Micronutrients
and
health

Nutriview 2003/3

Contents in brief:

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Editorial:

Food fortification successful in Central America

The countries of Central America (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama) were among the early pioneers in the developing world in the use of food fortification as a public health measure to improve micronutrient status. They introduced salt iodization and flour fortification more than 50 years ago, and were the first to fortify sugar with vitamin A in the 1970's.

Salt iodization

Costa Rica and Guatemala made salt iodization mandatory in 1948 and 1954, respectively. The program had achieved an acceptable coverage in Guatemala by 1962, and the elimination of goiter was documented in 1967. Salt iodization is effectively enforced today in all countries of the region except Guatemala.

The original legislation specified addition of 60–100 mg potassium iodate to 1 kg salt. Recently, the regulation was modified to 30–60 mg/kg. This change was introduced after realizing that intakes of iodine were unnecessarily high in the population. Potassium iodate has been kept as the fortificant of choice, although sodium iodide is allowed for refined salts. While harmonization among the different countries of the region has not yet been accomplished, discussions (and legislation of the countries that have up-dated regulation about salt iodization) are following the indicated criteria.

Wheat flour fortification

Wheat flour fortification was introduced in the period 1948–60, with legislative support in all countries of the region except Nicaragua (where flour fortification became mandatory in 1998). The original legislation observed the principles of restoration adopted in the USA and Canada, using elemental iron as the source of iron (Table 1). In 1992, the Institute of Nutrition of Central America and Panama (INCAP) in Guatemala recommended to raise the level of iron, and to use ferrous sulfate instead of elemental iron to improve iron bioavailability. In practice, countries often continued to use elemental iron of the atomized type (identified as reduced iron), because, at the requested iron levels, ferrous sulfate caused discoloration, and spoiled bread made with the fortified flour. Starting 1992, Guatemala and El Salvador also added folic acid (in restoration amounts), and eliminated calcium (Table 1).

Continuing our reflections on progress made in the use of food fortification over the 10 years since the first issue of Nutriview, we asked Dr Omar Dary for a summary of how food fortification programs have evolved in the countries of Central America during this period. As Head of the Laboratories of Nutritional Biochemistry and Food Composition in the Institute of Nutrition of Central America and Panama (INCAP) from 1990 to 2002, Dr Dary was involved in the food fortification programs of all the Central American countries. He is currently the Food Fortification Advisor for MOST, the USAID micronutrient program, in Washington, DC.

After conducting technological studies to find an iron formulation suited to the weather conditions and wheat flour use in Central America, INCAP suggested to use ferrous fumarate. This has two main advantages: ferrous fumarate is more bioavailable than reduced iron, and it can easily be distinguished from elemental iron (important for enforcement purposes). Levels of folic acid were also raised in response to the finding that this nutrient can prevent neural tube defects in folate-deficient populations. In 2002, the countries agreed on a harmonized and common regulation, which was the first regional legal accord in the field of food fortification. This measure was taken in order to facilitate trade of wheat flour among the countries of the region. To ensure the correct application of fortification, this regulation only specifies final minimum levels for nutrients, and it takes into account the natural nutrient content of the 70%-extraction flour (Table 1). Maximum tolerable levels are not mentioned, because if the flour contained large amounts of micronutrients, especially iron, its physical properties would change.

Sugar fortification

Costa Rica, Guatemala, Honduras and Panama enacted laws and regulations for addition of vitamin A to sugar 1974–76. Currently, El Salvador, Guatemala, Honduras and Nicaragua fortify sugar; Costa Rica has plans to reactivate its program. Panama considers that vitamin A deficiency is no longer a public health problem, and has discontinued sugar fortification.

