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Research Article

# Nanotechnology in Food Packaging

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## ABSTRACT

In recent years, food packaging continues to grow along with the modern technology. Modern lifestyle led people too busy to cook a proper meal at home. Due to time constraint and hectic schedules people prefer readymade foods and packed ingredients to consume. This creates increased demand on innovations in food packaging. Introduction of nanotechnology has brought new techniques and methodologies in packaging. Food packaging with nano materials acts as a barrier to microorganisms and ensures quality and safety. This paper explains the impact of nanotechnology and role of nano materials in food packaging.

**Keywords:** Food packaging; Nanotechnology; Nano materials; Health; Sensors

## INTRODUCTION

Nanotechnology is the most excited and a newly emerging technology which brought a breakthrough in scientific revolution. Nanotechnology is the rearrangement of atoms and molecules of a material to make an incredibly small things or a product with new and advanced structure and properties. Still there are a lot of unanswered questions about the impact of nanoparticles on the human health. Nanotechnology is an interdisciplinary field that has placed its foot in various fields like agriculture, medicine, food, health, machineries.

## ROLE OF NANOTECHNOLOGY IN FOOD PACKAGING

Food packaging is the packaging of food to protect it from contamination, spoilage and to increase its shelf time without much loss in its nutritive value. Packaging of food allows for easy storage and transportation. In recent years food packaging shows continuous growth along with modern technology. This technological advancement in food packaging is due to increased demand on ready to eat food concept, less processed and healthy foods. Food packaging through nanotechnology is an alternative approach to the conventional method of packing because packaging with non-degradable plastic polymer is a threat to the environment. Nano packaging provides the real conditions like temperature, odour, colour and freshness of food inside the packaging. The use of nano materials in food packaging provides better barrier properties, stability, minimizes the rate of spoilage and extends the shelf life of the product [1].

## NANO MATERIALS

Nanomaterials plays a vital role in food packaging. The most commonly used nano materials are AgNP, nano clay, nano zinc oxide, titanium oxide and titanium nitrate nanoparticles. Due to difference in their chemical properties each nano materials shows distinct properties in packaging. Nano materials are used as sensors to detect the internal and external conditions food packaging. Nanosensors help to detect the contamination, leakage, spoilage and moisture content of food inside the package. They can monitor the temperature conditions during the process of storage and transportation with the help of its unique chemical and electro-optical properties. These applications improve food safety and helps consumers to purchase the fresh and healthy products. Nanocomposites are materials that are made up of fusion of nano particles with a polymer matrix of a standard material. They shows a strong mechanical and antimicrobial properties.

### Silver nano particle

Silver nanoparticles has antimicrobial, antiviral, antifungi properties. It can combine with both non degradable and edible polymers for an effective food packaging. Silver nano particles releases Ag+ ions continuously in a low proportion and migrate into packaged foods for the protection against bacterial effects.

### $Tio_2$

Tio2 has various applications in food industries. It is known for its antibacterial properties. Tio2 helps to extend the shelf of the food products and prevents spoilage. Combined with silver it enhances antimicrobial properties of the food products. According to research there is no side effects of using tio2 in food packaging however, recent animal studies shows inhalation of tio2 leads to lung tumour [2-5].

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Table 1. Methods of Active packaging.

| Applications | Uses | Food products |
|---|---|---|
| **Antimicrobial films** | | |
| **Oxygen scavengers** | Helps to maintain the optimum oxygen level eliminate excess oxygen in the package | Breads, biscuits, cheese, meat and dried foods |
| **Carbon dioxide emitters** | Excess carbon dioxide is added to inactive microbial growth and helps to extend its shelf life | Coffee, fresh meat, fresh nuts, snack foods |
| **Ethylene scavengers** | Slows down the ripening process and extends shelf life by eliminating ethylene in the package | Fruits and vegetables |
| **Moisture absorbers** | Regulates water activity and maintains relative humidity in the food package | Fish, meat, poultry, fruits, vegetables |

Table 2. Methods of Intelligent Packaging.

| Applications | Uses | Food products |
|---|---|---|
| **Oxygen indicator** | Used in controlled atmosphere packaging or modified atmosphere packaging and provides information about the presence of O2 | Fresh meal, processed meal, milk powder |
| **$Co_2$ indicator** | Used in controlled atmosphere packaging or modified atmosphere packaging to indicate the concentration of Co2 | Readymade foods, fruits, vegetables, fresh poultry |
| **Colour indicator** | Provides information about temperature inside the food package | Fruits, vegetables, meat products |
| **Pathogen indicator** | Indicates microbial Status | Meat, fish and poultry products |
| **Breakage indicator** | Indicates broken package | Canned baby foods |
| **Freshness indicator** | Detects the quality of the product and indicates in the form of colour change | Milk bottles |
| **Leak indicator** | Indicates if package leaks which leads to product contamination | Fruits, Vegetables, meat, canned foods. |
| **Intelligent sensor** | Detects the chemical and physical property of the food and indicates in the form of colour change | Fruits and vegetables |
| **Bio sensor** | Measures biological analyte, CO2, alcohol and acid | Production of beer, yoghurt and soft drinks |
| **Gas sensor** | Identifies different types of gases, measures gas concentration and detects toxic or explosive gases | Salads, fruits, baked goods |

### Carbon Nanotubes

Carbon nanotubes are utilized in various fields. They can be either single walled or multi walled carbon nanotubes. Carbon nanotubes helps to pump carbon dioxide or absorb undesirable flavours from food package. It has significant mechanical strength and antibacterial property. However migration of carbon nanotubes into food is a major threat which causes toxic effects to human health.

