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Editorial:

Hitting the target

Mass fortification of staple foods can be an effective and economical way to improve the nutritional status of a population. In most circumstances, however, it does not provide enough nutrients for young children, who consume only relatively small amounts of the fortified food. Yet children should be one of the main targets for nutrition interventions, because micronutrient deficiencies in childhood can permanently interfere with growth and development. Ideally, adults should ensure they are properly nourished before becoming parents, because malnutrition can have a devastating effect on the health of the offspring from the moment of conception.

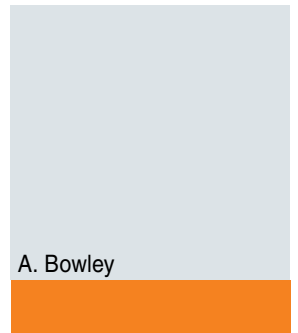
Fortification with folic acid shows how this can work. It has led to a significant reduction in the prevalence of neural tube defects in the offspring, even in industrialized countries. Currently experts are debating whether fortification should also include other micronutrients, such as vitamin B₁₂, which might also play an important role in preventing these abnormalities, especially in developing countries.

A novel approach in Chile aims to improve fetal nutrition and the quality of mothers' milk. The government distributes a food supplement containing milk protein, calcium, docosahexaenoic acid (an essential long-chain, omega-3 polyunsaturated fatty acid), and all

the micronutrients needed for good health to pregnant and lactating women when they attend the health center. At the same time, the health attendants encourage the mothers to breastfeed their infants exclusively for the first six months of life (see next article).

In many regions of the world where malnutrition is common, health authorities distribute micronutrient supplements at routine health checks. While this can be effective for vitamin A and other nutrients that are stored in the body for several months, the intervention demands a considerable amount of organization. Another promising development of recent years for improving micronutrient status is known as 'home fortification'. This involves mixing a powder, soluble tablet or paste into a child's meal just before serving. The product is usually packed in individual doses to improve shelf life and make it easier for the person taking care of the child to add the correct amount to the meal.

Following an appropriate period of exclusive breastfeeding, mothers can also help to avoid malnutrition in their infants by providing complementary foods with a high nutrient value. This can involve the reduction of absorption inhibitors in traditional foods, and inclusion of foods from animal sources in the diet. It is clear which target we should aim at; we just need to choose the right weapon!



Feature:

Maternal supplement benefits next generation

The government of Chile has a long tradition of conducting measures to improve health. More than a century ago it realized that malnutrition creates an ethical, social and economic problem affecting, not just a few individuals, but the nation as a whole. In 1952, the Chilean National Health Service established guidelines to ensure that nutrition programs meet the population's requirements. Thanks to these efforts, Chile appears to have all forms of undernutrition in young children under control. (1.3% are moderately stunted, 0.7% underweight, and 0.3% wasted, according to the WHO 2008 Global Database on Child Growth and Malnutrition). Nevertheless, to ensure sustainable economic development, the government still aims to improve the social and health status of the next generation, so that children can grow up to be productive citizens capable of building the country's future.

A novel approach

From this basic idea, the Ministry of Health of Chile, in close collaboration with the University of Chile

medical school and the food industry, has developed a novel food supplement that improves infants' nutritional status in the womb as well as during the first six months of life. The supplement (called *Purita Mamá*) consists of a fortified, milk-based, low-fat beverage in powder form that is consumed by the mother during pregnancy and the nursing period. Incorporating the latest knowledge about the nutrients needed for human development, a serving of *Purita Mamá* provides 4.5 g milk protein, 400 mg calcium, appropriate amounts of the other micronutrients essential for good health and 60 mg docosahexaenoic acid (DHA). It is the first such product to contain this long-chain, omega-3 polyunsaturated fatty acid (PUFA) that is essential for proper development of the brain and eyes.

Regular intake of *Purita Mamá* during pregnancy helps to eliminate women's nutritional deficiencies, support the optimal development of the fetus and reduce the risk of premature birth. *Purita Mamá* also improves the nutritional quality of the mother's milk. Babies fed with this milk have a greater intellectual





The successful development of this nutrition project involved a lot of people from government, academia and industry who had to collaborate closely.

potential, and are less susceptible to pneumonia or diarrhea, conditions that, in former times, caused more than half of infant deaths in the country.

