Nutriview

2010/2

A quarterly newsletter on the role of micronutrients in nutrition and health for health-care professionals and science communicators

Review:

Flour fortification recommendations updated

The supplement of the Food and Nutrition Bulletin published in March 2010 presents the proceedings of the Second Technical Workshop on Wheat Flour Fortification organized by the Flour Fortification Initiative (FFI) that was held in Atlanta in 2008. Its purpose is to provide guidance for the fortification of wheat and maize flours.

Wheat naturally contains several vitamins and minerals, but much of its nutritional content is lost when the grain is milled into flour. Fortification replaces those nutrients and can add higher levels or additional nutrients as needed by the population. Although flour can be fortified with many vitamins and minerals, the five reviewed in this supplement are iron, zinc, folic acid, vitamin B12 and vitamin A. When setting national standards for flour fortification, countries are encouraged to make their recommendations in light of the micronutrient deficiencies that exist in the population, the sensory and physical effects of the fortificant on flour and flour products and which other foods are effectively fortified.

Balance benefit against risk

The document recommends that flour fortification should be considered as a public health intervention when industrially produced flour is regularly consumed by large population groups in a country. Depending on the target population, fortification of food vehicles other than flour can also be considered. The selection of the type and quantity of vitamins and minerals to add to flour, either as a voluntary standard or a mandatory requirement, lies with national decision makers in each country.

Women of childbearing age are the main target group for fortification; young children are less likely to benefit, because of their low flour consumption. For maximum impact, fortification should be mandatory, and legislation enforced at the national level. Effective monitoring is essential to ensure that the program is implemented as planned, and to minimize possible health risks.

Recommendations made by the individual working groups include:

- Sodium iron ethylenediaminetetraacetate (NaFeEDTA), ferrous sulfate and ferrous fumarate are the preferred forms of iron for flour fortification. Appropriate levels of these compounds can improve iron status with little risk of adverse effects. Reduced elemental iron powders have a low bioavailability, and are not recommended. However, electrolytic iron (a type of elemental iron) might still be useful when wheat flour consumption is greater than 150 grams per day.
- Flour fortification with appropriate levels of folic acid can effectively reduce mortality and morbidity due to debilitating neural tube defects, especially in populations with low dietary folate intakes. Concerns about potential negative health consequences of excessive folic acid intakes remain unconfirmed.
- Populations with a limited intake of animal-source foods are at a high risk for vitamin B12 deficiency. This applies particularly to people with a reduced ability to absorb the vitamin (elderly, people with HIV/AIDS). Although flour fortification with B12 might protect against becoming deficient, people with an existing deficiency due to malabsorption require a high-dose oral supplement.
- Wheat flour is a suitable candidate for fortification with vitamin A in populations that routinely consume adequate amounts of flour products.
- In countries with a high risk of zinc deficiency, fortification of flour with zinc should be encouraged. There is no evidence that zinc fortification has any clinically important adverse effects on iron or copper status.
- Addition of other nutrients, such as other B vitamins, may also be considered.

The World Health Organization (WHO) and other institutions have endorsed these recommendations in a "Meeting Report: Interim Consensus Statement" (accessible in six languages at http://www.who.int/nutrition/publications/micronutrients/wheat_maize_fortification/en/)

Fortified wheat flour

Flour fortification with iron, folic acid, vitamin B12, vitamin A, and zinc: Proceedings of the Second Technical Workshop on Wheat Flour Fortification. Guest editors: Mary Serdula, JP Peña-Rosas, GF Maberly and I Parvanta. Food Nutr Bull 2010; 31: S3–S96.
A PDF file of this document can be accessed at: http://www.foodandnutritionbulletin.org/downloads/FNB_v31n1_suppl_web.pdf

Review:
Addressing malnutrition in South Africa

The working paper published by the Global Alliance for Improved Nutrition (GAIN) in August 2009 summarizes the progress that South Africa has made in reducing malnutrition in recent years. It also explores some of the main reasons why greater progress has not been made, and presents some suggestions for policy priorities to effectively address the identified nutrition issues.

