



Biological synthesis of Nanoparticles from Medicinal Plants: Recent Studies

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ABSTRACT

In a recent trend, nanotechnology has been developed to be an important field of research in various fields like medicinal chemistry, pharmaceuticals and all. On the other hand, compared to chemical method of synthesis, method of synthesis of nanoparticles by green method is simple, effective & ecofriendly. Plant extracts are obtained from the plant, creep, cereals, etc. generally natural extracts are prepared by decoction method or solid powder formation method. The natural extracts are very much effective in the medicinal approach. The study of Nano sized particles towards natural extracts has given a novel way in the field of medicines. So from the nanomaterials of natural extracts, one can expect still good effective results. As we know that preparation of nanoparticles through green approach is one of the good selections in the view of betterment of ecology. Therefore by taking aqueous extracts of medicinal plants' parts and metal ions, nanoparticles can be synthesized. The plant extract and metal ions are taken in a fixed ratio and keep at room temperature for the reduction. The Changes in the Color confirmed the formation of nanoparticles. Further, the synthesized nanoparticles were characterized by UV, EPMA, XRD and FTIR data.

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INTRODUCTION

In the oldest ayurvedic epic of India i.e. in the Charaka Samhita, have paid an attention regarding the concept of reduction of particle size of metals. In earlier days use of Bhasma of metals in the treatment ailments. Now it is proved that bhasmas have nanoparticles of metals. If we compare both green method & chemical – mediated synthesis,

green approach of synthesis of nanoparticles is eco-friend, simple and effective method. Also now a day the nanotechnology is been growing to be an important thing in all areas including medicinal chemistry. The natural extracts are very much effective in the medicinal approach. The study of Nano sized particles towards natural extracts has given a novel way in the field of medicines. So from the nanomaterials of natural extracts, one can expect still good effective results.

There will be great interest over the field of nanotechnology. The advancement of the synthesis of nanomaterials is mainly with respect of consideration of range of size, shape and chemical compositions. This is been from the era of Michael faraday. The transformation from micro-particles to nanoparticles can cause a range of physical properties changes. The increase in the ratio of surface area to volume and the scale of the particle heading into the domain in which quantum effects predominate are two of the major factors in this (Holister *et al.*, 2003).

As we all know that the potency of nanoparticles is utilized in the Nano device applications. Thus nanoparticles' synthesis and assembly techniques will often follow liquid, solid and gas phase precursors; employs various strategies such as chemical, physical and biological approach.

The materials where the functional structures are designed from atomic or molecular level; they will be exhibiting novel and advanced physical, chemical and biological properties and processes only because of their size. A human hair width is about 30-40 micro meter, $1\text{nm} = 30000^{\text{th}} - 40000^{\text{th}}$ of a hair width, so on this point of view, we just say that nanometer scale is completely a unique area. Because of this high distinction from larger scale, the properties of nanomaterials cannot be easily predictable. The various changes in the behaviour observed are not only due to size, but also because of the new phenomena such as quantum confinement. Therefore nanoparticles are likely to impact on many fields.

Methods of Preparation of Natural Extracts

Natural extracts are used to create flavors of food and pharmaceutical products. These extracts are available in the forms such as solid extracts, fluid extracts and powder extracts.

The process where one can extract naturally occurring components from the plant parts. It is an activity of solid/liquid separation. Usually solids are added in suitable solvents to get extracts. The desired plant components are made to dissolve in the appropriate solvent. The final supernatant liquid is referred as natural extract. During earlier times, natural extracts were used to prepare through aqueous extraction and alcoholic fermentation and also some other methods like infusion, decoction and maceration etc. The simplicity of these procedures is quite natural. Now a day these activities have been modified and there is a use of precise methods. It is benefitted to process engineering, phytochemistry and analytics.

Raw plant material is subjected for drying under shadow of sun light, then made it a fine powder by grinding. The obtained powder is introduced for extraction procedure, to get a natural extract sample for regarding various studies (Figure 1).

On according to conventional methods, No other methods are possible in the case of solid/liquid extraction. On the other hand, we can combine these methods with other processes such as distillation, steam distillation, rectification, etc. we can also Use different solvents. Among the above techniques, Soxhlet is the compatible technique to

obtain a proper natural extract without much complexity in the experimental procedure.

Methods of Preparation of Nanoparticles

Nano chemistry has speeding up in a high rate for the past 4 decades. Also at present era, it is been creating a new opportunities for various aspects such as from the field of "information & communication technology" to the field of "health care & medicine". "Generally owing to the sources of nanomaterials, they have been categorized as i) incidental nanomaterials ii) engineered nanomaterials and iii) naturally produced nanomaterials" (Jeevanandam *et al*, 2018; Ealia and Saravanakumar, 2017).

