976 and amended in 1985, 1987, and 1989. Much of the standard is concerned with the essential composition and quality factors, including consistency and particle size, purity requirements, additives, hygiene, and labelling. Under the heading "Information for Utilization" it is stated that:

> For canned beets (beetroot) and spinach, the following statement shall appear on the label "use after the age of 12 weeks."

This statement is worrying for two reasons: first, 12 weeks is too early to introduce canned beets and spinach to infants. But more importantly, this provision implies that for other canned food products there is no minimum age limit. This goes against many of the recommendations of the World Health Assembly that have been described above.

The standard then states that:

> The products covered by this Standard are not breastmilk substitutes and shall not be presented as such.

However, we have seen that the categorization of a product as a breastmilk substitute depends upon the way it is marketed or used, and not upon the nature of the product. Hence canned spinach advertised for infants at 12 weeks, when they should ideally be exclusively breastfed, may lead to the replacement of breastmilk with spinach, which thus becomes a breastmilk substitute.

The Codex Standard for Processed Cereal-Based Foods for Infants and Children, adopted in 1976 and amended in 1985, 1987, and 1991, is currently undergoing further revision. The current standard simply defines processed cereal-based foods for infants and children as being "intended to supplement the diet of infants and children." Again, the standard deals mainly with the essential composition and quality factors, permissible food additives, contaminants, hygiene, packaging, and labelling.

The proposed revised standard will make reference to the appropriate age of introduction of complementary foods, and at the last meeting, held in Berlin in September 1998, there were extensive discussions on this very issue. Despite the very clear recommendation of the World Health Assembly in Resolution 47.5 (1994) that complementary foods should be introduced at the age of "about six months," the draft standard placed before the Committee indicated that such products should be intended for feeding infants as a complement to breastmilk or infant formula from the age of four to six months. There was strong resistance to this from the delegations of Bolivia, Egypt, Hungary, Norway, Korea, India, Brazil, Venezuela, and Uruguay, and despite a call from the Delegation of France, the Observer from the European Union, and other Delegations from industrialized countries, to retain the "four to six month" language, the matter was left undecided until the next meeting of the Committee. UNICEF hopes that the Committee will follow the recommendations of the World Health Assembly on this issue and encourage the use of cereal-based complementary foods from the age of about six months.

The content of the labelling of cereal-based foods and the statement as to whether these products are or are not breastmilk substitutes were also left undecided pending the resolution of the age of introduction.

Conclusions

After a brief examination of the main relevant international provisions, recommendations, and standards relating to complementary feeding, the following conclusions can be distilled:

- International regulations emphasize the use of a variety of locally available foods in addition to breastmilk in ensuring a balanced diet for infants from around the age of six months.
- There is a need for those proposing to promote the consumption of processed complementary foods to be aware of the provisions of the International Code of Marketing of Breast-Milk Substitutes and subsequent World Health Assembly Resolutions, and to ensure that their products are not marketed in ways that interfere with exclusive or sustained breastfeeding.
- There is need for government support for educating parents in the proper feeding of children in accordance with Article 24 of the Convention of the Rights of the Child [17].
- Care should be taken to avoid confusion between education, which is the responsibility of the government, and the commercial promotion of infant foods.

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Summary of discussion of article by Clark and Shrimpton

The Code of Marketing of Breast-Milk Substitutes is all the more important in the context of HIV and breastfeeding, so that breastfeeding continues to be promoted among women who are HIV-negative or of unknown status. The Code also protects artificially fed infants in terms of preparation instructions, labelling, etc. Therefore, there should be increased surveillance of the Code in light of HIV.

The Codex Standards are based on the consensus of scientific evidence and are recognized by the World Trade Organization. They are updated as new scientific information becomes available. The Code of Marketing of Breast-Milk Substitutes has not come before the World Trade Organization for recognition.

The Code does not address the issue of nutrient supplements versus nutrient substitutes. There is no recommendation for vitamin E in the Codex.

The Codex as well as the infant-feeding guidelines and recommendations issued by WHO and UNICEF tend to stress the use of local or locally produced complementary foods. However, a processed complementary food produced or purchased at the national level for use in the targeted age range could be conceived of as "local." It can be promoted as a complementary food as long as it is not promoted for children at ages when exclusive breastfeeding is recommended or promoted as a breastmilk substitute for children up to two years of age, when breastfeeding should be sustained. The World Food Programme (WFP) updates its foods on the basis of recommendations from competent agencies. WFP follows international standards issued by WHO, FAO, and other UN agencies.

Development, production, and quality control of nutritional supplements for a national supplementation programme in Mexico

Jorge L. Rosado, Juan Rivera, Gladys Lopez, and Lourdes Solano

Abstract

The objective of this study was to develop supplements for nutritional support of children less than two years old and for pregnant and lactating women under a multidisciplinary Programme of Education, Health, and Nutrition (PROGRESA) that the Mexican Government is implementing for populations in extreme poverty. Nutrient composition, physicochemical properties, and feasibility of production and utilization were considered in designing the supplements. The nutrient composition took into account the dietary patterns and nutritional status of the target populations. The ingredients and processing methods were selected considering local availability and production at a relatively low cost while maintaining a supplement of a high quality that would be widely accepted by the target population. The final products were initially evaluated for acceptability by 40 children, 52 pregnant women, and 62 lactating women. Nine products were developed: six for children and three for women. The children's products were three powders that were used to prepare a beverage with chocolate, vanilla, and banana flavours and three powders that were used to prepare a more viscous solution in the form of pap with the same three flavours. After the acceptance test, the use of the pap supplements was recommended for children four months to two years of age. The supplements for women were also powders used to prepare a beverage with vanilla or banana flavour or with no flavour. The products were widely accepted in sensory evaluation tests. For the children's products, the average scores were 4.11 to 4.29 for the beverage and 3.98 to 4.15 for the viscous mixture (range, 1 to 5). The women's products received average scores of 4.75 to 5.70 from pregnant women and 4.80 to 5.40 from lactating women (range, 1 to 7). Evaluation in the community demonstrated that the supplements were widely acceptable and well consumed. Today more than three million rations of supplements are consumed every day, and an evaluation of their potential benefits is being carried out.

Introduction

In 1997 the Mexican Government initiated a Programme of Education, Health, and Nutrition (Programa de Educación Salud y Alimentación; PROGRESA) to improve the living conditions of families in extreme poverty. PROGRESA is a multidisciplinary programme covering three areas that are closely related. In the area of education, PROGRESA provides scholarships for every child under 18 years old attending school between the third year of primary school and the third year of secondary school. The programme is also directed to improving educational services and stimulating the involvement of parents in education. In the area of health services, PROGRESA offers a strategic plan that includes actions to improve maternal and child health, prevent and quickly attend to infectious diseases, and improve health education. In the area of food availability and nutrition, the programme provides cash to families to make food more available to them and offers a nutrient-supplementation plan for children under two years age and for pregnant and lactating women. About four million families meet the programme's criteria for extreme poverty. A detailed description of the beneficiaries, the programme, and its evaluation has been published [1].

An important instrument of the nutritional component of PROGRESA is the availability of nutritional supplements that can improve the nutritional status of the target population. Several factors should be considered in the development of an adequate nutritional supple-

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ment [2, 3]. First, to ensure the nutritional quality and composition of the supplement, the product should include all of the nutrients that are adequate for the target population in forms that are readily available. Second, the supplement should be well tolerated and accepted by the target population in terms of its flavour and appearance. Previous food supplementation programmes in Mexico failed because the supplements were not attractive to the targeted populations [4, 5]. Third, the supplement should be easy to use, be stable, and have a shelf-life long enough to allow for adequate distribution and utilization. Finally, the supplement should be produced at low cost. The production process should be as simple as possible so that it can be produced locally.

The purpose of this study was to develop methods of production and quality control for nutritional supplements used in the PROGRESA Programme.

Methods

Characteristics and nutritional composition of supplements

The supplements were formulated to have the following characteristics: they should be a good source of those nutrients known to be deficient in the Mexican population; the ingredients needed for production should be available in the country in sufficient quantities and at a relatively low cost; the processing costs should be low enough to allow the supplements to be produced locally; the flavour and appearance of the supplements should be highly acceptable to the target population; the final form of the supplements should allow their appropriate distribution and consumption; and the packaging should allow good use and conservation of products.

The nutrient composition of supplements was defined after careful revision of available data on the existence of nutritional deficiencies in different regions of the country [5–8]. The supplements should contribute to the intake of high-quality protein, energy, and the vitamins and minerals that are known to be deficient in Mexico. Table 1 shows the nutrient composition of the supplements and the content of nutrients for each daily ration. The supplements were developed for children aged four months to two years and for pregnant and lactating women.

Processing and production of supplements

The supplements consisted of instant dry whole milk, hydrolysed cornstarch with a dextrose equivalent of 20, sugar, flavours, and a pre-mix of vitamins and minerals defined according to the nutrient composition given in table 1. The supplement for children could be prepared as a low-density beverage or as a pap of higher viscosity. The pap and the beverage were evaluated for acceptability and preference to determine the better alternative. The supplements for children came in chocolate, vanilla, and banana flavours, and those for pregnant and lactating women came in vanilla, banana, and natural (no flavour added) flavours. The supplements were processed by dry mixing the ingredients (fig. 1). The samples were packaged in laminated envelopes that allowed for an adequate shelf-life. A detailed description of the processing and packaging of the products has been published elsewhere [3].

Sensory evaluation and acceptability of supplements

In order to have supplements that were widely accepted, a series of sensory evaluations was carried out in 40 children six months to two years of age from a nursery

TABLE 1. Nutritional composition of supplements

	Children's supplements		Women's supplements	
Nutrient	g/100 g	g/ration (44 g)	g/100 g	g/ration (52 g)
Protein (g)	13.3	5.8	23	12
Energy (kcal)	440	1,941	480	250
Iron (mg	23	10	28.8	15
Zinc (mg)	23	10	28.8	15
Vitamin A (μg)	920	400	—	—
Vitamin E (mg)	13.8	6	19.2	10
Vitamin C (mg)	92	40	134.4	70
Vitamin B_2 (mg)	1.8	0.8	2.9	1.5
Vitamin B_{12} (mg)	16.1	0.7	5.0	2.6
Folic acid (μg)	115	50	192	100
Iodine (μg)	—	—	192	100

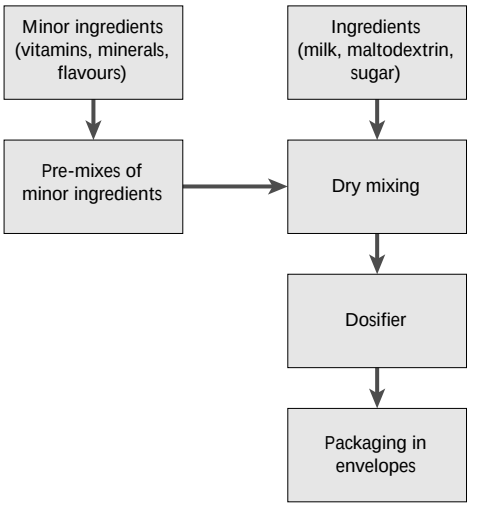

FIG. 1. Diagram of processing of nutritional supplements for the PROGRESA Programme

school and in 53 pregnant and 62 lactating women from the Manuel Gea Gonzalez Hospital. The response of each child or woman was measured by a hedonic test with a score range of 1 to 5 for children and 1 to 7 for women [9, 10]. Trained personnel observed the children and completed questionnaires to obtain a score based on the child's behaviour after consuming the supplement [7]. Once a final flavour profile had been defined, the acceptability of the supplements was compared with that of commercial products known to be widely consumed in Mexico (Quick, Compañia Nestle S.A. de C.V.). The acceptability of the pap was not compared with that of a commercial brand because this type of product is not available in the Mexican market. The acceptance scores were compared by analysis of variance, and differences among groups were compared by the method of least significant difference [11].

Results

Definition of formula and utilization of product

Tables 2 and 3 give the final formulas of the children's and the women's products, respectively. Figure 1 shows the methods of processing. The supplements are powders that are mixed with water before they are consumed (44 g of powder with 150 ml of water for children's beverages, 44 g of powder with 25 ml of water for children's paps, and 52 g of powder with 150 ml of water for women's beverages). All products should be consumed shortly after preparation. The powders are soluble in water, so that mixing is easy and the resultant solution is homogeneous and stable.

Sensory evaluation

Table 4 shows the sensory evaluation scores for the children's supplements. There were no significant differences among flavours in the level of acceptance. The score was lower for the commercial vanilla-flavoured drink than for the PROGRESA vanilla-flavoured supplement. There were no differences between the scores for the chocolate-flavoured commercial drink and the PROGRESA supplements. The score was highest for the chocolate-flavoured pap and significantly lower for the banana-flavoured pap.

Table 4 also shows the sensory evaluation scores for the women's supplements. Pregnant women preferred banana to other flavours, and lactating women had no flavour preferences. PROGRESA supplements were significantly preferred to commercial products.

Suggested quality assurance in production of supplements

Inasmuch as the processing of the products is relatively simple, the focus for the system of quality control is to ensure consistency in formulation with respect to the nutritional characteristics.

TABLE 2. Formulas of children's supplements

Ingredient (g/100 g)	Beverage			Pap		
	Chocolate	Vanilla	Banana	Chocolate	Vanilla	Banana
Powdered whole milk	54.93	54.93	54.93	54.93	54.93	54.93
Sugar	7.95	7.95	7.95	5.68	4.55	4.55
Hydrolysed cornstarch	34.30	35.23	36.70	37.25	39.75	40.17
Vitamins and minerals	0.32	0.32	0.32	0.32	0.32	0.32
Flavour						
Chocolate	2.5	—	—	1.82	—	—
Vanilla	—	1.57	—	—	0.45	—
Banana	—	—	0.10	—	—	0.34

TABLE 3. Formulas of women's supplements

Ingredient (g/100 g)	Natural	Vanilla	Banana
Powdered whole milk	80.00	80.00	80.00
Sugar	9.61	9.61	9.61
Hydrolysed cornstarch	10.01	8.68	9.89
Vitamins and minerals	0.38	0.38	0.38
Flavour			
Vanilla	—	1.33	—
Banana	—	—	0.12

All ingredients must be carefully analysed before they are mixed. Analysis should include nutrient composition, stability, microbiological content, and physicochemical characteristics. The dry milk must be in a soluble form. The vitamin and mineral pre-mixes must be analysed for nutrient content. The hydrolysed cornstarch should be 20 dextrose equivalents to avoid unnecessary increments in osmolarity while at the same time allowing for good solubility. Each batch of flavours should be compared with standards to avoid a change in flavour profile. The dry ingredients can be mixed in a standard mixer after its efficiency has been tested for producing a homogeneous product; this is especially important for mixing the vitamins and minerals. It is critical to obtain a homogeneous product, and in order to assure mixing efficiency, analysis of some of the micronutrients could be used as markers. The final product should also be subjected to analyses for nutrient composition, microbiology, solubility, and sensory evaluation. The production and quality control of the supplements should be a straightforward operation in well-equipped laboratories and food plants.

Discussion and conclusions

Formulas were developed for use as nutritional supplements for Mexican children ranging between four months and two years of age and for pregnant and lactating women. The programme for which these supplements were developed is directed towards populations in extreme poverty living in different regions of the country. Several studies have identified marginal deficiencies of several nutrients in these populations, especially of some vitamins and minerals [7, 8]. Thus, the products were designed to contain those nutrients that are considered to be beneficial for these groups. The quantity and source of nutrients were based on the optimum for the different groups of beneficiaries in consideration of their habitual diets, regional variation in nutrient deficiencies, and the bioavailability of the different sources of nutrients. Given the large scope of the food component of PROGRESA, it was important to select the ingredients while taking into account their availability and cost in Mexico.

TABLE 4. Level of acceptance in sensory evaluation of supplements by children and by pregnant and lactating women.

Supplement	Acceptance (mean ± SD)
Children's beverage	
Vanilla	$4.26 \pm 0.88^{a,b}$
Banana	$4.11 \pm 0.99^{a,b}$
Chocolate	$4.29 \pm 0.85^{a,b}$
Commercial vanilla	3.94 ± 1.19^{a}
Commercial chocolate	4.38 ± 0.83^{b}
Children´s pap	
Vanilla	$3.98 \pm 1.01^{a,b}$
Banana	3.67 ± 1.20^{a}
Chocolate	4.15 ± 0.96^{b}
Women´s beverage evaluated by pregnant women	
Vanilla	4.75 ± 2.12^{a}
Banana	5.70 ± 1.50^{b}
Natural flavour	4.75 ± 2.00^{a}
Commercial vanilla	3.13 ± 2.19^{c}
Women´s beverage evaluated by lactating women	
Vanilla	5.29 ± 1.93^{a}
Banana	5.48 ± 2.04^{a}
Natural flavour	4.84 ± 2.11^{a}
Commercial vanilla	3.45 ± 2.86^{b}

Means with different letters within same product are significantly different ($p < .05$).

Milk was selected as a major ingredient for the products after other sources, including cereals, soya, and amaranth, had been carefully evaluated. In light of the high incidence of lactase deficiency in Mexico, a potential limitation on the use of milk in the supplement is its high lactose content. Recent studies have evaluated the prevalence of lactase deficiency and lactose intolerance in Mexico [12–14]. Those studies included populations with different habitual intakes of milk and population groups from young children to the elderly from rural and urban regions of the country. After careful review of all the studies, it was concluded that lactase deficiency and lactose intolerance in Mexico do not constitute a limitation for using milk in food supplementation programmes or any other form of social assistance [15, 16].

The functional and physicochemical characteristics of the supplement that allow for its appropriate transportation, storage, distribution, and utilization are also important for its feasibility. The products developed are easy and inexpensive to transport, the ingredients and packaging chosen allow for a shelf-life of at least one year, and the production process for the supplements was chosen to be as simple and cheap as possible. The simple production process allows the supple-

ments to be produced in different regions of the country, therefore facilitating their distribution.

There are several aspects central to the programme's success. The supplements should be consumed in the recommended quantities; they should be consumed for the period of time that could be expected to make a nutritional impact on the target population; and the flavour, appearance, and texture should be acceptable to the target groups. The latter was emphasized during the development of the supplements. The new product's level of acceptability was excellent when compared with that of highly acceptable commercial products. Of course this was a short-term evaluation. The long-term acceptance and efficacy of the supplements and the supplementation programme need to be evaluated. More than three million rations of these supplements are consumed every day, and an evaluation of their potential benefits is being carried out.

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Implementation, monitoring, and evaluation of the nutrition component of the Mexican Social Programme (PROGRESA)

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Abstract

Mexico has implemented a number of food and nutrition programmes and policies since 1950. However, these initiatives have been largely ineffective. A new social programme targeted to poor families has been implemented. It now covers almost 2 million families and is expected eventually to cover 4.2 million families. The programme facilitates access of beneficiaries to health and education services, and includes monetary transfers and a nutrition component targeted to the critical development period between gestation and the age of two years. Pregnant and lactating women and children under two years of age receive food supplements fortified with key micronutrients. After decades of food and nutrition interventions that were not carefully evaluated, the programme performance and its nutritional impact will be evaluated. A baseline survey was conducted in 1998 on a random sample of communities selected as beneficiaries of the programme and on a sample of similar communities that will participate in the programme after the end of the evaluation. Additional surveys will be conducted in 1999 and 2000. Each survey will include a cross-sectional evaluation of children and women and a cohort of children zero to 12 months of age at baseline who will be followed. Preliminary results from the baseline survey of beneficiaries are presented and discussed.

Introduction

A number of food and nutrition programmes and policies have been implemented in Mexico, including economic and food policies at the macro level, social-sector support programmes for human development, and food distribution programmes. Between 1950 and 1980 a mixture of wide-ranging initiatives was implemented, including regulation of food prices, provision of subsidized basic foods through government-owned retail stores, general subsidies on staple foods, school lunch programmes, and the distribution of food baskets to poor families. Since 1990 food and nutrition policies and programmes have been reviewed in terms of their cost-effectiveness. The review concluded that food and nutrition programmes have been ineffective, largely because the services have not been targeted to those in need. A substantial proportion of the subsidies went to groups that were not vulnerable in socio-economic or biological terms. This low effectiveness was in part the motivation behind the Programme for Education, Health, and Food (Programa de Educación, Salud y Alimentación; PROGRESA), which the administration of President Zedillo implemented as its main social programme. There are three main components, as the title of the programme indicates: education, health, and food. PROGRESA also includes several activities aimed at improving the nutritional status of children under five years of age and of pregnant and lactating women.

Description of PROGRESA

PROGRESA was designed as a programme that emphasizes adequate targeting of its beneficiaries. The goal of the programme is to reach the estimated 4.2 million families (about 25 million people) who, according to government estimates, are below the extreme poverty line. The ultimate objective of the programme is to improve human capital among poor families through investments in education, health, and nutrition.

The first stages of the programme, which started in May 1997, were directed at rural areas, and coverage has gradually increased. The beneficiaries up to March 1999 were over 1.9 million families living in 1,750 *municipios* (counties) in about 41,000 communities.

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These families were selected through a two-stage process. First, the rural communities with the poorest infrastructure, least education, and fewest economic opportunities were selected. Two other conditions were required for the communities to be included in the programme: a population between 50 and 4,999 and access to health and education services. These two conditions are likely to exclude very poor people from the programme, but were deemed necessary. The lower population limit was set because the cost of delivering services to communities of fewer than 50 people is prohibitive, and access to health and education services is required, given the nature of the programme, which offers its services through the health and education sectors.

The identification of communities was followed by the selection of individual families within those communities. On the basis of surveys in which the socioeconomic condition of the families was evaluated, those classified as living in extreme poverty were chosen as beneficiaries of the programme. In order to receive benefits, selected families must comply with health-care visits and attend health education sessions, and the children must attend school regularly.

The programme includes the following benefits for participating families:

A monetary transfer for food purchases to all families. Every family receives a fixed monetary transfer regardless of the number of family members and their ages. The purpose of the transfer is to improve the family diet, and it is intended for food purchases. The amount of the transfer in March 1999 was 115 pesos per month (US$11.50). The amount is adjusted for inflation every six months.

Grants to families whose children attend school. One of the principal obstacles to human capital formation is dropping out of children from primary and secondary school, which often results from the need of parents to increase household income. The cost of education and the opportunity cost of having a child who can generate income at school are factors that stimulate dropping out of school. The objective of this component is to provide incentives to families to keep their children in primary and secondary school.

The participating families receive a grant for each child attending school between the third grade of primary school and the third grade of secondary school. The amount of the grant varies as a function of the grade for primary schoolchildren and as a function of the grade and the child's sex for secondary schoolchildren (table 1). Because girls drop out from secondary school at a higher rate than boys, the amounts granted to girls are larger. The additional amount granted to girls is a function of the difference between boys and girls in the opportunity cost of remaining in school. In addition to these benefits, families receive small amounts of money to cover the cost of school supplies. The educational grants are also adjusted for inflation every six months. Benefits are not provided if children do not attend school regularly.

TABLE 1. Education grants to beneficiaries of PROGRESA whose children attend school

School/grade	Monthly grant (Mexican pesos)[a]	
Primary		
3	75	
4	90	
5	115	
6	150	
Secondary	Boys	Girls
1	220	235
2	235	260
3	245	285

a. 1 peso = US$0.10.

The amount of the combined food and education grants is substantial relative to the incomes of the families, averaging 268 pesos per month (about US$27), about 30% of monthly income.

Health care for all family members. All members of participating families have access to free health care at government health clinics. A primary health-care package, including basic preventive and curative services, is offered at health clinics serving PROGRESA communities. The infrastructure and equipment of clinics in these communities have been improved substantially through PROGRESA. In addition, personnel attending programme clinics receive special training and supervision. Moreover, physicians attending programme clinics are paid at substantially higher rates than physicians attending clinics in communities not included in PROGRESA.

Participating mothers or child-care providers must also attend health education sessions. At these sessions 25 topics are presented, including nutrition, hygiene, infectious diseases, immunization, chronic diseases, and other topics. Physicians and nurses who are trained in the specific topics conduct these sessions.

Nutrition component of PROGRESA

In addition to the above benefits, food supplements are provided to all children under two years of age, regardless of nutritional status, to all pregnant and lactating women, and to children between two and four years of age with moderate to severe underweight (weight-for-age < -1 Z score of CDC/NCHS/WHO reference population [1]). The supplements were specifically formulated by an advisory committee brought

together by the Secretary of Health that included nutritionists, food scientists, and public health specialists. A detailed description of the products and the process of their development is presented elsewhere [2, 3]

Supplements for children and women contain the following ingredients: whole dry milk, sugar, maltodextrin, vitamins, minerals, and artificial flavours and colours. The supplements are distributed in 240-g packages and are ready to eat after they are hydrated. Once hydrated, the supplement for children has the appearance of a pap or puree (a thick liquid suspension). The product is called *papilla* (Spanish for pap) and is produced in banana, vanilla, and chocolate flavours. A daily ration consists of 44 g of the dry product (69 g after hydration) and supplies 194 kcal of energy, 5.8 g of protein, and approximately the recommended daily allowance (RDA) of vitamins A, E, C, B_{12}, and folic acid, as well as of iron and zinc. The energy and nutrient composition of one ration of pap is presented in table 2.

The supplement for pregnant and lactating women is intended to be hydrated and consumed as a beverage. The beverage, *suplemento alimenticio* (food supplement), is available as banana flavour, vanilla flavour, and natural (without flavour). A daily ration is 52 g of the dry product (202 g of the beverage) and contains 250 kcal of energy, 12–15 g of protein, and vitamins E, C, B_{12}, and folic acid, as well as of iron, zinc, and iodine. The energy and nutrient composition of one ration of the beverage for women is presented in table 2.

The supplements are distributed through the health clinics every month. Each family receives a one-month supply of supplements for each participating member. Four of the 25 topics covered in the education programme are designed to encourage supplement consumption and adequate feeding practices: the PROGRESA supplements, diet and health, nutrition during pregnancy and lactation, and breastfeeding.

The topic dealing with the PROGRESA supplements provides motivational messages that encourage adequate child feeding and the administration of the supplements to the intended beneficiaries and provides practical information about the preparation, administration, and storage of the supplements.

TABLE 2. Energy and nutrient content of one ration of the PROGRESA supplements[a]

Content	Children's pap	Women's beverage
Protein (g)	5.8	12–15
Energy (kcal)	194	250
Iron (mg)	10	15
Zinc (mg)	10	15
Vitamin A (μg)	400	—
Vitamin E (mg)	6	10
Vitamin C (mg)	40	70
Vitamin B_{12} (μg)	0.7	2.6
Folic acid (μg)	50	100
Iodine (μg)	—	100

a. One ration (dry weight) consists of 44 g of children's pap or 52 g of women's beverage.

Community study of acceptability and intake

As part of the development of the supplements, spot taste tests were conducted [3]. In addition, the acceptability and consumption of both supplements over two weeks were studied in a semi-rural community in the State of Morelos. The pap was evaluated in a group of 108 children: 81 children under two years of age (58 breastfed and 23 weaned) and 27 moderately underweight children between two and three years of age who were already weaned. The beverage was evaluated in 128 women, of whom 64 were pregnant and 64 were breastfeeding. The composition of the groups reflected that of potential beneficiaries.

The supplements were prepared according to the instructions in the package, using a scale with a precision of 2 g. The acceptability of both supplements was assessed during three consecutive days. The flavours were randomly selected, prepared, and administered to each subject on the three days. Hedonic scales were used to assess the acceptability of the flavours and the consistency of the products. Acceptability was measured by a five-point scale in children and a three-point scale in adults.

Intake was assessed for 14 consecutive days (except Sundays) during which a ration of the favourite flavour was offered to the mothers and children daily at a supplementation centre. In both the acceptability and the intake assessments, the amount served and the leftovers were weighed on an electronic scale with a precision of 2 g. The amount consumed was recorded daily. Some of the results for acceptability and intake have been reported elsewhere [3]; here we present a brief summary of the main findings.

The results of the tests with hedonic scales to assess acceptability of the flavours were satisfactory for the pap and the beverage. The average score for different flavours of pap ranged between 4.0 and 4.1 over a five-point hedonic scale. For the beverage the average was 2.8 over a three-point hedonic scale for all flavours. No significant differences were found between flavours for the pap or the beverage. Similar satisfactory scores (not presented) were found for consistency and for other organoleptic characteristics of the supplements.

During the three-day acceptability tests, the intakes did not differ significantly by flavour for either pap or beverage. On average, 73% of the pap and 96% of the beverage served were consumed. Figure 1 presents daily consumption over the 14 days of the study. The amounts

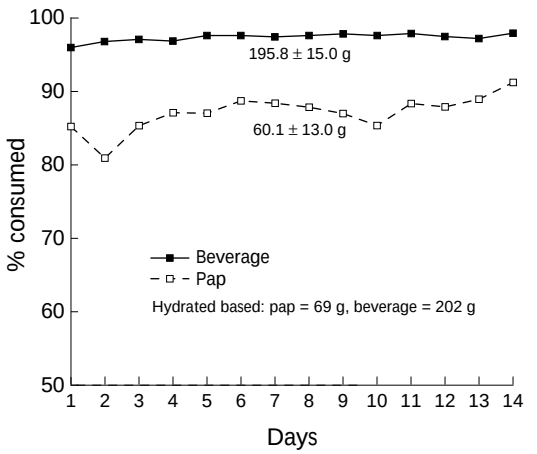

FIG. 1. Average daily consumption of PROGRESA supplements (percentage of ration) over 14 days of study

of pap and beverage offered were 69 and 202 g, respectively. The average intakes (±SD) over the 14 days were 196 ± 15 g for the beverage (97% of the ration) and 60 ± 13 g (87% of the ration) for the pap. These intakes are equivalent to 244 kcal for the beverage and 168 kcal for the pap. The intakes were relatively constant over the 14 days (fig. 1). Although the follow-up period was short and longer-term evaluations are advised, the amounts consumed during the study period were satisfactory and, if continued for a longer period of time, would have a positive impact on the nutritional status of children and women.

Process and impact evaluation

The advisory committee in charge of the design of the supplement developed a proposal for evaluating the process and the impact of the programme on the nutritional status of children and women.

