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# combatting pre-school child malnutrition in Venezuela

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THE EXISTENCE of a serious nutritional problem in Venezuela, especially among the children, was recognized several years ago. A group of pediatricians undertook one of the earliest studies of this problem in Latin America. The term "Sindrome Pluricarencial Infantil" was coined by them to designate what is now called "Kwashiorkor." Cases were studied mostly in hospitalized patients and treated with milk diets. A system of "Centros Materno Infantiles" was established covering the whole territory of the Republic. Distribution of milk for newborn children was initiated. In order to discourage use of this milk by other members of the family, and also for reasons of better digestibility, acidified commercial milk formulas were used. This program had a very favorable effect on reduction of the mortality rate of infants. But it was not recognized clearly at first that the problem was merely postponed to children of 1 to 7 years of age for whom no comparable program existed.

When the National Nutritional Institute of Venezuela was created by the National Government in 1950, the investigators decided that their first task would be study of the incidence of malnutrition in different age groups and in different regions of the country. At the same time, they decided to study composition and availability of foods. It was soon realized that the age group most affected by malnutrition was children between 1 and 7. The organization of mother and child health centers would not help them nor could these children benefit from the school lunch program. It became clear that one of the foremost tasks of the Nutritional Institute was to help the 1 to 7 year old children.

Based on these results, and the fact that the number of patients admitted to the children's departments of national hospitals because of malnutrition was large, organization of special prophylactic measures was considered an urgent task. After studies of the biological and economic aspects of available protein sources, it was concluded that a product based on dried skim milk would be most promising. The worldwide campaign of UNICEF after World War II, using this product, in programs to combat child malnutrition was an important factor in reaching this conclusion.

## COMPOSITION OF "PL"

A special formula was developed which contains added vitamins A, D, thiamine, riboflavin, niacin, $B_{12}$, and C, calcium phosphate, iron glycerophosphate and sugar in amounts such that a feeding of 60 grams of the product per day will provide 65 to 100% of the daily requirements of these nutrients for a 1 to 7-year old child. The formula (Table 1) was supplemented with DL-methionine (0.3%) in order to obtain an optimal effect of the daily ration, which would provide 33% of the protein requirement of this age group. Color and flavor were added to make the product clearly distinguishable from milk to avoid the possibility that some children would not like the product and would extend their distaste to milk. The product was called PL ("Producto lácteo").

At the beginning, four different flavors were used. Later, this number was increased to twelve because it was found desirable to change flavors frequently in order to obtain good acceptance.

## FEEDING TRIALS

Previous experiments with rats had demonstrated that diarrhea was frequently observed when animals were put on a diet of the product described. This probably resulted from the high lactose content. Thereafter a trial was initiated in the Nutritional Institute in order to further investigate, in children, several aspects, such as acceptability, tolerance, and effect on growth and general health. The children were brought daily by their mothers to take the product at the Institute between 10 and 11 a.m. This method had to be abandoned later because a large number of mothers could not make daily visits. But it served for a study of the acceptability of the product and helped establish a schedule for feeding. In a subsequent experiment with 78 children, it was observed that 45% presented at first some intolerance, manifested by diarrhea and in a few cases also by vomiting and intestinal pains. These symptoms ceased promptly after discontinuation of the PL feeding. The feeding schedule established was as follows: During the first week, 2 large

spoonsful of the product were given daily in one half glass of water; during the second week twice this amount; from the third week on the daily dose was 60 grams of PL dissolved in one large glass of water. With this schedule, slight intestinal disorders were observed in 27% of the children. These ceased with very few exceptions after a few days.

## RESULTS OF TRIALS

A test with 312 children over a year showed that those who took the product regularly grew 7.15 cm and gained 2.562 kg while those in a control group grew 6.46 cm and gained 1.946 kg. Children who took the product irregularly grew and gained at rates between these rates. All the children had been sent to the Institute underweight, but they were not in a condition of acute malnutrition. In children who had hemoglobin values of 11 g% at the start of the treatment no change was observed. But in 28 children with 6–8 g% a rise to 10.7 after 6 months was observed.

