Biochemistry and Biophysics Reports 11 (2017) 46–57

Contents lists available at ScienceDirect

Biochemistry and Biophysics Reports

journal homepage: www.elsevier.com/locate/bbrep

Phyto-assisted synthesis, characterization and applications of gold nanoparticles – A review

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ARTICLE INFO

Keywords:
Plant
Gold nanoparticles
Characterization
Synthesis

ABSTRACT

Nanotechnology is the formation, running and use of operation at the nanomaterial size scale (1–100 nm). Nanoscale materials can also be obtained by biological synthesis materials via eco-friendly green chemistry based technique. Current development and numerous strategies involved in the green synthesis of nanoparticles were focussed. This review mainly focused on plants which include scientific name, family name, common name, plant parts, its characterization, size and shape of the nanoparticles. Plant extract which was done experimentally gives its various characterization which leads to the identification of compounds of different nano size and shape. Biosynthesis of gold nanoparticles is in different shapes like spherical, rod, cubic, triangle and also in different sizes. Various application and importance of gold nanoparticles in numerous fields were discussed. The mark of the review is to provide an overview of recent learning in biosynthesized nanoparticles, its characterization and their potential applications.

1. Introduction

Nanotechnology has been the subject of great research and enthusiasm for researcher's in recent years [1]. Nanomaterial having nanoscale dimension possess unique properties as compared to their bulk equivalent. The Recent approach focuses on economically alternative methods for the creation, manipulation of material at nanometre scale level [2]. Nanotechnology is one of the most exigent and fastest growing branches in the field of science and engineering. 16th century people already used noble gold nanoparticles for the medical and staining purpose. They have proved to be very useful for stomatology, pharmacy and implantology tissue engineering [3].

Nanoparticle synthesis is conducted by physical, chemical and biological or green method. A physical and chemical technique of synthesizing nanoparticles has proved to be quite expensive and potentially hazardous to the environment. Toxic and perilous chemicals involved in the synthesis of nanoparticles in chemical synthesis technique possess various biological risks and are responsible for several health diseases. Gold nanoparticles have been extensively used for biomedical applications (Fig. 1) [4], in separation sciences and disease diagnosis [5].

Use of plant materials for the green synthesis of nanoparticles has evolved in the last decade. The ability of plant extract to reduce metal ions has been known since the early 1900s but it was used only in last 30 years for the reduction of metal salt. Plants contain certain bioactive compounds like flavonoids, phenols, citric acid, ascorbic acid, polyphenolic, terpenes, alkaloids and reductase which act as reducing agents. Plant-mediated synthesis of nanoparticles is a very promising area of nanotechnology because the plant itself acts as both reducing and capping agent. Plant system can synthesize nanoparticles both intracellularly and extracellularly [6]. Intracellular methods for synthesizing of nanoparticles includes growing the plant in metal-rich organic media [7], metal-rich soil [8], metal-rich hydroponic solution [9]. At the same time, extracellular methods include nanoparticles synthesis by using leaf extract prepared by boiling and crushing of leaves [10].

Gold nanoparticles have bactericidal effect against animal pathogens, food pathogens and it has other pharmacological activities. Applications include tumor destruction via heat separation, pharmacokinetic studies [11], separation science [12], health care, environmental, drug delivery, gene delivery, optics, food industry, space industry [13]. The aim of this review is to focus on different plants extract mediated synthesis of gold nanoparticles, particularly where plant compounds react with metal ions and salt and lead to its reduction. These nanoparticles are further characterized by different size, shapes and morphology.

2. Characterization techniques

Technically two broad approaches are used for the synthesis of nanoparticle: top down approach and bottom up approach. The top-

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http://dx.doi.org/10.1016/j.bbrep.2017.06.004
Received 10 May 2017; Received in revised form 15 June 2017; Accepted 19 June 2017
Available online 21 June 2017

