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Food fortification

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Abstract
Food fortification or enrichment is the process of adding micronutrients (to food). It can be carried out by food manufacturers. Fortification refers to "the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals in a food, so as to improve the nutritional quality of the food supply and to provide a health benefit with minimal risk to health", whereas enrichment is defined as "synonymous with fortification and refers to the addition of micronutrients to a food which are lost during processing". Vitamins and minerals are only needed in small amounts, but are essential for normal growth, good health, Normal brain growth, good performance, strengthening immune system, healthy babies and healthy aging. These vitamins and minerals are not produced by the body it has to come from the diet.

Keywords: Food, fortification, vitamins, body, PEM

Introduction
Life cannot be sustained without adequate nourishment. About one-third of world population is being affected by hidden hunger which means the deficiencies of essential micronutrients (vitamins and minerals) in individuals or populations which impact on health, function, survival and economic development. Vitamins and minerals are only needed in small amounts, but are essential for normal growth, good health, normal brain growth, good performance, strengthening immune system, healthy babies and healthy aging. These vitamins and minerals are not produced by the body and have to come from the diet.
Deficiencies of vitamins and minerals can cause learning disabilities, mental retardation, poor health, low work capacity, blindness, premature death. The result is a devastating public health problem. Protein-energy malnutrition (PEM) and micronutrient deficiencies has been a subject of great concern for nutritionists and health authorities.
The World Bank “World Development Report 1993” found micronutrient programs to be the most cost-effective of all health interventions. There are different approaches that can be used to improve micronutrient malnutrition management.
These include: Supplementation, Dietary diversification, Fortification

Supplementation
Supplementation is the provision of large doses of nutrients usually in the form of pills, capsules or syrups. It supplies optimal amount of specific nutrients in highly absorbable form. It is the fastest way to control deficiencies in population.
Supplementation usually requires: Procurement and purchase of micronutrients, Effective distribution system, high degree of consumer appliance
Disadvantage: Lack of supplies and poor compliance

Dietary diversification
This approach involves creating larger and more diverse diets for the target population. Educational complaining should be conducted to provide the information about which food promotes higher levels of vitamins and minerals. Another possibility is increasing the distribution of food to the regions from another areas.

Fortification
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.

Importance of fortification
- It helps in Prevention or minimization of the risk of micronutrient deficiencies.
- It involves in Contribution to the correction of demonstrated micronutrient deficiency.
- Results Improvement in nutritional status.
- Results Improvement in health conditions.

Need of fortification in fruits and vegetables
Fruits and vegetables are the source of essential nutrients like vitamin C and ß-carotene. These intake is below the recommended levels. Due to high perishable nature these are wasted to the tune of 25-30% in the glut period. To cope up these problems of wastage these commodities available in glut period has to be processed. Processing of fruits and vegetables in combination with enrichment of nutrients will help in development of nutritionally rich products. Fortification is one of the best technique of producing the nutrient rich foods. Preservation of nutrients in the processed foods has a special health and nutritional significance in India.

Status of fortified fruit and vegetable products
- Fruit juices, Nectars : Rich in iron, calcium, Vitamin A, C, E and B
- Fruit bars: Rich in proteins, vitamin C
- Fruit pulps: Rich in proteins
- Jams Jellies Seasonings : Rich in Vitamins A, D, E
- Vegetable products : Rich in iodine, antioxidants

Any fortification program should be based on a demonstrated need for increasing the intake of an essential nutrient in one or more population groups. This may be in the form of clinical or subclinical evidence of deficiency estimates indicating low levels of intake of nutrients or possible deficiencies likely to develop because of changes taking place in food habits

Guidelines on food fortification with micronutrients
WHO and FAO, 2006 had given the following guide lines for fortification of food. Food fortification should be:
- Socially acceptable
- Does not require change in food habits
- Does not alter the characteristics of the food
- Produce nutritional benefits for the target population
- Safe
- Cost-effective

Selection of vehicle for fortification
- Commonly consumed by the target population
- Constant consumption pattern
- Good stability during storage
- Relatively low in cost
- Available unrelated to socio-economic status of the people

Techniques of fortification
- It requires uniform mixing of micronutrients in to the food product being processed.
- Dosing equipment like dosing meters are required to be installed for continuous production plants.
- Measured quantity of fortificant can be added to batches of food product during processing.

Types of fortification
- Mass fortification
- Targeted fortification
- Market-driven fortification
- Home fortification
- Bio fortification

Mass fortification
It refers to the addition of micronutrients to foods commonly consumed by the general public.

Targeted fortification
It refers to the fortification of foods designed for specific population subgroups, such as complementary weaning foods for infants.

Market-driven fortification
It refers to the situation where the food manufacturer takes the initiative to add one or more micronutrients to processed foods.