Since August 2008, the government includes *Purita Mamá* as part of the National Program of Complementary Feeding, which has distributed products and services free of charge for more than twenty years. Expecting and nursing mothers affiliated to the public health system collect a month's supply of the product when they visit the health center every month to check their health status. After the baby's birth, they are encouraged to breastfeed exclusively for the first six months.

From an idea to a national program

Efforts to develop *Purita Mamá* began in 2004, when researchers at the University of Chile medical school under the leadership of Dr Eduardo Atalah, together with professional R&D staff of Watt's SA, a leading food manufacturer, were awarded government funding to investigate the role of PUFA in pregnancy and lactation. They had discovered that the milk of Chilean mothers provides only 20% of the DHA needed for the optimal development of their infants.

The primary objective of the project was to formulate, manufacture and evaluate a high-quality, yet affordable, dairy-based beverage containing long-chain PUFA and other essential nutrients, for pregnant and nursing women. Once this was achieved, the team measured the impact of the product on pregnancy progress, childbirth, nutritional composition of the mothers' milk and its effect on babies' development during the first months of life. The results were compared with those from a control group that consumed another fortified, powdered milk available at the time.

The results were significantly better than expected. Mothers who consumed *Purita Mamá* had fewer premature births and higher breast milk concentrations of DHA, while their babies had a markedly improved psychomotor development than in the group using the other product. Because of this, The National Fund for Research and Development in Health agreed to move to the next stage. So, in April 2005, work

started to develop the project from the laboratory to an industrial scale.

After several disappointing attempts, the project team decided that *Purita Mamá* needed a high-quality form of DHA from a reliable source. Facing the challenge, the chosen DHA manufacturer tested various options to obtain maximum stability at a minimum cost. Finally, in 2007, a formulation was chosen that could be produced industrially at a reasonable price. It had a good shelf life, and was well accepted by consumers.

Preparations for the launch of the program consisted mainly in sensitizing the nutritionists and health attendants, so they would encourage women attending the health center to consume *Purita Mamá* as proposed. Support materials included information brochures for health professionals and consumers, promotional banners in the health centers, a web page and a *Purita Mamá* mobile to hang over the baby's cradle.

An example to follow

The government realizes that *Purita Mamá* can only improve the nutritional status of the target population if its delivery is reliable, and high safety and quality standards are met. This could explain why it is willing to invest the equivalent of almost US\$20 million annually in this program. Chile's President Michelle Bachelet officially inaugurated the distribution of *Purita Mamá* on the national "Breastfeeding Day" (Cover photo).

By the end of 2008, four months after the inauguration, almost 90% of the target population consumed *Purita Mamá*. This success has considerably increased awareness about the benefits of consuming omega-3 fatty acids.

Considering this as one of Latin America's greatest advances in the fight against malnutrition, all the partners involved in the *Purita Mamá* project in Chile are ready to help other countries benefit from their experience. To create more opportunities for consumers, plans are also being made to introduce *Purita Mamá* to the retail market.

Review:

Strategies to improve zinc nutrition

On the initiative of the International Zinc Nutrition Consultative Group (IZiNCG), the *Food and Nutrition Bulletin* has published a supplement reviewing recent advances in knowledge of zinc nutrition and human health. This 186-page issue evaluates various intervention strategies to improve zinc nutrition, and concludes that supplementation, fortification and dietary diversification/modification can have a beneficial impact on zinc status and zinc-related functional outcomes (Table 1).

The authors note that information about the prevalence of zinc deficiency and about the effectiveness of large-scale zinc intervention programs is lacking. The WHO estimates that there is a high risk of zinc deficiency in countries where more than 20% of children aged less than five years are stunted (see map on page 5). As zinc deficiency is not the only factor affecting growth, the IZiNCG steering committee calls for a global commitment to conduct systematic assessments

of population zinc status, and to develop interventions for controlling zinc deficiency in the context of existing public health and nutrition programs in countries with a high risk of zinc deficiency.