Original levels of vitamin A, using gelatin-based microencapsulates of retinyl-palmitate (CWS-250 Roche or CWD-250 BASF), were established at 13.5–16.5 mg/kg sugar. In 1992, after recognizing that variability in the fortification process (around 20-30%) made this requirement unrealistic, the range was changed to 10–20 mg/kg. But even this range did not fit the real performance of the program. We found that, under very humid and warm conditions,

Table 1: Evolution in Central America of micronutrient levels (mg/kg) in fortified wheat flour

Nutrient	1948-60	1993-2002	2002 final minimum
Thiamin	4.4 – 5.5	4.4 – 5.5	6.2
Riboflavin	2.5 – 3.3	2.5 – 3.5	4.2
Niacin	35.2 – 44.0	35.0 – 40.0	55.0
Folic acid	0.0	0.35 – 0.45	1.8
Iron	28.7 – 36.6	55.0 – 65.0[1]	55.0[2]
Calcium	1100.0 – 1375.0	0.0	0.0

[1] From ferrous sulfate. Atomized iron (identified as reduced iron) was also used.

[2] 45.0 mg from ferrous fumarate.

up to 50% of the added vitamin A was lost within 6 months. Furthermore, we saw that people consumed more sugar than expected, which allowed the use of lower vitamin A levels. Thus, the most recent recommendation is to fix a minimum level of 5 mg/kg at retail stores, and a maximum tolerable level of 25 mg/kg at any time. Nevertheless, national regulations are still in process of adjustment, and a regional accord with common bases is still lacking. In Panama, regulation of sugar fortification was never implemented, and probably never will be, as long as vitamin A deficiency there is under control.

Table 2: Performance of food fortification programs in Central America.
Percent of samples that fulfilled the criteria (salt: >15 mg iodine/kg; wheat flour: >60 mg iron/kg; sugar: >3.5 mg vitamin A/kg) at the household level in 2001.

Country	Salt	Wheat flour	Sugar
Guatemala	36	81	77
El Salvador	76	81	94
Honduras	98	72	60
Nicaragua	98	81	35
Costa Rica	100	[?]	NA
Panama	100	[?]	NA

[?]: No information available for 2001; earlier data suggest situation is similar to other countries.
NA: Not applicable.

Monitoring and evaluation

Realizing, in the 1990's, that enforcement, supervision and surveillance were not permanent components of the food fortification programs, the Central American countries designed, tested and adjusted a monitoring system (with technical assistance of INCAP and financial support from USAID, MI, and UNICEF). This comprised quality control and quality assurance at the factories, inspection and auditing by food control authorities, and household monitoring by external public institutions.

The system included definition of success criteria for the micronutrient levels in the staples at each stage. The system has worked for three years in a row, and allowed documentation of the fortification programs at the national level. The results show that, except for salt iodization in Guatemala and sugar fortification in Nicaragua, food fortification programs have been very successful in Central America. (Table 2).

Through these programs, 10 g of salt daily provides 100% of the recommended iodine intake; 60 g of wheat flour (1–2 breads) provides 30% of thiamin, 20% of riboflavin and niacin, 45% of folate and 16% of iron, while 60 g of fortified sugar provides 40% of the recommended vitamin A intake.

Plans for the future

It is anticipated that the new challenges for Central America, as a region, are the addition of fluoride to salt, the fortification of lime-treated corn flour, and the justification, design and incorporation of zinc and vitamin B_{12} into wheat and corn flours. Costa Rica, as the region's leader in the field of food fortification, already has a lot of experience in salt fluoridation (175–225 mg/kg). This formulation provides 100% of the biological needs of fluoride to prevent tooth decay.

Legislation has also been passed to fortify fluid milk with iron (5.6 mg/L), folic acid (1.6 mg/L) and vitamin A (0.7 mg/L), and to fortify rice and lime-treated corn flour with the same micronutrients as wheat flour. Corn flour has great potential to meet the micronutrient needs of the population in the northern countries of Central America. People consuming industrially-produced corn flour (around 250 g/day in 10 tortillas) would receive significant amounts of the nutritional recommendations for thiamin (85%), riboflavin (50%), niacin (70%), folate (130%) and iron (70%). – *Omar Dary, PhD*

Feature:
Fewer neural tube defects in Costa Rica following food fortification

Mandatory fortification of wheat flour and corn flour with folic acid and other micronutrients in Costa Rica has had a marked impact on public health. Within two years, prevalence of folic acid deficiency in women has decreased 87% in urban areas and 63% in rural areas. There has also been a significant reduction in the incidence of neural tube defects.

