En: "Proceedings of the Seventh International Congress of Nutrition". Hamburg 1966. Volume 3. Nutrition under various Geographic and Climatic Conditions. Braunschweig, West Germany, Verlag Friedr. Vieweg & Sohn GmbH, 1967. 1st ed. p. 194-198.

New Dietary Sources of Proteins

Moisés Béhar, Institute of Nutrition of Central America and Panama (INCAP) Guatemala City

The Problem

In this presentation it is not necessary to emphasize the well-known fact, discussed in other meetings of this Congress, that protein deficiency constitutes one of the most serious and generalized problems of our times. Likewise, I do not wish to analyse the complexity of the responsible factors and their inter-relationships.

Our only interest is to point out that insufficient availability of adequate dietary sources of protein is one of the causal factors of fundamental importance. Unfortunately, this problem shows a tendency to become more crucial in many regions, and precisely in those where it is currently at its gravest, because production of these sources does not progress at a sufficiently rapid rate, compared with the speed of population expansion. This is mainly the result of socio-cultural and economic conditions which prevent a more rational utilization of existing resources in the area, and of currently available scientific knowledge and technological developments.

Limitations in protein availability and consumption are in many cases qualitative. The habitual diet of large and mainly adult sectors of the population contains ample quantities of protein, but its biological value is so low that the need for essential sources of nitrogen is not satisfied. In other population groups, particulary small children, the deficiency is both qualitative and quantitative. Within the same family, there is a difference between the diets of the child and the adult. The child's diet contains proteins which are low in biological value but, in addition, they occur in such small quantities that severe deficiency results. Problems of a cultural nature, regulating the distribution of available food within the family, are mainly responsible for this problem.

Possible Solutions

The first, an emergency measure, is to distribute production surplus from the most privileged areas among the neediest population groups in the affected regions. Distribution can vary in form, but generally should be gratuitous. This is obviously an inadequate measure from many points of view and cannot be considered permanent. Therefore, we must determine whether or not each country is able to utilize its own resources for a resolution on a more rational and lasting foundation.

Some countries are unable to produce enough necessary foods. For other it is more economical to import them. Importation may be necessary in both cases, but it implies a degree of industrial, social and economic development that will guarantee financial accessibility to these imported foods for all population groups. This is generally not the case in the great majority of countries facing this problem. Almost all these countries have a basically agricultural economy, and must depend on their own food production to satisfy the needs of their populations. The first measure which comes to mind is a considerable increase, according to need, in the production of currently scare traditional or habitual foods, mainly of animal origin, such as meat, milk and eggs. This measure, however, is limited by economic factors related to the cost of these products and the population's capacity for demand. Frequently, social and cultural factors limit their production and

consumption to an even greater degree. If all is left to this measure, a short-term solution cannot be expected to work out for the majority of regions with the problem of dietary protein deficiency.

Another possible solution is the enrichment of basic habitual foods with protein concentrates, such as fish meal, skim milk, defattened flours from oily seeds, and products of microbial origin.

It is possible through these measures to improve both the protein concentration and the quality of basic foods such as cereals and their products. However, even when this is so, their effective application requires an industrial scale of production for these foods. In the majority of cases, they are still processed at the home level or by very primitive industrial methods which do not make enrichment feasible. Also, organoleptic changes which may be produced by this procedure in the appearance, consistency, color, odor or flavor, are particularly difficult for the population to accept in traditional foods. Another possibility to consider is improving the biological value, either of proteins in cereals and their products, or of the total diet, by supplementation with the deficient essential amino acids. This measure is also limited by the need for an industrial production of foods. In addition, its flaw is that the low protein concentration of the foods does not change. Thus, it could not be effective for small children in which the problem is greater and whose protein needs could not be satisfied by products such as cereals with an 8 to 10 % concentration of proteins, even if they do have a high biological value.

Lastly, another possible solution, particularly for the small child, is the development of new foods which can be used either as supplements to the habitual diets, or as replacements for common foods of inferior nutritional value. This last idea has received much attention during the last few years, as it allows the utilization of locally produced and available raw materials in the areas where the problem prevails. Consequently, special attention has been given to meals from oily seeds. These meals are obtained as by-products of the oil-extraction industry. Their cost is low and their protein content high. The proteins in these products can supplement those in the cereals, and mixtures can be produced with proteins in adequate concentrations and of sufficiently high biological value for use as mentioned above. Other nutrients considered necessary may be added to this basic formula. The product can be elaborated in the form best adapted to local conditions concerning dietary habits and other characteristics related to the production, distribution and use of such foods.