Recommended activities

To motivate appropriate action, the review identifies several key operational issues that are currently impeding progress, and recommends various alternatives for implementing and scaling up interventions. Proposed activities include:

- Collect objective information on population zinc status in countries with elevated risk; utilize already scheduled surveys.
- Mobilize interest in zinc nutrition among policy makers and program managers; enlist help of nutrition stakeholder groups.
- Exploit existing delivery platforms for preventive supplementation (e.g. programs for vitamin A

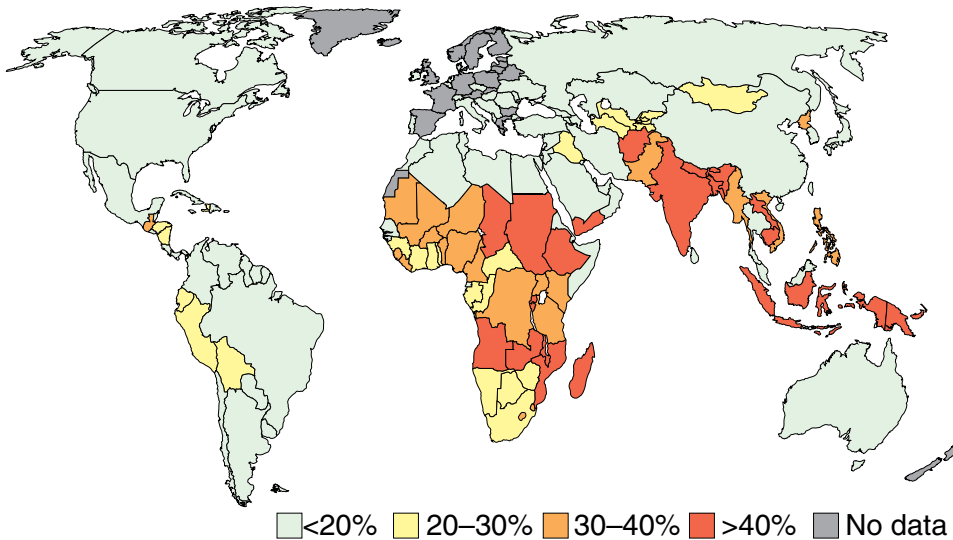
A PDF copy of this document can be downloaded from:

http://www.foodandnutritionbulletin.org/downloads/FNB_v30n1_Supplement_izinc.pdf



Table 1: Impact of zinc intervention strategies

| Intervention | Effects |
|--|---|
| Preventive supplementation in children | Reduces incidence of diarrhea and acute lower respiratory tract infection. Lowers mortality rate. Increases growth velocity. Most benefit in children aged 12 months or older. No adverse effects on iron and copper metabolism. |
| Therapeutic supplementation in children | Reduces duration and severity of acute or persistent diarrhea. Effects on pneumonia, malaria or tuberculosis not established. |
| Maternal supplementation | Reduces premature delivery. No consistent impact on birthweight and other pregnancy outcomes, or on lactation performance and infant growth. No adverse effects on iron and copper status identified. |
| Food fortification | Increases zinc intake and total absorbed zinc. Effect on zinc status indicators not yet established. Effect of household fortification not established. No adverse effects on iron and copper status. |
| Dietary diversification and modification | Agricultural interventions can enhance intake of zinc. Increased consumption of animal-source foods may enhance zinc intake and bioavailability. Zinc bioavailability in cereals/legumes compromised by phytates. Reducing phytates in complementary foods unlikely to improve zinc status unless red meat/liver included in diet. |
| Breastfeeding | Meets zinc requirements for first 6 months of life. Can meet more than half of zinc requirements after introduction of complementary foods. |
| Biofortification | Impact on zinc status and associated health outcomes not yet established. Unlikely to result in higher risk of toxic intakes or unwanted changes in organoleptic properties. |



Prevalence of nutritional stunting in children under five years of age. (IZiNCG Technical Brief No.1, 2007).

distribution, growth monitoring, health promotion and social marketing); provide special support for low-birthweight infants.

- Include zinc in diarrhea treatment.
- In high-risk countries include zinc in maternal supplements.
- In high-risk countries include zinc in the fortification premix.
- Ensure universal access to diets with adequate zinc content and bioavailability through home gardens, small-animal production etc. Ensure effective behavior-change communication.

Careful monitoring and evaluation of scaled up intervention programs are highly recommended.

Research needs

The list below shows what the authors consider as the most important research needs:

- Develop biomarkers of zinc status that are reliable, low cost and feasible for field implementation.
- Establish optimal dosage regimens for preventive supplementation.
- Examine efficacy of preventive supplements for reducing mortality in low-birthweight infants
- Examine efficacy of therapeutic supplements in various diseases.
- Establish optimal time for initiating maternal supplementation during pregnancy.
- Determine the effectiveness of fortification of specific food vehicles in various groups.
- Evaluate the nutrition and health impacts of dietary interventions to enhance zinc status.