Neural tube defects (NTD) are the second cause of infant mortality in Costa Rica (Department of Statistics, National Children's Hospital). Moreover, in 1996, a national survey found a high prevalence of folic acid deficiency (25%) in women of childbearing age [1]. More women in rural areas were deficient (31%) than in cities (19–23%).

The same survey also identified vitamin A deficiency in 9% of children under 6 years, and a low consumption of vegetables and organ meats, indicating a deterioration of diet quality compared with a similar study conducted in 1982.

Food fortification directives revised

Based on this knowledge, the Ministry of Health identified actions needed to alleviate micronutrient deficiency, and included them as part of its health policies for the periods 1998–2002 and 2002–2006. Directives gave particular importance to 'food and nutritional

surveillance, including the consumption of fortified foods'. Supported by these directives, a Food and Nutrition Security Plan was elaborated, a National Commission for Micronutrients created, and its working agenda formulated. One of the main public health challenges over the past decade has been to reduce infant mortality, and, in particular, to achieve a better control of congenital malformations, including NTD.

As a first step, in 1997, the government revised the executive decree for the fortification of wheat flour, published in 1958, to include addition of folic acid (1.5 mg/kg) as well as iron and other B-complex vitamins. Two years later, it also decreed the fortification of corn flour with 1.3 mg folic acid/kg.

An encouraging impact

Two years after starting flour fortification with folic acid, the Ministry of Health, with the assistance of UNICEF and INCAP/PAHO, established two representative sites to measure the impact in rural (District of San Antonio in Nicoya) and urban (District of Damas in San Jose) areas [2]. In the year 2000, representative household surveys with measurement of plasma folate levels indicated an 87% reduction in folic acid deficiency in urban areas (19.0→2.5%), and a 63% reduction in rural areas (31.4→11.6%). At that time, food fortification provided 29% of the folic acid daily dietary recommendation (DDR).

Flour fortification had a similar positive effect on the incidence of NTD, which fell from a mean rate of 9.7/1000 live births in the period 1996–1998 to 6.3/1000 live births in the period 1999–2000 [3]. Rates diminished in all provinces except one (Table 1) and in both sexes (although the difference was significant only in females). Similarly, the National Children's Hospital, functioning as a national reference center, has reported a 74% reduction in the incidence of spina bifida, the commonest form of NTD, since 1995 (Figure 1). It also registered a similar impact on the incidence of more severe cases affecting the brain. While there were 55 cases of hydranencephaly (cranial cavity filled with water instead of a brain), five cases of encephalocele (protrusion of the brain through an opening in the skull) and one case of anencephaly (no brain) in 1995, only nine cases of hydranencephaly were registered in 2001.

In the meantime, the government has issued executive decrees to fortify other staple foods with folic acid and iron. Fortification of fluid and powder milk started in January 2002; fortification of rice was expected to begin in January 2003. If the targets are successfully accomplished, food fortification should provide 437 µg folic acid/day, which is equivalent to 109% of the DDR (Table 2). Clinicians still advocate for folic acid supplementation. However, the cost and logistical constraints make this a less attractive alternative.

We conclude that the addition of folic acid to staple foods has been the main reason for lowering the incidence and severity of NTD in Costa Rica. We still have to determine if it is necessary to support food fortification with supplementation. Another challenge is to improve the technology concerning rice fortification. – *Dr Luis Tacsan Chen, Ministry of Health, Costa Rica*

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1. Ministerio de Salud, Encuesta Nacional de Nutrición, Segundo Fascículo, 1996.
2. Ministerio de Salud et al. Desarrollo de Comunidades Centinela sobre Alimentación y Nutrición, Costa Rica, 2000.
3. INCIENSA. Centro de Registro de Enfermedades Congénitas (CREC). Prevalencia de enfermedades congénitas por provincias y cantones. Costa Rica 1987–2000.

