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GREEN SYNTHESIS OF METALLIC NANOPARTICLES USING PLANT EXTRACT: A REVIEW

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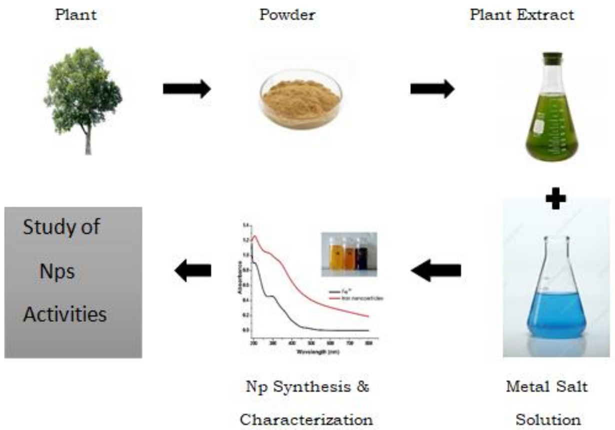
ABSTRACT:
The rewards of using plants over chemical and physical methods for CuNPs synthesis have fascinate simple and eco-friendly green route may be profitable as compared with other methods. The structural and morphological properties of CuNPs were determined by using XRD, FTIR, IR, SEM, TEM, EDX and shows extreme antibacterial, antioxidant, catalytic, ovicidal effect along with anticancer activities. This review explains techniques used in synthesis of CuNPs, characterisation techniques, their role and limitations in preparation, synthesis procedure, screening analysis in different parts of plant is presented from the recent published literature which has been reviewed and summarised. The main purpose of this review was to summarized the data of plants used for the synthesis of CuNPs that gives overall idea to the beginners and open a new pathway for researchers to investigate those plants which have not been used in the past.

GRAPHICAL ABSTRACT:



Keywords:- Green synthesis, Plant extract, Nanoparticles, Antibacterial activity, Catalytic activity.

INTRODUCTION :

Nanotechnology is an important field of modern research has recently attracted much interest over wide range of fields. Particle size is the unique property of nanoparticles, within this size range all the properties (chemical, physical and biological) changes in changes in fundamental ways of both individual atoms/molecules. Nanoparticle has multifunctional properties and very interesting applications in various areas such as healthcare sector, nutrition and energy and commercial product manufacturing (1). The biosynthesis of nanosized particles, wires, flowers, tubes was reported successfully. Several methods have been devised in order to prepare metallic

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nanoparticles like physical and chemical and biological methods. Synthesis of nanoparticles by chemical method uses variety of hazardous chemicals may have considerable environmental defect, technically laborious and economically expensive (2,3). The biological method of nanoparticles synthesis is economic and environmental friendly based on green chemistry principles and are simple, relatively inexpensive, and easily scaled up for larger scale production (4) Plant extract used in biosynthesis of nanoparticles contains primary and secondary metabolites such as phenolic acid, flavonoids, alkaloids and terpenoids which constantly used as reducing agent in the redox reaction to synthesize eco-friendly nanosized particles (1). Over all, our goal while writing this review literature study is to summarised the plant mediated synthesis of variety of nanoparticles their characteristic properties that will benefit researchers involved in this emerging field while serving as a useful guide for readers with a general interest in this topic.

Preparation of Nanoparticles

For nanoparticle synthesis, there are two general pathways: a bottom-up and top-down approach, Fig. (1). In top-down approach, a larger structure is broken down into smaller pieces using chemical, physical, and biological energy; and the bottom-up approach, in which material is synthesized from the atomic level using various chemical, physical, or biological reactions to make a large nanostructure (5). In the Green Synthesis of nanoparticles, concept has been applied for the development of clean and environment-friendly nanoparticles. Plants are known as chemical factories of nature which are cost-efficient and need little maintenance.

Green Synthesis of Nanoparticles

Plant mediated biosynthesis, various parts of plants such as fruit, leaf, stem, root have been widely used for green synthesis of nanoparticles due to the excellent phytochemicals they produce. The protocol for nanoparticle synthesis involves, the collection of part of the plant of interest from available sites was done. The plant was taxonomically identified, were washed thoroughly twice/thrice with tap water followed by distilled water to remove dust if any. The fresh and clean plant parts were air dried in the shade for 10-15 days and then powered using domestic blender. For plant extract preparation, put Specific amount of dried plant part in a flask, add solvent and boiled at specific temperature. The extract was filtered and centrifuged at 1000 rpm. Plant extract was stored in refrigerator 4 for further studies. Add plant extract in to a conical flask containing aqueous salt solution and mixture was heated with continuous stirring under a magnetic stirrer. Colour change in the solution is the primary conformation of nanoparticles. The formed nanoparticles were stored protected from sunlight.

Characterization of synthesized nanoparticles

The absorption behaviour of the synthesized nanoparticles were recorded in UV-Visible spectra as a function of wavelength using UV - Vis spectrophotometer m. The shape and size of silver nanoparticles were determined by SEM equipped with EDX, FESEM and TEM. The X-ray diffraction (XRD) technique is employed to check the phase purity and to determine crystal symmetry. Surface morphology of nanoparticles can be investigated using Scanning Electron Microscope (SEM). The EDS analysis confirmed chemical composition of examined nanoparticles. The physical and chemical stability of nanoparticles can be confirmed using Fourier Transform Infrared (FT-IR).