## DISTRIBUTION OF PRODUCT

After these preliminary tests a large-scale program was started. Distribution centers were put in rural schools, public health centers, or popular restaurants. PL, packed in 1 kg capacity plastic bags, was shipped directly to the distribution centers from a small plant operated by the Nutritional Institute. A public health nurse, auxiliary nurse, or woman teacher was taught how to prepare the product and how to organize the distribution. The necessary utensils were provided by the Institute. The local public health physician was instructed to send children who were underweight, or exhibited other signs of malnutrition, and to recheck them at monthly intervals. Each center had a capacity of 50 children who attended for periods of up to 6 months. Children discharged from a public hospital after treatment for malnutrition (and their brothers and sisters) are given preference.

A card for each child contained monthly data on weight and height. One physician and 6 visiting supervisors paid by the Nutritional Institute, regularly visited the centers. The program had 64 centers with 3,985 children in 1958 and grew to 875 centers with 78,500 children in 1963. Today there are 1065 centers with an attendance of 82,750. It is estimated that little further expansion of the program will be needed. The number of children treated since the beginning of the program is over 500,000.

## ECONOMIC CONSIDERATIONS

The program was viewed from the beginning as a temporary measure to prevent advanced malnutrition and prevent recurrence of malnutrition in children discharged from a hospital. It appeared evident that preventive treatment would be cheaper than curative treatment, inasmuch as the cost of maintaining a child in a hospital for the 1 to 2 month period usually necessary for nutritional recuperation would exceed the cost of PL feeding over a period sufficient to prevent the occurrence of malnutrition.

The saving to the government because of the reduction in number of children admitted to public hospitals with nutritional disorders is difficult to evaluate. On the basis of our experience with PL treatment, however, we estimate that each hospitalized case of malnutrition costs as much as the prophylactic treatment of 100 children over a 4 month period.

This calculation can also illustrate the limitations of the program. It requires the existence of a system of public health stations to select the undernourished children, enough money to cover a sizable part of the territory with distribution centers, and the existence of a nutrition problem severe enough to justify the program. It is hoped that the nutritional problem will be eliminated soon by improvement of the economic status of Venezuela so that the PL program will become unnecessary.

The death rate for children 1 to 4 years old dropped from 10.5 per 1000 in 1957 to 5.2 per 1000 in 1965. About 32% of these deaths were due to gastroenteritis, 17% to pneumonia, and 10% to malnutrition. It is known that the death rate in the two former diseases is much higher in malnourished than in normal children. We feel that a substantial part of the drop can be attributed to the PL program.

## SUBSTITUTES FOR SKIM MILK

After the PL program started, studies were initiated to replace the skim milk, not produced in Venezuela in substantial amounts, with an alternative low-cost protein of local origin. Interest centered on sesame press cakes and fish meal. Both are produced locally although not yet in forms for human consumption.

Solvent extracted sesame residue contains about 40% protein of relatively good biological value. But it may also contain between 5 and 11% crude fiber and relatively large quantities of calcium oxalate. By a suitable screening process, the crude fiber content of the product can be reduced to below 4%, but the oxalate level of this product is slightly higher than that of the starting material. However, no harmful effects were found in rats kept for 3 generations on a diet made with this material.

Table 1. Nutrients in 60 g of PL.

| | | |
|---|---|---|
| Proteins | 16.2 | g |
| Fat | 0.46 | g |
| Carbohydrate | 36.06 | g |
| Vit. A | 1,784 | I.U. |
| Vit. D | 150 | I.U. |
| Thiamine | 1.26 | mg |
| Niacin | 7.01 | mg |
| Vit. C | 36.0 | mg |
| Vit. B-12 | 6 | mcg |
| Ca | 1.05 | g |
| P | 0.723 | g |
| Fe | 7.37 | mg |
| DL-methionine | 0.18 | g |
| Calories | 213 | |

In later experiments we observed definite signs of toxicity in animals fed with certain lots of sesame press cakes. High selenium content was shown to be the cause of the toxicity. We found that most residual cakes produced from locally-grown sesame has a relatively high level of selenium. It ranges from 3 to 40 ppm. The level of toxicity in our experimental feedings was determined to be around 8 ppm. The toxic samples came from western Venezuela where nearly all sesame is produced.