Fig 1: Incidence of spina bifida in National Children's Hospital, Costa Rica, 1995–2001

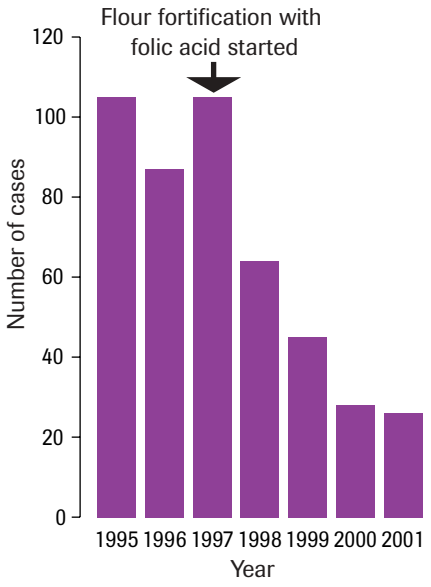

Table 1: NTD rates (cases/1000 births) in Costa Rican provinces before and after fortification

Province	1996–1998	1999–2000
San José	12.6	5.3
Alajuela	7.3	6.5
Cartago	9.3	8.6
Heredia	7.7	3.8
Guanacaste	10.5	6.6
Puntarenas	8.3	5.6
Limón	5.9	9.4
Costa Rica	9.7	6.3

Source: INCIENSA, Centro de Registro de Enfermedades Congénitas, 2002.

Table 2: Current situation of food fortification in Costa Rica

Food	Fortification level (mg/kg)	Amount consumed daily		DDR * (%)
		Fortified food (g)	Folic acid (µg)	
Wheat flour	1.8	60	108	27
Corn flour	1.8	20	36	9
Milk	0.4	220	88	22
Rice	1.8	114	205	51
Total			**437**	**109**

* Daily Dietary Recommendation
Source: Ministry of Health, Costa Rica, 2003.

Conference report:

Improving nutrition in Asia – A vision for action

The 19th Asian Congress of Nutrition, organized by the Nutrition Foundation of India, in conjunction with the Nutrition Society of India and the Federation of Asian Nutrition Societies was held in New Delhi on February 23–27, 2003. It attracted more than 1000 delegates from 41 countries (including India, Japan, China, Malaysia, UK, USA and Australia). Theme of the congress was: Nutrition Goals For Asia – Vision 2020.

Plenary sessions dealt with such issues as the changing nutrition scene in Asia, new technologies for augmenting food production and ensuring food security in the 21st century, and the effects of diet, genes and traditional foods on Asians' health. The program also included 30 Symposia (covering topics such as vitamin A deficiency, iron deficiency anemia, fatty acids and growth, nutrition in specific situations and age groups, and food fortification) as well as 111 posters and 21 free communications on a variety of topics.

Changing nutrition scene

In his keynote address, Dr C Gopalan, FRS (President, Nutrition Foundation of India) addressed a need for paradigm shift in the objectives of policy makers, who should aim at nutritional security rather than food security, at child health rather than child survival, and at teaching of skills rather than just of literacy.

Further he advised Asian countries not to make the mistake of accepting the 'western model' as perfect. Instead, the challenge for Asian countries over the next twenty years is to derive benefit from globalization and evolution in information technology to improve the nutritional status of the coming generations.

Improving food security

In the Srikantia Memorial Lecture, Dr MS Swaminathan of MS Swaminathan Research Foundation, Chennai, emphasized a variety of constituents that are important for "Ensuring Ecological, Social and Economic Access to Balanced Diets and Safe Drinking Water". He addressed several dimensions of hunger (chronic hunger, hidden hunger and transient hunger) in which girls and women suffer the most, and stressed why it is essential to initiate a gender mainstreaming of nutrition security programs. He also expressed a need for bringing about a speedy demographic transition to lower birth rates, since the capacity of the ecosystem to support current population growth is being exceeded in many places. In revealing a strategy for the elimination of hunger, Dr Swaminathan introduced a life-cycle approach to nutrition along with the appropriate intervention and nutritional safety-net programs.

