International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 19
August 2018

"Food Fortification"-A Valuable Mystery in Present Food Decades for Wonderful Nutrition

DR. D. PADMAVATHI M.Sc., M.Phil., PGDHRM., Ph.D.

GUEST PROF, PG DEPT OF FOODS & NUTRITION, MUTHURANGAM GOVERNMENT ARTS COLLEGE(A), VELLORE.,

EMAIL ID; dr.deenapadmavathi@gmail.com

Abstract

Food fortification is the process of adding micronutrients (essential trace elements and vitamins) to food. Staple foods of a region can lack particular nutrients due to the soil of the region or from inherent inadequacy of a normal diet. As defined by the World Health Organization (WHO) and the Food and Agricultural Organization of the United Nations (FAO), fortification refers to "the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food irrespective of whether the nutrients were originally in the food before processing or not, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health", From the technical point of view, nutritional stability during formulation, preparation, and processing is crucial for the effective production of fortified foods. benefit of food fortification with selected micronutrients most relevant for developing countries. Micronutrients covered include iron, iodine, vitamin A, and zinc. The main focus is on commercial fortification, although home fortification and biofortification are focussed. Fortification with iron, vitamin A, and zinc averts significant numbers of infant and child deaths and is a very attractive preventive health-care intervention. Fortification with iron, iodine, and potentially zinc provides significant economic benefits and the low unit cost of food fortification ensures large benefit: cost ratios, with effects via cognition being very important for iron and iodine. Fortification will not reach all individuals and is most attractive as an investment where there is a convenient food vehicle, where processing is more centralized, and where either the deficiency is widespread or the adverse effects are very costly even though only a small group is affected.

Based upon this background this present paper reviews and summarize the importance need and advantages over **"Food Fortification"**

Keywords: Fortification, Nutrition, Nutrients, Food standards, Health benefits, Food laws, Food Policy

INTRODUCTION

Food Fortification was defined as in the Codex Alimentarius, (1991) namely, "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 ".

Food fortification has proved to be one of the safest and most cost-effective measures to improve the nutritional value of a specific diet. It is being applied since decades in various countries by adding value to different staple foods. The selection of an appropriate food to be fortified is very important and the decision should be taken before the fortification process. The selecting criteria of appropriate food depends on factors like choices in food that are commonly consumed by that particular population, affordability, and availability in all seasons throughout the year. In several developing countries, wheat flour and sugar has been preferred for fortification in order to enrich the food lacking in essential micronutrients and to reduce the prevalence of identified deficiencies. Fortification as part of a country's nutrition strategy is supported by global organizations such as UNICEF, the World Health Organization (WHO), the World Food Programme (WFP), the U.S. Centres for Disease Control and Prevention (CDC), the Global Alliance for Improved Nutrition (GAIN), and Nutrition International. For the latest evidence and guidance on nutrition interventions. Many countries have used rice as an important staple food for fortification. The addition of macronutrients to food is somewhat different sort of food fortification as compared to micronutrients.

History of Food Fortification

- Dietary supplementary of nutrients began in the 1920's
- Food fortification with nutrients was recommended by the American Medical Association and the National Academy of Sciences in the 1930's
- At the instigation of these two organizations (Food and Drug Administration) began to promulgate food standards for fortified food in the early 1940s, and continued this policy following World War II

Why is food fortification important?

Fortified foods help to fill in the nutritional gaps in our diet. They can deliver vitamins and minerals to large portions of the population without requiring large changes in our behaviour or diet.

Advantages of Fortification

- Food fortification does not require people to change their eating habits thus it is socially acceptable.
- The effect of fortification is both fast and board.
- Fortification does not affect organoleptic properties
- Food fortification is the safest strategy as the added nutrient is provided in the diet is low but constant amounts
- Way to deliver necessary amounts of micronutrients.

Food Fortification Policy (21 CFR 104.20)

The objective is to establish a uniform set of principles/guidelines that would serve as a model for the rational addition of essential vitamins and minerals to foods • Discourages indiscriminate addition of nutrients to foods

Fortification Policy

Does not consider it appropriate to fortify fresh produce; meat, poultry, or fish products; sugars; or snack foods (e.g., candies or carbonated beverages)

Principles: Reasons for Adding Essential Nutrients

- To correct a dietary insufficiency recognized by the scientific community to exist and known to result in nutritional deficiency disease and/or for a public health purpose
- To restore nutrients to levels representative of the food prior to storage, handling, and processing
- To maintain a balanced nutrient profile in proportion to the caloric value of a food (e.g., meal replacement products)
- To avoid nutritional inferiority in foods that replace traditional foods.