Malnutrition impairs economic development

Although the country has initiated various national nutrition and primary health care programs, malnutrition is still widespread. National figures show that 18% of children are stunted and 9% are underweight; at the same time,10% are overweight and 4% are obese. Poor vitamin A status, affecting about 60% of children and 25% of women, continues to be a matter of grave concern. Almost 30% of women and children are anemic, and almost half of the country's children are deficient in zinc. Low rates of exclusive breastfeeding and use of inadequate complementary foods contribute to the situation in infants. People living with HIV/AIDS are particularly vulnerable to hunger. The existing levels of malnutrition are clearly linked to poverty and food insecurity, and seriously impair the economic development of the country.

This situation is a challenge to public, private and civil society sectors to act collectively to focus investments on integrating and prioritizing nutrition more effectively within the broader environment.

Multi-sector partnerships needed

The authors of the report insist that the country's nutrition problems could be solved with a collaborated effort by all the involved stakeholders. Priority interventions include:

- Encourage better breastfeeding and complementary feeding practices;
- strengthen micronutrient deficiency control programs;
- coordinate nutrition efforts by government departments;
- develop appropriate partnerships;
- improve nutrition surveillance.

In particular, they propose that the South African government should revise its National Integrated Nutrition Policy to focus on infants, and to promote healthy lifestyles for adults. To implement this policy, it should provide the resources, training and support needed for an integrated, synchronized approach by managers in the various government departments. It should also create an environment that makes it easier for civil society and the private sector to play a greater role, and strengthens the safety nets for poor people.

They also ask the private sector to comply with the International Code of Marketing of Breastmilk Substitutes, to adopt the Global Commitment to Action on the Global Strategy on Diet, Physical Activity and Health, and to help with the National School Feeding Program. Besides improving the quality of foods through appropriate fortification, food companies should invest in better quality control processes and assist government agencies that monitor quality.

South Africa has made considerable progress in reducing malnutrition

Chopra M, Whitten C, Drimmie S. Combating Malnutrition in South Africa. GAIN Working Paper No. 1. GAIN, August 2009. A PDF file of this document can be accessed at: http://www.gainhealth.org/reports/gain-working-paper-series-no-1-combating-malnutrition-south-africa

Feature:

CeSSIAM celebrates 25 years of nutrition research (part 1)

The Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) in Guatemala was founded on July 1, 1985, to assert the need for academic freedom in the pursuit of public health research. It allowed the researchers to move forward, rather than looking backward, in the development of a research agenda. Throughout the 25-year history of CeSSIAM, the study of micronutrients has been central to its scientific fabric, enabling progress in understanding the health implications of vitamin A, vitamin D, riboflavin, zinc, iron and iodine. The following article highlights some of the ways in which CeSSIAM has contributed to knowledge on vitamins. Information about how CeSSIAM has contributed to research on zinc, iron and iodine follows in Nutriview 2010/3.

CeSSIAM 25th anniversary exhibit booth at the national Science Week 2010 celebration with staff members

Vitamin A

The first study from CeSSIAM to be published in an international journal compared the dietary intakes of vitamin A as assessed in the same individuals by 24-hour recall or food frequency measurement [1]. It seemed that research on vitamin A was the thing to do in those days. A few years earlier, mandatory fortification of table sugar with vitamin A in Guatemala, by a process developed by Guillermo Arroyave at the Institute of Nutrition of Central America and Panama (INCAP), had failed because of resistance from the sugar industry.

Our patron organization, the Guatemalan National Committee for the Blind and Deaf, understood "nutritional blindness" in its relationship to hypovitaminosis A, and had been pivotal in the earlier movement to introduce mandatory sugar fortification. So, after Alfred Sommer and colleagues at the Johns Hopkins School of Hygiene and Public Health (JHSHPH) demonstrated a causal relationship between marginal vitamin A status and child mortality in Indonesia [2], two of the founding coordinators of CeSSIAM, the late Oscar Pineda and Fernando Beltranena, took up the challenge to document the magnitude of the vitamin A problem, and reassert public interest in universal sugar fortification. The breakthrough came when JHSHPH, in collaboration with CeSSIAM, established the conjunctival impression cytology method as a functional assessment of hypovitaminosis A [3]. This led civil society and the medical authorities to persuade the sugar industry to reinitiate sugar fortification in 1987, and continue through all sugarcane harvests to the present day.