Process evaluation

The objective of the process evaluation is to assess the performance of the programme. This will be done by contrasting the norms, procedures, and goals of the project as stated in the programme plan with the way the programme actually works. This will enable us to determine the degree to which the goals of the programme are met. Two sources of data will be used: information produced on a routine basis in health units and information obtained through surveys conducted in health units and at homes in communities where the programme is in progress.

Routine information is generated and analysed periodically by the Secretary of Health. A number of variables are already part of a surveillance system. In order to reduce the need for special information, some variables that are currently produced by the system will be used. These variables include changes in prevalence of low weight-for-age, percentage of children recovering from malnutrition, and mortality due to nutritional deficiencies.

The following variables, not currently included in the system, will also be obtained: participation in key health-care programmes, coverage of nutrition education programmes, and distribution of supplements.

All the information will be obtained for children under five years of age and for two subgroups: children under two years of age and those between two and four years of age.

Information will be obtained by surveys conducted in health units and in selected homes. Households will be selected centrally from a list of beneficiaries. In the health units, questionnaires will be given to physicians and nurses. In addition, inspection of stored supplements and examination of records will be made. During the home visits, a questionnaire will be completed for families included in the programme.

The areas that will be assessed are delivery of supplements to units, status of stored supplements, selection of beneficiaries, delivery of supplements to beneficiaries, participation in nutrition education sessions, acceptance of supplements by children, sharing supplements with other family members, and satisfaction of beneficiaries.

Impact evaluation

The purpose of the impact evaluation is to assess the benefits of the programme to the nutritional status of children. Two study strategies will be used: a cross-sectional design to estimate the impact on the prevalence of malnutrition and micronutrient deficiencies, and a longitudinal design to assess the impact on growth and micronutrient status. For both types of strategies, a design with intervention and control communities will be used.

As mentioned earlier, since May 1997 the programme has increased its coverage gradually over different recruitment phases. Since the protocol for the evaluation of PROGRESA was completed after the programme began, beneficiaries included in the evaluation were selected from communities that joined the programme during the fourth recruitment phase, which started in September 1998.

Cross-sectional design strategy

Table 3 illustrates the cross-sectional design strategy. Three cross-sectional surveys will be conducted over two years. Each survey will use an independent random sample of children residing in 224 communities that were randomly selected from communities that joined PROGRESA during the fourth recruitment phase

TABLE 3. Cross-sectional design

Groups	Baseline survey, August 1998	Follow-up	
		August 1999	August 2000
PROGRESA $n = 224$ $n = 2,240$	Anthropometry Haemoglobin Blood sample Dietary intake Supplement intake	Same as for baseline	Same as for baseline
Control $n = 224$ $n = 2,240$	Anthropometry Haemoglobin Blood sample Dietary intake Supplement intake	Same as for baseline	Same as for baseline

in six states. The numbers of communities and of children within communities that were sampled were determined on the basis of the expected impact of the programme on the prevalence of undernutrition and of micronutrient deficiencies. Control communities were selected among eligible communities that were not selected to participate in the first four phases of the programme. Once a community had been selected as a control, entrance to the programme was postponed until completion of the last evaluation survey (by the end of the year 2000). The control communities were selected individually to match each PROGRESA community in population, indicators of community infrastructure, wealth, and geographic location. The control communities had to be in the same *municipio* as the matched PROGRESA community. As will be explained in detail later, since not enough communities were found to match each PROGRESA community, the number of control communities did not reach the intended number of 224.

Three cross-sectional surveys were planned for both PROGRESA and control communities. A baseline survey was carried out between August and September 1998, one follow-up survey took place in August and September 1999, and another will take place in August and September 2000.

In each PROGRESA community, 10 families with children under five years of age that were selected to participate in the programme were randomly chosen for participation in the survey. In each survey, an independent sample was to be obtained. The questionnaire used in PROGRESA communities for the selection of beneficiaries was also used in control communities and was administered by the personnel who conducted the survey regularly. Families from the control communities that would qualify as beneficiaries of the programme were the group from which families were selected for participation in the survey. Therefore, families selected for the survey in control communities were similar in socio-economic status to those selected for the survey in PROGRESA communities.

The following information and measurements were obtained for children and their families: age; anthropometric measurements (weight and length or height); haemoglobin (using a portable photometer); dietary intake (using a 24-hour recall questionnaire); and vitamins A, E, C, and B_2, as well as zinc and iron, from a venous blood sample

The principal outcome variables of the cross-sectional design are the prevalences of malnutrition, anaemia, and micronutrient deficiencies. For the prevalences of wasting, stunting, and underweight, –2 standard deviations of the NCHS/WHO norm [1] were used as cut-off points. For anaemia, a cut-off of 110 g/L, adjusted for altitude, was used. The cut-off points for micronutrient deficiencies were plasma ferritin concentrations below 12 μg/L for iron, serum retinol concentrations below 0.7 mmol/L for vitamin A, and plasma concentrations below 10.7 mmol/L for zinc. Other variables that were used as covariates were socio-economic conditions, satisfaction with the programme, and intake of the supplements.

Longitudinal design strategy

Table 4 illustrates the longitudinal design strategy. The group of children who were between zero and six months of age studied at baseline will be followed one and two years apart to assess the impact of the programme on growth and micronutrient status. The children will be between 12 and 18 months old at the second follow-up and between 24 and 30 months old at the third follow-up. The information and measurements obtained will be the same as those in the cross-sectional surveys. However, the outcome variable will be the change in nutritional status over time. The principal outcomes will be linear growth and changes in length-for-age *Z* score, weight gain and changes in weight-for-age *Z* score, changes in weight-for-length *Z* score, changes in the mean values of haemoglobin and micronutrient status (vitamins A, E, C, and B_2, as well as zinc and iron), and changes in the prevalence of wasting, stunting, underweight, anaemia, and micronutrient deficiencies.

TABLE 4. Longitudinal design

Groups	Baseline survey, August 1998	Longitudinal follow-up	
		August 1999	August 2000
PROGRESA	0–6 mo	12–18 mo	24–30 mo
Control	0–6 mo	12–18 mo	24–30 mo

Data analyses

The prevalences of malnutrition, anaemia, and micronutrient deficiencies will be compared between the type of community (PROGRESA and control) at baseline and at the two cross-sectional follow-up surveys. Unadjusted comparisons will be made first (using chi-square tests), followed by adjusted comparisons using logistic regression models, with the prevalences as dependent variables, and the type of community, an indicator variable for time of follow-up, and a number of covariates and potential confounding factors as independent variables. An interaction term between type of community and time of follow-up will be tested to assess the impact of the programme.

To identify subgroups with larger impact, a number of statistical interactions between type of community and potential effect modifiers will be tested. In addition to the comparison of prevalences, differences in mean or median values between groups will be studied using the cross-sectional data. Analysis of the longitudinal data will use two approaches. In the first approach, multiple linear regression models will be used, with the indicators of nutritional status *Z* scores at the last survey as dependent variables, and the *Z* scores at baseline, an indicator variable for type of community, and a number of covariates and effect modifiers as independent variables. In the second approach, generalized estimating equation techniques will be used to take advantage of the longitudinal nature of the data. The structure of the equations and variables used in generalized estimating equations will be similar to those used in the multiple linear regression models. As in the case of prevalences, interactions will be tested. Similar analysis will be conducted with anaemia and with the indicators of micronutrient status.

Results of baseline survey

The baseline survey was conducted during August and September 1998, with 222 PROGRESA communities and 146 control communities finally selected for the evaluation. The intended number of PROGRESA and control communities was 224 of each. Because of coding errors in the selection process, two of the PROGRESA communities were not included in the final set. The reason for the substantially smaller number of control communities was that not enough communities, among those that qualified as potential controls, were found to match the selected PROGRESA communities. Given the smaller number of control communities, in order to reach the required sample size of 4,480 children and 416 pregnant women, the number of children randomly selected within communities was set to be larger in control than in PROGRESA communities.

Data analyses have not been completed; however, preliminary results for children under five years of age indicated high coverage rates (about 94%) and a high prevalence of malnutrition and anaemia. The overall prevalences of malnutrition were 36% for stunting (length/height-for-age *Z* score < -2), 22% for underweight (weight-for-age *Z* score < -2), and 5% for wasting (weight-for-length/height *Z* score < -2). The prevalence of anaemia (haemoglobin < 110 g/L) was 25%, and that of severe anaemia (haemoglobin < 100 g/L) was 12%. No differences were found in the prevalences of malnutrition or anaemia between children in the PROGRESA and control communities. These results indicated that children in PROGRESA communities may benefit from the programme, given their high prevalences of malnutrition and anaemia. In addition, the similar nutrition status in the two study groups indicated that the control communities were adequate to be used for comparisons in the two subsequent surveys.

Conclusions

The principal features of PROGRESA are its emphasis on targeting the benefits of the programme to poor, vulnerable families and the importance given to investing in human capital formation by facilitating access of beneficiaries to health and education services of high quality and through improvements in nutrition during the critical period between gestation and the age of two years. In order to accomplish its goals, PROGRESA requires the coordination of three key government sectors—Education, Health, and Social Development—that are working in a specific intervention in which the role of each sector has been clearly defined.

The recognition of nutrition as a key component of PROGRESA is an important feature of the programme. Moreover, for the first time in Mexico, a nutrition intervention has been targeted to the critical development period between gestation and the age of two years. The rationale for this is the evidence in the literature that the largest effects of dietary improvements occur during this crucial period [4, 5]. Another important feature of the project was the decision to add key micronutrients to the supplements. The micronutrient mixture added to the supplement was defined on the basis of evidence about micronutrient deficiencies in Mexico [6–8].

Finally, after decades of food and nutrition interventions that were not carefully evaluated, the performance and the nutritional impact of the programme will be evaluated. The projected cost of the nutrition component (about two million dollars) is very small relative to the total investment in the programme. Its results will allow measurement of the magnitude of the nutritional impact and will also provide answers if the programme is less effective than expected. The performance evaluation will allow lessons to be learned from mistakes.

The programme started in May 1997. Since then, coverage has increased substantially. The fact that almost two million families were beneficiaries of PROGRESA as of March 1999 reflects the political support for the programme. Ironically, this support may be the principal drawback to the sustainability of the programme. President Zedillo's administration will end in the year 2000. In Mexico large-scale programmes such as PROGRESA are usually not sustained after the end of a presidential term. Since PROGRESA is envisioned as the social programme of President Zedillo's administration, it is likely that the next administration will not continue with the programme as such, regardless of what political party wins the presidential election. However, certain components of the programme, particularly those that are most appreciated by the beneficiaries, may persist, even if the name and certain components of the programme change. That is probably the case for the money transfers, which are highly valued by beneficiaries. At this point it is difficult to judge the degree to which the public appreciates the nutrition component of the programme.

Since the performance evaluation has not yet been conducted, we do not know at this point how the programme is being implemented. If indeed the nutrition component is implemented as planned, its most important benefits will probably be observed in the long run, when children who benefited from the different components of the project reach their productive age. The expected benefits will be better physical and mental performance that may improve the chances of the beneficiaries to lead healthy and productive lives.

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Summary of discussion of articles by Rosado et al. and Rivera et al.

Cost. Originally, a single sachet cost US$0.12 to produce and package. The cost has been reduced to US$0.08 per ration by packaging five rations. Each ration weighs 44 g. This cost only covers production and packaging and does not include transportation and distribution. Packaging constitutes 30% of the total cost.

The food supplement is a small part of the overall costs of the PROGRESA Programme, which has many other more costly components to reduce poverty. The processed complementary food is also intended to replace other programmes subsidized by the Government of Mexico. Currently, the Government is spending about US$2 million per day in food programmes. One objective of this programme is to replace these other programmes with a more targeted programme. Therefore, a beneficiary of PROGRESA is not permitted to participate in other programmes. The price of PROGRESA and the processed complementary food may be high, but it is less expensive and better targeted than the programmes it replaces.

Public- versus private-sector production. A risk of sole dependence on the government for production is the possible loss of support and the disappearance of the supplement if the government changes. The government company now responsible for production cannot adequately meet the demand, and the private sector has expressed interest in becoming involved. The programme will be open to bidding by the private sector, and there are many private companies interested in

making the product. If the private sector becomes involved, the government will purchase the product and distribute it; however, the logistics of how this would occur have not yet been established. There is interest on the part of the private sector in the commercial sale of the product, but a mechanism for doing this has not yet been established.

Clinical tests. In the past it was recommended that a processed complementary food be tested clinically among malnourished children in a tightly controlled setting to ensure that the food met the nutritional needs of the target population. Although clinical tests were not conducted for the PROGRESA product, its development drew upon the collective experience of scientists with other products with similar characteristics. Clinical tests are important for products that have new and untested formulations, but they are less important for products with formulations that are similar to those previously tested.

Effectiveness trial. The need for an effectiveness trial is recognized and a proposal is available, but no funding has yet been received. Political considerations resulted in the product being launched immediately.

Target population. All children between the ages of four months and two years and all malnourished children (–1 SD weight-for-age) between two and five years of age.

Product composition. Ferrous sulphate and zinc oxide are added to the processed complementary food. The reasons for the high percentage of milk in the product instead of a higher cereal content are the unacceptable taste of a corn and oil product that was tested and the availability of inexpensive imported milk. Some of the participants voiced doubts about the sustainability of a product that is so dependent on imported milk powder. The market cost of milk powder in Guatemala appears to be twice that in Mexico.

Volume of ration. The total cooked weight is about 80 g, and the dry weight is 44 g.

Sharing of supplements and leakage. There are anecdotal reports that the processed complementary food is being used to make desserts and beverages for the entire family. The issue of leakage to the private sector is an open question, which the International Food Policy Research Institute will be doing research on in the context of a broader evaluation of PROGRESA.

Pap versus beverage for children. Because pap is more viscous and cannot be served in a bottle, it was selected as the supplement rather than a beverage. A more concentrated product also has a higher energy density.

Ecuador experience. Cost is important, because the lower the cost, the more children can benefit at a constant budget. Ecuador has a lot of experience in school feeding programmes. The food product is designed by the government but manufactured and distributed by the private sector. The mean estimated cost for production, packaging, transportation, and distribution to the schools is US$1.20/kg. The programme is largely focused on schools in rural areas where transportation is difficult. The cost is US$0.13 for each ration, which consists of a beverage and fortified cookie and provides 400 kcal.

Addition of water. The label on the Mexican product recommends that the "best water" be used. Water quality has improved in Mexico in recent years. Although there is concern about the use of contaminated water, a greater concern is the possibility that the food will be prepared only once a day if boiled water is required for preparation and that contaminated leftover pap will be served to children.

Ration. Families receive a one-month supply of the processed complementary food at a time.

Quality control. One plant is being used for production. The Ministry of Health is doing some monitoring. A manual was prepared to guide quality control of production.

Experience with complementary feeding in the FONCODES Project

Guillermo López de Romaña

Abstract

Alli Alimentu, a processed complementary food, is currently consumed by 50,000 children per day in Peru. The food, developed by the Instituto de Investigación Nutricional, is produced and distributed by the private sector in programmes funded by the government. In this paper, the development of the food is described, and issues related to financing, cost, production, and distribution are discussed. Monitoring and evaluation has focused on three activities: operational processes, communication and training, and impact. The impact evaluation showed that the consumption of energy, protein, iron, vitamin A, and calcium increased and the prevalence of anaemia and vitamin A deficiency decreased among targeted children. Surprisingly, the project did not affect child growth, suggesting that stunting is associated with multiple factors (genetic, environmental, and infectious) that the project did not modify.

Nutritional characteristics of the product

Alli Alimentu was developed as a pre-cooked (extrusion) food with instant preparation and high nutritional value. It was designed to cover 33% of the energy requirements, 100% of the iron, zinc, iodine, vitamin A and vitamin C requirements, and 60% of the other micronutrient requirements of 6- to 36-month-old children living in a region of the country with high indices of malnutrition and poverty. The reconstituted product has a semi-solid consistency (3,000–6,000 cp) with an energy density of 1 kcal/g (table 1).

In addition, the product has the following characteristics:

» 20% of total protein of animal origin;
» 3% of total calories supplied by essential fatty acids;
» less than 10% of total calories supplied by sucrose and glucose;
» contains 30 mg/kg of α-tocopherol as preservative;
» acidity less than 0.04 mEq of sulphuric acid;
» peroxide index less than 10 mEq/kg of fat;
» gelatinization index greater than 94%;
» free of aflatoxins and saporins;
» free of pathogenic bacteria and fungi;
» can be stored more than 60 days in good state for consumption.

TABLE 1. Nutritional characteristics of Alli Alimentu (Peru)[a]

Nutrient	Amount per 100 g dry product
Protein	14.4 g
Energy	444 kcal
Fat	14.8 g
Vitamin A	2,400 IU
Thiamine (vitamin B_1)	0.50 mg
Riboflavin (vitamin B_2)	0.50 mg
Niacin	5.00 mg NE
Pyridoxine (vitamin B_6)	0.60 mg
Vitamin B_{12}	0.50 mg
Folic acid	30.00 mg
Vitamin C	50.00 mg
Calcium	200.00 mg
Zinc	10.00 mg
Iron	10.00 mg
Magnesium	50.00 mg
Phosphorus	200.00 mg
Iodine	70.00 mg
Selenium	0
Copper	0
Other	0.50 mg

a. *Ingredients:* rice, barley, beans, powdered milk, vegetable oil. *Energy density:* 1.0 kcal/g. *Daily ration size:* 250 g. *Suggested servings:* infants < 12 months, 125 g twice per day; infants ≥ 12 months, 250 g once per day. *Daily energy supplied:* 400 kcal. *Cost per ration:* US$0.1916. *Cost per 100 g:* US$0.2128. *Rations per package:* 10. *Mixing instructions:* Fill bowl with water up to the line, add one full measuring cup of powder, and stir. *Other information:* Cost includes transportation to rural areas.

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This kind of pre-cooked, instant food supplemented with micronutrients was developed for the first time in 1993 by the Instituto de Investigación Nutricional (IIN). Presently they are used in the majority of the supplementary programmes being implemented in the country, which cover more than two million beneficiaries per day (children under three years of age and school feeding programmes).

Development of the product

After the product was formulated by the IIN, a reduced sample was prepared in order to undertake formative research studies (focus groups and initial acceptability trials in mothers and children) to determine:

» whether mothers considered that the consistency of the product was acceptable and adequate for their children;
» whether the designed quantities were adequate;
» how many times per day the mothers would offer the product to their children;
» any suggestions for modification of the product;
» the name of the product.

With this information, the IIN developed the basis for public bidding to select producers and distributors of the product.

Financing and costs

Within the operative mechanism developed, the Peruvian Government, through the National Fund of Development and Social Compensation (FONCODES), covered the costs of the project. The costs were divided into two areas: the cost of food and the cost of development, implementation, monitoring, and evaluation of the impact of the project.

To cover the cost of food, which was 90% of total project costs, FONCODES chose a private bank in which money was deposited monthly so that the producers could charge for the number of rations given to the community. The payment invoice had registered signatures of the community representative and the IIN supervisor. The initial cost for the purchase of food was calculated to be US$0.2335 per ration. However, as a result of the public bidding process, each ration was purchased at US$0.1916, a substantially lower cost.

Additional costs, amounting to 10% of total project costs, covered community organization, selection of suppliers, education and communication campaigns, supervision and monitoring of delivery and consumption of the product by laboratory analysis of the food coming out of the factory and at the moment of consumption by children, the purchase of bowls and spoons of known sizes, and impact evaluation.

Production and distribution

Companies were chosen to produce and distribute the product by public bidding. In order to participate, each company acquired the technical specifications developed by the IIN and developed its products according to the specifications, which did not specify raw materials but rather nutrient content and composition. Afterwards, each company sent a sample of its product to a public notary selected by the IIN, where the technical information of the product and the product samples were coded. The notary sent the coded samples to a certifying laboratory, which performed all examinations required by the technical specifications. The results from the laboratory were then returned to the notary, who presented all the coded information to a project selection committee. This committee was composed of six members, all with known experience in nutrition, food science, or both. The members were selected from multiple academic institutions and from the government. The committee proceeded to make a first selection of the product once it was reconstituted. All products that did not comply with the specifications were eliminated.

The remaining products were sent to the intervention area for the acceptability trials in mothers and children. Groups of 20 mothers with their children (30% of whom were less than one year old) were organized in several parts of the intervention area. Each group evaluated one of the products and assigned a score based on the trials of acceptability by mothers (25% of the score), acceptability by children (25% of the score), and consumption by children (50% of the score). Different scores were given to the quantities consumed by children older and younger than one year. After obtaining the results and the accumulated score for each product, which included laboratory examinations, acceptability trials, and cost, the notary proceeded to break the codes. An inspection visit was then made to the factories to evaluate the plants, their production capacity, and their sanitary conditions. Two companies were chosen as winners of the bidding process.

Concurrent with the public bidding process was a process of community organization. To promote community participation, radio programmes announced the beginning of the FONCODES Project and advised communities with 300 or more children to organize implementation committees. Project inspectors from FONCODES participated in many of the community meetings where implementation committee representatives were chosen. Once each implementation committee was formed, they went to the nearest FONCODES office to register, present the list of beneficiaries, register the accredited signatures for payment of the producers, and participate in training sessions. Although registration was voluntary, each implementation committee had to make a commitment to transport the food from the

distribution point to the communities, store it, and distribute it to all mothers.

The implementation committee was also responsible for training mothers in proper food preparation. Educational material was designed and printed for this purpose. Educational campaigns were conducted during the development of the project using mass media and direct training of the leaders and the population. Training was conducted by inspectors of the project in each registered community and in the communal fairs that the implementation committees organized, in coordination with the project, once a week in strategic points of the region. In these meetings contests took place between implementation committees, each making an object using the plastic bags the product was packaged in to prevent environmental waste. In addition, street theaters performed plays that gave messages on how to prepare and use the product.

The implementation committee representatives received the food at the assigned distribution points every two months. Each time they received the food they signed that the quantity was correct, requested new rations, and signed the payment bill so that the producer could cash it at any of the bank branches assigned by FONCODES. An IIN inspector verified the process and gave his or her consent by also signing the payment bill.

The IIN closely monitored the whole process: production of food, delivery and distribution to the implementation committee, transport to the communities, and final delivery to each home.

Focalization

The pilot project was designed to cover for one year all children between 6 and 36 months of age living in the Department of Ancash, which had a population of about 50,000. One of the goals of the pilot project was to analyse the effectiveness of the project before national implementation. The prevalence of infant malnutrition in Ancash is 51%, as compared with the national average of 37%. Previous studies showed a high prevalence of diarrhoea (more than 10 episodes per child per year) and inadequate infant feeding practices, including a low prevalence of exclusive breastfeeding and use of inadequate foods for complementary feeding.

Monitoring and evaluation

Operational processes

Operational processes included all the activities between the inspection and analysis of the quality of products (proximal and microbiologic analyses done by the certifying laboratory) before their distribution and the development of a method to obtain regular random samples of the food prepared by the mothers for analysis. As mentioned before, the project inspectors were present every two months at the distribution points, and this opportunity was used to reinforce knowledge and find out about possible problems. During the 12 months of project implementation, inspection visits were made to different communities chosen at random. During the visits, 100% of the implementation committees and 20% of the families were sampled. The visits were used to evaluate the organization of the implementation committee and the storage and distribution of food, and to verify the number of beneficiaries. Home visits were also used to evaluate mothers' knowledge of the project and their preparation of food. In addition, the mothers were asked to show the product in its bag (to verify its conservation and the quantity consumed since the last distribution) and were invited to prepare a ration so that the process could be observed. If the child was receiving or had received the food and there were leftovers, a sample was taken for laboratory analysis. This whole process was documented in coded forms.

Communication and training

During the inspection visits, surveys were performed to monitor the educational campaign. The results were used to change, adjust, and reinforce some of the messages.

Nutritional impact

Two different areas were selected for impact evaluation. Within these two areas, communities were chosen randomly as intervention or control communities. Within each area, intervention and control communities were similar with respect to parental schooling and socio-economic status. The sample size was calculated for each evaluation area, taking into account the expected change in each variable of interest. To evaluate nutritional status by anthropometry, 500 children (250 per area of evaluation and 125 per intervention or control group) were selected. To evaluate nutrient consumption using quantitative 24-hour recalls, a total of 400 children were selected. To evaluate serum levels of haemoglobin, vitamin A, and zinc, a total of 125 children were selected. The design of the impact evaluation was longitudinal, with the same children participating in the evaluations before and after the intervention.

Results

Operational processes

The formation of the implementation committees and the inclusion of children in the project were performed according to the design, beginning in the first month

with 10,000 children and 83 implementation committees and reaching 50,000 children and 158 implementation committees by the fifth month. Food distribution by the companies was very good, with an average of four days required for transport of food from the production centre to the distribution area. Distribution to the homes required an enormous effort by the communities, which used several kinds of transportation methods ranging from horses and donkeys to manual transport by parents living close to the distribution points. The first evaluation found that the whole operational process took approximately 18 days (fig. 1). After the project inspectors had worked with the implementation committees, the average time was reduced to 10 days. Food was stored in more than half of the communities in adapted facilities (communal areas or private homes). It is believed that the active participation of the community decreased the operational costs of the project and increased its efficiency and coverage.

Communication and training

The monitoring of the communication component showed that the most efficient way for mothers to learn about the project was personal contact. Fifty-seven percent of the contacts were with district authorities or project inspectors (fig. 2). The results were similar for the learning process on food preparation, with the implementation committee and the project mechanisms (inspectors, regional fairs, street theaters, etc.) rather than the mass media playing an important role. The evaluation also showed that 73% of mothers correctly prepared the product and that 63% had offered it to their children on the previous day, which coincides with the finding from the 24-hour recalls that 60% of the target population had received the product on the previous day.

Nutritional impact

Nutrient consumption results show clearly that children who participated in the project significantly increased their consumption of all nutrients evaluated, covering up to 98%, 160%, 67%, 100%, and 83% of their energy, protein, iron, vitamin A, and calcium requirements, respectively (figs. 3–5). The control group did not show any significant changes in energy, protein, or calcium consumption. However, their iron consumption increased significantly, although less than in the intervention group, whereas their vitamin A consumption decreased significantly. The supplement contributed significantly to the children's nutrient intake on the previous day and was an important contributor to overall intake (fig. 6).

The percentage of the intake of energy and of the majority of nutrients contributed by Alli Alimentu was similar in younger and older children, except for vitamin A. The supplement contributed 59% of the total consumption of vitamin A, because maternal milk in younger children is one of the few sources of vitamin A. As expected, Alli Alimentu displaced the consumption of other foods. The supplement contributed 36% of the calories consumed on the previous day (fig. 6), but the increase in total energy was only 13% (fig. 3). It is likely that the supplement replaced foods of lower nutritional quality, since an increase in the consumption of all nutrients was observed.

The results showed very positive changes in micronutrient status. The intervention group showed a significant increase in haemoglobin levels, and the prevalence of anaemia decreased from 63% to 36% (table 2). Serum retinol levels increased significantly (table 3). The percentage of children with vitamin A deficiency (serum retinol < 20 mg/dl, excluding children positive for C-reactive protein, an indicator of the presence of

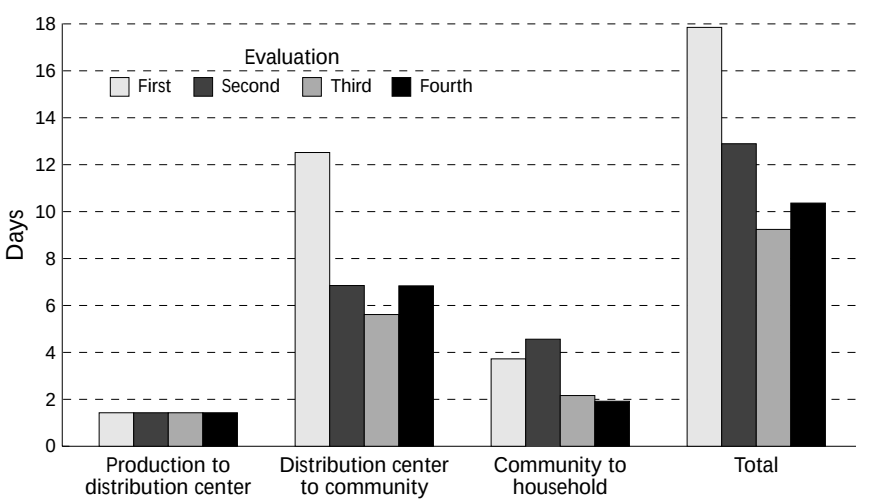

FIG. 1. Number of days required for each stage of distribution of Alli Alimentu in four evaluations

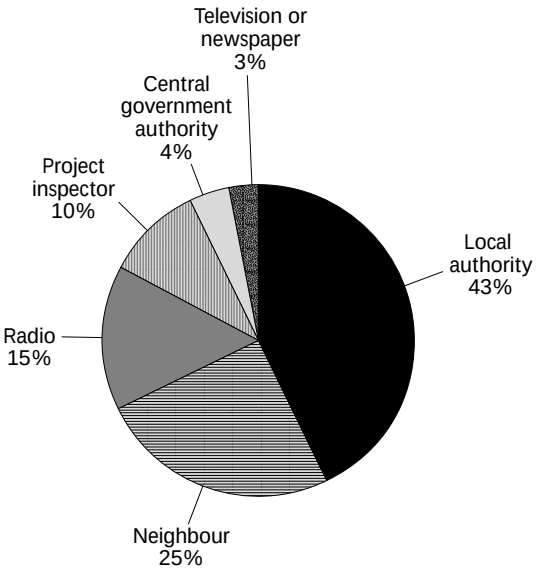

FIG. 2. How mothers learned about the project

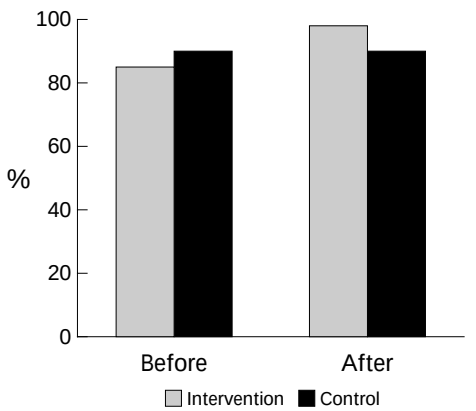

FIG. 3. Percentage of daily energy requirements obtained by children before and after intervention

TABLE 2. Initial and final percentage of anaemia in intervention and control groups according to age

	Intervention		Control	
Age (mo)	Initial	Final	Initial	Final
6–13	59	30	67	66
14–23	66	40[a]	50	27[b]
6–23	63	36	57	44[c]

a. $p < .05$ intervention vs control.
b. $p < .05$ initial vs final.
c. $p < .01$ initial vs final.

