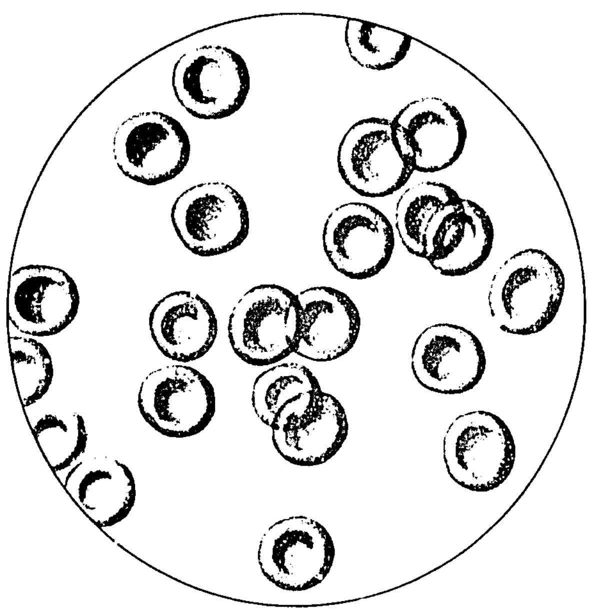
SUMMARY

XII INACG Meeting

COMBATING IRON DEFICIENCY ANEMIA THROUGH FOOD FORTIFICATION TECHNOLOGY



International Nutritional Anemia Consultative Group

5-7 December 1990

Washington D.C.

COMBATING IRON DEFICIENCY ANEMIA THROUGH FOOD FORTIFICATION TECHNOLOGY

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The purpose of the International Nutritional Anemia Consultative Group (INACG) is to guide international activities aimed at reducing nutritional anemia worldwide. The group offers consultation and guidance to operating and donor agencies seeking to reduce iron deficiency and other nutritionally preventable anemias. As part of this service, INACG has prepared guidelines for assessing the regional distribution and magnitude of iron deficiency, developing intervention strategies and methodologies to combat iron deficiency anemia, and evaluating intervention programs. INACG has also prepared recommendations regarding needed research to support the assessment, intervention, and evaluation of programs.

These guidelines and recommendations are available through INACG's publications program. A list of publications is available from INACG, along with ordering information.

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INTRODUCTION

The theme of the XII International Nutritional Anemia Consultative Group (INACG) Meeting, held 5-7 December 1990, in Washington, D.C. was "Combating Iron Deficiency Anemia Through Food Fortification Technology." The meeting brought together individuals from industry, academia, governments, and private nonprofit organizations whose common goal was to develop an effective strategy for food fortification.

The primary objective of the INACG Meeting was to produce an Action Plan for combating iron deficiency anemia through food fortification. As a prelude to designing this Action Plan, a series of presentations provided a technical background based on research findings as well as on insights gained during implementation projects. Together this information formed the substantive basis for the deliberations, which led to group consensus on the general design of an effective plan that would result in the fortification of food with iron in countries where iron deficiency anemia is a serious problem.

A problem as complex as iron deficiency, the most prevalent nutritional disorder in the world, requires innovative thinking coupled with political commitment before a reduction in its serious consequences for children and women can be expected. Long-term solutions to iron deficiency require large scale, integrated prevention programs that, of necessity, demand multisectoral partnerships. Yet, while programs such as iron fortification of food can prevent iron deficiency in substantial segments of the population and are feasible, they are rarely initiated in developing countries. Instead, anemia-control programs that tend to focus on short-term therapeutic strategies (e.g., distribution of iron tablets to pregnant women) are favored.

This report attempts to convey both the factual material presented at the XII INACG Meeting, and the essence of the ensuing discussion. The report provides readers with a frame of reference for the Action Plan that resulted from the deliberation of participants at this meeting.

OPENING SESSION

Welcoming Remarks

Presenter: ■ Dr. Samuel G. Kahn, U.S. Agency for International Development (USAID, United States)

Dr. Kahn began the opening session by welcoming all in attendance to the twelfth international meeting of INACG. He expressed appreciation for the willingness of each participant to interrupt personal work schedules and noted that there was a broad cross-section of representation, including participants from industry, donor agencies, private voluntary organizations, academia, and U.S. government agencies. Dr. Kahn focused attention on the importance of the meeting by citing the commonly known reality that iron deficiency anemia is the most prevalent nutritional deficiency in the world today, with particularly high prevalence in developing countries.

In reviewing the schedule for the meeting, Dr. Kahn indicated that the first two days of the conference would be devoted to reports, case studies, country experiences, and panel discussions on costs of iron fortification and marketing issues. These sessions were intended to serve as background for four working groups assigned to address the construction of an Action Plan for developing national iron fortification programs. The design of the conference called for a plenary session to review the products of the working groups and, through consensus, to develop an Action Plan to guide governments, donors, and the private sector to collaborate in joint efforts to combat iron deficiency anemia through iron fortification programs.

Dr. Kahn then introduced Dr. Norge W. Jerome, Director of the USAID Office of Nutrition, to present introductory remarks.

Introductory Remarks

Presenter: ■ Dr. Norge W. Jerome, U.S. Agency for International Development (USAID, United States)

Following her personal welcome to the group, Dr. Jerome expressed the opinion that the twelfth INACG meeting was a very special one, from several standpoints. First, it was a meeting of partners, some of whom were mentioned by Dr. Kahn: policy makers from both the national and international arenas; private industry, both large and small; private voluntary organizations, large and small; universities; and donor agencies, both multilateral and bilateral. The significance of this mix of participants lay in the bringing together of potential partners whose common interest is to combat iron deficiency anemia through iron fortification technology. The meeting was thought to be the first to address the distribution of food to malnourished populations by utilizing the partnership modality.

The second important aspect of the meeting commented upon by Dr. Jerome was its orientation towards action. The goal, as stated by Dr. Jerome, was to develop an Action Plan to move forward the work already done in fortifying food with iron, in order to address malnutrition in populations at risk. Thus the purpose of the meeting was not merely to generate a report or to publish proceedings.

Dr. Jerome briefly described the activities of the Nutri-Business Roundtable, which had recently met in order to devise a strategy for providing quality foods at affordable prices to malnourished populations through commercial channels. She indicated that the twelfth INACG meeting captured the theme and the spirit of that Roundtable. She expressed a belief that the existence of technologies and the adequacy of current information provide an opportunity to address iron deficiencies globally and that key partners could develop just such an Action Plan. Development of an Action Plan should have secondary benefits as well, since it should strengthen future collaboration and lead to concrete action at the national level.

Dr. Jerome then introduced Dr. Richard Bissell, Assistant Administrator for the Bureau for Science and Technology; she expressed her sense of privilege at having an individual of Dr. Bissell's caliber at the head of the Bureau.

Opening Remarks

Presenter: ■ Dr. Richard E. Bissell, U.S. Agency for International Development (USAID, United States)

Dr. Bissell acknowledged the importance of the topic to be considered at the conference and observed that the number and representation of participants gave testimony to that fact. He reiterated the importance of partnership since iron deficiency anemia is a problem whose solution will require many different perspectives and the energies of many people, in both donor and developing countries. To these two points Dr. Bissell added his endorsement of the INACG meeting as designed, stating that the technology is available to get iron into the diet of people in developing countries, but that the most vulnerable high-risk groups, pregnant women and young children in particular, are the hardest to reach through development programs in poor countries. Thus imaginative approaches to implementation that take this reality into account are essential. Consequently, Dr. Bissell expressed the hope that the INACG meeting would deal not only with how to treat or to prevent iron deficiency anemia, but also with how to educate and to communicate with people most at risk.

The problem of communication is particularly crucial in the area of nutrition. How can the receptivity and the motivation of individuals and families be increased so that they will sustain the remediation effort and look upon it as a life-long requirement? The participants at the meeting, therefore, must consider this factor even though it goes well beyond their scientific, technical, or medical expertise. This involves consideration of basic human nature and of how experts in nutrition can communicate and educate so that people will begin to care for themselves rather than relying on support systems organized by central governments. Inevitably the workshop must address this issue. It can come up with the finest technical solutions possible, but unless those designing such solutions understand that there must also be a willing market among high-risk groups, then such technical efforts will fail in the long term.

Dr. Bissell concluded his remarks by again welcoming the participants to the meeting. He expressed his delight that the goal was not to produce another massive report or proceedings but rather to develop a viable plan of action. He wished the participant group well in that effort.

SESSION 1. CURRENT OPERATIONAL IRON FORTIFICATION SYSTEMS

Chairperson: ■ Dr. George Purvis, Gerber Products Company (United States)

The purpose of Session 1 was to share with participants the experience of situations iron fortification systems which are currently operating. In the case of cereal grains, this experience spans the past 50 years. Much of the technology is applicable for grains in general, due to the fact that milled cereals, including infant cereal products, are excellent vehicles for fortification. Other technologies, particularly those related to infant formulas, were also reviewed during this session.

Case Study: Wheat Flour and Cereal-Based Foods

Presenter: ■ Mr. Peter Ranum, ATOChem North America (United States)

The fortification of milled cereal staples in a number of countries, including Belize, Canada, Haiti, Jamaica, the United Kingdom, the United States, and Venezuela, has been implemented either as a result of government regulation or the adoption of the practices of parent companies in Canada and the United States. For public health reasons, the objective is to add back the iron lost through milling. Rarely do consumers have a choice of purchasing an unfortified product at a lower cost. In most cases, retailers and consumers are not even aware that the products are fortified.

As staples, milled cereals are relatively inexpensive; they are grown and consumed worldwide by all economic classes, versatile in preparation and use, and generally processed in large, centralized plants. Consequently, milled cereals are a good vehicle for fortification. Ferrous sulfate is the most common form of iron used in milled cereals such as wheat, corn, and rice. In products likely to be stored for a long time before consumption, however, reduced iron is preferable because of its greater chemical stability. Table 1 lists iron fortificants and their attributes.

Operationally, the constant monitoring of iron levels in fortification systems is important. For example, mills may experience "chokes" when the flow of ground flour

Table 1.

IRON SOURCES USED IN CEREAL FORTIFICATION

Source	% Fe	1990 Cost ($/kg)	Cost ($/kg of Fe)	Bioavailability	Color	Stability
Hydrogen Reduced Iron	98	1.94	2.00	Fair -	Black	Good
Electrolytic Iron	98	4.71	4.80	Fair +	Black	Good
Ferrous Sulfate	32	2.35	7.30	Good	Tan	Fair
Ferric Orthophosphate	28	2.73	9.80	Poor	White	Excellent
Ferrous Fumarate	33	2.94	8.90	Good	Red	Fair ?
Iron EDTA	13	2.40	18.50	Excellent	Off-White	Good ?

is stopped. Unless the nutrient feeders are set up to stop when milling stops, excess iron may be added accidentally. In order to ensure that the flour is not being excessively fortified, it is recommended to do a quick iron spot test. The reagents should be mixed and flooded over the flour. The resulting spots indicate the level of iron, making it very easy to see if the product has been over-fortified, or not fortified at all.

Case Study: Infant Cereal Products

Presenter: ▪ Dr. George Purvis, Gerber Products Company (United States)

Because they are fortified with iron, baby foods made from cereal grains are an important source of iron in infants' diets in the United States. It is estimated that 92% of all infants in the United States are fed cereal at some time during their first year of life. Through consumer research and national dietary surveys, infant eating patterns, including the types of products and the quantities consumed, are well known.

The objective of fortification of baby foods in the United States is to provide approximately 50% of the United States Recommended Daily Allowance (USRDA) of iron through these cereal products (about 7 mg). Reduced iron and electrolytic iron are the fortificants currently being used. Encapsulated ferrous sulfate and iron complex with ethylene diamine tetraacetate (EDTA) are now being tested in a typical dry baby food. The process consists of making a 23% slurry with oat, barley, and soy mixtures; treating the mixtures with enzymes to partially hydrolyze the carbohydrate (for ease of manufacturing and enhancement of digestibility); and heating and drum drying to form flakes that can be easily dispersed in juice, breastmilk, or infant formula.

