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OILSEED PROTEIN STRATEGIES FOR WORLD FOOD SUPPLIES

By

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I would like to describe to you some aspects of world protein problems and some of our strategies regarding oilseeds as a solution.

The world food problem is a complex one. Most world problems are complex. You cannot separate the problem of world food supply from the problem of protein supply or from population growth.

I would list the food problems as threefold:

1. To have enough.

2. To have enough of the right kind. Just having food isn't quite enough. You can have calories and get a bad case of Kwashiorkor.

3. The food has to be available at a price that people can afford.

Solving the problem of having enough food staves off famine, but doesn't solve the problem of malnutrition. The solution to malnutrition requires adequate protein. We all require a certain amount of protein. Certain types of population are more sensitive to these requirements. Young children, pregnant women and the sick require higher levels, but all of us need some. And protein is relatively expensive. How we handle the protein problem in the world determines our total food supply. We can handle it in the European-American way and get one kind of an answer, or we can handle it the Asian way, and get another kind of an answer.

For example, there is an enormous variation in the world of the proportion of grain used to feed animals and proportion used to feed man. Most of the world can ill afford to use any of the grain for feeding animals because there is barely enough to feed humans. In other parts of the world, in the more affluent West, 80% of the grain is fed to animals and we get most of our protein from these animals. For example, there are about 25 million tons of protein annually made available from animals in the world. It requires 135 million tons of vegetable protein to make the 25 million tons of animal protein.

If you decide to eat less animal protein, there is more grain to feed people and there are many more calories. You can't divorce the two questions of total food supply and how we use it for protein.

The world, in the last year, has a feeling of optimism. We are

producing more grain. East Asia has had a couple of good seasons and has produced much more grain than usual. Countries such as India and Pakistan have planted new high yielding varieties of wheat and rice and have been importing less.

This brush of optimism has been called the "Green Revolution". I don;t know how far it will go toward eliminating famine in the world, but certainly it is an improvement. However, there is no evidence yet that the problems of malnutrition - - that is of having a balanced diet, with sufficient protein, vitamins, minerals and other nutrients - - has been in any large measure improved. FAO has reported that there has been a 6% increase in the protein intake in richer countries and an equal decrease in per capita protein intake in poorer countries since World War II. So we haven't made any net progress yet.

Poverty

But what is the major food problem? The major food problem is poverty. People say, "I hear that we have protein deficiency; let's get fish flour, or grow proteins from petroleum, or let's use algae". But getting an additional source of protein doesn't solve the problem. That isn't the issue at all. The issue is poverty; people can't afford to buy the protein. The G.N.P., Gross National Product, in underdeveloped countries at the present time, is something like $180 per person. In the U.S., it is over $3,000.

A few weeks ago I was in Tunisia. I went into a village where they were doing some experiments with food. I asked the scientist, who was getting background data on the village, what was his estimate of the per capita income of the village. The estimate was $30 per person, per year. Well, that doesn't go very far.

Resources, material and humans are also deficient.

Electric power available per capita in the underdeveloped countries is 150 kilowatt hours per year, against 3,740 in the developed countries. Life expectancy in underdeveloped countries is 48 years; in developed countries life expectancy is 70 years. None of this is expected to improve very fast.

In a very interesting book titled The Year 2000, the authors try to project per capita GNP at that time. Their projections call for $10,000 per capita in the United States, $8,500 in Japan, $4,600 in Russia, $270 in India, $321 in China and $123 in Indonesia, about double what they have now. So merely increasing protein supplies will not solve the world protein problem in the poor countries. What will help and what is needed is to provide good nutrition at lower costs. This is the issue.

This is the challenge that former Secretary of Agriculture, Orville Freeman, threw at me four years ago when he asked me to come to Washington. I had written a book -- Proteins, Their Chemistry and Politics. Freeman read it and said "I like the book, so why don't you come to Washington and do something about the problem?" I have been trying to do something ever since. We'll have to wait for history to let us know if we have been successful or not.

Let me give you an idea of what we have been doing, what other people have been doing, and where we stand.

The classical solution to improving the lives of poor people is to increase their income. This has been the effort generally favored by UN agencies and this has been our major effort in the United States. The domestic food problem, again, is one of poverty. But, general feeling now is that, while income can be raised, one cannot expect it to increase significantly in the next generation.

The second theory that many people are working on is nutrition education; tell the people what to eat. This has not been very successful. It works after a fashion, but it is not the answer.

What we are trying to do is convert the feeding of people into a food system. Let me explain. Let's look at how we feed animals. I shudder at comparisons with animals, but we are all animals. Most of what we have learned in physiology has come from the study of rats, mice, rabbits and guinea pigs. So why not talk about feeding animals and see what we can learn?

