Review Article

USES AND PROSPECTS OF NANOTECHNOLOGY IN FOOD & NUTRITION: A REVIEW

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ABSTRACT

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Use of nanotechnology in food science to increase/alter nutritive value and shelf life of food has provided lot of dimensions in research to meet out the need of food for globally growing population. Fortification of food with nano nutrients and also the use of nanotechnology to enrich the nutritive values of food have explored avenues in nutritional science for the production of highly nutritive food products required for different diseases, gender based requirements, age wise need and variable requirements under different climatic conditions. On the other hand discussions have also initiated about the safety of nano food for consumption, its assimilation in human system and its acceptance by human body. This review briefs the use of nanotechnology in food industry for improvising the quality and quantity of food with keeping an eye on health and environmental concerns.

INTRODUCTION:

Consumption of food comprises a complex of nano elements having variable physical and chemical characters which determine their stability and properties. Assembling and interaction of nano particles with controlling through nanotechnological tools provide a mean to design food from scratch.

NANOTECHNOLOGY AND FOOD:

"Nano Food" can be defined as the outcome of cultivation, processing or packing of food with the help of nanotechnology or the food in which nano materials have been added. Nano food is a revolution in food industry involving techniques to improvize food safety, nutritional values, their flavours and slash in food cost. Currently development of nano food is in very primitive stage. Food industry use nano particles as a carrier of microbial polypeptides to check microbial damage of food. Nano food also includes health promoting additives and extended shelf lives of food for new variety of tastes and flavours. It has been also observed that newly designed nano particles may react with the living systems leading to unexpected toxicity. Use of untested nanotechnology has been reported in hundreds of food worldwide.

Nano food or food nano technology is promising field and expecting new positive results in food science. Food scientists are emphasizing in development of new properties of food using nano technology, encapsulation of bioactive food to enhance their nutritive value, use of nano particles for biosensing of food borne microbes and packaging of food to enhance shelf life.

NANO ENCAPSULATION:

This is a technique to pack substances in the form of nano composite, nano emulsification and nano structuration having controlled release(1). The bioactive compounds like carbohydrates, lipids, proteins, vitamins and antioxidants are when protected with nano encapsulation their stability increases. This technique cuts cost for formulators reducing the quantity of active ingredients. Nano encapsulation technology has the potential to meet challenges concerning the effective delivery of health functional ingredients and control release of flavor compounds. Zein, the prolamine in corn endosperm binds and enrobes lipids protecting them from deterioration. Soy lecithin is the main structural ingredients in the formation of aqueous nano dispersions that carry high loads of water-insoluble actives. These active includes water insoluble nutraceuticals, fat soluble vitamins and flavours(2). The encapsulated active disperse easily into water based products, showing improved stability and increased bioavailability.

NANO MATERIALS IN NUTRITION

Variety of food products have been developed by nano materials(1). Nano materials are helpful in development of healthy and nutritive food. Nano materials usually occur in the form of uncomplexed metals (e.g. Gold), inorganic metal (e.g. Oxides and iron) and carbon based compounds (e.g. polymers). Most commonly used are carbon and metal based

materials, dendrimeters and composite material.

Nutritional supplements in the form of nutraceuticals such as vitamins, antioxidants, fats, proteins, natural extracts and minerals of low bio availability affected by factors such as solubility and stability are results of nanotechnology. Nutraceuticals provide health benefits by effectively delivering nutrients and help to prevent bone diseases, regulate blood glucose, cholesterol levels, reduce the risk of cancer and improve immune system.It has been observed that the benefits of foods are lost because many bioactive compounds are not water soluble like fat soluble vitamins are not readily processed and taken up by the small intestine as water soluble components but are required to undergo a pretreatment phase involving micelle encapsulation to penetrate cells to release their contents. This delay results in the absorption of only 25% after fat digestion and this leads a greater risk to individual with fat related metabolic disorders. The challenge has been to develop methods to solublize these essential components to be effectively absorbed. In food technology many nano encapsulation delivery systems are being used like nano emulsions, surfactant micelles, emulsion bilayers, reverse micelles and functionally designed nano capsules. Micro emulsions have gained much interest because of their useful characteristics and in particular the ability to solubise water soluble compounds at the nano level (3).

NANO FERTILIZERS

Widely used carbon-based fertilizers like ammonium bicarbonate and urea in different soils are susceptible to decomposition and hydrolysis leading to increased levels of byproducts like nitrogen, ammonia and ammonium carbonate in soils. Their further decomposition leads to increase in soil toxicity and environmental deterioration. Use of nano materials is growing in farming. Environment friendly fertilizers are developed to decrease green house emissions. Nano materials with fertilizers reduce green house emissions and increase fertilizer efficiency by incorporating carbon nano constituents viz. nano-graphite and carbon-collosol. The nano fertilizer composition reduces gas emission by increasing the utilization of ammonium bicarbonate and reduces the fertilizer usage with increase in its efficiency (4).

NANOTECHNOLOGY AND FOOD SAFETY

Food preservation and increase in its shelf life always have been a problematic concern for industry. Illness and causalities due to food borne microorganisms and pathogens have been a great financial load on health industry (5). Nanocomposite materials have shown several advantages over conventional food packaging material due to their superior polymeric properties reinforced by the addition of nanosized particles. These nanomaterial polymers are highly suitable for food storage because their structures are much less permeable to gas than other materials(6). They are also able to maintain their resistant properties at half the thickness of other nanocomposites, therby, offering cheaper production cost and light weight materials. Wastage and spoilage of food when exposed to atmosphere or moisture or light is another universal problem of food industry. Enhancement of barrier properties of packaging by addition of nanomaterials decreases entry of atmospheric agents. Low permeability nanocomposites have been developed by blending nanocomposites such as nanoclays with thermoplastics and elastomeres (7) for consumer products and food packaging among other applications. Food industry is striving for development of antimicrobial food packaging to increase quality as well as shelf life of food products.

SAFETY CONCERNS OF NANOFOODS

Availability of nanofoods in market has largely attracted concerns on health issues, safety and quality. Health issues associated with use of nanomaterials in food have not been assessed till date. Nanotech properties of food materials may result in toxicological eventualities when they come in contact of human body via digestion. The risks are largely associated with inhalation, ingestion and skin absorption of nanoparticles of unknown toxicities. Toxic effects of nanoparticles on animals have been observed by food scientists (8). This reflects an urgent need of systematic studies of nanotoxicity on animals and human beings.

FUTRE PROSPECTS OF NANOTECHN-OLOGY IN FOOD INDUSTRY

Nanotechnology is very useful in food industry having lots of potential in the area. It can meet out with the challenges of food deterioration during storage. Healthy food for globally growing population especially in India is a big challenge. Nano food can incorporate merits of multiple foods in single food product. Further researches in nanotechnology be benefitting in packaging and transportation of food. Cost cutting of food production is possible with the use of nanotechnology. Use of nano fertilizers and development of crops immune against devastating pest infestations with the help of nanotechnology may lead to increase in cultivation. However, standard rules and regulations are still to be defined for the use of safe nanotechnology.

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