Home fortification
This approach consists of supplying deficient population with home mixed vitamins and minerals in packages or tablets that can be added when cooking meals. This approach is a merger of supplements and fortification

Biofortification
Enriching germplasm with micronutrients through conventional breeding methods, molecular breeding and genetic engineering is a promising method for increasing dietary access to micronutrients. Bio-fortification is a sustainable intervention being a seed-based technology. There is no recurring cost once the varieties are developed and adopted. It can benefit the farmer as well as the consumer if the cost of the seed is kept low and not exploited by seed companies. Bio-fortified plants grow better. The Harvest Plus: bio-fortification challenge programme is an interdisciplinary, global alliance of research and implementing institutions. India is part of this programme. It includes: ß carotene (pro-vitamin A) - rich sweet potato and cassava, zinc and iron rich rice, wheat, maize, pearl millet and beans.
For conventional breeding or molecular breeding to improve the micronutrient content of the foods, sufficient within species diversity with appropriate gene pool would be necessary. Also this approach is slow.

Phyto fortification
It is a part of biofortification. Fortification of plants with essential nutrients and vitamins is called as phyto fortification.
Phyto fortification was divided into:
- Agronomic phyto fortification
- Genetic phyto fortification

Agronomic phyto fortification
- Fortification of plants with essential nutrients by mens of soil application or through spraying is known as phyto fortification.
- This could be used by food companies as a cost-effective method to produce nutrients rich products.
  Eg: Enrichment of potatoes with Iodine in Italy.

Genitic phyto fortification
Breeding of crop varieties with enhanced accumulation characteristics through conventional breeding methods, molecular markers is known as genetic phytofortification.

A number of crops are currently investigated for bio-fortification

Crop: Nutrient

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

However due to regulatory and other reasons most of the developments did not make it to the market yet.

Microbial fortification

It involves using probiotic bacteria, which ferment to produce Beta-carotene in the foods. Lactic acid bacteria is often selected for addition to food because they are presumed to have beneficial effects on the host.

Examples of fortified foods

- Iodized salt has been used in the United States since before World War
- Folic acid is added to flour in many industrialized countries, and has prevented a significant number of neural tube defects in infants
- Niacin has been added to bread in the USA since 1938 a programme which substantially reduced the incidence of pellagra.
- Vitamin D is added to a few foods (especially margarine)
- Fluoride salts are added to water and toothpastes to prevent tooth decay.
- Calcium is frequently added to fruit juices, carbonated beverages and rice

Advantages

- If consumed on a regular and frequent basis, fortified foods will maintain body stores of nutrients more efficiently and more effectively.
- Fortified foods are better at lowering the risk of the multiple deficiencies that can result from seasonal deficits in the food supply.
- Fortification of widely distributed and widely consumed foods has the potential to improve the nutritional status of the people.
- When properly regulated, fortification carries a minimal risk of chronic toxicity.
- Fortification is often cost-effective strategy, especially if the technology already exists and appropriate food distribution system is in place.
- It does not affect the organoleptic properties.
- It is usually possible to add one or several nutrients without adding substantially to the total cost of the food product.

Limitations

- Fortification alone does not correct the micronutrient deficiencies. While fortified foods contain increased amounts of selected micronutrients, they are not a substitute for a good quality diet that supplies adequate amounts of energy, protein, essential fats and other food constituents required for optimal health.
- A specified food stuff might not be consumed by all members of the target population. Conversely, everyone in the population is exposed to increased levels of micronutrients in the food irrespective of whether or not they will benefit from fortification.
- Fortified foods often fail to reach the poorest segment of populations due to low purchasing power and underdeveloped distribution channel. In populations who rely on staples, it may be difficult to find an appropriate food to fortify. Fortification of sugar, seasonings, sauces and condiments may provide a solution to this problem.
- The nature of the food vehicle and/or the fortificant, may limit the amount of fortificant that can be successfully added. For example, some iron fortificants change the colour and flavor of many foods to which they are added, and can cause the destruction of fortificant vitamin A and iodine. Ways of solving these problems (e.g. microencapsulation of fortificants with protective coatings) have been developed, but some difficulties remain.
- Very low-income populations are known to have coexisting multiple micronutrient deficiencies, as a result of inadequate intakes of the traditional diet. Although multiple micronutrient fortification is technically possible, the reality is that the poor will be unable to obtain recommended intakes of all micronutrients from fortified foods alone.
- Technologies related to fortification have yet to be fully resolved, especially with regard to appropriate levels of nutrients, stability of fortificants, nutrient interactions, physical properties, as well as acceptability by consumers including cooking properties and taste.

Future challenges

- Create community awareness about benefits of food fortification on improvement of Productivity and Health in general
- Private Sector, Governments and International Agencies need to make commitments for investing in food fortification
- Ensure increased availability of fortified foods to the vulnerable groups of populations
- Governments and International Agencies should encourage Food processors to take up food fortification of their products by way of tax concessions or duty rebates
- Regulatory authorities in geographical regions to recommend Uniform Food Fortification Guidelines to the group countries
- Develop Technologies that will produce the Futuristic foods

Conclusion

- Fortification of fruits and vegetable products improves the nutritional status of the people by correcting the deficiencies of the nutrients.
- It increases the nutritional value of processed foods.
- It is the safest strategy of providing measured amount of nutrients in the diet in low concentration.
- It's most cost effective approach to prevent stated deficiencies and does not require change of food habits or practices.
- It is the sustainable approach to overcome the problems of wastage of produce during glut period and malnutrition.

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