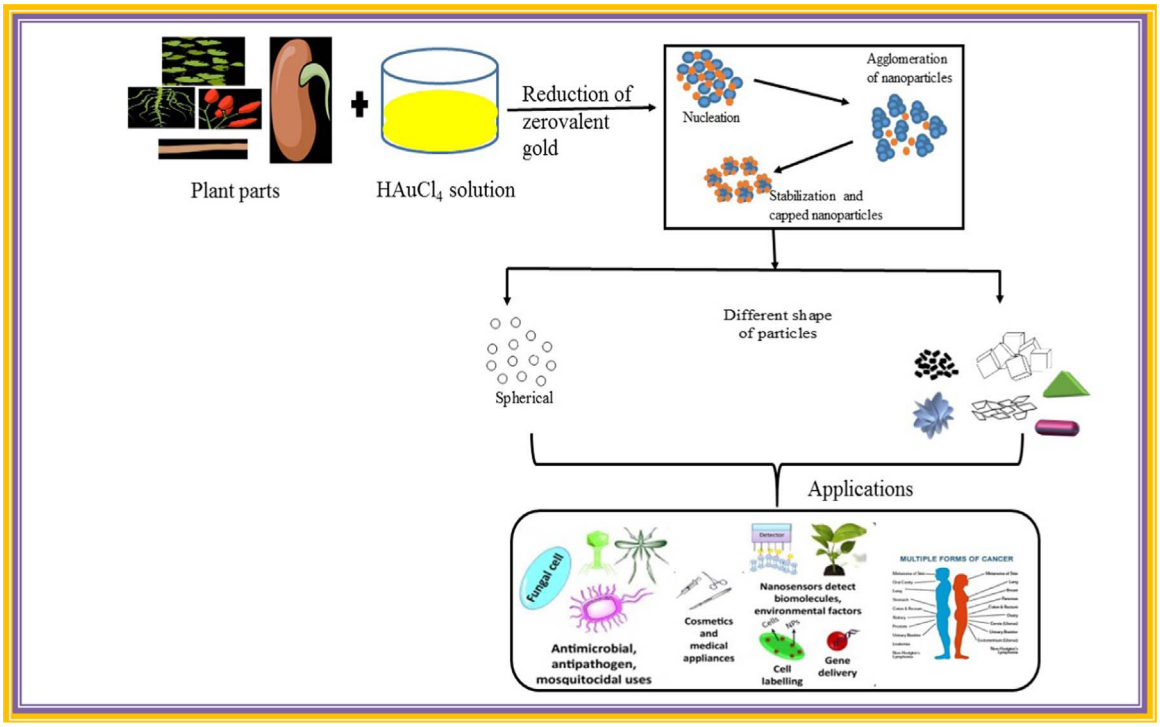

Fig. 1. Reactions involved in green synthesis of nanoparticles and its application.

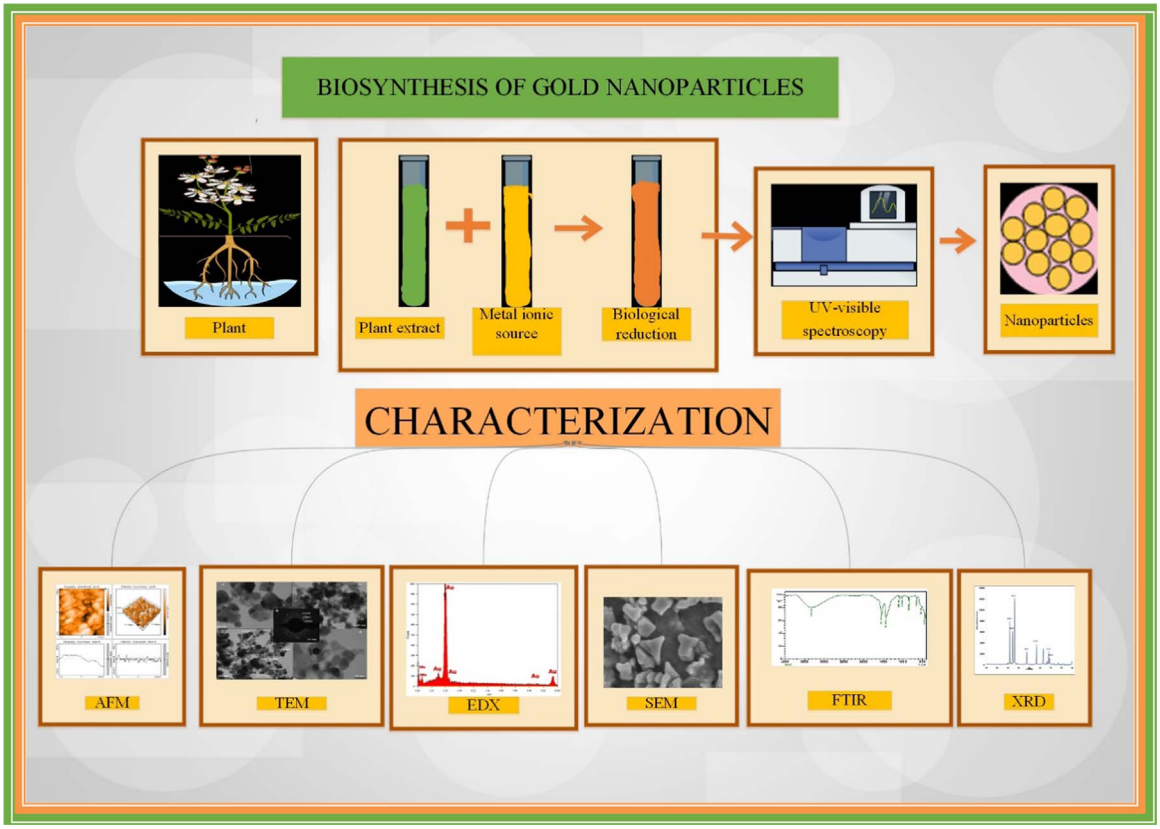

Fig. 2. Synthesis and different characterization.

down approach deals with material size reduction of particles via the physical and chemical process to produce nanoparticles. The size, shape, overall physiochemical properties and surface structure are processed throughout the process [14]. Bottom-up approach deals with engineering at atomic, molecular level [15]. Nanoparticles of different size, shape, surface area are characterized by various techniques like UV-visible spectroscopy (UV-vis), powder X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), Gas chromatography-mass spectrometry (GC-MS), High performance liquid chromatography (HPLC), energy dispersive spectroscopy (EDS), dynamic light scattering