VAD still a problem

In the symposium on combating vitamin A deficiency (VAD), Dr Vinodini Reddy (former Director of the National Institute of Nutrition, Hyderabad) described the changing profile of VAD in Asia. She highlighted the prevalence of VAD in Southeast Asian countries, its significance as a public health problem, and its multiple effects such as anemia, growth retardation and increased risk of infection. Considering the serious magnitude of the problem and its impact on child health and survival, she emphasized the need to intensify intervention efforts.

Dr B Sivakumar (National Institute of Nutrition, Hyderabad) provided an insight into the methods of assessing vitamin A status. He suggested that the use of the plasma retinol method alone could underestimate the vitamin A status of an individual as it does not consider the amount in the protein-bound fraction. He presented two biochemical functional tests based on increased erythrocyte oxidative stress and ammonia nitrogen excretion that were developed at his institute.

Dr Emorn Wasantwisut (Institute of Nutrition, Mahidol University, Thailand) discussed recent findings about the ability of plant foods to meet the vitamin A requirements of vulnerable groups. She pointed out that the bioefficacy of beta-carotene in mixed diets is now considered as 1:12 and that of other provitamin-A carotenoids as 1:24. To control VAD, she recommended fortification/enrichment of staple foods.

Dr Abas Jahari (University of Indonesia) discussed how to control VAD. He emphasized the need for a comprehensive approach (short, medium and long term) and for appropriate policies to improve the vitamin A status of the community. Policies should set simple and reliable indicators of mild VAD, and include multi-micronutrient interventions, long-term diet-based interventions, fortification of commonly consumed foods, fortified supplementary feeding, and vigorous nutrition education and social marketing.

Food fortification rules explained

In the food fortification symposium, Dr Florentino Solon (Manila, Philippines) explained that research should aim to find appropriate fortification vehicles and fortificants, set standard fortification levels, and determine organoleptic effects of fortificants, nutrient interactions, and stability of fortified foods under various packaging, storage, marketing and cooking conditions. Research findings should be disseminated widely and utilized to achieve successful and sustainable food fortification programs.

Dr Solon also discussed the role of quality assurance to analyse critical points and factors in production, storage, packaging, the distribution and marketing of fortified foods, the development of in-plant semiquantative assay methods for vitamin A and iron, and the importance of establishing standard fortification technology and monitoring systems at all stages of distribution.

Dr Nguyen Kim Vu talked about issues related to production, distribution and quality control of iodized salt in Vietnam. The Vietnamese government promotes the program by subsidizing the price of iodized salt. Novel techniques of food fortification such as replacement of animal fats with palm oil in meat products, and development of a double-fortified (iodine and iron) fish sauce for improving the nutritional quality of food were also discussed in this symposium.

Hopes for the future

Two innovative sessions allowed delegates to hear the viewpoints of nutrition students, and to address the subject of science and industry interaction. In the

first of these sessions, nutrition students discussed their visions for the future with eminent professors. In the second, Dr RA Mashelkar (DG, Council for Scientific and Industrial Research, Delhi) and Mr Pradeep Podder (MD, Heinz India Ltd.) presented their views on the future of the nutrition industry and the objectives of research.

The congress provided an excellent forum for lively discussions between scientists, academics, industry and NGO's from around Asia, and culminated in the formulation of recommendations concerning nutritional objectives for the entire Asian region. It showed the way for a holistic approach to eliminate the micronutrient malnutrition problem, and strengthened future directions for food fortification programs by sharing experience across nations. The congress recommended a roadmap for the future to develop a healthy Asian population free of hunger and malnutrition. – *Ninad V. Chikhalikar, Technical Promotion Manager, RSA Vitamins Private Ltd, India*

News in brief:

GAIN starts fortification funding

During the World Economic Forum's Africa Economic Summit in Durban, South Africa in June 2003, the Global Alliance for Improved Nutrition (GAIN, a coalition of public and private sector organizations) announced that South Africa, China, Morocco and Vietnam will be the first four countries to receive grants to support their fortification efforts. Other countries are expected to be added by the end of the year.