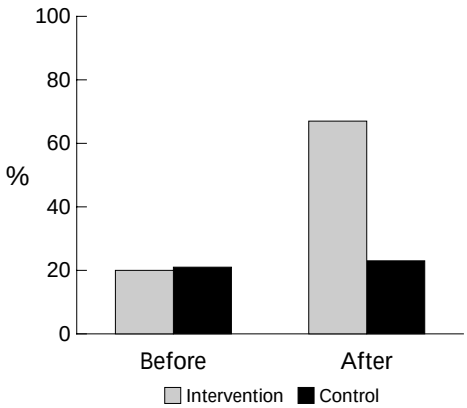

FIG. 4. Percentage of daily iron requirements obtained by children before and after intervention

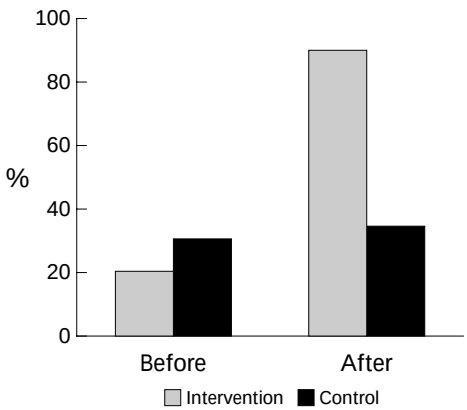

FIG. 5. Percentage of daily vitamin A requirements obtained by children before and after intervention

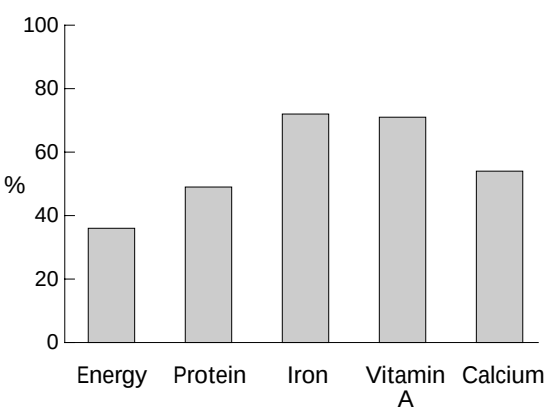

FIG. 6. Percentage of energy and nutrient intakes contributed by Alli Alimentu on the previous day

acute infection) increased from 36% to 8%. In the control group there was also a significant increase in serum retinol levels and a decrease in the prevalence of anaemia, but less than in the intervention group. Unfortunately, the basal serum zinc samples were lost because of contamination. The average final serum zinc levels of the intervention and control groups were 61 ± 35 and 57 ± 46 mg/dl, respectively.

The project did not change the children's growth pattern; in both the control and the intervention groups, height and weight gain velocity decreased progressively in relation to international standards beginning before six months of age (table 4). Only after the first year of life did most of them have a "catch-up" period in weight gain and (more slowly) in height. The results showed that 43% of the children at the start of the project were stunted (< 2 SD height-for-age), with the younger children less affected than the older children. At the end of the project, the prevalence of stunting had increased to 57% in the younger group and had improved somewhat to 55% in the older group. The control group followed exactly the same pattern. These results showed that even though the children's nutrient consumption and micronutrient status improved, their growth pattern did not change. We believe the results indicate that stunting is probably associated with multiple factors (genetic, environmental, and infectious) that the project did not modify.

TABLE 3. Initial and final serum retinol levels (μg/dl) in intervention and control groups

Group	Initial	Final[a]
Intervention (n = 60)	20.9 ± 6.8	28.2 ± 7.0
Control (n = 47)	21.1 ± 6.0	27.7 ± 6.4

a. $p < .01$ by Wilcoxon test.

TABLE 4. Initial and final prevalence (%) of stunting (height-for-age < 2 SD) in intervention and control groups according to age

	Intervention		Control	
Age (mo)	Initial	Final	Initial	Final
6–13	23	57[a]	33	59[a]
14–23	60	55	60	53

a. $p < .01$ initial vs final.

Summary of discussion of article by López de Romaña

The fact that the evaluation found improvements in intakes of nutrient and energy but not in growth is puzzling. The dietary data indicated that about two-thirds of infants and children had consumed the product on the previous day, and the complement had contributed the expected amount of energy to the diet. Vitamin D was not in the complement, but vitamin D deficiency is not a problem in this area because the children are exposed to enough sunlight.

However, it should be noted that recent studies in Nigeria have shown that vitamin D deficiency can occur in areas of large amounts of sunlight when calcium intakes are low (see Thacher TD et al. A comparison of calcium, vitamin D, or both for nutritional rickets in Nigerian children. N Engl J Med 1999;341:563–8).

Nutrition education was part of the project. This included the promotion of a general awareness of the product and of the nutrition project, the nutritional needs of children of this age, breastfeeding promotion, and instructions on how to prepare the complement.

The development of the product included input from the beneficiaries on adequacy of the product, cost, how many times they fed the child each day, suggestions for improvements of the product, suggestions for a name for the product, and general recommendations

Overall, there were no problems or difficulties in working with the private sector on this project. Since 1993, when the school feeding programme was initiated, there has been a good experience in working with the private sector.

The government-assigned price was US$0.20 per 100 g for processing, packaging, and distribution of the food.

Back-up formulations were developed and provided to the producers so that if a particular ingredient was unavailable or too expensive, another could be substituted. However, the IIN has to be notified before this substitution occurs. All candidate ingredients are selected for cost and availability.

The project is an excellent example of how the public sector (Ministry of Health), which determines composition and quality, identifies beneficiaries, and pays for the product, works with the private sector, which produces, packages, transports, and distributes the product in a manner that maximizes social welfare.

Incaparina and other Incaparina-based foods: Experience of INCAP in Central America

Florence Tartanac

Abstract

Incaparina is a high-quality protein vegetable food used in Guatemala. It was developed in the 1960s for children and other population groups with nutritional deficiencies. The original formula is still used as a commercial product, but both its ingredients and its micronutrient composition needed to be improved. Protein quality was improved, vitamin A content was reduced, and the contents of iron, B vitamins, zinc, and calcium were increased. The price of new Incaparina is still very competitive. In order to ensure the quality of this commercial product, a Seal of Nutritional Excellence was developed and is expected to be used by private firms.

Introduction

Incaparina was the result of a research programme initiated in 1950 to develop a high-quality protein vegetable food mainly for children but also useful for other population groups with nutritional deficiencies [1]. It has been the subject of numerous scientific papers published over the past 20 years and is well known all over the world. The objectives of this paper are to present basic information about the original Incaparina, focusing on its nutritional characteristics and development as a commercial product; to provide an overview of the efforts of the Institute of Nutrition of Central America and Panama (INCAP) to improve Incaparina's formulation; and describe INCAP's plan for monitoring the quality of commercial nutritional foods.

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Mention of the names of firms and commercial products does not imply endorsement by the United Nations University.

Original Incaparina

The purpose of developing Incaparina was to provide a food capable of efficiently supplementing the usual diets of children [2], with the following features:

- » in the form of a flour;
- » consistent with the dietary habits and practices of the population;
- » formulated from locally available ingredients with a corn-like flavour;
- » protein content and quality similar to that of animal proteins;
- » supplemented with B vitamins as well as with vitamin A and iron;
- » free of anti-physiological factors;
- » stable with an acceptable shelf-life;
- » cooked before consumption.

Nutritional characteristics

The nutritional characteristics of original Incaparina are shown in table 1. The ingredients are maize flour, cottonseed flour, and soya bean flour, and it is fortified with vitamin A, thiamine, riboflavin, niacin, calcium, zinc, phosphorus, and lysine.

Product development

Incaparina is similar to a traditional drink in Guatemala called *atole*, which is made with maize and consumed by a large population, especially in the highlands. Details about the development of Incaparina have been widely published [4–14]. In addition to food technology research, INCAP also conducted clinical evaluation and acceptability trials. The clinical trials showed that Incaparina not only was widely accepted in the diets of persons without obvious malnutrition but also was effective in the treatment of severe protein malnutrition in children [15]. The results of the acceptability trials showed that Incaparina was well accepted, especially in the highlands (table 2) [16]. After the clinical and acceptability trials, INCAP transferred the tech-

TABLE 1. Nutritional characteristics of original Incaparina (Guatemala)[a]

Nutrient	Amount per 100 g dry product	Compound (where applicable)
Protein	21.3 g	NA[b]
Energy (CHO)	373 g	NA
Fat	5.3 g	NA
Vitamin A	4,500 IU	Vitamin A acetate 500
Thiamine (vitamin B_1)	1.7 mg	Thiamine mononitrate
Riboflavin (vitamin B_2)	1.01 mg	Riboflavin
Niacin	13.6 mg NE	Nicotinamide
Vitamin B_6	—	—
Vitamin B_{12}	—	—
Folic acid	—	—
Vitamin C	—	—
Calcium	305 mg	Tricalcic calcium
Zinc	—	—
Iron	11.2 mg	Ferrous fumarate
Magnesium	—	—
Phosphorus	65 mg	Phosphorus
Iodine	—	—
Selenium	—	—
Copper	—	—
Other: lysine	250 mg	Lysine

a. Ingredients: maize flour (65%), cottonseed flour (25%), soya bean flour (10%). *Energy density (kcal/g)*: dry product, 3.67; with water added, 0.27; with water and sugar added, 0.58. *Ration size per day (dry product)*: 18.75 g. *Volume per ration with water added*: 250 ml. *Suggested servings per day*: 4. *Energy per day*: 69 kcal. *Cost (US$)*: per ration, 0.018; per 100 g, 0.10. *Rations per package*: 24. *Cooking instructions*: cook for at least 15 min. *Other relevant information*: protein efficiency ratio (PER), 1.93 ± 0.13 [3], representing 67% of casein protein quality.

b. Not applicable.

nology for commercial production of Incaparina to a national company, Alimentos.

Cost

Because of inflation, the cost of all foods has increased since Incaparina was introduced in the market. At the moment, its price is about US$0.10/100 g, as compared with about US$0.05 when it was introduced in the 1960s and 1970s.

Production and distribution

To protect the consumer by guaranteeing the quality of the mixtures licensed by INCAP to qualified industries, INCAP established licensing requirements as well as a control system for the packaging, identification, advertising, and quality analysis of the product at the moment of the technology transfer [2]. The control included analysis of chemical composition and microbiological quality, and, less frequently, control of biological nutritional quality. The analyses were carried out on samples collected at the production level or in food stores at the intervals and in the manner prescribed in the respective authorization. The number of samples analysed was based on the quantity produced.

TABLE 2. Acceptability trials of original Incaparina in Guatemala

Location	Duration (wk)	No. of children	% consuming ≥ 2 glasses/day
Amatitlan I	17	28	74.2
Amatitlan II	15	21	92.1
Escuintla	17	24	65.6
Zacapa	19	26	65.1
Quetzaltenango	18	51	89.5

Source: ref. 16.

An example of the quality-control scheme is shown in table 3.

Presently, all the responsibility for production, quality control, and distribution rests on Alimentos, the private firm that produces Incaparina, and INCAP no longer has control over its quality. From time to time INCAP samples Incaparina from the market for quality analysis. No major problems have been found with nutritional composition. However, problems have been detected with microbiological quality, especially with mycotoxin content (aflatoxin), because of inefficient storage of grain or other raw materials.

TABLE 3. Original quality-control scheme for Incaparina

Production (metric tons)	No. of samples[a]
10	1
11–24	2
25–49	3
Each additional 25	1 additional

Source: ref. 2.

a. Samples taken at production site or market place. *Chemical analyses:* moisture, protein, fat, fibre, ash, vitamin B_2, vitamin A, free gossypol, available lysine, trypsin inhibitors. *Microbiological analyses:* total bacterial count and *E. coli*. *Biological assays:* protein efficiency ratio (PER) or net protein ratio (NPR) occasionally or when requested.

Each month about one million pounds of weaning foods produced by Alimentos are sold. On the basis of an intake of 60 g per child per day, it can be calculated that these foods are reaching around 260,000 Guatemalan children under four years of age. This number is relatively small, about 16% of the children in this age group in Guatemala [2]. Incaparina is also still used in government programmes to give a nutritious breakfast to school-aged children.

New Incaparina

Some problems have been encountered with respect to the availability of raw materials for the production of Incaparina, especially cottonseed flour, since cotton is no longer produced in the region. Alimentos has to import the flour from the United States, where cottonseed flour is primarily used for animal food and there is less control of the gossypol content and the presence of aflatoxins. Governmental institutions (hospitals and pre-schools) report that Incaparina has changed its flavour and is not as well accepted by consumers.

To address the problems outlined above, INCAP contacted Alimentos in 1998 to discuss the preparation of an improved formulation for Incaparina. The goal was to replace the cottonseed flour with another flour available in the region and to revise the micronutrient content on the basis of the most recent scientific evidence. A new formulation of Incaparina has been developed and will be marketed later this year.

A similar effort to improve the quality of a product developed by INCAP, Bienestarina, was made several years ago with another company. Unfortunately, INCAP received financial remuneration neither for the technology transfer nor for the monitoring of quality. Therefore, INCAP had to remove its support for this firm. Bienestarina is still on the market but is of poor quality.

Nutritional characteristics

New Incaparina is based on the following three concepts:

» The principal ingredients are maize and soya bean flours;
» The micronutrient content is based on the recent nutritional situation in Central America and calculated to provide at least 20% of the recommended daily allowance (RDA) for adult women;
» It requires less cooking time than old Incaparina.

The nutritional characteristics of new Incaparina are shown in table 4. In addition to the elimination of cottonseed flour, it differs from old Incaparina in its protein quality and its contents of vitamin A, iron, vitamin B, zinc, and calcium.

Protein quality

As a consequence of the substitution of soya bean flour for cottonseed flour, the protein quality has been increased. A specific biological evaluation done recently at INCAP to calculate the protein efficiency ratio (PER) showed that the new formulation reached 97% of casein protein quality.

Vitamin A content

The vitamin A content has been reduced. Sugar in Guatemala has been fortified with vitamin A since 1974 at a minimum level of 5 mg/kg, and vitamin A deficiency is no longer a public health problem in several countries of Central America. The preparation of Incaparina for consumption by cooking in water involves the addition of sugar at a weight ratio of about 3 to 7. Therefore, the intake of vitamin A by the consumer is increased through the addition of the fortified sugar. The level of fortification of new Incaparina with vitamin A was kept to 25% of the RDA for children one to five years of age. This is the only group that still has relatively high levels of deficiency, with 16% having retinol levels < 20 μg/dl (table 5).

Iron

The iron content was increased to cover 48% of the RDA for one- to five-year-old children. Iron deficiency is still common in Central America, especially in this age group. However, the iron may not be as readily available because of factors in the product, such as dietary fibre, phytate, and other compounds, which interfere with its bioavailability. INCAP is conducting a new study to address the bioavailability of different compounds of iron in maize flour used in tortillas fortified with soya bean flour and several other micronutrients.

Vitamin B

The content of the B vitamins—niacin, thiamine, riboflavin, B_{12}, and folic acid—was increased to between 32% to 40% of the RDA for one- to five-year-old children.

Other minerals

Zinc was incorporated at a level of 35% of the RDA

TABLE 4. Nutritional characteristics of new Incaparina (Guatemala)[a]

Nutrient	Amount per 100 g dry product	Compound (where applicable)
Protein	23.5 g (23.5%)	NA[b]
Energy (CHO)	63 g (63%)	NA
Fat	4 g (4%)	NA
Vitamin A	1,759 IU	Vitamin A palmitate 500
Thiamine (vitamin B_1)	0.85 mg	Thiamine mononitrate
Riboflavin (vitamin B_2)	1.2 mg	Riboflavin
Niacin	15 mg NE	Nicotinamide
Vitamin B_6	—	—
Vitamin B_{12}	1.1 µg	Vitamin B_{12} 0.1% in mannitol
Folic acid	213 µg	Folic acid
Vitamin C	—	—
Calcium	1,066 mg	Tricalcic calcium
Zinc	15 mg	Zinc oxide
Iron	25.6 mg	Ferrous fumarate
Magnesium	—	—
Phosphorus	—	—
Iodine	—	—
Selenium	—	—
Copper	—	—
Other	—	—

a. Ingredients: maize flour (70%), soya bean flour (30%). *Energy density (kcal/g):* dry product, 5.33; with water added, 0.40; with water and sugar added, 0.69. *Ration size per day (dry product):* 18.75 g. *Volume per ration with water added:* 250 ml. *Suggested servings per day:* 4. *Energy per day*: 100 kcal. *Cost (US$):* per ration, 0.02; per 100 g, 0.11. *Rations per package*: 24. *Cooking instructions:* cook for 10 min. *Other relevant information:* protein efficiency ratio (PER), 2.81 ± 0.20 [3], representing 97% of casein protein quality.

b. Not applicable.

TABLE 5. Micronutrient status of populations in Central America

Country	Vitamin A[a] in children 1–5 yr	Iron[b]			Iodine[c] in students
		Children 1–5 yr	Women 15–48 yr	Pregnant women	
Guatemala	16	26	32	39	22
Belize	—	—	—	52	18.4
El Salvador	<5	31	16	—	—
Honduras	13	28	22	30	—
Nicaragua	31	28	36	—	10.6
Costa Rica	9	26	19	28	23.3
Panama	6	18	—	—	>15

a. % < 20 µg retinol/dl.

b. % prevalence of anaemia (% haemoglobin < WHO cut-off point).

c. Median urinary iodine (µg/dl).

for one- to five-year-old children, and calcium was increased to 50% of the RDA for this group.

Cost

The new Incaparina is slightly more expensive than the original (table 6). Both the new and the original Incaparina are still very competitive in price with other products on the market such as milk, infant formulas, and instant cereals, which cost between one and eight times as much per ration. Other products cost one to five times as much as Incaparina per unit of energy or protein.

Monitoring of quality: INCAP's seal of nutritional excellence

To assure the quality of complementary foods developed by INCAP and produced by private firms, INCAP

TABLE 6. Costs of food products in Guatemala

Product	Size of marketed unit (g)	Cost (US$)				
		Marketed unit	100 g	Ration	100 kcal	100 g protein
Formula Nido Crecimiento	900	5.8	0.64	0.16 (25 g)	0.13	3.06
Milk Nido	500	2.64	0.53	0.132 (25 g)	0.10	2.5
Milk Pinito (2 Pinos)	400	2.1	0.52	0.131 (25 g)	0.10	2.5
Atol Cerevita	300	0.92	0.30	0.061 (20 g)	—	—
Innovarina	454	0.47	0.10	0.019 (18.75 g)	0.019	0.55[a]
Vitatol	375	0.39	0.10	0.019 (18.75 g)	—	—
Incaparina (original)	454	0.45	0.099	0.018 (18.75 g)	0.027	0.53[a]

a. Cost for protein in vegetable mixture was corrected with a factor of 0.8.

is promoting a Seal of Nutritional Excellence. The objective of this seal is to assist the producers to promote nutritious foods in order to increase their consumption in regional markets as well as to recognize the prestige and image of INCAP in the field of nutrition and in the development of these kinds of foods.

The seal has been defined as a graphic representation on the product that is proof of external monitoring by INCAP to verify its technical, nutritional, sanitary, and toxicological quality. In addition, it will permit consumers to identify the product as a nutritious food.

The seal would be optional when a producer wants to use it for its own existing or new products, using its own technology and trademark. However, it would be obligatory for a producer using INCAP's name and trademark or INCAP's technology either for existing products or new products. The cost of the seal would be proportional to the number of samples analysed.

The main services offered by INCAP for the monitoring of quality are identification of market regions and sales in order to calculate the number of samples to analyse, collection of samples, chemical and nutritional analysis, and microbiological and toxicological analysis.

This seal has been used for three years by the Panamanian company DEMASA on a product they developed called Nutricrema. It is very similar to Incaparina but is adapted to Panamanian consumption habits.

Conclusions

Incaparina appears to be a good commercial product in the long term in Guatemala and has been popular among both children and adults. Its manufacture has contributed to industrial and economic development in the region. The product concept used in developing Incaparina has been exported to a number of countries in Central and South America and has been used to develop other nutritious products, such as the cookie used in school feeding programmes and maize flour for tortillas.

The experience with Incaparina was also a successful transfer of technology to private industry. However, the relation between INCAP and industry has not always been so successful. The failure with Bienestarina and other products and the recent problem with the presence of aflatoxin in Incaparina show that INCAP does not have control over the product it has developed.

The challenge for INCAP is to develop a mechanism to continue to offer nutritious products to the population, but with the assurance of quality, not only nutritionally but also microbiologically and toxicologically. This assurance of quality needs to be based on the most recent methods, such as Good Manufacturing Practices and Hazard Analysis and Critical Control Point in the factory, and on external quality monitoring, such as INCAP's Seal of Nutritional Excellence.

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Summary of discussion of article by Tartanac

Enforcement of agreements. It is important to enforce agreements, but how do you do this? Legal action is viewed as too expensive. INCAP's enforcement procedures need to be clarified. INCAP has no negotiating power over the original Incaparina that is already on the market. However, if a private company does not conform to quality standards for a new product, INCAP will not work with it. Withdrawal of the Seal of Excellence, a registered trademark, is seen by INCAP as its legal recourse. INCAP needs to look at existing government regulations regarding trademarks to ensure legal protection of its trademark. Several of the participants challenged INCAP to look very carefully at its licensing agreements and the trademark laws in Central America.

Starting out with a good contract and licensing agreement is critical. To ensure quality control in Peru, the private sector must produce a laboratory certificate stating that each batch that leaves the company has the composition stated in the contract. Contracts can be terminated for poor quality.

Governments in Latin America tend to have strict regulations for their export products but not for those consumed internally. In Guatemala the government has no systematic control of food products.

Data from the 1960s and 1970s show that low-income families did not use Incaparina because it was too expensive. More recent data show that about 80% of the high-income groups and 50% of the low-income groups consume Incaparina. About 28% of the very poorest use Incaparina. Although some say that this is poor targeting, industry would argue that the consumption of a specific product by 28% of a population group is excellent.

Although observational data suggest that Incaparina is not used as a breastmilk substitute, breastfeeding women do consume it themselves because it is seen as a good food for lactating women.

The efficacy of Incaparina has been demonstrated repeatedly, but its effectiveness has not been investigated.

Incaparina is partially pre-cooked. It is important to take the effect of dilution into consideration when calculating nutrient composition. Thirty percent of vitamin A is lost during cooking. The new formula will put extra micronutrients into the product to compensate for this loss.

The cost data are for the purchase price only and do not include the cost of cooking the product. A subsidy was never provided when the product was marketed. There is no regulation of the price of Incaparina on the open market.

Complementary foods in Colombia

Camilo Rozo

Abstract

This paper describes the development of processed complementary foods in Colombia and the composition of currently available foods. The main product, Bienestarina, has been produced by the Instituto Colombiano de Bienestar Familiar since 1976. The total annual production of the product exceeds 300,000 tons. In 1999 nearly 27,000 tons were produced and served to over 4.2 million beneficiaries. Both the government and the private sector are involved in the production of these foods. Bienestarina and other complementary foods appear to be widely accepted by the low-income population. Their nutritional impact has not been evaluated, and their composition reflects former concerns about protein rather than micronutrient adequacy and bioavailability.

Introduction

The development of high-nutrition, low-cost vegetable mixtures or complementary foods suitable for feeding to young children and other vulnerable age groups started in the early 1950s at the Institute of Nutrition of Central America and Panama (INCAP). The foods were formulated from locally available ingredients processed into flour, with a protein content and an amino acid balance comparable to that of animal proteins. They were also supplemented with vitamins, iron, and calcium. The final product had a good shelf-life and was easy to prepare as a supplement to the diets of malnourished population groups [1].

After careful testing of its nutritional characteristics, safety, and efficacy, the commercial production of the first type of this new food, Incaparina, started in Guatemala in 1961. After the introduction of Incaparina to the market, INCAP licensed private companies to manufacture and sell the product in different countries. The product concepts of Incaparina were also used in several countries, including Colombia, to develop similar foods [2].

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Mention of the names of firms and commercial products does not imply endorsement by the United Nations University.

Production of complementary foods in Colombia

The production and commercialization of complementary foods began in Colombia in 1962, when INCAP licensed Productos Quaker in Cali to manufacture yellow Incaparina, based on cottonseed and corn flours. The National Institute of Nutrition has supported the use of Incaparina in complementary feeding programmes nationwide since its introduction into the market [3].

The success of Incaparina stimulated the interest of other companies in developing competitive products. Between 1962 and 1967, Alimentos, a subsidiary of Cervecería Bavaria, developed and successfully launched a new product made from rice and defatted soya bean flours called Pochito. However, two years later the Bavaria group redefined the diversification policies of their subsidiaries and stopped its production [4].

At the same time, the Department of Nutrition of the Universidad del Valle in Cali, in cooperation with the local company Molinos Santa Rita, developed a product called Colombiharina, which was also based on rice and defatted soya bean flours. The acceptability and commercialization tests of this product were very successful, and it was put on the market in 1969 [3].

Maizena, the Colombian affiliate of Corn Products Corporation, began marketing the vegetable mixture Duryea in 1969. This product was made initially from corn, opaque-2 corn, and defatted soya bean flours, but it was modified in 1976 when the production of opaque-2 corn in Colombia was stopped. This product had an excellent acceptability and attractive packaging. However, because its price was twice as high as that of other competitive products on the market [5], sales were not satisfactory and the company stopped its production in 1981 [4].

The success of Colombiharina and Pochito led to a decrease in the sales of yellow Incaparina, which had a lower acceptability because of its cottonseed flour content. This led Productos Quaker, the producer of Incaparina, to market a more competitive product in 1969. The original formulation was modified to that of a mixture of rice and defatted soya bean flour, quite like the Colombiharina formulation. However, the sales of the two products did not increase, and the company stopped production in 1970. Although production ceased, it is nonetheless recognized that the introduction of vegetable mixtures by Productos Quaker in Colombia and their sales for over 10 years brought favourable changes in food habits and generated a positive attitude towards high-nutrition, low-cost complementary foods in the low-income population of Colombia [4].

In 1971 the Instituto Colombiano de Bienestar Familiar (Colombian Institute of Family Welfare; ICBF) initiated a research project to develop a vegetable mixture based on foods donated by the World Food Programme (WFP) and the US Agency for International Development (USAID), through CARE and CARITAS. The mixture was launched in 1976 under the generic name of Bienestarina. The production and distribution of Bienestarina has been fully subsidized by the ICBF and is no longer dependent on external food aid. Since 1976 it has been distributed to low-income beneficiaries through the applied nutrition programmes of the ICBF [6].

The last complementary food introduced to the Colombian market was Solidarina, launched in 1993. This product is distributed by the Fundación Solidaridad por Colombia. A summary of the complementary foods produced in Colombia, the year of introduction, and their manufacturers is shown in Table 1. Only Bienestarina, Colombiharina, and Solidarina are produced today.

TABLE 1. Complementary foods in Colombia

Product	Year	Producer
Incaparina-yellow	1962	Productos Quaker
Pochito	1967	Alimentos—Bavaria
Incaparina-white	1969	Productos Quaker
Colombiharina	1969	Molinos Santa Rita-Pampa
Duryea	1969	Maizena—CPC
Bienestarina	1976	ICBF
Solidarina	1993	Solidaridad por Colombia —CPC

TABLE 2. Test formulations of Bienestarina (%)

Ingredients	1124-A	1124-B	1207-A
Soya bean flour defatted	45.0	37.5	30.0
Opaque-2 corn flour	30.0	—	—
Corn flour	—	41.0	—
Wheat flour	—	13.4	—
Rice flour	16.9	—	61.9
Non-fat dry milk	5.5	5.5	5.5
Vitamin/mineral pre-mix	2.6	2.6	2.6
Total	100.0	100.0	100.0

TABLE 3. Chemical score of Bienestarina formulations

Bienestarina formulation	Egg	Cow's milk	Human milk	FAO/WHO amino acid pattern (1973)
1124-A	75	82	83	109
1124-B	72	72	74	103
1207-A	77	75	80	107

Bienestarina

Bienestarina was developed by the ICBF to increase the availability of high-quality protein at low cost for the beneficiaries of its applied nutrition programmes [6]. In the first stage of the project, several formulations were designed with consideration of both their nutritional value and the availability of raw materials in the country. Three formulations were finally selected (table 2), and were evaluated in regard to their chemical composition, nutritional attributes, and acceptability.

The chemical scores of the three Bienestarina formulations, calculated with four reference proteins—egg, cow's milk, human milk, and the Food and Agriculture Organization/World Health Organization (FAO/WHO) 1973 amino acid pattern—are given in table 3. All three formulations showed good scores and exceeded the FAO/WHO pattern [7, 8].

The protein quality of the formulations was evaluated by the protein efficiency ratio (PER) assay, following the standard procedure [9]. At the same time, the other vegetable mixtures available in Colombia were tested. The PER results were corrected to a value of 2.50 for casein. The results of this assay are shown in table 4. All the Bienestarina formulations performed very well, indicating a protein quality higher than 87% of the 100% value for casein.

The acceptability of porridges made from Bienestarina was assessed in the laboratory by a trained panel of 12 persons who found the three formulations satisfactory. The product was also tested in 20 pre-school children and 225 schoolchildren and had an acceptability of nearly 100%, as measured by the quantity eaten divided by the quantity offered

The first experimental batch of 100 metric tons of Bienestarina (1124-B formulation) was produced in 1974. The product was distributed to the regional offices of the ICBF for purposes of accessing its acceptability in 28,000 pre-school children attending day-care and com-

TABLE 4. Corrected protein efficiency ratios (PER) of Bienestarina and other complementary foods

Product	PER
Casein	2.50
Bienestarina 1124-A	2.39
Bienestarina 1124-B	2.18
Bienestarina 1207-A	2.50
Duryea	2.15
Incaparina-white	2.29
Colombiharina	2.01

munity centres. The study was carried out in the second half of 1974, during which time pre-schoolers received a daily ration of 30 g over the course of 120 days. Again, the acceptability of the product was nearly 100%. The children also tolerated the product very well [10].

