CHAPTER 29

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Safe and Nutritious Food Supply[1]

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Two worldwide conditions existing today have been considered for the presentation of the topic "Safe and Nutritious Food Supply." They are (1) the rapid rate of world population growth and (2) the low production of foods. The two parameters yield a value of less food per person per day. Therefore, if all human beings are to live under adequate nutritional conditions, it is necessary to: (1) increase food production; (2) decrease rate of population growth; or (3) provide people with foods in lower amounts but with a higher efficiency of utilization.

Although agricultural technology is improving, and an increase in food production is feasible, its development is slow, particularly in areas of the world where foods are most needed. The rate of population growth can also be controlled, but not in the near future, as many problems still await solution. Therefore, we are left with the last proposition of making foods and their nutrient content more efficiently utilized by the consumer.

The term "feed efficiency," often used in evaluation of the nutritional quality of feeds, is defined as "the amount of food consumed over the gains, usually in weight of the animal." In this expression, the larger the number, the poorer the value of the feed. The number contains an expression of the overall quality of the feed, not only from the nutritional point of view, but from the physical and sensory ones as well, as they are important in determining intake, which in turn affects growth.

Although growth is not necessarily an index of health, it falls within the meaning of the term "efficiency," which will be used in discussing the topic "Safe and Nutritious Food Supply." More attention will be given, however, to the nutritive aspects, since food safety has been amply discussed in previous sessions.

The question is: how can high feed or nutrient efficiency be accomplished? A study of the available published information indicates that efficient foods can become available to the population if attention is given to the following aspects: (1) study of the effect of environmental factors or production and nutritive value; (2) effect of genetic composition on nutrient content; (3) efficient storage and handling, (4) controlled processing techniques; and (5) application of nutrition knowledge to food enrichment and preparation of highly nutritive foods. However, none of this can have

[1] INCAP Publication I-416.

I-416
En: "The Safety of Foods". (Chapter 29). Ed. H. D. Graham. Westport, Conn., The Avi Publishing Co. Inc., 1968, p. 245-261.

any impact unless government officials take positive action in their respective fields.

The subject is obviously very broad. This presentation will consist, therefore, of a general discussion of those aspects that determine the nutritional quality of foods from the level of production to that of consumption by the people, with particular attention to the effect of genetic composition on nutrient content and the effects of processing and of enrichment.

EFFECT OF ENVIRONMENT ON NUTRIENT CONTENT

Safe and nutritious food supply, particularly those aspects concerned with production level per unit area of land, starts in the field. Only recently have agronomists given attention to this problem in Latin America, and several efforts are being made to improve soil fertility for greater yields by fertilizer application, crop rotation, erosion control, and by selection of varieties of increased disease resistance. In the most advanced countries, particularly the United States, the problem of increased yields per unit of land was considered over 100 yr. ago. Because of great material and academic efforts of past and present times, agricultural productivity is highly efficient. In this respect, it should be pointed out that, in most countries in Latin America, agriculture has received little attention until now, and govemment investments in this important field have been minimal.

There are many publications dealing with studies of the effect of environment on the nutrient content of food crops. The results of such investigations are not clear. However, it is generally accepted that the amount and intensity of light affect the composition of plants, especially their ascorbic acid content. The optimum temperature for the most rapid rate of growth of each edible plant is not usually the optimum for synthesis and storage of nutrients in its tissues. Similarly, season of harvest is not related to nutrient content. However, a number of studies have demonstrated that the location in which a plant is grown can have a significant effect upon the nutrient content of its tissues. Corn grown at a low altitude usually contains more protein than corn grown at 5,000 ft. This has been attributed to various factors, including low light intensity and temperature, which retard maturation, increasing storage of carbohydrate in the seed. The literature relating to the effect of soils and fertilizers upon nutrient content is voluminous and generally contradictory. The results indicate, however, that fertilizers increase crop yield, but their effect on nutrient content is minor and usually insignificant.

The results have been contradictory, since it is difficult to control all factors present at any one time, such as the ratio between different fertilizers, quality of the soils, moisture conditions, and climate.

