

# Chapter 10

## New Horizons of Nanotechnology in Agriculture and Food Processing Industry

**Shabir Ahmad Mir**

*Pondicherry University, India*

**Manzoor Ahmad Shah**

*Pondicherry University, India*

**Mohammad Maqbool Mir**

*Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, India*

**Umar Iqbal**

*Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, India*

### ABSTRACT

*This chapter addresses the potential application of nanotechnology in various areas of agriculture and food processing sector. Nanotechnology is an exciting and fast developing field which aims to generate new materials and devices with wide range of applications. Nanotechnology is capable to solve the very complex set of engineering and scientific challenges in the agriculture and processing industry. Nanotechnology has great potential in providing novel and improved solutions to many challenges facing agriculture and food sector. Nanotechnology based products and its applications in agriculture include nano-fertilizers, nano-herbicides, nano-pesticides, recalcitrant contaminants from water, nano-scale carriers, nan-osensors, veterinary care, fisheries and food processing etc. Nanotechnology revolutionized the agriculture and food industry by innovation new techniques such as: precision farming techniques, more efficient and targeted use of inputs, disease detection and control, withstand environmental pressures and effective systems for processing and packaging.*

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## **INTRODUCTION**

Nanoscale science, engineering and technology embrace an exciting and broad scientific frontier which will have significant impact on nearly all aspects of the global economy, industry and people's life in the 21<sup>st</sup> century. Nanoscale science reveals the properties, processes and phenomena of matters at the nanometer (1 to approximately 100 nm) range. This technology renders precise capability to control and fabricate matters at this scale to provide novel and useful properties, thus leading to many new applications of nanoscale science and nanomaterials that can be used to address numerous technological issues.

Plant based agricultural production is the basis of broad agriculture systems providing food, feed, fibre and fuel through advancement in material sciences and biomass conversion technologies. While the demand for crop yield are rapidly increasing, the agriculture and natural resources such as land, water and soil fertility are finite. In agriculture and food science, a wide range of nanotechnology applications are being developed and commercialized with different goals ranging from improved food safety to reduced agricultural inputs, enhanced packaging, improved processing cum nutrition and the potential to promote sustainable agriculture and deliver better food globally (Gruere, 2012; Schnettler et al., 2013).

In agriculture, nanotechnology research and development have mostly focused on improving better input use, from water to nutrients, nano-pesticides, and nano-herbicides. Interesting applications include the use of nanoporous zeolites to slow the release and increased efficiency of fertilizers, nanosensors to measure soil quality and smart delivery mechanism for herbicides (Sastry et al., 2010).

Nanotechnology has the potential to improve food quality and safety significantly. It offers a wide range of opportunities for the development of innovative products and applications in food system. Nanotechnology and nanomaterials are a natural part of food processing and conventional foods, because the characteristic properties of many foods rely on nanometer sized components (Mir and Shah, 2014). Nanotechnology has been touted as the next revolution in many industries, including food processing and packaging. These applications are divided into several categories including food processing, nutraceutical delivery, packaging, and safety and sensing

## **BACKGROUND**

### **Nanotechnology in Agriculture**

Nanotechnology has the prospective to modernize the agricultural research and development with new tools for the molecular treatment of diseases with rapid detection and to enhancing the ability of plants to absorb nutrients etc. Smart sensors and smart delivery systems will help the agricultural industry, combat viruses and other crop pathogens. Nanotechnology also protects the environment indirectly through the use of alternative (renewable) energy supplies and filters or catalysts to reduce pollution and clean-up existing pollutants.

In the agricultural sector, nanotech research and development is likely to facilitate and frame the next stage of development of genetically modified crops, animal production inputs, chemical pesticides and precision farming techniques. While nano-chemical pesticides are already in use, other applications are still in their early stages and it may be many years before they are commercialized. These applications are largely intended to address some of the limitations and challenges facing large scale chemical and capital intensive farming systems.

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