Micronutrient Fortification of Food: Issues for Asia

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Summary

More than 2 billion individuals globally suffer some degree of deficiency of one or more micronutrients, with the largest numbers in Africa and Asia. Fortification of foods with vitamins and minerals is a proven public health intervention. In Asia, salt iodization, fortified flour and condiments such as fish sauce and soy sauce are reaching hundreds of millions. However, many individuals still do not have adequate intakes of numerous micronutrients, and better fortification strategies and practices will help to alleviate these deficiencies. The International Life Sciences Institute (ILSI) has supported research and scientific dialog about technical and health issues related to micronutrients. Recent studies have indicated widespread vitamin D deficiency among children in SE Asia, and in India. A new trial shows the efficacy of vitamin D-fortified milk in addressing deficiencies, which may have applicability in school feeding programs in India and other parts of Asia. Infant nutrition is also critical, and complementary foods can play an important role after exclusive breastfeeding in providing critical nutrients. A formulation developed in China, Ying Yang Bao, has shown significant reduction of anemia and improved growth in infants. Fortification in Asia has the potential to greatly reduce micronutrient deficiencies and improve health, but more structured efforts are needed to achieve these goals.

Key Words

fortification, vitamin D, NaFeEDTA, Ying Yang Bao, thiamin

Micronutrient deficiencies remain common, with estimates of over 100 million individuals being vitamin A deficient, over one billion with some degree of iron deficiency, and over two billion people with vitamin D insufficiency (based on a cutoff of 50 nmol/L) (1, 2). Even in developed countries, deficiencies can be found in certain populations. A recent review has found that of 128 countries with data, only 37 countries have salt iodization coverage that meets the goal of at least 90% of households consuming adequately iodized salt (3).

Numerous approaches are possible to address these deficiency issues, including dietary quality improvement and diversification, supplementation, and production of crops with higher levels of nutrients (biofortification). All of these have a role to play in any general nutrition strategy or policy. An additional strategy, the fortification of foods with added vitamins and minerals, now has a history of over 90 y of implementation, and billions of people around the world are consuming foods and condiments with some added level of nutrients. Nevertheless, many additional billions of individuals are not receiving adequate micronutrient intakes, and steps could be taken to improve health outcomes by more extensive use of fortification as a tool.

Fortification

Iodization of salt was introduced in the US in 1924, where endemic iodine deficiency was prevalent in the Great Lakes, Appalachian, and Northwestern regions of the U.S. (4). This program quickly led to significant reductions in goiter in these regions that adopted iodized salt. Another early use of fortification was the introduction of vitamin D in milk. By the end of the 1930s, virtually all milk in the U.S. was fortified (5). Thiamin (vitamin B1) was first synthesized in 1936 by Robert R. Williams, and in 1942, the fortification of white flour and bread with thiamin became required by the State of South Carolina. This was followed by the adoption of legislation in 26 additional US states (6). Roberts later supported efforts to fortify rice in the Philippines with thiamin, led by Dr. Juan Salcedo, Jr. (7, 8).

Numerous studies have shown that fortified foods provide a significant source of vitamins and minerals in the US and help prevent deficiencies (9–12). For example, without fortification it was estimated that over 50% of the US population would have intakes of thiamin below the estimated average requirement (EAR), while with fortification the level is below 5%.

Developments in Asia

Fortification efforts have been undertaken in Asia for more than 50 y, and some programs have become established policies. The International Life Sciences Institute (ILSI) is a non-profit, global scientific organization that has supported research and scientific discussion on fortification as a tool to address micronutrient deficiencies in Asia. Part of that work, also supported by other institutions, has investigated iron fortification of soy sauce and fish sauce with water-soluble, bioavailable iron (NaFeEDTA) (13–17), under its Project IDEA (Iron Deficiency Elimination Action, Center for Health Promotion). These fortified fish and soy sauces are reaching an estimated 50 million individuals in China and SE Asia. There is a need for greater scale up. The fortification of condiments has been the subject of a recent consultation organized by the World Health Organization (WHO) and the Sackler Institute of Nutrition. Recommendations from this workshop are expected to be published in 2015.

Although fortification is a simple concept, and the basic implementation is also relatively simple, the issues
involved are often highly complex in terms of science and basic data. The principles for required data for fortification are clear, as outlined by WHO (18). However in many countries, the basic data for good fortification strategies is not always in place. It has been recognized from the beginning of fortification that data is needed on food intake, food composition, and nutritional status. The FAO-maintained food composition database (International Network of Food Data Systems, INFOODS) (19) is a valuable framework but is not yet fully populated for many Asian regions and not always up to date. Without adequate data, good policies cannot be well designed, and effective follow up monitoring and evaluation will not be possible.