Case Study: Infant Formula and Milk Products

Presenter: ▪ Dr. David Cook, Mead Johnson Company (United States)

In the United States, where consumption of infant formula is substantial, iron fortification has played an important role in the iron nutriture of infants consuming iron-fortified formula. Studies show that the total amount of iron in a newborn's body (about 250 mg) remains fairly constant until four months of age. By 12 months this amount has risen to about 420 mg, a change suggesting a need for additional iron at a rate of about 0.47 mg per day. Body iron accretion depends on net balance between the amount of iron absorbed and the amount of iron lost from the body. Iron absorption is affected by the form and level of iron in a food or supplement, and the presence or absence of facilitators or inhibitors of absorption. Gastrointestinal blood loss, which is commonly associated with infection and drinking cow's milk, accounts for most of the iron lost by the human infant.

Iron in human breastmilk is highly available to the newborn even though it is present in relatively low concentrations. Iron in breastmilk is absorbed up to ten times more efficiently than iron in other infant foods. Cow's milk alone can cause a net loss of iron due to an increased gastrointestinal blood loss. Iron-fortified formula contributes an estimated 0.4-0.5 mg of iron daily to total body iron.

Discussion Points

Unlike the cited examples of cereal manufacturers in certain developed countries, millers in most other countries are unlikely to absorb the costs associated with iron fortification of staple cereal grain flour or other products. Typically, fortification must be mandated by government regulation that eliminates competition with unfortified products. In the United States, fortification at the community level is uncommon unless production exceeds 100 sacks of flour per day. When introducing populations of countries to iron-fortified products, it is best to start with the largest mills for better control of costs and quality. It may not be feasible for each country to attempt indigenous production of fortificant iron sources. Maintaining the quality of a fortificant requires expensive processing and high-level technology. The main concern is avoiding contamination with heavy metals. However, production capacity could be developed within four or five major geographic regions.

SESSION 2. EXPERIMENTAL IRON FORTIFICATION SYSTEMS

Chairperson: ■ Dr. A. Wynante Patterson, Caribbean Food and Nutrition Institute, Pan American Health Organization (PAHO, Jamaica)

Session 2 dealt with experimental iron fortification systems based on more recent technologies, in contrast to operational systems based on well-established technologies. Addition of iron to foodstuffs and ingredients indigenous to the cuisine and dietary patterns of a given country or people must be considered where the introduction of more traditional approaches is not consistent with the cultural context.

Fortification of Condiments

Presenter: ■ Dr. Sean Lynch, Hampton Veterans Affairs Medical Center (United States)

Studies conducted on limited populations since the 1970s have demonstrated the effectiveness of adding iron to a broad range of condiments, including fish sauce, monosodium glutamate (MSG), curry powder, and sugar. Improvements in iron status (measured by packed erythrocyte volume, iron stores, and levels of hemoglobin and serum ferritin) were greatest in iron-deficient groups.

In one such research effort, a two-year, well-controlled South African study used curry powder fortified with iron to selectively reach an Indian population. Such targeting was critical to avoid potential iron overload in other susceptible ethnic groups with abnormally high intakes of iron. Fortification produced marked improvements in hemoglobin and iron stores in all members of the Indian community, but especially in menstruating women who had the highest baseline frequency of iron deficiency symptoms.

It should be noted that cereal bran, a diet staple in many developing countries, contains phytate and other factors that greatly reduce the effectiveness of any iron fortificant. One possible exception, iron-EDTA, resists this effect. An alternative approach is to increase the consumption of foods containing ascorbic acid, which enhances absorption of ferrous sulfate; however, it must be recognized that the costs associated with changing eating behavior to ensure adequate intake of ascorbic acid may be greater than the costs of fortifying a staple with a fortificant such as iron-EDTA, whose use does not require modification of food habits.

Fortification of Salt

Presenter: ▪ Mr. Venkatesh Mannar, Consultant to the United Nations Children's Fund (UNICEF, India)

Nutritional anemia is a major public-health problem in India, and the current delivery system (mainly a government-run maternal and child health service) for distributing iron supplements is considered inadequate. Multicenter studies conducted in all regions of the country clearly demonstrated a reduction in the prevalence of anemia when iron-fortified salt was consumed. Furthermore, studies of salt procurement and consumption patterns in rural areas showed the potential for reaching a significant proportion of high-risk groups through this mechanism. In India, because the consumption of cereals, unlike that of salt, varies from region to region, and most grain is processed locally in the home or village, iron-fortified salt reaches a larger proportion of the population at risk than would fortified cereals.

Cost and technology are the most critical constraints in converting the salt fortification programs into a nationwide system. Cost estimates indicate that fortification with iron would add 50% to the retail price of salt, which neither producers nor consumers would be able to pay. When elemental iron is added to iodinated salt, the potassium iodate quickly decomposes. More stable combinations such as ferrous fumarate plus potassium iodide or ferrous sulfate plus potassium iodide are currently being tested. Costs to consumers could be significantly reduced if donor agencies and industry collaborated to provide the iron source for national programs. A similar arrangement between UNICEF and F. Hoffmann-La Roche, Ltd. successfully provides vitamin A capsules at a reduced cost.

Even if issues of cost and technology can be resolved, sustained impact will still depend on quality control, regulatory mechanisms, and overall capacity to monitor and enforce compliance. From the experience in India, steps in a strategy to produce and deliver iron-fortified salt might be conceived as follows:

1. Conduct a baseline survey to determine the prevalence of anemia (and/or other indicators of iron deficiency) in the country and determine the feasibility of control through iron fortification of salt.

2. Establish feasibility of developing an iron fortification program covering the entire population of the region or country.

3. Select technology for salt refining and fortification appropriate to the country.

4. Test consumer acceptability of the fortified salt, bioavailability of iron and iodine in salt after storage, and stability after cooking.

5. Initiate Knowledge, Attitude, and Practice (KAP) studies to develop a consumer education strategy.

6. Consider economic and subsidy issues.

7. Implement quality-control procedures.

8. Monitor and evaluate protocol.

Fortification of Rice

Presenter: ■ Dr. Rodolfo Florentino, Food and Nutrition Research Institute (The Philippines)

Rice is widely consumed in the Philippines. Intake is fairly constant across age, gender, and region, with highest intakes seen in lower income groups who have the highest prevalence of anemia. Through the government's National Food Authority, some control is exercised over private millers scattered throughout the country. Because discolored grains are easily picked out and the rice is washed before cooking, the iron fortificant should be colorless and not easily washed off the grain. Two technologies are being tested: surface-coating and simulated rice kernel. Surface-coating has been successful but is not yet compatible with simultaneous fortification of rice with vitamin A. This is an area of ongoing research.

Apart from the technology, the issue of mandating that all rice be fortified has been a concern. In a comparable situation there has been a nationwide regulation requiring all millers to add a vitamin-mineral mix to all rice (the concern was eradication of vitamin B_1 deficiency or beriberi). However, when the government began using the amount of premix purchased as a basis for taxation, millers strongly pressured the government to drop the mandatory fortification of rice. Presently, only selected millers and retailers who participate in the government-subsidized rice-distribution program are being considered for mandatory fortification. If the mandatory fortification of rice is to be preserved, a government subsidy for millers will probably be necessary as will strong advocacy for continuation of this program and consumer demand. The government's capacity to monitor compliance by millers also needs to be strengthened.

SESSION 3. SAFETY AND OTHER CONSIDERATIONS

Chairperson: ■ Dr. Wilma Freire, CONADE (Ecuador)

Safety in Iron Fortification

Presenter: ■ Dr. John Vanderveen, Food and Drug Administration (United States)

National nutrition surveys in the United States have shown that the general population has adequate body-iron stores. Consequently, a proposal to increase the level of iron fortification in cereals was rejected. Further, there is some concern about potential iron overdose since a significant proportion of the population consumes nutritional supplements containing iron. The age group at highest risk for iron deficiency is children under two years of age. However, the incidence of low iron stores is negligible (approximately 3%) as compared with 30%-50% in many developing countries.

Iron-EDTA is not currently approved for use in foods in the United States because total EDTA levels in the diet from other types of EDTA used in processed foods approach allowable limits. Iron-EDTA is a more bioavailable form of iron compared to some other forms. Recommended safe levels of EDTA would have to be raised, or other use of EDTA disallowed, before the addition of iron-EDTA to the U.S. diet would be permitted. Nevertheless, in countries where people consume much less total dietary EDTA, iron-EDTA should be seriously considered as an attractive iron fortificant.

Codex Alimentarius: Current Status of Sodium Iron-EDTA

Presenter: ■ Mr. Richard Dawson, Food and Agriculture Organization of the United Nations (Italy)

The Food Quality and Standards Service of the Food and Agriculture Organization of United Nations (FAO) lists products recommended as safe for human consumption. For a compound to be added to the *Codex Alimentarius* a member country of the FAO must make an official request. Before the committee can consider action, the requesting country must have already approved it for its own use, and data from safety or toxicologic tests must be submitted. At this time (December 1990), no country has taken these steps.

Inhibitors of Iron Absorption in Food

Presenter: ■ Dr. Richard Hurrell, Nestlé (Switzerland)

Foods most commonly fortified with iron contain substances that strongly inhibit the absorption of iron; exceptions are salt and sugar which, however, are normally consumed with other foods containing inhibitors. Of the fortificants available, iron-EDTA is most resistant to common inhibitors, excepting polyphenols in tea, bush teas, and coffee. Consuming these beverages along with meals severely inhibits the absorption of iron present in any form. Phytic acid is the major inhibitor in cereals and legumes and can be removed by enzyme treatment or fermentation. Analyses of fermented whole-grain sorghum and the germinated grain showed that the processes of fermentation and germination reduced the concentration of phytic acid to the extremely low levels needed for significant improvement in iron absorption. The poor availability of iron in soy mixtures and soy isolate is now believed to result from formation of a complex of soy peptides, phytate, and other minerals with iron. Absorption can be increased by adding supplemental ascorbic acid or eating ascorbate-rich foods, removing inhibitors, or using "protected" fortification compounds such as iron-EDTA.

SESSION 4. CHILE: A CASE STUDY

Presenter: ■ Dr. Tomas Walter, Institute of Nutrition and Food Technology (Chile)

A case study illustrating the complex interaction between technology, social psychology, and the political reality confronting the public-health community as it seeks to implement or improve iron fortification programs in developing countries was presented in Session 4.

The Chilean case study demonstrates how the partnership of industry, government, and academic research can work well. It also points out why, despite technological advances, anemia remains the chief nutritional deficiency in Chile. The country has seen successful improvement in nutritional status indexes (except anemia in infants) despite static economic conditions over the past two decades. The academic community has been a leading partner in the planning and implementation of successful interventions through the University of Chile's Institute of Nutrition and Food Technology (INTA).

The main nutrition-delivery system is the nationwide public-sector network of clinics and hospitals, reaching 75-80% of the population. This network provides, in addition to disease control, food supplements targeted to pregnant women, infants, and children. In addition, the national preschool and school lunch and snack program reaches one million children daily, and the national bread-fortification program (60% coverage) appears to have been effective in reducing anemia in other age groups.

Although other health and nutrition indexes have improved, anemia among infants remains a major problem. Infants and young children were identified in INTA studies as the groups at highest risk for anemia; this finding led to the choice of milk (distributed through national food-supplement programs) and weaning cereals as the vehicles for iron fortification. Technological manipulation of the milk (adding ascorbic acid to increase bioavailability of iron and acidification to reduce intrafamily dilution) was shown to almost eradicate anemia in infants under two months of age.

Several factors prevented this fortification program from becoming a national system. First, there was concern that this milk would not be considered important or prestigious, since other family members could not consume it. It was feared that this situation would result in reduced attendance at distribution centers and that, therefore, coverage of other health services would suffer. Second, all manufacturers did not have the technical capabilities for acidification and packaging in aluminum cans, therefore preventing them from bidding procurement contracts. Third, the cost of fortification increased slightly, but significantly, the purchase price of this product during the 1982 recession.

At present, plans are underway to fortify both an infant formula product that will be distributed through the national health services as well as the milk sold for general consumption. In addition, a special program initiated through the Ministry of Education in which hemoglobin-fortified chocolate cookies are distributed as part of school lunch programs, has been successful in reducing anemia in the targeted children.

SESSION 5. COSTS OF IRON FORTIFICATION

Chairperson: ■ Dr. T.N. Maletnlema, World Health Organization, Southern African Regional Office (Zimbabwe)

In addition to consideration of appropriate technologies to be used in any given country with respect to the vehicles and delivery systems for iron fortification, the cost factors related to those strategies are critical. Session 5 dealt with some of the issues of cost-effectiveness and the economics of iron fortification.

