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Crowley, P. R.

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FOOD FORTIFICATION
Development of Food Fortification Programs

by

Paul R. Crowley
U.S. Department of Agriculture
Washington, D.C.

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DEVELOPMENT OF FOOD FORTIFICATION PROGRAMS

by

Paul R. Crowley

(1) For many years now, the international nutrition community has talked about fortification as one of the important ways of dealing with contemporary nutrition problems in developing countries. We have talked about goals and technical guidelines for fortification, about foods that might be fortified and technologies for fortification, about sources of fortificants, and about many other relevant and important aspects of fortification. And we've especially talked a great deal about the benefits of fortification--about eradication of blindness caused by vitamin A deficiency, about eliminating iron deficiency anemia, about reducing goiter, and about other socially important goals that might be achieved through fortification.

(2) However, sometimes it seems all this talk has had little impact. Fortification does not seem to have achieved anywhere near the potential our talk has led us to believe it should. In fact, there seems to be few examples of fortification programs that have actually been implemented. And it is hard to think of very many recent examples of nutrition problems that have been solved through fortification.

(3) This is not to say that fortification has not been used or that it has not accomplished impressive things. Certainly iodization of salt, which was initiated many years ago, has had a great impact on reducing goiter in the U.S. and in Brazil and other places around the world. Also margarine, wheat flour, rice and other food staples used in commerce in a number of countries have been fortified with vitamins and minerals for up to 50 years. The recent excellent work by Dr. Arroyave and his colleagues at INCAP on fortification of sugar with vitamin A which resulted in implementation of large scale programs in Central America which has been evaluated and found to be effective, is a truly notable achievement. But if we count

these achievements, there seem to be many fewer than we would hope. Perhaps more important, there seem to be many nutrition deficiency problems that persist even though fortification could, we believe, remedy them--children who go blind from lack of vitamin A, people whose energy is sapped because of iron deficiency, and others who have goiter and worse because of lack of iodine.

(4) Since we are here to discuss food fortification in Asia, it might be appropriate to focus on what could be done to try to foster and accelerate the use of fortification in Asian countries, to see what might be done to better utilize the potential power of fortification to deal with nutrition problems.

(5) For this purpose, I would like to describe briefly some of the work on fortification that has been undertaken in other parts of the world which might have applicability in Asian countries and then to suggest something that might be helpful in developing new fortification programs.

Fortification of Cereal Grain Products

(6) During the 1950's the United States initiated a program to make U.S. food commodities available to countries in need of food assistance. The program, which has been an ongoing activity for over 20 years, is known as the Food for Peace program and consists of a donation component and a loan component. Under the donation component Food for Peace has shipped nearly 50 million tons of food commodities valued at over \$9 billion since its inception in 1955. The purposes of the foods are to meet famine or other urgent relief requirements, to combat malnutrition, especially in children, and to promote economic and community development. Certain parts of the program, particularly child feeding, are highly targeted, aiming to reduce hunger and malnutrition among those most vulnerable. In recent years the program has donated typically about 1½ million tons of food annually to roughly 60 million needy persons in approximately 80 countries.

(7) In the early days of the Food for Peace program, donated foods were largely basic food commodities like wheat and wheat flour, corn and corn meal, milk powder and vegetable oil. However, as the needs of the recipients became clearer, it was concluded that they could be served better if the commodities were selected to try to meet their special requirements. Commensurate with this, it has been a long standing policy of those who select and procure the foods used in this program that the program should be "furnishing the most highly nutritious processed foods" which can be made available taking into account the needs of recipients, cost-benefits ratios, budget limitations, and of course the other policies of the U.S. Government. This policy has led to perhaps the largest food fortification program in the world.

(8) Foods provided under the Food for Peace program are designed and manufactured to try to alleviate nutrient deficiencies which occur among the intended recipients. Many of the foods contain beneficial levels of added vitamins and minerals which are likely to be deficient in the diets of the recipients. They also contain substantial amounts of added protein so that the foods can serve, at least in part, to substitute for the meat, eggs, legumes and other protein foods which are almost always deficient in the diets of low income persons.