Let's take the feeding of poultry in the United States. That's about as efficient a feeding process as has been developed. There are two things involved.

First, you give the animal a complete diet. We know what a complete diet is; we take the cheapest sources of calories, which in the United States is corn; the cheapest source of protein, which is soybean meal; and you make up the difference, whatever it is, with added vitamins or minerals. That's number one, to provide the animal with a complete diet.

Second, we have learned that there is such a thing as interchangeability; certain ingredients can be exchanged for others. One can use cottonseed protein in place of soy protein, and/or interchange certain sources of vitamins. So with this interchangeability, you can actually program the feeding of an animal on a computer to achieve the lowest cost per unit of nutrition. The computer, depending on price, will calculate the composition of the diet that is best for the poultry. Feed manufacturers don't guarantee to the purchaser the exact ingredients in what he is buying. What they guarantee is performance. If you feed an animal in a certain way, you will get a certain kind of performance; that's what they guarantee. But what they put into the feed depends on the cost of the various ingredients and the level of interchangeability. Why can't we do this for humans? We could cut the cost enormously.

We have one major constraint, but we live with it. That is, in a free society human beings want and are entitled to free choice. You just can't tell them what to eat. You can tell a bird what to eat, a bird has no choice; but human beings have a free choice. And so one wonders if you can have a system under those conditions.

But I think there is a way, and we have been trying to introduce it as much as possible, a better system of feeding humans. The system has two components; Major Intervention and Interchangeability.

Let me explain the Major Intervention first.

Fortification

In most of the world, people depend on one food. In Tunisia the people get 80% of their calories from wheat or wheat products. There is little choice. In Guatamala, they get 80% of their calories from corn. In Thailand, they get 80% from rice.

This is not just grain for adults with something different for the children; the children are weaned on grain. There are no baby foods. There's hardly any milk to wean children on. Those of you who are mothers think about how you would wean a child if you had no milk. That's exactly the situation for most people in the world.

Cereals are and will continue to be one of the most efficient protein sources. But cereals do not provide adequate quality protein. To avoid protein malnutrition, the following amino acids must be present in the diet: leucine, isoleucine, lysine, threonine, tryptophan, valine, methionine and phenylalanine. All cereals are deficient in the amino acid lysine. In addition corn is deficient in trytophan, and wheat and rice in threonine.

What can you do about it? One can convert grain into almost a complete food by adding the deficient amino acids. You also can add the missing vitamins, minerals or iron, if they are deficient. And, these amino acids do not change the food's taste or appearance.

So we are taking the major foods and making them complete. This is possible in a culture where there is a major food.

It would be interesting for you to know that there are subcultures in the U.S. where corn is a major food, where wheat is a major food, or even where rice is a major food. In this country, we are doing the same in order to speed up the elimination of malnutrition.

Institutions

The second type of an Intervention is to use institutional feeding. This is far more prevalent than people think. In the U.S., 30% of our meals are eaten at a restaurant, school, hospital, or factory canteen. Here again you have a chance to make a system because the people don't have completely free choice. Even in a cafeteria, you don't have total free choice. We can restrict the choices so that whatever people take will be balanced. We are looking very hard at the use of institutions, particularly in the U.S. as a means of creating food systems.

Rutgers University has a contract with the Department of Agriculture to study school lunches in the U.S., with the objective of trying to see that we have a system where children can get a completely nutritious meal at lowest cost. Our hope and expectation is, and I think we will be terribly disappointed if it doesn't happen, that in the future school lunch programs in the U.S. will be computerized. The child will get a complete lunch that he likes and the cost will be less than now. That is important in our country because the Secretary of Agriculture has promised that by Thanksgiving, all needy children will be getting free or reduced-cost lunches. Over four million are getting them now, but there are still two million who are not. He doesn't have much extra

money, so we are going to have to help him. One way we can help is to allow the school board to get more nutrition for the same budget.

Interchangeability

Now let's talk about Interchangeability, the second part of this equation. One phase of interchangeability is the development of analogues of more expensive products.

In most of the world there is little or no milk. Milk is on the world market now because of the peculiar circumstances in many countries, including ours, with a surplus of milk; via subsidy, it is sold in the world market at a cheap price. But that is a temporary situation. Milk is basically an expensive food. We know now, nutritionally, that one can make admixtures of oilseed protein and cereal that are equal to milk. One of the best examples started with cottonseed. Incaparina -- a weening food made of cottonseed protein concentrate and corn -- has cured malnutrition in thousands of children in Central America.