Iron Fortification in Indonesia

Presenter: ■ Dr. Darwin Karyadi, Nutrition Research and Development Center (Indonesia)

Iron deficiency anemia affects 20-60% of the Indonesian population, especially children and pregnant women. Recent knowledge of the effects of iron deficiency on mental function (in addition to the well-known reduction of work capacity) has led to a new national policy to expand efforts to reduce anemia beyond distribution of supplements. Studies of food consumption patterns led to selection of salt and noodles as vehicles for iron fortification.

Cost and feasibility of monitoring and enforcing a nationally mandated system for the double fortification of salt and iron fortification of noodles are currently major concerns. Table 2 presents a summary of cost and other considerations for the two proposed systems.

Table 2.

ELEMENTS OF FORTIFICATION STRATEGY

KEY

H — HIGH N — NONE
M — MEDIUM D — DIFFICULT
L — LOW S — SIMPLE

	INITIAL COST	CONTINUING COST	CENTRALIZER PROC	DECENTRALIZER PROC	QUALITY ASSURANCE	LEGAL EXECUTION	PUBLIC PARTICIPATION	PERSONNEL	EXPERTISE	EASE OF SYSTEM MONITORING
IRON-IODINE SALT FORTIFICATION	M	L	D	S	D	D	N	M	H	D
IRON and with MULTINUTRIENTS OF NOODLE (WHEAT FLOUR)	M	L	S	S	S	S	N	L	H	S

Iron Fortification -- Is It Cost Effective?

Presenter: ■ Dr. Judith McGuire, The World Bank (United States)

Iron fortification can be characterized as having high global or total costs but low per capita costs since a very large population is affected. On the other hand, investment in iron fortification produces a high return because economic productivity and education costs are protected when iron status improves. However, the costs associated with iron fortification will need to be shared by industry, governments, donors, and consumers.

A World Bank study using data from India, Guatemala, Kenya, Indonesia, and Mexico indicated that iron fortification is highly cost effective. This conclusion was based on a conservative analysis of economic returns gained from iron fortification, and it held up under assumptions about replacement of labor and increased energy requirements.

Costs of Fortificants

Presenter: ■ Mr. John Watson, Watson Foods Company, Inc. (United States)

The costs of more common iron fortificants used in the formulation of food pre-mixes were reviewed. Table 3 summarizes iron fortificants in relation to their effectiveness and use characteristics. (The table has been recently revised by the INACG Secretariat to reflect most recent information on iron compounds).

Cost Issues for Industry

Presenter: ■ Dr. Soliman Shenouda, Kraft General Foods (United States)

A marketing experience in Egypt demonstrated why industry has not participated more fully in expanding iron fortification technology in developing countries. In order for a business proposition to work, the venture must have either a high profit margin or high volume. To test the feasibility of assisting the government of Egypt to reach high-risk groups with an iron-fortified product, a 12-week trial was conducted with more than 1700 school-age children in Menoufia Governorate. Kool-Aid® fortified with iron and ascorbic acid was given to the children. Increases in hemoglobin and ferritin levels observed at the end of the study were related to the degree of deficiency at baseline.

However, the program was not implemented at a national level because of increasing costs of trade incentives and duties that left a low profit margin for the company. Raw materials constituted only 20-30% of total costs. Figure 1 presents a summary of cost elements in such a system. When this market test was being completed, all low-profit projects were being discontinued by the parent company in the United States, and the venture in Egypt was dropped.

TABLE 3

TABLE OF COMMERCIALLY AVAILABLE IRON COMPOUNDS (MARCH 1992)

KEY:

G = Good, F = Fair, P = Poor
— = Information not available

R = Recommended, V = Variable,
NR = Not Recommended

Relative Cost Factor:
$= \frac{100}{\%\ \text{iron}} \times$ Bioavailability factor in humans

Bioavailability factor: G = 1, F = 2, P = 3

	% Iron Content	Bioavailability in Humans	Bioavailability in Animals	Common Vehicles: Processed Cereals	Salt	Sugar	Infant Foods (milk)	Beverages	Relative Cost Factor
Freely water soluble									
Ferrous sulfate - $7H_2O$	20	G	G	V	V	R	R	R	5.0
Ferrous gluconate	12	G	G	V	V	R	R	R	8.3
Ferrous lactate	19	G	G	—	NR	NR	V	R	5.3
Ferric ammonium citrate	18	G	G	V	NR	NR	R	V	5.5
Ferrous ammonium sulfate	14	—	G	—	—	—	—	—	—
Ferric choline citrate	14	—	G	—	NR	NR	—	—	—
Slowly soluble									
Dried ferrous sulfate	33	G	G	V	V	R	V	R	3.0
Ferric glycerophosphate	15	G	G	V	NR	NR	V	V	6.6
Ferric citrate	17	P	F	V	V	R	V	R	17.6
Ferric sulfate	22	P	G	NR	NR	NR	NR	NR	13.6
Ferric saccharate	3-35	F	G	R	—	—	—	R	5.7-6.6
Ferric chloride	34	F	G	NR	NR	NR	NR	NR	5.9
Poorly soluble									
Ferrous fumarate	33	G	G	R	R	NR	NR	NR	3.0
Ferrous succinate	35	G	G	R	—	—	NR	NR	2.8
Ferrous tartrate	22	F	F	—	—	—	—	—	9.0
Ferrous citrate	24	F	F	V	V	—	V	R	8.4
Almost insoluble or insoluble									
Ferric pyrophosphate	25	P	P	R	R	R	NR	NR	12.0
Ferric orthophosphate	28	P	P	R	R	R	NR	V	10.7
Sodium iron pyrophosphate	15	P	P	NR	NR	NR	NR	NR	20.0
Reduced elemental iron									
a. Reduced by hydrogen (15-45 μm)	96	F	F	V	NR	NR	NR	NR	2.1
b. Reduced by carbon monoxide	96	F	F	V	NR	NR	NR	NR	2.1
c. Carbonyl iron	98	F	F	V	NR	NR	NR	NR	2.1
d. Reduced by electrolysis - 20 μm	97	F	F	V	NR	NR	NR	NR	2.1
Ferric oxide	70	P	P	NR	NR	NR	NR	NR	4.2
Ferric hydroxide	62	P	P	NR	NR	NR	NR	NR	4.8
Ferrous carbonate	35	P	P	NR	NR	NR	NR	NR	8.5
Iron Complex Compounds									
Sodium Ferric EDTA	13	G	G	R	—	R	V	V	7.7

To determine equivalent costs on a bioavailability basis, multiply the relative cost factor by the available price per kilo of iron compound. Current local costs per kilo should be used when available.

Figure 1.

Key Cost Elements Considered by Industry

Raw materials

Packaging

Other

↓

Variable Materials cost + Overhead + Trade Incentive + Transportation Warehousing + Duties

↓

FACTORY DOOR COST

\+

ADVERTISING AND PROMOTION

\+

MARKUP

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FINAL COST

Discussion Points

Costs of iron fortificants are significant and are increasing rapidly. This fact, coupled with the probability that donors may soon discontinue the practice of distributing free health supplies (including vaccines), suggests that fortification programs need to be rigorously evaluated for cost-effectiveness. Where there is political will and commitment, costs tend to be taken care of. The critical issue is how to generate that degree of will and commitment. The International Council for Control of Iodine Deficiency Disorders has been very successful in obtaining such a commitment, and they are seeking donor assistance from Japan, the major producer of iodine. This program is a good model for groups interested in iron fortification to follow.

Production at the national or regional level needs to be carefully explored as a means of cost control. Quality issues, such as contamination of iron fortificants with heavy metals, are serious concerns. Targeting the fortification system by selecting commodities consumed only by high-risk groups may also help to limit costs.

SESSION 6. MARKETING ISSUES

Chairperson: ■ Dr. Anthony Meyer, Office of Education, USAID (United States)

The identity of target population groups in countries around the world is fairly constant and easily defined. It is well understood that the most desirable way to reach these target groups is through a fortified food; fortification must be achieved at minimal additional cost and as a result of government regulation or subsidy. Beyond those considerations, it is essential to communicate the benefits and desirability of the fortified product to consumers so as to create awareness, demand, and potentially, political pressure. Session 6 dealt with some of these marketing-related issues.

Marketing Concerns in Ecuador

Presenter: ■ Dr. Wilma Freire, CONADE (Ecuador)

Recent studies have shown that iron deficiency anemia is highly prevalent in Ecuador, affecting 60% of pregnant women in the third trimester, 70% of children between six and 11 months of age, and 45% of children aged 12-23 months. Intervention through food fortification has good potential in Ecuador because there are three suitable vehicles: wheat flour, salt, and sugar. These food products are widely consumed by all social classes, and each is processed at relatively few locations within Ecuador, a situation permitting good control of the iron fortification. Salt is currently fortified with iodine.

A key issue to developing and marketing an iron fortification program in Ecuador is selection of the appropriate vehicle for delivery of the fortificant in terms of bioavailability of iron, patterns of food consumption and preparation, intrafamily food distribution, and socioeconomic characteristics of target consumers.

Is There a Role for Marketing?

Presenter: ■ Dr. J. Michael Gurney, WHO Regional Office for Southeast Asia (India)

Population groups to be targeted for iron deficiency control programs do not vary greatly among countries. Women and adolescent girls are the primary group, followed by infants six to 12 months of age, and then the rest of the population. The most desirable way to reach the target groups is through a food fortified at minimal additional cost.

Some marketing communication is necessary to allay any false concerns that something with negative consequences is being added to foods. Consumer communication can aid in creating a demand for a fortified product. Producers and sellers may not want to promote a product that is more costly or is unfamiliar to the consumer. If the vehicle is a widely-used current product, problems of marketing are reduced considerably.

Promotional efforts are designed to increase use of a product, while effectiveness of the program for consumers creates demand. A simple test for compliance with stated fortification levels would help assure the consumer that the iron was appropriately added.

It is important to consider the whole spectrum of cost factors related to fortification. Purchase of a fortified product could conceivably make less money available to buy other important foods and thus result in different nutritional problems. For an iron fortification program to be effective, it should be linked to other segments of a total program for control of anemia, including treatment of parasitic infestation.

The Role of Consumer Research

Presenter: ■ Dr. William Smith, Academy for Educational Development (United States)

Consumer research must be part of an iron fortification program. Consumer research may be needed to determine how much and what kind of promotion is necessary to be effective. If the vehicle used for iron fortification is a currently used food and the addition of iron does not perceptibly change the product, less promotion may be necessary than if there is a perceptible change.

The principal goal of iron fortification must be to benefit consumers. The aim should be to minimize the perceptible effect of the iron fortificant on the taste, color, consistency, and convenience of the selected vehicle. An appropriate distribution system should be chosen, and any increase in cost should be perceived as adding real value for which the consumer is willing to pay. Consumer research is important to evaluate these factors as well as the perceived value of the product, as judged by the consumer. Consumer research should also look for possible negative and/or positive factors related to perceptions and potential use of the fortified product. Successful products stress what consumers think they need.

If a product has negative qualities or competition from unfortified products, additional promotion will be needed. Promotion may be necessary if a newly recognized benefit would increase use or improve overall consumer health. In the absence of the above factors, promotion may have little benefit. Consumer research provides the basis for making these determinations.

How Industry Markets a New Food Product

Presenter: ■ Ms. Kathryn L. Weimer, General Mills, Inc. (United States)

Product positioning is oriented to fulfill consumer needs or wants. The four primary variables in marketing a food product in the United States are taste, convenience, cost, and nutrition. The importance of each of these variables may change over time and depends upon the target audience. It is important to determine the relative importance of these issues and to look for ways to add a perceived value to the product. Both product testing and use of focus groups with potential users provide important marketing information. It is essential to determine what drives consumer interest so that the promotion can focus on that issue. It is also important to identify the target for any promotion: is it to be directed at the actual user or at the person who controls purchasing?

Discussion Points

It is difficult and costly to change food behavior. The advantage of food fortification lies in not needing to change existing eating practices. Ideally, there should be no perceptible change in the product. The role of marketing and promotion is to advance the increased value so that the additional cost of iron fortification can be recovered from the consumer. Allocation of available money is largely based on consumers' perception of benefits. Careful targeting may be important if benefits accrue to one family member rather than the entire economic group. Promotion may be needed even when no perceptible change is made to an existing product so as to prevent the potentially adverse effects of rumors and myths from affecting acceptance of the product.