In order to increase the possibilities for the use of Bienestarina in households as well as the nutritional value of commonly prepared foods, a number of recipes were developed incorporating the product. The recipes included preparations to be used in bottle-feeding, porridges, cold beverages, soups, purees, sauces, and cakes [11].

The industrial production of Bienestarina started in 1976 in three small mixing plants donated by UNICEF and modified by the ICBF under USAID supervision [12]. The 1124-A formulation was selected because it was easier for the donor agencies to supply the raw materials used in its production. In 1981, to improve the characteristics of the product, the ICBF set up a new plant financed by a loan from USAID. This plant was designed to process an extruded pre-cooked product that was easy to reconstitute into porridge. In the same year, the formulation was changed to 1207-A, with some adjustments in the raw materials. The chemical composition is shown in the Annex. This generic formulation includes 60% of one of the cereal flours (corn, rice, or wheat) that have been used in production. The ingredients are shown in table 5, together with those of Colombiharina and Solidarina, for comparison purposes.

The complementary feeding programme of the ICBF has used Bienestarina for several categories of beneficiaries. In 1999 the ICBF will distribute 26,813 metric tons of the product to 4,234,365 beneficiaries in nine different kinds of programmes that they operate (table 6). The product is distributed in 25-kg packages for institutional feeding and in 1-kg packages for households [Medina MT, ICBF, personal communication, 1999]. The product is not sold in the retail market.

The ICBF has produced a total of 316,293 metric tons of Bienestarina since 1976 [Pérez H, ICBF, personal communication, 1999]. The quantity produced per year is shown in table 7. The quantity of production has fluctuated for many reasons, primarily because of changes in the policies of the different administrations. Between 1992 and 1995, the production was contracted through the private sector. One of the ICBF plants has also been operating since 1997 under contract with a private company. Millions of low-income children and families have received Bienestarina as a result of the great economic and logistic effort of the ICBF throughout this period of time.

Colombiharina

The development of Colombiharina started with tests of the properties of mixtures of rice and bean flours. Since the cooking of these mixtures required a long time, other protein sources were studied: cottonseed, sesame, and soya bean. Defatted soya bean flour was selected because of its local availability and excellent amino acid composition [Bedoya F, Pampa Ltda, Cali, personal communication, 1999].

The PER assay of different combinations of rice and soya bean flours was performed. The highest value (PER 2.35) was obtained with a 70:30 mixture of rice and soya bean. Its chemical score was 87% of the FAO/WHO amino acid pattern [3]. The chemical composition of the product is shown in the Annex.

The acceptability of the product prepared as porridge and tested in 800 people was nearly 100%. The

TABLE 5. Composition of complementary foods currently available in Colombia

Ingredient (%)	Bienestarina	Colombiharina	Solidarina
Soya bean flour defatted	30	30	35
Rice flour	(60)[a]	69	—
Corn flour	(60)[a]	—	55
Wheat flour	60[b]	—	—
Non-fat dry milk	8	—	8
Vitamin–mineral pre-mix	2	1	2
Total	100	100	100

a. Ingredients used formerly.
b. Ingredient used currently.

TABLE 6. Complementary feeding programmes with Bienestarina (ICBF-1999)

Programme	Target group	Bienestarina ration	No. of beneficiaries	Bienestarina required (kg)
Welfare nurseries	Children > 7 yr; mothers	30 g/d	913,054	11,274,941
Welfare nurseries	Children 6–24 mo; pregnant and lactating women	1 kg/mo	486,300	4,688,480
Day-care nurseries	Children > 7 yr	30 g/d	151,834	201,233
Community nurseries	Children 2–5 yr	30 g/d	4,658	28,647
Mother and child programme	Pregnant and lactating women	2 kg/mo	260,652	4,206,444
Nutritional recuperation (ambulatory)	Children > 5 yr	3 kg/mo	155,998	956,338
Foster homes	Boys and girls > 18 yr	1 kg/mo	16,192	110,928
Schoolchildren and adolescents	Boys and girls > 18 yr and 5–14 yr	20 g/d	2,201,202	5,247,251
Youth clubs	Boys and girls 7–18 yr	4 kg/mo	44,475	118,600
Total			4,234,365	26,812,912

TABLE 7. Production of Bienestarina, 1976–99 (metric tons)

Year	Quantity	Year	Quantity
1976	7,040	1988	13,330
1977	8,113	1989	18,011
1978	9,059	1990	20,979
1979	3,689	1991	18,163
1980	4,258	1992	20,008
1981	2,198	1993	24,581
1982	1,943	1994	18,079
1983	2,324	1995	21,938
1984	1,383	1996	20,934
1985	4,180	1997	21,967
1986	7,506	1998	27,556
1987	9,055	1999	30,000[a]
Total			316,293

a. Estimated production.

product was used in the recuperation of eight undernourished children between two and five years of age. Feeding with Colombiharina stopped the children's diarrhoea and improved their levels of haemoglobin and serum proteins [4].

The amount of the product sold increased from 60 tons in 1969, when the product was launched, to 540 tons in 1985. The total amount sold during this period was 5,767 tons [4]. The estimated yearly amount sold during recent years is 500 tons [Bedoya F, Pampa Ltda, Cali, personal communication, 1999]. The product is sold at retail in 500-g packages.

Solidarina

The Fundación Solidaridad por Colombia is a nonprofit organization with a mission to help underprivileged populations, including abandoned children. With this purpose, the foundation established a complementary feeding programme based on Solidarina. The coverage of the programme is restricted by its financial resources, which have limited the distribution of the product to 120 metric tons per year [Ortiz GE, Fundación Solidaridad por Colombia, personal communication, 1999].

Solidarina is manufactured by Derivados del Maíz, an affiliate company of CPC International, under strict quality control. It is the most complete complementary food on the market in terms of the micronutrients added (see Annex). It is sold at retail in Bogotá and Medellín in 500-g packages. However, the foundation has not carried out promotional campaigns for the product.

Final considerations

Complementary foods have been produced and commercialized in Colombia for almost 40 years and have been well accepted by the low-income population. Therefore, they represent a high-nutrition, low-cost food alternative. Many factors should be considered in measuring the effectiveness of the complementary feeding programmes in the population and the sales of these products on the retail market. If the history of these products is regarded, a closing comment about three issues could be useful. First, the impact of the consumption of the product on the nutritional status of beneficiaries has never been measured. Second, what would happen to Bienestarina if the subsidy were to be removed and it was offered in the retail market? Finally, these products have not evolved through the years and reflect former concerns about protein rather than micronutrient adequacy and bioavailability.

Annex

Characteristics of complementary foods used in Colombia

Bienestarina: nutritional characteristics

Nutrient	Amount per 100 g dry product[a]	Compound
Protein	26.0 g	
Energy	319 kcal	
Fat	1.4 g	
Vitamin A	2,000 IU	Vitamin A palmitate 250CWS
Thiamine (vitamin B_1)	1.99 mg	Thiamine HCl
Riboflavin (vitamin B_2)	0.50 mg	Riboflavin
Niacin	9.7 mg	Nicotinamide
Vitamin B_6		
Vitamin B_{12}		
Folic acid		
Vitamin C	27 mg	Ascorbic acid
Calcium	512 mg	Dicalcium phosphate
Zinc	1.8 mg	
Iron	14.1 mg	Ferrous sulphate
Magnesium	140 mg	
Phosphorus	766 mg	Dicalcium phosphate
Iodine		
Selenium		
Copper	1.10 mg	

Ingredients: cereal flour (wheat) 60%, soya bean flour 30%, non-fat dry milk 8%, vitamin–mineral mix (dicalcium phosphate, ferrous sulphate, vitamin A, vitamin C, thiamine, riboflavin, and niacin) 2%. *Energy density:* per dry weight, 3.2 kcal/g; mixed according to recipe (15 g product + 25 g sugar + 240 ml water), 148 kcal/240 ml. *Phytate/iron ratio:* 3.7. *Phytate/zinc ratio:* not available. *Ration size per day:* 30 g. *Volume per ration size:* 240 ml. *Suggested servings per day:* 2. *Energy per day:* 296 kcal. *Cost (US$):* per 30-g ration, 0.0216; per 100 g, 0.072 (cost of sugar not included). *Rations per package:* 33 rations of 30 g each. *Weight of package:* 1,000 g. *Mixing and cooking instructions:* Ingredients for one serving: 3 tbsp product, 1½ cups water, 2 tbsp sugar, cinnamon. Place one cup water in a cooking pan, add sugar and cinnamon, heat until boiling. Dissolve product in ½ cup water and mix with the other ingredients. Boil for 10 min, stirring constantly. Serve hot. *Other relevant information:* Bienestarina does not contain additives or preservatives. Keep product in cool place, protect from moisture and heat. Product cannot be sold. Bienestarina is produced both raw and pre-cooked.

a. A blank space indicates that the product was not fortified with this nutrient. However, the nutrient may be present if it occurs naturally in the product.

Colombiharina: nutritional characteristics

Nutrient	Amount per 100 g dry product[a]	Compound
Protein	21.7 g	
Energy	383 kcal	
Fat	1.3 g	
Vitamin A	5,000 IU	Vitamin A acetate 325
Thiamine (vitamin B_1)	1.83 mg	Thiamine HCl
Riboflavin (vitamin B_2)	1.08 mg	Riboflavin
Niacin	13.3 mg	Nicotinamide
Vitamin B_6		
Vitamin B_{12}		
Folic acid		
Vitamin C		
Calcium	500 mg	Calcium carbonate
Zinc	8.33 mg	Zinc sulphate
Iron	14.2 mg	Ferrous sulphate
Magnesium		
Phosphorus	275 mg	
Iodine		
Selenium		
Copper		

Ingredients (in descending order): rice flour, soya bean flour, calcium carbonate, iron, zinc, phosphorus, vitamin A, niacin, thiamine, riboflavin, natural and synthetic flavors and colours. *Energy density:* per dry weight, 3.8 kcal/g; mixed according to recipe (12 g product + 24 g sugar + 230 ml water), 142 kcal/230 ml. *Phytate/iron ratio:* 4.0. *Phytate/zinc ratio:* 8.7. *Ration size per day:* 12 g. *Volume per ration size:* 230 ml. *Suggested number of servings per day:* up to 7. *Energy per day:* 142 kcal per ration. *Cost (US$):* per ration, 0.022 (cost of sugar not included); per 100 g, 0.186. *Rations per package:* 42 rations of 12 g each. *Weight of package:* 500 g. *Mixing and cooking instructions:* For 6 servings of porridge: bring 3 cups of milk to boil. Dissolve 4 tbsp product in 3 cups of water, add to boiling milk. Add sugar and continue boiling for 10 min, stirring constantly. Serve hot. *Other relevant information:* Not recommended for use as a breastmilk substitute before 6 months of age. Feed child using spoon or cup. Instructions for preparing cake and cold beverage. Nutritional labelling in Spanish and English. One 12-g tbsp can be used to prepare two glasses of cold beverage or one cup of porridge. Registered in Costa Rica.

a. A blank space indicates that the product was not fortified with this nutrient. However, the nutrient may be present if it occurs naturally in the product.

Solidarina: nutritional characteristics

Nutrient	Amount per 100 g dry product[a]	Compound
Protein	23 g	
Energy	340 kcal	
Fat	2 g	
Vitamin A	1,733 IU	Vitamin A acetate
Thiamine (vitamin B_1)	0.40 mg	Thiamine HCl
Riboflavin (vitamin B_2)	0.53 mg	Riboflavin
Niacin	6.66 mg	Nicotinamide
Vitamin B_6		
Vitamin B_{12}	1.7 µg	Vitamin B_{12}
Folic acid	170 µg	Folic acid
Vitamin C	29 mg	Ascorbic acid
Calcium	568 mg	Dicalcium phosphate
Zinc	6 mg	Zinc sulphate
Iron	10 mg	Reduced iron
Magnesium		
Phosphorus	440 mg	Dicalcium phosphate
Iodine		
Selenium		
Copper		

Ingredients (in descending order): corn flour, soya bean flour, non-fat dry milk, dicalcium phosphate, ferrous sulphate, zinc sulphate, and vitamins. *Energy density:* per dry weight, 3.4 kcal/g; mixed according to recipe (40 g product + 20 g sugar + 240 ml water), 216 kcal/240 ml. *Phytate/iron ratio:* not available. *Phytate/zinc ratio:* not available. *Ration size per day:* 40 g. *Volume per ration:* 240 ml. *Suggested servings per day:* 1 for infants and children, 2 for adolescents and adults, 3 for pregnant and lactating women. *Energy per day:* 216 kcal per ration. *Cost (US$):* per ration, 0.071 (cost of sugar not included); per 100 g, 0.177. *Rations per package:* 12.5 rations of 40 g each. *Weight of package:* 500 g. *Mixing and cooking instructions:* For 2 servings of porridge. Ingredients: 4 tbsp product, 4 tbsp sugar, 2½ cups water, cinnamon. Bring to boil 1½ cup water, sugar, and cinnamon. Dissolve product in 1 cup tap water, add to boiling water. Boil for 5 min, stirring constantly. Serve hot. *Other relevant information:* Solidarina does not contain additives, preservatives, or colours. Product can be used also to prepare cold beverages, cakes, cookies, and soups. Manufactured by CPC-Colombia for Fundación Solidaridad por Colombia.

a. A blank space indicates that the product was not fortified with this nutrient. However, the nutrient may be present if it occurs naturally in the product.

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Summary of discussion of article by Rozo

The bioavailability of nutrients in processed complementary foods, particularly iron and zinc, is of concern. Many products use corn and other grains that have factors that are known to affect bioavailability. Products use different mineral salts that have implications for bioavailability. Including vitamin C in a product can enhance iron absorption, but much of the vitamin can be destroyed upon cooking. In tables of the nutrient composition of processed complementary foods, it is important to include iron/phytate and zinc/phytate molar ratios, which will provide a reasonable approximation of the adequacy of mineral absorption. Likewise, energy density information should be calculated on the basis of prepared weight rather than dry weight. Clinical trials should be conducted on these foods to determine bioavailability and effects on growth and should be a high priority for research. The cost of adding mineral compounds should be considered in the context of their bioavailability.

There is a need for more data on the bioavailability and absorption rates of minerals, especially zinc. There is also a need for data on the bioavailability of iron and zinc compounds, especially in soya products. In addition to containing phytate, many vegetable proteins inhibit iron absorption. Data on the bioavailability of different compounds of iron need to be collected and summarized. There is an aggressive marketing campaign in Latin America to promote amino-chelated iron, but there is no convincing scientific evidence that its bioavailability is better than that of other, less expensive compounds. Iron-EDTA is a possible replacement for other iron salts and is provisionally allowed by the Joint Expert Food Additive Committee of the Codex. Policy makers need information so that their decisions are evidence-based and not influenced by aggressive marketing. Research is needed on the quality, purity, and bioavailability of different mineral compounds with well-controlled human studies. USAID has historically supported research on the bioavailability of iron in traditional foods. The International Life Sciences Institute (ILSI) has published documents on micronutrient bioavailability.

The Protein Advisory Group, which pre-dated the UN Sub-Committee on Nutrition (SCN), advised the United Nations on issues related to nutrition. They issued a report that outlines a protocol for assessing the clinical efficacy of products intended to be used as processed complementary foods. Because small sample sizes can be used in tightly controlled conditions, the costs of such trials can be kept reasonable. However, because at the time this document was written the focus was on protein deficiency, and hence revolved around issues of protein quality, the document may need updating or a new protocol developed to examine nutritional quality in the light of new scientific evidence. It also does not give the criteria for judging what is worthwhile to do.

The former focus on protein deficiency is reflected in the nutrient composition of many processed complementary foods that tend to be high in protein and do not reflect new scientific evidence. Not only are such high levels of protein unnecessary, but if the protein is provided by soya, it may negatively influence the flavour and acceptability.

In considering biological impact, it is important to consider who is paying. When a complementary food is purchased, the quantity purchased can be used as a proxy for biological impact, since it is assumed that a purchased food will eventually be consumed. When the government or the public sector is paying, there are very different considerations.

Processed complementary foods in the World Food Programme

Pieter Dijkhuizen

Abstract

The World Food Programme (WFP) distributes approximately 125,000 metric tons per year of processed complementary foods in maternal and child health and school feeding programmes and for use in refugee and emergency projects. In formulating the foods, WFP seeks the highest nutritional quality for the best cost. Safety is never compromised. The cost of WFP foods is about US$360 per metric ton. The United States Agency for International Development provides half of WFP's demand, and the local manufacturers provide the rest. WFP has had a very successful experience in working with the private sector.

Introduction

The World Food Programme (WFP) distributes approximately 125,000 metric tons per year of processed complementary foods or blended foods for use in maternal and child health and school feeding programmes and in refugee and emergency projects. These foods include the well-known corn–soya blend as well as locally produced brands such as Unimix, Indiamix, and Lakuni Phala. In maternal and child health programmes, WFP takes the approach of providing large rations of low-cost commodities, recognizing that sharing of commodities among family members is likely to occur. WFP's goal is to produce as large a ration as possible for the lowest cost.

Production

Initially the US Agency for International Development (USAID) was the sole source of blended foods. Since the mid-1980s, local production has met a substantial amount of WFP's demand. Currently, USAID provides half and local manufacturers provide the other half of the blended foods that are used in programmes and projects. Local manufacturers use local ingredients, with the exception of the vitamin and mineral pre-mixes, which are purchased from international suppliers. WFP provides these local manufacturers with the product specifications and the processing instructions, which are consistent with those in the Codex Alimentarius. Independent registered surveyors inspect the product to ensure that it qualifies for the Certificate of Fitness for Human Consumption required by the General Assembly 1995 Consumer Protection Act. The cost for this certificate is less than US$2 per metric ton. WFP allows local producers a 10% profit on the product.

Efforts to involve local manufacturers started with small-scale, community-based projects. However, these initial efforts, in which each producer only produced about 300 metric tons per year, were not successful, for a number of reasons. With small-scale production, the production levels were not large enough to permit the necessary economies of scale. In addition, there were problems of quality control and of finding and maintaining qualified managers. Several of these projects are still operational, though without outside technical support from WFP.

Since 1991, WFP has shifted its focus to work with private-sector companies in a number of countries, including Bangladesh, Eritrea, Ethiopia, India, Kenya, Malawi, Nepal, Nicaragua, Senegal, Uganda, and Zambia. Each company produces in excess of 2,000 metric tons per year. WFP regulations require that foods produced locally be compatible and comparable with substitutes such as corn–soya blend, which can be produced in the United States and imported into a given country for less than US$500 per metric ton.

The approach taken in developing local processing capability starts by the assessment of potential processing capability. Companies are selected through a process of public tender, which includes price agreements. WFP provides training and technical assistance to ensure that

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Mention of the names of firms and commercial products does not imply endorsement by the United Nations University.

foods meet all product specifications. In instances where it is determined that inadequate processing capacity exists, WFP leases the necessary equipment to a private-sector company and provides training as well as technical assistance. Repayment for the leased equipment is made as foods are produced and sold to WFP. This approach has proved feasible in situations where no local capacity exists, since it requires no investment and risk-taking on the part of the producer and thus guarantees that WFP can negotiate a very low price for the food.

Cost

Cost is an important factor in the formulation of foods, and WFP seeks the highest nutritional quality for the best cost. Sometimes there must be a compromise between quality and cost. Safety, however, is never compromised. By reducing the fat content from 10% to 6%, the cost was reduced by 10% to 15%. For the same reason the content of calcium was reduced from 600 to 100 mg per 100 g of dry product. The addition of dried skim milk increases the cost but greatly improves the flavour and is used in only a few situations. The costs of WFP products per metric ton are given in table 1. On average, the foods cost US$360 per metric ton, with 70% of the cost going towards the purchase of raw materials. The remaining costs relate to direct costs, indirect costs, interest, and the profit margin allowed to local producers.

WFP is able to produce processed complementary foods at costs about 15 to 20 times less than those of brands on the commercial market. Cost is extremely important, not only in situations in which the food is provided free of charge in the context of a programme or project, but also because of implications for commercial marketing. Social marketing research in Benin, Burundi, and Sierra Leone in the 1980s showed that a weaning product (100 g/day) that cost two to three times as much as a staple food was affordable for poor mothers.

WFP has had a very successful experience working with the private sector. The contracts that WFP uses are always very clear. If compliance is a problem, WFP threatens to take legal action, although usually initiating such actions is sufficient to resolve any problems. Relationships with governmental organizations, however, have proven more difficult.

TABLE 1. Cost analysis per metric ton (US$)[a]

Variable	Cost	Analysis	Range
Raw materials			
Ingredients	200		
Pre-mix	30	250	200–330
Packaging	20		
Direct costs			
Energy	15		
Labour	15		
Management	10	45	
Maintenance	5		
Indirect costs			70–120
Administration, etc.	10		
Depreciation	15	35	
Interest	10		
Profit 10%	30	30	
Total		360	300–500

a. Corn–soya blend from USAID costs US$325 FOB. The brand Indiamix costs US$300 ex-factory.

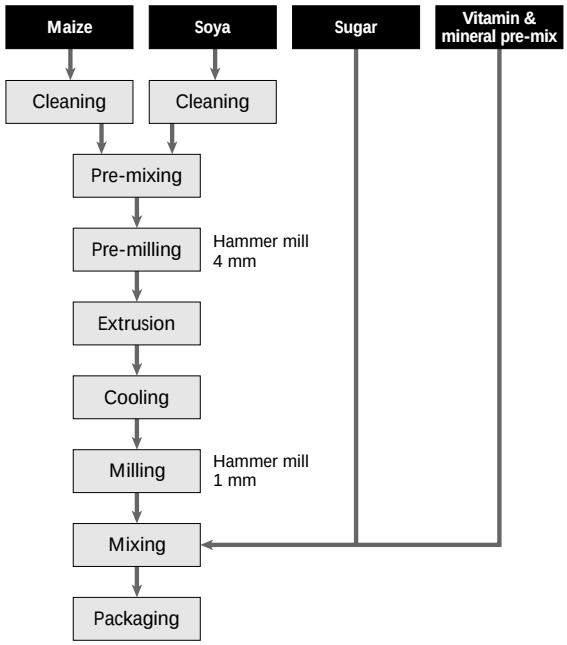

FIG. 1. Processing by the extrusion method

Equipment

Complementary foods are generally manufactured by one of two processes: extrusion and infra-red roasting. Extrusion is a more technologically advanced method, and the extruder costs about US$300,000. The extruder can produce between 1 and 1.5 metric tons per hour and requires 125 kilowatts of power per metric ton. The maintenance costs are about US$2 per metric ton.

An infra-red roaster costs about US$100,000 and can produce between 0.75 and 1 metric ton per hour. In addition to 50 kilowatts of power, it requires 5 litres of

diesel fuel per metric ton. The maintenance costs are about US$1 per metric ton.

Examples of processing for both types of equipment are illustrated in figures 1 and 2. WFP recently commissioned a complete extrusion facility for the production of corn–soya blend in Nicaragua.

Products

Corn–soya blend is a very basic product. It contains very little flavouring and is acceptable as an *atole* or drink in many countries. Corn–soya milk has a formulation similar to that of corn–soya blend, with the addition of 5% to 10% of dried skim milk. The addition of dried skim milk significantly improves the taste but also increases the cost by US$100 per metric ton.

Packaging costs are highly variable, depending on the amount packaged and the quality of materials used. Attractive small-quantity packaging increases the cost by about US$100 to US$150 per metric ton as compared with the current packaging costs. The cost of producing corn–soya milk in attractive small packages in Latin America is likely to be around US$500 to 600 per metric ton.

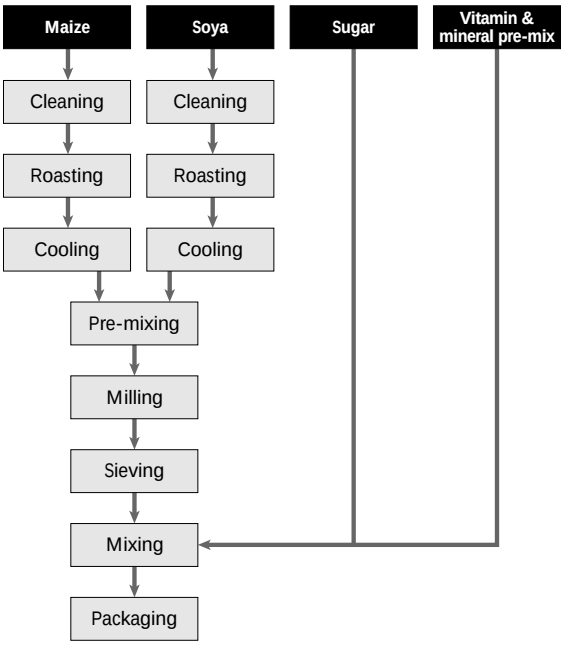

FIG. 2. Processing by the infra-red roasting method

Title II food aid and the nutrition of children in Latin America and the Caribbean

Thomas Marchione

Abstract

This article addresses the policy, programme, and food-commodity aspects of United States non-emergency food assistance programmes in the Latin American and Caribbean region since the end of the Cold War. The article contains an analysis of the cost, composition, and quality-control improvements of United States Public Law 480 (P.L.480) Title II foods, which reach over one-half million recipients each year through 16 maternal and child health programmes in 6 countries. After a description of the changes in maternal and child health programmes in the 1990s, the author concludes that further improvement in the nutritional status of young children in Latin America will take place more readily from the transformation of food distribution programmes into food and nutrition security programmes than from isolated acts of supplying complementary foods of improved quality.

Introduction

The mixed reputation of non-emergency project food aid as a means to improve the nutritional status of needy children is changing, because programmers have realized that nutrition results do not come about simply by providing food. Title II has provided good-quality complementary foods to children for decades, yet the nutritional results of maternal and child health feeding programmes up to the early 1990s were uneven at best. In the 1990s, foods intended for children have been further improved, but it is the sweeping amendments to Public Law 480 Title II that have forged non-emergency food aid into a more effective development and public nutrition tool in the hands of the US Agency for International Development (USAID) and its co-sponsoring non-governmental organizations. In 1990 the US Congress transformed the overall foreign policy mandate of the law from the development of the US international agricultural market to the enhancement of food security in developing countries. The new legislation applied particularly to Title II programmes, which were provided an annual cash component for the technical improvement and administration of food programmes supported by non-governmental organizations, and both USAID and non-governmental organizations were held accountable for achieving food security and nutrition results, such as child growth.

These changes were further stimulated by other economic and development conditions of the post-Cold War period. Throughout most of the 1990s, US food stocks were declining, development budgets were shrinking, and emergency demands for food aid were soaring. Development project planners were motivated to use food aid more efficiently or not to use it at all. Eventually the overall volume of US and global food aid fell by nearly two-thirds during the period from 1993 to 1998, but P.L.480 Title II, supported by a variety of humanitarian and commercial interests, survived relatively undiminished. In the late 1990s, annual non-emergency Title II food aid continued to be around 900 thousand metric tons, valued at approximately US$400 million a year. Over half was directed to maternal and child health and nutrition programmes, and in general project food aid began to fill an increasingly vital role in social development, as developing countries shifted to market development and more democratic local governance.

Title II complementary foods in Latin America

The US Government has provided food assistance under the Public Law 480 Title II programme to Latin

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America and the Caribbean for decades. In fiscal year 1998,* 26% of all Title II P.L.480 non-emergency food aid went to Latin America and the Caribbean. The total programme, valued at US$124 million, was composed of maternal and child health nutrition, water and sanitation, agriculture productivity, micro-enterprise development, school feeding, and humanitarian relief programme activities. Maternal and child health nutrition programmes comprised about one-third of this total, although the other activities, or combinations of activities, also have positive food and nutrition security implications for children of the region.

In the 1990s, as Title II worldwide became more focused on food-insecure, low-income countries, the numbers of programme countries decreased in Latin America and the Caribbean. In 1998, 16 non-emergency Title II programmes remained in 6 countries: Bolivia, Guatemala, Haiti, Honduras, Nicaragua, and Peru. The programmes were being conducted largely by international non-governmental organizations based in the United States and a few non-governmental organizations based in the recipient countries. US Government programme grants totaled US$46 million, including the value of the food and its transportation plus US$1.5 million in programme administration dollar assistance. About half of the food was directly distributed and half was sold within the recipient countries to support non-governmental organization local currency programme expenditures (monetization). However, only in CARE's programme in Peru were all commodities monetized; in all the other programmes, direct distribution of commodities to households or institutions continued to play a part in the maternal and child health programmes.

A variety of P.L.480 foods were directly distributed in the maternal and child health programmes, including corn, vegetable oil, and bulgur wheat and other wheat-based products. The foods specially designed for complementary feeding of children are corn–soya blend and wheat–soya blend. In 1997 wheat–soya blend was used exclusively in the Haitian programmes, and corn–soya blend was used in the other five countries. Wheat–soya blend and corn–soya blend are produced by US commercial food processors; they are formulated, blended foods composed of partially pre-cooked cereal grains, enhanced with protein concentrates and fortificants. Blended foods were specifically designed for young children as supplements to a regular diet. In fiscal year 1997, 13,051 metric tons of corn–soya blend and 54 metric tons of wheat–soya blend were distributed in Latin American and the Caribbean, intended for consumption by approximately 600,000 recipients [1].

* The US Government fiscal year runs from 1 October to 30 September. For example, fiscal 1997 began on 1 October 1996 and ended on 30 September 1997. All annual periods in this article are US fiscal years.

Composition and cost of blended P.L.480 foods

Corn–soya blend consists of two-thirds gelatinized corn meal by weight, to which are added defatted and toasted soya flour and soya bean oil, and vitamin and mineral pre-mixes. Wheat–soya blend is more than half bulgur wheat flour, to which are added wheat protein concentrate, soya flour, soya bean oil, and the pre-mixes. The pre-mixes, although a small proportion by weight (3%), are made up of 17 minerals and vitamins important to the growth and health of young children and other physiologically vulnerable groups (table 1) [2, 3].

