PHYTONANOTECHNOLOGY

Challenges and Prospects

Edited by
N. Thajuddin
Silvy Mathew

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Contents

CHAPTER 3

Plant extracts: Nanoparticle sources

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3.1 Introduction

Nanoparticles (NPs) (usually in dimensions of 1–100 nm) have been proven, through numerous research findings, to have excellent properties in term of physiochemical, antifungal, chemical, catalytic, thermal conduction, mechanical, electrical, optical, and many more [1,2]. NPs have vital roles in agro-production and protecting crops from diseases, both directly and indirectly, and they go even further to influence the soil microbial population. At the nanoscale, the elementary understanding of chemical and physical properties is very distinctive. As such, research outputs at different scales will have different interpretations that in turn radiate different properties, even for the same element. Owing to the superior qualities of NPs, research on them is intense, as many researchers are intensively working in the area. Nanoparticle utilization is glaring in many areas, including healthcare and cosmetics, food and feed, drug delivery systems, the space industry, electronics, optoelectronics, biomedical science, and many more [3,4].

Plant-based NPs are in the limelight due to their environmentally friendly nature, ability to be scaled up, operation under mild conditions, and possible to extract under nontoxic chemicals. Using harmful chemical precursors, external stabilizing and capping agents will definitely cause adverse consequences to humans and nature in general. This green synthesis route (plant-based NPs) that evades the use of synthetic reductants and stabilizing agents can readily serve for the medical and pharmaceutical applications such as the diagnosis and treating of acute and chronic diseases. The major issues associated with these plant-based NPs are that the choice of NP cannot be custom-made as well as the presence of NPs in minute quantities. The limited quantity of NPs produced in the bio-route as compared to other routes is one of the bigger challenges that needs to be tackled. Plant-based nanoparticle synthesis methods can be broadly categorized into three routes: physical, chemical, and biological. However, there are many more methods such as thermal reduction, the polyol method, vacuum vapor deposition, solvothermal, microwave irradiation and heating, microemulsion, and sonochemical reduction (Table 3.1).

The chemical route is seen as an easy and cost-effective one that operates at lower temperatures, but the issue of utilizing toxic reducing agents needs to be addressed.

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Index

Note: Page numbers followed by *f* indicate figures, *t* indicate tables, and *s* indicate schemes.