It may be concluded that environmental factors can affect nutrient content. However, because of the complexity of the various factors involved, it has been difficult, if not impossible, to show a definite and consistent cause-effect relationship.

EFFECT OF GENETIC COMPOSITION

In plant breeding, efforts are usually concentrated on developing strains that, in the prevailing climate, give large yields and are resistant to plant disease. Much less attention has been paid to the nutritional quality of the products, although it is known that the nutritional value of different strains varies greatly. Genetic factors have been found to affect the protein and vitamin contents of plant products especially. There are reports indicating that the ascorbic acid and carotene content of tomatoes can be increased significantly by genetic means. Similarly, there are studies showing that corn can be selected for higher carotene and niacin concentration.

Cereals such as wheat, corn, and rice, are the main sources of protein for many people of the world. Thus, it is desirable that the cereals contain adequate amounts of proteins and that their amino acid composition be as favorable as possible.

One of the best examples of the benefits to be obtained by genetic means of controlling nutritive value, is provided by corn. Since 1914, when Osborne and Mendel indicated that corn proteins were deficient in lysine and tryptophan, many efforts have been made to select varieties with a higher content of these two amino acids. From many such studies it was learned that variety composition is important in determining the content of these two amino acids and consequently of nutritive value. Similarly, many efforts have been made to increase the concentration of lysine and tryptophan by means of fertilizer application and selection for higher protein content in the kernel. All efforts, however, have been negative in the sense of obtaining a higher quality corn, until 1962, when Mertz and co-workers were able to show that a gene, known as opaque-2, caused an increase in the concentration of lysine and tryptophan. Further studies showed that this corn has a high nutritional quality for both animals and humans. Results obtained in children are shown in Table 73. The data indicate that the protein quality of opaque-2 corn is as high as that of milk at physiological levels of protein intake. On the basis of the retention values shown, its biological value is around 88%.

The high nutritional quality of this corn implies that a reduced amount of it would be required, in comparison with common corn, to supply the protein needed by a human being. Therefore, it is more efficient than ordinary corn.

This very important discovery, however, has not been applied for practical purposes in countries where corn is an important staple, except in a few

Table 73

Nitrogen Balance of Children Fed Skimmilk and Opaque-2 Corn at Two Levels of Intake

Protein Source	Nitrogen Intake Mg./Kg./Day	Absorbed	Retained
		% of Intake	
Milk	271	84.5	28.0
Opaque-2 corn	300	76.3	29.0
Milk	187	83.4	36.4
Opaque-2 corn	238	71.4	26.5

Source: INCAP Studies.

isolated cases. In many parts of Latin America, reluctant acceptance and general apathy toward important discoveries such as this generally are due to a lack of knowledge and understanding on the part of people working with such food crops and government officials.

Effects similar to those found in corn, caused by certain genes, are probably to be found in other cereal grains and edible seeds. Sorghum grain varieties with protein levels as high as 20% and a large variation in lysine content have been reported, which is also the case with rice and wheat varieties. Leguminous seeds also offer variations in nutrient composition, but little work has been carried out to select varieties with higher concentrations of the nutrients that are needed to balance the nutrients from other foods for efficiently utilized diets.

It has long been known that there are differences in the fat content of different strains of oil seeds, but it is interesting to note that the amounts of linoleic acid and tocopherols also vary greatly in different varieties, and that it is likely to produce oil containing large amounts of both linoleic acid and vitamin E. A further example of genetic control on composition is provided by the development of cottonseed varieties that are free of gossypol. This is also a significant accomplishment, since cottonseed protein is being used in the preparation of protein-rich foods throughout most of the world.

Genetic factors have a marked effect on the nutrient content of many animal products. For a long time this has been recognized in animal breeding. The best example is perhaps the fat content of milk, which has increased considerably as a result of several decades of breeding. It is also possible to improve the quality of meat and eggs by breeding, and products with a relatively low fat and high protein content have been developed. The fat content of meat and even the quality of fats in the meat can be greatly affected by feeding. Thus, the content of polyethenoid fatty acids in pork is increased considerably by addition of oil seeds to the feed. The same phenomenon is also observed in the meat of poultry, The oil in the feed may also increase the polyethenoid fatty acid content of eggs.