SESSION 7. ISSUES IN IMPLEMENTING NATIONAL PROGRAMS

Chairperson: ■ Dr. Carlos Daza, PAHO (United States)

Session 7 dealt with practical considerations based on the experience of implementing iron fortification programs in different countries and regions of the world. Each presenter addressed the specifics of the iron fortification program in his or her country or region and then drew generalizations from that experience.

The Philippines

Presenter: ■ Dr. Rodolfo Florentino, Food and Nutrition Research Institute (The Philippines)

The Rice Enrichment Experiment in 1950 was designed to eliminate beriberi by fortifying rice with vitamins B_1 and B_2 and with iron. The rice millers blended a premix rice kernel with regular rice at the rate of one premix kernel to 200 regular kernels. This experiment resulted in a two-thirds decline in the incidence of beriberi, and there were no deaths due to the disease over a two-year period.

After this experiment was completed, the Philippine Congress passed a requirement that all rice sold in that country must be enriched. This ruling was heeded for several years, after which the rice millers began to evade the law because they were taxed at the rate of 1-2% on the amount of rice milled, and the government could determine the amount of rice they were milling by the amount of premix rice they purchased. The actual cost of rice enrichment was not high, but the cost of enforcement was.

There were also problems with consumer acceptance because the premix rice was colored. General practice in the home was to remove foreign substances (like stones) during washing and cleaning of rice. Because of their color, premix kernels were often picked out and discarded. After about 10 years, the program was terminated. By that time, infantile beriberi no longer existed.

Today, an estimated 37% of the population shows evidence of iron deficiency anemia, and efforts are underway to develop a fortification system. Experience from the earlier rice enrichment program indicated that several issues need to be addressed. Among them are: selecting the proper iron source, establishing contact with the large number of rice millers in the country, and obtaining a political commitment leading to legislation that requires iron fortification.

These objectives will be difficult to achieve. Therefore, instead of a universal coverage program, two targeted programs are being considered: enrichment by government-controlled rice mills that reach low-income groups, and a program of selling small packets of fortified rice to be added directly to rice cooked in the home.

A multi-sectoral program and communications effort will be required to convey the importance of this program and mobilize the political will necessary to establish and sustain it.

Egypt

Presenter: ■ Dr. Osman Galal, University of Arizona (United States)

Surveys conducted during 1978-1980 revealed that 38% of Egyptian preschool children were anemic, one-third of these being severely anemic, and that 25% of pregnant lactating women were also anemic. Recent studies showed no improvement in the situation; 48% of all two-year-olds and 35-50% of schoolchildren were found to be iron deficient. Anemia occurs early in life and lessens with age, but it has a significant impact on child health and development. The course of iron deficiency anemia is rooted in feeding practices, poor sanitation, and frequent infections. Most iron in the Egyptian diet is provided by plant sources, from which it is poorly absorbed.

A decision was made in the early 1970s to fortify bread with ferrous sulfate, even though its bioavailability in Egyptian balady bread is poor. Later iron-EDTA, which showed significantly better bioavailability, was tested. There were problems, however, in implementing such a program, which depended on the willingness of the government.

Recently, Collaborative Research Support Program studies compared risk factors for the development of iron deficiency anemia in young children from a high socioeconomic area, a poor area, and a rural area. Analysis of blood samples revealed that the onset of anemia occurred at seven to 12 months of age and that anemic children had lower weights for their age than did children without anemia. When intakes of heme iron and vitamin C were reviewed in relation to the prevalence of anemia, vitamin C intake was more predictive of iron deficiency anemia. Even though Egypt produces a significant amount of citrus fruit, it is generally not given to young children. If it is decided to fortify bread with iron, there will still be a need to look at how to reach infants one to 12 months of age because they generally are not fed bread.

The Caribbean

Presenter: ■ Dr. A. Wynante Patterson, Caribbean Food and Nutrition Institute, PAHO (Jamaica)

Iron deficiency anemia is a major problem in the Caribbean region, affecting both sexes and both rural and urban groups. The most seriously affected are young children; those least at risk are older males. The problem is largely a result of the inadequate consumption of iron-rich foods and the poor bioavailability of iron from local foods. Unfortunately, credible data on food composition do not exist, and therefore the iron content of local foods as they are commonly prepared and eaten cannot be determined.

There appears to be agreement to fortify wheat flour with a highly-available iron source. Wheat flour represents a suitable vehicle for fortification and since there is only one flour mill in the area, the fortification process can be controlled. However, wheat flour is not consumed to any significant extent by infants. In Jamaica many babies are fed corn meal as a weaning food, but it is not currently fortified with iron. Supplementation of corn meal with iron is one proposal being considered in an attempt to reach the group aged four to 12 months.

Issues to be considered in implementing an iron fortification program in the Caribbean are as follows. Selection of the food vehicle is important since it must be consumed by the public and, in particular, by the most disadvantaged groups. Fortified food must continue to be affordable by the most socioeconomically deprived groups. The iron fortificant used must be bioavailable. The fortified product should be produced by a central source to permit adequate quality-control procedures. An efficient distribution system is needed to get the food product to the public promptly while maintaining quality. It is important to monitor the process of supplying fortified food and its impact on iron deficiency anemia. Distribution of iron supplements is still necessary to reach physiologically vulnerable groups. Nutrition education is also essential to optimize the effects of the program.

Southern Africa Region

Presenter: ▪ Dr. T.N. Maletnlema, WHO, Southern African Regional Office (Zimbabwe)

It is estimated that in the southern region of Africa 50-80% of young children under the age of five and approximately 50% of all pregnant and lactating women suffer from iron deficiency anemia. The problem exists in both urban and rural areas, with the situation worsening in urban areas because of population migration.

The development of anemia in many areas of Africa is aggravated by such factors as hemorrhage due to parasites, hemolysis caused by malaria, and congenital abnormalities of red blood cells. In other situations, the body is unable to manufacture adequate numbers of red blood cells because of deficiencies of such essential nutrients as iron, folic acid, and protein. Another challenge is the high prevalence of the Acquired Immune Deficiency Syndrome (AIDS) in Africa.

Iron present in many foods is poorly bioavailable, and this factor, combined with blood loss due to the ravages of disease and parasites, is a major contributor to the extensive iron deficiency anemia found in southern Africa. In tackling the problem in areas of Africa, approaches that minimize blood loss by reducing the effect of malaria and intestinal or urinary parasites, along with providing essential nutrients through foods, have the greatest potential for success. There is some interest in germinated cereal flours that improve acceptance of weaning foods and may also improve the bioavailability of iron.

Although iron fortification of centrally processed weaning foods (using local foods plus an iron fortificant) was tried and found valuable, the program was not sustained when the subsidy for the vitamin and mineral premix was discontinued. Since lack of foreign exchange is an overriding problem, systems that can be based on locally produced or locally available materials are important.

Discussion Points

In the discussion following these reports from various countries, the question was raised, "Why hasn't fortification of foodstuffs for the control of iron deficiency anemia progressed in the less-developed countries?"

It is apparent that the problem is not lack of technology to fortify foods, though some adaption of technology may need to be made on a country-specific basis. The problem seems to be primarily a political and economic one, and these factors are frequently intertwined. The political leadership of a country needs to recognize that a serious public-health problem is created by the prevalence of iron deficiency anemia and that an important, though not the only, step toward controlling the problem can be iron fortification of a key food or foods. The concern over lack of foreign exchange for purchase of a suitable fortificant is real, but vigorous attempts must be made to deal with this concern. Reordering priorities in the use of available foreign exchange may need to be considered. If the political and policy leadership of a country is committed to developing an acceptable solution, there are no real technological problems to prevent its implementation. The problem is how to obtain this top-level commitment to initiate and sustain action that successfully addresses iron deficiency anemia in a population.

SESSIONS 8 AND 9. WORKING GROUPS TO DEVELOP AN ACTION PLAN

The final sessions of the meeting were devoted to developing a plan of action for combating iron deficiency anemia in the developing world through food fortification. The reports of the working groups were incorporated into an INACG publication, *Combating Iron Deficiency Anemia Through Food Fortification Technology: An Action Plan.*

Closing Remarks

Presenter: ■ Dr. Robert Nesheim, Meeting Rapporteur

Dr. Nesheim was asked by Dr. Kahn to give a brief summary of the main points discussed at the meeting. Dr. Nesheim presented his observations as follows:

The participants appear to agree that iron deficiency anemia is a widespread problem which has a health as well as an economic impact. We need to further quantify this impact in order to solicit the support of policy makers. The technology of food fortification exists; the key to its application on a country-specific basis lies with obtaining a long-term commitment from political leadership. This is the primary challenge in the fight against iron deficiency anemia.

There is also a role for a strong internal advocacy--first at the consumer level, and then within the scientific community. The sustainability of iron fortification programs depend initially on the consumer recognizing the benefits of fortification. This recognition will enable industry to make economically feasible products which are accepted by the consumer.

Presenter: ■ Dr. Norge Jerome, Director, Office of Nutrition, USAID

Dr. Jerome began her closing remarks by thanking all the meeting participants. She also expressed her appreciation that the focus of the meeting was not limited to discussions about the technology of food fortification, but also included an emphasis on the consumer. The issues relating to implementation and sustainability of iron fortification programs need to take into account the needs of all levels of society.

Dr. Jerome also indicated her belief that discussions surrounding the issue of iron fortification of foods would lead to a larger role for INACG, a position which would require proactive leadership and stronger support from donor agencies. These measures would move INACG into a position of high visibility in the international arena, similar to that of the International Vitamin A Consultative Group (IVACG) and the International Council for the Control of Iodine Deficiency Disorders (ICCIDD).

Acknowledgements

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Combating Iron Deficiency Anemia Through Food Fortification Technology: An Action Plan was developed with the help of the XII INACG Meeting working groups and is now available from the INACG Secretariat. The Action Plan is available for a charge of $3.50 for developed countries, and in single copies free-of-charge to representatives from developing countries. To order the Action Plan or other INACG publications, please contact:

INACG Secretariat
The Nutrition Foundation, Inc.
1126 16th Street, NW
Suite 700
Washington, DC 20036

PARTICIPANT LIST

PARTICIPANTS XII INACG MEETING
5-7 December 1990
Washington, DC

Dr. George Alleyne
Assistant Director
Pan American Health Organization
525 23rd Street, NW
Washington, DC 20037
USA
Tel: 202-861-3404
Fax: 202-223-5871

Dr. Mary Ann Anderson
Office of Health
Bureau for Science and Technology
Agency for International Development
Washington, DC 20523-1817
USA
Tel: 703-875-4663
Fax: 703-875-5490

Ms. Susan Anthony
Office of Nutrition
Bureau for Science and Technology
Agency for International Development
Department of State
SA-18, 413A
Washington, DC 20523-1808
USA
Tel: 703-875-4035
Fax: 703-875-4394

Mr. Alan Berg
Population, Health, and Nutrition
The World Bank
1818 H Street, N.W.
Washington, DC 20433
USA
Tel: 202-473-3433
Fax: 202-477-0643

Dr. Richard E. Bissell
Assistant Administrator
Bureau for Research and Development
Agency for International Development
Room 4942 NS
Washington, DC 20523-0057
USA
Tel: 202-647-1827
Fax: 202-647-3028

Ms. Helen W. Bratcher
Catholic Relief Services
209 W. Fayette Street
Baltimore, MD 21201-3403
USA
Tel: 301-625-2220
Fax: 301-685-1635

Ms. Elisabeth Campbell-Asselbergs
Consultant to Canadian International
Development Agency
CIDA (c/o Dr. Rabeneck)
Professional Services Branch, 7th Floor
200 Promenade du Portage
Hull, Quebec
CANADA K1A 0G4
Tel: 819-994-3904
Fax: 819-953-4676

Mr. Mohamed Cassam
Private Sector Development Office
Asia and Near East Bureau
Agency for International Development
Washington, DC 20520
USA
Tel: 202-647-3731
Fax: 202-647-8557

Dr. C.O. Chichester
P.O. Box 271
Wakefield, RI 02880
USA
Tel: 401-783-9593
Fax: 401-783-9775

Dr. Eunyong Chung
Office of Nutrition
Bureau for Science and Technology
Agency for International Development
Room 411 SA-18
Washington, DC 20523-1808
USA
Tel: 703-875-4118
Fax: 703-875-4394

