

The analysis about the application of nanomaterials in food packaging

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Abstract: This paper gives a comprehensive overview of the application of different nanometer materials in different food packaging. At the same time, the advantages of nanomaterials used in food packaging is further discussed. The toxicity of various nanomaterials to different cell or organelle was also analyzed and summarized

1. Introduction

With the progress of the society, the packaging materials of food is constantly improving, and their types are constantly expanding. Food packaging materials not only can protect food from environmental pollution, but also ensure that the food's nutrition does not spill. However, there will also be some substance exchange between food and its packaging materials. Harmful substances in packaging materials may enter food, which indirectly affects people's health. In recent years, there have been many food problems caused by food packaging materials, and scientists are trying to find more and better materials to use as food packaging materials. A large number of international food enterprises have invested a large amount of funds in the development and application of nanomaterials. The advantages and disadvantages of nanomaterials in food packaging will be analyzed in this paper.

2. The application of nanomaterials

2.1 Nanometer antimicrobial packaging materials

Food contains a variety of nutrients, which is very suitable for the survival of various microorganisms. Therefore, the general food is highly susceptible to microbial contamination and deterioration. MOD series of nanometer high-performance inorganic antibacterial agents is a new kind of inorganic antibacterial packaging material that introduces nanotechnology into sterile composite packaging. The material has changed the traditional production process of antibacterial agent with copper, zinc, silver and other metal ions. This kind of material completely solved the problem of color change of inorganic antibacterial packaging material in practical application.

The ZnO/LDPE antibacterial composite developed by Gao yanling was tested under a variety of conditions. It was found that this material had obvious antibacterial effect on four kinds of bacteria. It is found that this material has excellent antibacterial properties, effectively inhibits the growth and reproduction of microorganisms in sauced beef, and extends the shelf life.

2.2 Nanometer fresh-keeping packaging materials



The nanometer fresh-keeping packaging materials can extend the shelf life of fruits and vegetables. However, fresh fruits and vegetables tend to rot due to the release of ethylene gas. When the amount of ethylene in the package reaches a certain level, the decomposition rate of fruits and vegetables will increase greatly.

Nano-ag powder can catalyze the oxidation and decomposition of ethylene. Adding a certain amount of nano-ag powder into the packaging materials can effectively accelerate the oxidation and decomposition of ethylene. Zhou ling found that the photosensitive quality of the material was significantly better than that of PE plastic bag.

Nano-molecular sieves have high specific area and multi-micropore structure. Because molecular sieves have unique gas selectivity for oxygen and carbon dioxide, they are very suitable to be used as air conditioning package additives. H- β composite film with a screening volume of 7.5% at room temperature had the best preservation effect on the cherries, and the preservation time was longer than 10d.

Taking LDPE /LLDPE as the base material and adding nanometer active molecular sieve. The results showed that the storage period of strawberry could be improved by 2d at room temperature, and it could reach more than 13d when stored in the storage cabinet. One of the basic elements of food packaging materials is high barrier. PET is often used as beverage packaging material due to its characteristics of good transparency. However, as a beer bottle, the blocking performance of PET is not good enough. Therefore, it is necessary to improve gas barrier of pet.

3. Biological polymer nanocomposites

Cellulose is a linear crystalline hydrophilic with strong hydrogen bonding in and between molecules. Compared with common edible films, the water vapor barrier ability of the composite film was significantly improved after the CNF dosage reached 10%. After the addition of 36% CNF, the tensile strength of the composite film increased by 114% and the water vapor permeability decreased by 37%.

Starch is a common raw material that can be completely degraded, and its price is low. Nano-silicate biodegradable materials are suitable for food packaging. When 5% zno-cmc was added, its tensile strength was originally 3.9MPa, the water vapor permeability was significantly reduced, and its fracture pull rate was reduced .

Proteins are spatial structures formed by the condensation of amino acids, often used as edible films or coatings in the field of food packaging. Chen studied the relationship between structure and performance in the legume protein system. The electrostatic effect between the two is the key to the improvement of the system performance. After adding 16%MMT, its tensile strength increased by 15.43mpa from 8.77mpa.