Laws for Food Fortification

Press Information Bureau

Government of India

Ministry of Health and Family Welfare

- In order to promote fortification as a means to address micro nutrient deficiencies, the Food Safety and Standards Authority of India (FSSAI) has operationalised on 16.10.2016, the draft Food Safety and Standards (Fortification of Foods) Regulations, 2016 that, inter-alia, includes provisions regarding standards for fortification of food articles namely wheat flour, rice, milk, edible oil and salt with vitamins and minerals. At present, all the major oil producers in the country are voluntarily fortifying at least one brand in their product portfolios.
- The draft Food Safety and Standards (Fortification of Food) Regulations, 2016 stipulate that the FSSAI may from time to time mandate fortification of any food article specified under the regulations on the directions of the Government of India or on the recommendations of the States/UTs and in consultation with stakeholders. Under Food Safety and Standards (Prohibition and Restriction on Sales) Regulations, 2011, sale of only iodized salt is permitted for direct human consumption. Further, Food Safety and Standards (Food Product Standards and Food Additives) Regulations, 2011 provide that Vanaspati shall contain synthetic Vitamin A.

Supplementation

Supplementation is the term used to describe the provision of relatively large doses of micronutrients, usually in the form of pills, capsules or syrups. It has the advantage of being capable of supplying an optimal amount of a specific nutrient or nutrients, in a highly absorbable form, and is often the fastest way to control deficiency in individuals or population groups that have been identified as being deficient. In developing countries, supplementation programmes have been widely used to provide iron and folic acid to pregnant women, and vitamin A to infants, children under 5 years of age and postpartum women. Because a single high-dose vitamin A supplement improves vitamin A stores for about 4–6 months, supplementation two or three times a year is usually adequate.

There are several main groups of food supplements like:

- Vitamins and co-vitamins
- Essential minerals
- Essential fatty acids
- Essential amino acids
- Phytonutrients
- Enzymes

Fortification in Foods

Many foods and beverages worldwide have been fortified, whether a voluntary action by the product developers or by law. Although some may view these additions as strategic marketing schemes to sell their product, there is a lot of work that must go into a product before simply fortifying it. In order to fortify a product, it must first be proven that the addition of this vitamin or mineral is beneficial to health, safe, and an effective method of delivery. The addition must also abide by all food and labelling regulations and support nutritional rationale.

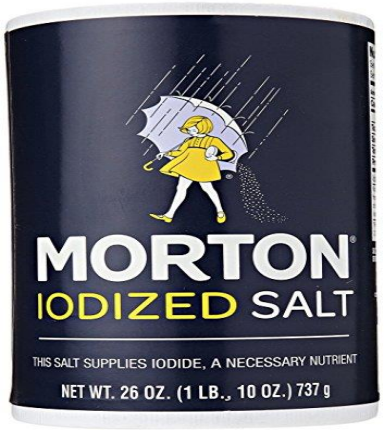
From a food developer's point of view, they also need to consider the costs associated with this new product and whether or not there will be a market to support the change.

Iodized salt

Iodine deficiency disorder (IDD) is the single greatest cause of preventable mental retardation. Severe deficiencies cause cretinism, stillbirth and miscarriage. But even mild deficiency can significantly affect the learning ability of populations. Today over 1 billion people in the world suffer from iodine deficiency, and 38 million babies born every year are not protected from brain damage due to IDD.Deputy Executive Director, UNICEF, October 2007.

Iodised salt has been used in the United States since before World War II. It was discovered in 1821 that Goitres could be treated by the use of iodized salts. However, it was not until 1916 that the use of iodized salts could be tested in a research trial as a preventative measure against goitres.

Diseases that are associated with an iodine deficiency include: mental retardation, hypothyroidism, and goitre. There is also a risk of various other growth and developmental abnormalities.



Folic acid

Folic acid (also known as folate) functions in reducing blood homocysteine levels, forming red blood cells, proper growth and division of cells, and preventing Neural tube defects(NTDs). In many industrialized countries, the addition of folic acid to flour has prevented a significant number of NTDs in infants. Two common types of NTDs, spina

bifida and anencephaly, affect approximately 2500-3000 infants born in the US annually. Research trials have shown the ability to reduce the incidence of NTDs by supplementing pregnant mothers with folic acid by 72%.

