

Nanotechnology-based methods for food augmentation

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ABSTRACT

Large segments of the population have been declining in their intake of micronutrients including vitamins and minerals in recent years. Therefore, food fortification adds necessary micronutrients to common foods. Carotenoids, essential oils, antioxidants, and chemicals commonly added to food to enhance its nutritional and

health characteristics are examples of bioactive substances that have an impact on the body. These nutrients are often found in trace amounts in plant-based meals, yet they have numerous advantages for human health. The functional needs for bioactive substances are not entirely satisfied by conventional techniques of food fortification. They also have low stability and bioavailability, as well as inferior flavour characteristics.

INTRODUCTION

Nanodelivery technologies can be used to get around these problems. Various nanotechnology methods, such as nanosuspensions, nanoemulsions, nanoliposomes, and cyclodextrin carriers, can be utilized to fortify food. Nanoscale food fortification offers a number of benefits, including the conservation of phytochemicals through the use of an encapsulating technology, and the assistance of some micronutrients that are fast lost or improperly absorbed by the body [1]. This review chapter addresses the current developments in nanofood fortification, including its advantages, problems, and future prospects. Phytochemicals and micronutrients are crucial for good health [2].

Nowadays, inadequacies and malnutrition are becoming more common among the world's population. This is a result of both the under consumption of dietary supplements like key phytochemicals and micronutrients as well as their limited bioavailability [3]. A solution to this problem is food fortification, a method of adding important nutrients to food. An effective approach of food fortification with better health benefits and sensory perception, including taste, is using nanotechnology techniques [4]. To combat obesity and encourage a healthy lifestyle, businesses have begun to provide nanofood products that are fortified with vitamins or minerals found in ordinary foods, fiber-fortified foods, fat- and sugar-blocked foods, salt, etc. Today, a lack of food supplements like micronutrients has a significant negative impact on both children's and adults' growth and some crucial phytochemicals may either not be consumed on a daily basis or may not be absorbed by the intestines sufficiently. Recent strategies, like food fortification, have

been crucial in addressing this gap. Dairy products are being fortified with nanotechnology by nanotech companies, who have found that the fortified dairy products taste better and are healthier. The encapsulation method stops the breakdown of bioactive compounds. Due to their greater occurrence rate, which greatly increases the burden of disease worldwide, there has been a lot of attention paid to the development of novel strategies to minimize diseases linked to key nutrient deficiencies in recent years. Iodine, iron, and other key nutrient deficiencies are linked to other factors that raise the risk of socioeconomic wellbeing and the prevalence of severe diseases, according to a study. Additionally, numerous clinical investigations have demonstrated that vitamin deficiencies cause a number of physiological issues, including poor infection resistance, metabolic issues, and lack of ontogenesis, as well as an annual mortality rate of almost 0.8 million individuals, according to the WHO. Significantly fatal deficiencies in vitamin A, iron, and iodine can result in the onset of additional illnesses. Anemia, which is caused by an iron deficiency, is most common among children under the age of five (43%) and pregnant women (38%). Similar to vitamin A insufficiency, which is reported to affect one in three children and one in six pregnant women worldwide, iodine deficiency affects one-third of the world's population. Nearly 90% of children in India suffer from anaemia caused by iron deficiency, as do 85% and 65% of pregnant and non-pregnant women, respectively. The Republic of India has launched many programmes to fortify commonly consumed foods with necessary micronutrients to meet the recommended daily consumption for a healthy life in an effort to combat diseases linked to nutrient deficiencies.