Working along these general guidelines, the Institute of Nutrition of Central America and Panama (INCAP), succeeded in developing formulas for vegetable mixtures several years ago. Several of these are already being produced industrially by private enterprises, and have reached the consumer public very successfully through normal commercial channels. Similar efforts have been made or are being made currently in several other regions of the world. The formulation, preparation and distribution of these new foods require consideration of the following indispensable conditions or requirements, grouped according to type:

I. Nutritional conditions:

a) To supply proteins with a high biological value and in adequate concentrations.

b) To supply sufficient quantities of the other nutrients that are deficient in the habitual diet of potential consumers.

c) Not to contain substances or compounds that will interfere with the digestibility or utilization of the nutrients.

II. Sanitary Conditions

a) Not to contain harmful or dangerous quantities of toxic substances or of any other substance with undesirable effects.

b) Not to be an actual or potential vehicle for infectious agents.

III. Socio-cultural Conditions

a) To be acceptable as food, within the dietary habits of the population for which it is destined.

b) To be easily and safely transported, stored and prepared within existing conditions in the communities and homes potential consumers.

IV. Economic Conditions

a) Cost for the consumer public must be within said public's buying power.

b) Industrial production and commercial distribution must be economically feasible.

As for *nutritional conditions,* it is obvious that, if the food is designed primarily as a protein source, special attention must be given to both the concentration and the biological value of these substances. Concentration must be adjusted to the use recommended and expected for the food. The food may be designed as a supplement for the habitual diet or as a substitute for others already in use. Capacity and habits concerning total food consumption must be taken into account always, especially in small children.

Incaparina formulas were designed to serve mainly as food for weaning and to substitute other inadequate beverages presently in use for that purpose. When the food is prepared in the reçommended way, protein concentration in these formulas is similar to cow's milk.

The biological value of the protein in the new food must be as high as possible, higher at all times, of course, than in the habitual diet. From this point of view, an evaluation of its supplementary value must involve testing not only the biological value of the proteins in the food itself, but also the improvement which its use could bring to the protein value of the total diet. This biological value of the food as such, and its value as a supplement, must be evaluated carefully, first in experimental animals and always in children, before production and distribution can be recommended.

In the formulation of such foods, even when their primary function is to correct the diet's protein deficiency, correction of other nutritional deficiencies in the population must also be attempted. The Incaparina formulas contain adequate amounts of calcium, vitamin A, and vitamins from the B complex, particularly riboflavin, known to be insufficient in the population for which the product was destined, especially as a weaning food. If we succeed in correcting only the major deficiency, in this case protein, we could provoke the appearance of other deficiencies, such as vitamin A, which were not manifest when protein deficiency eclipsed them by reducing the child's metabolic activity. In other words, this child can be receiving very small amounts of other nutrients which nevertheless are sufficient for its condition, but which could become a problem when the balance is upset if only one of the limiting dietetic factors is concerned.

The third nutritional condition is very important. The majority of vegetable products which can be used as protein concentrates may contain substances that interfere with utilization of the nutrients. As an example, we can mention the trypsin inhibiting factors

contained in various leguminous seeds, or the property of soy protein to interfere with zinc utilization. Also, the nutrients in these products should not be in compounds that make their utilization difficult, as indicated, for example, by the digestibility of proteins. These compounds may exist naturally, or be induced by the processes to which the product or raw materials are submitted. Damage to protein by inadequate heating processes that reduce available lysine, is an especially interesting example. For all these reasons it is indispensable to evaluate the final product biologically, and not exclusively on the basis of its chemical composition, or of a consideration of its ingredients.

Logically, it is very important to insist on the *conditions of safety from the point of view of health,* which must characterize a new food. At the present time there is much awareness of the possibility that the products used might contain toxic substances. In cottonseed products, for example, care must be taken that amounts of gossypol are not higher than what is considered safe. The problem of mycotoxins, especially the problem of aflatoxin in peanut products, particularly, is also very evident. The presence of these substances has even prevented use of these products to the extent which could otherwise be possible and desirable.