International Zinc Nutrition Consultative Group technical document #2. Systematic reviews of zinc intervention strategies. Guest editors: Kenneth H. Brown and Sonja Y. Hess. Food and Nutrition Bulletin 2009; 30: Supplement No 1: S3–S186.

Review:

Nutrition interventions: an investment for the future

Human capacity can only develop to its full potential when the diet contains adequate amounts of vital micronutrients. However, lack of these nutrients causes tremendous lifelong hardship to individuals; as a result of malnutrition, “*families, communities, societies, nations and ultimately the world all lose*”! This is one of the conclusions reached by a global report that was officially launched on May 12, 2009, at the Second International Meeting of the Micronutrient Forum in Beijing, China. The report, “Investing in the Future: A united call to action on vitamin and mineral deficiencies”, draws attention to the causes and effects of vitamin and mineral deficiencies, and shows how many people’s lives could be saved and improved through existing, cost-effective interventions, including supplementation and fortification.

The report confirms that vitamin and mineral deficiencies have multiple and interconnected causes. At the most basic level, they result from a poor diet. But the problem is made worse by inadequate health care and sanitation, and a lack of education in childcare. To improve health, educational achievement, and economic productivity long term, people must not only have access to better food. They also need to earn more. Delivery of health and nutrition services, as well as infant and young-child feeding practices must also be improved. The report reiterates the view of the 2008 Copenhagen Consensus panel that providing micronutrients is the world’s best investment for development.

To stress the importance of broad-based partnerships for the successful delivery of large-scale interventions, the report describes the roles to be played by various

Further information, and a PDF copy of this report can be accessed at: <http://www.unitedcalltoaction.org/>



stakeholders:

- National governments identify needs, set and monitor national policy and standards, provide budgets, train healthcare providers, launch social marketing and education campaigns. A long-term commitment is vital.
- Non-governmental organizations provide support with expertise in program design and delivery, research, advocacy, and procurement of products.
- International donors assist with large-scale procurement, boost global supplies, and cover implementation costs.
- The private sector brings its pharmaceutical and food processing expertise and ingenuity to produce, promote, and ensure quality control.
- Small-scale processors and farmers can also play key roles.

It also provides a list of priority actions for improving access to vitamin A, zinc, iodized salt, fortified foods, multiple micronutrient supplements for women

of childbearing age and children, and food security.

Experts in leading development agencies realize that strategic vision is the key to achieving the Millennium Development Goals by 2015. They envisage that adequate commitment and funding, supported by strong partnerships, will extend the reach of micronutrient interventions and leave no one behind.

Development of this report was coordinated through an Interagency Steering Committee including high-level participation from the Flour Fortification Initiative (FFI), the Global Alliance for Improved Nutrition (GAIN), the Micronutrient Initiative (MI), the United Nations Children's Fund (UNICEF), the United States Agency for International Development (USAID), the World Bank, and the World Health Organization (WHO). The Micronutrient Initiative funded its development and production with the financial support of the Government of Canada through the Canadian International Development Agency (CIDA).

Extract from the executive summary of the publication

In memoriam:

John Beard, a world-renowned iron expert

On February 13, 2009, the nutrition field lost an incredible advocate. Dr John Lawrence Beard, considered by many as one of the world's most influential and highly respected experts on iron in the brain and neurobehavioral function, died unexpectedly, aged 61, leaving behind his wife Diane Brannon and sons Zachary and Matthew Beard.

John, who graduated from the University of California (MS in biochemistry) and Cornell University (PhD in nutrition), was a well-respected colleague with a genuine desire to provide his students with the highest quality learning and research opportunities. He had an unparalleled commitment to science, his colleagues, and his students. He was a member of the Penn State faculty for 25 years, and was only recently (December 2008) named 'Distinguished Professor' in the department of Nutritional Sciences.

John's research has been instrumental in changing the way scientists think about how the brain uses iron. It has influenced approaches to dietary supplementation in developing countries, and has offered new perspectives for the treatment of clinical disorders. In addition to understanding the correlation between iron and brain function, John was most interested in helping those in need by translating these findings into "real world" applications. Some of his most recent studies (assessing the usefulness of iron fortification in staple foods, the importance of iron in postpartum depression, and the impact of iron in restless legs syndrome) have had profound public health implications. Because John was known to conduct studies of the highest quality, his findings were often cited, and applied in setting public policy.