There is a lot of work going on in making analogues of milk beverages. When you think about it, tea isn't a protein beverage, but I was surprised to find that in India, tea is a protein beverage, because it is taken with milk. India is exploring ways to make tea "whiteners" from soybeans, peanuts, and other protein sources. It would make it possible to get a lot more done with the limited amount of milk. Buffalo in India produce a peculiar kind of milk. It has seven and a half percent fat, twice that of ordinary cow's milk. You can mix it with soybean or peanut meal and have twice as much milk with the same fat content as cow's milk. That is being tried too.

Vegetable proteins are used more and more in foods, particularly textured proteins. The State Department, through the Agency for International Development, was able to get several countries to look at the possibility of Textured Vegetable Protein in cooperation with U.S. food companies. This protein looks like meat, tastes like meat and chews like meat; has a texture to it. We took a look at it in Pakistan. Wherever you go in Pakistan is a stand where you get a little meat on a skewer. We found we could add 40 or 50% textured soy protein and it tasted just as good; was as nutritious and costs less. Another interesting fact was that it cooked in one-third the usual time because the soy was pre-cooked. Fuel is a serious problem in that part of Asia. The major source of fuel is cow dung. They found an enormous economic advantage. It may now "go" in Pakistan.

So we have these analogues of more expensive products which have given us a kind of interchangeability. In the U.S., we had a luncheon for the Secretary of Agriculture several months ago. We served some of these soy products and showed him some of the economics. If you took 100 pounds of hamburger and added 40 pounds of soy ceoncentrate to it, you would save 25% on the cost of hamburger patties. That's two or three cents -- a lot of money for a school lunch program. That's the kind of economics beginning to emerge. That's one kind of interchangeability.

The second kind of interchangeability is to take advantage of bad habits. You can lecture to a person that he ought not to buy soft drinks and that he should drink milk or eat nutritious food. It won't do much

good. A poor child, as soon as he gets a nickel or a dime, anywhere in the world, will buy a Coke or a Pepsi or whatever the local soft drink is. He likes it, it tastes good, he doesn't care about nutrition; he just likes the taste.

I went to an American Indian reservation -- where family income was $2,000 a year -- and found case upon case of soft drinks stacked in the kitchen of one of the homes. We went over to the trading post and the most prominently displayed item in the trading post was a cooler of soft drinks. People buy these items because of taste, regardless of nutrition. They do it all over.

What are you going to do about it? Well, we have been talking with several companies about this. Some tell us what they are thinking and doing, others don't. We have asked a number of firms to look at soft drinks and see what they could do to improve them nutritionally.

Coca Cola is one firm interested in the project. I saw their plant in Brazil; they are making a soft drink that has 3% protein from soy; it's called Saci (saw-see). It's a carmel flavored soft drink. It's going fairly well, but not exciting. It is not cutting into their Coke sales, but they will keep on refining the product. Their main objective is a carbonated drink, which I believe they are quite close to.

Monsanto, with a franchise in Georgetown, Guyana, has a soft drink which they call Puma. It is 2% soy, and is doing much better. Number one is Pepsi, number two is Puma, which is their drink, and number three is Coke. They are not satisfied with this product yet and they are also working toward the carbonated beverage. I expect that many other people are doing the same. When a child gets this refreshment he gets some protein.

I will come back to an American Indian story. While visiting a reservation, a doctor asked me if I would like to see a child with Kwashiorkor. Kwashiorkor is a malnutrition disease, the ultimate end of poor protein nutrition. This is an African word and is prevalent in Biafra. You would not expect to see it in the U.S. Luckily for that child, the doctors caught it in time and the child is doing better. I asked the doctor how it happened. He told me that the child had diarrhea and the doctor put him on a soft drink. The parent kept the child on the soft drink for two months, so his total diet was sugar. The child got Kwashiorkor. Now, if the child had a soft drink like Saci or Puma or whatever the next generation of those drinks will be, he would have been as healthy as if he were drinking milk.

The other thing I saw on the reservation was snacks; potato chips, corn chips, and so forth. They are nutritionally better than soda pop because there is a little protein in them, but they are high in calories and low in protein and they can induce malnutrition in children who don't eat enough other foods. They are even a worry to parents who don't have a problem with nutrition as far as money is concerned. But bad habits are a problem with teenagers; they eat snacks and soda pop. I was recently at a company which had a wonderful potato chip; it has 20% protein. They say it didn't cost anything extra. I don't quite know how they managed that, but they did. It will soon be on the market, I hope.

I would venture that the time will come, and it won't be too long from now, when there will be three kinds of soft drinks available:

1. The present type with sugar in it.
2. One with complete nutrition.
3. A soft drink for people who want only pleasure and no nutrition.

I am willing to bet that in 5 to 10 years, the one with complete nutrition will be ahead of the one containing only sugar. I think the same will be true for snacks. There will be on the market a snack that will be quite nutritious, which will displace those that have less nutrition.

