

Programs to Improve and Protect Food for Consumers
Through Fortification

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Before I discuss the concept of fortification I think that there ought to be some general introduction to the food problem from the point of view of a food scientist. Everyone agrees that there is a food problem for the majority of the inhabitants of the world. I do not know the specifics of the food problem in your various countries; you know this better than I. But I can speak in general terms, and you can elaborate for the specific situation in your own country.

The food problem is comprised of two elements which are related: the first is that ⁱⁿ many parts of the world there just is not enough food and we measure this by the amounts of calories available to each individual per day; the second problem is that the quality of the food in terms of the balance of nutrients is unsatisfactory. Not only do people have to receive enough food but they have to receive enough protein and enough vitamins and minerals, so that their diet is balanced. And people differ in their needs: the groups that need balanced food the most are infants and children and pregnant and nursing women. Therefore, they are the first to show the effects of an imbalance in the food supply.

I am going to talk about proteins mostly because this is the key element in the entire problem. The best proteins for humans are the proteins that come from animal sources but there is protein in most

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of the basic foods; there is good protein in peas and beans; and there is protein in cereals. Actually most of the protein that poor people get comes from the cereals that they eat whether it is corn or wheat or rice. Certain foods are particularly low in protein and the best examples are mandioca or cassava which is a root starch and has very little protein, sugar--raw or refined-- and bananas and plantains. These are much lower than cereals in their protein content. In order to achieve a necessary balance of protein it has been customary to mix cereals with peas and beans and to add as much animal protein as possible. Particularly for children it has been considered desirable to supply them with milk.

Protein from animal sources is much more expensive than protein from plant sources. One review expressed it that 10 pounds of plant protein when eaten by animals are converted into 1 pound of animal protein. Another review stated that 1 pound of animal protein is equal to 28 pounds of grain. It is clear that animal protein is much more expensive than protein from grains or plants. If people decide they need a certain amount of animal protein to balance their diet, then this is going to greatly increase the cost of food and will decrease the amount of cereals available for direct consumption as a food.

This calculation leads us to the understanding that the major cause of the food problem today is poverty--poverty of large masses of people who are unable to buy the animal protein that they want or think that

they need in order to balance their diet. They are barely able to buy or raise in subsistence agriculture enough calories in terms of corn or other cereals, let alone an excess in the form of animal protein. We are dealing with a problem of poverty and must consider how we can lower the cost of protein to people so either the people themselves or their government can afford the additional protein needed to balance their diet.

I don't think that it is necessary for me to point out why people should have a good diet. First of all it is their right as human beings. Second of all they cannot function properly or even develop properly in the face of an inadequate diet. No one would think of operating a steam boiler with insufficient amounts of coal or water if he wanted to get any kind of efficient operation. This applies no less to human beings, perhaps more so.

In this century our understanding of food science and nutrition has increased immensely and we know now why certain foods are good and other foods are better or worse. And we now realize that there isn't anything special about animal protein from a nutritional viewpoint. It is possible to wean children on vegetable protein mixtures suitably blended to provide complete nutrition without any animal protein being present. It is possible to raise children on wheat protein if the protein is supplemented with the deficient constituents that ordinarily cause wheat protein to be poorer than animal protein. Without going

into technical detail we can say that the balance of the protein is better naturally when the proteins come from animal sources. But the balance of the protein from seeds and other vegetable sources can be improved to be equal to animal protein either by mixing as people traditionally did when they mixed cereal proteins with proteins of peas and beans or by adding synthetic ingredients such as amino acids to take care of the deficiency and to complete the balance.

Similarly it is possible to add vitamins to cereals or any other carrier in order to take care of deficiencies that the natural foods are not supplying. This is the principle of fortification. By proper blending of the major foods with small amounts of the deficient ingredients, be they protein or protein components or vitamins or minerals, it is possible to make the foods complete at far lower cost than would be necessary if these were to be turned into animal protein in order to make them more complete.

Let us take the example of cereals. Wheat can be made into a complete source of protein by adding the one deficient amino acid called lysine at the level of 0.1% to the whole wheat or 0.25% to the wheat flour. Lysine costs \$1.00 per pound so this cost is relatively small compared to the cost of the wheat. When lysine is added there is no change in the baking properties of the wheat, in the taste or the smell. There is no change in the distribution system or in the storage. Everything is the same except that now there is a 1/3 more

protein at a 1/20 more cost. Moreover, missing vitamins be they vitamin A or the B vitamins or missing minerals such as iron can be added to the wheat flour at the same time to eliminate specific types of malnutrition.