EFFICIENT STORAGE AND HANDLING

Storage under optimum conditions of moisture and temperature is required by most foods for protection against changes in physical and organoleptic properties. Similarly, optimum storage conditions are needed if nutritive value is also to be preserved. Of particular interest is the work of Jones and Gersdorff on the changes occurring in the proteins of various seeds and their ground products during storage. They studied changes in the physical and chemical properties of the proteins and the accompanying changes in protein digestibility. The proteins of wheat, corn, and soybeans and their ground products were shown to decrease in solubility and in digestibility by pepsin and trypsin in vitro. In a continuation of these studies, rats were fed ground corn stored at 24.4°C. for varying lengths of time. These experiments showed that the product decreased in palatability as well as in nutritive value as the length of the storage period increased. Similar observations have been made for other foodstuffs.

Many studies have appeared in recent years showing the decrease in nutritional value of foods infected with molds. Although in many cases the molds do not cause mortality in experimental animals, histopathologic changes in the form of toxic hepatitis, nephritis, and others have been observed. Other molds, such as *Aspergillus flavus,* have caused high mortality due to the toxins they produce. In a recent report of 45 isolates of *Chaetomium flobosum* Kunzc isolated from corn and fed to rats, 20 were lethal within 4 to 6 days.

In developing countries where agricultural practices are still very primitive, many of the basic staple foods become highly contaminated with fungi. An example from Guatemala is shown in Table 74. It is well-known that corn is the most important staple food in this country, and, according to the results shown, most of the corn consumed is contaminated with some of the fungi listed. It would appear from these results that in developing areas more emphasis should be placed on conservation of the foods pro-

Table 74

Frequency and Infection Percentage of Corn in Guatemala

Genus	Maximum % Frequency	% Infected
Aspergillus	57	46
Penicillium	91	43
Fusarium	91	34
Cladosporium	27	2
Nigrospora	18	5
Diplodia	9	3
Botryodiplodia	14	7

Source: INCAP Studies.
56 samples of corn.

duced in the area, rather than on the introduction of the latest techniques for food processing. There are some reports indicating that the adverse effect on the animal-consuming foodstuffs infected with certain molds has been reversed by supplementation with amino acids, suggesting that the mold has altered the quality of the protein of the food and that the effect observed is due to deficiencies of these nutrients.

Insects, mites, and other pests in human and animal foods may be a public health risk because they carry diseases, cause intestinal disorders or allergies owing to the by-products of their metabolism, or they are responsible for the presence of toxins. They may also become a potential public health risk if chemical measures for their control are used incorrectly or carelessly.

The enormous loss of stored produce caused by insects has been mentioned in countless papers since 1948. Of the real losses during storage, the most direct is the material eaten or destroyed by the pests. The greater the number of insects in the food, the greater the amount they are likely to consume, at least until they reach levels at which they interfere grossly with each other. Although the food is changed by pests in several ways, the change in nutritive value is particularly interesting.

The nutritive value of foodstuffs is much the same for insects and pests that attack stored products as it is for vertebrates, although some insects do attack other materials as well. Foodstuffs with the highest nutritive values for man are therefore the most susceptible to damage by insects, and insects often select the most valuable parts of a food, for example, the germ of cereal grain. Rodents also prefer the most nutritious section of the grain. It is, therefore, obvious that the quality of the remaining material would be decreased if it were meant for human feeding. The problems of contamination by insects and by excreta are closely linked. Many workers have reported changes in the quality and taste characteristics of grains infected by insects, brought about by the excreta of the insects, such as uric acid. Some groups have adopted a level of 15 mg. uric acid per 100 gm. (or 0.015%) as the limit of acceptability. Chemical composition is also altered. For example, nitrogen content is usually increased because of the nitrogen derived from uric acid and guanine excreted by the insects.

Breakdown of fat is also accelerated by insects, especially when the insects break off small particles, introduce microorganisms, or raise the temperature or moisture content. The breakdown of fat produces an increase of free fatty acids and of oxidative rancidity, which in turn cause off-flavors. Other nutrients are also affected. Reducing sugars usually increase, thiamine concentration decreases, and the overall nutritional quality is decreased.