Extending CeSSIAM's involvement with the assessment of vitamin A status, Jesus Bulux, working with Neal Craft (Craft Technologies, North Carolina, USA), demonstrated the validity of the dried blood spot approach (in which a drop of capillary blood is collected on filter paper) for accurate assessment of circulating retinol [4]. In a natural collaboration between CeSSIAM and the Human Nutrition Research Center on Aging (HNRC-A) at Tufts University in Boston (both organizations do research on aging) we examined the effect of advancing age on assessment of vitamin A status. After finding a poor within-individual reproducibility of the relative dose response in older individuals [5], we applied the deuterated-retinol-dilution technique (a

Collecting data in a CeSSIAM field study

stable-isotope label test) and found generally adequate liver stores [6]. Later, we showed that an abbreviated 3-day equilibration period was sufficient to provide a valid estimate of body stores of the vitamin [7].

CeSSIAM has also investigated the bioconversion of provitamin-A-carotenes to active vitamin A. In collaboration with Steve Schwartz, then at North Carolina State University, we produced an extensive update on the carotene composition of Guatemalan plants. From this experience, we developed a variety of sweet-potato flakes as a prototype of a potentially high-vitamin-A weaning cereal. Two experiments tempered our enthusiasm, however. We found that feeding carrots to schoolchildren, and distributing carrots, sweet potatoes and green herbs to rural households increased circulating concentrations of beta-carotene, but did not influence circulating retinol levels [8, 9]. At that time, it was assumed that six units of dietary beta-carotene or twelve units of other provitamin A carotenes were converted to one unit of vitamin A in the body. Jesus Bulux and I challenged the validity of this convention. In a 1993 article in Nutrition Reviews, we reasoned from a series of angles that these efficiencies were overly optimistic [10]. This was shortly before Saskia de Pee and colleagues published a study in The Lancet that provided empirical evidence for a lower bioconversion efficiency of plant sources of provitamin A carotenes [11]. As a consequence of these challenges, the Food and Nutrition Board of the US Institute of Medicine (IOM) set the equivalency factors for the bioconversion of dietary provitamin A carotenoids in the 2001 Dietary Reference Intakes (DRIs) at twelve and twenty four. Most recently, we have rejoined this aspect of inquiry with a field survey into the genetic variants of the enzyme beta-carotene monooxygenase-1. In collaboration with the laboratory of Georg Lietz in Newcastle, UK, we extracted DNA from the saliva of indigenous Guatemalans, and determined that the more efficient type of enzyme was common, consistent with the notion that evolutionary pressures from a high-plant, agrarian diet favored more effective extraction of vitamin A from provitamin-A-carotenes.

Riboflavin

CeSSIAM played a major role in assisting the IOM in its mission to extend and differentiate age-specific nutrient recommendations for riboflavin. The HNRC-A in Boston had the mandate to fill the outstanding gaps in the estimation of recommendations beyond age 51 years to needs for those 70 years and older within the context of the DRIs. William Boisvert performed his doctoral dissertation, assisted in Guatemala by Ivan Mendoza, in a metabolic study among free-living elderly men and women in which the graded addition of riboflavin to the diet provided an estimation of the intake needed to maintain adequate status [12]. These data formed the basis for the extension of specific riboflavin intakes for the elderly in the 1998 IOM publication of DRIs for the B vitamins.

In the course of this experience, we were able to document the existence of riboflavin deficiency in Guatemalan children, its relationship to dairying and non-dairying areas across the country, and the parallel association of riboflavin and vitamin B12 status in the same individuals [13, 14]. In addition, in the metabolic studies of the elderly, we discovered that the higher carbohydrate intakes in a day, the easier it was to extract and retain riboflavin from the diet [12].