Ms. Carolyn I. Coleman
Office of Nutrition
Bureau for Science and Technology
Agency for International Development
Room 411 SA-18
Washington, DC 20523-1808
USA
Tel: 703-875-4003
Fax: 703-875-4394

Ms. Brenda J. Colwell
Office of Nutrition
Science & Technology and Technology
Room 411 SA-18
Agency for International Development
Washington, DC 20523-1808
USA
Tel: 703-875-4030
Fax: 703-875-4394

Dr. David A. Cook
Vice President
Department of Food and Nutrition Research
Mead Johnson Research Center
2404 Lloyd Expressway
Evansville, IN 47721
USA
Tel: 812-429-7146
Fax: 812-429-7483

Dr. Omar Dary
Instituto de Nutricion de Centro America Y Panama
Calzada Roosevelt
Zona 11
Apartado 1188
Guatemala City
Guatemala, C.A.
Tel: 502-2-723762
Fax: 502-2-736529

Mr. Richard Dawson
Officer in Charge
Food Quality and Standards Service
Food Policy and Nutrition Division
Food and Agriculture Organization (FAO)
Via delle Terme di Caracalla
00100 Rome
ITALY
Tel: 39-6-57973150
Fax: 39-6-57973152

Dr. Carlos H. Daza
Coordinator
Food and Nutrition Program
Pan American Health Organization
525 Twenty-third Street, N.W.
Washington, DC 20037
USA
Tel: 202-861-4348
Fax: 202-452-9007

Dr. L. J. Filer, Jr.
University Hospitals and Clinics
The University of Iowa
Iowa City, IA 52242
USA
Tel: 319-356-2609
Fax: 319-356-8669

Dr. Claudia Fishman
Deputy Director
Nutrition Communication Project
Academy for Educational Development
1255 23rd Street, N.W.
Suite 400
Washington, DC 20037
USA
Tel: 202-862-1990
Fax: 202-862-1947

Dr. Rodolfo Florentino
Director
Food and Nutrition Research Institute
Pedro Gil Street, Manila 1000
P.O. Box EA-467, Ermita, Manila
PHILIPPINES
Tel: (63)59-49-98 or 50-30-41
Fax: (63)2-59-22-75

Dr. Leopoldo Vega Franco
Department of Epidemiologia
Facultad de Medicina
Universidad Autonoma De Mexico
Mexico City
MEXICO
Tel: 525-687-3885
Fax: 525-570-0918 c/o Nancy Gonzalez,
Procter & Gamble, Mexico

Dr. Wilma B. Freire
Consejo Nacional de Desarrollo (CONADE)
Division de Nutricion
Edificio Vivanco
Oficina 305
10 de Agosto y Arenas Esquina
Quito
ECUADOR
Tel: 593-2-564518
Fax: 593-2-563002

Dr. Osman Galal
Department of Family and Community Medicine
University of Arizona
2231 East Speedway
Tucson, Arizona 85719
USA
Tel: 602-626-7863
Fax: 602-321-7754

Dr. Phyllis Gestrin
Peace Corps
Office of Training and Program Support
1990 K Street, N.W.
Washington, DC 20528
USA
Tel: 202-606-3100
Fax: 202-606-3024

Dr. M. Martia Glass
Asia & Private Enterprise Bureau
APRE/DR/TR/HPN
SA-2, Room 50
Agency for International Development
Washington, DC 20523
USA
Tel: 202-663-2368
Fax: 202-663-2149

Ms. Sylvia Rebecca Graves
Office of Food for Peace Program Operations
Suite 400, SA-8
Department of State
Agency for International Development
Washington, DC 20523-0809
USA
Tel: 703-875-4434
Fax: 703-875-5693

Dr. Miguel Gueri
Pan American Health Organization
525 Twenty-third Street, NW
Washington, DC 20037
USA
Tel: 202-861-4349
Fax: 202-452-9007

Dr. J. Michael Gurney
Regional Nutrition Advisor
World Health Organization
Regional Office for South-east Asia
Indraprastha Estate
New Delhi 110002
INDIA
Tel: 91-11-331-7804 or 331-7823
Fax: 91-11-331-8607

Ms. Alameda E. Harper
AFRICARE
440 R Street, NW
Washington, DC 20001
USA
Tel: 202-462-3614
Fax: 202-387-1034

Dr. Gloria J. Harris
Ross Laboratories
625 Cleveland Avenue
Columbus, OH 43216
USA
Tel: 614-227-3807
Fax: 614-227-3453

Mr. Ray Hoehle
Executive Director
International Trade and Development
Education Foundation
1911 N. Ft. Meyer Drive, Suite 702
Arlington, VA 22209
USA
Tel: 703-243-1456
Fax: 703-524-4093

Dr. Richard F. Hurrell
Nestlé Research Laboratories
Vers Chez Les Blanc
CH 1000 Lausanne 26
SWITZERLAND
Tel: 41-21-785-8795
Fax: 41-21-785-8925

Dr. Fatimah Linda Collier Jackson
Departments of Anthropology and Zoology
1111 Woods Hall
University of Maryland
College Park, MD 20742
USA
Tel: 301-405-1423
Fax: 301-314-9346

Mr. Jeff Jackson
Marketing Specialist
USDA/ASCS
Commodity Management Office
P.O. Box 2415
Washington, DC 20013
USA
Tel: 202-382-9105
Fax: 202-447-2124

Dr. Robert T. Jackson
Department of Human Nutrition and
Food Systems
University of Maryland
3309 Marie Mount Hall
College Park, MD 20742
USA
Tel: 301-405-4533
Fax:

Dr. Norge W. Jerome
Director
Office of Nutrition
Bureau for Science and Technology
Agency for International Development
State Annex 18, Room 411
Washington, DC 20523-1808
USA
Tel: 703-875-4003
Fax: 703-875-4394

Dr. Guy H. Johnson
Director of Nutrition
The Pillsbury Company
330 University Avenue, S.E.
Minneapolis, MN 55414
USA
Tel: 612-330-5422
Fax: 612-330-1821

Mr. Michael Jordan
6901 Lennon Road
McLean, VA 22101
USA
Tel: 202-663-2296
Fax:

Dr. Samuel G. Kahn
Office of Nutrition
Agency for International Development
Room 413 B SA-18
Washington, DC 20523-1808
USA
Tel: 703-875-4228
Fax: 703-875-4394

Dr. Darwin Karyadi
Nutrition Research and Development Center
Ministry of Health
Jalan Semboja (Gizi), West Java
Bogor
INDONESIA
Tel: 62-251-311881
Fax: 62-251-326348

Dr. Marjorie A. Koblinsky
MotherCare
John Snow, Inc.
1100 Wilson Blvd., 9th Floor
Arlington, VA 22209
USA
Tel: 703-528-7474
Fax: 703-528-7480

Dr. Tung-Ching Lee
Department of Food Science
Center for Advanced Food Technology
Rutgers University
P.O. Box 231
New Brunswick, NJ 08903
USA
Tel: 201-932-9671
Fax: 908-932-6776

Ms. Laurie Lindsay Aomari
INACG Secretariat
The Nutrition Foundation, Inc.
1126 16th Street, N.W., Suite 700
Washington, DC 20036
USA
Tel: 202-659-9024
Fax: 202-659-3617

Dr. Nicolaas Luykx
Office of Nutrition
Bureau for Science and Technology
Agency for International Development
Room 413E SA-18
Washington, DC 20523-1808
USA
Tel: 703-875-4176
Fax: 703-875-4394

Dr. Sean R. Lynch
Chief, Hematology-Oncology Section
Medical Service (111)
Veterans Affairs Medical Center
Hampton, VA 23667
USA
Tel: 804-722-9961
Fax: 804-728-3110

Dr. T.N. Maletnlema
Secretary-General, AFRONUS
PO Box 20265
Dar es Salaam
Tanzania
Tel: 255-51-41205

Mr. Venkatesh Mannar
Consultant UNICEF/WHO
12 Lakshmana Chetty Street
T. Nagar
Madras - 600 017
INDIA
Tel: 91-44-441573
Fax: 91-11-619722 c/o UNICEF, New Delhi

Dr. Thomas J. Marchione
Bureau for Food for Peace
Agency for International Development
Room 841, Bldg. SA-8
Washington, DC 20523
USA
Tel: 703-875-4692
Fax: 703-875-5693

Dr. Judith S. McGuire
Population, Health, and Nutrition
The World Bank
1818 H Street, N.W.
Washington, DC 20433
USA
Tel: 202-473-3452
Fax: 202-477-0643

Dr. Haile Mehansho
The Procter and Gamble Co.
Miami Valley Laboratories
P.O. Box 398707
Cincinnati, OH 45239
USA
Tel: 513-245-2725
Fax: 513-245-2744

Dr. Anthony J. Meyer
AID/S&T/ED
SA-18, Room 609
Washington, DC 20523
USA
Tel: 703-875-4620
Fax: 703-875-5490

Dr. Timothy A. Morck
Nutritional Medical Affairs, R-1
Mead Johnson Research Center
2400 W. Lloyd Expressway
Evansville, IN 47721-0001
USA
Tel: 812-429-7965
Fax: 812-429-7483

Dr. Robert O. Nesheim
28009 Mesa de Tierra
Salinas, CA 93908
USA
Tel: 408-484-9296

Mr. James J. O'Connor
O'Connor-Abell, Inc.
1121 Arlington Blvd., 1014 N
Arlington, VA 22209
USA
Tel: 703-524-3953
Fax: 703-527-3498

Dr. Richard Orraca-Tetteh
University of Ghana & University of Maryland
Department of Anthropology
Woods Hall, Room 1111
University of Maryland
College Park, MD 20742
USA
Tel: 301-405-1437
Fax: 301-314-9346

Ms. Gail Ormsby
ADRA International
12501 Old Columbia Pike
Silver Spring, MD 20904
USA
Tel: 301-680-6383
Fax: 301-680-6370

Ms. Margaret Parlato
Academy for Educational Development
1255 23rd Street, N.W.
Washington, D.C. 20037
USA
Tel: 202-862-1279
Fax: 202-862-1947

Dr. A. W. Patterson
Director
Caribbean Food and Nutrition Institute
P.O. Box 140
Kingston 7
JAMAICA
Tel: 809-927-1540
Fax: 809-927-2657

Dr. George A. Purvis
Corporate Vice President
Research and Development
Gerber Products Company
445 State Street
Fremont, MI 49413
USA
Tel: 616-928-2529
Fax: 616-928-2964

Dr. Gur S. Ranhotra
Director-Nutrition Research
American Institute of Baking
1213 Bakers Way
Manhattan, KS 66502
USA
Tel: 913-537-4750
Fax: 913-537-1493

Mr. Peter Ranum
Iron Fortification Cereal Staples
ATOChem North America
Flour Service Department
P.O. Box 1048
Buffalo, NY 14240
USA
Tel: 716-877-1740
Fax: 716-877-3959

Dr. Eduardo L. Roberto
Asian Institute of Management
123 Paseo de Roxas
MCC P.O. Box 898
Makati, Metro Manila
PHILIPPINES
Tel: 63-2-874011
Fax: 63-2-817-9240

Dr. Tina Sanghvi
3406 Abingbon Street
Arlington, VA 22207
USA
Tel: 703-241-1491

Dr. Nina P. Schlossman
Education Development Center, Inc.
1250 24th Street, NW
Washington, DC 20037
USA
Tel: 202-466-0540
Fax: 202-223-4059

Dr. Loren L. Schulze
Office of Agriculture
Bureau for Science & Technology
Agency for International Development
Room 409D SA-18
Washington, DC 20523-1809
USA
Tel: 703-875-4049
Fax: 703-895-4394

Dr. Soliman Shenouda
Technical Manager
Kraft General Foods International
250 North Street, RA-6S
White Plains, NY 10625
USA
Tel: 914-335-7861
Fax: 914-335-1472

Dr. William A. Smith
Senior Vice President
Social Development
Academy for Educational Development
1255 23rd Street, N.W., Suite 400
Washington, DC 20037
USA
Tel: 202-862-1958
Fax: 202-862-1947

Dr. Charles H. Teller
The Pragma Corporation
116 East Broad Street
Falls Church, VA 22046
USA
Tel: 703-237-9303
Fax: 703-237-9326

Ms. Leola Thompson
Science & Technology/ Program Office
Room 305C SA-18
Agency for International Development
Washington, DC 20523-1808
USA
Tel:
Fax:

Dr. Aree Valyasevi
Professor and Institute Consultant
Institute of Nutrition
Mahidol University at Salaya
Nakorn Chaisri
Nakorn Pathom 73170
THAILAND
Tel: 66-2-441-9035-9
Fax: 66-2-441-9344

Dr. John E. Vanderveen
Director
Division of Nutrition, HFF 260
Food and Drug Administration
200 C Street, S.W., Room 1844
Washington, DC 20204
USA
Tel: 202-245-1064
Fax: 202-245-7494

Dr. Tomas Walter
Head, Hematology Unit
Instituto de Nutricion y Tecnologia
de los Alimentos (INTA)
Universidad de Chile
Casilla 15138
Santiago 11
CHILE
Tel: 56-2-221-4105
Fax: 56-2-221-4030

Mr. John J. Watson
Watson Foods Company, Inc.
301 Heffernan Drive
West Haven, CT 06516
USA
Tel: 203-932-3000
Fax: 203-932-8266

Dr. Paul Whittaker
Food and Drug Administration
200 C Street, S.W., Room HFF:268
Washington, DC 20204
USA
Tel: 202-245-3367
Fax: 202-426-1658

Ms. Kathryn L. Wiemer
General Mills, Inc.
Number One General Mills Boulevard
P.O. Box 1113
Minneapolis, MN 55440
USA
Tel: 612-540-4647
Fax: 612-540-4925

Mr. Ronnie Wilson
Marketing Specialist
USDA/ASCS
Commodity Management Office
P.O. Box 2415
Washington, DC 20013
USA
Tel: 202-382-9105
Fax: 202-447-2124

Dr. Ray Yip
Centers for Disease Control
MS A-41
Atlanta, GA 30333
USA
Tel: 404-639-3137
Fax: 404-639-3665

PROGRAM

XII INACG Meeting
Combating Iron Deficiency Anemia Through Food Fortification Technology

Washington, D.C.
5-7 December 1990

Program

Wednesday, 5 December (0730-1700)

0730 **Registration**

0830 *Opening Session*

0830 **Welcome**
Dr. Samuel G. Kahn, Senior Nutrition Advisor, Office of Nutrition, Bureau for Science and Technology, Agency for International Development, Washington, DC, USA

0835 **Introductory Remarks**
Dr. Norge W. Jerome, Director, Office of Nutrition, Bureau for Science and Technology, Agency for International Development, Washington, DC, USA

0845 **Opening Remarks**
Dr. Richard E. Bissel, Assistant Administrator, Bureau for Science and Technology, Agency for International Development, Washington, DC, USA

0900 *Session 1: Current Operational Iron Fortification Systems: Case Studies*

Chairperson: Dr. George Purvis, Gerber Products Company, Fremont, Michigan, USA

0900 **Wheat Flour and Cereal-Based Foods**
Mr. Peter Ranum, ATOChem North America, Buffalo, New York, USA

0930 **Infant Cereal Products**
Dr. George Purvis, Gerber Products Company, Fremont, Michigan, USA

1000 **Infant Formula and Milk Products**
Dr. David Cook, Mead Johnson Research Center, Evansville, Indiana, USA

1030 **Break**

1050 ***Session 2: Experimental Iron Fortification Systems***

Chairperson: Dr. A. Wynante Patterson, Director, Caribbean Food and Nutrition Institute, PAHO, Kingston, Jamaica

1050 **Condiment Fortification**
Dr. Sean Lynch, Veterans Affairs Medical Center, Hampton, Virginia, USA

1120 **Salt Fortification**
Mr. Venkatesh Mannar, Consultant, Madras, India

1150 **Rice Fortification**
Dr. Rodolfo Florentino, Director, Food and Nutrition Research Institute, Manila, Philippines

1230 **Lunch**

1400 ***Session 3: Safety and Other Considerations***

Chairperson: Dr. Wilma Freire, Consejo Nacional de Desarrollo (CONADE), Quito, Ecuador

1400 **Safety**
Dr. John E. Vanderveen, U.S. Food and Drug Administration, Washington, DC, USA

1415 ***Codex Alimentarius*: Current Status of Sodium Iron EDTA**
Mr. Richard Dawson, Food Quality and Standards Service, FAO, Rome, Italy

1430 **Food Iron Inhibitors**
Dr. Richard Hurrell, Nestlé Research Laboratories, Lausanne, Switzerland

1500 ***Session 4: Chile: A Case Study***

Dr. Tomas Walter, Instituto de Nutricion y Tecnologia de los Alimentos (INTA), Universidad de Chile, Santiago, Chile

1530 **Break**

1550 ***Session 5: Iron Fortification Cost Issues (Panel)***

Chairperson: Dr. T.N. Maletnlema, WHO, Zimbabwe

Panelists
Dr. Darwin Karyadi, Nutrition Research and Development Centre, Indonesia
Dr. Judith McGuire, The World Bank
Dr. Soliman Shenouda, Kraft General Foods International
Mr. John J. Watson, Watson Foods Company, Inc.

1630 **Discussion**

1700 **Adjournment**

Evening Reception (1800-2000)
The Conference Center, One Washington Circle Hotel, Washington, DC

Thursday, 6 December (0900-1600)

0900 ***Session 6: Marketing Issues (Panel)***

Chairperson: Dr. Anthony Meyer, Office of Education, Agency for International Development, Washington, DC, USA

Panelists
Dr. Wilma Freire, CONADE
Dr. J. Michael Gurney, WHO, Regional Office for Southeast Asia
Dr. William Smith, Academy for Educational Development
Ms. Kathryn L. Wiemer, General Mills, Inc.

0945 **Discussion**

1020 **Break**

1040 ***Session 7: Issues in Implementing Country Programs: Country Experiences***

Chairperson: Dr. Carlos Daza, Pan American Health Organization, Washington, DC, USA

Panelists

Philippines
Dr. Rodolfo Florentino, Director, Food and Nutrition Research Institute, Manila, Philippines

Egypt
Dr. Osman Galal, University of Arizona, Tucson, Arizona, USA

Caribbean
Dr. A. Wynante Patterson, Director, Caribbean Food and Nutrition Institute, PAHO, Kingston, Jamaica

Southern Africa Region
Dr. T.N. Maletnlema, WHO, Southern African Regional Office, Harare, Zimbabwe

1110 **Discussion**

1140 ***Session 8: Working Groups***

1140 **Introduction to Working Groups**
Dr. Timothy A. Morck, The Nutrition Foundation, Inc., Washington, DC, USA

1200 **Lunch**

1330 **Working Groups**

Working as teams, participants will develop action plans for different iron fortification systems. Maps of appropriate paths for each of the three partners--governments, industry, and donors--will be developed for establishing national programs. (Please refer to the list in your meeting packet to determine your assigned group.)

Friday, 7 December (0900-1200)

0900 ***Session 9: Plenary Session: Integration of Group Action Plans***

Chairperson: Dr. Aree Valyasevi, Institute of Nutrition, Mahidol University at Salaya, Thailand

0900 **Working Group Presentations and Discussion**

1030 **Break**

1045 **Synthesis and Consensus Building**
Dr. Aree Valyasevi

1100 **Final Product: Action Plan for Iron Fortification Systems**

1145 **Closing Remarks**
Dr. Samuel G. Kahn
Dr. Robert Nesheim, XII INACG Meeting Rapporteur
Dr. Norge W. Jerome

XII INACG Meeting
5-7 May 1990
Washington, DC

ABSTRACTS

Current Operational Iron Fortification Systems: Case Studies
Wheat Flour and Cereal-Based Foods

Peter M. Ranum
Atochem, Inc.

ABSTRACT OF TALK

The technology for adding iron to milled cereal products (wheat flour, maize, and rice) is well established. It has been practiced routinely in many of the developed countries (UK, Canada, USA) since the 1940s. Why then has it not been used more in the developing countries where the need for additional dietary iron is much greater? One reason is that cereal mills do not perceive iron fortification as being worth the expense, small though it may be. They either must be required to fortify, as is the case in most countries where it is practiced, or they must be fully reimbursed on the cost of doing it. At the same time they must be convinced that it is worth doing.

IRON FORTIFICATION OF CONDIMENTS AND SUGAR

SEAN R. LYNCH, M.D.
Professor of Medicine
Eastern Virginia Medical School

Successful field trials have demonstrated the potential value of condiments and sugar as vehicles for dietary iron fortification. The first was carried out in Thailand using fish sauce, a salt extract of marine fish.(1) Several iron compounds considered as possible fortificants caused precipitation when added to the fish sauce but NaFe(111)EDTA was undetectable at a concentration of 1mg Fe per ml. Radioisotopic studies demonstrated a mean absorption of 8% for meals containing fortified sauce indicating that the average daily fish consumption of 10-15 ml could provide an additional 0.8 to 1.2 mg of absorbed iron. Based on these preliminary observations, a field trial involving two villages and approximately 880 individuals was undertaken. The population of one village acted as the control while the other village was supplied with fortified fish sauce. The analysis of the impact of iron fortification on iron status was based solely on the change in hematocrit value after a one year fortification period. A statistically and clinically significant response of approximately 4.5 hematocrit units occurred in 25-35% of the supplemented subjects.

Fish based condiments have also been proposed as possible fortificant vehicles in the Philippines. Chinese soy sauce is another condiment vehicle being studied. Iron as ferrous sulphate may be added to soy sauce without changing its organoleptic properties. Radioisotopic studies have demonstrated satisfactory bioavailability.

The feasibility of fortifying sugar with one of several iron compounds has been established. Percentage iron absorption depends on the food or drink to which the sugar is added.[2-5] Iron is particularly well absorbed from fortified sugar added to citrus drinks or bottled beverages. Sugar is an attractive vehicle in the countries of the Caribbean and Central and South America where sugar is produced and consumed by all economic segments of the population. Preliminary information from an extensive field study using NaFe(111)EDTA fortified sugar in Guatemala suggests that it may be effective in improving iron status.[(5)]

The most enterprising experimental use of a condiment for iron fortification comes from Dr. Bothwell's group in South Africa. A unique situation exists in this country; iron deficiency in the Indian population coexists with iron overload in South African Blacks. Any benefit of fortification to the one group might be offset by the worsening of iron overload in the other. To circumvent this problem the investigators selected curry powder as the iron fortification vehicle because its consumption is wide spread and moderately constant among Indian families of low socio-economic status, while it is rarely eaten by the Black population. Preliminary radioisotopic studies demonstrated that NaFe(111)EDTA could be mixed with curry powder without affecting acceptability in terms of color, palatability, and stability. Bioavailability was satisfactory with a mean percentage iron absorption of approximately 10 (corrected to 40% reference absorption). A well designed double blind controlled fortification study using three parameters of iron status (hemoglobin, transferrin saturation and serum ferritin) and involving 264 families over a two year period was undertaken. NaFe(111)EDTA, fortified masala (a curry powder) was provided to the test families. The NaFe(111)EDTA concentration was 10mg per gram masala (1.4 mg Fe per gram) and the estimated per capita consumption of masala 5.5 gm per day. The predicted increase in available iron was therefore 0.8 mg per day. After two years there was convincing evidence of improved iron status with a reduction in the prevalence of iron deficiency anemia from 22% to 5% in women, the greatest benefit occurring in the most anemic individuals. Equally noteworthy was the absence of excessive iron accumulation in subjects who had a normal iron status at the beginning of the study.

It is evident that condiments may in certain situations provide an effective means of targeting iron fortification. One further issue deserves mention, NaFe(111)EDTA was used in all the field trials. This compound is particularly attractive for condiment fortification because its bioavailability is relatively constant and less affected by both dietary inhibitors and enhancers than most other forms of iron used for fortification.[8] The importance of this observation lies in the fact that condiments may be added to many different meals with very variable underlying effects on bioavailability.

The major hurdles to the implementation of iron fortification with NaFe(111)EDTA are cost and absence of a commercial supply of food grade material. There has also been concern about the safety of prolonged ingestion of iron EDTA because of its possible interaction with other trace metals although the widespread use of NaEDTA as an antoxidant in processed foods in the United States attests to the safety of ingesting small amounts of EDTA.

NaFe(111)EDTA is not an attractive option in the United States because EDTA consumption has been estimated to be close to the accepted daily intake of 2.5 mg per kilogram. Moreover, major advances in the control of iron deficiency have already been made in this country. However in countries where processed foods account for only a small proportion of the dietary intake NaFe(111)EDTA may be particularly applicable. NaFe(111)EDTA would provide a reliable source of bioavailable iron that would be relatively stable under most storage conditions. The total daily intake of EDTA would be far below that already consumed in the United States.