In addition to the direct effect of the insect pests, their presence in stored foods as well as the presence of fungi cause a rise in temperature, which can be as high as 46°C. for insect infested grain, or 55°C. and more if fungi are responsible. Continuous high temperature accelerates chemical degradation, especially destruction of vitamins and development of rancidity.

EFFECT OF PROCESSING ON NUTRITIVE VALUE

Of all the factors affecting nutritive value, the effects of processing are probably the best known. Excessive heat during processing can lead to the lowering of the biological value of proteins, to the destruction of heat labile vitamins, and to poorer palatability. An example for milk is shown in Table 75. The effects of high temperatures were responsible for the lowering of the epsilon amino lysine, a parameter indicative of the biological value of the protein. These effects have been observed with all types of food materials, and as a result, any process involving the application of heat is generally controlled carefully to minimize heat damage. In cases where no precise information is available, recommendations naturally tend to err on the safe side. However, heat can improve nutritive value when properly controlled. An example is shown in Table 76. Raw leguminous seeds are extremely toxic in most cases, because they contain hemaglutinins and trypsin inhibitors that cause adverse physiological effects. These compounds can be eliminated

Table 75

In Vitro Lysine Availability of Milk

Sample	Lysine % of Protein
Fresh milk	8.3
Milk powder (spray)	8.0
Evaporated	7.6
Milk powders	
Roller dried, commercial	7.1
Roller dried, commercial lower quality	6.8
Roller dried, slightly scorched	6.2

Source: NAS-NRC Publ. 843, p. 425, 1960.

Table 76

Effect of Cooking on the Nutritive Value of Black Beans

Cooking Time (Min.)	Av. Wt. Gain (Gm.)	P.E.R.	Mortality
0	—	—	6/6
10	75	1.31	0/6
20	72	1.35	0/6
30	76	1.29	0/6
40	59	1.20	0/6

Source: Brit. J. Nutr. *17*, 69, 1963.

Table 77

Effective of Processing on the Nutritive Value of Cottonseed

	Gossypol (%)	Wt. Gain (Gm.)	P.E.R.	Mortality
Cottonseed kernel	1.10	—	—	36/36
After cooking (190–220°F.)	1.10	−12	—	30/36
After drying (220–250°F.)	1.02	−13	—	30/36
After conditioner (260°F.)	0.97	−13	—	17/36
After expeller	0.06	82	2.00	0/36
After solvent extraction	0.07	81	1.91	0/36
Cottonseed flour	0.07	89	1.93	0/36

Source: INCAP Studies.

by heat, resulting in foods of improved nutritional quality. Another example is shown in Table 77 for cottonseed, which contains gossypol as the toxic compound. Elimination of part of this compound by processing resulted in a flour with high nutritive value.

When new techniques in food processing are introduced, extreme care should be taken to control the quality of the food, as in many cases the new technologies and even the older ones are utilized without sufficient knowledge, control, and/or experience by the food manufacturer. This is particularly true in developing countries. Irradiation, for example, is a practical means of preserving certain foods. Nevertheless, the acceptance of this method in practical applications also entails the responsibility of protecting the producer and the consumer. This must be accomplished by adequate quality control measures. Control measures will vary with type of food and its major components affected by irradiation. Perhaps the most important quality control measure is the selection of good, wholesome food prior to irradiation, or any other type of processing. Irradiation, or any process, will not improve quality in a poor food, but it will retain the attributes of good foods.

FOOD ENRICHMENT

One of the best examples available today of better and more efficient utilization of foods and its lasting effects on large numbers of people is found in the vitamin enrichment of bread, flour, and other cereal grain in the United States. A recent article by Sebrell indicated that in 1930 the Southern United States had approximately 200,000 cases of clinical pellagra a year. There were also numerous cases of beriberi and iron-deficiency anemia. Within five years after the introduction of the enrichment program, the number of cases of pellagra and beriberi decreased significantly. There was, therefore, no doubt that the disappearance of vitamin deficiency was due to the enrichment program.