Within this category, we must also consider substances which, though not toxic, may cause health problems or undesirable effects. An example, is the excess of crude fiber, particularly for small children.

Naturally, it is also necessary to take into account the aspects of purity or safety of the product from the microbiological point of view. Frequently, this becomes a problem when conditions of cultivation or storage of the raw materials, favor contamination, or when the product is processed under primitive and inadequate conditions, as often happens in underdeveloped areas where these products must be elaborated. It is also possible that the product can be perfectly safe from the microbiological point of view, but that conditions under which it is used can transform it into a vehicle of infection.

Conditions which we call socio-economic are really of basic importance. A food that is ideal from all other points of view is no good whatsoever if the population does not accept it, or if it is not practical within their living conditions. Concerning acceptability, we do not believe that the dietary habits of a population are absolutely inflexible and static. We observe changes in these habits every day, including the acceptance of food products that are totally new within a culture. However, this is conditioned by special circumstances and methods of introduction which are important to know. In new foods like the ones we are analyzing, the goal is that the product should be accepted as a habitual food, and used in the amount and form necessary for really effective results. There are many social or cultural factors that can be obstacles to the achievement of that goal. Therefore, very special attention must be devoted to the presentation of the product and to the way in which its use is recommended. In our opinion, the more these ways adhere to established ones, the easier it will be to introduce a new food. However, it is always possible that under certain conditions it may be easier to introduce a totally new food than to try to have the population accept substitutes or modifications for traditional foods with extremely deep roots in its culture.

From experience we believe that it is important to avoid, certain problems, such as the possibility that a product of this kind should be identified as a medicine rather than as a food; or that it should not acquire the necessary prestige when identified as a food for poor people or certain social classes or groups; or, even worse, that it should be associated with animal feeds.

Within the realm of socio-cultural conditions we also wish to point out the importance of the product's adjustment to existing conditions in the region, as far as its transportation, shelf life, and forms of preparation and use are concerned. It would not be practical, for example, that in regions where there is a greater need for these foods, they should require refrigeration or methods for preservation and preparation in the home that are impossible within the limited financial conditions and knowledge prevailing in the area with respect to these aspects.

Economic conditions are no less important in the decision regarding product's success. These are actually the factors that have prevented utilization of certain products or even caused them to fail, although they were very adequate from other points of view. This is logical if we consider that economic reasons are among the fundamental factors that make the development of these new foods necessary. The market price of the product is fundamentally important. The new food can fulfill its purpose only if its cost lies within the financial grasp of those who need it. The ideal situation, as we see it, must be that the consumers acquire the product on their own initiative and through the normal market channels. Under certain circumstances it may be necessary for governmental or other types of agencies to supply economic aid, or any other kind of direct assistance, in order to favor the product's price policy. Obviously, the less the product depends on this direct assistance, the more advantageous it will be. Notwithstanding, governmental or other interested agencies may contribute, for example, with legislations giving a certain amount of necessary protection to the product, or to the producer, favoring prices and availability of raw materials, or else supporting some appropriate aspects of promotion.

Industrial production and commercial distribution should be economically feasible operations. There should be an appropriate margin of profit for investment, except when the participation of the state or other agencies is indispensable for their insurance. This last condition is not the ideal situation for the majority of countries operating under an economic system of freedom of supply and demand.

In the end, and also with mainly economic implications, we come to the packing, storage and transportation conditions that make it possible for the quality of the product to be maintained, at the lowest cost and in the most practical way possible, from the time of its production to its acquisition by the consumer. The product's shelf life in relation to its rate of mobilization in the market, susceptibility to infestations by insects or rodents during the different stages of distribution, and convenience in transportation and storage, are related aspects in this matter. Likewise, the type and cost of promotion necessary to attain desired consumption, and the support on one hand and control on the other, which governmental or other responsible agencies must supply, are also influential in determining whether or not the product is going to attain the necessary economic characteristics for the producer and distributor, and the desired conditions for the consumer.

As may be appreciated, it is not easy to develop, produce and distribute a product of this kind and to attain the desired use. Scientific and technical difficulties and problems at the laboratory level, although considerable, are not the greatest. Many other problems, especially economic, socio-cultural, and sometimes even political, must be overcome. The effort, however, is worthwhile and urgently necessary.