John was constantly being invited to speak at national and international meetings. His research has been published in more than 150 peer-reviewed manuscripts, more than 60 of them in the past five years. As he was still involved in multiple other studies, his name will undoubtedly appear on many more research articles to come. He was also known for 'thinking outside the box' and providing a rational, objective viewpoint. John was also generous with his service to the field. He was President-elect of the American Society for Nutrition, a member of *The American Journal of Nutrition* and *The Journal of Nutrition* editorial boards, and an Associate Editor of *The Journal of Nutrition* for the past nine years. Additionally, he chaired or served on the committees of many national and international public health organizations.

While his professional accomplishments are remarkable, the manner in which he conducted himself is what has left the biggest impression on those privileged to know him. Despite his many accolades, John was a humble person who was kind to everyone. He was known for his fairness and integrity; he had a passion for conducting the highest quality research, and for imparting his knowledge to others. This passion was contagious. John had high expectations of his colleagues and students, never allowing them to get away with mediocrity. John cared deeply, and was, therefore, constantly challenging people; pushing them to give the best they could. He always made time for helping others. As a phenomenal and tough mentor, he has helped many of his students to become leaders in the field of nutrition.

Although John gave tirelessly of himself in order to



advance nutrition, his family always came first. His love for his wife and two sons was evident by the proud manner in which he constantly spoke of them and the gentle way in which he interacted with them.

John's research has greatly advanced our knowledge of the role that iron plays in human health, and his death has left a huge void. However, he has left a wonderful legacy and example for us when it comes

to being a productive scientist. Those of us who knew and learned from John first-hand realize that we now have the privilege of carrying on his legacy. This will be accomplished every time we patiently guide our students, enthusiastically impart our knowledge to others, passionately conduct our research, labor over the wording of a grant until it is just right, or publish our research findings. John will be sorely missed.

Laura E. Murray-Kolb, PhD.
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News in brief:

Home fortification safe and effective

Home fortification, the addition of a micronutrient-fortified seasoning powder directly to cooked food, is one of the options being applied to improve the nutritional status of preschool children in developing countries. The method presents several challenges to ensure a safe and effective result, however. Two recent papers (from China and Haiti) have investigated the feasibility, acceptability and efficacy of home fortification.

Chen et al. evaluated three different seasoning powders (containing, respectively, vitamin A; vitamin A and iron; vitamin A, iron, thiamin, riboflavin, folic acid, niacinamide, zinc and calcium) in 226 apparently healthy children aged 2–6 years attending nurseries in a middle-class suburb of Chongqing, China [1]. The children were randomly assigned to receive one of the powders (packaged in single-serving sachets providing 100% of the recommended daily allowance) once daily on five days a week for six months. The caregivers added the powder to porridge, soy milk, soup or noodles directly after cooking, and supervised consumption. Anthropometric status, micronutrient status indicators and hemoglobin were measured at the beginning and end of the study.

The group whose diet was fortified with multiple micronutrients showed the greatest improvements in nutritional status and some anthropometric measures (height-for-age, weight-for-age). Hemoglobin levels increased significantly and to a similar extent in all three groups. Reported compliance was greater than 90%.

1. Chen K, Li T-Y, Chen L, et al. Effects of vitamin A, vitamin A plus iron and multiple micronutrient-fortified seasoning powder on preschool children in a suburb of Chongqing, China. *J Nutr Sci Vitaminol* 2008; 54: 440–447.

Home fortification can use existing distribution channels

Loechl et al. describe their experience with the distribution of micronutrient powders as part of an ongoing food-assisted program [1]. The aim of the study was to assess whether adding a new element to an ongoing program is feasible and acceptable, and whether the product is used correctly.

Before receiving the micronutrient powders (packed individually in single-serving sachets) eligible mothers attended a training session to learn about the

benefits and side effects of the product, and how to use it correctly. In the following two months, staff at food distribution points handed a month's supply of the product and a set of instructions to the mothers, and reminded them again how to use it.

During the second month of the study, the researchers monitored distribution, and randomly interviewed selected participants. At the end of the study, they interviewed 254 caregivers to obtain additional information about the use and acceptance of the product. They also interviewed staff members to assess their experience with the intervention.

The initial learning sessions and product distribution were implemented as intended, but the reinforcement sessions at the distribution points were often neglected. Some staff felt that the intervention increased their workload, whereas others did not. Some discussants suggested that the program was beneficial for their reputation. Many recognized the importance of the added work, and most agreed that they had no problems educating mothers.