Of course this cannot be done everywhere. It must be done in places where there are mills. But wheat is generally milled in a small number of mills where it is possible to improve the wheat by relatively simple means. It is more complicated to improve corn because two amino acids are needed, but the same thing can be done by a mixture of one amino acid and an oilseed like soybean or cottonseed, and it can be done wherever there is a community grinding facility. The same is also true for rice.

In order to demonstrate these points the Agency for International Development, with our cooperation, has inaugurated major field studies of the fortification of wheat in Tunisia, the fortification of rice in Thailand; and the fortification of corn in Guatemala. We have selected a number of villages in the south of Tunisia; in some of these we are fortifying the wheat and in others we are not; we hope to determine the cost of so doing, how easy it is to do, the problems that might occur, what it does to the composition of the food that reaches the people, and what medical and other benefits might be measured after this has been done for several years. Synthetic rice granules are being tested in villages in Thailand. These contain the deficient amino

acids and vitamins and are being blended in at a level of 1% in the village rice mills. We are now getting set to undertake a similar test in Guatemala using some sort of pellets that would be added to the corn for fortification purposes.

This is just one way. Another way is to breed for improved protein quality and this subject will be discussed by the next speaker.

Aside from the major foods that I discussed it is possible to take special foods and improve them by one means or other by fortification. For example, Duryea which is being sold as a baby food in Colombia has as its major constituents high lysine corn and soybean protein with a little bit of milk protein. Incaparina is another mixture that has been fed to infants and is primarily corn and cottonseed protein concentrate. Textured soybean, soybean that tastes and cooks and chews like meat, can be added to regular meat products to reduce their cost and yet taste the same. Soft drinks are another vehicle to improving nutrition. Most people like soft drinks but all they get now when they buy the soft drinks is sugar which is empty calories and does probably more harm than good. But it is possible to make complete foods out of soft drinks; this is exactly what Coca-Cola has done with Saci and Samson in Brazil and Surinam, and what Monsanto has done in Guyana with their drink called Puma. These drinks contain 2 or 3% protein, either soy or milk protein, plus added vitamins, yet they are sweet and they are flavorful. Milk, you will remember, has 3% protein so these are not far from milk in much of their nutritive value.

General Foods has invented a new macaroni made out of 60% corn, 30% soybean protein concentrate, and 10% wheat flour. It has the equivalent nutritive value of meat and is no more expensive than ordinary macaroni. This is being tested out in Brazil. These are but a few examples of the many possibilities in fortification when government is interested and uses food science to the best present limit.

Let us conclude this discussion with a few questions. There are many who would like to solve the food problem by simple economic improvement with the notion that when this is done people will have enough money to buy the foods that they need. Theoretically this is true. However, it is generally conceded the GNP per capita must reach the level of \$700 to \$1,000 per year American dollars in order to achieve this solution. So, for practical purposes, this is an impossible solution for the next decade or two for many countries. It is our feeling that with the new technologies, some of which I described to you, it should be possible to do this job a lot cheaper, perhaps at a level of cost of 10% increase over the regular cost of the cereals, the major food. I would say that if one asked is there a practical solution to the food problem without the aid of a modern food technology, the answer would be no.

Conversely, is there a technical solution to the problem? Will just the application of science and technology save the food problem? Again, the answer is no. No amount of increase of food supply or

reduction in the cost of food without concomitant action to improve the lot of the people and to reduce the population growth will succeed in solving the food problem. So just as there is not a practical, non-technical solution, neither is there a strictly technical solution to the food problem. But there is a proper mixture of government action and improved technology. Whenever a government undertakes to improve the lot of the people and when it does make a serious attempt to reduce poverty which arises from large families and from reduced income, then it will be clear to the government authorities that good nutrition is indispensable to progress. Then the government will make it possible for improved technology to develop by giving food technology and its instruments, primarily the private sector, all of the proper support that it needs.

What could be done as a starter. Each government ought to examine its position in this field and decide whether or not it should undertake efforts at intervention in the food supply and expend the resources to do it. The question might better be whether the government can afford not to do it and yet claim that it has a serious interest in the welfare of the majority of the people. Government might start by looking for places to intervene in the food supply and in a small modest scale try interventions of a similar nature to the ones that I described. Moreover, government should look for opportunities to encourage the food industry to develop improved foods for the general market but then

make them available to the people who need these foods by special subsidies. I need not go into the detail of the subsidies--people like you are more qualified to discuss them.

I still remain an optimist. But I temper my optimism with realism--we do have a well developed food technology and it can be used much more than it has been used by the present governments. The problem is deeply serious and deeply difficult even at the best. But if a government agrees to tackle these problems realistically and seriously, then each government will find food technology a very useful ally.