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Role of Nanotechnology in Food Industry : A Review Perspective of Nanobiotechnology

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ABSTRACT

Use of Nanotechnology in food industry is growing rapidly. Key factors responsible for the use of nanotechnology are the favorable results in the area of nutrient delivery system, bioactive nanoencapsulation, and detection of biosensors and in quantification of pathogenic organic compounds, in food composition alteration, other chemicals and even edible film to preserve vegetables or fruits. This review paper emphasize the applications and the advantages of nanotechnology in diverse areas of food Industry that cover bioactive nanoencapsulation, packages, edible thin film and nanosensors. It is visible from the review that the nanotechnology improve and enhance the safety and quality of food with the time of pathogen finding.

Key words: *Encapsulation, Food industry, Nano biosensors, Nanotechnology, Packaging.*

INTRODUCTION

Person is endeavoring to save edibles items especially meat items. Men have utilized the antiquated strategies like maturing, salting, cooking, smoking, steaming, salting, pickling, canning, illumination and carbonation of food. Even chemical or artificial additives have also been utilized to save food from any type of impurity.

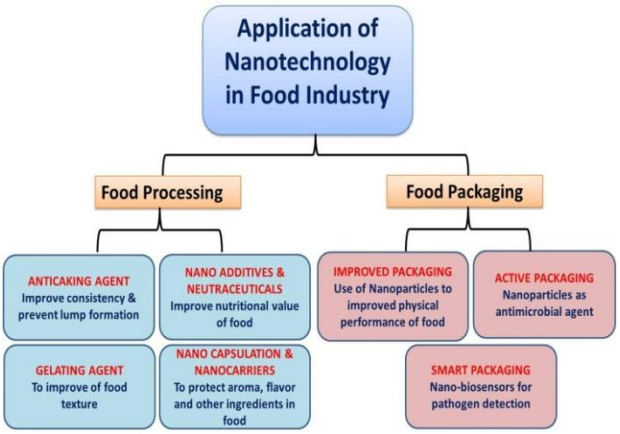

Fig. 1: Representation of role of nanotechnology in various phase in food industry

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In the field of Nanobiotechnology, some terms are most important and must be discussed. Nanotechnology as such is one of the most promising, multidisciplinary technological advancement to revolutionize conventional food industry and a rapid development of scientific field[1]. Researcher developed new tools in chemistry, physics, biology and engineering by using nanotechnology. Modification of size in materials on the scale of nanometer (10^{-9}m) is one such method which has not only altered the physio-chemical properties and biological properties but resulting in new applications[2]. Size reduction of materials of nanoparticles and its combination with huge surface area produce their special features of nanoparticles and massive potential for applications. Therefore such technology has boomed as revolution in various sectors of Science and Technology[3]. Even though in food industry sector, nanotechnology is just starting to be discovered their future seems to be at par with other sectors. Nanotechnology industry is expected to grow US$ 125 Billion mark by 2024[4]. Furthermore, potential payback of nanomaterials are enormous in the food industry while it covers packaging materials, food safety, nutrient delivery systems, Nanosensors, bioavailability, pathogen detection in new materials[5]. Therefore in recent centuries, it has been a high significance of practicing such nanosubstance in antimicrobial packaging of food materials. Packaging with an antimicrobials is a form of live packaging that has a touching base in food substance but reduce the growth of microbes which is present in food items surfaces[6]. Various nanosubstance e.g. copper, silver, metal oxide and chitosan nanosubstance such as titanium and zinc oxide have been indicated to have antibacterial characteristic[7,8]. What is unique about nanotechnology is that it gives protection against the pathogens via edible films or packaging with antimicrobial properties. Various nanostructure uses have risen drastically in the food sector which is evident from the investment in nanobiotechnology and growth of the nanotechnology material market from US$ 2.6 billion to 20.4 billion only in 5 years[9]. Various scholars have published reviews on related topics[10,11,12,13,14].

1. Encapsulation of bioactive compounds:

Commonly, for the control of pest we used pesticide which is only helpful for very short time duration. Pesticide concentration is very high for the control of pest and such highly concentrated solution have multiple side effects e.g. abdominal pain, eye pain, convulsions, paralysis, respiratory failure and even death[16]. Therefore, the encapsulation over the agrochemicals or other pesticides could reduce the chances of plant tissue damage of other plants and quantity of chemical out into the atmosphere thus as safe product[17]. Additionally, these methods can be used in flavor or nutrient delivery in food sector[18]. Application of Liposome is a good example for flavor, nutrient and food antimicrobials supply method[19]. Encapsulated with Liposome antimicrobial-peptide indicate significant in evaluation with Bacteriocins free (Nisin) and increased food life[20]. Thus, indicating to be significant supply method to food industry.