(9) Table 1 shows the list of donation food commodities that have been available under Food for Peace during the 1970's. Notice that the list still includes basic items like wheat and corn and their milled products identical to those distributed in the early days of Food for Peace. But notice in addition, that several processed forms of these commodities are also available, and these processed commodities have special characteristics intended to promote the nutritional welfare of recipients. For example, among the corn products are both whole grain corn (1) and fortified corn meal (2). The corn meal is fortified with thiamine, niacin, riboflavin and vitamin A and also with calcium and iron. In addition, soy fortified corn meal (3) includes 15% soybean flour as a protein

fortificant. The protein content of soy fortified corn meal is over 50% higher than ordinary corn meal and the quality of the protein is substantially improved due to the high lysine content of the added soybean flour.

(10) In addition, several processed blended foods made from corn are available through the program including corn soy milk (4) instant corn soy milk (5), and corn soy blend (6). These are all made from precooked corn meal so that the commodity needs little if any on-site cooking when prepared for the recipient. Some were also designed to provide higher than normal caloric density through special processing. The blended foods are designed to serve as protein, vitamin, and mineral supplements for children and they all contain 11 added vitamins, five added minerals (including calcium, phosphorous, iron, zinc, and iodine), and up to 20% high quality protein. Although they are designated as blended foods they are, in effect, heavily fortified cereal products.

(11) You'll notice in the table that 10 of the commodities are fortified with vitamins and minerals and that 12 are fortified with protein.

(12) Looking at the historical development of fortification of Food for Peace commodities, vitamin fortification of processed cereal grains was authorized to begin during 1958 in the very early stages of the program. From time to time changes were made in the amounts and kinds of fortificants to take into account our increased understanding of the nature of the problems of the recipients. For example, as a result of studies showing that xerophthalmia and blindness were serious problems in a number of countries which used donated milk powder (including Brazil, Nigeria, Zambia, Jordan, India, and Indonesia), fortification of the milk powder used in the Food for Peace program with vitamin A was initiated in 1965. Subsequently in 1968, fortification of corn meal and wheat flour with vitamin A was started.

(13) In the late 1960's the blended foods corn-soy-milk (CSM) and wheat-soy-blend (WSB) were introduced into the program. These were developed at a time when

a severe shortage of milk powder highlighted the need for additional sources of high protein foods in the program. While the blended foods were intended to provide inexpensive protein supplements to augment the diets of children whose family's income made it difficult to purchase adequate protein foods like meat, eggs, legumes, and milk, the foods were also formulated to include essentially all the important vitamins and minerals. As mentioned earlier they include 11 added vitamins, five added minerals, and enough added soy protein to increase the protein content of the products to 20%. Therefore blended foods are in fact heavily fortified cereal products.

(14) In the 1970's, a further change was made in the program to improve its benefits. At that time, the program started to focus more sharply on the needs of young children and pregnant and lactating women. The higher requirements for protein among these groups, and the continued recognition that low income families consume less of the more costly ordinary protein foods led to the introduction of soy fortified corn meal (3), bulgur wheat (10), sorghum (15), rolled oats (17), and rice (19).

(15) Thus from the 1950's through the 1970's the Food for Peace program changed in an evolutionary way from a simple food distribution program to a nutrition oriented program consciously designed to provide maximum benefit to the recipients through fortification with protein, vitamins, and minerals.

(16) Table 2 illustrates the recent changes in the Food for Peace program. Notice in the first column that by 1972, vitamin and mineral fortification was a well established practice and roughly one-third of the commodities were fortified with vitamins and minerals. This level continued through the 70's--30% in 1972, 36% in 1974 and 1976, and 30% in 1978. As mentioned earlier, protein fortification started in the 1960's, and by 1972 11% of the commodities contained soybean protein. By 1974, soy fortified wheat flour, bulgur, corn meal and other grain products had been introduced into the program and the proportion of protein

