FOOD FORTIFICATION : A NOVEL ATTEMPT TO COMBAT MICRONUTRIENT DEFICIENCY

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Changing lifestyles, unavailability of nutritious food and decreased energy intake of the population during recent years have placed greater emphasis on the need to measure the amounts and the bioavailability of nutrients in the food supply. Deficiency diseases in humans are directly or indirectly caused by a lack of essential nutrients in the daily diet. Deficiency diseases are commonly associated with chronic malnutrition. According to World Health Organization (WHO), malnutrition is the greatest single threat to world's public health. It is the biggest contributor to child mortality in the world as about 2.2 million children die of malnutrition. It also increases risk of infections and results in retarded growth, low cognitive development etc.

Micronutrient deficiency is a global burden and poses a great challenge for the policy makers and implementation agencies. This is further evident from the facts that about two billion people suffer from iron and folic acid deficiency, one billion people have chronic under nutrition, 200 million women are iodine deficient during pregnancy, 200 million children are vitamin A deficient and 167 million children are suffering from protein energy malnutrition.

Micronutrient malnutrition justifies its synonym "Hidden Hunger". It is widespread in the industrialized nations and even more so in the developing countries. It affects persons from all age groups, but young children and women of reproductive age are at greater risk of developing micronutrient deficiencies. Worldwide, iron, vitamin A and iodine deficiency are the most common forms of malnutrition affecting at least one third of the world's population. Since most populations in resource-poor settings do not have access to adequate quantities of fruits, vegetables and meat, providing vitamin tablets poses logistical and economic constraints; food fortification is a practical and inexpensive alternative.

Food fortification

Food fortification is defined as the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups (FAO/WHO, 1994). Thus, in this method a natural food is enriched with certain nutrient or nutrients that is/are not present in that foodstuff. Examples of fortification includes fluoridation of drinking water in endemic areas to prevent dental caries, Iodization of salt to prevent iodine deficiency disorder like goitre/thyroid dysfunction, vitamin A fortification of Vanaspathi to prevent xerophthalmia or night-blindness, iron to salt or flour for prevention of anaemia, a major public health issue in developing countries.

Advantages of fortification

- Food fortification is the safest strategy for providing measured amount of nutrient in the diet in low concentration.
- Potentially rapid improvements can be achieved in micronutrient status of population across geographies.
- Reasonable cost, especially with existing technology and local distribution networks.
- Requires no changes in existing food patterns or in individual compliance

Types of food fortification

1. Conventional fortification: e.g. Staple foods (flour, sugar, milk, oil, rice), dairy (milk, yoghurt), spreads (margarine), condiments (salt).
2. Home fortification: e.g. Crushable/ soluble tablets, powder, spreads.
3. Bio-fortification: e.g. Agricultural products (rice, maize, sweet potato)

Technologies for Food Fortification

Primary requirement for any fortification strategy is, the food should be centrally processed and distributed where the nutrient should be added at the point of processing. It requires uniform mixing of micronutrients into the food product being processed whether it's a dry powder mixing, oily product blending or water-miscible liquid blending. Dosing equipment like dosing meter is required to be installed for continuous production plants. Measured quantity of fortificant can be added to batches of food product during processing. In case of spray drying process food fortificants can be added to the slurry before spray drying. For fortification of items like sugar and rice special technologies have been developed.

Micronutrient premixes are prepared by addition of one or more physiologically active nutrients together in a base of inert carrier blended thoroughly in a blender/mixer to achieve a uniform particle distribution. Premixes are either in dry powder, oily liquid or water miscible liquid forms. Vitamins, minerals, trace elements are used in preparing premixes blended with an inert carrier like starch, dextrose. Fat soluble vitamins like A, D, E and K are made into water dispersible powder forms by emulsification. Therefore, all these vitamins are safely added into dry powder premixes in a stabilised form. Procurement of premixes offer several advantages to food manufacturers. The manufacturer must not only know the technology of combining ingredients to produce attractive, safe and nutritious foods, but in the current regulatory climate give serious attention to the formulation, labelling and cost implications of existing and proposed food regulations.

While selecting a vehicle (foods to be fortified like edible flour, edible oils, sugar, rice, salt, milk etc.), some criteria should be followed, i.e.

a. It should be commonly consumed by the target population
b. It should have constant consumption pattern with a low risk of excess consumption
c. It should have good stability during storage
d. Relatively low cost material
e. Having centrally processed with minimal stratification of the fortificant
f. Not having interactions between the fortificant and the carrier food
g. Contained in most meals, with the availability unrelated to socio-economic status and linked to energy intake

While selecting a nutrient for fortification, some criteria should be followed, i.e.

- It shouldn't develop colour when mixed with the vehicle
- It should be well absorbed in body when consumed with a meal
- It must not impart colour or taste to food
- It should be stable during storage and transportation of fortified foods

Bio-fortification

Bio-fortification is the method of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding, or through genetic engineering. Bio-fortification differs from ordinary fortification because it focuses on making plant foods more nutritious as the plants are growing, rather than having nutrients added to the foods when they are being processed. This is an improvement on ordinary fortification when it comes to providing nutrients for the rural poor, who rarely have access to commercially fortified foods. As such, bio-fortification is seen as an upcoming strategy for dealing with deficiencies of micronutrients in the developing world. In the case of iron, WHO estimated that bio-fortification could help in curing two billion people suffering from iron deficiency-induced anemia. The poor, particularly the rural poor, tend to subsist on a diet of staple crops such as rice, wheat and maize, which are low in these micronutrients, and most cannot afford or efficiently cultivate enough fruits, vegetables or meat products that are necessary to obtain healthy levels of these nutrients. As such, increasing the micronutrient levels in staple crops can help prevent and reduce the micronutrient deficiencies - in one trial in Mozambique, eating sweet potatoes biofortified with beta-carotene reduced the incidence of vitamin A deficiency in children by 24 percent.

A number of crops are being investigated for bio-fortification

Nutrient	Crop
β-carotene/ pro-vitamin A	Bananas, Orange sweet potatoes, 'Orange' Maize, Cassava
β-carotene/ pro-vitamin A, iron, zinc	'Golden Rice'
Iron	Beans, Pearl millet
Zinc	Wheat

Technologies of future food fortification

Different technologies will be used for production of different nutritious foods to meet the deficiency challenges, e.g. nanotechnology (to produce designer foods), biotechnology (to produce foods with probiotics), microencapsulation (controlled release of vitamins and flavours), colloidal technology (for creating food gels and sols), techno-foods (nutritional paste form, texturised form) and space food technologies (for transporting foods to spaceships to have longer shelf life of more than 2 years).

Conclusion

Fortification of foods is currently used to improve the nutrient intake of individuals in the community. It helps in improving the nutritional status of populations keeping the nutrient level adequate to correct or prevent nutritional deficiencies. If made universal through a commonly consumed product, food fortification can bring these benefits to whole populations and help to break the cycle of poverty. Direct technical assistance and training to indigenous food industries in food fortification, as well as in basic food processing, quality control, packaging and marketing, can strengthen these businesses' institutional capacity to deliver quality products on a sustainable basis and improve nutritional security.

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