Similar examples can be found in the rice enrichment undertaken between 1947 and 1950 in Bataan, where, as a result of thiamine supplementation, the rate of deaths from beriberi sharply declined. Iodine enrichment of salt has resulted in a decrease of goiter in areas of the world where this measure has been adopted. A further example of the benefits of vitamin enrichment is shown in Table 78. The addition of riboflavin to lime-treated corn to replace that destroyed during preparation results in improved growth, and a greater improvement is obtained when all B-vitamins are added.

Table 78

Enrichment of Lime-Treated Corn with Vitamins

Treatment	Av. Wt. Gain (Gm.)	P.E.R.
None	35	0.91
Riboflavin	53	1.09
Riboflavin + Thiamine	50	1.00
Riboflavin + Thiamine + Niacin	54	1.05
All B complex	65	1.13

Source: J. Agr. & Food Chem. *11*, 517, 1963.
Initial wt. 51 gm. 10 weeks.

There is no question, therefore, that proper enrichment of food not only makes the human population healthier, but also results in better utilization of the food itself. The question is why many countries today with definitely undernourished populations are still not adopting such excellent measures to improve the quality of their foods. The implementation of such programs is very complex, owing to the lack of interest by government officials and all others concerned. Also limiting are the habits of people in different areas, the preparation of foods in the home, and the lack of proper nutrition education programs.

AMINO ACID SUPPLEMENTATION

The possibilities of enrichment are not limited to the use of vitamins and minerals. The literature in nutrition contains a large number of reports of the benefits to be obtained in protein quality from the proper amino acid supplementation of cereal proteins, oil seed proteins, and other foods. The animal feeding industry seems to be much more active in this respect than those concerned with human nutrition. Methionine supplementation of feeds for swine and poultry were initiated 15 yr. ago. Likewise, lysine supplementation of feeds is already a commercial reality.

Bender, in 1965, showed that the biological value of bread could be increased from 50% with no supplement to 80% when lysine and threonine were added and to 93% upon the addition of lysine, threonine, methionine, and valine. These results can be interpreted to mean that 80 or 93% of the