"The GAIN initiative is going to make a real difference in people's lives," said Rolf Carriere, GAIN's Executive Director. He added that GAIN's large-scale fortification approach is new because it works on fortification at the international level, gathering technology and assistance from many advanced countries, then channeling it to individual countries, giving them the funds to do what they need to do.

Each of the four countries selected presented detailed proposals to GAIN. *South Africa:*GAIN approved a $2.8 million grant to help deliver fortified foods to 45 million South African consumers in the next 6–18 months. By fortifying maize and wheat flour, the South African government and its partners in industry will provide essential micronutrients to all strata of society in urban and rural areas. The South African proposal clearly demonstrated the country's commitment to a national fortification strategy in 1997 when it created the multistakeholder National Food Fortification Task Group.
*China:*GAIN approved two separate programs for China worth $3 million each. One proposal aims to produce soy sauce fortified with iron, which would reach 360 million people by the end of the five-year program. The other proposal is to fortify flour in the western region of the country, which will reach 49 million people. The flour fortification plan builds on a successful salt iodization program in the same region.
*Morocco:*GAIN is giving a $2.8 million grant to fortify wheat flour, edible oil and milk for 23 million low-income consumers in the next 18 months. The proposal is based on work carried out by government, industry, universities and partners such as USAID/MOST, Helen Keller International and the WHO. Several companies in the country have already gone ahead with voluntary programs (fortification of vegetable oil and milk with vitamins A and D), which suggests they are strongly committed to the idea. Moroccan universities and research establishments have a strong capacity to undertake baseline and impact studies.
*Vietnam:*GAIN approved a $3 million grant to help deliver iron-fortified fish sauce to 42 million at-risk people over the next three years. Vietnam demonstrated its commitment to control iron deficiency by the adoption, in 1998, of a strategy to implement iron deficiency anemia control nationwide, and its ratification, in 2001, of a National Nutrition Strategy. The Vietnamese government also reduced tariffs on premix imports.

GAIN is already working with other countries that are keen to embark on large-scale national fortification programs. Jordan is an example. It began to fortify flour, a staple food in Jordan, in May 2002, because of the high rates of iron deficiency anemia, especially among women of childbearing age and children, and now wants to expand its program. The government works closely with industry, and wants to involve all participants in the process to make sure it is done properly. There are no increased production costs for millers, because the micronutrient premix is provided free of charge by the government, and UNICEF and WHO have provided equipment and trained millers in the new technology.

GAIN has also been approached by other countries in Asia, Africa and Latin America to assist in efforts to design and implement their national fortification programs. In the words of Jay Naidoo, Chairperson of the Development Bank of South Africa and of GAIN. "Our goal is sustainable human development through nutritional status. The starting block is fortification. That's a building block to tackling the overall goal of improving nutritional status." – *Extract from GAIN press release, 12 June 2003*

South Africa launches national fortification campaign

The official launch of South Africa's program for the mandatory fortification of maize and wheat flour (see Nutriview 2003/2) took place in Orange Farm, a community near Johannesburg, on April 1st, 2003. Addressing those present, South Africa's Minister of Health, Dr Manto Tshabalala-Msimang, pointed out that the event was not to be considered as an April fool's day trick. April 1st marks the start of the 'Health' month in South Africa and was therefore a fitting

South Africa's Minister of Health, Dr Manto Tshabalala-Msimang (centre): "Please spread the message that we are what we eat. As a people, we deserve better and healthy food."

time to launch the program, which aims, above all, to promote good health among the country's people.

She expressed confidence that this national campaign, which comes into effect in October to give those involved time to implement the requirements properly, will help to significantly reduce suffering due to micronutrient deficiencies. She also stressed the minimal cost of fortification ("not more than 1 cent per loaf of bread and 2 cents per kilogram of maize meal"), and strongly urged the partners in the private sector not to increase the price of fortified foods. "An unfair price increase would affect consumer buying power and impact on those who can hardly afford a balanced diet," she said.