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FORTIFICATION OF SALT WITH IRON - A STATUS REPORT

By Venkatesh Mannar
Salt Consultant

ABSTRACT

Nutritional anemia often caused by iron deficiency is a continuing public health concern in developing countries. Among non-staple foods proposed for fortification with iron, salt appears promising from the point of view of coverage, uniform consumption and amenability to centralised processing. A process has been developed in India for the fortification with ferrous sulphate using sodium acid pyrophosphate as a coordinating agent and sodium acid sulphate as absorption promoter. This salt when tested in a multicentric field trial during 1978-80 showed significant impact by increasing hemoglobin levels and reducing anemia within 12-18 months. Commercialisation of the process has been slow owing to processing cost and marketing limitations. An added development in the 80s has been the major global thrust in control Iodine Deficiency Disorders through iodation of salt which is technologically simple and low cost. However, potassium iodate which is used for salt iodation is incompatible with the iron salt in an acid medium. To overcome this problem, two alternatives have been proposed: One using a stabilizer along with potassium iodate, ferrous sulphate and sodium acid pyrophosphate and the other using ferrous fumarate and potassium iodide with no stabilizers. However, several issues still need to be addressed before the large scale commercialization of iron or double fortification programs: the bio-availability of iron and iodine in the salt after prolonged storage is to be ensured; the fortified salt is to be tested for consumer acceptability and stability during storage and cooking; technology for processing and fortification of the salt needs to be refined; cost of fortification; and in developing countries the program needs to be supported with consumer education, subsidies, quality control, monitoring and evaluation.

RICE FORTIFICATION

Rodolfo F. Florentino and Regina Pedro
Food and Nutrition Research Institute
Manila, Philippines

The fortification of rice with iron can be a valuable strategy for the prevention and control of nutritional anemia in rice-eating populations. In such populations rice consumption is rather constant from day to day in each age and sex group thus permitting uniform dosing. In fact rice intake is highest in poorer segments of the population where anemia is likely to be common. The technology suitable in developing countries usually involves the coating of rice grains with suitable carriers to produce "premix rice". The premix is then mixed with ordinary rice in the proper proportion either in the mill or in the kitchen. Most iron fortificants are cheap and do not generally impart unacceptable organoleptic properties to the enriched rice.

There are, however, a number of factors that have to be considered for a successful iron fortification program. Apart from making sure that the fortificant is stable, not washable during preparation and cooking, and is bioavailable, the whole system from production, mixing in the mills, to marketing and distribution has to be carefully worked out. While legislation can force implementation in the short term, it carries many problems in the long term. The element of cost is of course most important in any system, but more so if the government is involved through subsidy schemes. Advocacy among policy makers and promotion to the general public are important for program's success, and so is monitoring compliance by rice millers.

An experiment on rice fortification with iron (and vitamin A) has been started in the Philippines where nutritional anemia is widespread. A simple technology of coating rice grains with ethyl cellulosemethyl - cellulose - chloroform - isopropyl alcohol together with ferrous sulfate has been developed, but the combination with vitamin A has given problems. After the technological problems have been solved, the intention is to conduct clinical trials among children in an orphanage followed by field trials utilizing the government's National Food Authority which exercises some functional control over a significant number of private rice millers and rice retailers scattered throughout the country. An opportunity also exists for home enrichment promoted through the on-going national nutrition program.

SAFETY IN IRON FORTIFICATION

BY

JOHN E. VANDERVEEN, PH.D. AND PAUL WHITTAKER, PH.D.

Fortification of foods with iron has been practiced in the United States and other countries for over fifty years. Through the years, there have been repeated concerns about the safety of adding iron to foods which would be consumed by all segments of the population including individuals with repleted iron stores. These concerns have been generated by the discovery of the severe consequences of both acute and/or chronic intake of excess iron. For example, records show that before the use of safety clo ures on iron supplement containers, iron toxicity was the leading cause of death from poisoning among young children. Excess iron storage was also shown to be associated with degeneration of limb joints, heart muscles, liver and kidney tissue. In addition, high iron intake levels have been claimed to be associated with an increased incidence of infection. Some clinicians have hypothesized that iron fortification would lead to the early onset of iron storage disease in homozygous hemochromatotic individuals and may also be a risk for heterozygous individuals. Careful evaluation of national survey data collected in the United States shows that fortification of basic food staples with iron has been both safe and effective in maintaining iron stores. These data demonstrate that only three segments of the population, women of child-bearing age, preschool children and rapidly growing teenage males, show evidence of reduced iron stores. Although the incidence of the defective gene for idiopathic hemochromatosis is 5-6% in the United States population with a disease frequency of approximately 3 in 1,000, there is no data to indicate such numbers are increasing or manifestation occurs at an increasingly younger age. Data on the incidence of infectious diseases, claimed to be associated with high iron intake, remains static and do not indicate that present fortification levels increase infection.

Considerable attention has been devoted to the safety and effectiveness of iron sources used in fortification, such as elemental iron and several iron compounds containing anions commonly found in food or approved for food use by international standard setting organizations. These iron forms have been shown to be safe when used in amounts consistent with standard fortification practices. However, the effectiveness and function of these iron sources vary widely and must be selected specifically for each application.

FOOD IRON INHIBITORS

by Dr. R.F. Hurrell
Nestlé Research Laboratories

Non-heme iron absorption is strongly influenced by the composition of the diet. Some foods such as cereals, soy, cow's milk and tea inhibit iron absorption, whereas others such as fruits, some vegetables, and meat enhance it. The food components responsible for the inhibitory effect of cereals are thought to be phytate, dietary fibre, polyphenol and saponins. Phytate and protein have been suggested for soy; calcium, phosphorus and protein for cow's milk; and polyphenols for tea.

The foods most commonly fortified with iron are cereals, legumes and milk-based products, and they are often consumed with polyphenol-containing beverages. In this short review I shall demonstrate the strong inhibitory nature of the polyphenol-containing beverages such as tea, coffee, cocoa, a selection of herb teas, and wine, on iron absorption from an iron fortified bread meal. I shall demonstrate that phytic acid is the major inhibitory factor in cereals and propose that the inhibitory nature of soy on iron absorption is due to a complex formation in the duodenum between soy peptides, phytic acid and minerals including iron.

COMBATING IRON DEFICIENCY: CHILE: A CASE STUDY

INACG '90

Tomas Walter, MD

During nearly two decades, the Institute of Nutrition and Food Technology (INTA) of the University of Chile has contributed to the solution of the nutritional problems of the people of Chile. It is remarkable, however, that even though the economical indices of the country have shown little or no progress, the indices that reflect the nutritional condition of the population have had improvements that place Chile par to countries of much greater wealth.

One of the reasons of this apparent paradox is that Chile has had the virtue of placing science at the service of its people. The scientific programs formulated at INTA have been instrumental to effect this change. Scientific research should permeate into industry to allow innovation in the development of products that solve nutritional needs of developing countries while still compatible with corporate goals of market and profit. While Industry may couple with science in such ventures, non-profit granting agencies must focus on endeavors that do not offer prospect for reward to private firms but are still universally desired: public health, preventive medicine, nutritional surveys, etc.

It is the goal of this meeting to bring these three complementary conceptions of man to interplay in order to promote their mutual better understanding and focus their goals on the same target.

The Chilean Case study may serve as an example of the accomplishments and pitfalls of such interplay.

In order to better understand and correctly interpret the Chilean Case study I will set the scene:

Chile is 2600 miles long, situated on the southwestern coast of South America, between the Andes and the Pacific Ocean. It is inhabited by 12,000,000 people, mostly of white-Spanish origin with about 30% mestizo admixture. Literacy is almost universal (95%) and over 80% of the population resides in urban regions. Since 1952 there has been a centralized, government funded National Health System (NHS), that has constructed a network of clinics and hospitals that span the whole nation, giving coverage to 75-80% of the population. The system provides efficient primary care, including well child care, immunizations, and anticipatory guidance that is linked to the National Supplementary Food Program (NSFP), providing targeted nutritional support to pregnant women, infants, and children. The NSFP is obligatory and enforced nationwide. In fact, its linkage to the NHS has provided great prestige to the system. The latest boost to its prestige was given in the early 1970s, when the milk that was provided free became also available on the supermarket shelf. Before, milk of identical constitution given in unlabeled bags was thought to be of poorer quality and was used even to chalk the limits of soccer fields.

Additionally, the Ministry of Education administrates the National Preschool and School lunch and snack program, which provides daily meals to over one million children nationwide.

These programs have very likely contributed to the decrease of infant mortality and malnutrition, due to their well planned calorie-protein content, however, they have had little or no impact in decreasing iron deficiency, that is now by a large margin, the most common nutrient deficiency in Chile.

The scientific design of INTA's iron nutrition research program began with an accurate description of the nutritional status. Once this was performed, the most affected groups were defined for targeted programs. Targeted intervention helps orient limited resources towards areas and population groups where they will be most efficient and thus, have the greater overall impact.

The extent of iron deficiency anemia (IDA) was first measured in a nationwide survey. This survey showed that infants, preschool, and school age children were the most affected groups followed closely by women in childbearing age.

Food and dietary habits were thoroughly studied, leading to the choice milk and weaning cereals as vehicles of iron fortification for infants. The fortificant chosen to be added to milk was ferrous sulfate. The initial field trials of a low fat milk with 15 mg of $FeSO_4$/lt demonstrated a reduction of iron deficiency from 27 to 10% after its consistent use from 3 to 15 months of age. Even though this reduction was significant, it was not considered satisfactory. This turned out to be due to the low bioavailability - the addition of ascorbic acid - and to reduce intrafamilial dilution - acidification, were employed and the field trial that followed resulted in virtual eradication of iron deficiency anemia in the infants consuming it. Now that the biologic efficacy was well proven in a tightly controlled field trial, the benefit of this product needed a test under the usual operating conditions of the National Supplementary Food Program. This full fat, fortified and acidified milk was given to the infants born in two consecutive months and its effect was compared to those infants given the normal unfortified milk who were born in the prior two months. Mothers could elect freely to return to the "original" milk upon request. The biologic effect, tested in a subsample of the infants from each group showed a marked reduction of IDA in the fortified group, understandably less perfect than during the field trial.

Now that the benefit of the product in eradicating anemia and the feasibility of its use under the operating conditions of the NSFP was proven. Why was it not implemented?

- The government has concerns that this milk - not palatable for consumption by adults or other members of the family would become unpopular, and that the prestige of the health program for women and infants would deteriorate in its wide coverage and efficiency. (The milk is given out only after the child is brought to the health center for well child care, anthropometry and immunizations). The potential weakening of this link was the political reason.

- The commercial reason was that not all the milk manufacturers in Chile had the infrastructure to perform milk acidification and the tin can packaging. Thus, they could not compete in the bids to supply the NSFP.

  The economic reason: Additionally, the acidification process and the need to package in tin cans (as opposed to polyethylene bags) increased slightly - but significantly the cost of the program, which would have been implemented during the 1982 economic recession.

An effort to circumvent some of these inconveniences was followed by studying a similar milk product that was not acidified, with results that were similar to the acidified product: eradication of anemia. However, the fact that this milk is non-palatable for adults indicates that a particular effort must be made in order not to jeopardize the prestige of the health clinic, either by a strong educational program or the provision of this product in addition to the products that are now provided.

Thus, to date, infants in Chile do not receive the benefit of what science has proven to be effective and food technology provided to be feasible. It is perhaps the turn of a large non-profit funding agency to intervene in order to implement this program. To avoid in the future these apparently unsurmountable problems; we now know, it is necessary to include in the initial planning of a nutritional program not only the most urgent needs - which were then protein - caloric requirements, but to add those that eventually may become a problem difficult to implement later - in this case, iron.

Breast fed babies, among other blessings of breast milk, are partially protected from iron deficiency at least until 4-6 months of life. Breast feeding has been strongly stimulated by the health clinics.

Because the efforts to prolong breast feeding must be coupled with the development of a weaning food that would provide the additional nutrients that are required after six months of age on breast milk, calories and iron, at INTA, we developed an extruded rice cereal that provided the iron in the form of bovine hemoglobin. The preparation of a gruel to be spoon-fed would additionally avoid competition with sucking and permit the successful continuation of breast feeding.