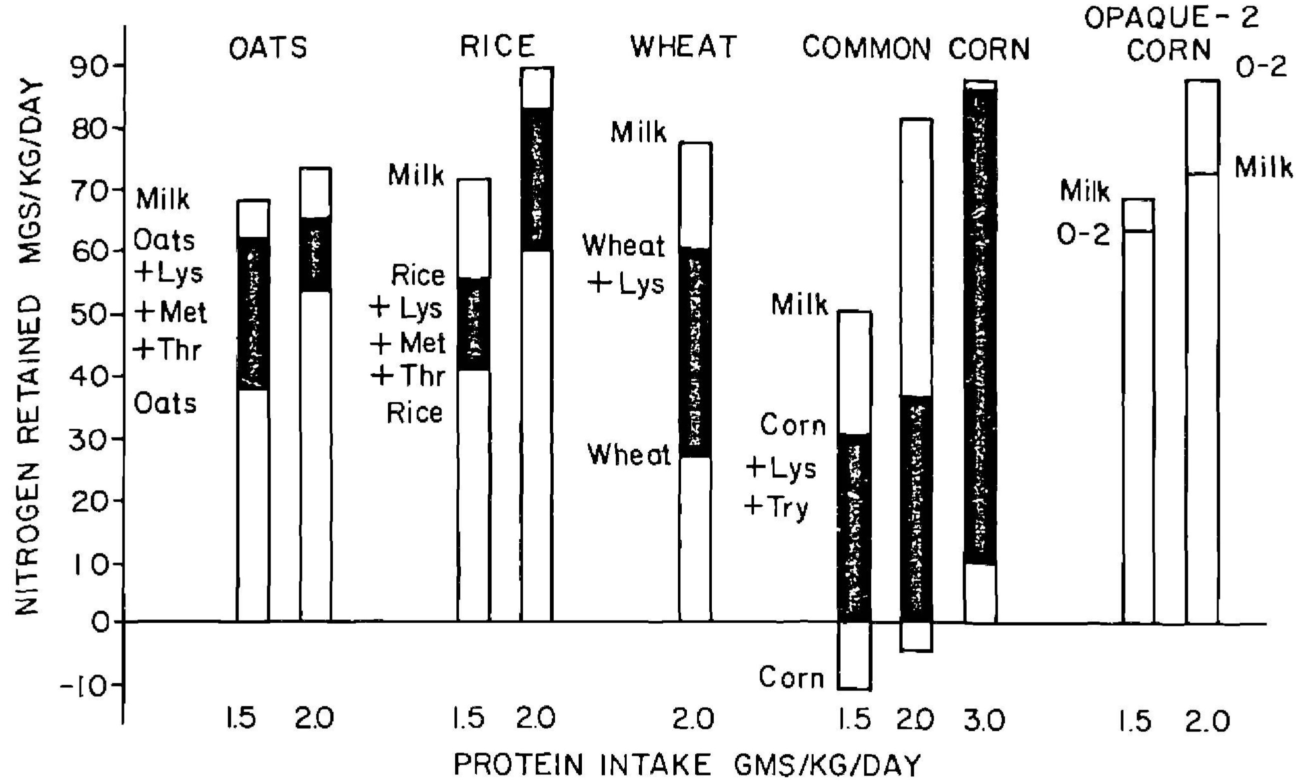

Fig. 28. INCAP series amino acid supplementation of cereal proteins

nitrogen absorbed was utilized by the organism when the bread was supplemented, while only 50% was utilized without supplementation. The efficiency of utilization is obviously much greater when the bread is enriched than when it is not supplemented.

Similarly, the results shown in Fig. 28, obtained from children 3 to 5 yr. of age, indicate that the supplementation of corn with lysine and tryptophan gives significant increases in efficiency of utilization of corn protein. Supplementation of rice with lysine, threonine, and methionine has also resulted in higher biological value. Likewise, wheat flour and oat protein can be improved by lysine supplementation. These results again indicate that there is sufficient knowledge concerning the improvement of the quality of foods consumed by humans through an increase in the efficiency of their utilization. Better results can be obtained when the foods are supplemented with both their limiting amino acids and vitamins. An example is shown in Table 79. In this case, lime treated corn was enriched with lysine, tryptophan, riboflavin, thiamine, and niacin. Both growth and protein utilization were highly improved. The results leave no doubts about the benefits that human health can derive from enrichment.

PROTEIN SUPPLEMENTATION

The possibilities of enrichment, however, are greater yet. Increased protein concentration and quality of foods with a low content of low-quality protein can also be achieved through supplementation with good quality proteins. An example of such improvement in corn can be seen in the results shown in Table 80. Small additions of milk, of fish protein, or of several other protein concentrates can result in food products of markedly improved nutritional quality. The use of a material such as yeast has certain advantages in addition to the increase of protein content and protein quality. This ingredient also contributes vitamins in significant concentrations. Table 81 gives an example for wheat bread. In these results great improvement is shown when wheat flour or whole wheat is supplemented with casein, soybean flour, and other protein-rich foods. Table 82 presents results obtained from rice supplementation. A significant improvement is observed upon the addition of all supplements. They are greater than those previously shown for corn and wheat because of the greater increase in total protein when the supplements are added to rice. It is well known that polished rice contains between 6 and 8% protein. The addition of the supplements increase the protein content to 12 or 15%. These results can, therefore, be utilized to implement enrichment programs in areas of the world with short food supplies, where protein calorie malnutrition prevails.

Table 79

Enrichment of Lime-Treated Corn with Vitamins and Amino Acids

Treatment	Av. Wt. Gain (Gm.)	P.E.R.
None	35	0.77
+ Lys + Tryp (A)	70	1.62
Riboflavin + Thiamine (B)	51	1.30
A + B	136	2.28
A + B + niacin	173	2.41

Source: J. Agr. & Food Chem. *11*, 517, 1963.
Initial wt. 46 gm. 10-week exposure period.

Table 80

Supplementation of Corn with Protein Concentrates

Supplement	Amount (%)	P.E.R.
None	—	1.00
Whole egg	3.0	2.25
Casein	4.0	2.21
Meat flour	4.0	2.34
Fish protein	2.5	2.44
Soybean protein	5.0	2.30
Soybean flour	8.0	2.25
Cottonseed flour	8.0	1.83
Torula yeast	2.5	1.97
Pepitoria flour	5.5	1.73

Source: J. Agr. Food Chem. *11*, 517, 1963.