The RDA for folic acid ranges from as low as 150 µg/day for children aged 1–3 years old, to 400 µg/day for males and females over the age of 19, and 600 µg/day during pregnancy Diseases associated with folic acid deficiency include: megaloblastic or macrocytic anaemia, cardiovascular disease, certain types of cancer, and NTDs in infants.

Niacin

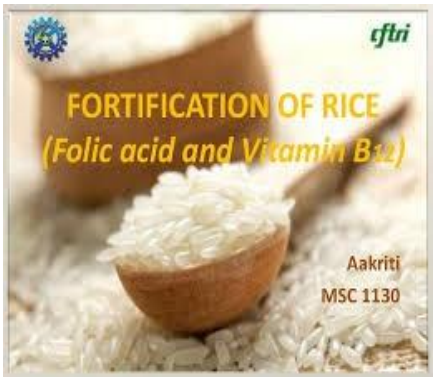
Niacin has been added to bread in the USA since 1938 (when voluntary addition started), a programme which substantially reduced the incidence of pellagra. As early as 1755, pellagra was recognized by doctors as being a niacin deficiency disease. Although not officially receiving its name of pellagra until 1771. Pellagra was seen amongst poor families who used corn as their main dietary staple. Although corn itself does contain niacin, it is not a bioavailable form unless it undergoes nixtamalization (treatment with alkali, traditional in Native American cultures) and therefore was not contributing to the overall intake of niacin.

The RDA for niacin is 2 mg NE(niacin equivalents)/day (AI) for infants aged 0–6 months, 16 mg NE/day for males, and 14 mg NE/day for females who are over the age of 19.

Diseases associated with niacin deficiency include: Pellagra which consisted of signs and symptoms called the 3D's-"Dermatitis, dementia, and diarrhoea.

Commonly Fortified Foods	
Salt	Iodine, iron
Wheat and maize flours	Iron, Folic acid, B Vitamins, Vitamin A, Zinc
Cooking oils and fats	Vitamins A and D
Sugar	Vitamin A

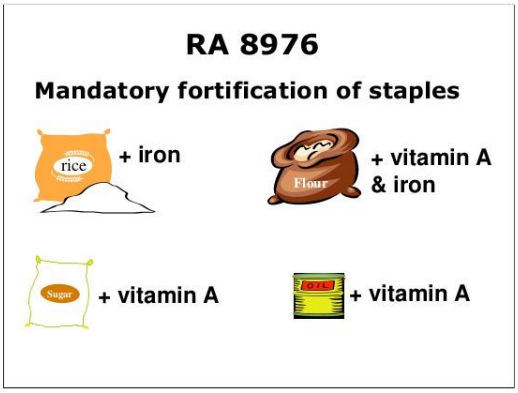
Condiments(sauces)	Iron
Milk	Vitamins A and D, Iron
Complementary Foods	Iron, Folic acid, B Vitamins, Vitamin A, Zinc.



Vitamin A fortification

Fortification of sugar with vitamin A is a strategy that has been used extensively throughout Central America. Starting in Guatemala in 1974, and extending to other countries in the region in subsequent years, the effect of this programme has been to reduce the prevalence of low serum retinol values – from 27% in 1965 to 9% in 1977 (45,46). There is also evidence to suggest that sugar fortification substantially increases the concentration of vitamin A in breast milk (47). When the programme was temporarily discontinued in parts of the region, the prevalence of low serum retinol again increased.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 19
August 2018



Vitamin D

Since Vitamin D is a fat-soluble vitamin, it cannot be added to a wide variety of foods. Foods that it is commonly added to are margarine, vegetable oils and dairy products During the late 1800s, after the discovery of curing conditions of scurvy and beriberi had occurred, researchers were aiming to see if the disease, later known as rickets, could also be cured by food. Their results showed that sunlight exposure and cod liver oil were the cure.

The current RDA for infants aged 0–6 months is 10 µg (400 International Units (IU))/day and for adults over 19 years of age it is 15 µg (600 IU)/day.

The following vitamins and minerals are used in flour and rice fortification globally. Each country sets standards to include the specific nutrients its population needs.