Interviews with mothers indicated that their knowledge about the benefits and use of the product was excellent. Acceptability and compliance were high. Most respondents reported using the product appropriately, and only for the intended child. The authors conclude that it is possible to deliver micronutrients effectively through an existing, well-established, food-assisted program, and that this study illustrates the value of attention to process within a program theory framework incorporated into an effectiveness study.

1. Loechl CU, Menon P, Arimond M, et al. Using programme theory to assess the feasibility of delivering micronutrient Sprinkles through a food-assisted maternal and child health and nutrition programme in rural Haiti. *Maternal and Child Nutrition* 2009; 5: 33–48.

Achieving an optimal folate status

Two articles in the March 2009 issue of *Nutrition Reviews* discuss the dilemma currently associated with increased intakes of folic acid. Mason reminds readers that, according to most studies, an adequate folate status protects against the development of colorectal cancer as well as embryonic malformations [1]. Evidence for a protective effect against other cancers also exists. However, the central role of folate as a cofactor in nucleotide synthesis also means it can

have the opposite effect, and promote the growth of preexisting cancer cells.

He underlines that it is essential to consider how other micronutrients (B₂, B₆, B₁₂) are involved in carcinogenesis as well as folate. Deficiencies of these vitamins are also common, even in industrialized countries such as the USA and UK. There is also some concern that high intakes of folic acid, the form of the vitamin used in supplements and fortified foods, might be detrimental, because it is not a natural nutrient. Following the introduction of mandatory folic acid fortification in the USA, studies have shown that people who consume a folic acid supplement and fortified breakfast cereals have detectable quantities of unmetabolized folic acid in the bloodstream.

These uncertainties are impeding the introduction of folic acid fortification programs in many countries, delaying efforts to reduce the number of babies born with neural tube defects (NTD). The author does not offer a definitive solution to the problem, but encourages countries introducing mandatory fortification to ensure adequate monitoring of cancer incidence.

Dary discusses the evidence for recommending an intake of 0.4 g/day folic acid, in addition to dietary folate, to reduce NTD risk, and concludes that the recommendation deserves to be reviewed [2]. He suggests that researchers need to establish whether a lower dose could prevent the consequences of folate deficiency without the adverse effects associated with folic acid excess. Available data, based on the minimum serum folate level associated with NTD protection, indicate that an additional intake of 0.1 mg/day might be appropriate. Hyperhomocysteinemia and megaloblastic anemia can be prevented with even less.

An adequate folate status can be effectively and safely ensured through mass fortification of a suitable staple food. Once a mandatory fortification program is running well, supplementation and voluntary fortification of other foods could be limited to specific population groups.

1. Mason JB. Folate, cancer risk, and the Greek god, Proteus: a tale of two chameleons. *Nutrition Reviews* 2009; 67: 206–212.
2. Dary O. Nutritional interpretation of folic acid interventions. *Nutrition Reviews* 2009; 67: 235–244.

Guidelines for nutrient levels in fortified flour

The WHO has published a consensus statement reflecting the views of nearly 100 experts from around the world, who met in the USA in 2008 to develop guidelines for national programs of wheat and maize flour fortification, premix formulation, and best practices for premix manufacturers and millers [1].

The document recommends that flour fortification should be considered when large groups of the country's population regularly consume industrially produced wheat or maize flour. It can be expected to be most effective when mandated at the national level. Factors affecting the choice and levels of nutrients to be added include existing nutritional deficiencies, the usual consumption of "fortifiable" flour, sensory and physical effects on the fortified foods, consumption of other fortified foods and supplements, and cost. Programs should include appropriate quality assurance and control measures, as well as public health monitoring.

For the purpose of the workshop, the experts focused their attention on five micronutrients recognized as being of public health significance in developing countries. A table in the document suggests levels for iron, zinc, folate, vitamin A and vitamin B₁₂, based on flour extraction rate, the fortificant compound used, and the estimated daily per-capita intake of wheat flour.

1. WHO, FAO, UNICEF, GAIN, MI, and FFI. *Recommendations on wheat and maize flour fortification. Meeting Report: Interim Consensus Statement. Geneva, World Health Organization, 2009.*

A PDF copy of the WHO guidelines can be accessed at: http://www.who.int/nutrition/publications/micronutrients/wheat_maize_fort.pdf

More details about the 2008 meeting are available at: <http://www.sph.emory.edu/wheatflour/atlanta08/>

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