Formulated blended foods were first introduced in 1966, over 10 years after the P.L.480 programme began in 1954. Corn–soya milk and wheat–soya blend were introduced to complement the uncertain supply and acceptance of dry milk as a protein source, which was widely distributed at that time. Blended foods were originally developed by the US Department of Agriculture (USDA) and USAID with the assistance of the National Institutes of Health. The nutrient profile was designed to supplement the diet of growing children, which was assumed to be more deficient in protein, minerals, and vitamins than in total energy, a prevalent view of nutritional deficiency in the 1960s. Ideally, 100 g of the food would provide a one- to two-year-old child with one-third of energy needs and two-thirds of the protein, vitamin, and mineral recommended dietary allowances established by the National Academy of Sciences/National Research Council [4]. Since these foods are also consumed by mothers in developing countries, the folic acid levels have been increased in keeping with the needs of pregnant women. As milk surpluses were exhausted in the later 1980s, corn–soya milk was replaced by corn–soya blend, but the nutrient profile was largely maintained.

Under the watchful eyes of nutritional expert groups, the formulation of blended foods has been changed slightly and infrequently to reflect new scientific knowledge. In 1988 vitamin A levels were doubled in all fortified foods, including wheat–soya blend and corn–soya blend. Also in 1998, magnesium was added, zinc levels were significantly increased, and vitamin B_{12} levels were decreased in the two blended foods [3, 5, 6].

Quality control

Until quite recently insufficient attention was given to quality control of micronutrient levels in blended foods. Unlike products made for the US commercial market, products made for the P.L.480 programme by US commercial food companies were not required by USAID or USDA, which procures P.L.480 foods, to meet product standards. The US Food Grain Inspection Service (FGIS) of USDA did routine proximate analysis of food aid

TABLE 1. Nutritional characteristics of wheat–soya blend and corn–soya blend per 100 g of dry product

Nutrient	Wheat–soya blend[a]	Corn–soya blend[b]	Vitamin and mineral compounds added
Protein (g)	21.5	17.2	—
Energy (kcal)	354.5	375.7	—
Lipid (g)	5.9	6.9	—
Vitamin A (IU)	2,323	2,612.2	Vitamin A palmitate, stabilized, 250 SD
Thiamine (vitamin B_1)(mg)	0.54	0.53	Thiamine mononitrate
Riboflavin (vitamin B_2)(mg)	0.50	0.48	Riboflavin
Niacin (mg)	8.19	6.23	Niacin
Vitamin B_6 (mg)	0.47[c]	0.5[d]	Pyridoxine HCl
Vitamin B_{12} (µg)	1.00	1.0	Vitamin B_{12}, 1%
Folate (µg)	275	300	Folic acid
Pantothenic acid (mg)	3.7	3.4	Calcium *d*-pantothenate
Vitamin C (mg)	40	40	Ascorbic acid, 2.5% ethyl cellulose coat
Vitamin D (IU)	198	198	Vitamin D, stabilized, 100 SD
Vitamin E (mg)	8.7	8.7	*dl*-α-Tocopherol acetate, dry, 50%
Calcium (mg)	842	831	Tricalcium phosphate
Zinc (mg)	5.5	5.0	Zinc sulphate
Iron (mg)	17.85	17.49	Ferrous fumarate
Magnesium (mg)	227.26	173.8	Magnesium sulphate
Phosphorus (mg)	294	206	Tricalcium phosphate
Iodine (µg)	56.88	56.9	Potassium iodate

Source: refs. 2 and 3.

a. *Ingredients:* 53% bulgur flour; 20% wheat protein concentrate; 20% soya flour, defatted; 4% soya bean oil, stabilized; 3% vitamin and mineral pre-mixes. *Energy density (g/kg):* 3.54 dry, 0.50 as cooked gruel. *Phytate/zinc ratio:* 23.1 molar. *Phytate/iron ratio:* 5.6 molar. *Other information:* ration size, cost, and preparation recipes vary widely. See text.

b. *Ingredients:* 69.5% corn meal, processed and gelatinized; 21.8% soya flour, defatted and toasted; 5.5% soya bean oil, refined, deodorized, and stabilized; 3.0% vitamin and mineral pre-mixes. *Energy density (g/kg):* 3.74 dry, 0.50 as cooked gruel. *Phytate/zinc ratio:* 7.8 molar. *Phytate/iron ratio:* 2.4 molar. *Other information:* ration size, cost, and preparation recipes vary widely. See text.

c. 0.17 mg pyridoxine HCl.

d. 0.2 mg pyridoxine HCl.

lots for bacterial contamination, moisture levels, and protein levels, among other processed food characteristics, but they did not routinely test, nor did procurement officials enforce, micronutrient levels in the products. In 1999, one-third of a century after blended products were introduced, USAID-sponsored research, conducted in cooperation with USDA, eventually led to the establishment of micronutrient standards and a USDA monitoring programme, and an enforcement programme was scheduled to begin on 1 January 2000 [7].

The new standards are consistent with the enforcement by the US Food and Drug Administration of label claims by the US commercial food industry. USDA will use vitamin A as a nutritional indicator to ensure that all vitamins in the vitamin pre-mix are present at a level no less than 20% of the added amount specified, i.e., 1,815 IU of retinal palmitate per 100 g in the finished product. Iron (ferrous fumarate) will be used as the nutrient indicator to ensure that minerals in the mineral pre-mix reach their full level, e.g., 14.7 mg in 100 g of finished product [3]. Lots of blended food aid will be routinely tested by USDA laboratories to ensure that these levels are met.

Cost of blended foods

The cost of P.L.480 food aid to the US Government changes frequently in response to US and world market conditions. In recent years, blended food commodity costs have ranged from around US$200 to US$400 per metric ton. When shipping and internal transportation costs were added, corn–soya blend was somewhat more costly to produce and deliver than other favourite processed food aid commodities, such as wheat flour, corn meal, and bulgur wheat, which ranged from US$258 to US$311 per metric ton in 1997 (table 2).

The greater variety of fortificants in blended foods also increased their cost in comparison with other processed and fortified foods. The cost of mineral and vitamin fortificants, the most costly of which was tricalcium phosphate, totalled US$47 per metric ton. Among the micronutrients added, vitamin C and vitamin A have been the most costly during the 1990s. From 1990 to 1998, USAID procurements of processed and fortified food aid commodities for its worldwide programmes included over US$40 million for vitamins A, C, and E and three of the B vitamins.

TABLE 2. P.L. 480 Title II fortified foods provided worldwide in fiscal year 1997

Commodity	Quantity provided (1,000 metric tons)	Average total cost[a] (US$/ metric ton)	Total value (million US$)
Corn–soya blend	211	335	70.7
Wheat flour	161	305	49.1
Bulgur	68	258	17.5
Bulgur, soya fortified	60	276	16.6
Corn meal, soya fortified	43	310	13.3
Corn–soya masa flour	1	362	0.4
Corn meal	24	311	7.5
Sorghum grits, soya fortified	14	304	4.3
Wheat–soya blend	9	458	4.1
Total	591		183.5

Source: ref. 3.

a. Cost to the US Government for procuring and shipping the commodity and for contributions to internal transportation and handling.

TABLE 3. P.L. 480 Title II maize-based foods provided to Latin America in fiscal year 1997

Commodity	Quantity provided (metric tons)	Average commodity cost (US$/ metric ton)	Average total cost[a] (US$/ metric ton)
Corn–soya blend	13,051	252	360
Corn meal, soya fortified	110	223	440
Corn–soya masa flour	980	237	362
Corn (unprocessed)	9,300	122	218
Total	23,441		

Source: ref. 1.

a. Cost to the US Government for procuring and shipping the commodity and for contributions to internal transportation and handling.

In 1997 corn–soya blend purchased for Latin American countries cost the US Government an average of US$252 per metric ton. This was comparable to the cost of other processed maize products and was more than double the cost of unprocessed bagged and bulk corn (table 3). When the costs of shipping and of USAID contributions to internal transportation to the distribution sites were included, the cost of corn–soya blend to the US Government was US$360 per metric ton or US$0.036 per 100 g. (Wheat–soya blend delivered to the region was probably more costly because it was ordered in smaller quantities and produced through batch-processing techniques that are more labour-intensive than the continuous processes by which corn–soya blend is produced.) In 1997 the median corn–soya blend ration in the Latin American maternal and child health programmes was 47 g per person per day, and the cost, including shipping and transportation, was 1.7 cents per person per day.

Although the commodity costs of blended foods were greater than those of other foods that were supplied, they were less than 10% of the costs of US Government grants for maternal and child health nutrition programmes in the region. The reason is that other foods were needed in the diet or were more readily monetized by non-governmental organizations for cash proceeds. In addition, cash grants to the non-governmental organization headquarters and country programmes made up a small but significant part of the costs.

Reaching the recipient child

Overcoming the problems of producing an adequately designed complementary food is only the first step for anyone relying on food aid to directly address the food needs of poor children. Nutrients have to be stable during shipping, storage, and food preparation, be culturally acceptable to householders, and reach the intended beneficiaries in adequate amounts. Regarding the latter point, although blended foods are thought to be "self-targeting" to young children, they are frequently used as ingredients in other family dishes and do not always naturally gravitate to pre-school children.

Most nutrients in blended food are quite stable in shipping and storage, but a loss of up to 36% of vitamin A has been observed in wheat–soya blend and a smaller loss in corn–soya blend. This loss occurred nine months after the food had been produced, packed in paper bags with double polyethylene linings, shipped, and stored in Haitian warehouses. Once food aid reaches the appropriate recipient households, losses in cooking can also be large. During the preparation of a gruel (12% solids), losses of 50% of the vitamin A and 75% of the vitamin C present in the dry product before cooking are not uncommon, although these losses are less in preparations requiring less water, such as Haitian dumplings [3].

Once the food is prepared, there is always the problem of assuring that the food will be acceptable and will be offered to and consumed by the intended children in the household. On the assumption that corn–soya blend planned for Latin American programmes in 1997 reached children under five years of age, corn–soya blend was indeed a good source of nutrients. For

example, 47 g of corn–soya blend consumed by a child from one to two years of age would have provided a good complementary source of key nutrients important to growth and health, particularly protein, because of the copious soya fortification of these products (table 4). The nutrient density per 100 kcal is high, especially for protein, but where energy is limiting child growth, corn–soya blend does not fill the requirements. Other foods in a food ration or food from the family pot would have to meet the energy shortfall.

Improving children's nutritional status through Title II food aid programmes

Accepting that blended food aid can deliver adequate nutrients in complement to breastmilk does not ensure the nutritional well-being of children. Nutritionally oriented food assistance programmers have learned over the past five years that if sustainable food security and nutritional outcomes are to be achieved, direct feeding is a limited means of achieving that goal [9, 10]. Clearly, food itself must be complemented with other development inputs to yield sustainable nutritional improvement or any nutritional improvement at all. In fact, recent evidence from "hearth" programmes in Haiti and Vietnam has demonstrated that even under severe conditions of economic deprivation, dramatic positive impact on children's nutritional status can be achieved without any resort to outside food assistance [11, 12]. The focus of such programmes is on improved child-feeding practices, targeted health interventions, and alleviation of poverty. The foods introduced for children are locally available and already known to the few low-income mothers with well-nourished children, such as river shrimp in Vietnam.

In households and institutional settings in developing countries of Latin America and the Caribbean, malnutrition of children is generally the result of the combination of food insecurity, poor access to health services and poor public health infrastructure, and poor care in the home, the three underlying causes of all nutritional failure [13, 14]. Where households have the potential, more basic causes can be addressed. Food-for-work programmes and activities funded through the monetization of food aid can be used to stimulate longer-term food security by helping to build agricultural infrastructure and micro-enterprises, combined with nutrition and child-care education of mothers, for example. Monetization resources can also strengthen access to health care by training local health facilitators and promoters, and food itself can serve as a incentive for busy mothers to participate in health and nutrition activities [15]. In orphanages and institutional settings, food aid may be needed indefinitely, but even in these situations, attention to health services and child care cannot be neglected.

Grass-roots organizations and many US non-governmental organizations that operate food aid programmes, such as CARE and Catholic Relief Services, have developed this approach over the past five years. Former maternal and child health food aid distribution programmes are becoming more sophisticated and similar to cash-funded child-survival programmes in their designs and impact monitoring. Maternal and child health nutrition programmes in Latin America are usually coordinated with agriculture, micro-enterprise, water, and sanitation or other activities in an effort to make a sustainable impact on food and nutrition security. Especially where national economic and political policies are favourable to food security and grass-roots social programming, this new approach holds great promise for the nutritional improvement of low-income groups in Latin America and the Caribbean.

The shift in the strategy of food aid programmes from food delivery to child survival and food security programmes has been in direct response to the 1990 P.L.480 legislation which mandated that food aid programmes

TABLE 4. Estimate of corn–soya blend as a complementary food in Latin American maternal and child health nutrition programmes

Nutrient	Available[a] (per gram)	Consumed[b] (per day)	Needed[c] (per day)	Need satisfied (%)
Energy (kcal)	3.78	219	746	29
Protein (g)	0.17	8.0	5.0	160
Vitamin A (IU)	6.53	307	378	81
Iron (mg)	0.18	8.5	11.8	72
Zinc (mg)	0.05	2.4	4.1	58

a. It is assumed here that 75% of vitamin A is lost in transport, storage, and cooking; other nutrients are taken as their target levels.

b. Consumption at 47 g of corn–soya blend per day, the median level in Latin American maternal and child health nutrition programmes in 1997.

c. Estimated from WHO [8] for children 12–23 months of age at average levels of breastmilk intake.

address food insecurity, be better integrated with development programmes, and be more accountable for achieving improvements in food security and nutritional results in the poorest communities in the more food-insecure countries [16]. A significant part of this legislation was the provision of more direct dollar support to cooperating non-governmental organization sponsors and raising the minimum level of monetization for local programme financing. This change occurred when agricultural prices were rising and food stocks were falling as a result of liberalized international trade agreements and lower US agricultural subsidies that took hold after the end of the Cold War.

In recent years, however, this new strategy has succeeded all too well. Non-governmental organizations have used the new cash funding to become more technically competent in designing food aid programmes and have pushed monetization of food aid from the 15% minimum mandated by the US Congress to more than 50% [17]. The increase in monetization was further accelerated when USAID field missions curtailed funding for complementary programme inputs to field programmes. This was one of the consequences of shrinking development assistance since the early 1990s, a post-Cold War trend with wide ramifications for the practice of nutrition [18, 19]. Furthermore, the social budgets of developing countries have been stressed by structural adjustments beginning in the 1980s, precluding their participation in such programmes.

This has resulted in negative trends in the use of formulated foods, which are used for direct feeding, in favour of bulk foods and whole grains, which are more easily monetized. The decreased use of formulated foods has caused alarm on the part of US food aid processors and other food commodity interests, who view the food aid programme in terms of jobs and income for US workers and market development abroad, and who form part of the strong US constituency viewing food aid as the simple act of feeding people. The position of US commercial food interests has been further motivated by the reversal in food commodity prices and the growth of food surpluses in the later 1990s. For example, wheat prices have declined sharply in recent years, and in the summer of 1998 President Clinton directed the US Government to purchase 2.5 million metric tons of wheat and wheat products from US farmers under the Agricultural Act of 1949 to support prices and meet humanitarian needs. This situation ended the unbroken string of declining national food stocks and federal subsidies to US agricultural producers, rekindling market surplus pressures on food aid programmes. Consequently, the programme faces pressures to use more direct feeding and, if possible, to increase the sale of value-added commodities such as corn–soya blend in developing countries. The question now facing the Title II development programme is how to accommodate these pressures while maintaining the more sophisticated and innovative uses of food aid to address food and nutrition insecurity that emerged in the middle of the decade.

Summary

P.L.480 blended foods play a small but significant part in filling the need for complementary foods in Latin American development programmes. Corn–soya blend and wheat–soya blend reach approximately 600,000 recipients of maternal and child health nutrition programmes in low-income communities in six of the more food-insecure countries of the region: Bolivia, Guatemala, Haiti, Honduras, Nicaragua, and Peru. These products were formulated and introduced through the Title II programme in 1966 to meet the needs of growing children. They are high-quality foods that potentially can meet the entire protein needs and a large portion of the other nutrient needs of children under five years of age, if the programmes are able to appropriately target the foods on such children. However, these foods, even under ideal conditions, are not provided in sufficient quantities to meet the complementary food energy needs of this age group, and probably should not be expected to do so, considering that food aid should be provided only on a temporary basis and could easily be given with the use of less costly sources of food energy.

In any event, the provision of the best complementary food through the best delivery vehicles, either through public programmes or commercial markets, cannot solve the nutritional and food security needs of the region's poor communities. Title II programmers, like all health and nutritional programmers, have discovered that nutritional improvement is tied to a broader set of underlying and basic causes of poor nutrition, including access to health care, better care of children, and alleviation of poverty and food insecurity. The transformation of Title II programmes in the 1990s from largely distribution programmes to child survival and food security programmes has raised hopes that food aid can have a greater effect on the nutritional status and food security of low-income families in Latin America and the Caribbean then it ever has, if it can stay on course.

Acknowledgements

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Summary of discussion of articles by Dijkhuizen and Marchione

Acceptability and use. The notion of a "captive audience" when speaking of food recipients was challenged because of studies that show that even malnourished children who were not meeting their energy needs left food on their plates. The WFP representative responded that the WFP has a mandate to provide wholesome, nutritionally balanced, and culturally acceptable foods. With respect to the idea of a "captive audience," it is important to note that the WFP distributes three-fourths of the food in emergency situations, and in the other non-emergency settings the poorest of the poor are being selected as beneficiaries. The WFP provides recipes showing how corn–soya blend or wheat–soya blend can be used for making traditional foods. Therefore, the recipients do not consume the blended food as it comes but use it as an enriched staple with which to make their own traditional foods. Fancy tastes are not added.

When the use of these blended foods has been studied, it has been found to be quite variable. In Haiti corn–soya blend is used to make dumplings and is cooked for a very long time, with a consequent loss of nutrients. In the refugee camps in Tanzania, it is used to make pap, whereas in other places it is made into *ugali*, a maize paste eaten with the hand. The blended foods have become very much adapted to local cultural norms. There is enormous variation in India from one state to another, since blended foods have been there for so many years that they have been integrated into various types of foods.

Use and impact. It is often difficult to evaluate the impact of blended foods, because they can be sold and used for income transfer. One participant noted that often this seemed to be accepted by the agencies distributing these blended foods. However, as noted by one of the speakers, to measure the impact of only the food component of the overall health and nutrition strategy does not make a lot of sense. A recent USAID report on food aid in five countries made negative comments about the nutritional impact, because it was difficult to disentangle the impact of food as a result of leakage, sharing, etc. However, the problem is that these programmes were incorrectly designed. Food is part of a broader intervention that should include nutrition education, health care, etc., before an effect on nutritional status should be expected. It's not just "food as food" that needs to be measured. Very little is known about the extent to which blended foods are sold.

The WFP commissioned Oxfam to study the acceptability of corn–soya blend in refugee camps in Asia and Africa. Oxfam found that the product was well accepted because it could be easily adapted to local cultural practices. Because blended foods have no commercial value, they are not sold. Oil is much more likely to be sold because there is a market for it.

Monetization. The large amount of monetization that is occurring with food aid and the subsequent decline in the use of value-added commodities such as blended foods has resulted in a discussion of the marketability of blended foods in the recipient countries. A commercial market has not been developed around these foods; however, they appear to be acceptable. There is interest on the part of US manufacturers in having these blended foods commercially marketed in recipient countries owing to the drop in their use in food aid programmes because they cannot be monetized to pay for other programme inputs. Because the blended foods cannot currently be monetized, they are less in demand in food aid programmes. If a commercial market were to be developed for these foods, however, other problems would need to be resolved, such as disincentives for the development of local or national blended foods.

Programme objectives. The context in which these blended foods are used is important. If the objective is the alleviation of poverty, does it matter if the foods are sold? On the other hand, if the objective is improved nutrition, then the sale of foods is of importance. Ten years ago most of these foods were used for development, whereas today most of them are used for emergency feeding. In an emergency setting, the blended foods play a very crucial role that the other foods do not. Refugees treat these foods very differently and are less likely to sell them. Because much of the food is used for feeding refugees, the value-added foods are likely to play a critical role in infant and young child nutrition. There is almost no research on how these blended foods are used.

Complementary inputs. Context-specific complementary inputs are often necessary when food aid is considered. In emergencies women often need firewood, pots, or both to prepare food, and if these are not provided, the food is more likely to be sold.

Roasting. Extensive studies have been done on protein, particularly on the lysine content of WFP foods after roasting. When a cooling mechanism is used immediately after roasting, the lysine levels are acceptable. Extrusion is a better and more easily controlled method, but it not always feasible.

Panel: What are the relative roles of processed complementary foods and behavioural change in improving nutritional status?

The need for strategic planning, not a technological fix

Marcia Griffiths

Abstract

We know from past experience that nutritional status can be improved by improving practices without the use of processed food. The question should be: Can food alone, in the absence of improved practices, improve nutritional status outside a rehabilitative, structured feeding situation? Projects discussed in this paper demonstrate that there can be biological impacts from improved practices. Helping families use their own resources better is an important first step, not a last step, in programme development. The lessons that have been learned over the years for improving young child feeding are as follows: science is not enough; knowledge is not enough; the focus should be on improving practices; mothers are not a homogeneous group; and the solution is seldom singular. Processed complementary food is really a small piece of a larger picture that needs to be thought about strategically on the basis of practices and the barriers to improving them. It is important to work with governments to help them formulate and think through the options that present themselves to improve the nutritional intake of young children. Rather than using a zoom lens, which often magnifies the food component, we need to use a panoramic lens to see other options when helping countries.

Introduction

The question put before the panel was: What are the relative roles of processed complementary foods and behavioural change in improving nutritional status? We know from past experience that nutritional status can be improved by improving practices without the use of processed food. The question should be: Can food alone, in the absence of improved practices, improve nutritional status outside a rehabilitative, structured feeding situation?

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A brief refresher

In the late 1970s and early 1980s, the Government of Indonesia implemented the Nutrition Communication and Behaviour Change Project, which offered no processed or subsidized food. Through radio and village volunteers, mothers were taught to prepare an improved homemade food and to improve daily practices. Significant differences in weight-for-age and height-for-age were found between the project and the control villages. The nutritional status of 40% of the children in the programme was significantly improved. By 18 to 24 months of age, there was an average difference of +0.5 SD between children in families participating and not participating in the programme. After the introduction of an improved home-prepared weaning food and improvement in feeding frequency, the precipitous drop in weight that normally occurs at about three to four months of age was delayed until seven months [1].

Several years later, the Applied Nutrition Education Project (ANEP) sponsored by the US Agency for International Development (USAID) in the Dominican Republic also focused on changing practices. No new food was introduced. In fact, this project replaced an ineffective feeding programme. After two years of implementation of ANEP, the prevalence of moderate and severe nutrition was reduced by 38% in ANEP communities as compared with control communities. A 43%

reduction in moderate and severe malnutrition was found in ANEP communities over the course of the project. The longer a community participated, the greater was the reduction in malnutrition. This improvement occurred while overall rates of malnutrition were worsening in the country [2].

Improving feeding practices without introducing new foods was also the focus of the Weaning Project, a multicountry effort supported by USAID. The only country with a rigorously evaluated programme was Indonesia. Nutrition education alone produced significant increases in both weight-for-age and height-for-age of children who participated in the project as compared with children in control communities. The longer the children participated, the greater was the improvement [3].

Lessons learned

These projects and others demonstrate that improved practices can have biological impacts. In country after country, trials of improved practices (TIPS) done as part of formative research show that families can improve the food intake of their children from their own resources. Helping families while their own resources improve is an important first step, not a last step, in programme development. The following lessons have been learned over the years for improving child feeding.

Science is not enough. Certainly nutrition improvement programmes must be based on the latest scientific findings about what is efficacious. But for programmes to be successful and sustainable, there has to be a merger between the science and the feasibility of implementation. If the perfect food is diluted, not fed frequently enough, or allowed to spoil, it will not have its intended results.

Knowledge is not enough. In order for practices to change and nutritional status to improve, we need to do more than just teach nutrition. We need to close the gap that exists between knowledge and practice.

The focus should be on improving practices. This means that programme actions should be designed to remove barriers to improving child feeding, whether they are physical or attitudinal.

Mothers are not a homogeneous group. We need to understand their lifestyle contexts and make the programme relate to it. This means that one processed food is not going to fit all, and the same is true for improving practices.

The solution is seldom singular. In all of the successful projects mentioned above, the programmes were multifaceted and matched the lifestyles, needs, and desires of the potential beneficiaries.

The need for strategic planning, not a technological fix

How does a processed food fit into a strategic plan? First, the nutrition problem needs to be identified. Is it lack of energy or micronutrients? Is it the food, the frequency of feeding, the preparation with respect to dilution and hygiene, the method of feeding, or the quantity? It is usually not one of these problems but rather a complex of all these problems that needs to be addressed. Therefore, the strategy is multi-pronged with different components to overcome the barriers faced by families. The barriers come from many sources. It is not just that mothers do not understand. Therefore, the answer is not just knowledge, although communication for behavioural change is often a piece. It is sometimes policies that are in place in countries, other times it is the training people have received. Policy reform or enforcement and training can be important programme elements. Finally, another piece of the programme may focus on products. In some cases, it could be food. Options are multiple: a recipe for a more complete food; the addition of an ingredient from the home, such as liver or a green leafy vegetable; or an ingredient supplied by the project, such as the Nutripak in the Philippines with oil, rice, and green vegetables. There could also be a processed food that is either commercial or non-commercial, subsidized or non-subsidized. The point here is that the processed complementary food is really a small piece of a larger picture that needs to be thought about strategically on the basis of people's practices and the barriers to improving them.

My appeal is that as we work with governments to help them formulate and think through the options that present themselves to improve the nutritional intake of young children, rather than using a zoom lens, which often magnifies the food component, we need to use a panoramic lens to see other options defined by what people need and want. The Integrated Management of Childhood Illness (IMCI) initiative offers a wonderful opportunity to get key health officials to think about young child-feeding practices and the role of a food product in broader recommendations. So the answer to the question posed by the organizers of this session is that it is imperative to work on improving practices, whether or not new foods are introduced, when the goal is improved nutrient intake.

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Improving young child feeding with processed complementary cereals and behavioural change in urban Kenya

Sandra L. Huffman, Ruth Oniang'o, and Victoria Quinn

Abstract

In urban Kenya the rates of exclusive breastfeeding are low, and complementary feeding practices result in inadequate intake of energy and nutrients by young children. Although information on appropriate feeding of young children has been widely promoted through the health system for years, and mothers are knowledgeable about recommendations, inadequate feeding practices still result in high rates of malnutrition. Processed cereal blends are used by some urban mothers for infant feeding, and their cost is similar to that of porridges enriched in the home by the addition of milk, margarine, or soya flour. However, little has been done to ensure that these products are nutritionally adequate or to ensure that labelling instructions are appropriate and that they promote exclusive breastfeeding from four to six months of age. Social marketing to low-income families of fortified cereal blends that would address these concerns could be a sustainable means of improving infant-feeding practices.

Introduction

Low rates of exclusive breastfeeding in the first 6 months of life and limited intake of appropriate foods from 6 to 24 months of age are major causes of childhood malnutrition in Kenya. Combined with high rates of infection, poor feeding practices result in high rates of morbidity, retarded intellectual development, and mortality.

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Breastfeeding practices

Although about 97% of infants in urban Kenya are breastfed at birth and are breastfed for an average for 19 months, the proportion who are exclusively breastfed is minimal [1]. The median duration of exclusive breastfeeding is only 0.5 months. Other liquids or foods are given to three-fourths of all Kenyan infants by the end of the first month and to 90% of them by the end of the third month (fig. 1).

Complementary feeding practices

The principal food given to children 6 to 12 months of age is a cereal-based porridge (*uji*) made from maize or finger millet (locally known as *wimbi*). Uji is generally fed by cup about three times per day and is supplemented when possible with fruit (banana and papaya), vegetables (pumpkin, potatoes, and kale), or milk. Many urban mothers purchase pre-processed cereal blends to make uji for their infants. Children 12 to 23 months old drink uji in the morning and as a snack, but they are also fed *ugali* (made with corn meal) during the family meals.

Few quantitative data are available to assess dietary intakes of young children in Kenya. One study conducted in rural Kenya found that toddlers consumed only about 80% of energy requirements, with only 8% of their calories coming from animal products and 13% from fat, compared with 36% and more than 25% in the United States [2]. Several micronutrients have been shown to be low in children's diets, including zinc, iron, vitamin B_{12}, fat-soluble vitamins (A, D, and E), and calcium. For example, 90% of toddlers had inadequate intakes of zinc [2, 3].

In the studies in rural Kenya, maternal intake of zinc during pregnancy was related to infant length at birth,

and zinc intake among infants and toddlers was related to length. The consumption of animal products (which are high in zinc and iron) also was closely associated with length in toddlers and schoolchildren [4]. In Kwali District, Kenya, Latham et al. [5] found that schoolchildren who took iron supplements (400 mg of ferrous sulphate) on school days for 32 weeks had improved weight gain. A subsequent study in the Coast Province found that supplementation of schoolchildren with 150 mg of ferrous sulphate for 14 weeks resulted in improved appetite and increased weight gain [6].

Both iron and zinc are needed for growth, and improvement in zinc intake has been shown to reduce diarrhoea, pneumonia, and stunting and to improve intellectual functioning. Both zinc and iron intakes have been associated with improvement in appetite, which may explain their relationship with increased growth. The low intake of several other micronutrients by preschool and school-aged children affects their growth, cognitive development, and school performance.

Nutritional status of young children in Kenya

The prevalence of stunting in Kenya increases from 8% among infants less than 6 months of age to 18% at 6 to 11 months, peaking at 40% at 12 to 23 months [1]. In urban areas, 25% of children less than five years old are stunted, compared with 35% of those in rural areas. Anaemia is common in infants and toddlers in Kenya owing to low intakes of animal products and fortified food. Longitudinal studies in rural Kenya found that nearly three-fourths of toddlers were anaemic [2, 3].

Poor nutritional status in young children has been shown to be clearly related to increased risk of death. However, in addition, poor nutritional status in Kenya has been shown to be related to poor cognitive development in young children [7]. Studies in Kenya have shown that taller, heavier babies were talked to more by their caregivers and were more sociable at 6 months, and more sociable infants had greater motor skills at 30 to 36 months of age. They were also more verbally competent at five years of age [8].

What are the constraints to improving young child feeding in urban Kenya?

