ADVANCEMENTS OF NANOTECHNOLOGY IN FOOD PACKAGING

Anu Keshwani, Bhanu Malhotra, Dr.Harsha Kharkwal*

HOI, Amity Institute of Phytomedicine & Phytochemistry and Coordinator for Amity Center for Carbohydrate Research Amity University, Noida.

ABSTRACT

From an era the over-exploitation of petrochemical based non-biodegradable packaging materials have led to threat our environment in a serious way, which necessitates the need for the use of natural polymer based packaging materials in food packaging & wrapping which not only maintains the quality and safety but also extends the shelf life of food product. Nanotechnology referred to as the science of very small materials, is researched to have a powerful impact on food production and packaging. Today, R&D of food packaging and the monitoring of the use of nanotechnology food packaging is a major focus in the food industry to prevent food spoilage, increase its shelf life, and provide quality and safety to the consumers as well as to ensure food reaches them in a wholesome form. A considerably low level of a nanoparticle is required and thought to be sufficient to change the properties of packaging materials without many changes in their density, transparency and packaging, processing characteristics due to their large aspect ratios. Nanotechnology solutions focus on food safety by controlling pathogenic microbial growth, improving tamper visibility, delaying oxidation, and convenience. Though the use of nano-based packaging materials in food packaging films has also raised a number of environmental, ethical, safety, and regulatory issues. But nanotechnology is expected to play a keen role, taking into consideration all additional safety measures and reach present packaging needs in the food industry. Near one billionth of a meter, is a much too small for the human eye to see is a nanometer a miniscule. For humans, a substance measuring 100 nm or less is impossible to comprehend. For the same reason, structures measuring 1 - 100 nm are not seen by a naked eye but exist and have applications that could be essential to humankind.\[1\]
Unfortunately, the use of natural polymer based biodegradable films for food packaging has been strongly limited due to the limitations of poor barrier properties and weak mechanical properties exhibited by natural polymers. However, the application of nanocomposites as additives in food packaging film formulations promises to expand the use of edible natural polymer based films.\textsuperscript{[2]} Nanocomposites tend to reduce the packaging waste associated with processed food products and serve to accomplish preservation requirements of fresh foods by extension their shelf life.\textsuperscript{[3]} Nanotechnology enables the researchers to alter the structure of packaging materials at the molecular level. For example, the manufacture of certain packaging plastics which fit the requirements of food products such as fruits, beverages and wine, vegetables molecularly with different nanostructures to develop various gas and water vapour/moisture permeabilities to flavour, color, pathogen preservation, shelf life of the food products can be improved and achieved using natural polymer-based formulations containing these nanoparticles.

Use of nanosensors in food packages will help the determination of the nutrient content of food along with its quality. By adding certain nanoparticles into packaging material and bottles, food Packages of food can be made lighter, with stronger mechanical and thermal properties, as well as fire resistant. But the achievements and in nanotechnology are still challenging and beginning to impact the food safety because of the molecular synthesis of new food products and ingredients.\textsuperscript{[4]} The term nanofood is used for the food product which has been produced, cultivated, processed, and packaged using nanotechnology tools, or to which nanomaterials have been added.\textsuperscript{[5]}

Nano-Coatings are the waxy coatings used widely for food products like cheese and apples. Recently the scientists across the globe have managed to develop nanoscale edible film coatings as thin as 5 nm, invisible to the human eye. These edible coatings and films are used on a wide variety of foods, like fruits, meats, vegetables, cheese, chocolates, candies, bakery products. These coatings are a barrier to moisture and gas.\textsuperscript{[6]} Clay nanoparticles and nanocrystals improve the water vapour barrier properties of dairy and food packaging materials are enhanced by incorporating nano clays and nanocrystals. One of the advantages of clay nanocomposite seen in the food packaging films offers improved shelf life, light in weight, and heat resistant.\textsuperscript{[7]}

Silver is known for its antimicrobial activity against Gram-positive and Gram-negative bacteria including some of the antibiotic-resistant strains of bacteria, fungi, and many viruses.
The application of silver has led to its incorporation into materials like polymers, forming nano-silver composites. This study on nano-silver antimicrobial packaging applications is found to be a novel approach towards preservation of food and its shelf life extension. Two types of silver nanomaterial are used as antimicrobial agents- Ag and TiO$_2$ nanoparticles. The structural analysis explained the intercalation of Ag and TiO$_2$ nanoparticles of silver in the 20-70nm range which was found to be within the nanoparticles 20 bulk polymer, which explained its antimicrobial activity. The further investigation showed Ag and TiO$_2$ nanoparticles used in these composites are distinctly layered and incorporated into the bulk polymer instead of a coating on the polymer surface. The work performed includes data pertain to insignificance levels of Ag and TiO$_2$ nanoparticles in the selected food matrices which are a far lower than the acceptable levels at 0.01mgL$^{-1}$.[8]

Food safety is a growing concern for all food products for their protection from biological, chemical, physical, and radiation contamination which can occur through processing, cultivating, handling, and distribution of the nanomaterial. Since nanotechnology has brought revolution in food packaging research is going on to develop cling films from natural polymers incorporating these nanoparticles to enhance their various properties to reach at par with the synthetic packaging films available in the market. However, the additives universally accepted as GRAS will have to be re-evaluated examined when used at the nanoscale level to comply safety regulations. The use of nanoparticles must undergo a full safety assessment by the relevant scientific advisory association before their use is permitted and allowed in food packaging. Research is going across the globe to revolutionize the food packaging industry using nanotechnology as a powerful emerging tool for enhancing the flavour, texture, processing functionalities, shelf-life, and transportability of foods at feasible costs to thereby meet the contemporary demands for both health and convenience.

REFERENCES