Applications of Nanoparticles

The silver nanoparticles synthesized showed scavenging, Antimicrobial, Antidiabetic, Catalytic and antioxidant activities have been used most widely in the health industry, food

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storage, textile coatings and a number of environmental applications (17). The multifunctional AgNPs have a promising activity against spore producing fungus and effectively destroy the fungal growth (1). The CuO Nps showed significant antibacterial activity on bacterial strains with some reports available for the antimicrobial activities (18). TheTiO_2 nanoparticles shows significant antibacterial activity, increased with increasing the concentration of TiO2 nanoparticles (19). The Fe nanoparticles shows catalytic activity for methyl orange removal is presented (12). Anticancer activity has been reported in Pt nanoparticles (10).

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Table 1: Green synthesis of nanoparticles by different researchers using plant extract

Plant	Part of plant	Np	Conc. Of salt	Temp	Characterization	Size	Shape	Activity	Ref
Erythrina abyssinica	Steam, leaves, bark	Ag	1mM $AgNO_3$	80	UV-Vis., FTIR, SEM	8.4-10 nm	-	Antimicrobial	6
Rumex hymenosepalus	roots	Ag	2.5,5,7.5,10, 15mM $AgNO_3$	-	UV-Vis, NMR, EDS, TEM, HR-TEM	2-40 nm	hexagonal	-	2
Banana	peels	Ag	1nM $AgNO_3$	30	UV-Vis, SEM, EDX, TEM, XRD, FE-SEM, FTIR	23.7 nm	Spherical	Antimicrobial	3
Tectona grandis	seed	Ag	1mM $AgNO_3$	Heated below B.P	UV-Vis, SEM, FESEM, EDX, TEM, XRD, FTIR	10-30 nm	Spherical	Antimicrobial	7
Embelio robusta	seed	Ag	0.01M $AgNO_3$	45±2	UV-Vis, PS, FTIR, XRD, TEM	5-15 ±2 nm	Irregular spherical	Antidiabetic, Antioxidant, Antibacterial, Catalytic, Scavenging test	8
Carnivorous plants		Ag	8nM $AgNO_3$	70	UV-Vis, SEM, FTIR, XPS, EDS, TEM, HPLC	-	-	Antimicrobial Susceptibility	9
Saudis Dates	-	Pt	-	-	UV-Vis, TEM, XRD, EDX, TGA,	1.3-2.6nm	homogenous	Antimicrobial, Antibacterial, Anticancer	10
Cambretum indicum	Flowers petal	Ag	10nM $AgNO_3$	-	UV-Vis, SEM, EDX, PL, XRD, DLS	58.57nm	Spherical	-	11
Mediterranean cypress	leaf	Fe	1M FeCl3.6H2O	-	FTIR, TEM, XRD	˜1.5nm	-	Dye removing essay	12
Fritillaria	Flower	Ag	0.01M AgNO3	-	UV-Vis, SEM, TEM, EDX, FTIR, XRD, TGA	5-10nm	Spherical	Antimicrobial	13
Psidium guajava	leaf	Ag	1nM AgNO3	-	UV-Vis, XRD, TFIR, SEM	62nm	Spherical	Antibacterial	14
Gloriosa superba	leaves	CuO	2.32 g Cupric nitrate	400± 10	PXRD, UV-Vis, SEM, TEM	5-10 nm	Spherical	Antibacterial	15
Ledebouria revoluta	Bulb	TIO2	5nM TiO2	50	XRD, FTIR, HRTEM, EDAX, UV-Vis	47nm	spherical	Antibacterial, larvicidal, Anticancer, Histopathological	16

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Fig. 1: Different approaches for synthesis of nanoparticles

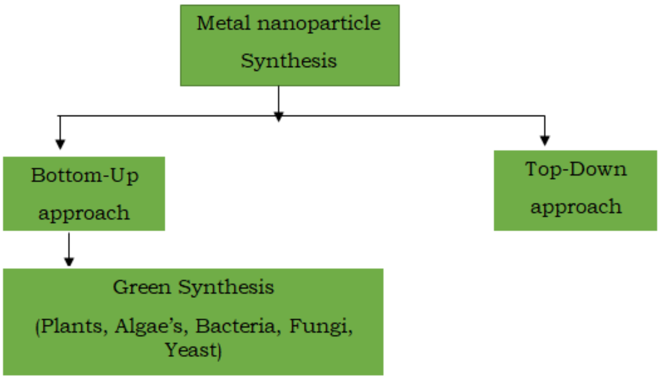
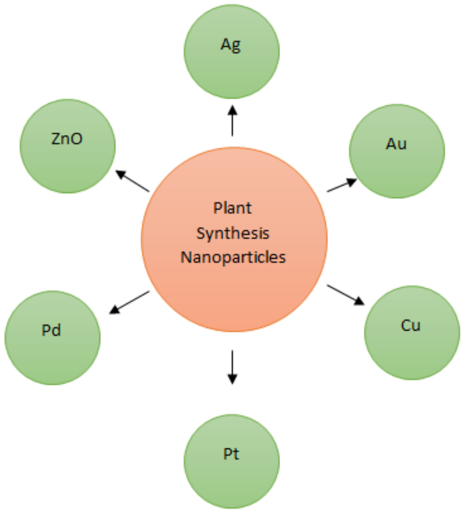


Fig. 2: Different types of nanoparticles synthesised from plant resources



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