Factors affecting exclusive breastfeeding

Too early use of semi-solids and liquids in addition to breastmilk is a major feeding practice that should be reversed. However, detailed studies in the slums of Nairobi found that knowledge of exclusive breastfeeding and exposure to health services did not influence the incidence of exclusive breastfeeding [9]. Social support was found to be inversely associated with exclusive breastfeeding. Only those mothers with less support were free to practise exclusive breastfeeding because of lack of pressure to conform to non-exclusive breastfeeding practices.

In this study, the most common reasons mothers reported for giving their infants additional fluids varied with the baby's age. In the first two weeks, 25% of mothers indicated that the baby had stomach problems, and 17% said the stool needed softening. At three months, two other reasons were predominant: the baby was hungry (21%) and the mother's milk was not sufficient (15%). By four months, 36% reported insufficient breastmilk [9]. Such beliefs about a mother's ability to produce enough breastmilk influence the duration of exclusive breastfeeding.

UNAIDS has set guidelines stating that although there is a risk of transmission of the human immunodeficiency virus (HIV) through breastfeeding, breastfeeding should be promoted among all women except those who have been identified as HIV-positive. This is because of the high costs of alternative modes of feeding, limited access to appropriate breastmilk substitutes,

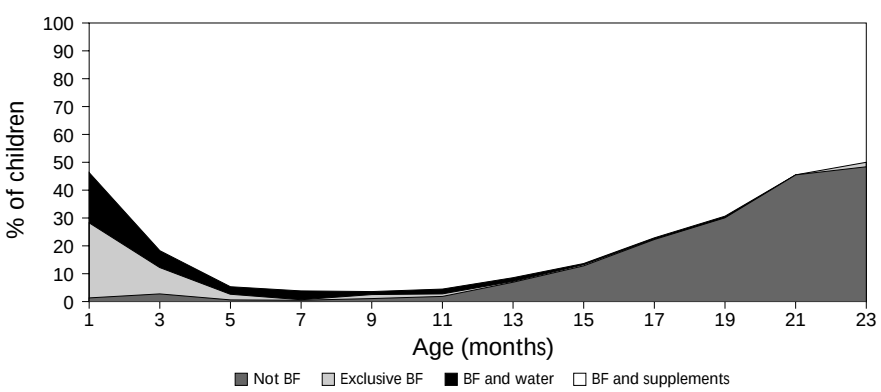

FIG. 1. Breastfeeding (BF) practices in Kenya (1998)

and likely contamination of breastmilk substitutes [10]. Even though HIV affects up to 25% of pregnant women in urban Kenya, only an estimated 4% of all infants will be infected with HIV via breastfeeding.* If breastfeeding were to decline in Kenya because of limited access to appropriate uncontaminated breastmilk substitutes, deaths from diarrhoea and acute respiratory and other infections would increase. Effective promotion of exclusive breastfeeding would improve the nutritional and health status of 98% of infants. Recent studies of HIV-positive mothers in South Africa reported that the rate of transmission of HIV to infants who were exclusively breastfed for the first three months of life was similar to that of infants who were not breastfed and substantially lower than that of infants who were partially breastfed [12].

Constraints to complementary feeding

When mothers do not have sufficient income, they feed young infants a maize-only porridge that is too low in energy density to meet their needs. Although sources of vitamin A can be procured at relatively low cost, the addition of fat sources (such as margarine) or protein and fat sources (such as soya flour or milk) is often beyond the reach of poor families. Poverty also particularly hits toddlers, because they generally eat from the family pot of ugali and vegetable sauce (and thus seldom receive foods containing milk, margarine, or soya flour) and get less special attention for feeding. Attention to feeding is particularly important when mothers have little time and their infants are not hungry. Often children do not finish their uji because of lack of appetite.

Nearly 50% of Nairobi mothers surveyed in the Demographic and Health Survey worked outside the home, and about 30% of them took their children to work [1]. Mothers often left food prepared for their infants with a caregiver, who was likely to be a relative, neighbour, young girl, or sibling of the child. Education of caregivers other than mothers about appropriate feeding is therefore also needed to improve feeding practices.

Mothers prepare meals an average of three times a day for the whole family, and the child's food takes about 30 to 45 minutes to cook. Most mothers use small kerosene burners for cooking. Because kerosene is expensive, it is difficult to cook food frequently enough to reduce the risk of contamination.

Food contamination is one major cause of diarrhoea. Once uji is prepared, it is stored in a pot and reheated, but the reheating time is insufficient to kill bacteria. The risk of diarrhoea increases dramatically in the first six months of life in urban Kenyan infants. At one month of age, about 3% of infants have had diarrhoea in the preceding two weeks, but by six months of age, 25% of infants have had diarrhoea in the preceding two weeks. This rate remains at the high levels of 25% to 28% for children 12 to 17 months of age [1].

Availability of processed complementary cereals

Several studies in urban Kenya have shown high rates of use of commercially processed cereals for infant feeding. In 1978 a study of births in the Aga Khan hospital in Nairobi among middle-class families reported that nearly half of mothers gave their infants commercial cereals rather than home-prepared cereals [13]. A study conducted in 1982 of nearly 1,000 low- and middle-income women in Nairobi found that 21% of infants were consuming packaged cereals at four to six months of age [14].

Focus group interviews conducted in 1999 found that many mothers reported buying locally made, pre-processed cereals, including both brand-name and generic products. Mothers reported using such products or adding milk, margarine, or soya flour to enrich plain maize or millet flour uji fed to young infants. Although the addition of these foods will increase the calorie content to the level needed to meet the energy needs of young children (since maize or millet flour alone is too low in calories), these foods do not contain sufficient iron, zinc, or several other nutrients to meet minimum requirements.

Table 1 shows the characteristics and costs of processed cereal flours or blends sold in Nairobi in 1999 for young child feeding. Numerous products are available. Although some of the products state on the label that they are fortified, most do not. However, several of the fortified products contain only cereals, with no legumes or other fat or additional protein source. Most are not fortified with zinc, and/or levels of fortification of zinc are not listed on the label.

None of the products now available for sale include information on breastfeeding or appropriate feeding practices. Information on preparation and mixing instructions to ensure adequate energy intake and prevention of food contamination are also not given. None mention the importance of exclusive breastfeeding. Some of the products have been pre-cooked and thus require little additional cooking, whereas others need to be cooked for a period similar to that for cooking maize flour. There are also several other fortified products currently produced in Kenya but not now marketed to the public, such as UNI-MIX produced by House of Manji and Soy-Afrique, and sold to the World

* The 75% of infants who are born to HIV-negative mothers are not at risk of HIV infection through breastmilk. Breastfeeding will also improve the health status of those infants infected during pregnancy or delivery (estimated at 20%) [11]. An additional 15% of infants born to HIV-positive mothers are estimated to be infected by breastfeeding (15% of 25% = 3.75% of all infants). Thus, less than 4% of all infants are estimated to be infected through breastfeeding.

TABLE 1. Processed cereals given to young children and sold in Nairobi

Name	Cost/100 g (US$)[a]	Ingredients	Fortified[b]	Preparation time (min)	Packaging
Maize flour	0.03	Maize	—	30–45	Brown paper bag
Bora-Bora (Soy Afrique)	0.09	Soya, maize	Yes	30–45	Brown paper bag
Jelly porridge (Favourke Farm Products)	0.09	Wimbi, cassava	No	5–7[c]	Cheap plastic bag
Uji-mix (Joy products)	0.08	Wimbi, maize	No	30–45	Brown paper bag
Elna Ujimix (Asal Foods)	0.09	Sorghum, millet, soya bean, whole wheat	No	30–45	Plastic bag
4-C multi cereal (Vwezo Mom saver)	0.43	Maize, sorghum, oats, wimbi, peanuts	No	2–3[c]	Plastic bag
Cerelac (Nestlé)	0.66–0.97[d]	Wheat, skim milk	Yes	0[c]	Tin
Soya Best Wimbi Flour (Soy ABEST Investments)	0.12	Heat-treated soya, wimbi	No	0[c]	Plastic bag
Maizena (CPC)	0.13	Maize, soya	Yes	10[c]	Plastic bag

a. US$1.00 = 60 Ksh (February 1999).
b. Specified on label, but not verified.
c. Pre-cooked or ready-to-eat.
d. The cost is US$0.48 for a 50-g sachet, US$2.00 for a 250-g tin, and US$3.33 for a 500-g tin.

Food Programme (WFP), UNICEF, and several non-governmental organizations for use in refugee camps. The cost of producing and marketing these to the public has been estimated at US$0.07 per 100 g [House of Manji, personal communication, 1999]. The prices of the currently sold processed cereals range from US$0.07 to US$0.97 per 100 g, the daily amount needed for a breastfed 9- to 11-month-old infant. On the basis of family food expenditures in developing countries, Wurdemann and van de Meerendonk [15] reported that low-income mothers can spend two to three times the price of the staple food for complementary foods. In Nairobi several products (Bora-Bora, Elna Ujimix, Soya Best Wimbi Flour, Maizena, and UNI-MIX) are available at US$0.10 to US$0.15 per 100 g, two to three times the cost of maize.

What means are available to improve complementary feeding?

Promotion of ideal complementary feeding would address the constraints mentioned above and provide foods containing adequate energy, protein, fat, and micronutrients to meet the needs of breastfed children from 6 to 24 months of age at low cost. Porridges should contain at least 100 kcal per 100 g of cooked food. A food that combines maize or millet with a legume (such as soya beans or peanuts) can include sufficient protein, fat, and energy, whereas a cereal made with only maize flour will have insufficient energy density to satisfy the infant's needs. An ideal food would only need a short cooking period, which would save mothers time and enable the food to be cooked each time it is served to reduce the risk of contamination. Special foods used in young child feeding should preferably be sold in small packages to suit normal purchasing styles of low-income mothers.

The best way to improve complementary feeding is to enhance the adequacy in foods and feeding practices with as minimal changes as possible. Table 2 shows that such changes can be made using fortified pre-processed cereals or through behavioural change communication to change household practices without the use of pre-processed cereals. In both cases, changes in feeding practices are needed in order to increase the attention to interactive feeding, increase the frequency of feeding, increase the consistency of the foods to increase their energy content (by making the uji thicker), and prevent food contamination.

The costs are similar whether pre-processed cereals or cereals enriched with other foods are used. The daily cost is about US$0.11 to feed a 9- to 11-month-old child fortified processed cereal made into uji (at a cost of US$0.07 per 100 g) plus US$0.02 for sugar and fruits or vegetables. The daily cost of home-enriched uji as currently prepared with maize meal, margarine, and milk in addition to sugar and fruit or vegetables is about US$0.13.

Although fortified cereal blends can meet zinc and iron requirements, home-prepared foods would need to include a haem source of iron to increase iron and zinc intakes substantially. For example, an ounce of beef (about 30 g) could be fed to the child daily. This amount would meet about one-sixth of the iron requirements and about half of the zinc requirements, both major

TABLE 2. Comparison of the use of fortified processed cereals and of behavioural change communication to improve complementary feeding

Constraint	Actions needed	Cereal	Behavioural change
Social norms do not support exclusive breastfeeding	Change norms and attitudes to support exclusive breastfeeding	Promotion of breastfeeding along with marketing of product	Promotion of breastfeeding
Maternal concerns about sufficiency of breastmilk	Increase women's confidence along with marketing of product	Promotion of breastfeeding along with marketing of the product	Communication
Poverty	Keep food costs as low as possible	Cost to feed is about US$0.11/day Meets nutrient requirements for iron and zinc	Cost to feed is about US$0.13–0.14/day Meets less than 20% of RDAs for iron and less than 60% for zinc
	Use foods currently consumed	Not all households purchase processed foods	Household foods can be used but requires behavioural change communication
Working mothers	Provide information to caregivers and mothers	Less information is needed on appropriate types of foods	More information is needed on appropriate types of foods
Lack of appetite	Promote interactive feeding	Promotion of improved practices along with product marketing	Promotion of improved practices
Fuel costs and cooking time	Reduce cooking time	Pre-processed cereals take less time to cook	Cannot be addressed easily
Childhood illness associated with food contamination	Cook food before feeding (no storage of cooked food)	Pre-processed cereals can be prepared in serving size amounts at each feed	Difficult to promote frequent cooking to reduce contamination because of cost of fuel and time

improvements over the current uji enriched with milk and margarine. However, this would require significant behavioural change, because giving meat to infants is uncommon in Kenya. A recent study in Denmark found that infants 8 to 10 months of age consumed only about 10 g of meat per day [16], although increasing their intake to 30 g improved their haemoglobin levels.

Because meat is expensive in Kenya, it is unlikely that mothers will increase the amount of meat they give their infants. They will need to use fortified foods or iron and zinc supplements. Supplements would cost US$0.01 per day* and would necessitate a distribution system, educational campaign, and individual counseling to ensure widespread appropriate use. The total cost of this home-enriched diet would therefore be US$0.14 per day with iron and zinc supplements.

The major difference between the two approaches is that ongoing marketing of processed cereals can be built into the cost of the product. It is often more difficult for governments to obtain the necessary funds to build in the level of behavioural change needed to sustain improved feeding practices.

Conclusions

Improving the dietary intake of breastfed infants has been shown to be feasible with the use of processed complementary cereals in a research setting where they have been provided free to households. Similar improvements have also been shown in programme settings by educating caregivers how to improve grain-based porridges by adding nutrient-rich ingredients available in the community [17]. In most of the latter programmes, both mass media and one-on-one counselling have been used to obtain changes in practices.

Although processed complementary cereals (previously referred to as weaning foods or formulated foods) were developed in the 1970s, few have been success-

* A 30-ml bottle containing 25 mg of iron and 10 mg of zinc per milliliter that is now being distributed by UNICEF costs US$0.72. If a child was given 0.5 ml per day (12.5 mg of iron and 5 mg of zinc), the bottle would last for two months at a cost of US$0.012 per day.

fully marketed to low-income families in developing countries. Many of the products developed at that time contained milk, and as world milk prices rose, the cost of producing these foods put them out of the reach of low-income families. Other cereal- and legume-based products were developed and clinically tested. However, these products were still too expensive for most people because many of them were imported.

Recent improvements in manufacturing techniques and local production of blended cereal products have enabled the production of low-cost fortified products that are within the reach of family incomes, as shown in Kenya. There has been little social marketing of such products to low-income families. However, such efforts are likely to have benefits for the nutritional status of young children.

Pre-cooked cereals reduce the amount of fuel and cooking time needed. They also save time in preparation because few ingredients need to be added, since they contain additional fat and protein-containing legumes. They are fortified with micronutrients that are difficult to obtain from local low-cost foods (especially iron and zinc). Marketing of cereals can also be a means of educating caregivers about appropriate preparation and feeding practices, including exclusive breastfeeding. In rural areas foods are primarily home-grown, and few families are able to purchase processed complementary cereals. Helping such households to improve feeding will require behavioural change communication to encourage the use of low-cost local foods and beneficial feeding practices. However, in urban areas, as shown in this paper, the costs of modifying current practices and using pre-cooked cereals are similar. Households already purchase processed foods for infant feeding from the market (maize, millet, and soya bean flours, margarine, and packaged milk), and fortified pre-cooked cereal blends can offer more nutritious and more easily prepared alternatives.

In either case, the cost of appropriate complementary feeding often exceeds the amount that very poor families can spend. A fortified product would still be beneficial even when not consumed daily, because nutrients (especially iron, zinc, and vitamin A) are stored in the liver for long periods and in the blood for several days. Weekly or biweekly iron, iodine, vitamin A, vitamin D, folic acid, and riboflavin improve micronutrient status [18–20] and promote child growth [20]. Thus, even if the fortified product is consumed less than daily, it can still have a positive effect on micronutrient status.

Concerns about working with the private sector to promote improved infant feeding have been expressed because of past negative experiences associated with the marketing of breastmilk substitutes. However, in urban areas, households are purchasing more of their basic foods in processed forms (flour, milk, and margarine) and are increasingly relying on the food industry to supply them. Since processed cereals for infants are among these purchases, an appropriate role for the public sector is to ensure that they provide optimal nutrition and are appropriately marketed. With such support, they can lead to improved feeding practices and have benefits for child health.

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The essential role of communication in behavioural change

Judith McGuire

Abstract

The use of a processed weaning food in a public health programme should never proceed without an effective programme of communication for behavioural change. There is a long and largely unsuccessful history of public health-oriented weaning foods. Most of the problems have been due to the lack of attention to behaviour, which is not a priority for most nutritionists. Food consumes programmes and consequently uses most of the economic and human resources devoted to the programme. A food programme is not a nutrition programme, and processed weaning foods are not always necessary and are not a priori the best food. The trade-offs between promoting processed foods versus promoting local foods must be considered. It is important not to let the scientifically perfect weaning food stand in the way of practical, sustainable solutions for improving the nutrition of infants and toddlers.

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Introduction

The question is: Should you proceed with a processed complementary food in a public health context without an effective programme of communication for behavioural change? The answer is no. There is a long and largely unsuccessful history of the use of complementary foods. Some of the problems are logistic, but many of the problems result from the complete lack of attention to behaviour.

The basic premises of this presentation are as follows:

» The main nutritional problems are growth failure in children less than two years of age and anaemia. Although anaemia is more prevalent in an epidemiological sense, it is impossible to separate the two.
» Growth is a product of the quantity and quality of food, disease, and care.
» Children grow up in families, and malnourished children generally grow up in poor families.
» The outcome of interest is healthy growth and development of children. It is not whether they buy or accept a food in a health centre.

In discussing processed weaning foods, it is important to note that we are talking about public programmes that are publicly financed and not commercial products. Consequently, there are constrained resources and trade-offs. It is a zero-sum game. When you put your money into one thing, you are taking it away from something else. We do not have unlimited resources.

Key issues

Food does not equal a nutrition programme. In Nicaragua, where the World Bank is financing a health project, the one nutrition component is a weaning food. The consultant who prepared the project could provide great detail about the weaning food, the formula, the processing, the distribution system, etc. However, when asked about the communication component, he responded that the Ministry of Health was taking care of that part of the project. I know quite well that the Ministry of Health is not taking care of the communication component. Although intellectually we all accept that food is not the same as a programme, in practice policy makers and programme managers spend most of their time on the food portion of such programmes. Whether the food is handed out or provided through a subsidy or other mechanism, it is seen as a programme, and it is up to us to get rid of that myth.

Processed weaning foods are not always necessary and are not a priori the best food. There are alternatives, including local foods. Home-based fortification is also being tried. There are also supplements that can be used to fill micronutrient gaps. One of the renewed justifications for processed foods is the interest in micronutrients.

As far as possible, we should use commercial preparations already on the market, which have their own distribution channels. Public production of processed complementary foods does not work. Private production is the most efficient way to proceed.

Formulated weaning foods have a long and largely unsuccessful history. A study of nutrition interventions in developing countries by the Harvard Institute for International Development, which was financed by USAID, found that in 1978 there were more than 100 processed weaning foods on the market [1]. Where are they now? They have largely disappeared, largely because of lack of attention to the consumer.

The trade-offs between promoting formulated weaning foods and promoting local foods are real. It is important not to let the "best" or the scientifically perfect weaning food stand in the way of practical, sustainable solutions for improving nutrition. This has occurred time and time again in Latin America. We have to look at the micronutrients and energy-density issues raised in the report by Brown et al. [2] in terms of cost and feasibility. The Institute of Nutrition of Central America and Panama (INCAP) has pushed the perfect food, and it has not had an impact on the nutrition of poor children. Micronutrients are not the only problem. We must try to help women within their own power and within their own resources solve their families' nutrition problems.

Food consumes programmes. Food overwhelms everything else that is going on in a programme. The logistics of food, the management of food, and the targeting of food overwhelm everything else. In particular, food crowds out behavioural change in terms of funding and managerial time and in the eyes of a health-service provider, who is given more esteem for giving out the food than for giving good counselling. Food is physical, but counselling and communication for behavioural change are intangible.

Behavioural change is not in the "comfort zone" of most nutritionists. This is a psychological barrier that must be overcome.

Micronutrients are not the only nutrition problem in Latin America. There is also a very serious food inadequacy problem for children under two years of age.

Words matter. Complementary food versus weaning practices. Weaning food versus weaning practices. Weaning versus growth. Nutrition education versus communication for behavioural change. Are we going to talk about weaning or focus on the child's growth?

We are talking about a very complicated set of behaviours. Weaning is a sociocultural event. Socialization of children takes place at the time of weaning. Some people think that if you give children too much food you will spoil them. The key behaviours that need to be looked at are those of the food processors, distributors, and regulators; those surrounding the demand and purchasing behaviour of the mother; and those related to the intra-household allocation of time, authority, and consumption of food.

In addition, there are the behaviours we typically think of in relation to weaning, such as behaviours around the following:

» *Exclusive breastfeeding.* In Latin America we find that weaning is too early most of the time, women do not give colostrum, and women give water and other liquids very early in life. There are also the early introduction of non-breastmilk foods and the issues of interactions among breastfeeding, weaning foods, and family food.
» *FADU.* In Bolivia the acronym FADU is used, which stands for frequency, adequacy, density, and utilization. With respect to frequency, the idea is to get children to eat four to five times a day. Adequacy is used not in a nutritional sense but rather in terms of vol-

ume. How much should a child eat? A lot of mothers do not know. It has very little to do with gastric capacity; it has to do with how much a mother thinks a child should be eating. Density is a difficult concept to communicate. How do you teach a mother that the food should not just pour off a spoon, but should stick there? It cannot be so thick that it cannot flow. Utilization refers to the actual process of feeding.

» *Feeding during and after illness*. Children are often ill with diarrhoea. How are ill children going to be fed?
» *Hygiene, water, and food safety.*
» *Preparation of weaning food*. This is what most programmes that have processed foods focus on, but even correct preparation is difficult to communicate. A lot of women just want to have something so liquid that you can put it in a bottle. Feeding with a cup and spoon takes time. Do women have the time?
» *Active feeding*. There are a lot of positive deviance studies that show that the mother has to be an aggressive feeder to get the child to eat.
» *Teething*. There are a lot of beliefs about teething and what a child can and cannot eat.
» *Aging of the child*. We need a set of messages that are appropriate to the age of the child that communicate when the child needs more solid food, less liquid food, etc.
» *Positive reinforcement of the mother*. How does she know if she is doing well?
» *Mothers' time management*. Most poor families do not have time to burn. Incaparina is supposed to be cooked for 15 minutes. The fuel and water costs of that need to be considered. The mother has limited time, money, and managerial resources.

The bottom line is that a processed weaning food cannot be separated from the whole gamut of behaviours that affect child growth and development.

Most governments in Latin America are extremely weak in communication for behavioural change. They provide "talks," stand-alone mass media, posters of food, etc. There is no research with beneficiaries or trials of improved practices to inform the communication strategy. There is no training, no supervision, and no monitoring. What are we going to do about weaning foods, weaning, or growth if our counterparts in the governments are so weak in behavioural change?

Unless we spend as much time, resources, and brainpower on behavioural change, formative research, trials of improved practices, and exchange as we do on defining nutritional requirements and designing and testing processed complementary foods, we are not going to have an effective programme.

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The need for a market-oriented approach

José O. Mora

Abstract

In most countries, processed complementary foods have been developed to be used in free or highly subsidized food distribution programmes, but little effort has been made to introduce them in the regular market. They have been positioned as "food for the poor" and, as such, carry a stigma. If nutritionally improved complementary foods were made commercially available at affordable prices, their coverage and contribution to improve nutrition would be more significant and sustainable at lower cost to governments. The question is whether a market-oriented approach is feasible, that is, whether the food industry would be willing to produce and market such foods and whether a demand for them can be created. A number of issues along these lines are briefly discussed, including the available evidence for the effectiveness of processed foods in improving nutritional status, the role of nutrition education and social marketing, and the need and rationale for a market-oriented approach.

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Nutritional effectiveness

Results from efficacy trials have shown that, when certain conditions are met, targeted food distribution is effective in increasing energy and nutrient intake and improving physical growth [1–3]. Processed complementary foods have been used in most cases, including wheat or corn flours, blended products, vegetable oil, and specially designed foods (e.g., vegetable mixes, fortified biscuits, and enriched beverages). Documented conditions for effectiveness and impact modifiers are related to existing dietary deficiencies in the target population, characteristics of the foods being distributed, and programme implementation features, as well as to behavioural responses of the recipients.

Existing dietary deficiencies

» Existing significant energy, protein, and other nutrient intake gaps;
» Relative contribution of deficient intake versus infection to growth retardation in the target population.

Characteristics of foods distributed

» Proper nutritional content of food to meet existing deficiencies;
» Size of daily food ration (e.g., contribution to meet nutrient gap);
» Type of foods distributed (processed/traditional), cultural acceptability, and food preparation requirements.

Programme design and implementation

» Modality of food distribution: on-site feeding versus take-home;
» Programme timing (season, child's age and risk status) and duration;
» Complementary non-food inputs: preventive and curative health care, nutrition education.

Recipients' behavioural response

» Recipients' behavioural response to food distribution: misuse or sharing (take-home), substitution for regular diet, actual incremental intake.

Obviously, the existence of dietary deficiencies needs to be documented. Significant efforts have been made to develop appropriate, nutritionally improved, and culturally acceptable processed foods suitable to population needs and preferences, as well as to improve programme implementation. However, the lack of nutritional impact of a programme may still be accounted for by failure to address recipients' behaviour in response to food supplements (e.g., sharing and substitution may largely reduce actual dietary supplementation).

Research findings and programme evaluations have also highlighted some critical issues in food distribution programmes:

» *Sustainability*. Most programmes are funded through food donations or otherwise significant donor input, and weak governmental commitment and budgetary constraints reduce financial sustainability.
» *Implementation*. The food distribution operation and logistics for food storage, transportation, and distribution are complex. There is frequent corruption associated with food distribution programmes.
» *Cost*. The total cost may be beyond the reach of many governments.

Nutrition education and social marketing

Dietary deficiencies are thought to be to a large extent the result of faulty feeding practices; thus, changes in such practices should lead to improved food intake (in quantity and quality) and better nutritional status. Such practices have been expected to change as a result of nutrition education and social marketing interventions. Positive short-term changes in key specific feeding practices have been reported. Social marketing appears to be effective in temporarily generating demand and increasing the use of particular products (e.g., oral rehydration solution, contraceptives, carrots, green leafy vegetables, and vitamin A capsules) and in changing very specific feeding practices (e.g., more frequent feeding or denser food preparations). Permanently changing more complex behaviours related to infant and child feeding has proved to be more difficult.

Need for a market-oriented approach

In most countries, processed complementary foods have been developed for use in free or highly subsidized short-term food distribution programmes with limited coverage. Little effort has been made to introduce them to the regular market in order to reach the majority of the population at risk for nutritional deficiencies. They have been positioned as free or cheap "food for the poor" and continue to carry such a stigma. By making nutritionally improved complementary foods commercially available at affordable prices, their coverage and contribution to improve nutrition would be more significant and sustainable at lower cost to governments. The question is whether a market-oriented approach is feasible, that is, whether the conditions could be created for the food industry to willingly engage in producing and marketing such foods and whether a demand for them can be created.

In addition to getting the private sector involved in the production and distribution of processed complementary foods for government programmes, as in Mexico and Peru [4–6], marketing nutritionally improved processed complementary foods at affordable prices should be encouraged. The goal would be to make such foods commercially available to the population at risk for nutritional deficiencies. For this purpose, a number of economic, marketing, trade, and consumer behaviour issues will need to be addressed locally. A

marketing-oriented approach should be explored in countries with a predominantly urban population, where women's employment is rising and the consumption of processed foods is growing.

There is an increasingly recognized need for the development of partnerships between the public and the private sectors to address health and nutritional problems [7]. In the past, this was seen with skepticism on the grounds that the only motivation of the private sector (e.g., the food industry) is profit; however, there have been some positive experiences, and there are a number of possibilities to reconcile the interests of the public sector in public health and nutrition with the economic interests of the private food production sector. The first step is to remove the long-existing mutual mistrust and to create the basis for a real partnership based on mutual respect, confidence, rewards, and social responsibility. The experience with micronutrient fortification of staple and non-staple foods (wheat flour, sugar, salt, and margarine) is certainly relevant.

In general, consumers are attracted to commercial food products that:

» meet their perceived needs;
» are of good quality regarding some functional properties (texture, colour, flavour, expediency of preparation, and preservation), not necessarily health or nutritional quality;
» are reasonably priced.

Low-income consumers are not expected to behave differently, except that price is of critical importance to them. Nutritionally poor processed foods meeting the above-mentioned requirements are now widely used for infant and child feeding in low-income groups. There are four important reasons to advocate partnerships between the public and the private sectors to make nutritionally improved processed complementary foods commercially available and accessible, and to promote consumers' demand for them:

» The perceived needs of consumers can be modified through education and social marketing interventions aimed at enhancing awareness of health and nutrition, and public and private resources can be shared to this end.
» Nutritionally improved foods can be adapted to local consumer needs and preferences.
» Prices can be made affordable by reducing packaging, advertisement, and marketing costs, as well as by compensating reduced profit margins by mass production and expanded markets. Nutritional quality may be improved without significant effects on cost (e.g., the cost of fortification of staple foods with multiple micronutrients rarely exceeds 1% of the retail price).
» Consumer demand for processed foods is growing with urbanization, favoring the promotion of nutritionally improved complementary foods.

Four critical questions are to be answered:

» To what extent and under what conditions can such foods be produced and marketed at affordable prices to low-income consumers?
» How can the public sector generate a positive policy and legislative environment that encourages the production and marketing of such foods at affordable prices?
» What would be the best approach to reduce production and marketing costs through joint government–industry ventures?
» How can consumer demand for such foods best be promoted?

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Summary of panel discussion

The concept of demand is important, because often we create a supply without demand. We need communication for behavioural change to create this demand, which will also improve sustainability. We also have good examples, particularly in the area of breastfeeding but also with respect to key complementary feeding behaviours, that public health programmes can be effective. The key question is how to change complementary feeding behaviour, because the challenges are so big, because the food often overwhelms the other components, and because we tend to be weak in the area of behaviour.

The successful projects involving communication for behavioural change have had large financial inputs from the World Bank and USAID, and yet we want to be moving towards programmes that governments can implement in the absence of these inputs. We do not yet have good models for a successful public health strategy that involves communication for behavioural change and processed complementary foods.