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Both fortification and enrichment refer to the process of adding necessary nutrients to food products in accordance with the standards advised by the Food and Drug Administration (FDA) in order to combat malnutrition globally in both developed and developing countries for improved health and quality of life. Iodized salt, vitamin and folic acid-fortified foods, and other notable food fortification techniques are used around the world to prevent diseases caused by nutrient deficiencies. When compared to people living in affluent nations, people in developing nations are more prone to micronutrient deficiencies, especially in Asian nations like India where micronutrient deficiencies are common in both the rural and urban population. To stop malnutrition, thorough fortification efforts are implemented nationwide. The most widely consumed fortified foods are rice, milk, wheat flour, and oil, which make up a significant portion of the regional culinary staples and are adapted to the region's diverse cultural and gastronomic preferences to ensure consumption of the recommended amounts of nutrients for long-term health benefits. In affluent nations, the fortification process has been devised as a form of nutritional insurance to make it easier for people to consume nutrients through food and to guarantee their affordability. Technology for fortification is simple to use and straightforward to apply, making fortified products affordable and appropriate for a wide range of consumers. To enhance the nutritional quality and health of the populace, India has created a number of publicly financed programmes, including Integrated Child Development Services, the public distribution system, and noontide meals. The immune system, cellular activities, and essential eye functions all depend on vitamin A. Vitamin A deficiency has a significant impact on people in underdeveloped nations, particularly youngsters and pregnant or breast-feeding women. Long-term vitamin A deficiency can result in vision problems, respiratory infections, and measles vulnerability. Vitamin A deficiency can be treated in a variety of ways, such as by consuming foods high in vitamin A, adding vitamin A powder or capsules to food, or fortifying foods with vitamin A. These strategies can help a huge portion of the population avoid vitamin A insufficiency and improve their health. Sugar, oils and fats, and cereal flours are common food options for vitamin A fortification. Large numbers of clinical problems, including abnormal skeletal and bone formation and soft bone formation as a result of insufficient intake of vital nutrients, were seen in the early 20th century. Due to a shortage of food, poor hygiene, and lifestyle changes, the issue of undernutrition among the poor, especially children, was brought up throughout the modernising era. However an English doctor who conducted canine studies is credited with discovering the link between disease and food. His findings showed how study into the production and purification of vitamin D was directly aided by a disease-preventive substance that is predominantly present in milk. As a result, milk is supplemented with vitamin D at the recommended level in accordance with FDA rules. But vitamin-fortified milk not only meets daily vitamin needs, it also guards against diseases caused by vitamin insufficiency. The main sources of vitamin D are oily fish and cod liver oil. Fruit juices, cereal flours, and other foods are also supplemented with vitamin D in addition to milk. Since vitamin D is necessary for growth, consumers have recently preferred its presence in fortified goods rather than in regular diets. A fat-soluble vitamin called vitamin E is crucial for good physiological function. This fat-soluble vitamin must be consumed in

sufficient amounts for carotenoids to be absorbed and transformed into their biologically active form, which has health benefits. Frequently ingested fats, oils, and morning cereals are fortified with vitamin E to guard against exposure to potentially fatal chronic diseases.

A water-soluble important vitamin with numerous health advantages is vitamin C. There are several technologies on the market for adding vitamins to dairy products, fruit juices and drinks, and fruit smash. The above-mentioned popular foods have been fortified with vitamin C to assist the body reach the necessary level of vitamin C and to give vital antioxidant activity to prevent a variety of illnesses. According to research, vitamin C also increases the bioavailability of iron. Due to the modern lifestyle and decreasing consumption of nutrient-rich meals across all social levels, micronutrient deficiencies do not distinguish between the rich and the poor. Despite the abundance of appealing food options provided by the current modern lifestyle, they irrationally fall short of providing nutritional needs. The practise of food fortification was founded as a simple means of addressing the nutritional needs in order to resolve this issue. It has been used for a long time, taking into account the needs of human populations in many nations, each with their own methods for obtaining and routinely consuming food. Fortification of raw food products like rice and wheat with nutrients is required in many nations in order to increase their nutritional content and prevent diseases caused by nutrient deficiencies. The modern populace wants to spend less time on routine, necessary tasks like preparing food because they are generally busier and have greater time demands. So they should be able to easily access multinutrient foods to satisfy their nutritional needs. Most people in developed countries anticipate that their regular food will provide all the additional nutrients they need to maintain or improve their health in addition to the essential nutrition, according to a survey by the International Food Information Council Functional Foods/Foods for Health Consumer.

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