

Nanotechnology – Recent Advances in Horticulture

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Abstract - Horticulture sector was playing a pivotal role in fostering world economic revenue. Most importantly this sector also finds a new route for reshaping a healthier world. Rising trends towards health-conscious eating habits have evoked the consumption of fresh fruits and vegetables as an available option for better, healthier and smarter that meet modern lifestyle and needs. Now a day's nanotechnology became a one of the most important tools and an efficient option for extending the shelf life of foods. Reducing particle size to nanometric scale gives materials distinct and improved properties compared to larger systems. For food applications this technology allows the incorporation of hydrophilic and lipophilic substances with antimicrobial and antioxidant properties with the help of these we can increase the shelf life of disease products. Edible coatings are usually prepared with natural polymers that are non-toxic, economical and readily available. This review summons a comprehensive and current overview of the widely available information and recent advances in nanotechnology.

Index Terms - Nanotechnology, antioxidant, antimicrobial, edible coating.

INTRODUCTION

Horticulture sector plays an important role to bring up the world economy. Now a day's people concentrated towards their health and changing their food habits which evoked the consumption of freshly available fruits & vegetables for better health and smarter work to meet their new trending lifestyle and needs. Raising of nanotechnology presents a prominent tool for enhancing the shelf life of foods. Nanotechnology reduces the particle size to nanometric scale which gives materials distinct and improved its properties that are compared to larger systems. Nanotechnology generally derived from the Greek word, the nano which means 'dwarf'. It defines the study and structure between one nanometer and hundred nanometer in

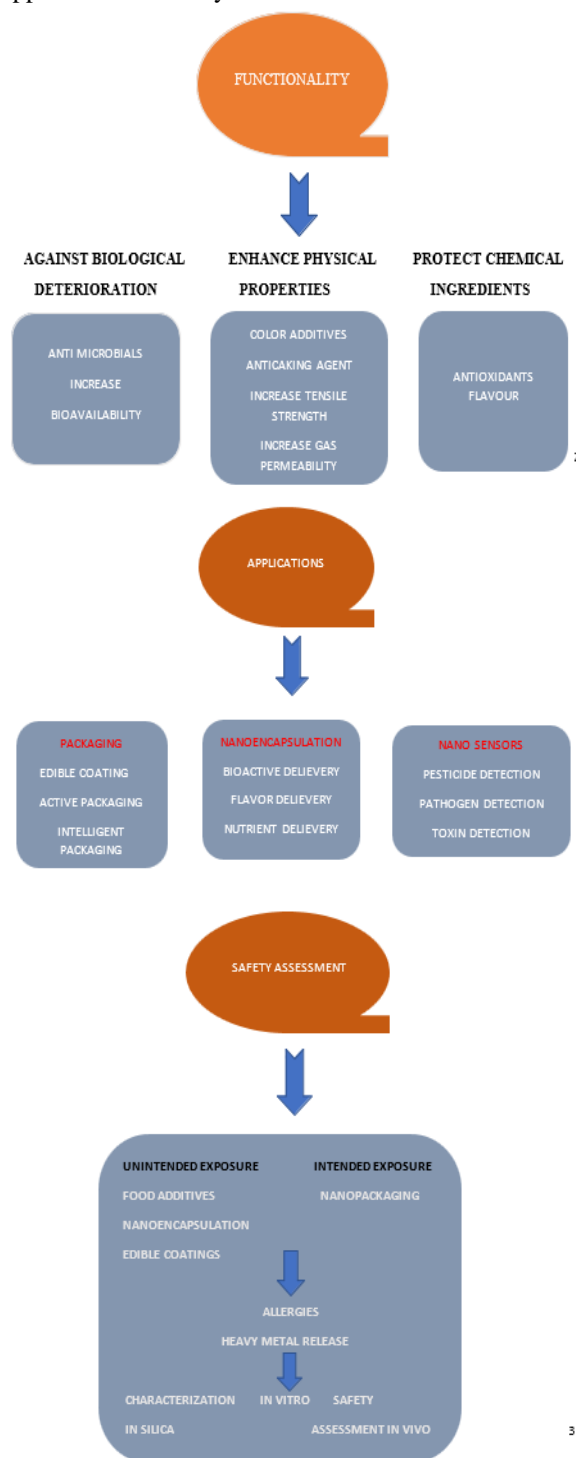
particle size. The novel properties of these nano materials providing many new opportunities (Sujithra.S and Manikkandan. T.R., 2019). In food application technology, it incorporates with hydrophilic and lipophilic substances, and also with antimicrobial and antioxidant properties which are released during storage period. It also became one of the obeying technologies to revolutionize and conventional food science and food industry. In food science, for developing nano particles using different technologies with different physical properties (Xiaoja He and Huey-Min Hwang, 2016). Usually, edible coatings are prepared with natural polymers, which are nontoxic, feasible, economical and readily available. Coatings are used for fruits and vegetables and the nano-based coating will be used mainly. These coatings provide a barrier for gas exchange, moisture loss and act as a flavor production, antioxidants, enzymes and anti-browning agents which would enhance the shelf life of prepared foods (Eman Abdel Bakhy et.al., 2018). Recently, the nano coatings are being used as a promising technology which improves the quality and extended storage life of fruits and vegetables (Mohamad Fauzi, S. and Abu Hassan, 2016). The main objective of these nanomaterials is to increase the shelf life of diverse products and made ecofriendly. Various types of technologies are using to produce nanoparticles with different physical properties that are going to be used in food. The concept of nanotechnology was first given by Richard P Feynman. The adoptions of these technologies reduce input losses and increase the production by site targeted specific delivery of applied inputs.