1. Packaging of edible thin film

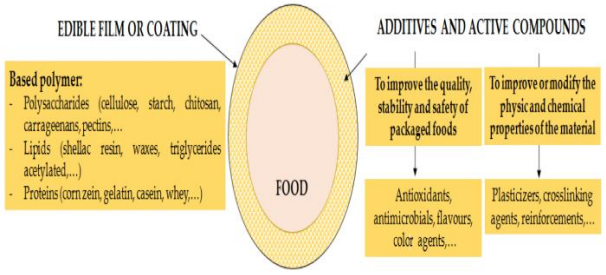

Fig. 2: Packaging of edible thin film and compositions

In previous section, we discussed about main problem of stability mainly physiochemical and its contamination with microbial during packaging in food sector. Lipid, protein, carbohydrates and water present in food transformation takes place due to time with respect to environmental condition that depend on temperature , light and moisture etc. However, practice of edible thin film can reduce the deterioration of shelf life of food that increase the food quality of food. Chitosan, gelatin polylactic acid, carrageenam, blend of starch, alginate and sodium caseinate are few substances practices in the manufacture of bioplastic with use in packing of edible thin film in figure 2. [21, 22, 23, 24]

Packaging of the Nonedible thin film

Extensive literature review on the packaging states that the nanobiotechnolgy can be used for the improvement of the plastic substance barrier, incorporation of bioactive, sensing and signaling of relevant information about the food; for the alteration of the pervasion action of foils, growing barrier characters thermal, mechanical , microbial and chemical); enhancing heat-resistance and mechanical characters.[6,25]

Moreover, nanobiotechnology might decrease the environmental contamination via the preparation of decomposable packaging. Furthermore, decomposable/biodegradable substances present poor barrier with mechanical characteristics and those characters need to be enhance considerably beforehand they should replace customary plastics. The combination of nanostructures e.g layered silicates, in decomposable or biodegradable substance can enhance its mechanical characteristics, allowing its practice for packaging. The practice of inorganic elements also makes it promising to present multiple functionalities, enhancing the distribution of micronutrients.[26,27] In such way, a literature review demonstrating new functionalities in the nanobiocomposite thin film, the boosts vapor, gas and UV-barriers or précised discharge volume of few active agent in the biopackaging of food was also noticed[28,29].

NANOSENSORS

In nanotechnology, nanosensors has significant importance in agriculture area as such devices are capable to find out and detect very small quantity of organic compound, very less concentration of pathogens and other harmful chemicals. Moreover, such devices demonstrate extraordinary sensitivity, quick response and rescue, possibility for the combination of addressable ranges on large scale[30,31].

Mainly nanosensors are used in pesticide recognition as organophosphate in plants, fruits and aquatic. Because of high permeability and solubility characteristics of pesticides and their great level of harmfulness, their extensive use in agronomy, there is significant importance in residue analysis of high sensitive contamination or pollutants.[32] As we know various methods of analytical procedures to find out and quantify or detect insecticide/pesticides that cover gas/liquid chromatography and mass-spectroscopy. Nanosensors devices have benefits that contain high surface to volume ratios, primarily loading of more antibody/enzymes and accordingly great sensitivity interface; less recognition limits; exceptional selectivity; small size and quick response. Furthermore, use of possible nanosize materials effect that enhance the sensitive transducer indication or signals e.g. semiconductor and metal nanosubstances or carbon nanotubes which has exceptional electrical or optical characteristics.[33] Intelligent packaging is one of another aspect of interesting packing covering a nanobiosensor that makes the sensor fluoresces in various colours by interaction with pathogens of food materials. Various types of devices have been find out to identify abundant contaminants, chemical in food materials and pathogens also used in packaging as antibodies and nanowires.[34] Nanobioluminescence is specially developed by the AgroMicron that is detection spray characteristics, possessed by a protein which is a luminescent that has been specifically designed to bind to the external surface of micro-organism, microbes and germs such as

E.coli and Salmonella.[35] produced a sensor that is amperometric with MWCNT (Multiwalled carbon nanotupes) through Nafion (Perfluorosulfonated catio-exchanger polymer) to identify coliforms of E.Coli. Therefore, such device is sensitive and fast sensitive in identifying coliforms, screening it to stand a worthy method to spread over in the food engineering.

Quality of food materials was observed through an antibody functionalized (carbon nanotube nanosensors) to identifying salmonella contamination in complex solution and nutrient containing broth solution.[36] Current era application of nanobitechnology based on nanomaterials and biosensors as long as prospect of produce a new characteristics of biosensor knowledges and with the significant in food investigation.[37] The progresses in nanosensors technology and nanobiosensors knowledge were discussed in present review emphasizing motivating immunosensors built on associated biomolecule through nanoparticles by a comprehensive choice of uses in food industry[38].

CONCLUSION

Many advantages and benefit of nanotechnology in food industry depends on research in nanotechnology. Nanotechnology has high potential to improve the food quality and give revolutionary benefit to the food industry. Improvement in inorganic nanosubstance and microfluid manufacturing have permitted the preparation of effective and competent sensors to quickly detect/identify pathogens or microbes or pesticides. The Nano sensor or Nano biosensor should also be used in environmental contaminations control in the food sectors. Functionalized food and nanosubstance as aromas, flavors and nutrients transporters should improve food value and protection. The significant concern in the direct upcoming will be poisonousness of these nanosubstance in animals, humans and plants also. Moreover, it is mandatory to evaluate the accretion of these nanoparticles in animals and plants with their biotransformation. Such kind of review and research will enhance better and harmless products.

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