Vitamin D

Vitamin D and calcium are most often discussed as a tandem in human nutrition. The maize tortilla, staple food of the traditional Guatemalan diet, is prepared and cooked with lime (calcium oxide), providing the nation with a very high calcium intake. Until last year, however, nothing was known about vitamin D nutrition in this country other than from dietary surveys at CeSSIAM and elsewhere showing meager consumption of foods and beverages rich in the vitamin. In collaboration with the Osteoporosis Center at Creighton University in Nebraska, USA, a team of CeSSIAM researchers evaluated the circulating 25-hydroxy-vitamin D concentrations in 115 elderly Mayan (indigenous) residents of the western highlands province of Quetzaltenango. Despite high altitude and outdoor activities, low or deficient vitamin D status was found in the vast majority of participants, with women having significantly lower blood vitamin levels than men. We suspect that the dominant factors for this are exclusion of sunlight to the skin due to the design of traditional Mayan dress, pigmentation and aging of the skin, and low dietary vitamin D intake.

Noel Solomons and Odilia Bermúdez, Associate Professor at Tufts University School of Medicine, Boston, present the results of the vitamin D study in Guatemala

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Noel Solomons

Feature:
Biofortified wheat can improve zinc status

One of the major questions concerning biofortification as a nutrition intervention is whether we can breed sufficient amounts of micronutrients into staple crops to have a measurable impact on human health (see Nutriview 2009/1). This presumes that eating biofortified foods will improve people's nutrient status. New research from a group of HarvestPlus collaborators has shown for the first time that zinc from zinc-biofortified wheat is bioavailable [1].

More zinc absorbed

After growing enough zinc-biofortified wheat to conduct a small feeding trial, the International Maize and Wheat Improvement Center (CIMMYT) in Mexico recruited 27 women from a local community to test if more zinc is absorbed from biofortified wheat (containing 41 µg Zn/g) than from traditional wheat (24 µg Zn/g).

To assess the impact of phytate on zinc absorption, the wheat was milled to produce flours with 95% and 80% extraction (100% extraction = whole-wheat flour). Although milling removes zinc and phytate, the biofortified 80% flour still had 65% more zinc (23.8 µg/g) than the equivalent control flour (14.4 µg/g), whereas the phytate content of both was similar.

For the study, the women were fed tortillas made with 300 g of flour, a tomato-based salsa and apple juice on each of two consecutive days. The groups were randomized so that the women who ate tortillas made with biofortified wheat on the first day received the control wheat on the second, and vice-versa.

The women absorbed 0.5 mg/day more zinc from the biofortified wheat tortillas at both extraction rates than from those made with control wheat. Overall, the researchers concluded that 300 grams of zinc-biofortified wheat flour daily could provide two-thirds of the physiological zinc requirements of adult women.

Of particular interest is that the amount of zinc absorbed from biofortified flour at 80% extraction was similar to that of biofortified flour at 95%, indicating that the benefits of zinc-biofortified wheat are

not lost upon milling. This is because, even though a significant amount of zinc is lost with milling at 80% extraction, the phytate level is also reduced. So, biofortified wheat not only contains more zinc, but more of it can be absorbed.

The study also established that the phytate content of biofortified wheat was similar to the regular diet of the participants, which supports the assumption that zinc absorption is primarily regulated by current and very recent intake of zinc, and would not be impacted by a lack of adaptation to a high-phytate diet.

A step closer to the goal

Zinc deficiency is a major public health problem that affects about one-third of the world's population. HarvestPlus is leading a global effort to breed more zinc into staple food crops that are regularly consumed by those most at risk for zinc deficiency.

Findings from this study will therefore be instrumental in estimating the impact of dietary phytate on zinc requirements, and help HarvestPlus to set more realistic targets for zinc biofortification of staple crops. They also allow researchers to establish the appropriateness of existing models for zinc absorption based on phytate intake of children, rather than adults, who have been the focus of studies to date. Once the appropriate models for children are established, we will be able to predict zinc absorption for children.