To date we have only looked at components of the broader strategy we are discussing. The issue is strategy: How do we put the components together? In the next five years we need a systematic view of these components, with sufficient clarity in describing these components to determine costs and to define the specific contexts in which the components should be applied.

In thinking about strategy formulation, we need to merge the science of optimal nutrition with the strategy of behaviour. Communication for behavioural change is one component of a behaviour strategy. Behaviours are also affected by policy, communication, and the choice of foods. A processed food is one alternative; however, in other situations a home-prepared food will be appropriate. In each country a strategic mix is needed, and a lot is known about this strategic mix. What is lacking are good cost data for the different components and for the whole strategy.

Costing of programmes of communication for behavioural change is important. There is the belief in developing countries that mass media are too expensive, but this is not always true. Follow-up is important to see if the changes in behaviour are sustained. Funding is needed for such follow-up studies. Governments in Latin America are willing to borrow for strategic programmes in primary health care that include improvements in nutrition, but cost-effectiveness data are needed.

There are many challenges in the area of how to most effectively combine programmes that involve food and communication for behavioural change. There was disagreement as to whether we now have good public health models to show us how such strategies work. There is a need to scale down the food interests and to examine how programmes to improve child growth can accommodate processed complementary foods rather than to see how food programmes can accommodate communication for behavioural change.

The oral rehydration model is relevant, in that processed packages, home-prepared formulas, and behaviours such as continued breastfeeding are promoted. This larger strategy can be applied to the area of child growth, in which a processed complementary food is one of many components.

Evaluation and monitoring: Who needs what information and why do they need it?

Jean-Pierre Habicht

Abstract

Any evaluation should start with the question: "Who will use the information and for what purpose?" This question implies that one must consider not only the facts presented in the evaluation, but also whether the person who receives the information is motivated and has the authority and resources to implement changes that emerge from the evaluation. The similarities and differences among summative, formative, and process evaluations are discussed. Particular attention is given to stakeholder participation, choosing the appropriate level of statistical significance, and separating issues relevant to public-sector versus private-sector investment as they relate to evaluating the targeting and effect of processed complementary foods.

Introduction

It is assumed that we all agree about why we need evaluations and, therefore, that we agree in general about what kinds of information we want from evaluations. However, it is useful to first ask: "Who will use the information from the evaluation and for what purpose?" This question implies that one must ascertain not only who will consider the facts presented in the evaluation, but also whether this person (or persons) are motivated and have the authority and resources to implement changes that will emerge from the evaluation. It is clear from the presentations of past and current evaluations and from comments by other authors in this issue that:

» Many feel that the audiences for evaluations are policy makers who will decide whether and how programmes should be implemented;
» Some feel that the evaluations should be aimed at identifying areas necessary for more research to improve the design and implementation of programmes. In other words, evaluations should be directed to the scientific community;
» Very few have shown interest in monitoring and evaluation to improve the implementation of an ongoing programme;
» Nobody discussed evaluating programmes for internal cohesion and staff morale, or for capacity to elicit programme resources from a changing world of clients and of local and international funding agencies. These are characteristics that affect sustainability. For instance, one often finds that the most cost-effective food distribution programmes were not politically sustainable because their targeting was too good. The poor who benefited did not have the political power to ensure programme survival.

This distribution of interest about evaluations reflects our experience and expertise but results in confused discussions. Therefore, I am going to discuss larger issues in evaluation, including the relationships between the decisions that will be made on the basis of evaluation information, the kinds of information necessary for those decisions, the kinds of data to be collected (process versus impact), and the methods to collect those data (quantitative and qualitative).

Types of evaluations

An evaluation that assesses the impact of the programme in terms of how well it met its goals and why this happened is a "summative evaluation." A summative evaluation demonstrates the adequacy of a programme, or whether or not its impact is evolving as it should. A demonstration of adequacy is often all that many programme managers need to assure them that the programme is functioning as it was designed. A summative evaluation is useful to funding agencies and policy makers who make decisions about continuing and expanding programmes. However, these evaluations must

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Mention of the names of firms and commercial products does not imply endorsement by the United Nations University.

demonstrate more plausibly that the programme was indeed the cause of the improved outcome than is necessary for a programme manager. A summative evaluation is also useful for scientists, especially when there is even more attention to the plausibility that the causal pathways are as postulated, even to the point where certainty is specified to a given level of probability. The reason for the scientists' concern with causality is that their inferences must permit much wider generalization to other circumstances than is the case for national or even many international policy makers. Scientists are also interested in knowing why a programme was less effective than hoped for, not only to understand the causality better, but also to identify where more research is needed. Summative evaluations usually measure the ultimate outcomes of concern, the impact outcomes, such as improved nutrition, health, and survival. But impact outcomes may also be improved purchasing behaviour or diet, if these are the objectives of the programme. The definition of an outcome variable within programme evaluation should be determined by the programme's objectives (and not by disciplinary biases).

Summative evaluations should also measure intermediary physical and behavioural input and outcomes that link the programme's interventions to its impact. For instance, if the programme is to have its impact on survival, then the intermediary variables can be measures of physical outputs (food distributed) and of staff activities. Other intermediary variables could be related to the programme beneficiaries, such as inputs (e.g., food received), knowledge, behavioural outcomes (e.g., purchasing and dietary behaviour), and physical intermediary outcomes (e.g., nutrition, growth, health, and other indicators of well-being). All these can be measured on programme participants; however, another important variable, programme coverage, cannot. Measuring coverage requires collecting information on non-beneficiaries who are targeted by the programme. Another intermediary variable in judging the quality of the programme is targeting relative to programme goals. Information about food targeting requires yet a larger extension of data collection to those whom the programme did not target to measure unplanned "losses."

Evaluation of all the variables described above, which are not impact variables, is often called process evaluation. Most variables measured in summative evaluations are subjected to quantitative statistical analyses, whether they are physically measured or obtained by qualitative methods such as interviews. Some variables are qualitatively assessed, especially those that relate to mental constructs that underlie understanding, motivation, and behaviour. Process evaluation should always be important for scientists because it increases plausibility, but it is also important to other users of evaluation if the programme's impact is less than expected. Policy makers and funding agencies may decide that an unsatisfactory programme should be stopped if the failures revealed by process evaluation cannot be remedied. Or they may decide that the failures can and should be corrected. Thus a summative evaluation can be formative in the sense of reforming a programme.

Formative evaluations should be designed to improve a present programme, not only as it begins, but throughout its life. Some summative evaluations are designed to give information useful for improving a programme and, therefore, have a formative component. However, not every summative evaluation needs a formative evaluation component, for example, end-of-project evaluations performed for a donor that does not propose to continue funding the programme. Many formative evaluations are directed to finding and breaking bottlenecks in the implementation of a specific programme. Such operational research (which is different from operations research) is usually qualitative and addresses process. Sometimes quantitative analysis of process and impact data is important to demonstrate a failure; therefore, operational research may involve quantitative and qualitative aspects, just as summative research does. This is even more the case if the formative research is directed to finding more widespread or generic problems in a programme, such as inappropriate management procedures.

This short description of kinds of evaluation, measurements, and methods shows that it is a mistake to think that formative evaluation only measures quantitative impact variables. It is equally wrong to confuse formative evaluation with process evaluation, and neither is necessarily restricted to qualitative data and analyses.

Stakeholder participation

The above background permits us to look at an issue that pertains to all evaluations: the need to involve the intellectual and emotional participation of stakeholders. It may be useful to understand the point of view of the most obvious stakeholder, the targeted beneficiary. The same is true for programme staff, although this point is often neglected. But this understanding may not require their intellectual and emotional participation; in fact, such participation may be unethical if it raises expectations that cannot be fulfilled. The stakeholders whom one must involve are above all those who will have to implement a decision. For summative evaluation, it is those who will decide whether to continue or stop a programme. For formative evaluation, it is those who will be making the desired changes. This is a major reason for differentiating between summative and formative evaluations: one needs to involve different actors. Other stakeholders whom one must engage are those who can facilitate decisions and actions,

even if they do not themselves decide or act. Sometimes these are the only people one can engage, a less than desirable situation. Sometimes participant and staff lobbying can facilitate action and decisions, and in such circumstances engaging them in the evaluation is useful. And sometimes one should engage stakeholders who can obstruct to encourage them not to use that power.

Choosing the appropriate level of statistical significance

Scientists use statistical conventions to decide whether an outcome or relationship is due to chance or might be due to the programme. Except in the very rare evaluations that are designed to give a statistical probability of efficacy, the statistical significance of the evaluation results is inadequate to substantiate a claim for causal impact. Other information to increase the plausibility is also necessary. However, no such claim can be made without statistical significance. The major problem is that the scientists put much higher stock in not claiming impact than in missing impact. The usual ratio of probabilities is fourfold ($p = .05/[1 - \text{power} = 1 - .80]$) in favour of not making a claim, even when in fact impact is present. This is usually an absurd ratio to use for making a decision to stop an ongoing project, and it is unscientific because it is illogical. Evaluators need to think through and discuss with the pertinent stakeholders the appropriate ratio between making a mistake in believing that there is an effect when there is none and making the opposite mistake of believing there is no effect when in fact one actually exists.

Targeting and cost-efficiency

Targeting and cost-efficiency are particularly important in food distribution programmes, such as those directed to providing complementary foods to households. The better the targeting, the lower is the cost of the programme per recipient who will most benefit. However, this consideration only makes sense if the government is footing the whole bill. If the government is not footing the bill and the food depends on a large market to keep the price down, as is the case for Incaparina, then targeting is a mistake. In fact, the high proportion of rich people who buy Incaparina is necessary for that programme's success. Without the 80% market penetration among the rich, Incaparina could not achieve its relatively high penetration of 28% among the poor. For the poor, Incaparina is cost-effective because it substitutes a more expensive complementary food with a less expensive and equally well-accepted complementary food that is of as high nutritional value as the food it replaces. The Incaparina programme is very cost-effective for the government, because it costs the taxpayer nothing for a large benefit to the poor. Such a programme should be part of a larger strategy of programmes. For instance, other programmes may be necessary to reach the 72% of the poor not reached by Incaparina, including possibly a programme that subsidizes or provides free Incaparina targeted to the poorest. This targeted programme would cost government money, but far less than it would if the Incaparina marketing programme had not been successful.

The importance of strategy

In this paper, I have only discussed distribution of complementary food through government programmes and commercial markets. However, feeding appropriate complementary foods at the right ages and by appropriate means requires much more than single or even multiple distribution methods. It requires behavioural change on the part of households and caregivers, as well as behavioural and attitudinal changes in society as a whole. Achieving these and the distributional goals requires a larger strategy than a single programme can achieve. Evaluating such a strategy involves yet other considerations and approaches than those discussed above. In particular, the evaluation of a strategy must address the whole strategy but can rarely identify the impact of each individual programme. This is because a good strategy is synergistic, so that the impact of each programme improves the success of the other programmes.

Further reading

General introduction to evaluation
Rossi PH, Freeman HE, Lipsey MW. Evaluation. Thousand Oaks, Calif, USA: Sage, 1999.

Summative evaluation for different kinds of decision
Habicht J-P, Victora CG, Vaughan JP. Evaluation designs for adequacy, plausibility and probability of public health programme performance and impact. Int J Epidemiol 1999;28:10–18.

A step-by-step approach for nutrition programme evaluations, including study designs and measurements of impact variables
Sahn DE, Lockwood R, Scrimshaw NS, eds. Methods for the evaluation of the impact of food and nutrition programmes. Tokyo: United Nations University, 1984: 1–25.

Summary of discussion of article by Habicht

Donors often ask for impact evaluations. Which outcome is measured is important. For example, the effect of exclusive breastfeeding on morbidity and mortality is well established, and therefore it should be enough to measure changes in exclusive breastfeeding. What arguments can be used to convince donors that it is not necessary to measure impact in this situation? One can ask how they measure impact in immunization or family-planning programmes or educate them with respect to the links between the punitive behaviour and the biological outcome.

Being on target with a message is important, and the immunization and family-planning disciplines have been clearer with their message than have the nutritionists. However, the question of who cares is also important. The constituencies are small with respect to some issues of nutrition; however, with respect to immunization, infectious diseases travel across borders and therefore the constituencies are larger.

Nutrition is in a powerful position because it is allied with food production. This alliance has resulted in the large number of feeding programmes that exist. A large amount of international as well as national funds also go into feeding programmes. The message of what we are trying to achieve with food has been too narrowly defined by being primarily focused on growth. Nutrition programmes are directed not only to malnutrition but also to the problem of hunger. In the United States we have moved the debate away from preventing malnutrition to providing safety nets to prevent hunger. We need to think more clearly about these issues. We should work together internationally and use our energy and power to move forward on the issue of complementary feeding.

The issue of coverage is important. Often programmes fail to achieve an effect in a public health setting because coverage has been inadequate. For example, it is difficult to cover 100,000 children with good-quality services. The question of what is worthwhile is important. Sometimes it is important to cover a small proportion of the beneficiaries with effective services, if the cost is sufficiently low.

Process evaluations are important to ensure efficacy. If problems arise in the implementation of the programme, changes can be made to ensure that all the steps are in place to ensure that the complement will be biologically effective. Better models of how to do process evaluations are needed, because there are not enough good examples of field process evaluations. If funding agencies do not fund process evaluations and summative evaluations, they should not ask for accountability in the end. There is no incentive for programme implementers to do monitoring and evaluation; the funding and collection of data need to come from outside. Process, outcome, and impact evaluations within formative evaluations are needed as separate enterprises. However, the information collected should be fed back to decision makers in order to make needed changes in the system. A big problem is that there is no link between process evaluations and decision makers. This link is critical if the programme is to succeed.

Scientists are trained in summative evaluation, not formative evaluation. Formative evaluation can include summative parts and should do so. It is not enough to just measure process. Process, outcome, and, to some extent, impact also need to be measured. What characterizes formative evaluation is that the information collected is fed back to the decision makers so that new decisions in light of this information can be made. This feedback is crucial, so that the evaluation development process can be linked with the decision process.

Social marketing of processed complementary foods

Imran Zafar

Abstract

Social marketing is the use of marketing techniques to achieve a public health goal. In the context of developing countries, social marketing has often been coupled with the availability of health products, allowing the use of other elements of the marketing mix: product, price, and distribution. The strength of social marketing, within a larger strategy, is its ability to harness existing private-sector infrastructure to create access to information and products. In this paper, issues related to targeting, pricing, and how to develop a social marketing programme for processed complementary foods are discussed.

Introduction

Social marketing is the use of marketing techniques to achieve a public health goal. A well-known example is the anti-smoking campaign, which relied largely on advertising and communication. In the context of developing countries, social marketing has often been coupled with the availability of health products, allowing the use of other elements of the marketing mix: product, price, and distribution. This is the model most relevant to processed complementary foods. Social marketing is only one of a variety of initiatives that are necessary to deal with a particular health issue. The strength of social marketing, within a larger strategy, is its ability to harness existing private-sector infrastructure to create access to:

» *Information*. In order for people to adopt healthier behaviours, they need to be informed and motivated. Communication and advertising is, therefore, a major element of social marketing.

» *Products*. In order for people to take action on education or motivation campaigns, they need an appropriate health product to be easily available. The product also needs to be attractively packaged and affordable. This is why product, price, and distribution are such critical components of social marketing. The importance of availability cannot be underestimated. Social marketing experience has shown that for many health products there is latent demand that can be met simply by improving the availability of an affordable product in local retail outlets.

The use of the existing private sector infrastructure, such as the thousands of retail outlets available in a country, presents a potent opportunity to take programmes to a large scale. Mass media advertising and communication are also most efficient when used on a large scale. Social marketing is, therefore, most efficient when used to implement national projects.

Targeting

To determine whom to target in a social marketing project, the first step is to determine the role of social marketing within the larger strategy. One of the primary considerations is market segmentation. The population can be viewed in at least three segments:

» those who can afford commercial prices: usually served by the commercial sector;

» those who can only afford a subsidized price: usually served by a social marketing intervention;

» those who cannot afford to pay anything: usually served by traditional public-sector interventions.

A number of research studies and project experiences have established that for most health products, such as oral rehydration salts and contraceptives, the vast majority of people in developing countries fall in the middle of a normal bell-curve distribution.

Pricing

Pricing of health products is an important aspect of social marketing. Most importantly, pricing allows for

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private-sector distribution infrastructure to be harnessed. The key to social marketing is making health products more conveniently available in local stores. Without putting a price to the product on which a "margin" can be made, no distributor, wholesaler, or retailer will make the necessary effort to improve availability.

It is also very important that an affordable health product that has been purchased is much more likely to be used than one that is given away freely. The need to reimburse a base price also allows for better monitoring of distribution and eliminates the risk of "leakages" of free product into the commercial market.

Pricing allows for the most efficient allocation of scarce resources. Traditional public-sector approaches often end up fully subsidizing a large portion of the population who could afford to pay for health products, albeit at a partially subsidized price. Social marketing allows for costs to be paid by this segment to the extent that they can afford.

Pricing allows for programmes to move in the direction of sustainability. It gets people used to valuing and paying for health products, and as economic conditions improve over time, prices can be increased to recover full costs without disturbance. The base price recovered by the programme also generates funds to be reinvested in public health.

Development of a social marketing programme for complementary foods

Many of the basic elements of marketing have been used in a number of complementary food programs. There are two basic models, each of which often supplements the availability of complementary foods through the public sector.

In the manufacturer's model, the public health agency contracts with a commercial manufacturer to make the product more widely available, e.g., Incaparina in Guatemala. This model has the advantage of being more financially sustainable. However, there are serious concerns that it leads to lower public health impact because of the different motivations of a commercial manufacturer.

In the "own product" model, the public health agency contracts with a social marketing organization to make the product more widely available. This would allow for the incorporation of private-sector distribution to retail outlets and the use of community-based distribution through non-governmental organizations. It would also ensure that the goal of public health impact remains the primary consideration.

The decision as to which model to use depends largely on the goals of the project and the ability of the poor to pay a price that is commercially feasible. If the target audience is willing to pay a commercially feasible price, then the manufacturer's model can be used, with appropriate monitoring and controls. On the basis of the assumption that research to establish the need for complementary foods is already available, the basic marketing elements, irrespective of the model used, are described below.

Product development

Local research is required to establish the type of product best suited to the situation. In the case of complementary foods, the two critical elements are composition and taste. In addition, the product needs to be developed in a convenient package size with a packaging design and directions that are pre-tested to appeal to target consumers.

Distribution

Research is conducted to determine the most appropriate distribution mechanisms in the private sector. This could include the appointment of a distributor or licensing of distribution agencies, sales to major wholesalers, or sales directly to retailers. The appropriate distribution mix and distribution margins are determined on the basis of industry standards, and the product is made available in retail outlets of target areas.

Price

Willingness-to-pay research is conducted with the target audience to determine affordability. This should be supplemented by information on the cost of alternative foods, i.e., basic commodities such as flour. Research conducted by the World Food Programme shows that the poor are willing to pay about twice the price of a basic commodity for a packaged complementary food. The price to be established should also take into account a convenient currency denomination.

Promotion

Promotion is a key component for all social marketing initiatives, but it is especially important for complementary foods because of the need to incorporate breastfeeding promotion in the campaign. For complementary foods, this is another reason why the own product model is more suited for social marketing. There are two major elements of a social marketing campaign: behavioural change/information education and communication (IEC), and product advertising

IEC is a general campaign that promotes the importance of exclusive breastfeeding up to four to six months of age, followed by the introduction of appropriate complementary foods. It may be useful, in the context of complementary foods, to introduce a national logo for "quality" complementary foods. This would allow

a mix of the two social marketing models proposed. Manufacturers may use this logo on their products when they meet standards for composition and price that are established by a public health agency, and an "own product" would serve as the lead brand in the market. The IEC campaigns undertaken under a social marketing initiative have proven that there is a "halo" effect, which also increases demand for free and commercial products, because the size of the entire market grows. Campaign development requires research into current behaviour and practices so that appropriate messages and communication channels are used. The campaigns should include mass media, particularly editorial content; print materials for each target audience; and interpersonal communication and training components. The campaign should also clearly identify target audiences, such as consumers, health professionals, etc.

Product advertising is a campaign to promote the product and its logo while ensuring that breastfeeding messages are incorporated, even in product advertising. Product promotion involves the same channels as the IEC component (mass media and print) but addresses a few specific target audiences, such as consumers and retailers. This allows the use of point-of-purchase promotional materials (posters, mobiles, stickers, etc.) to remind and motivate consumers.

Monitoring

Each activity needs to be monitored, particularly advertising, distribution, and sales, in order to feed back into changes in the intervention and allow appropriate action to be taken to improve these activities. Social marketing is well placed to produce demonstrable results, since increasing sales are a good indicator of increasing use. Project research and evaluation should fit into the overall framework of the larger overarching strategy and initiative.

Conclusions

Social marketing has been successfully used for a variety of health interventions but has not been yet been tried for complementary foods. The principles outlined here provide a framework to consider when planning new interventions so that the potential of the private sector can be harnessed to its fullest.

Summary of discussion of article by Zafar

Target group. Social marketing is targeted to low-income populations, because middle-income and high-income consumers are expected to be served by commercial marketing from private industry. It is only the low-income population that requires the allocation of public resources for programmes targeted to them. Is an opportunity being lost by focusing only on the low-income population? Feeding practices need improvement in all groups. Moreover, there is concern about stigmatizing a product as one for low-income groups. However, the market must be segmented in order to target the messages to fit a consumer profile. A single message to both low- and high-income consumers is likely to miss much of the target group. There are strategies to target different consumer groups. One possibility is to have a product for the high-income consumers and one for the low-income consumers, with the high-income consumers subsidizing the low-income consumers. The question of stigmatization by targeting at the low end is important. The campaigns around products that have been socially marketed, such as oral rehydration solution or contraceptives, appeal to the aspirations of the low-income groups. They are not promoted as something that is cheap or of low quality but as something that is of high quality and made available to them. It is important to differentiate "sales" from "marketing." Nutritionists often try to sell their product rather than market it. Rather than telling someone to buy something because it is good for them, the strategy in marketing is pitched to the perception of the consumer. This is a major difference.

Fairness of subsidized products. From the perspective of some, subsidized products result in unfair competition. Others argue that although this may be true in the United States, it is not the case in developing countries. Social marketing has been conducted for contraceptives and other goods without complaints of unfair competition. There are data to show that social marketing, involving subsidies for some products, may "grow" the market for the commercial sector, producing a kind of "halo effect."

Economic generation. Feeding programmes are conducted by Ministries of Health, although sometimes they are tied to Ministries of Agriculture. Ministries of Agriculture are often much stronger than Ministries of Health or Education and are often able to get things done. Agriculture provides a profit, whereas health is a cost. Nutrition is the nexus between health and agriculture. By bringing agriculture into the picture, nutrition programmes could get more support by showing an economic benefit through the creation of new small industries and jobs, etc.

Role of the private sector

» In the 1990s, public-sector capacity has diminished, while the private sector is soaring in the developing world. This carries with it a responsibility to do something for low-income populations, particularly in Latin America where there is not such a large population of poor relative to other areas. The private sector, which has benefited so much in the 1990s, could sacrifice a bit and subsidize some costs to get a successful complementary food product to the poor. They do not have to recover their entire profit margin. We have some "missionizing" to do with the private sector to help them see a public health goal as well as a potential opportunity for profit.
» There are mechanisms for public agencies to market products without waiting for the private sector to take the lead. This creates the environment for the private sector eventually to enter.
» We cannot expect the private sector to take a loss. The bottom-line approach of the private sector is something we have to accept, and we have to find ways to work with the private sector within their operating constraints.
» We need to be very careful in working with the private sector. Rarely will a company reveal their profit margin. In the context of HIV and infant feeding, it was impossible to get industry figures prior to a public offer to sell generically labelled formula.
» We need to sit down with the private sector to get their costs when public funds for the purchase of its product are involved. This has been done in Ecuador with the school feeding programme.
» We need to be careful about cause-related marketing, whereby a company will try to buy a good cause to gain credit with the public instead of clean up its operations. We need to go in as equal partners and lay down the rules and not be used or tarnish our own reputations.
» Even if the public sector takes the lead, it still needs to take the same approach as outlined by Habicht. Public expenditures through businesslike practices can reduce costs.

Cost of social marketing. Although social marketing is often thought to be expensive, social marketing uses not just mass media, which does tend to be expensive. On the issue of cost, it must be remembered that social marketing reduces the burden of carrying those who can afford to pay subsidized prices. With respect to iodized salt, there are two options. The first is to iodize the salt and deliver it free to all consumers. The second is to run a campaign to create a demand for iodized salt, so that the consumer will be motivated to pay slightly more for iodized salt because of its benefits. The cost of the social marketing campaign to promote the use of iodized salt would be a fraction of the cost of the first option. In Pakistan social marketing created a demand for iodized salt resulting in 50 million new consumers. It was not just an information, education, and communication campaign, but a concerted effort to work with about 500 small salt producers and thus to address issues related to both supply and demand. That campaign cost US$1,000,000 per year and benefited 50 million people. The costs depend on the scale of the country. An oral rehydration therapy campaign in Haiti will cost US$250,000, a fraction what the public-sector costs of free distribution would be.

Processed complementary foods: Summary of nutritional characteristics, methods of production and distribution, and costs

Chessa K. Lutter

Abstract

The cost of feeding Latin America's children is high, when viewed in the context of public expenditures on food. The need to increase the cost-effectiveness of such expenditures, coupled with the growing interest in partnerships between the public and private sectors and increases in urbanization, female employment, and household food expenditures, suggests a potential role for processed complementary food in the prevention of malnutrition. The nutritional characteristics of the various foods currently used in nutrition and health programmes are variable, depending on the scientific information available when the food was formulated. A growing interest in the role of the private sector in public health interventions is evidenced by the number of programmes in which such a collaboration exists. The cost of production per 100 g of dry product varies from US$0.04 for World Food Programme blended foods to approximately US$0.20 for recently formulated foods with a significantly higher fat content for national programmes in Mexico and Peru. The constraints and challenges for harnessing the potential of processed complementary foods to improve infant and child nutritional status are numerous. However, the multifactorial causation of child malnutrition points to the importance not only of ensuring access to the appropriate mix of foods, but also of promoting optimal breastfeeding and complementary feeding practices and care.

Introduction

Although the importance of a larger strategy to improve infant and young child nutrition is recognized, the congruence of a number of factors led to the idea of examining the role of processed complementary foods in preventing malnutrition in Latin America's children. These factors include the following:

» the current large public expenditures on food, coupled with pressures to increase the cost-effectiveness of such expenditures;
» the increases in urbanization, female employment, and household food purchases;
» the narrow window of opportunity for improving young child nutrition;
» the increasing interest of the public sector in working with the private sector to maximize efficiencies.

This summary paper provides information on the factors outlined above and summarizes the nutritional characteristics of the foods presented at the meeting, the methods of production and distribution, the programme characteristics, and costs.

Congruence of factors

The cost of feeding Latin America's children is high. Despite the conceptual and practical problems of measuring the cost of feeding programmes [1], where the costs have been measured the numbers are staggering. In 1991 the World Bank estimated that US$1.6 billion was spent annually in Latin America in 104 different programmes [2]. In a review of World Bank nutrition programmes since 1990, a total of US$44 million has been allocated for food loans to Argentina, Ecuador, Guyana, Honduras, Mexico, Nicaragua, Panama, and Paraguay [Rokx C, World Bank, personal communication, 1999]. In the 1997 Peruvian National Food and Nutrition Plan, a total of US$326 million was allocated for food for pregnant and breastfeeding women, children, and at-risk adolescents; prevention of micronutrient deficiencies, *comedores populares* (popular kitchens); and milk distribution programmes [3]. A review of Title II US Agency for International Development (USAID) Food Aid programmes shows that in 1998 nearly US$50 million was spent on commodities and programme support costs in Bolivia, Guatemala, Haiti, Honduras, Nicaragua, and Peru [Rajabium S, Food and

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Mention of the names of firms and commercial products does not imply endorsement by the United Nations University.

Nutrition Technical Assistance, personal communication, 1999]. Missing from this summary are the costs of World Food Programme (WFP) foods and national costs associated with their storage, transportation, and distribution; allocations from national budgets (except that of Peru); and private allocations.

Latin America is undergoing large demographic shifts, with increasing urbanization, female employment, and food purchases [4]. Consistent with such demographic changes are increasing opportunities as well as constraints for child feeding and care. Urban populations tend to purchase most, if not all, of their food and have access to well-developed commercial markets. Women, who are the primary caregivers of infants and young children, are also under increasing time pressures because of employment, time spent commuting, and less flexible schedules than they previously had in rural areas.

Analysis of national representative data from Demographic and Health Surveys shows that despite decreasing prevalences of malnutrition as measured by stunting (height for age < 2 SD) in Latin America (fig. 1), prevalences are still unacceptably high (fig. 2). These data also show that despite the varying levels of stunting, from 45% in Guatemala to 10% in Brazil, the age-specific nature of stunting remains constant (fig. 3). The window of vulnerability is narrowly focused between birth and two years of age, corresponding to the period of breastfeeding and complementary feeding.