Food fortification is the third element in South Africa's efforts to reduce malnutrition. The others are micronutrient supplementation programs for women and children, and programs to promote better dietary habits. The latter include breast-feeding initiatives, school feeding programs and campaigns to encourage people to grow their own vegetables and fruits and so improve household food security as well as increasing intakes of micronutrient-rich foods.

While millers and bakers get ready to implement the regulations, the government and donor organizations have already started to educate consumers about the health benefits of eating fortified maize and wheat flour products. – *South African Department of Health Media Room*

Guatemala introduces once-a-week supplementation

Guatemala led the way in nutrition innovation with the first demonstration of the utility of the iodate form of iodine for salt iodination, and with the fortification of table sugar with vitamin A. Now, the Guatemalan government continues in its leading role by adopting another novel public health measure: once-weekly administration of iron and folic acid supplements to priority groups.

Many individuals consider taking a daily supplement an onerous burden, and compliance with daily regimens of micronutrient supplementation is notoriously poor. The notion that people would be more adherent to supplementation regimens if the periodicity was reduced to weekly or biweekly has permeated the public health community for years, and has lead to numerous studies of intermittent-day dosing-regimen efficacy.

In May 2003, the Guatemalan Ministry of Health issued new programmatic norms for the once-weekly administration of various, age-specific combinations of ferrous sulfate and folic acid to four specific target groups served by the public health system (children aged 6 months to 5 years, adolescent, non-pregnant women, and pregnant/lactating mothers; see Table 1).

The dosing is done with standard-issue supplements (a flavored syrup with 15 mg/ml elemental iron, scored tablets with 60 mg elemental iron, and tablets with 5 mg folic acid). These dosages may be considered hefty, but they are given only once every seven days. Weekly dosing will be relied upon in government health stations, even for individuals diagnosed as frankly anemic, to resolve the hematological deficit over time.

This nationwide norm for targeted weekly contacts to deliver a prophylactic dose of micronutrients to prevent anemia and reduce birth defects bears watching for evidence of its effectiveness and efficiency in improving the health and productivity of the less privileged segments of this Central American nation. – *Noel W. Solomons, Guatemala City*

Mobilizing flour fortification

The Universal Flour Fortification initiative (see Nutriview 2003/1) continues to make rapid progress under a new name (Flour Fortification Initiative; FFI). While still in a phase of strategic mobilization, it has received backing by the International Association of Operative Millers (IAOM) and formalized a larger set of partners at a meeting held in London, England on June 26, 2003, following the International Grains Council Conference.

Table 1: New once-weekly supplementation schedule in Guatemala

Priority group (with or without anemia)	**Weekly dosage**	
	Ferrous sulfate	**Folic acid**
Children aged 6–18 months	Half a tablet or 2 ml syrup (30 mg elemental iron)	1 tablet (5 mg)
Children aged 19–60 months	1 tablet or 4 ml syrup (60 mg elemental iron)	1 tablet (5 mg)
Nonpregnant women aged 15–19 years	1 tablet (60 mg elemental iron)	1 tablet (5 mg)
Women during pregnancy and up to 6 months post-partum	2 tablets (120 mg elemental iron)	1 tablet (5 mg)

The initiative seeks to build an alliance between governments, international agencies, industry and consumer/civic organizations to promote flour fortification in all countries where wheat flour is consumed in sufficient quantities by a substantial proportion of the population. Its long-term goal is to ensure that flour is fortified with iron and folic acid as a minimum "routine" practice.

The FFI now has a working web site (www.sph.emory.edu/wheatflour/main.htm) for those supporting the initiative. It is organized along the main categories of activities. Sections relate to upcoming events, data and evaluation, communication products, initiative development, training and technical, industry and public relations.

The data and evaluation section shows wheat statistics, milling infrastructure, estimates of deficiency burden, fortification status and fortification benefits in individual countries. The communication-products section has PowerPoint presentations, multimedia meeting reports and other resource materials that may be used to advance FFI in different situations. The initiative-development section includes reports of activities over the first 12 months of the initiative.