The promising results from this study contribute to the growing body of research on biofortification and lead us one step closer to establishing biofortification as an important intervention for fighting micronutrient deficiencies.

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Hannah Guedenet and Yassir Islam, HarvestPlus

Events:

Second World Congress of Public Health Nutrition; September 23–25, 2010, Porto, Portugal

The II World Congress of Public Health Nutrition (I Latin-American Congress of Community Nutrition) will present the most recent advances in human nutrition, and discuss their intimate relationships to global health and wellbeing. The scientific program (theme: 'Moving towards a healthy and sustainable nutrition for all') is being prepared by the world's leading specialists in public health nutrition. Each session will be organized to capture the viewpoints in food and nutrition from both global and local perspectives. Topics will include (among others): Climatic changes and public health nutrition, nutrition and aging, public health and nutrigenomics, dietary guidelines and nutrition education, and international cooperation. During the meeting, the Hildegard Grunow Foundation will present the First Rainer Gross Award for Recent Innovations in Nutrition and Health in Developing Societies.

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Fourth Africa Nutritional Epidemiology Conference (ANEC IV) October 4–8, 2010, Nairobi, Kenya

ANEC IV, the leading regional conference on nutrition in Africa, provides a unique opportunity for food and nutrition scientists, health professionals and policy makers, representatives of NGOs, private sector organizations and international organizations with an interest in Africa's nutrition agenda to meet in an African country.

The theme, Nutrition and Food Security: Successes and Emerging Challenges, has been chosen to reflect a major area of historical and contemporary importance to human health, survival, and economic development in Africa and other developing regions of the world. Attaining food security in a challenging world is essential not only to meet Millennium Development Goals but ultimately will have an impact on nutrition through the life cycle and the epigenetic factors which link poverty with chronic non-communicable diseases.

Sub-themes and symposia reflect topical issues of growing concern to nutritionists and health-care professionals across the world, and include climate change, food security and nutrition; school health and nutrition; nutrition, immunity and communicable diseases; epidemiology of diet and chronic disease in developing countries; current management strategies for nutritional disorders; maternal and child health and nutrition; nutrition in emergency situations; sports nutrition and physical activity.

Conference secretariat: Centre for Public Health Research, Kenya Medical Research Institute, P. O. Box 20752 00202, Nairobi, Kenya. Tel: +254 20 2725017 Ext 233; 2729891; Email: anec4@kemri-nuitm.or.ke; Web: http://www.anec4.or.ke

Editorial:
The time to act

Why should we scale up support for nutrition right now? The policy brief 'Scaling Up Nutrition: A Framework For Action' (http://www.unscn.org/files/Announcements/Scaling_Up_Nutrition-A_Framework_for_Action.pdf) not only answers this question; it also shows which actions are most urgently needed to reduce hunger and its effects on public health and economic development. Its recommendations are based on a series of consultations hosted by the Center for Global Development, the European Commission, the International Congress of Nutrition, the United Nations Standing Committee on Nutrition, USAID, UNICEF, WHO and the World Bank, with contributions by numerous developing country partners, civil society organizations and academia, as well as other UN and aid agencies.

The brief makes it clear that countries can only meet the Millennium Development Goals, and contribute to agreed human rights for health and freedom from hunger, if they successfully address undernutrition. This means that nutrition strategies and programs must be built on each country's specific needs and capacities, and receive substantial domestic and external assistance; the approach should integrate nutrition in related sectors and use indicators of undernutrition as one of the key measures of overall progress; for the highest return on investment, interventions should target the life period from conception to two years of age.

With such a broad endorsement, this document is essential reading for all policy makers and opinion leaders, not only in nutrition, but also in other sectors, such as food security, agriculture, health and social protection. Maybe it can generate a strong sense of urgency, and facilitate collective action by developing countries, external partners, civil society and the private sector. As the brief concludes: "There is now a window of opportunity for the global community to take effective action to reduce global undernutrition, particularly among the youngest and most vulnerable children. The stakes are high and so are the returns. The time to act is now."

A. Bowley

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