A growing interest in the role of the private sector in pubic–private enterprises is evidenced by the number of programmes described at this consultation in which a public–private collaboration exists. The role of social marketing, or the use of marketing techniques to achieve a public health goal, in the area of processed complementary foods is particularly appealing [5]. The strength of social marketing within a larger strategy is its abil-

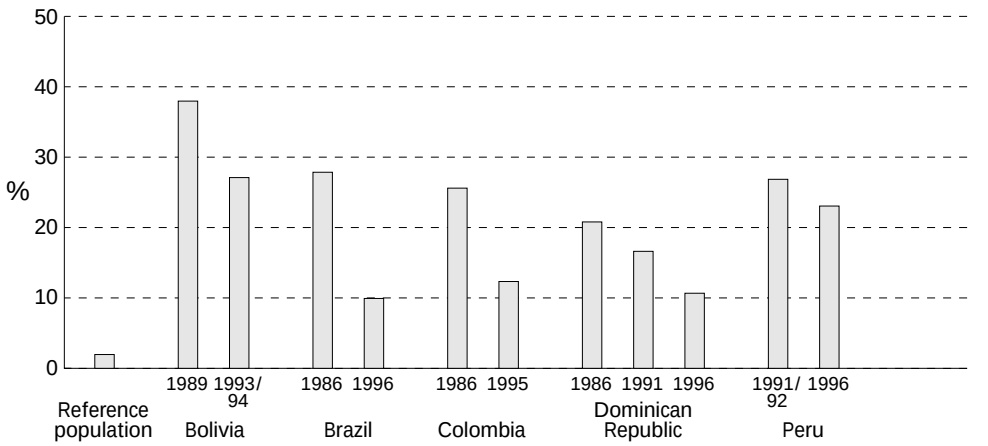

FIG. 1. Changes in stunting among Latin American children under three years of age. Stunting is defined as height-for-age < 2 SD of the WHO reference population. Source: Demographic Health Surveys 1986–96

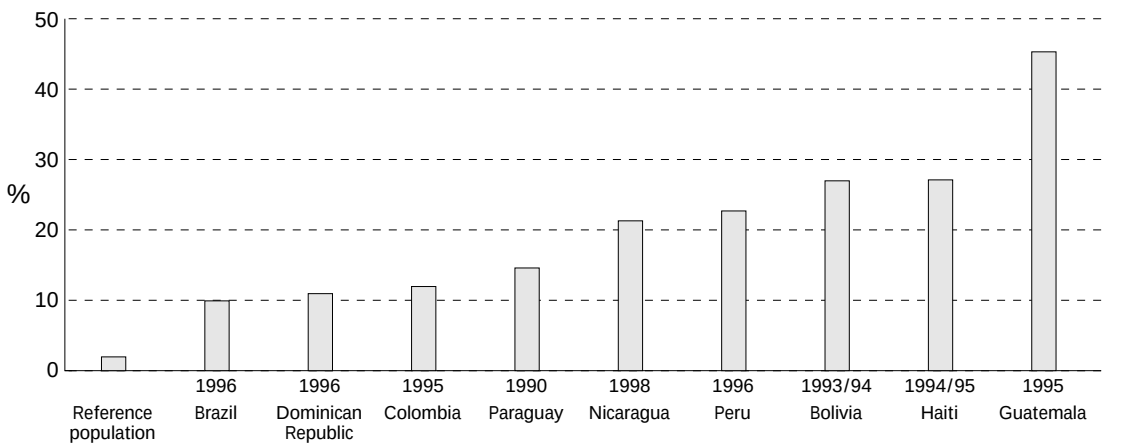

FIG. 2. Stunting among Latin American children under three years of age. Stunting is defined as height-for-age < 2 SD of the WHO reference population and reflects chronic malnutrition. Source: Demographic Health Surveys 1990–98

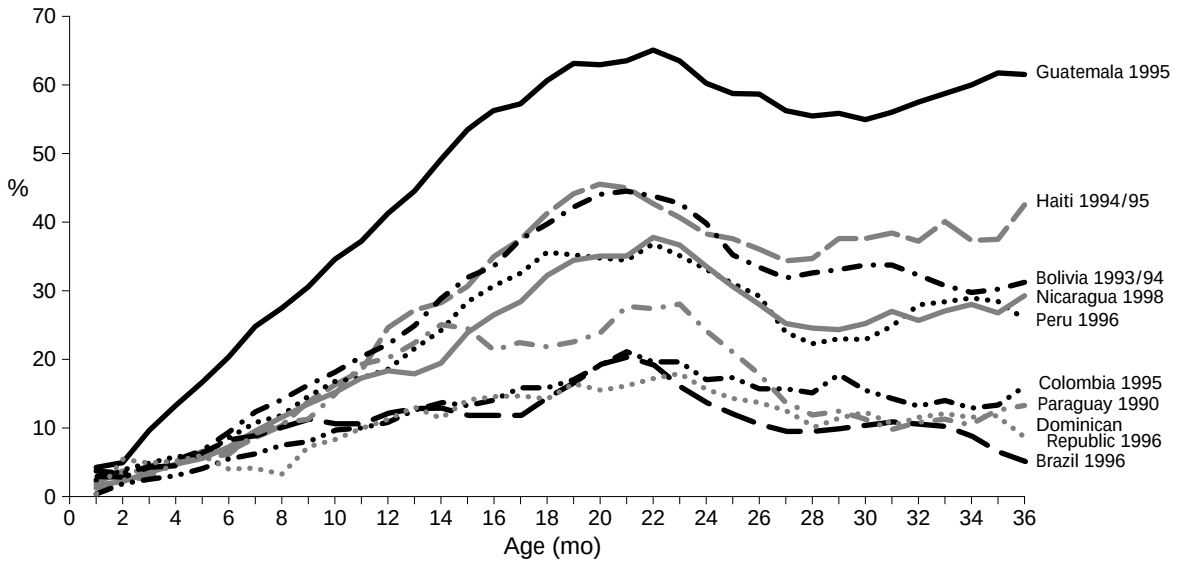

FIG. 3. Stunting among Latin American children according to age. Stunting is defined as height-for-age < 2 SD of the WHO reference population and reflects chronic malnutrition. Source: Demographic Health Surveys 1990–98

ity to harness existing private-sector infrastructure to create access to information as well as to products.

Nutritional characteristics

The nutritional characteristics of the processed foods presented at the consultation are variable, depending on when the food was formulated (table 1). Foods that were formulated in the 1970s and 1980s have a higher content of protein and a lower content of fat than foods formulated in the late 1990s. The protein contents of Nutrisano and Alli Alimentu are less than 15 g per 100 g of dry product, compared with 23.5 g for Incaparina and 26 g for Bienestarina. The fat content of Alli Alimentu is nearly 15 g per 100 g of dry product, compared with less than 2 g in all the Colombian products. The different mix of macronutrients is likely to have implications for taste and acceptability as well as for absorption of micronutrients. The ratios of phytate to zinc and of phytate to iron would have been helpful to understand the potential for absorption of these minerals, but such calculations were not possible from the product data available.

The content of micronutrients also varies considerably (table 1). Iron is routinely added to all foods. However, zinc, which along with iron and vitamin A was identified as a problem nutrient, is not routinely added [7]. Alli Alimentu has 10 mg of zinc per 100 g of dry product and Nutrisano has 23 mg of zinc per 100 g of dry product, but no zinc is added to either Incaparina or Bienestarina. The content of vitamin A ranges from approximately 2,000 to 5,000 IU per 100 g of dry product.

Methods of production and distribution

As mentioned above, the private sector is playing an increasingly important role in the production and distribution of processed complementary foods. Alli Alimentu is produced and transported to the distribution points entirely by the private sector under contract to the Government of Peru [8]. One-third of all foods distributed by the WFP are produced by private-sector companies in countries that use the foods. The remaining two-thirds are produced by private-sector companies in the United States [9]. Incaparina is produced by a private company for sale in the commercial market [10]. In contrast, Nutrisano is produced in plants owned and operated by the Government of Mexico [11, 12]. The Colombian foods are produced by both private- and public-sector plants [13]. The vast majority of the participants reported excellent experiences in working with the private sector. Dijkhuizen [9] noted the particular importance of good legal contracts in contributing to excellent experiences between the public and private sectors.

The methods of distribution of the foods varied among countries. In Peru the private sector transported the food to local distribution points, and community organizations then took responsibility for transporting the food to the beneficiaries [8]. This system not only lowered the costs to the government but ensured community ownership and participation. Foods provided by both the WFP and USAID rely on non-governmental organizations for their distribution [9, 14].

To date, none of the foods involve a mixed private–public-sector model in which the same food is provided free of charge to one group of beneficiaries while

TABLE 1. Summary of nutritional characteristics of complementary foods per 100 g of dry product[a]

Nutrient	WHO requirements[b]	Incaparina (Guatemala)	Alli Alimentu (Peru)	Nutrisano (Mexico)	Wheat–soya blend[c] (USAID/WFD)	Corn–soya blend[c] (USAID/WFP)	Bienestarina	Colombiharina	Solidarina
Protein (g)		21.3	14.4	13.3	21.5	17.2	26	21.7	23
Energy (kcal)		373	444	440	355	376	319	383	340
Fat (g)		5.3	14.8		5.9	6.9	1.4	1.3	2
Vitamin A (IU)	1,333	4,500	2,400	3,067	2,323	2,612	2,000	5,000	1,733
Vitamin E (mg)	5			13.8	8.7	8.7	2.0	1.8	0.4
Vitamin D (pg)	10				198	198			
Thiamine (vitamin B_1) (mg)	0.5	1.7	0.5		0.5	0.5	2.0	1.8	0.4
Riboflavin (vitamin B_2) (mg)	0.8	1.0	0.5	1.8	0.5	0.5	0.5	1.1	0.5
Niacin (mg NE)	9.0	13.6	5.0		8.2	6.2	9.7	13.3	6.7
Vitamin B_6 (mg)	0.9		0.6		0.5	0.5			
Vitamin B_{12} (mg)	1.0		0.5	16.1	0.1	0.1			
Folic acid (pg)	50		30.0	11.5	27.5	30.0			170
Vitamin C (mg)	20		50	92	40	40	27		29
Calcium (mg)	800	305	200		842	831	512	500	568
Zinc (mg)	10.0		10.0	23.0	5.5	5.0		8.3	6.0
Iron (mg)	12.0	11.2	10.0	23 .0	17.9	17.5	14.1	14.2	10.0
Magnesium (mg)			50		227	174			
Phosphorus (mg)		65.0	200		294	206	766	275	440
Iodine (mg)	50–70		70		56	57			
Selenium (mg)									
Copper (mg)									
Fluoride (mg)			0.50						

Abbreviations: WHO, World Health Organization; USAID, US Agency for International Development; WFP, World Food Programme.

a. A blank space indicates that the product was not fortified with this nutrient. However, the nutrient may be present if it occurs naturally in the product.

b. Daily requirements according to the 1991 Codex Alimentarius are given. The Codex (p. 63) states that when a supplementary food for older infants and young children is supplemented with one or more nutrients, the total amount of the added vitamins and minerals should be at least two-thirds the reference daily requirements per 100 g of the food on a dry matter basis. However, the Codex also states that this table is "simply a guideline to emphasize the nutrients to be considered in the development of a supplementary food" (p. 60), and that "appropriate modifications might have to be made for adapting them (the guidelines) to specific conditions" (p.57) [6].

c. Amount of nutrient in product occurring both naturally and through fortification.

being available on the commercial market for those who can afford it. Interest is growing, however, in such a model. With the exception of Incaparina, which is not specifically formulated for infants and young children, most processed complementary foods on the commercial market are extremely expensive and available only in urban settings. Commercial marketing of a less expensive alternative would make available to large segments of the population a nutritious product for their young children [15]. At the same time, it would allow for economies of scale in production that would permit the public sector to purchase at a reasonable price the necessary quantities to meet the needs of those without the resources to purchase the commercial product. Such a model has been used successfully with other health products, such as contraceptives and oral rehydration packets [5].

Processed complementary foods, whether produced by the public or the private sector, need to be in compliance with the Code of Marketing of Breast-Milk Substitutes and the Codex Alimentarius [16]. For the Code, this means that the food must never be promoted as a breastmilk substitute. For most countries in Latin America, which recommend six months of exclusive breastfeeding, this means that they should be promoted to infants over six months of age. For the Codex, this means that the foods must be produced in accordance with the Standard for Processed Cereal-Based Foods for Infants and Children.

Costs

The cost of producing and packaging the different foods varies considerably, reflecting their different macronutrient and micronutrient composition. The foods for-

mulated more recently, Alli Alimentu and Nutrisano, which reflect the most recent scientific information on the dietary needs of the target population, are more expensive than the other products. Alli Alimentu costs US$0.2128 and Nutrisano costs US$0.1818 per 100 g of dry product. In contrast, Bienestarina costs US$0.072 per 100 g of dry product. The retail price of Incaparina is US$0.10 per 100 g of dry product, indicating that the production costs are less.

Data on the transportation and distribution costs of the different foods are not available. These costs are probably highly variable. Transportation costs are a function of distance and the conditions of roads, among other things. Distribution costs are a function of the larger programme or strategy in which the foods are provided. In particular, foods provided under the USAID Title II Programme are provided through maternal and child health programmes, which have a number of components in addition to provision of food. To date, none of the programmes uses a coupon system in which coupons are provided through special centres, and foods are redeemed in commercial establishments, as in the United States special programme for Women, Infants, and Children (WIC).

Looking forward

The constraints and challenges for harnessing the potential of processed complementary foods to improve the nutritional status of infants and young children in Latin America are numerous. Mora [15] argues for a market-oriented approach and the move away from free or highly subsidized food distribution programmes. He further argues for the need to create a demand for processed complementary foods. At the same time, it is recognized that food, in the absence of behavioural change, is unlikely to improve the nutritional status of children [17]. The role of behaviour in infant and young child nutrition points to the importance of a strategic plan, in which processed complementary foods could play a role, rather than a technological fix in which the focus is on food [18]. Analysis of the nutrition situation in Kenya led to the suggestion that social marketing of fortified cereals to low-income families and the promotion of exclusive breastfeeding for the first four to six months of life could provide a sustainable means of improving infant and young child nutrition [19].

Programme evaluations can serve many different purposes, and it is important to decide who needs what information and why in designing an evaluation strategy [20]. Attention needs to be given to evaluation not only of impact but also of process.

Although efficacy trials show the effectiveness of food supplements in improving infant and child nutritional status [21–23], data from effectiveness or public health interventions are scarce. Where such data are available, all the findings are not always consistent with expectations, showing the multifactorial causation of young child malnutrition [8].

The multifactorial causation of young child malnutrition points to the importance not only of ensuring access to the appropriate mix of foods, but also of breastfeeding and complementary feeding practices and care. It is unlikely that any food in and of itself will prevent malnutrition in the absence of a larger strategy directed not only to caregivers but also to the overall environment in which infant-feeding decisions are made and executed [24]. This is not to diminish the importance of food and the potential for processed complementary foods to contribute towards preventing malnutrition in Latin American children. It is rather to put the issue of food into the broader context and need for an overall nutrition strategy directed at infants and young children.

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General guidelines for the use of processed complemetary foods

» Processed complementary foods should be used in the context of a broad strategy to improve infant and child nutritional status and development. Such a strategy should also include communication for behavioural change to promote key behaviours such as breastfeeding, particularly exclusive breastfeeding, active feeding, and care.
» Processed complementary foods should be used when infants and young children are most likely to suffer from growth retardation, generally up until 24 months of age. They should be introduced at the time when the recommended age of exclusive breastfeeding, as determined by the Ministry of Health, ends. In most Latin American countries, this is at six months of age.
» Processed complementary foods should be of a consistency that facilitates use of a cup and spoon for feeding (by either the caregiver or the child). They should never be given in a bottle.
» Processed complementary foods should provide close to 100% of the recommended intakes for problem nutrients, such as iron and zinc. Their use should be promoted along with the promotion of nutritionally appropriate traditional complementary foods to ensure a smooth transition to the family diet.
» Processed complementary foods should be marketed in accordance with the Code of Marketing of Breast-Milk Substitutes and relevant standards of the Codex Alimentarius.

Research needs

Programmatic

» Effectiveness studies that include cost data of foods and programmes now in the public health arena to complement the efficacy studies.
» The use of processed complementary foods in the home vis-à-vis preparation (dilution and mixing) and hygiene.
» The cost of social marketing of processed complementary foods and broader strategies to improve infant and child nutrition and health.
» Protocols for process evaluations.

Biological

» Empirical studies on the effect of different patterns of complementary feeding on breastmilk intake.
» Empirical studies in which the feeding frequency, density, and quantity offered are experimentally varied to determine the effect on intake.
» Empirical studies on the bioavailability of different mineral salts and compounds and the cost, given differences in bioavailability.
» Development of a protocol to test products with respect to nutrient absorption, particularly with respect to problem nutrients.

Erratum

Dusch E, Galloway R, Achadi E, Jus'at I, Sibale C, Franco C, Cousens S, Morison L. Clinical screening may be a cost-effective way to screen for severe anaemia. Food Nutr Bull 1999;20:409–16.

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Books received

High dose irradiation: Wholesomeness of food irradiated with doses above 10 kGy. Report of a joint FAO/IAEA/WHO study group. WHO technical report series 890. World Health Organization, Geneva, 1999. (9-2412-0890-2) 197 pages, paperback. Sw fr 42.–/US$37.80. In developing countries: Sw fr 29.40. (Available in English, French, and Spanish in preparation)

The three organizations, the Food and Agriculture Organization, the International Atomic Energy Association, and the World Health Organization, have a long history of successive committees to evaluate the safety and nutritional value of food irradiated for enhanced preservation. In 1980 such a committee concluded that "irradiation of any food commodity up to an overall average dose of 10 kGy* presents no toxicological hazards…and introduces no special nutritional or toxicological problems." This clearly established the wholesomeness of any food irradiated up to this average dose and ended decades of technical uncertainty. Most of the uses proposed at this time required less than this dose. They included the elimination of bacterial pathogens from meat, poultry, fish, fresh fruits, and vegetables; the inhibition of sprouting of tubers; the insect disinfestation of grains and dried fruits, such as dates and figs; the extension of the shelf-life of refrigerated foods; and the treatment for quarantine purposes of fruits and vegetables. The available data at the time were insufficient to evaluate the wholesomeness of food treated with higher doses.

In 1983, on the basis of the report of the 1980 committee quoted above, the FAO/WHO Codex Alimentarius Commission adopted a General Standard for Irradiated Foods that limited the average overall dose to 10 kGy. A large number of governments accepted this recommendation and initiated regulatory actions permitting the irradiation of a considerable number of food commodities. However, misconceptions about whether irradiated foods are safe to eat and how irradiation can complement or replace other methods of preserving foods have limited the application of this technology. Consequently, the benefits of food irradiation are not generally available to individual consumers and societies.

The fact that the international organizations and the Codex limited the dose level to 10 kGy has frequently been interpreted as meaning that above this dose toxic substances could be introduced or the nutritional adequacy of foods harmed. However, there are current applications of food irradiation involving doses above 10 kGy that indicate that this is not the case. These include the development of high-quality shelf-stable convenience foods. Such shelf-stable foods have been used successfully by astronauts, military personnel, and others. This publication is the report of a Study Group convened to evaluate the data that have become available on the irradiation of foods with doses above 10 kGy.

The report presents a comprehensive summary, along with over 500 references, of the effectiveness and safety of the irradiation process. It concludes that foods treated with doses greater than 10 kGy are safe and nutritionally adequate when produced under established Good Manufacturing Practices. The experts further concluded that no upper dose limit need be imposed and that irradiated foods are wholesome through the technologically useful dose range both above and below 10 kGy.

Nutritional anthropology: Biocultural perspectives on food and nutrition. Edited by A.H. Goodman, D.L. Dufour, and G. H. Pelto. Mayfield Publishing Co., Mountain View, Calif., USA, 2000. (0-7674-1197-8) 392 pages, paperback.

This volume provides a core set of readings across the broad spectrum of nutritional anthropology and related nutritional disciplines suitable for a university course on this subject. The articles of parts 1 and 2 cover the evolutionary and comparative perspective,

* The gray (Gy) is the unit of absorbed dose of ionizing energy and is equivalent to 1 joule/kg. It replaces the rad (radiation absorbed dose) as the unit of absorbed dose. One gray is equivalent to 100 rad.

including diet and primate evolution, agricultural revolutions, and the pluses and minuses of the variations of contemporary food systems. Part 3 has articles dealing with cultural differences in approaches to food, adapting foods to people and people to the food supply, including foods as medicine. Part 4 has articles dealing with the nutritional problems of the contemporary world, including undernutrition and overnutrition in lands of scarcity and of plenty. The 40 carefully selected articles by recognized authorities provide a fascinating insight into food and nutrition from the standpoint of human populations and cultures. They make the information readily accessible and are so comprehensive and authoritative that they can be read with profit by anyone concerned with the multifaceted nature of human relations, including not only students but all health professionals.

Scaling up, scaling down. Overcoming malnutrition in developing countries. Edited by Thomas J. Marchione. Gordon and Breach Publishers, Amsterdam, The Netherlands, 1999. (90-5700-547-6) 292 pages, hardcover. US$5.00/£3.00 Additional copies US$2.00/£1.30.

This book has been edited by an anthropologist with long hands-on experience with a development process that has often been viewed critically. This is evident in the two chapters by the editor and in the other 12 chapters by outstanding authors with similar experience. They champion the idea of increasing, or scaling up, grass-roots operations to provide nutritional security while scaling down the efforts of national and international institutions.

Scaling up involves strengthening local capacities to improve and expand upon current successful programmes by building upon local cultures and organizations. This in turn enables the programmes to strengthen relationships with national governments, international bilateral or multilateral donors, and nongovernmental organizations. Scaling down concerns the ways and means by which these various organizations encourage and complement local development. Therefore, as local capacities are scaled up, the external control over decisions and functions, ideally, is scaled down. This book describes a new array of opportunities and constraints for conquering the world's nutrition problems but stresses that this is an achievable goal. However, it warns against the negative developments—the decline in development assistance, the impact of market forces, and, worst of all, the large number of civil conflicts that create the worst nutritional situations.

The four chapters of the initial section describe the challenge of malnutrition and hunger. The next five chapters deal with scaling up from the grass roots and include examples from Vietnam, Haiti, Togo, and Bangladesh. Three chapters deal with scaling down top-down management, food and livelihood security assessment, and constraints on nutrition capacity building in South Africa. The final two chapters deal with improving the practices of "public nutrition" and "overcoming nutrition in the new era." In the last chapter, the editor, Thomas Marchione, summarizes the lessons of the previous chapters and presents the unique challenges and opportunities of the new millennium. The book's attractive price puts it within the reach of everyone concerned with overcoming malnutrition through the development process.

Toward the conquest of vitamin A deficiency disorders. Donald S. McClaren. Taskforce SIGHT AND LIFE, Basel, Switzerland, 1999. (3-9064-1202-4) 144 pages, paperback.

This book is an autobiographical account of the personal odyssey of one the pioneers of vitamin A investigation whose life has been devoted to advocacy for the prevention of vitamin A deficiency. Donald McClaren has done as much as any single person to alert medical and health workers to the prevalence and significance of vitamin A deficiency. His career has spanned over 50 years from the time when it was recognized that blindness was caused by avitaminosis A-induced xerophthalmia and keratomalacia, to the period when it was gradually recognized that subclinical vitamin A deficiency was a major factor in the mortality of preschool children in many developing countries, to the current efforts by UNICEF, WHO, and other agencies to eliminate vitamin A deficiency as a public health problem. It is filled with historical anecdotes and illustrations and provides a unique insight into the history of vitamin A deficiency in the twentieth century. It is fascinating reading and should be on the bookshelf of everyone interested in the history of nutrition and in library collections on this subject.

News and notes

JECFA gives full approval to sodium iron EDTA

At its recent meeting in Rome, the Joint Expert Committee on Food Additives (JECFA) agreed that sodium iron EDTA is considered to be safe as a source of iron in food fortification. This statement is part of the summary of the fifty-third meeting of JECFA, which took place on 1–10 June 1999.

JECFA made this determination based on data submitted by the International Nutritional Anemia Consultative Group (INACG). In 1993 JECFA had reviewed safety data for sodium iron EDTA submitted by INACG and gave the compound a provisional approval. At that time, JECFA asked for additional data on the pattern of iron deposition with this iron chelate.

Working with private-sector partners, INACG was able to generate support for a toxicology study to answer JECFA's request. The data from this study, conducted by the TNO Nutrition and Food Research Institute, showed no difference in the patterns of iron deposition in rats fed sodium iron EDTA and rats fed ferrous sulphate, a form of iron commonly used for food fortification. As a result of this research, JECFA removed the provisional aspect of the approval dating from 1993.

Sodium iron EDTA is an excellent source of iron for food fortification when inhibitors such as phytates or tannins are present in the fortification vehicle, as is the case with whole wheat flour. In these cases, absorption of iron as sodium iron EDTA is not inhibited by phytate, whereas the absorption of other iron compounds can be greatly inhibited. They may require large amounts of enhancers of iron absorption, such as vitamin C, in order to have adequate bioavailability. In populations at risk for iron-deficiency anaemia, especially young children and women of childbearing age, having access to bioavailable iron sources will reduce the risk of developing iron-deficiency anaemia and its serious health consequences. This is especially important because the usual plant-based diets of these populations are high in iron inhibitors.

INACG is sponsored by the US Agency for International Development through a cooperative agreement with the International Life Sciences Institute Research Foundation. INACG developed strategic partnerships with several companies (Kellogg, Nestlé, and the Dr. Paul Lohmann Company) interested in contributing to the improvement of iron status in developing countries through improved iron fortification of foods. Through this partnership, INACG was able to gather the funds necessary to carry out the needed research.

Approval of this compound by JECFA is a significant step towards providing bioavailable iron to millions of people in Asia, Africa, and Latin America at risk for iron-deficiency anaemia.

For more information, please contact:

INACG Secretariat
ILSI Human Nutrition Institute
1126 Sixteenth St., NW
Washington, DC, USA 20036
Tel: 202-659-9024; Fax: 202-659-3617

Nominations are requested for the Prince Mahidol Award 2000

The Prince Mahidol Award Foundation of Thailand offers two prizes of US$50,000 each to an individual or individuals who have made important contributions to the health of large numbers of people regionally or globally. In rare cases an award may be given to an institution. In principle one of the awards is given more for the development of knowledge leading to health improvements and the other more for the effective large-scale application of health knowledge. The two awards may be given in the same or in different areas. Nominations of two persons for the same achievement who have worked together or entirely separately is encouraged.

For the 1999 award the Foundation received a total of 57 nominations from 25 countries that had been forwarded from the Secretary-General to the Scientific Advisory Committee for initial screening. After that the nomination forms were transmitted to the International Award Committee, which then considered and

recommended names of the proposed awardees to the Board of Trustees of the Prince Mahidol Award Foundation chaired by Her Royal Highness Princess Maha Chakri Sirindhorn for final approval.

The 1999 awardees were Dr. R. Palmer Beasley, an American, and, jointly, Dr. Adetokunbo Olumide Lucas, a Nigerian, and Dr. Tore Godal, a Norwegian. In the field of medicine Dr. Beasley is recognized for his contribution to the understanding of the pathogenesis of hepatitis B, a major viral infection of the liver in hundreds of millions of people in different parts of he world. In the field of public health Drs. Lucas and Godal won the award jointly for their contributions towards the development of the special programme on Tropical Disease Research (TDR) into a world-acclaimed, highly productive, and effective research programme on tropical diseases, particularly malaria, schistosomiasis, the filariases, leishmaniasis, Chagas disease, African trypanosomiasis, and leprosy. These diseases affect millions of people in tropical Africa, Asia, and South America. The advance in research has been in several fronts, including strengthening research capacity in developing countries. Drs. Lucas and Godal successively showed innovative and highly successful management of the TDR programmme operated under the umbrella of WHO.

Of the 23 awards that have been made since the first in 1992, four have been in the field of nutrition. They were made to:

» John Stanbury (1993) for his contributions to the understanding and conquest of iron-deficiency disorders;
» Fred Sai (1995) for his early work on the prevention of kwashiorkor and his leading role in developing family planning in Ghana and other African nations;
» Alfred Sommers (1997) for his demonstration that periodic supplementation with massive doses of vitamin A can result in decreased mortality among pre-school children;
» Guillermo Arroyave (1997) for his demonstration that fortification of sugar with vitamin A on a national scale in Guatemala and Costa Rica can eliminate vitamin A deficiency as a public health problem.

Nomination forms for 2000 can be obtained from:

Prince Mahidol Award Foundation
Office of the Dean, Faculty of Medicine,
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International scientific unions
International Union of Food Science and Technology (IUFoST)
International Union of Nutrition Sciences (IUNS)

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The UNU Programme of Food and Nutrition for Human and Social Development cooperates with the appropriate units or divisions of the following organizations, among others:
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World Bank (IBRD)
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World Health Organization (WHO)

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Research networks

Chronic energy deficiency

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Iron-deficiency anaemia

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Language. Contributions may be in English, French, or Spanish. If French or Spanish is used, the author should submit an abstract in English if possible.

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Length. Ordinarily contributions should not exceed 4,000 words.

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1. Alvarez ML, Mikasic D, Ottenberger A, Salazar ME. Caracteristicas de familias urbanas con lactante desnutrido: un análisis critico. Arch Latinoam Nutr 1979;29:220–30.

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2. Committee on Enzymes of the Scandinavian Society for Clinical Chemistry and Clinical Physiology. Recommended method for the determination of gammaglutamyltransferase in blood. Scand J Clin Lab Invest 1976;36:119–25.

Book or other monograph reference

—*personal author(s):*

3. Brozek J. Malnutrition and human behavior: experimental, clinical and community studies. New York: Van Nostrand Reinhold, 1985.

—*corporate author:*

4. American Medical Association, Department of Drugs. AMA drug evaluations. 3rd ed. Littleton, Mass, USA: Publishing Sciences Group, 1977.

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5. Medioni J, Boesinger E, eds. Mécanismes éthologiques de l'évolution. Paris: Masson, 1977.

—*chapter in book:*

6. Barnett HG. Compatibility and compartmentalization in cultural change. In: Desai AR, ed. Essays on modernization of underdeveloped societies. Bombay: Thacker, 1971:20–35.

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1. Alvarez ML, Mikasic D, Ottenberger A, Salazar ME. Caracteristicas de familias urbanas con lactante desnutrido: un análisis critico. Arch Latinoam Nutr 1979;29:220–30.

—*auteur d'une société:*

2. Committee on Enzymes of the Scandinavian Society for Clinical Chemistry and Clinical Physiology. Recommended method for the determination of gammaglutamyltransferase in blood. Scand J Clin Lab Invest 1976;36:119–25. Livre ou autre monographie

—*auteur(s) à titre personnel:*

3. Brozek J. Malnutrition and human behavior: experimental, clinical and community studies. New York: Van Nostrand Reinhold, 1985.

—*auteur d'une société:*

4. American Medical Association, Department of Drugs. AMA drug evaluations. 3e éd. Littleton, Mass. (E.-U.): Publishing Sciences Group, 1977.

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5. Medioni J, Boesinger E, éds. Mécanismes éthologiques de l'évolution. Paris: Masson, 1977.

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1. Alvarez ML, Mikasic D, Ottenberger A, Salazar ME. Caracteristicas de familias urbanas con lactante desnutrido: un análisis critico. Arch Latinoam Nutr 1979;29:220–30.

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5. Medioni J, Boesinger E, editores, Mécanismes éthologiques de l'évolution. París: Masson, 1977.

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