fortified commodities had grown to 22%. By 1976 the proportion of protein fortified foods had grown substantially more to 52%, and thereafter roughly one-half of the commodities provided through Food for Peace have been fortified with protein (17). The kinds of foods distributed through Food for Peace in the future will, of course, change, hopefully to reflect our better knowledge of the requirements of the food recipients. In the meantime, however, the Food for Peace program certainly illustrates how cereal fortification can be used to address the nutritional needs of a target group. It shows that a technology exists for fortification that is practical and can be applied--because many millions of pounds of fortified foods are manufactured every year. It shows that fortified foods are acceptable--because millions of recipients eat it every day. It shows that the costs of fortification are affordable--because the costs have in fact been budgeted and paid for by Food for Peace.

(18) The Food for Peace program illustrates one additional very important point. That point is that the food distributed through the Food for Peace program including fortified foods can be manufactured in essentially any country in the world and used in local nutrition programs. This has happened in many countries including several Asian countries.

(19) For example, as shown in Table 3, in India, a country that has pioneered in many nutrition interventions, a locally made protein, vitamin, and mineral fortified cereal food called Balahar has been manufactured since 1967 and distributed to millions of Indian children in place of CSM provided through Food for Peace.

(20) In Colombia, a similar blended food called Bienestarina, formulated and manufactured locally, has been in production since 1976. Bienestarina replaces Food for Peace commodities which started to phase out as Colombians chose to expand the use of their own indigenous resources to deal with problems of malnutrition.

(21) In Sri Lanka, the Government of Sri Lanka, in cooperation with the private voluntary organization CARE, has undertaken a long term program to phase in a locally produced fortified food called Thriposha for use in feeding programs for preschool children. This program aims to extend Food for Peace commodities with locally grown cereals and was put in action several years ago and has grown considerably with time. Today a factory outside Colombo is producing a corn and soybean blend made from locally produced grains for use in Thriposha that reaches over 400,000 food recipients. The Government of Sri Lanka budget covers the locally procured ingredients and the processing.

(22) Similar operations to produce special cereal-soy foods for use in the government sponsored feeding programs to reach targeted recipients have begun recently in several other countries including Guyana, Bolivia, Costa Rica, and Mexico.

(23) The Mexican operation, undertaken by the Centro de Investigaciones y Asistencia Tecnologica del Estado de Chihuahua (CIATECH) is especially interesting. In 1979 CIATECH built a small factory to produce soybean flour for use as an inexpensive protein fortificant and as an ingredient in other low cost foods. Today that factory is producing 300 tons per month of soybean flour which is used as a protein fortificant in corn flour for tortillas. Additional flour from the factory is being used in commercial markets as an inexpensive substitute for eggs in baked goods and as an inexpensive extender for fluid cows milk. Another factory was built in Chihuahua this year and is now producing soy fortified tortilla flour and corn-soy and oat-soy beverage-base products. While many of the foods made in Chihuahua are sold through commercial markets and are intended to be viable commercial products, the bulk of the food is targeted at low income people who are in need of nutritious but inexpensive food commodities. Although the Mexican operation is not a follow-on to the Food for Peace program, it illustrates an application of cereal fortification which clearly fits the pattern established

by Food for Peace food commodities--production of fortified cereals and inexpensive blended foods to promote the nutritional welfare of those in need.

Program Development

(24) In the beginning of this paper it was pointed out that we've talked a great deal about fortification but it appears we've done little in implementing fortification programs. The programs just described, the Food for Peace program and the several similar food distribution programs now in progress around the world, contradict, in a way, the contention that little has been done. Other speakers at this Congress have described or will describe other fortification activities that illustrate progress--Dr. Arroyave's work at INCAP on vitamin A fortification of sugar and the large programs in Central America to implement sugar fortification, are clear evidence of substantial progress. Even so, it seems fair to say that fortification can make a greater contribution than it has in solving the real problems of malnutrition.

(25) Evidence for this rests on the fact that nutrient deficiencies--iron, vitamin A, iodine, and others--are clearly in evidence in many countries around the world. Many millions of people eat foods that could be fortified to help reduce those deficiencies, and yet the foods are not fortified and the deficiencies persist.

