Nanotechnology in Food Industry- A Review

Chandreyee Saha, Assistant Professor, Department of Basic Sciences, Galgotias University,

Dr.P.Gajalakshmi, College of Arts and Science for women (Autonomous), Perambalur

Dhanalakshmi Srinivasan College of Arts and Science for women (Autonomous), Perambalur

ABSTRACT

Widespread usage of nanotechnology in the food and feed industry is still at an emerging stage, and being currently under research. Nanotechnology is the magical power to reform every field touched by it. Naotechnology is establishing great potential in food industry and processing as new tool for pathogen detection, disease treatment delivery system, food packaging and delivery of bioactive compound to target sites. The application of nanotechnology in food systems will provide the new method to improve safety and nutritional value of food products. One important focus is use of nanotechnology to improve easier nutrition availability for the body to absorb amino acids, vitamins co enzymes conjugated with nanoparticle. This article will review the potential of nano particles and its applications in food industry.

KEY WORDS: Nanotechnology, bioactive compounds, nutritional value, nano particles.

INTRODUCTION

Nanotechnology has been considered as to be vital technology that has revolutionized the food sector. The word “nano” in layman terminology refers to something small, tiny, and atomic in nature (1). Nanoparticle is a small object that acts as a whole unit. It ranges from 1to 100 nm in scale, it spreads its potential to many industries and able to create new devices and techniques. The nano materials used in food industry include inorganic (metal and metal oxide NPs), organic (mainly natural product NPs) and combined (i.e. clay). Among all metal NPs, silver NP is the widely prepared due to its antimicrobial activity while gold NP is used as a detector. Titanium dioxide NPs acts as disinfecting agent as well as food additive (white color pigment) and flavor enhancer. The synthesised nanoparticles possess one or more external dimensions, or an internal structure. It is understood that these particles have unique properties due to the high surface to volume ratio and other unique physiochemical properties like color, solubility, strength, diffusivity, toxicity, magnetic, optical, thermodynamic, etc. (2-3). Nanotechnology has brought new industrial revolution and both developed and developing countries are interested in investing more in this technology (4).

The demand of nanoparticle-based materials has been increased in the food industry as many of them contain essential elements and also found to be non-toxic (5). They have been also found to be stable at high temperature and pressures (6). Nanomaterials bring about a great difference not only in the food quality and

safety but also in health benefits that food delivers. Many organizations, researchers, and industries are coming up with novel techniques, methods, and products that have a direct application of nanotechnology in food science (7).The significance of nanotechnology in food can be categorized in two groups: food nanostructured ingredients and food nanosensing. The food nanostructured ingredients category covers food processing and packaging, and encompasses additives, which are carriers for the smart delivery of nutrients and antimicrobial agents.Foodnanosensing helps achieve better food quality and safety (8).

Increase in shelf life of food and decrease in spoilage of food can be attained with the help of nanotechnology. Different form of nanosystems like solid nanoparticles, nanofibers, nanocapsules, nanotubes, nanocomposites, nanosensors, nanobarcodes are important nanomaterials that play important role in the food processing, packaging, preservation sectors (9).

NANOTECHNOLOGY IN FOOD PROCESSING

Food processing is a practice of preserving food with the help of methods and techniques in order to transform food to a consumable state. These techniques are designed as such that the flavour and quality of the food are kept intact but they are also protected from infestation of microorganisms that leads to food spoilage. The nanostructured food ingredients are being developed with the claims that they offer improved taste, texture, and consistency (10). Nanotechnology increasing the shelf-life of different kinds of food materials and also help brought down the extent of wastage of food due to microbial infestation (11).

Food processing methods that involve the nanomaterials include incorporation of nutraceuticals, gelation and viscosifying agents, nutrient delivery, mineral and vitamin fortification, and nanoencapsulation offlavours (12,13). The different area of application of nanotechnology in food industryis given in figure 1. Further, the role of nanotechnology in food processing can be studied by its play in (i) food texture, (ii) food appearance, (iii) food taste, (iv) nutritional value of the food, and (v) food shelf-life.

