



Food Fortification: A Modern Approach to Combating Nutritional Deficiencies

*Monica Reshi, Neeraj Gupta, Rhythm Gupta, Mahima,
Kamakshi Sharma and Harish Kumar

Division of Post Harvest Management, Sher-e-Kashmir University of Agricultural
Sciences and Technology of Jammu-180009, Jammu and Kashmir, India

*Corresponding Author's email: monikareshi@gmail.com

Food fortification is an important food-based strategy for improving the nutritional quality of commonly consumed foods by deliberately adding essential nutrients or other bioactive components in order to prevent or reduce nutritional deficiencies and promote better health. It involves the addition of vitamins, minerals, proteins, dietary fibre, or other beneficial compounds to foods at appropriate levels without adversely affecting their safety, sensory acceptability, stability, or overall quality. Fortification is particularly valuable because it can improve the nutrient density of foods that are already widely consumed by different population groups.

Micronutrient deficiencies, particularly those involving iron, iodine, vitamin A, vitamin D, folate, calcium and zinc, remain important nutritional concerns in many developing countries. Such deficiencies can adversely affect growth, immunity, cognitive development, physical performance and overall well-being. Food fortification provides a practical approach to addressing these deficiencies because it can reach large population groups through regularly consumed foods and does not necessarily require major changes in dietary habits.

The choice of a suitable food vehicle and fortificant is critical for successful fortification. Cereals, bakery products, beverages, dairy products, edible oils, salt and other frequently consumed foods can serve as effective vehicles for nutrient delivery. The fortificant should be nutritionally appropriate, stable during processing and storage, bioavailable, and compatible with the food matrix. Processing conditions such as heating, drying, extrusion, fermentation and storage may influence nutrient retention and bioavailability; therefore, optimization of fortification levels and processing conditions is essential.

In recent years, the concept of fortification has expanded beyond conventional vitamins and minerals to include proteins, dietary fibre, antioxidants, polyphenols, natural pigments, prebiotics and other functional food components. Incorporation of nutrient-rich plant materials, fruit and vegetable powders, cereal and pulse ingredients, oilseed products and agro-processing by-products can simultaneously improve nutritional value and contribute to the utilization of locally available resources. Such approaches are particularly relevant for developing affordable, nutritious and value-added food products.

Fortification therefore represents an important link between food processing, nutrition, health promotion and value addition. Properly designed fortified foods can help improve nutrient intake, enhance the functional properties of food products and create opportunities for the development of innovative products from locally available agricultural and horticultural resources. However, successful fortification requires careful consideration of nutrient stability, bioavailability, interactions with other food components, recommended intake levels, sensory quality, consumer acceptance and regulatory requirements.

Importance of Food Fortification Nowadays

In the present era, food fortification has gained considerable importance because of changing lifestyles, increased consumption of processed and convenience foods, inadequate dietary diversity, and the continuing prevalence of micronutrient deficiencies. Even when sufficient calories are consumed, diets may not provide adequate quantities of essential micronutrients, proteins, dietary fibre and other health-promoting components. Fortification can therefore help bridge nutritional gaps and improve the overall nutrient density of commonly consumed foods.

1. **Prevention of nutritional deficiencies:** Fortification can contribute to reducing deficiencies of nutrients such as iron, iodine, vitamin A, vitamin D, folate, calcium and zinc. Adequate intake of these nutrients is essential for normal growth, immunity, cognitive function, bone health and overall well-being.
2. **Improvement of nutritional quality:** Fortification enhances the nutritional value of food products by increasing their content of specific nutrients. This is particularly useful for foods that are widely consumed but naturally contain limited amounts of certain nutrients.
3. **Addressing hidden hunger:** Hidden hunger refers to inadequate intake of essential vitamins and minerals despite adequate or excessive energy intake. Fortification provides an effective means of increasing micronutrient intake and addressing this nutritional gap.
4. **Support for vulnerable population groups:** Children, adolescents, women, pregnant and lactating women, older adults and economically vulnerable populations may have increased nutritional requirements. Appropriately fortified foods can contribute to meeting these requirements.
5. **Development of functional and value-added foods:** Modern food technology has expanded fortification beyond conventional vitamins and minerals. Ingredients rich in protein, fibre, antioxidants, polyphenols and natural pigments can be incorporated into food products to develop functional and health-oriented foods.
6. **Utilization of locally available resources:** Fortification using cereals, pulses, fruits, vegetables, seeds and selected agro-processing by-products can improve nutritional value while promoting the utilization of locally available raw materials. This creates opportunities for value addition, entrepreneurship and sustainable food processing.
7. **Increasing demand for healthier foods:** Consumers are increasingly interested in foods that provide additional health benefits beyond basic nourishment. This has encouraged the development of protein-enriched bakery products, fibre-rich foods, vitamin- and mineral-fortified beverages, nutrient-enriched cereals and other functional food products.
8. **Relevance to food and nutrition security:** Fortification can complement dietary diversification and other nutrition interventions. When properly designed and regulated, it can provide a practical approach for improving nutrient intake at the population level.

