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Review Paper

Plants as Green Source towards Synthesis of Nanoparticles

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Abstract

The recent development and implementation of new technologies have led to new era, the nano-revolution which unfolds role of plants in bio and green synthesis of nanoparticles which seem to have drawn quite an unequivocal attention with a view of synthesizing stable nanoparticles. Although nanoparticles can be synthesized through array of conventional methods biological route of synthesizing are good competent over the physical and chemical techniques. Green principle route of synthesizing have emerged as alternative to overcome the limitation of conventional methods among which plant and microorganisms are majorly exploited. Employing plants towards synthesis of nanoparticles are emerging as advantageous compared to microbes with the presence of broad variability of bio-molecules in plants can act as capping and reducing agents and thus increases the rate of reduction and stabilization of nanoparticles. Biological synthesized nanoparticles have upsurge applications in various sectors. Hence the present study envisions on biosynthesis of nanoparticles from plants which are emerging as nanofactories.

Keywords: Plants, nanoparticles, biosynthesis, biomolecules.

Introduction

The emergence of nanotechnology has provided an extensive research in recent years by intersecting with various other branches of science and forming impact on all forms of life[1]. The concept of nanotechnology was first begun with lecture delivered by Richard Feynman in 1959[2]. Nanotechnology is a field of science which deals with production, manipulation and use of materials ranging in nanometers. In nanotechnology nanoparticles research is an important aspect due to its innumerable applications. Nanoparticles have expressed significant advances owing to wide range of applications in the field of bio-medical, sensors, antimicrobials, catalysts, electronics, optical fibers, agricultural, bio-labeling and in other areas[3] (figure-1).

Nanoparticles Synthesis

Arrays of conventional methods have been employed in synthesis of nanoparticles. But these conventional methods are bound with various limitations such as expensive, generation of hazardous toxic chemicals etc., which has upsurge the researchers to develop safe, eco-friendly alternative approaches in synthesis of nanoparticles among which biological systems have been focused and exploited as a preferred green principle process for synthesis of nanoparticles. Undoubtedly, biological systems have a unique ability for production of precise shape and controlled structures. Methods employed for the synthesis of nanoparticles are broadly classified under two processes such as "Top-down" process and "Bottom-up" process (figure-2).

Top-down approach: Bulk material is broken down into particles at nanoscale with various lithographic techniques e.g.: grinding, milling etc. Bottom-up approach: Atoms self-assemble to new nuclei which grow into a particle of nanoscale. With the advent of advance technologies and improved scientific knowledge have paved a way for research and development in the field of herbal and medicinal plant biology towards intersection of nanotechnology. One such interference is employing plants in synthesis of nanoparticles. The possibilities of employing plants in the deliberate synthesis of nanoparticles have burgeoning interest as an important source towards reliable and environmentally benign method of metallic nanoparticles synthesis and its characterization (figure-3).

The present review emphasizes reported plant resources for the synthesis of different nanoparticles. Plants are known to possess various therapeutic compounds which are being exploited since ancient time as a traditional medicine. Due its huge diversity plants have been explored constantly for wide range of applications in the field of pharmaceutical, agricultural, industrial etc. Recent reports of plants towards production of nanoparticles is said to have advantages such as easily available, safe to handle and broad range of biomolecules such as alkaloids, terpenoids, phenols, flavanoids, tannins, quinines etc. are known to mediate synthesis of nanoparticles. Plants reported to mediate nanoparticles synthesis are mentioned in the table-1 which is discussed briefly in this present review.