NANOTECHNOLOGY IN FOOD SCIENCE

Recently novel nano antimicrobials are in trending, it is showing promising effects on safeguarding the food deterioration, hence it's increases shelf life of the

product. One of the mostly used nano materials are silver nanoparticles and nano composites, these act as anti-microbials in food industry (Xiaoja He and Huey-Min Hwang, 2016).

Fig.1- Diagram showing the development of nano technology in food science & its functions & applications & safety assessment



Nanocomposites added the stability, which is important for sustaining antimicrobial activity and reducing the likelihood of migration of metal ions into stored foods. For food application, polymers are largely coincided to form nano composites with metals. Among the polymers, low density polyethylene, gelatin, isotactic polypropylenes and polylactic acid are mostly used materials of nanocomposites. Nanoencapsulation also allows direct contact of nanomaterials with humans through oral intake. To enhance the performance of antioxidants, lipid based nanoencapsulation systems are been developed which improves their stability and bioavailability and entrap bioactive for efficient absorption (Maria L. Zambrano-Zaragoza et.al., 2018).

EFFECT OF NANO MATERIALS ON EDIBLE COATING

The active items such as anti-browning agents, colorants, flavors, nutrients, spices and anti-microbial compound which can enhance products shelf life and reduces the risk of pathogen on food surfaces are potentially contained by edible coatings. Edible nano coatings can be used in fruits and vegetables, these provides a barrier for moisture loss and gas exchange. The thickness of the coatings layer should stick on the surface of the fruits and vegetables and it is mainly depending on the type of coating emulsion and the variety of treated fruits and vegetables. Chitosan is one of the edible coating which increases the shelf life of the products by reducing the rate of respiration and minimizing the water loss (Eman Abdel Bakhy et.al., 2018). The films were printed with chitosan-tripolyphosphate nanoparticles loaded with thymol. The TiO₂ nanoparticles having an excellent photocatalytic activity which eliminates the organic pollutant (Zuhal Okcu et.al., 2018).

NANOTECHNOLOGY IN PACKAGING OF FOODS

Nano packaging is now in trending which makes an impact in the development of functional or interactive foods and respond to the body's requirement and deliver nutrients more efficiently. In addition of nanoparticles, it helps in production of bottles and packages with more light and fire resistance, strong

mechanical and thermal performance and less gas absorption. The properties of nano packaging significantly increase the shelf life and efficiently preserve flavor and color and facilitate transportation and usage. Nano sensors are used in the packaging materials which will be able to read the food inside. If the food is rotten inside the product it gives an alarm for us by using sensors.

VARIOUS TECHNOLOGIES IN NANO PACKAGING

1. Chemical Release nano packaging

These enables food packaging to interact with the food it contains. The process of exchange can take place in both the directions. Packing can release nanoscale anti- microbials, antioxidants, flavors, fragrances or nutraceuticals are added into the food to extend its shelf life. With the help of nano packaging material carbon nanotubes are being developed. The ability of carbon nanotubes is to pump out oxygen and carbon dioxide that would result in food deterioration. These nano packaging can absorb undesirable flavors is also in development. Nano magnesium oxide, nano copper oxide, nano titanium dioxide and carbon nanotubes are also predicted for future use.

2. Nano sensor and Track and Track packaging

Nano sensors are designed to track the internal or external conditions of the food products, pellets and containers throughout the supply chain. Nano technology is also enabling sensor packaging to incorporate cheap Radio Frequency Identification (RFID) tags. Nano enabled RFID tags are smaller and much flexible and are printed on thin labels. This technology raises its versatility and provides cheaper production. Nano based track and track packaging technologies are in development. United states company Oxonica Inc has developed nano barcodes to be used for individual items or pellets, these codes can be read under modified microscopes. These systems are being developed mainly for anti-counterfeiting purpose. One of the nano-based track and track packaging company had been developed to detect the pathogens in food for food tracing, for food preservation and temperature, measurements in food storage.

3. Nano biodegradable packaging

The use of nano materials ate to strengthen bioplastics may enable bio plastics to be used instead of fossil fuel-based plastics for food packaging and carry bags. When the bioplastics are mixed together with nano clay particles, the resultant nano composites exhibit improved barrier properties compared with the pure bioplastic. After their use it can be composted and left to the soil (Umar Shah et.al., 2015).

CONCLUSION

As the change in the world, one should be cautious but not to be afraid, in the embrace of development of nano technology. Globally many of the countries are been identified the potentiality of the nano technology in various sectors i.e., in food industry, in packaging sector and in edible coatings and films sector. Also given equal importance to the social issues which are related to the nano technology and are improving public awareness. Many of the people globally expected that this nano technology would allow the more efficient work and sustainable food production process took place where the availability of raw material is less consumed and food with higher nutritional quality is obtained. In nano edible coatings sector the nano technology plays a vital role for to extend the shelf of fruits and vegetables. Now a day's nano barcodes system is in trending way which gives the cautious to the consumers before opening the packaged foods.

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