## FPC SUBSTITUTED FOR SKIM MILK

For this reason we abandoned the work on producing an edible protein supplement with sesame and concentrated on fish flour or, as it is called now, fish protein concentrate, FPC. FPC is not yet produced in Venezuela so samples were purchased from the U.S. Experiments were performed with with liquid formulas and with crackers, the latter in collaboration with a large American producer. For the liquid formulas we used different types of popular beverages called "chica" made with rice meal or with toasted corn meal. Up to 20% of fish flour could be incorporated in a product with some color change but acceptable in preliminary trials.

Crackers with 35% of fish flour have been prepared. Texture and color are quite different from those made without fish flour. Loss of biological value and available lysine was slight and

trials in children have been started. Seven crackers provide the same amount of protein as one glass of PL. Part of the fish meal can be replaced by soymeal. A superior product can be prepared with 30% of margarine but this would be expensive for our program. It is hoped that crackers can be produced at lower cost than PL and that distribution will be easier. If controlled tests in children should give satisfactory results, and fish protein concentrate is available in the amounts required (about 400 tons/year), the PL program will be changed as soon as possible. The new product would be commercially available, which is not the case with the PL.

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# food technology & the nutrition of the pre-school child in the tropics

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DURING the last few decades, products of modern food technology have become increasingly available in developing tropical countries through commercial channels and through international assistance programs. An impact on the pattern of malnutrition in young children has already been made, both beneficially and detrimentally.

This account is concerned not with details of food technology but with how the existing processed foods for young children appear to the field worker in pediatric nutrition. Also, we will consider the most useful and profitable developments for the future.

## PCM—THE WORLD'S MAIN NUTRITION PROBLEM

WHILE in some areas of the world a degree of subnutrition affects all ages, on a global basis the group of conditions known as "protein-calorie malnutrition of early childhood" (PCM) comprise the main nutritional public health problem (1). In developing areas, PCM has a high incidence and a high death rate, and it leads to long-lasting physical and mental after effects.

The two main severe forms of PCM are kwashiorkor and nutritional marasmus. However, although these obvious severe cases have correctly received much attention, the less marked "mild-moderate" degrees of PCM outnumber them tenfold or a hundredfold (2).

The cause of *all* degrees and clinical forms of PCM is complex and multifactorial, and it should be remembered that bacterial infections and parasitic diseases play their part in adding to the nutritional problem. Nevertheless, inadequate diet is always central.

The differences in the dietary causes of the two main severe forms of PCM should be pointed out, since only through understanding them can a rational approach be made to prevention.

Kwashiorkor results from a diet which is low in protein but contains carbohydrate calories which are usually derived from coarse, ill-cooked, high cellulose vegetable foods. It is, in fact, due not only to protein lack, but also to an imbalance between protein and calories. Kwashiorkor can occur at any age in childhood, or even (rarely) in adult life. But in most tropical countries it tends to be seen mostly in the second year of life, following the young child's change from breast milk to starchy carbohydrate foods.

By contrast, nutritional marasmus is the result of what has been euphemistically termed "balanced starvation"—that is, a gross shortage of both protein and calories.

The difference in the dietary cause is usually reflected in the clinical appearance of victims of the two conditions. In both, muscle wasting attests to severe protein lack, while the differing intake of calories is shown by the subcutaneous fat, usually present in kwashiorkor and absent in marasmus.

Nutritional marasmus can occur at various ages. But it is commonest in