For the Asian Congress of Nutrition, ILSI has organized a session covering two aspects of fortification—vitamin D deficiency and infant nutrition.

a. Vitamin D—Recent, nationally representative studies in Indonesia, Malaysia, Thailand and Vietnam (the SEANUTS studies) (20–23) reported significant levels of vitamin D deficiency (using the cutoff of 50 nmol/L; 20 ng/mL) in children 6 mo to 12 y old. Although widespread vitamin D deficiency would not have been expected in sunny, mid-latitude countries, the studies showed 47.5% of all children in Malaysia 4–12 were vitamin D deficient, including 66.7% of urban girls 7–12 y old. In Indonesia, 61.4% of rural girls aged 5–12 were vitamin D deficient. Following up on these important studies, ILSI South East Asia Region (SEAR) held a workshop in November, 2014 on vitamin D and health (24).

ILSI India held a workshop in 2013 on fortification of milk with vitamin D (25). At the ACN session, Dr. Manfred Eggersdorfer will present the results of a clinical trial of vitamin D-fortified milk in India. The second presentation, by Prof. Oran Kwon, will cover vitamin D status and fortification in Korea.

There is a need for nationally representative data in most countries in Asia on vitamin D status. There are few studies in Asia on vitamin D metabolism in Asian diets, or the vitamin D content of local foods.

b. Infant nutrition—Early life nutrition, as embodied in the concept of 1,000 d (from conception to 24 mo) is a critical aspect of both short-term infant health and also the individuals’ long-term health. After the recommended six months of exclusive breast feeding, it has been shown from some diets that partial breast feeding plus small quantities of family foods do not provide the WHO-recommended intakes of some micronutrients (26). Roughly 15 y ago, the Chinese Center for Disease Control and Prevention (Chinese CDC) developed a complementary food which included essential fatty acids and protein through the inclusion of full fat soy flour, mixed with multiple micronutrient powders and given the name Ying Yang Bao (YYB). This complementary food has been trialed successfully and is now being rolled out extensively in China. (27–29).

In various trials the use of YYB reduced anaemia prevalence by 45% in 6 mo, improved child growth compared to a placebo, and in a follow-up study found that those given YYB had significantly higher IQs than controls; this difference was sustained until 6 y of age. Dr. Junsheng Huo of the Food Fortification Office, Chinese CDC, will present an update of this work, which is now reaching more than 12 million children in China, at the Asian Congress of Nutrition, in Yokohama, Japan, May, 2015.

The Way Forward:

Fortification is already widely used as a tool in Asia to address micronutrient deficiencies, but there is significant scope for greater use to dramatically reduce these deficiencies and to improve health.

1. Better quality and more consistent data on fundamental foundational issues (food intake data, food composition data, nutritional status data) are needed in most Asian countries. Progress has recently been made but greater efforts are needed, especially in newly developing countries such as Myanmar.

2. Rice is the staple food of the majority of people in Asia, and little fortified rice is consumed so far. Technical issues are being addressed and greater efforts to scale up are critical.

3. For wheat flour fortification, many countries in Asia are not yet following the WHO/FAO recommendations for fortificants and dose levels (30). These recommendations address critical bioavailability issues that have hindered the effectiveness of flour fortification in the past.

4. Stunting has fallen significantly over the past three decades in Asia but levels are still high. Infant nutrition needs greater focus, in conjunction with the Scaling Up Nutrition (SUN) activities that are already starting in many Asian countries.

5. Broad regions of Asia, from central India through SE Asia and southern China have significant levels of genetic polymorphisms and hemoglobinopathies, especially thalassemia. A recent study in Cambodia has shown in one rural city, 54% of women had a genetic hemoglobin disorder, which included 25 different genotypes (most commonly, hemoglobin E variants and α-thalassemia) (31). These disorders can also cause anemia, so it’s important to know the cause of anemia in order to determine proper treatment.

6. Consideration should be given to looking at a broader range of micronutrients for potential deficiencies. A recent study in Cambodia in two cities (urban and rural) showed thiamin and riboflavin deficiencies. Thiamin insufficiency (TDP≤90 nmol/L) was common among both urban (39%) and rural (59%) Cambodian women (32). This vitamin will be included in a nationally representative survey in Cambodia to be completed in 2015, which will determine if this is common countrywide. Although beriberi is the most common endpoint for concerns over thiamin deficiency, recent extensive studies have shown that deficiency of this vitamin causes increased levels of lactic acid and reduced concentrations of several cellular substrates that are generated from TPP-dependent enzymes. This in turn may cause metabolic, neurological, and developmental problems, encompassing brain, cerebellar, and neurological dysfunction (33).
Generally, intakes of thiamin in Asia are unknown at present, as are, for example, vitamin K, magnesium and other potentially important micronutrients.

REFERENCES