- **Iron, riboflavin, folic acid, zinc, and vitamin B12** help prevent nutritional anaemia which improves productivity, maternal health, and cognitive development.
- **Folic acid (vitamin B9)** reduces the risk of severe birth defects of the brain and spine. Fortifying with folic acid may also have a role in the child's mental health.
- **Zinc** helps children develop, strengthens immune systems, and lessens complications from diarrhoea.
- **Niacin (vitamin B3)** prevents the skin disease known as pellagra.
- **Riboflavin (vitamin B2)** helps with metabolism of fats, carbohydrates, and proteins.
- **Thiamine (vitamin B1)** prevents the nervous system disease called beriberi.
- **Vitamin B12** maintains functions of the brain and nervous system.
- **Vitamin D** helps bodies absorb calcium which improves bone health.

- **Vitamin A** deficiency is the leading cause of childhood blindness. It also diminishes an individual's ability to fight infections. **Vitamin A** can be added to wheat or maize flour, but it is often added to rice, cooking oils, margarine, or sugar instead.
- **Calcium** builds strong bones, helps transmit nerve messages and assists with muscle function and blood clotting. A few countries add calcium to flour, but it is more commonly added to other foods.
- **Selenium** helps with reproduction and thyroid gland function.
- **Vitamin B6** is needed for enzyme reactions involved in metabolism.
- **Folic acid, vitamin B6 and vitamin B12** lower homocysteine levels.

Effectiveness of food-fortification programmes

Food fortification differs from other programmes that involve the addition of nutrients to foods. Fortification is a nutritional intervention programme with a specifically defined target, and fortified food products are expected to become a main source of the specific added nutrient. Consequently, food fortification is expected to help prevent nutritional inadequacy in targeted populations in which a risk of nutrient deficiency has been identified. The criterion of the effectiveness of a food-fortification programme is whether the nutritional and health status of a targeted population has been improved.

Several other important factors that should be considered carefully in designing food-fortification programmes are the following.

- The food chosen as the carrier should be consumed in sufficient quantities to make a significant contribution to the diet of the targeted population. Salt, sugar, flour, monosodium glutamate (MSG), and cooking oil have been used. Other foods should be explored, especially with reference to the specific food habits and preferences of targeted populations.
- The addition of nutrients should not create an imbalance of essential nutrients. This is especially important for doubly, triply, or multiply fortified foods, in which interaction among the added nutrients (and also among the added nutrients and the nutrients that are naturally present in the food carrier) is likely to occur.

- The added nutrient should be stable under normal conditions of storage and use. Data on the stability of the added nutrient are also important for labelling purposes.
- The price of the fortified food should be affordable for the targeted population.
- Programmes of quality assurance and control of fortified food can be more easily implemented if the fortification programme is centralized and involves mass production.
- The food should be distributed to as much of the targeted population as possible.

Nutrient stability

Nutrient stability under normal conditions of storage and use is one of the important factors determining the effectiveness of a food-fortification programme. From a technical standpoint, nutritional stability during formulation, preparation, and processing is very crucial in determining the effective production of fortified foods. The following factors relating to nutrient stability are important for the manufacturers of fortified foods.

- The technologist needs to know the extent to which food processes and distribution systems could affect nutrient retention; at the same time, the technologist needs appropriate data to develop strategies for minimizing the losses caused by nutrient instability.
- The quality, legislative, and marketing specialists need adequate information on nutrient stability, especially to enable them to make statements or claims on labels and advertising.
- The accountant needs to be aware of the stability data to establish and justify expenditures on potential modifications of processing techniques, the cost of nutrient premixes, etc.
- The nutritionist needs to be aware of the stability data to assess the choices and, ultimately, the supply of nutrient(s) for consumers. Nutrient stability is affected by physical and chemical factors. A wide range of physical and chemical factors.

Bio-fortification

The breeding and genetic modification of plants so as to improve their nutrient content and/or absorption is Bio-fortification.

Biofortification is the therefore a process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology.

Biofortification aims to increase nutrient levels in crops during plant growth rather than through manual means during processing of the crops, as is the case of standard fortification.

It involves selection of certain cereals such as rice and legumes for their high iron content, various varieties of carrots and sweet potatoes for their favourable β-carotene levels, and maizes for their low phytate content – which improves the absorption of iron and zinc.

Biofortification presents a way to reach populations where supplementation and conventional fortification activities may be difficult to implement and/or limited.