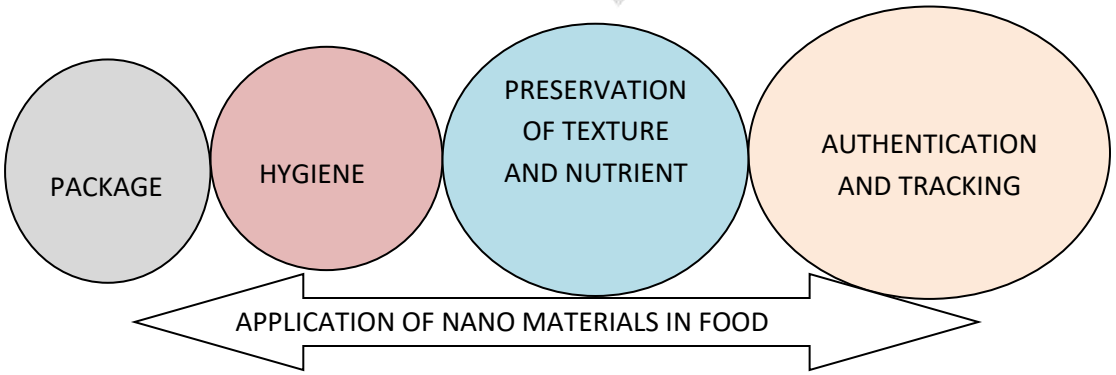

Figure 1. areas of application of nanotechnology in food industry

Nanoencapsulation

Nanoencapsulation is done with nanocapsules. They offer huge benefits such as easy handling, enhanced stability, protection against oxidation, retention of volatile ingredients, taste making, moisture triggered controlled release, pH triggered controlled release, consecutive delivery of multiple active ingredients, change in flavour character, long lasting organoleptic perception, and enhanced bioavailability and efficacy (14, 15). Food preservation is done by Entrapment of the odour and unwanted components in the foodbynanocapsules

There are six basic ways of preparation of nanocapsules, namely, nanoprecipitation, emulsion-diffusion, double emulsification, emulsion-coacervation, polymer coating, and layer-by-layer (16). The advantage of nanoemulsion is that when it is added into the food it does not change the appearance. The nanocapsules are used to deliver lipophilic health supplements such as vitamin and minerals in the food, fatty acids, and growth hormones, increasing the nutrient content of the food (17). Nanoliposome are known to deliver nutraceuticals, nutrients, enzymes, vitamins, antimicrobials, and additives (18).Nanocochleates help in improving the quality of the processed food. Micronutrients in the food can be stabilized by nanocoils.Milk can be protected from degradation by nanoencapsulating α-tocopherol in fat droplets (19). Encapsulating functional components within the droplets often enables a slowdown of chemical degradation processes by engineering the properties of the interfacial layer surrounding them.(20).

Nanoemulsion

In the production of, flavoured oils, sweeteners, personalized beverages, and other processed foods Nanoemulsions are used. Several lipophilic components are encapsulated with the help of nanoemulsion formation, for example, β-carotene, citral, capsaicin, flaxseed oil, tributyrin, coenzymeQ and several oil soluble vitamins (21). Nanoemulsions are known to have antimicrobial activity and they are more effective on Gram-positive organisms than on Gram negative-organisms (22). Decontamination of food packaging articlesis done by usingnanoemulsions.The advantage of nanoemulsion is their reduced size which makes it efficient.

Nanotechnology in Food Packing

The advantage of Nano-based food packagings is it provide better packaging material with high mechanical strength, barrier properties, antimicrobial films to nanosensing for pathogen detection and alerting consumers to the safety status of food (23).Application of nanocomposites as an active material for packaging and material coating can also be used to improve food packaging (24). Packaging is revolutionized due to the integration of nanocomposites, nanosensors, bio-degradable nanocomposites for leakage proof, gases free, and pathogen less food packaging.

Nanosensors and nanocomposite

The colour change in the food and the production of gas due to spoilage of food can be identified by Nanosensors.It help in detecting the presence of pesticides on the surface of fruits and vegetables. Not only pesticides, but there are also nanosensors that have been developed to detect carcinogens too in food materials (25). The time-temperature integrator and gas detector are the main sensors which are used in food packaging industry. Several different types of nanosensors are used for example, array biosensors, nanoparticle in solution, nanoparticle based sensors, electronic noses, nano-test strips, nanocantilevers.They usually act as gas barriers in order to minimize the leakage of carbon dioxide from the bottles of carbonated beverages (26). In this way, it increases the shelf life of the product.

CONCLUSION

The revolutionin food processing and preservation sector of food industry was attained by nanotechnology. Its significance in the food industry particularly in food packaging and food processing are well studied. The protection of the food from moisture, lipids, gases, off-flavors, and odors is achieved concretely by nanomaterials. The future of nanotechnology role in the food industries are unclear. Yet there is many advantages on nanotechnology, there is a drawback on the increased cost of production.

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