The training and technical section features a support group sponsored by IAOM in conjunction with FFI to develop a network of milling schools around the world to share material and curricula related to flour fortification. The industry and public-relations section describes current and future activities in this field, and acknowledges funding organizations. Initial steps have been taken to establish a communication strategy to promote FFI to the flour industries around the world, and to persuade the public to consume fortified wheat products. – *Glen Maberly, Emory University, Atlanta, GA, USA*

Fortification has economic benefits

Available evidence shows a strong association between iron deficiency and motor and mental impairment in children, and lower work capacity in adults. Horton and Ross [1] have measured the economical implications of this. According to their calculations for 10 developing countries, the median total losses (physical and cognitive combined) are about 4% of GDP. Physical productivity losses are greatest in the poorest countries, where heavy manual labour and anemia rates are highest. In absolute dollar terms, such losses are staggering. In South Asia (Bangladesh, India, Pakistan) for example, they amount to more than $4 billion annually.

The median benefit-cost ratio for long-term iron fortification programs for these 10 countries was 6:1 (based on a cost of $1.33 per case of anemia prevented as found in an effectiveness study in Venezuelan children, where a national program of maize and wheat flour fortification began in 1993). It rose to 36:1 when the discounted future benefits attributable to cognitive improvements were included.

These results have to be treated very cautiously. The simulations give estimates of the relative orders of magnitude potentially involved, but are not definitive. Further work is needed to strengthen and refine the estimates.

1. Horton S, Ross J. The economics of iron deficiency. Food Policy 2003; 28: 51–75.

Support for program managers

Drs Penelope Nestel and Ritu Nalubola have compiled a series of 14 fact sheets for the US Agency for International Development's Micronutrient Global Leadership project to help program managers develop accurate and practical messages for their nutrition programs. The sheets are grouped into three categories (food fortification, vitamin A, iron) and review evidence on:

- the use of food fortification as an effective public health intervention;
- the safety of vitamin A in fortified foods;
- the importance of breast milk as a source of vitamin A and iron for infants in the first 6 months of life;
- the absorption of β-carotene from the diet;
- the need for caution when feeding cow's milk to young infants;
- factors affecting the bioavailability of dietary iron.

The sheets can be downloaded from: http://www.ilsi.org/publications/index.cfm?pubentityid=121 or ordered from ILSI Human Nutrition Institute, One Thomas Circle, Washington, DC. 20005-5802, USA.

***Erratum**:*
Our first 'News in brief' in Nutriview 2003/2 (page 8) interpreted one of the study's conclusions incorrectly due to confusion between particle size and surface area. In fact, the study found a direct relationship between RBV and surface area. We publish the report again below with the correct wording (new text in bold type).

Particle surface area may predict bioavailability of iron fortificants

When seeking a suitable iron form for use as food fortificant, one of the problems that needs to be addressed is bioavailability. This can vary considerably, depending on several factors. It would therefore be useful to have a simple test that could predict bioavailability in advance.

Researchers at the US Department of Agriculture, working in collaboration with SUSTAIN (Sharing U.S. Technology to Aid in the Improvement of Nutrition) and it's partners, think they may have found a solution as far as elemental iron powders are concerned [1]. After feeding rats a diet fortified with one of six commercially available elemental iron powders or iron sulfate, they measured the relative biological value (RBV) of each. The results varied considerably (21–64%; FeSO4: 100%). Examining the powders under a scanning electron microscope, they saw that they differed in physical structure. When they measured the surface area of the different powders with a gas adsorption technique, they found a similarly wide range of values (90–370 m^2/kg). **The smallest particles (those with the largest surface area) had the highest RBV**. Solubility of the powders in dilute acid (pH1.0) at 30 minutes was an equally good predictor of RBV, but solubility at pH1.7 was not.

These data suggest that the bioavailability of elemental iron powders can be predicted by surface area. Solubility in acid at pH1.0 may offer a rapid, low-cost alternative.

1. Swain JH, Hunt JR. Elemental iron powder used for food fortification: does physicochemistry predict bioavailability? Poster. INACG Symposium, 2003, Marrakech, Morocco.