Table 81

Supplementation of Wheat with Protein Concentrates

Supplement	Wheat Flour Amount (%)	Wheat Flour P.E.R.	Whole Wheat Flour Amount (%)	Whole Wheat Flour P.E.R.
None	—	0.86	—	1.62
Casein	6	2.62	4	2.44
Soybean flour	10	2.01	6	1.89
Cottonseed flour	12	1.96	10	2.10
Torula yeast	10	2.31	4	2.17
Skimmilk powder	10	2.19	6	1.98

Source: Arch. Lat. Nutr. *16*, 89–103, 1966.

Table 82

Supplementation of Rice with Protein Concentrates

Supplement	Amount (%)	P.E.R.
None	—	1.90
Cottonseed flour	12	2.32
Skimmilk	12	3.16
Soybean flour	10	2.84
Torula yeast	8	3.29
Fish Protein	6	2.70

Source: INCAP Studies.

PROTEIN RICH FOODS

Another way to improve the nutritional condition of large groups and also to extend food supplies is the preparation of scientifically-formulated, protein-rich foods. Although not new, this area of research has received much attention during the last 15 yr., and recently it has been emphasized even more. These foods can, of course, be made from conventional sources, such as milk, cereal grains, and beans. However, with improvements in technology, other sources not previously accepted for human consumption are being utilized, such as the protein from the oil-containing seeds. Among these, soybean, peanut, and recently cottonseed are already being used in varying amounts. The advantage of such protein-rich foods over amino acid enriched foods, even over those supplemented with small amounts of protein, is that they contain a greater concentration of protein, thereby serving very well as protein supplements to the ordinary diets of people. Furthermore, they make use of materials that were utilized mainly as animal feeds not long ago. These mixtures can be formulated to serve as whole foods or as supplements to common diets. Examples of such mixtures are shown in Table 83. This is a group of mixtures developed and extensively tested at INCAP. They have a protein concentration of about 27%, a

Table 83

Incap Vegetable Protein Mixtures

Component	No. 9	No. 14	No. 15	No. 17
Cottonseed flour	38.0	—	19.0	27.0
Soybean flour	—	38.0	19.0	—
Cowpea flour	—	—	—	44.0
Corn flour	58.0	58.0	58.0	25.0
Torula yeast	3.0	3.0	3.0	3.0
Calcium carbonate or phosphate	1.0	1.0	1.0	1.0
	100.0	100.0	100.0	100.0
Vit. A IU/100	4500	4500	4500	4500

Source: INCAP Studies.

relatively high nutritive value, and therefore supplement poor quality diets efficiently and are within the purchase capacity of people of low income. Furthermore, they are free of adverse physiological factors and, are so far, relatively well accepted by people. The nutritive value of these foods as tested in children is shown in Table 84. Nitrogen retention values are as

Table 84

Nitrogen Balance of INCAP Vegetable Protein Mixtures, Milk and Whole Egg Protein

Protein Food	Nitrogen		
	Intake (Mg./Kg./Day)	Absorbed % of Intake	Retained % of Intake
Milk	231	80.9	21.6
Whole egg	240	88.3	28.7
Veg. Mixt. 9	243	69.5	16.5
Veg. Mixt. 14	230	70.0	28.3
Veg. Mixt. 15	235	75.7	21.7

Source: INCAP Studies.

high as the values from animal proteins in most cases, even at low levels of protein intake. Those with cottonseed flour as main protein source show lower values that are, however, higher than the common proteins of most cereal grains.