3.1 He toxicity of nanomaterials

At present, nanomaterials have been widely used in food packaging. However, nanomaterials can migrate from food packaging to food, leading to food contamination and potential safety risks. Therefore, it is necessary to study the independence of nanomaterials. Some scholars believe that when the particle size of the non-toxic substance is reduced to a certain extent, the substance will start to become toxic or strengthen the toxicity. Therefore, nanomaterials may not be suitable for the safety evaluation results obtained by conventional material studies.

Studies have shown that nanomaterials have certain toxic effects on cells. Toxicity can be achieved by detecting the number of living cells and the integrity of cell membrane. LDH in the cytoplasm can be released due to cell membrane damage. Therefore, the integrity of cell membrane can be detected by LDH activity detection. Lin and others found that dose levels between 10 and 100 micrograms/ml 48 hours to reduce the cell survival rate in dose dependent manner.

The large surface area of nanomaterials makes them have good adsorption capacity. After absorbing proteins, nanomaterials can change the normal physiological conception of proteins to a certain extent, make them denaturing or even inactivation. Mitochondria exist in every cell of the body, and their main function is to convert organic matter into energy. Sun found that the particles can enter the cells through

different pathways and disperse in the cytoplasm and deposit in the mitochondria. Mitochondrial membrane potential is a negative and positive potential difference in cells and an intuitive indicator of the functional state of mitochondria. When nanoparticles enter the damaged mitochondria, they will lead to decreased membrane potential.

Duan exposed endothelial cells directly to nano-silica particles through intravenous administration, and the results showed that the degree of DNA damage were all significantly increased. In addition, DNA damage may be regulated by oxidative stress, which depends on the balance between ROS production and antioxidant function. Nanoparticles with a high surface area can promote the generation of reactive oxygen species, leading to oxidative DNA damage.

3.2. The damage of nanomaterials to organisms

The properties of nanoparticles are similar to that of gases and can be Brownian motion. Nanoparticles with respiratory tract entry into organisms are very dangerous. Prolonged stimulation of inflammation can lead to granuloma and fibrosis in lung tissue. Even more dangerous, nanoparticles deposited in the lungs may enter the alveolar interstitium, further infiltrating the capillaries and spreading throughout the body, triggering a series of adverse reactions. Rodent experiments have shown that nanomaterials can cross the alveolar capillary barrier and enter the bloodstream, causing cardiovascular and other systemic effects.

Transgenic mouse model studies have shown that nanomaterials in blood can enter vascular endothelial cells, inducing the production of large amounts of ROS and causing damage to vascular endothelial cells. ROS are released into the bloodstream. At the same time, ROS released by endothelial cells can rapidly bind to smooth muscle cells to release NO and deplete them, inhibiting smooth muscle cell relaxation and increasing the risk of heart arrhythmia and myocardial infarction. The nanomaterials adsorbed on the nasal mucosa of mice can be absorbed by the olfactory mucosa into the olfactory bulb tissue, and then enter the brain indirectly through the blood-brain barrier, causing oxidative damage to the brain. Once the nanomaterials damage the central nervous system, neurodegenerative diseases such as Parkinson's disease can be induced.

The liver is the most toxic accumulation site in the organism. If nanoparticles have entered the body and reached the blood circulation, the liver is likely to arrive and accumulate in the organism. Many nanomaterials are non-degradable, and their enrichment in the liver can trigger multiple biological reactions or interfere with normal metabolism. In particular, when phagocytosis is conducted by macrophages, inflammatory mediators, enzymes and cytokines are secreted to cause liver tissue damage, which can lead to hepatitis, liver cirrhosis, liver cancer and other symptoms.

4. Summary and outlook

At present, nanomaterials have been widely used in the food packaging industry, which can improve the barrier, insurance and antibacterial properties of food packaging. Various nanomaterials play an irreplaceable role. At the same time, the safety of nanomaterials has attracted much attention. The toxicity of nanomaterials is different due to the different types of nanoparticles, and the toxicity of the same nanomaterials to different cells is also different. Therefore, it is necessary to further explore the toxicity of nanomaterials and find out how to reduce the toxicity of nanomaterials as much as possible.

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