Here the synthesis strategy of nanoparticles is mainly categorized as

Top-down approach (Gour and Jain, 2019)

Bottom-up approach (Gour and Jain, 2019)

Top-down approach

In this method, bulkier or larger material can be fragmented into nano sized particles. It is used for producing micron sized particles (Figure 2). This approach is simple and it depends on the division of bulk material. Only the draw back with this method is that, imperfectness of the composition of surface.

Bottom-up approach

It is one of the alternative methods with respect to the top down technique (Figure 2). Here the residue obtained is small, thus more economic too. In this case generally, the material is assembled from the bottom; like atom by atom or cluster by cluster or even molecule by molecule.

Normally following techniques are used to prepare nanoparticles

Sol-gel synthesis, colloidal method, hydrothermal technique, template assisted sol-gel, electro-deposition and *green synthesis* etc.

Top down approach and Bottom up approach of synthesizing nanoparticles have bifurcated into chemical, physical and green approaches.

Actually, in the process synthesis of nanoparticles, there is an involvement of metallic precursors, stabilizing agents and reducing agents. Whereas, in the case of physical approach; the material is subjected for reduction of size by using the top-down approach.

On the other hand, the green approach is one of the ecofriendly method of producing nanoparticles, here we will be preparing a crude extract of natural material from bulk to small i.e. top-down approach and the extract is used for the preparation of nanoparticles from bottom-up approach.