So no matter what kind of bad habits you have, you will get good nutrition whether you like it or not. The main thing is that we don't want to leave nutrition to chance and we have reached the stage in our understanding where it needn't be left to chance.

There's one thing I have left out and it's terribly important. There is a lot of work going on in breeding crops that are just better to begin with. The classic example, of course, is high lysine corn, which is as good as a complete food. In Colombia, one company is selling a milk substitute that is made from lysine corn, soy and some milk. They are also selling high lysine corn for general use. This could have an enormous influence on nutrition.

Where do oilseeds fit into this picture? That is really the question I should be talking about. Well, most everything I have talked about involves soybeans, because soybeans are the major oilseed crop. If you add together all the potential available protein -- cottonseed, soybeans, peanuts, sunflowers, and rapeseed -- you would have 23 million tons of protein available annually. If you use it all for humans, you would have 23 million tons of protein available to humans. Sounds good, but the only one that is available directly for human consumption is a portion of the soybean crop that is grown in the East.

But let's see how it compares. The world 's population consumes something like 70 million tons of protein per year. The major sources of protein are cereals (35 to 40 million tons), animal protein (about 25 million tons), and legume protein (another 8 to 10 million tons). As mentioned earlier, it takes 135 million tons of plant protein to make the 25 of animal protein. So you can see that most protein is fed to animals. Of course, if you fed all this protein to humans you would have to find something else to feed the animals. So people are trying to grow all kinds of things to feed the animals.

Engineered Food

Up until very recently, we had to take what we could get. Either we took it directly off the land or from animals. We had to take the composition that the animals provided us. We had to take the composition that the plant provided. Now we are engineering our food. We are engineering it by breeding different plant varieties and breeding better animals for more efficient feed usage. But beyond that, we are engineering food to have any composition we want it to have.

We had an interesting problem in respect with school feeding. We now have a school breakfast program. We will reimburse the school 15¢ for it and half of that goes for the milk. A company that makes cakes came to see us and asked what they could do to help. We asked: "Why don't you make a cake that cost 7½¢ so that the complete breakfast cost only 15¢, and the school won't have to worry about preparation and dishes and cleanup?" And you know, they made it. We didn't have vitamin C in the milk so they put vitamin C in the cake, the protein in the cake compensated the protein in the milk; the vitamins in the cake compensated for the vitamins in the milk. They needed more iron, so they put iron in the cake; and the cake and milk breakfast is now being very much accepted. This is what I mean by an engineered food.

This is one example of interchangeability.

Now, about sunflower seeds. Most of what I know about sunflower seeds is what I read in a book. I expect some of it is true and maybe some of it is new. But I see no reason why sunflower seed could not be a part of these new protein developments. There is probably a good chance that those of you from other countries are doing some of that now. We in the U.S. are using soy because that is what we have and that is what we know about. But we know that the protein in sunflower seed is good protein; it's a little deficient in lysine, but you can buy lysine cheaply so there's no need to worry about the nutritional quality of sunflower seed protein. We need texture. There's no reason you can't have texture in sunflower.

The role that sunflower protein can play in all these developments is not just a matter of technology and cost. It is the question of whether you can do something with sunflower seed that you can't do with other proteins. This, of course, requires more research.

I would like to conclude by adding a somewhat optimistic note. People are beginning to realize, economists and others, that the most important resource any nation has is its human resource. It is the people; how smart they are; how hard they work' and how diligent. This is what determines the success or failure of a nation. Whether or not a nation has raw materials is helpful, but secondary.

Perhaps we can learn a lesson from the Japanese, who have very few raw material resources but have very extensive human resources. Therefore, they have been able to do a job. It is predicted that pretty soon they may have the highest per capita Gross National Product in the world. Human resources are affected by nutrition, among other things. You can't teach a child who is hungry. He can't learn, he can't attend school. There is some evidence that if the child is malnourished early enough, or if the mother was badly malnourished during pregnancy, the child is permanently affected. If in the course of the child's development he is not able to take full advantage of the educational material that is put forward to him, he will not develop his potential -- human resource. Knowing that, and knowing that we can develop food systems and we can develop a degree of interchangeability, is making it more difficult for government.

Until now, governments have taken the position that we just won't worry about nutrition. We will just try to raise our economic level as fast as we can and everything else will take care of itself. Well, it doesn't. And since it is a vicious circle, somewhere you have to break that circle and include nutrition. Now that we think we can do it, we are a little cockier and we are telling governments that they have it in their hands and it is up to them to make that decision. I am rather impressed with the fact that many of the governments are offering to put more emphasis on nutrition and more emphasis on eliminating malnutrition. I think this speaks well of the chances of making a more sensible world.

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