19CH101– ENGINEERING CHEMISTRY

Unit-3 NANOCHEMISTRY

APPLICATION OF NANOTECHNOLOGY

(i) MEDICINE

Some nanotechnology-based drugs that are commercially available or in human clinical trials include:

- Doxil was originally approved by the FDA for the use on HIV-related Kaposi's sarcoma. It is now being used to also treat ovarian cancer and multiple myeloma. The drug is encased in liposomes, which helps to extend the life of the drug that is being distributed. Liposomes are self-assembling, spherical, closed colloidal structures that are composed of lipid bilayers that surround an aqueous space. The liposomes also help to increase the functionality and it helps to decrease the damage that the drug does to the heart muscles specifically.
- Onivyde, liposome encapsulated irinotecan to treat metastatic pancreatic cancer, was approved by FDA in October 2015.
- Rapamune is a nanocrystal-based drug that was approved by the FDA in 2000 to prevent organ rejection after transplantation. The nanocrystal components allow for increased drug solubility and dissolution rate, leading to improved absorption and high bioavailability.
- Cabenuva is approved by FDA as cabotegravir extended-release injectable nano-suspension, plus rilpivirine extended-release injectable nano-suspension. It is indicated as a complete regimen for the treatment of HIV-1 infection in adults to replace the current antiretroviral regimen in those who are virologically suppressed (HIV-1 RNA less than 50 copies per mL) on a stable antiretroviral regimen with no history of treatment failure and with no known or suspected resistance to either cabotegravir or rilpivirine. This is the first FDA-approved injectable, complete regimen for HIV-1 infected adults that is administered once a month.
- Abraxane, approved by the U.S. Food and Drug Administration (FDA) to treat breast cancer, non-small- cell lung cancer (NSCLC) and pancreatic cancer, is the nanoparticle albumin bound paclitaxel.

(ii) AGRICULTURE

Ensuring food security in developing countries is highly challenging due to low productivity of the agriculture sector, degradation of natural resources, high post farming losses, less or no value addition, and high population growth. Researchers are striving to adopt newer technologies to enhance supply to narrow the food demand gap.

Nanotechnology is one of the promising technologies that could improve agricultural productivity via nano fertilizers, use of efficient herbicides and pesticides, soil feature regulation, wastewater management, and pathogen detection. It is equally beneficial for industrial food processing with enhanced food production with excellent market value, elevated nutritional and sensing property, improved safety, and better antimicrobial protection.

Nanotechnology can also reduce post-farming losses by increasing the shelf life with the aid of nanoparticles. However, further investigation is required to solve the safety and health risks associated with the technology.

AREAS OF NANOSCIENCE RESEARCH IN AGRICULTURE AND FOOD SCIENCE

Contribution of nanoscience research in agriculture will be in the following areas:

- Food safety and biosecurity
- Material science
- Food processing and product development

NANO-PARTICLES CONTROLLING THE PLANT DISEASES

Some of the nano particles that have entered into the arena of controlling plant diseases are nanoforms of carbon, silver, silica and alumina-silicates.

NANOPARTICLES FOR THE CONTROL OF DISEASE AND PEST INCIDENCES IN PLANTS

Nanoparticles of defined concentrations could be successfully used for the control of various plant diseases caused by several phytopathogens.