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Nanotechnology in food packaging

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Packaging of food products provides protection from contamination, spoilage and increases their shelf-life, without much loss in their nutritive value. It also allows easy storage and transportation. The technological advancement in food packaging is due to increased demand for ready-to-eat food concepts which are less time-consuming to prepare. The packaging of food through nanotechnology is an alternate approach to the traditional method of packing as the packaging with non-degradable plastic polymers may be a threat to the environment. Nanomaterials play a vital role in food packaging. The most commonly used nanomaterials are AgNPs (silver nanoparticles), nano clay, nano zinc oxide, titanium oxide and titanium nitrate nanoparticles. Due to the differences in their chemical properties, each nanomaterial shows distinct properties in packaging. Nanomaterials are used as sensors to detect the internal and external conditions of packaged food, for instance, leakage, contamination, moisture content and spoilage. They can monitor the temperature conditions during the process of storage and transportation with the help of their unique chemical and electro-optical properties. These applications improve food safety and help consumers to purchase fresh and uncontaminated products. Nanotechnology-based food packaging is divided into three categories, such as active packaging, improved packaging and smart packaging. In active packaging, the nanomaterials, such as nano copper oxide, nano silver, nano magnesium oxide and other nanomaterials with antimicrobial properties are incorporated into the packaging film that interacts directly with the food or environment by absorbing or releasing gases which allow better protection of the food products. This results in extending their shelf-life. In improved packaging, the nanomaterials are mixed with a polymer chain to reinforce the packaging quality, gas barrier properties, temperature, humidity and resistance of packing. Smart or intelligent packaging is the incorporation of nanomaterials to monitor the condition of food and the presence of pathogens inside the package. Intelligent packaging can sense the chemical and microbial changes and can repair itself by responding to the temperature conditions. It gives the history of the storage period and alerts the customers in case of any spoilage. Continuous changes in consumers’ preferences, cooking style and schedule have put an increased demand for an advanced food packaging and preservation system. This leads to dynamic innovations in food packaging, and innovations are also expected in the near future. Even though nanotechnology has huge benefits, it also has some potential risks, like their migration into the body through food resulting in free radicals causing damage to DNA and cell damage. Consumer’s safety and the lack of knowledge about human exposure to nanomaterials need to be looked into. Hopefully, the gaps in our knowledge can be overcome through further studies and research on nanotechnology and nanomaterials.

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