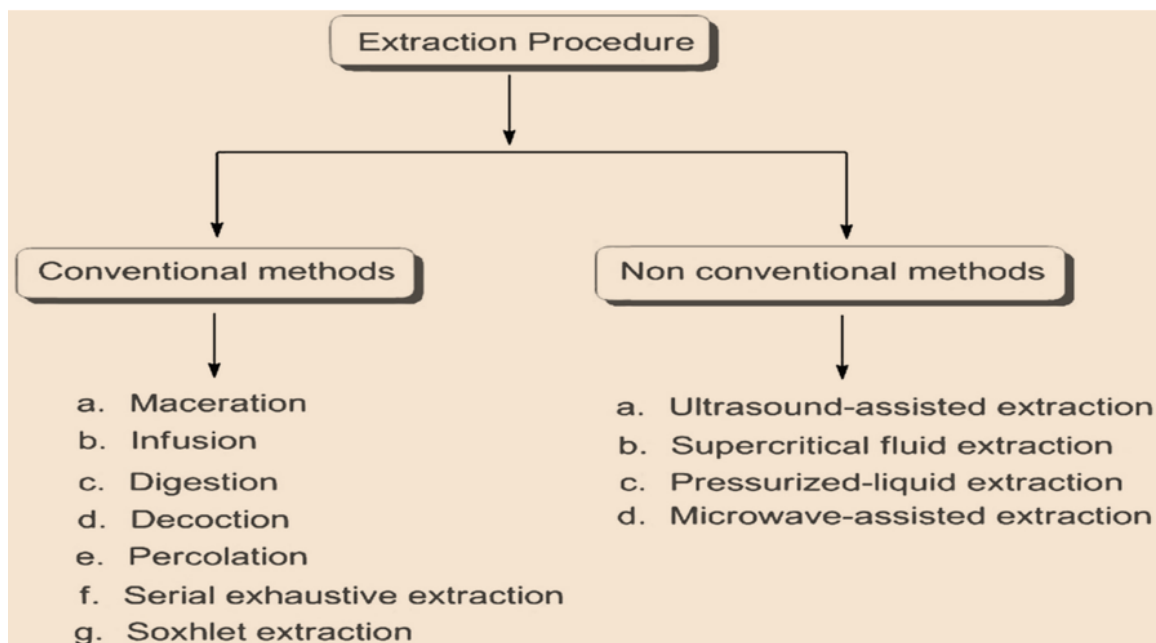


Figure 1: Various Nanomaterial Extraction Methods

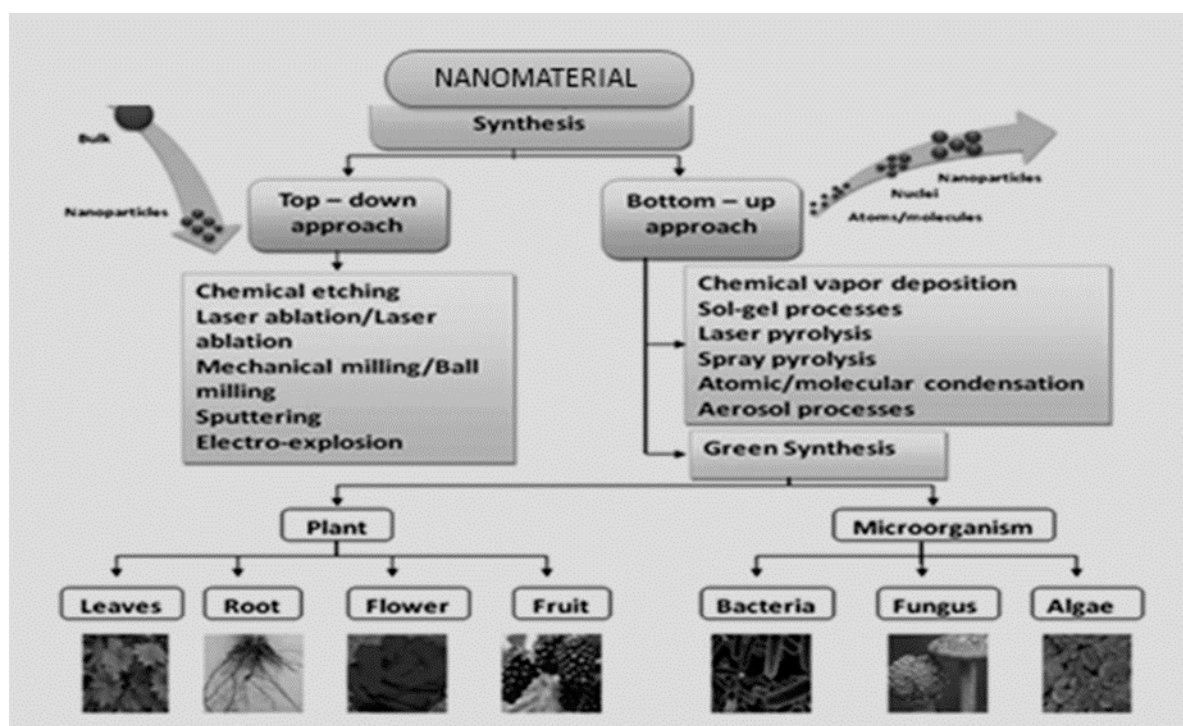


Figure 2: Various Types of Nanomaterial Synthetic and Natural Approaches

Green synthesis

Green synthesis is a significant method for the nanoparticles synthesis in the future perspective. This field of Nanoscience involves safer and ecofriendly system with respect to the society. Size, shape and properties of nanoparticles are incorporated in this area, which will impact on the utilization of nanoparticles. Plant material is dried under shadow of sun light; make a fine powder by grinding. The obtained powder is extracted to get a

natural extract to prepare nanoparticles.

Synthesis of nanoparticles by the Green approach: “AbdelghanyTM et al. have observed that the green techniques are more efficient for the NPs synthesis with the slight chances of risk, with cost effective and characterization is done so easily” (Abdelghany *et al.*, 2018). “In the techniques of Chemical & Physical, the utilization of various chemicals that is hazardous and poisonous to mankind and the nature, which would raise the activity as well as tox-

icity of the particulate. Also it might cause undesired adverse effects on health due to the lack of order and compositional instability" (Hussain *et al.*, 2016). In these days, the usage of the identification and isolation of vitamins, amino acids, flavones and other chemical constituents from plant extracts have become popularized. Synthesis of nanoparticles from the enzymes, vitamins, and microwave assisted, and bio based, bacteria & actinomycetes, yeasts & fungi, algae, plants & phytochemicals are all generally adapted techniques in the case of green approach.

"The extracts of natural entities like black and blueberries, turmeric and pomegranate have shown a different antioxidant nature. Among them the pomegranate extract has found to produce gold and silver nanoparticles of uniform size and shape around 20 - 500 nm range" (Nadagouda *et al.*, 2014). "According to DobruckaR, the isolate of F.Herba was used in the reduction of the compound, which constitutes platinum, the closeness between H₂ and CO to the compound of polyphenol is the one which is a fixing technique for the particles of metal" (Dobrucka, 2019). "The generation of nanoparticles would be completed in very short period of time within salt solution, on the basis of nature of the extracts of plant materials. The silver nanoparticles are reduced by the usage of dihydroquercetin, quercetin and rutin has caused to get an intensive band of SPR" reported by Veisi *et al.* (2018). "For the preparation of silver nanoparticles by exposing microwave irradiation using the juice of the natural material beet, which will be the reducing agent, Kou and Verma have reported a quick, green and fast approach. In the obtained sample, it is observed that a good catalytic behaviour with respect to the degradation of methyl orange." (Kou and Varma, 2012).