A field trial of the heme fortified cereal in exclusively breast fed infants (this meaning milk exclusively from the breast but allowing other solids) showed that the cereal was a good source of iron and that the incidence of anemia was greatly reduced in the fortified infants, even though the efficacy of this reduction was lower than that of fortified milk. This is likely due to the fact that milk is consumed in large and constant amounts and begun earlier in life, whereas the amount of cereal only reached significant quantities by 6-8 months of age and is consumed in variable amounts day to day.

Science and food technology have thus shown that the eradication of iron deficiency in infancy is feasible and efficacious. Industry should take these facts - as many may already have - in the developed world, however, how may they to be made extensive to the poorer countries to allow for the eradication of IDA there? Perhaps, it should be the task of non-profit agencies? This workshop will - I'm sure - address these issues.

The next most affected group with IDA throughout the world are preschool children (6-18 yrs.). Through the school lunch program, that provided a snack consisting of a glass of milk or milk substitute plus three 10g wheat cookies, a program was devised substituting these cookies with bovine hemoglobin fortified cookies. After a short field trial in schools in Santiago, the Ministry of Education was very receptive and, surprisingly, immediately implemented this program nationwide, with the exception of one province, to our suggestion, left as control. Why was this ministry so receptive and eager to implement this program, that had hardly been proven to be efficacious? (Ways to approach government agencies need to be discussed). Is there competition of merits when the health ministry is approached with a plan devised by the University? Why was this not the case with the Education Board?

After four years the program was evaluated by comparing the iron status of 500 school children from the non-fortified province of Linares and 500 children from the contiguous northern limiting province of Curico, which had received BHC fortified cookies. The impact of the program on hemoglobin levels and iron stores was statistically significant, however, these children had no anemia, including those of the non-fortified province. Thus, even though an improvement in iron status of this population was demonstrable, the prevalence of anemia was so meaningless that the additional expense was considered with a low cost/benefit ratio and the program was reduced to only one province.

What had exerted this change in nutritional status of school children over the 15 years since the national survey that showed 6% prevalence of anemia?

Our hypothesis is that bread consumption which is highly prevalent in the Chilean population starting at a very early age and reaching high quantities is probably the cause of this change.

The legislation to enrich flour with iron and riboflavin, niacin, and pirydoxine was passed in the 1950s, however, it was not strictly followed for quite some time. The exact date when it began to be enforced is not available, nor we had access to the data of the quality control. The mills were not agreeable to provide their products for our testing so we chose to go to the source. Of the 1500 bakeries in Santiago, we randomly sampled 400, taking bread off the shelf. The assays showed that at least 60% of the bread had the recommended 3g of $FeSO_4$/kg flour. The absorption of this ferrous sulfate was excellent (10%), and an estimate of the iron absorbed from the amount of bread consumed by the average Chilean school age population accounts for the virtual absence of anemia.

In summary, during these years of research at INTA we have been able to move from the benchtop to nationwide programs with varying degrees of success. The source of failures, however, is not the lack of scientific rigorousness, but the inability to convey the significance of these findings to governments, agencies, industry, and other levels of decision. May this gathering enlighten our abilities to construct a real "success story".

This document summarizes studies done in the Hematology Unit by Abraham Stekel, Eva Hertrampf, Manuel Olivares, and Fernando Pizarro.

IRON FORTIFICATION COST ISSUES

by Darwin Karyadi

Abstract

Nutritional Anemia due to iron deficiency remains a public health problem in Indonesia with a prevalence among several population groups were found between 20-60% especially among the pregnant women, preschool and school children. Therefore, it has been stated in the State-Guideline 1988 in view of the adverse effects of functional consequences, an immediate measures beside iron-supplementation through the existing primary health delivery system, fortification of food with iron are justified. Salt and noodles are likely to be suitable vehicles. In this communication will be hightlighted issues regarding cost relevant to centralized and decentralized processing, distribution problems, quality assurance as case studies in Indonesia.

Food Behavior, Population Acceptance, Pricing and Marketing Strategies, and National Policy and Their Effect on the Possibilities for Iron Fortification in Ecuador

Wilma B. Freire

According to recent studies, iron deficiency anemia is highly prevalent in Ecuador. 60 percent of pregnant women suffer from iron deficiency anemia after the third month of pregnancy, while 70 percent of children between 6 and 11 months of age--and 45 percent of children between 12 and 23 months of age--are anemic.

This situation clearly requires priority action. One of the interventions under discussion is iron fortification because if the vehicle used is consumed nation-wide and on a massive scale, iron availability can be enhanced. Nevertheless, before such a policy can be adopted, several issues must be addressed.

There are three likely alternatives for iron fortification in Ecuador: wheat flour, salt, and sugar. While there are clear differences in consumption patterns, all three are widely consumed throughout Ecuador by all social classes.

After rice and corn, **wheat** is the most important cereal in the Ecuadorian diet, is most frequently consumed in the form of bread and noodles, and is considered a prestige food item. One of the potential advantages associated with using wheat flour is that practically all wheat processing is concentrated in ten mills, which means that controlling the iron fortification process would be relatively simple and efficient. Nevertheless, wheat may not be the best available option for fortification because even though it is widely available, average consumption in rural areas is less than in urban areas, where the prevalence of iron deficiency is much higher. In addition, 98 percent of wheat that is consumed is imported, so that a program that calls for increased consumption could have a deleterious effect on the country's balance of payments.

Ecuador produces all the **sugar** that is consumed in the country. Its use is diffused throughout the population and its cost is relatively low. Like wheat, sugar is processed in a limited number of establishments, so that its fortification could be closely monitored.

Salt is another possible vehicle for iron fortification. It is also processed in a limited number of establishments, and is widely consumed by all sectors of the population. Salt is currently used for iodine fortification, so that the use of processed salt has received a great deal of promotion through official channels under a national program to reduce problems related to iodine deficiency. If salt is also to be iron fortified, technical questions related to simultaneous fortification with two micronutrients have to be addressed.

In addition to the relative merits of the three potential vehicles for iron fortification, we must consider the presence of substances that inhibit or enhance iron absorption. A future decision on iron fortification must also take into account patterns of food consumption and preparation, intrafamiliar food distribution, and the socioeconomic characteristics of consumers.

In conclusion, iron fortification is a promising intervention for mid- and long-term improvement in the iron status of the Ecuadorian population. At least three food items are available and suitable for fortification. The decision to enter into a wide-scale program of fortification must be accompanied by the availability of additional information on the relative advantages of the alternative vehicles.

Don't Forget the Consumer

It's clear when we introduced new and strange foods that consumer preference makes a difference. But what about iron fortification where most consumers may not even notice a change has been made. Why invest in consumer research at all? The answer is threefold. First, iron fortification may change some foods--the case of rice, for example. Understanding how consumers perceive these changes and identify ways to help people accept them is fundamental. Secondly, even if the changes are not immediately detectable--there may be unpredictable consumer resistance which only consumer research will uncover. Finally, there may be consumer benefit--again unexpected areas that research can identify and then build into program to promote even wider use of fortified products. This presentation will look at ways to do practice food preference research in developing countries.

William A. Smith, Ed.D.
Executive Vice President and
Director, Social Development
Programs, Academy for
Educational Development

RICE FORTIFICATION IN THE PHILIPPINES

Rodolfo F. Florentino and Ma. Regina A. Pedro
Food and Nutrition Research Institute
Manila, Philippines

The Philippine experience on a national rice enrichment program started in the early fifties arising out of an experiment on the effectiveness of enriched rice in controlling beriberi (and incidentally anemia) which was at that time a major cause of infant mortality in the country. The experiment was conducted in the whole province of Bataan where the seven municipalities of the eastern coast (experimental) received enriched rice - a mixture of premix rice (rice coated with thiamine, niacin and iron) and ordinary rice - while the other five municipalities of the same province served as the control. Iron pyrophosphate was the iron fortificant used. After nine months of the experiment, the experimental area showed a marked reduction in morbidity and mortality from beriberi but the effect on anemia prevalence was not mentioned in literature.

As an offshoot of the experiment, a Rice Enrichment Law was enacted which provided that all rice millers in the country enrich all the rice they mill with premix rice 2 mg B_1, 16 mg niacin and 13 mg ferric pyrophosphate per pound at a proportion of 1:200. The program was carried out in the early years of the 1950's during which the incidence of beriberi drastically diminished.

The practice of rice enrichment in the rice mills eventually died down because of many problems. Enforcement of the law was difficult and costly, necessitating the employment of monitors from the Department of Health to inspect rice sold in retail shops. The millers circumvented the law as much as possible because of its connection with taxation. The public did not quite accept the enriched rice because of the discolored premix grains so that many picked them out before cooking.

It is concluded that rice fortification may be a valuable strategy for the control of nutritional anemia for as long as the necessary conditions are met - the right form of iron fortificant which is bioavailable and does not color the rice grains; a program which requires a minimum of cost and overt enforcement; and a strong program of advocacy and promotion.

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ISSUES IN IMPLEMENTING COUNTRY PROGRAMS: COUNTRY EXPERIENCES*

by

A. WYNANTE PATTERSON

Iron deficiency anaemia is a public health problem in the Caribbean.

The major aetiological factor is an inadequate consumption of foods rich in bioavailable iron.

A three-pronged approach is recommended - (1) an iron fortification program, (2) upgrading of iron supplementation programs to physiologically vulnerable groups, and (3) a credible nutrition education program.

With reference to the first; i.e. iron fortification, the major issues are presented.

In the Commonwealth Caribbean, there appears to be consensus for the fortification of wheat flour with a highly bioavailable iron. The absence of credible food consumption data, or of knowledge of, the iron content of meals as commonly eaten represents a deficiency in the information which needs to be corrected in order to vitalize the implementation of the decision, and to optimize the effectiveness of the program.

***Abstract of Paper prepared for X11 INACG Meeting, 5-7 December 1990.**

INACG MEETING, WASHINGTON

5 - 7 DECEMBER, 1990

by T. N. Maletnlema

ABSTRACT

Anaemia affects people in all countries of Africa. Underfives children and mothers are worst hit with prevalences of 50-80% and 30-50% respectively.

Causes of Anaemia

i) Haemorrhage due to parasites:

- hookworm, Ancylostoma duodenale
- schistosoma, S.mansoni and S.haematobium
- other causes of bleeding

ii) Haemolysis caused by - malaria attacks
- congenital red cells abnormality

iii) Failure of the body to manufacture red cells

- deficiency of essential nutrients particularly iron, folic acid and proteins.
- other factors especially chronic diseases like AIDS.

Control Measures

These have to consider the causes and feasibility in Africa.

1. Minimize blood loss by tackling malaria and the intestinal/ urinary parasites.
2. Provide essential nutrients through local foods or other acceptable and widespread methods. Research into Africa foods like the germinated cereals flour which improves iron bioavailability.

Fortification with iron is possible through:

a) Staple cereals - ? distribution.
b) Common salt, possibly combined with iodine?
c) Special multimix concentrate for home use.

(This is an area of a lot of research, e.g. LIKUNI PALA (Malawi), NUTRESCO (Zimbabwe) and LISHA (Tanzania) fortification.)

INACG PUBLICATIONS

The following monographs are published by the International Nutritional Anemia Consultative Group:

- *Guidelines for the Control of Iron Deficiency Anemia* (1977)
- *Iron Deficiency in Infancy and Childhood* (1979)
  (Available in English, French and Spanish)
- *Iron Deficiency in Women* (1981) (Available in English, French and Spanish)
- *Iron Deficiency and Work Performance* (1987)
- *Design and Analysis of Iron Supplementation Trials* (1984)
- *Measurements of Iron Status* (1985)
- *Combating Iron Deficiency in Chile: A Case Study* (1986)
  (Available in English, French and Spanish)
- *Guidelines for the Control of Maternal Nutritional Anemia* (1989)
  (Available in English, French and Spanish)
- *Combating Iron Deficiency Anemia through Food Fortification Technology: An Action Plan* (1992)
- INACG Meeting Reports (1990, 1988, 1987)

These documents are available free of charge to developing countries and for $3.50 (U.S.) to developed countries. The meeting reports are free. Copies can be ordered from the INACG Secretariat:

INACG Secretariat
The Nutrition Foundation, Inc.
1126 Sixteenth Street
Suite 700
Washington, DC 20036