Increasing Concern About Food Fortification and Health Nowadays

In recent years, consumers have become increasingly conscious of the relationship between food, nutrition and overall health. The growing prevalence of lifestyle-related disorders, nutritional deficiencies, sedentary lifestyles, irregular eating patterns and increased dependence on processed and convenience foods has encouraged people to pay greater attention to the nutritional quality of their diets. As a result, there is a growing demand for foods that provide not only energy and basic nutrients but also additional health-promoting benefits.

1. This changing consumer attitude has increased interest in food fortification. People are increasingly looking for foods enriched with essential nutrients such as iron, calcium, zinc, vitamin D, vitamin A, folate and proteins, particularly when normal diets may not provide adequate amounts. Fortification can help improve the nutrient density of commonly consumed foods and can be especially useful for individuals whose nutritional requirements are higher or whose diets lack sufficient diversity.

2. The concept of fortification has also expanded from conventional vitamin and mineral enrichment towards the development of functional and health-oriented foods. Consumers are showing greater interest in foods containing dietary fibre, high-quality proteins, antioxidants, polyphenols, natural pigments, omega-3 fatty acids and other bioactive compounds. Consequently, food industries and researchers are exploring cereals, pulses, fruits, vegetables, seeds and agro-processing by-products as sources of valuable nutritional and functional ingredients.
3. Another important factor is the increasing awareness of preventive health care. Consumers are becoming more interested in maintaining health through appropriate dietary choices rather than relying only on treatment after illness occurs. This has stimulated the market for nutrient-enriched cereals, fortified bakery products, functional beverages, protein-rich foods and other value-added products.
4. Therefore, modern food fortification represents more than simply adding nutrients to food. It provides an opportunity to develop nutritionally improved, functional, affordable and convenient foods that respond to changing consumer needs. Scientifically designed fortification, however, must consider nutrient bioavailability, stability during processing and storage, sensory acceptability, safety and appropriate levels of supplementation. Thus, the increasing public interest in health and nutrition is expected to continue driving innovation in fortified and functional food products

Conclusion

Food fortification has become an increasingly important approach for improving the nutritional quality of foods and addressing the changing nutritional needs of modern populations. The primary purpose of fortification is to bridge nutrient gaps by increasing the concentration of essential nutrients such as vitamins, minerals, proteins and other beneficial components in commonly consumed foods. In a situation where many people may consume adequate calories but still have inadequate micronutrient or functional nutrient intake, fortification provides a practical means of improving the nutritional value of the everyday diet. The need for fortified foods is particularly relevant today because of changing lifestyles, busy schedules, reduced dietary diversity, increased consumption of convenience foods, sedentary habits and growing concerns about nutritional deficiencies and lifestyle-related health problems. People are becoming more aware that good health depends not simply on eating enough food, but on consuming foods that provide adequate amounts of essential nutrients and health-promoting compounds. This has shifted consumer preference towards nutrient-dense, functional and health-oriented foods.

Food fortification is also becoming a trend because consumers are increasingly interested in preventive nutrition and healthy ageing. Foods enriched with protein, dietary fibre, iron, calcium, vitamin D, antioxidants and other bioactive compounds are receiving greater attention. At the same time, advances in food processing and food technology have made it possible to incorporate nutrient-rich ingredients from cereals, pulses, fruits, vegetables, seeds and selected agro-processing by-products into a wide range of food products. The current trend towards fortification is therefore driven by the convergence of health awareness, nutritional security, convenience, functional food development and consumer demand for value-added products. However, fortification should not be viewed as a substitute for a balanced and diversified diet. It should complement healthy eating practices and should be scientifically designed to ensure appropriate nutrient levels, bioavailability, stability, safety and consumer acceptability.

Overall, food fortification is no longer limited to correcting nutrient deficiencies; it has evolved into an important tool for developing healthier, functional and value-added foods for modern consumers. With increasing awareness about the relationship between diet and health, the demand for fortified foods is likely to continue growing. Thus, fortification represents an important opportunity for researchers and the food industry to develop innovative foods that support better nutrition, improved health, food security and sustainable utilization of locally available resources.

References

1. Allen, L., de Benoist, B., Dary, O. & Hurrell, R. (Eds.). 2006. *Guidelines on Food Fortification with Micronutrients*. World Health Organization and Food and Agriculture Organization of the United Nations.
2. Ofori, K.F., Antoniello, S., English, M.M. and Aryee, A.N. 2022. Improving nutrition through biofortification—A systematic review. *Frontiers in nutrition*, **9**:1043655.
3. Ashraf, S.A., 2025. Food fortification as a sustainable global strategy to mitigate micronutrient deficiencies and improve public health. *Discover Food*, **5**(1):201.
4. Poniedziałek, B., Perkowska, K. and Rzymski, P. 2020. Food Fortification: What's in It for the Malnourished World? *Vitamins and minerals biofortification of edible plants*, **7**(6):27-44.
5. Bashir, K., Jan, K., Maurya, V.K. and Shakya, A. eds. 2024. *Food Fortification: Trends and Technologies*. CRC Press.