Food Fortification Techniques

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Micronutrient deficiencies form a serious world health issue, with deficiency disease affecting key development outcomes as well as poor physical and mental development in kids, vulnerability or exacerbation of the illness, mental retardation, visual impairment, and general losses in productivity and potential. In contrast to energy-protein malnourishment, the health impacts of micronutrient deficiency aren't continually acutely visible; it's so generally termed 'hidden hunger'.

It is widespread within developed countries as well as developing countries. It affects all age groups; however, young kids and ladies of reproductive age are among those most in danger of this malnutrition.the main vitamin deficiencies nowadays are most likely vitamin A, vitamin D, and folic acid, though niacin deficiency in maize intake populations, vitamin B1 deficiency in rice-eating populations, and scurvy disease caused by lack of eating fresh fruits and vegetables.Globally, the one-third population is affected by the 3 most common varieties of malnutrition, micronutrient iron, vitamin A, and iodine deficiency.

Food fortification

According to FAO/WHO (1994) Food fortification has been defined as the addition of one or more essential nutrients to a food, whether 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.

Advantages of fortification

- Since staple foods that are normally consumed are enriched with nutrients, this is a splendid technique to enhance the health of a population with lesser effort.
- Fortification may be a safer means of making certain higher nutrition among people. Since fortification is done as per tips by approved standards, an overdose never happens.
- It is not necessary for folks to form changes in their routine food habits.
- It is socio-culturally acceptable thanks to delivering nutrients to folks.
- Food characteristics don't seem to be altered by fortification.
- Implementation of fortification programs will be fleetly done. The positive impact on organic process status is quickly evident too.
- If the present technology and delivery platforms are taken advantage of, fortification will be cost-efficient.
- It has a high benefit-to-cost ratio. The Copenhagen agreement estimates that each rupee spent on fortification leads to an advantage of Rs 9.

Types of food fortification

1. Conventional fortification:

e.g., Staple foods (flour, cereals, oil, rice), dairy (milk, yoghurt, milk powder), spreads (margarine, butter), condiments (salt, sugar).

2. Home fortification:

e.g., Crushable/ soluble tablets, powder, spread.

3. Bio-fortification:

e.g., Agricultural products (rice, maize, sweet potato)

Food vehicle for fortification

The carrier material is required for food fortification which carries the micronutrient and is commonly consumed by the target population. These carrier materials are daily-use foods like cereal and grain products, milk and dairy products, fats and oils, infant formula and substitution foods, and condiments like salt and sugar. There are specific foods which are used to fortify the different micronutrients like edible oil is used to fortify with vitamins A, D and E; Milk with vitamins A and D, Ca; Cereals with Fe, Zn Vit. B1, B2, B3, B6, B12 Folic acid Vitamin A; salt with Iodine and Fe, Sugar with vitamin A.

Technologies for Food Fortification

The 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 needs uniform mixing of micronutrients into the food product under processing. For this, we use various techniques for the fortification of diverse types of foods. Like dry blending, microencapsulation, micronutrient premixes etc.

Dry Blending Process

In the dry blending process, the ingredients are completely dehydrated powders. Micronutrients are mixed to achieve a uniform blend of macro and micronutrients. Two or more vitamins can be added at the same manufacturing stage. Micronutrients are added to the food and mixed with the help of blenders like Tumble Blenders, Ribbon Blenders, and Vertical Blenders.

The challenge of blending ingredients with different particle sizes is that bulk density and variable particle sizes can lead to segregation. Therefore, for the homogeneous product, micronutrients are first mixed with the carrier and made into a blend, and then this blend is mixed into the product.

Premix fortification technique

It is a fortification practice to add multiple vitamins and minerals using a single ingredient called a premix. Premixes are either in dry powder, oily liquid, or water-miscible liquid forms. In premixes, these micronutrients are blended with an inert carrier like starch or dextrose, and a water-dispersible powder forms by emulsification. In the case of flour fortification, premixes contain diluents (starch, calcium salts, maltodextrin, or other bulking agents) and free-flow agents (tricalcium phosphate, silica) along with micronutrients.

There are 3 types of feeders that are commonly used to meter premix into product

a. Screw type feeder
b. Revolving disk feeder
c. Drum feeder

Microencapsulation

During the storage of encapsulated foods, there will be more loss of micronutrients such as vitamins and minerals due to oxidation or heat degradation. Due to this, encapsulation is the best approach for delivering two or more micronutrients simultaneously in a stable and bioavailable form without interaction and degradation. It also improves the properties of fortified food by hiding the unwanted colours and tastes of fortification by preventing the interaction between the fortification and the food carrier.This technology overcomes the instability of vitamins and reactivity of minerals in the processed products. It maintains the active ingredients in a stable environment, separated from other food components and thereby preventing undesirable changes in fortified foods. This technology can be the best approach for delivering two or more micronutrients simultaneously in a stable and bio-available form.

Microencapsulation consists of mixing the active material with the encapsulant material, making an emulsion. The mixture can be made with one or two agents. The mixture is then dried, producing microcapsules of different diameters and forms depending on the preparation method and materials used.

Benefits associated with encapsulation.

- Microencapsulation is a method for preventing the compounds, which are volatile and vaporize at room temperature.
- The microencapsulation process can also help to mask undesirable odours and flavours in the final product.
- Protection of active components from factors that can cause oxidation and hence prolong shelf life.

Methods of microencapsulation

- Physicochemical methods (separation of the organic phase, simple or complex coacervation, and liposomal wrapping),
- Physical methods (spray-drying, spray chilling, spray coating, fluidized bed, extrusion, centrifugation with multiple orifices, co-crystallization, and lyophilization),
- Chemical methods (interfacial polymerization and molecular inclusion) have been developed for microencapsulation.

Bio-fortification

Bio-fortification is the process of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding or through genetic engineering (Table 1). Instead of adding nutrients to the meals after they are processed, bio-fortification concentrates on enhancing the nutritional value of plant foods while the plants are still growing.

Micronutrient deficiency is a problem in the developing world, and bio-fortification is being considered as a potential solution. According to WHO estimates, the bio-fortification of iron could help treat two billion cases of anemia brought on by an iron shortage. Similarly, in one trial in Mozambique, eating sweet potatoes biofortified with beta-carotene reduced the incidence of vitamin A deficiency in children by 24 per cent.

Table1. Crops are being investigated for bio-fortification.

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

Conclusion

Micronutrient malnutrition has been a major problem in the world. That should be reduced, and the best and convenient method to reduce this problem is fortification. Fortification is the addition of micronutrients to the food that is consumed on the daily basis. The main purpose of fortification techniques is that the micronutrients should be properly blended and stable with the product. So Nowadays many techniques have been developed to fortified different products.

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