Chapter 7
Applications of Nanotechnology for Improving Food Safety and Security

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ABSTRACT

In order to ensure a consistent supply of nutrient-rich nutritious food, food safety and security are gaining a lot of attention on a global scale. Numerous technical activities, such as the creation of novel materials and the improvement of food safety and security, need nanotechnology. Nanomaterials are utilized to enhance food protection and aid in the detection of pesticides, toxic chemicals, and microbiological

contamination. Nanomaterials are utilized to enhance the detection of pesticides, toxic chemicals, and microbiological contamination. Nanocapsulation, which enables the release of bioactive substances, raises food bioavailability, and lengthens food shelf life, improves food processing even further. The main purpose of food processing is to fortify food by adding nutrients and beneficial ingredients. This chapter covers a variety of subjects, including the use of nanotechnology in food packaging, food safety, food preservation using smart nanocarriers, the detection of allergens and food-borne viruses using nanosensors, and crop growth and yield enhancement.

FOOD SAFETY AND SECURITY

Food security means having both the means and the ability to access a sufficient, safe and nutritious food supply that supports a healthy and active lifestyle. When people don't have enough food security, it can lead to malnutrition and this, in turn, can result in chronic diseases. Food access, food use, food stability, and food availability are the basic pillars of food security. By 2050, the world faces a significant challenge, as projected by the United Nations Food and Agriculture Organization (UNFAO). The demand for food is expected to rise substantially, by 59 to 98%, due to global population growth. This increase will be especially pronounced in developing countries, where the population is expected to reach 9 billion people. To ensure food security, food production needs to increase by 70%. Several factors will influence this increase, including available land, climate change, agricultural productivity and the food supply (Ansari, 2023).

The UNFAO also mentioned that food waste happens for different reasons in various parts of the world. In high-income countries, it's often related to outdated packaging and appearance preferences. In contrast, in underdeveloped countries, it's more common due to issues like spoilage, contamination, and low food quality. It has been demonstrated that abiotic stresses (such as soil salinization, high CO_2 and temperature levels, drought and nutritional imbalances) have a detrimental effect on plant growth, development, production, and quality. These events have sometimes helped in the local extinction of some species. Additionally, it has been noted that most crops experience an average yield loss of more than 50% due to abiotic stressors. Nanotechnology help to enhance the plant development and resistance to abiotic and biotic challenges, in order to improve the quality and agriculture productivity. Food waste negatively impacts the amount of land and water that may be used to grow food as well as the amount of greenhouse emissions that cause climate change (Kalpana et al., 2019).

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