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REVIEW

Biosynthesis of metallic nanoparticles using plant derivatives and their new avenues in pharmacological applications – An updated report

Palaniselvam Kuppusamy *, **Mashitah M. Yusoff, Gaanty Pragas Maniam, Natanamurugaraj Govindan**

Biomaterial and Biosensor Laboratory, Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia

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Abstract The field of nanotechnology mainly encompasses with biology, physics, chemistry and material sciences and it develops novel therapeutic nanosized materials for biomedical and pharmaceutical applications. The biological syntheses of nanoparticles are being carried out by different macro–microscopic organisms such as plant, bacteria, fungi, seaweeds and microalgae. The biosynthesized nanomaterials have been effectively controlling the various endemic diseases with less adverse effect. Plant contains abundant natural compounds such as alkaloids, flavonoids, saponins, steroids, tannins and other nutritional compounds. These natural products are derived from various parts of plant such as leaves, stems, roots shoots, flowers, barks, and seeds. Recently, many studies have proved that the plant extracts act as a potential precursor for the synthesis of nanomaterial in non-hazardous ways. Since the plant extract contains various secondary metabolites, it acts as reducing and stabilizing agents for the bioreduction reaction to synthesized novel metallic nanoparticles. The non-biological methods (chemical and physical) are used in the synthesis of nanoparticles, which has a serious hazardous and high toxicity for living organisms. In addition, the biological synthesis of metallic nanoparticles is inexpensive, single step and eco-friendly methods. The plants are used successfully in the synthesis of various greener nanoparticles such as cobalt, copper, silver, gold, palladium, platinum, zinc oxide and magnetite. Also, the plant mediated nanoparticles are potential remedy for various diseases such as malaria, cancer, HIV, hepatitis and other acute diseases.

* Corresponding author. Tel.: +60 1117901062, +60 95492465 (O); fax: +60 95492766.
E-mail address: kpalaselvam@yahoo.co.in (P. Kuppusamy).
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1. Introduction

Nanoparticle has multifunctional properties and very interesting applications in various fields such as medicine, nutrition and energy (Chandran et al., 2006). The biogenic syntheses of monodispersed nanoparticles with specific sizes and shapes have been a challenge in biomaterial science. Also, it has created remarkable advantages in the pharmacological industry to cure various bacterial and viral diseases (Song and Kim, 2009). Biosynthesis methods have more compensation over other classical synthesis procedures due to the availability of more biological entities and eco-friendly procedures. The rich biodiversity and easy availability of plant entities have been highly explored for the nanomaterials synthesis (Monda et al., 2011). Recently, the biosynthesis of nanosized particles, wires, flowers, tubes was reported successfully. These biological synthesized nanomaterials have potential applications in different areas such as treatment, diagnosis, development surgical nanodevices and commercial product manufacturing (Bar et al., 2009). Nanomedicine makes a huge impact in healthcare sector in treating various chronic diseases. Hence, eco-friendly synthesis of nanoparticles is considered as building blocks of the forthcoming generations to control various diseases (Cruz et al., 2010).

Plant crude extract contains novel secondary metabolites such as phenolic acid, flavonoids, alkaloids and terpenoids in which these compounds are mainly responsible for the reduction of ionic into bulk metallic nanoparticles formation (Aromal and Philip, 2012). These primary and secondary metabolites are constantly involved in the redox reaction to synthesize eco-friendly nanosized particles. Many previous reports are demonstrating that biosynthesized nanoparticle effectively controlled oxidative stress, genotoxicity and apoptosis related changes (Kim et al., 2007). Additionally, nanoparticles have broad application in agriculture industry and plant sciences. For instance, the nanoparticle using bioprocessing technology converts the agricultural and food wastes into energy and useful by-products. Based on that, the review focused on biosynthesized metallic nanoparticles from plant derivatives and its application in medical and commercial sectors including waste water treatment, cosmetics and food industry.

1.1. Classical approaches of metals

Anciently, the gold metal is known as a symbol of power and wealth. The gold metal is used in different forms to improve the human health ever since. Even today, the biological aspects of metallic gold nanoparticles (GNPs) are very useful to human health and cosmetics applications (Alanazi et al., 2010). In the 18th century, Egyptians used gold metal solubilized water for mental and spiritual purification. The restorative property of gold is still honoured in rural villages, where peasants cook their rice with a gold pellet to replace the minerals in the body via food intake. Traditionally, silver metal is used to control bodily infection and prevent food spoilage. Silver is used as wound healer agents and ulcer treatment