Green Synthesis - Metal Nanoparticles

"Alijan *et al.* have found that the nanoparticles are of 8.35 nm size, usually they are stable and spherical in shape. In a particular concentrated aqueous solution ZnS nanoparticles were arranged with the glycoside sweetener, the sweetness should be 250 - 300 times sweeter than sucrose, the ZnS nanoparticles would be a great bio - Reductant" (Alijani *et al.*, 2019). By the method of green approach, the synthesized nanoparticles are found to be having the application in clinical antimicrobial wound healing cases (Khatami *et al.*, 2018). For the treatment of obesity, a pharmaceutical approach has been observed by Rocca *et al.* i.e. antioxidant effects of CeO₂ NPs as great potential activity (Rocca *et al.*, 2015). "Miri and Sarani performed investigation

regarding the cytotoxicity behaviour by using the extracts of *Prosopisfarcta*, cerium oxide nanoparticles are biosynthesized using the extract, observed that nanoparticles are of 30nm size and round shaped." (Miri and Sarani, 2018).

Gold and silver nanoparticles have been found to be used in many fields like the area of electronics and light, catalytic reactions, pharmaceutical field. The particular nanoparticles prepared by the interference of honey, such nanoparticles are expressing their unique properties in the aspects like anticorrosive, catalysis process and antimicrobial behaviour. Gold and silver nanoparticles were prepared by using *M.Glabrata* leaf extract by the help of MW assistance from their respective metal salts precursors. According to researchers review, It is clear that without taking into consideration of qualitative and quantitative properties with respect to chemical and physical nature of nanoparticles, also without getting an appropriate experimental evident, it is not possible to design the nanoparticles with no negative effects and one cannot estimate the corresponding impacts on biological system (Sukhanova *et al.*, 2018).

Characterization of Nanoparticles

It is important think about morphology after the synthesizing nanoparticles. UV, IR, SEM, XRD & EPMA so on are the instrumentations used for the characterization of nanoparticles.

Ultra Violet -visible spectra

It is also referred as absorption spectroscopy, is the part of ultraviolet region. In this region of EM spectrum, atoms and molecules undergo electronic transition. Because of the surface plasmon reverberation band, since the electrons are present in conduction band on the nanoparticles' surface. Shubhapriya *et al.* have reported bio-reduction of silver nitrate to silver nanoparticles can study by UV spectral estimation frequently" (Gour and Jain, 2019).

FT-IR

Fourier - Transform Infrared is a technique in which there is an absorption or emission of the sample and provides IR spectral data over respective range. This one is used to discover data about the range of peak positions, even the range of functional groups, any active metabolites present over surface of Nanoparticles. These surface nanoparticles are responsible for their reduction and stability".

High resonance SEM

In the modern trend HRSEM allows the determination factor for more than 1nm sized particles. The morphological information and measurement

of the quantitative aspects of the nanoparticles are obtained by TEM & SEM tests. TEM analysis it is known that the Ag NPs are both round and mono-disperse (Gour and Jain, 2019).

XRD spectroscopy

The powder diffraction is an analytical technique used for the identification of the phase of crystal. Also it provides information of unit cell dimension. Nanomaterials of x-ray diffractograms offer an abundance of data from phase formation of crystallite estimation (Gour and Jain, 2019).

Electron Probe Micro Analyzer

The various naming's for this instrument are, electron micro probe analyzer, electron probe micro analyzer and electron microprobe is the one mainly used for the determination of composition of the chemical compound of very small volumes of solid samples. Here the electron beam bombards the sample, releasing x – rays at wavelengths typical of the elements being studied.

CONCLUSION

From the above data collected it is clearly known fact that, nanoparticles can be prepared by various techniques. Also we came to know that green approach is the most appropriate method of synthesis in accordance to Eco friendliness as well as more economic. Even many chemical approaches are also there. But the nanoparticles obtained through those methods, are less stable, not easy to measure their characteristics. In the agricultural engineering field, nano fertilizer, nano pesticides are trending. Silver nanoparticles have been utilizing in the dentistry field. These nanoparticles are having a great potential as a drug carrier. Due to the smaller size of the nanoparticles, they exhibit improved characteristics such as high reactivity, strength, surface area, sensitivity stability etc. In order to create new therapeutic and diagnostic modalities, the Nano medicine is concerning greatly the use of nanomaterials in the field of pharmaceuticals where Nano engineered materials precisely scaled. On the whole, we want to conclude here is that Green synthesis is the alternate approach with respect to the physical and chemical approach. The green nanoparticles are having a various applications in the areas such as pharmaceutical, agriculture, dentistry, medicines etc. By the natural source that is plant extraction as sample, we can prepare green nanoparticles. Further we can study the novel entities of nanoparticles for the betterment of society.

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Conflict of Interest

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