Examples of biofortification projects include.

1. Iron-biofortification of rice, beans, sweet potato, cassava and legumes.
2. Zinc-biofortification of wheat, rice, beans, sweet potato and maize.
3. Provitamin A carotenoid-biofortification of sweet potato, maize and cassava.
4. Amino acid and protein-biofortification of sorghum and cassava.

Conclusion& Recommendations

Food fortification is an essential element in nutrition strategies to alleviate micronutrient deficiencies. It is a dynamic area developing in response to the needs of population groups and industry. Efforts should continue to develop improved and new systems of delivering micronutrients to target populations through appropriate fortification procedures. To facilitate this, those involved in the establishment of food fortification programmes locally must have ready access to information concerning fortification techniques and procedures being used all over the world. A multi-disciplinary approach is essential for successful fortification with active collaboration of all sectors involved. These include; government, donor agencies, food industry, local academic institutions, food legislators and consumers. Adequate monitoring of food fortification is essential and should include both, monitoring of critical control points in the production and distribution of fortified foods and monitoring of micronutrient status of target populations, in establishing the need for intervention and to assess food fortification impact. The importance of this underlines the need for agreement on suitable

clinical and analytical methodologies to be used, where satisfactory methodologies do not exist, improved procedures should be developed. Following the deliberations of the Consultation, general recommendations for food fortification were agreed upon, and specific recommendations were made with respect to technical aspects of food fortification as deemed necessary.

Recommendations

The Consultation agreed upon the following general recommendations regarding food fortification:

1. Where foodstuffs cannot provide naturally occurring essential nutrients to population groups, the use of fortification, following the principles outlined in Codex Alimentarius, should be given serious consideration as a means of achieving ICN goals.
2. A multi-sectoral approach must be adopted in the establishment of any food fortification programme, encompassing participation of relevant governmental organizations, food industry, trade organizations, consumers, academic and research facilities, marketing specialists and any involved international organizations and agencies.
3. Efforts should continue to harmonize national legislation concerning fortified foods, with the international standards of the Codex Alimentarius.
4. International guidelines to advise food aid donors on acceptable and safe fortification practices should be developed; guidelines should not be so restrictive as to impede the provision of high quality food aid commodities nor hinder communication on fortification between relevant parties.
5. There should be appropriate fortification of foods used in food aid programmes, with donors being required to provide relevant nutritional information particularly through adequate.

References

- [b] *"Micronutrient Fortification and Biofortification Challenge | Copenhagen Consensus Center". www.copenhagenconsensus.com. Retrieved 2017-06-14.*

- [b] [c] [d] World Health Organization and Food and Agriculture Organization of the United Nations Guidelines on food fortification with micronutrients. Archived 26 December 2017 at the Wayback Machine. 2006 [cited on 2011 Oct 30].
- Micronutrient Fortification of Food: Technology and Quality Control Archived 2 September 2016 at the Wayback Machine.
- [b] *Liyanage, C.; Hettiarachchi, M. (2011). "Food fortification" (PDF). Ceylon Medical Journal.* ***56*** *(3): 124–127. doi:10.4038/cmj.v56i3.3607. PMID 22164753. Archived from the original (PDF) on 13 May 2016*
- *Darnton-Hill, E (1998). "Overview: Rationale and elements of a successful food-fortification programme". FOOD AND NUTRITION BULLETIN (United Nations University).* ***19*** *(2): 92–100. doi:10.1177/156482659801900202.*
- *Darnton-Hill, E (1998). "Overview: Rationale and elements of a successful food-fortification programme" (PDF). FOOD AND NUTRITION BULLETIN (United Nations University).* ***19*** *(2): 92–100. doi:10.1177/156482659801900202.*
- *"Recommendations on Wheat and Maize Flour Fortification Meeting Report: Interim Consensus Statement" (PDF). Who.int. Retrieved 2016-03-30.*
- *"Food Science | Educating Food Leaders for over 100 years". Uoguelph.ca. Retrieved 2016-03-30.*
- *Bruno Waterfield (24 May 2016). "Marmite made illegal in Denmark". The Telegraph.*
- *McNulty, Helene; Pentieva, Kristina (2007). "Folate bioavailability". Proceedings of the Nutrition Society.* ***63*** *(04): 529–536. doi:10.1079/PNS2004383. ISSN 0029-6651.*