Finally, synthetic foods are already being prepared from specific protein isolates, such as soybean protein, egg albumin, and wheat gluten. The protein isolates are available in monofilament, granular, or powder form, which makes them suitable for a wide range of functional uses, such as whipping, emulsifying, gelling, stabilizing, thickening, and moisture binding. Thus, the number of food products that can be made from them is practically unlimited. Textured foods have been prepared from such protein isolates, which, being man-made, can be given the desired structure, flavor, and nutritive value. An example of the nutritional quality of one

Table 85

Nitrogen Balance in Children and Young Dogs Fed Milk, Meat, and Soybean Textured Foods

Protein Food	Nitrogen Intake Mg./Kg./Day	Nitrogen Absorption % of Intake	Nitrogen Retention % of Intake
Milk	342	84.8	23.4
Soybean textured food	312	85.2	26.6
Natural meat	261	78.9	26.0
Soybean textured food	292	76.4	25.3

Source: INCAP Studies.

such product simulating ground beef is given in Table 85. The results show that its protein quality is as good as the quality of natural proteins in milk, when tested in children, or in meat, when tested in young, growing dogs.

The possibilities, therefore, of making synthetic foods, such as the one presented, are unlimited. Although such foods are in the experimental stage and are expensive, advances in technology, production, and demand will make them readily available to man.

From the material presented, and from all available information existing today, there is no doubt that man's supply of food can be made safe and that its nutritional quality can be raised to the highest levels desired.

The amelioration of the food supply situation and the prevention of large scale hunger should be possible by means of protective measures evolved by modern advances in food production, storage and preservation, processing, and nutritional science. Governments and other people concerned should establish and implement sound food and nutrition policies. These must include proper food enrichment laws and regulations, and orientation in efficient production and utilization of all available resources. The consideration of nutritive value together with economic, physical, and organoleptic properties can result in more efficient food utilization.

RESUMEN

PROVISIONES SEGURAS Y NUTRITIVAS DE ALIMENTOS

El perfeccionamiento en la situación de abastecimiento de alimentos y la prevención del hambre en grande escala podría ser posible por medios de medidas protectoras desarrollados por adelantos modernos en la producción de alimentos, almacenaje y preservación, proceso, y ciencia nutritiva. El consumo per capita está disminuyendo por los grandes aumentos en la población y pequeños cambios en la producción de alimentos.

Por lo tanto, mejor consumo debe ser en una eficiente utilización de alimentos, llevada a cabo por la producción, el proceso, y la preservación de alimentos con el más alto valor nutritivo posible. Para perfeccionar esto, un artículo de alimentos debe ser estudiado como afectado por el ambiente en que éste es producido, por el consumo genético, por su almacenamiento, y preservación, por la presencia de factores fisiológicos tóxicos y adversos, y por su proceso. La mejorada fertilidad de tierra resulta en el aumento en producción y el valor nutritivo de granos y cosechas de verduras. Composición genética controla la cantidad y calidad de proteínas. Almacenamiento y manejo propio reducen las pérdidas y conservan la calidad nutritiva. Condiciones controladas de procesos resulta en alimentación más segura y más nutritiva. La ciencia nutritiva ha aplicado sus principios en la combinación propia o preparación de alimentos para rendir mejores productos.

El uso impropio de avances modernos en la producción de alimentos puede tener, sin embargo, resultados adversos particularmente en áreas donde la ciencia y la tecnología todavía no han alcanzado el entendimiento necesario. El uso impropio de insecticidas y los aditivos alimenticios pueden resultar en alimentos malsanos. Cuando tales materiales son introducidos en esa producción y conservación, extensión adecuada debe ejecutarse al mismo tiempo. Cuando nuevas técnicas prácticas para el proceso de alimentos son introducidas, de ahí también viene la responsabilidad de proteger al productor y al consumidor por medidas adecuadas del control de la calidad.

Información nutritiva indica que muchos problemas nutritivos pueden ser eliminados de una forma relativamente fácil y con el uso más eficiente de alimentos disponibles si los gobiernos establecieran o utilizaran politicas salubres de alimentos y de nutrición. Esto debe incluir leyes adecuadas del enriquecimiento de alimentación y reglamentación orientación en una producción eficiente y utilización de todos los recursos disponibles con relación a las necesidades de la problación.

Aunque es aceptado que la gente compre alimentos no necesariamente por su valor nutritivo, este aspecto debe recibir creciente atención. En adición a programas educacionales, la consideración del valor nutritivo con las propiedades físicas y organolépticas puede resultar en más eficiente utilización de alimentos.

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