(26) It's probably true that fortification will not totally eliminate the problem of deficiency; but a program need not reach 100% of the target to be useful and it seems clear that fortification can, in many instances, reduce the deficiencies among large numbers of people. It's probably true that other methods of dealing with nutrient deficiency problems might, in certain instances, be more effective or less costly interventions (such as use of vitamin pills or nutrition education); but these approaches also seem to be rarely implemented, and the result is that deficiencies that could be treated by fortification persist.

It's probably true that there is competition from other important activities for the funding needed to implement fortification programs; but governments and concerned organizations do have funds, they allocate those funds, and they can, if they choose, make those funds available for fortification programs. It's also probably true that we can't answer all the hard questions about economic benefits and other issues which are generally raised in conjunction with project approval; but many reasonable people have accepted that improved quality of life is a valid "benefit" even if it can't at the present time be given a sound monetary value.

(27) What appears to emerge from this type of thinking is the conclusion that fortification can be undertaken--that fortification can be used to deal with nutrient deficiency problems and solve them, albeit often in imperfect ways and with some uncertainty in measureable benefits, and that countries can raise the required funds to implement the programs. These things have all been done in the past in various countries around the world--they therefore can be done in the future in other countries. The fact that they can be done, however, doesn't mean they will be done. The real issue, then, is what causes them to be done.

(28) We can find technical guidelines or preconditions for fortification in the proceedings of our past meetings that tell us the technical factors to consider in fortification programs. For example, the National Academy of Science has suggested the technical guidelines listed in Table 4.

(29) These guidelines deal with the choice of carriers, the nutritional effectiveness of the system, safety and so on. These and other similar guidelines we've proposed are excellent principles and clearly ought to be followed. But there seems to be another type of guideline or set of issues that should be considered when we look at the practical aspects of implementation of fortification programs. These have to do with making things happen, the issues that must be addressed if the program is to get active support, and to be acted on positively. I don't recall seeing guidelines of this type arising from past discussions of fortifica-

tion. Therefore it might be useful to try to develop a set of "action guidelines." Table 5 lists a set of guidelines which might be considered for this purpose.

(30) These "action guidelines" are, as are the technical guidelines, inter-related and should probably be treated collectively as a group rather than handled one at a time, stepwise. However, first on the list is the suggestion that clear specific objectives should be defined for fortification programs. Presumably when considering the technical guidelines, decisions will be made as to the carrier, the amount and type of fortificant, and similar technical issues covered in Table 4. However, normally decision makers want to know the specific objectives of a program that go beyond these broad ones--they want to know how many tons of the carrier will be fortified, which processors will be involved, and how many people will benefit. Therefore it seems reasonable that the persons responsible for the program should address these issues and develop reasonable, attainable quantitative objectives for the program.

(31) Secondly, to implement a fortification program, a number of actions must generally take place in order to move from a condition of having no program to a condition of having an effective, operational program. These actions might include clinical tests of effectiveness, procurement and installation of new equipment, passing new laws or issuing new regulations to permit or perhaps require fortification, undertaking appropriate evaluations of the program, obtaining any special funds required, and so on. None of these things happen by themselves, and often they require considerable preplanning to make them happen. Developing an action plan which lists the required activities, indicates who is responsible, and when the activity must be completed should help assure that the activities take place and the program is implemented.

(32) Third, no program is likely to take place unless decision makers have some reasonable idea as to what it will cost and can allocate the required funds. Generally, specific program development funds and some operational funds are

required, and these can't be secured unless the funding agency knows the cost. Beyond that, if the costs should turn out to be more than can be secured, obviously the program can't go forward--it must be dropped or postponed or changed. Clearly the costs should be estimated at an early stage in program development and, as plans solidify, the costs should be refined and updated.