## TYPE OF PACKING

Nanotechnology based food packaging is divided into three categories i.e., improved packaging, active packaging and smart or Intelligent packaging. The detailed information about each category is listed below.

### Improved packaging

In Improved packaging, the nano materials are mixed with polymer chain to enhance the packaging quality, gas barrier properties, temperature, humidity and resistance of packing.

### Nanoclay

Nanoclay is a natural nano layer structure that is incorporated into polymer for effective food packaging. The most commonly used nano clays are Montmorillonite (MMT, MMT-Na+) and Organophilic MMT (organic modified MMT, OMMT). They are used in packaging of cheese, confectioneries, processed meats, cereals and boil and bag foods. Nano clays exhibit low specific gravity, high surface area. They act as a barrier for gas and moisture.

### Nano coatings

Nano coating is the coating of thin edible layer of the food products. Many lipid components are used a coating material such as waxes and fatty acids which acts as a barrier for microorganisms [6-10]. Nano coating is used in coating of fruits, vegetables, meat, and cheese and in sweets. It has an excellent antimicrobial and antioxidant property.

### Active packaging

In active packaging, the nano materials such as nano copper oxide, nano silver, nano magnesium oxide and other nano materials with antimicrobial properties are incorporated into the packaging film that interacts directly with the food or environment through the absorption or release of gasses which allows better protection of the food products and also helps to extends its shelf life [11-14].

### Smart or intelligent packaging

Smart or Intelligent packaging is the incorporation of nano materials to monitor the condition of food and presence of pathogen inside the package. Intelligent packaging can sense the chemical, microbial changes and they can repair it by responding to the temperature conditions. It gives the history of storage period and in case of any spoilage it can alert the customers.

## CONCLUSION

Continuous changes in consumer's preferences, cooking style and time availability puts an increased demand on advancement in food packaging and preservation. This led to dynamic innovations

in food packaging also expected for more innovations in near future [15]. Even though Nanotechnology has the huge benefits in food packaging as a coin with two sides it also has some potential risk like migration of nanomaterials into food consumer safety and lack of human exposure in nanotechnology threats human health and environment.

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## REFERENCES

1. Fuertes G, Soto I, Carrasco R, Vargas M, Sabattin J, Lagos C. Intelligent packaging systems: sensors and nanosensors to monitor food quality and safety. J Sens. 2016.
2. Semih O, Buket Y. Intelligent food packaging. Log Forum. 2008;4:1-8.
3. Bumbudsanpharoke N, Ko S. Nanoclays in food and beverage packaging. J NanoMat. 2019;1-9.
4. Orlando simbine E, Cunha rodrigues L, Lapa guimarães J, Setsuko kamimura E, Humberto C, Fernandes de Oliveira CA. Application of silver nanoparticles in food packages: a review. Food Sci Technol. 2019;39:1-10.
5. Chaudhary P, Fatima F, Kumar A. Relevance of nanomaterials in food packaging and its advanced future prospects. J Inorg Organomet Polym Mater. 2020;30:5180-5192.
6. Sharma C, Dhiman R, Rokana N, Panwar H. Nanotechnology: an untapped resource for food packaging. Front Microbiol. 2017;8:1735.
7. Fotie G, Amoroso L, Limbo S, Muratore G, Piergiovanni L. Food life extension by cellulose nanocrystals coatings. Ital J Food Sci. 2019;27:8-14.
8. Ranjan S, Dasgupta N, Lichtfouse E. Nanoscience in food and agriculture. Cham: Spr Int Pub. 2016.
9. Pal M. Safety and Hygiene. J Food Microbiol. 2017.
10. Mobasser S, Firoozi AA. Review of nanotechnology applications in science and engineering. J Civil Eng Urban. 2016;6:84-93.
11. Hayes AW, Sahu SC. Nanotechnology in the food industry: a short review. FDA consum. 2017;23:18-9.
12. Brody AL, Bugusu B, Han JH, Sand CK, Mchugh TH. Innovative food packaging solutions. J Food Sci. 2008;73:107-16.
13. Wesley S, Praveen R, Allwyn A, Rajand D Review on nanotechnology applications in food packaging and safety. Int J Eng Res. 2014;3:645-651.
14. Huang Y, Mei L, Chen X, Wang Q. Recent developments in food packaging based on nanomaterials. Nanomaterials. 2018;8(10):830.
15. Nura A. Advances in food packaging technology-a review. Int J Postharvest Technol. 2018;6(4):55-64.