(33) Fourth, fortification programs involve many people from many organizations who contribute to the program and effect decisions. Technologists and nutritionists are clearly involved. Also the processors and their business managers, sales personnel, production units and quality control groups are often involved. Suppliers of equipment and fortificants are involved. Government administrators and law makers are involved. Consumer groups are sometimes involved. All these groups must work together to have a successful program. And sometimes the various groups are not in accord; in fact sometimes one or more of the groups are strongly opposed to some aspect of the program. Therefore it is extremely important that those groups which will be involved participate in the planning and try to work out jointly solutions to problems which affect the project. Just as important, it is vital that decision makers support the program--participation of the decision makers and those who influence decisions in project planning is one important way to secure that support.

(34) These "action guidelines" are not sacred in the sense that a program will fail unless each issue is examined and some formalized action taken. Nor are they unique for fortification programs--these are considerations taken up in essentially all types of programs so the guidelines are not new. All of us who have been involved in implementing projects and programs have had to deal with these matters. Even so, it seems to me we should consciously take "action guidelines" into consideration when we think of developing fortification programs, just as we do the "technical guidelines." If we devote as much attention to defining specific objectives, developing action plans, and

participation of decision makers, as we do to seeking appropriate carriers for fortificants, and the other technical issues, I suspect we will substantially increase the number of fortification programs which are implemented in the future.

Table 1. Food for Peace Commodities

Commodity	Vitamin and mineral fortified	Contains soybean protein	Blended food
1. Corn (maize), whole grain			
2. Corn meal	X		
3. Soy fortified corn meal	X	X	
4. Corn Soy Milk (CSM)	X	X	X
5. Instant Corn Soy Milk (ICSM)	X	X	X
6. Corn Soy Blend (CSB)	X	X	X
7. Wheat, whole grain			
8. Rolled wheat			
9. Bulgur wheat			
10. Soy fortified bulgur wheat		X	
11. Wheat flour	X		
12. Soy fortified wheat flour	X	X	
13. Wheat Soy Blend (WSB)	X	X	X
14. Sorghum, whole grain			
15. Soy fortified sorghum grits		X	
16. Rolled oats			
17. Soy fortified rolled oats		X	
18. Rice, whole grain			
19. Soy fortified rice		X	
20. Nonfat dry milk powder	X		
21. Whey Soy Drink Mix (WSDM)	X	X	X
22. Vegetable oil			
23. Soybean flour		X	
24. Peas			
25. Beans			

Table 2. Shipment of Food for Peace Commodities

	1972	1974	1976	1978
Total Shipment (million pounds)	5,562	3,002	2,442	3,242
Vitamin and Mineral Fortified (million pounds)	1,654	1,081	876	957
(% of total)	30%	36%	36%	30%
Protein Fortified (million pounds)	594	655	1,277	1,356
(% of total)	11%	22%	52%	42%

Table 3. Fortified Cereals Manufactured in Developing Countries

Product*	Country
Balahar	India
Bienestarina	Colombia
Thriposha	Sri Lanka
Cerex	Guyana
Maisoy	Bolivia
Nutrisoy	Costa Rica
Sunuko	Mexico

*NOTE: The product listing is intended to be illustrative and is not complete. Products which are exclusively or primarily manufactured for the commercial retail market have been omitted entirely.

Table 4. Technical Guidelines for Fortification Programs 1/

- The intake of the nutrient, in the absence of fortification, is below the desirable level in the diets of a significant number of people;
 - the food from which the nutrient is to be derived is likely to be consumed in quantities that will make a significant contribution to the diets of the population in need;
 - the addition of the nutrient is unlikely to create an imbalance of essential nutrients
 - the nutrient added is stable under proper conditions of storage and use;
 - the nutrient is physiologically available from the food to which it will be added; and
 - there is reasonable assurance against intake sufficiently in excess to be toxic.
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1/ Proposed Fortification Policy for Cereal-Grain Products, National Academy of Sciences, Wash. D.C. 1974.

Table 5. Action Guidelines for Fortification Programs

- Define the specific nutritional and operational objectives of the program
 - Develop an action plan describing the activities that will be undertaken to implement the fortification program and achieve its objectives.
 - Estimate the costs of the program.
 - Enlist the participation and support of decision makers and those who influence decisions.
-