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Green synthesis of Silver nanoparticles using different plants: Review

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ABSTRACT: Plants have been used from ancient times to cure for many diseases, as there is no or minimal side effects. Treatment with medicinal plants is considered very safe. In modern material science, nanotechnology is one of the most active areas of research. Green synthesis of nano-materials gets more attention towards the researchers day by day, because it does not involve any harmful effects. These materials are cost effective and ecofriendly. This review article is focused on the green synthesis of Silver nanoparticles using various medicinal plants and characterization of the synthesized nanoparticles through various techniques.

Keywords: Nanotechnology; green synthesis; silver nanoparticles; medicinal plants

INTRODUCTION

In rural India, more than half of the population depends on the traditional type of medicine. There are many forms of Ayurvedic medicines for those, who do not want conventional medicine or who cannot be helped by conventional medicines [1]. The Golden fact about the Ayurvedic medicines are that it has lesser or minimal side effects. Ayurvedic medicines has preferred by many people than other conventional type of medicines because of its better compatibility with their body and less harmful effects and also these medicines independent of any age and group. Indian forests are the major source of medicinal plants. There are various medicinal plants such as Tulsi, Neem, Bryophyllum pinnamtum, Mint, Aloevera, Catharanthus Roseus with which several medicines are produced.

Nanotechnology is becoming most active area of research among the researchers. Based upon their specific characteristics such as size, nature, distribution and morphology, nanoparticles have distinct properties compared with bulk form of the same material [2]. Nanoparticles show completely different and improved properties than bulk materials. The pure metals in nanoparticle form are applied in the field of diagnostics, antimicrobial, antifungal, antibacterial and anti-proliferative agents, textiles (clothing), optics, electronics, drug delivery, bio-sensing, food industry, paints, cosmetics, medical devices and treatment of several acute and chronic diseases- Malaria, hepatitis, Cancer and AIDS [3]. Metals nanoparticles such as Silver and Gold are receiving great interest due to their applications in different areas such medicine, electronics and biotechnology [4].There are various medical use of Silver include the use of Silver in wound dressings, creams and as an antibiotic coating on medical devices [5]. Several medicine based on Silver are available in the market like Sulphadiazine, which may be used for external infections. It is a topical antibiotic used to burn partial thickness to prevent infection [6]. Nanoparticles show completely different and improved properties than bulk materials. There are different methods for the synthesis of metal nanoparticles such as chemical vapour depostion method, physical vapour deposition method, laser ablation method, pulsed laser method etc. But most of these methods are too expensive and also involve the use of toxic, harmful chemicals that are responsible for various biological risks and have harmful effects on humans and environment. Hence there is growing need to develop enviroment friendly, cost effective processes [7]. For this growing need, researchers are using green synthesis methods for synthesizing various metal nanoparticles [8]. The rate of synthesis of nanoparticles by plant extracts is higher than of chemical methods and green synthesis by micro-organisms [9]. Silver nanoparticles is a non toxic, safe inorganic antibacterial agent used for centuries and is capable of killing more than 500 types of micro-organism which cause diseases [10]. In the recent days, Silver nanoparticles have been synthesized from various naturally occurring plants and their products like Neem (Azadirachta indica) [11], Aloevera [12], Tea leaf [13], Lemon grass leaves extract [14], Nelumbo nucifera leaf [15], Catharanthus roseus [16], Spinacia Olracea and Lactuva Sativa [17], Raspberry Leaf [18], Bryophyllum Pinnatum [19], Lippia Javanica [20], Murraya Koengii [21], Argemone maxicana leaf [22], Matricaria Chamomilla [23]. Amaranthus viridis twig extract [24], Geranium leafs [25].

MATERIAL AND METHODS

Sample synthesis methods: (i)10g of fresh leaves of Mulberry leaves were washed dried and finely chopped in 250 ml glass beaker along with 200 ml of Sterile distilled water. The mixture was boiled for 10 minutes until the colour changes from watery to light yellow. Then the extract was filtered with Whatman filter paper before centrifuging at 3500 rpm for 5 minutes. Then 5ml of Mulberry leaves extract was added to 50ml of 1x10-3 M aqueous AgNO3 solution at room temperature. The resulting solution becomes grey black after 60 minutes indicating the formation of Silver nanoparticles [26].

(ii) 20g of air dried leaves of Mentha Piperita leaves were finely cut and were boiled with 100 ml of distill water for 2 minutes in 500 ml Erlenmeyer flask. Leaf broth was sterilized by filteration. Silver nanoparticles were prepared by reducing 1mM silver nitrate aqueous solution with freshly prepared leaf broth [27].

(iii) 50 gm fresh leaves of Cymbopogan citrates (Lemongrass) were cut into small pieces and boiled with 200ml distilled water for 10-12 minutes. Then extract was filtered using Whatmann filter paper and filterate was collected. Then extract of Cymbopogan citrates (Lemmongrass) leaves was mixed with aqueous solution of 1mM silver nitrate in 1:4 ratios in conical flask under aseptic conditions. The pH was adjusted to 8.0. The solution was subjected to microwave irradiation (90 watts) till color change was observed indicating the formation of Silver nanoparticles [14].

(iv) The collected fresh blackberry fruit (5g) was washed thoroughly and heated for 62-650 C in 50 mL of deionized water for 1 hr. After cooling, the red colour extract was filtered using Whatman filtere paper. For green synthesis, 1.0mL of Andean Blackberry fruit extract was mixed with AgNO3 (10ml, 1Mm) solution and kept at 250C. Green synthesis of AgNPs was confirmed by the appearance of yellowish-orange solution with lapse of time [28].

(v) 1.5g leaves of each O. Tenuiflorum, S. Tenuiflorum, S. Tricobatum, S. Cumini, C. Asiatica and peels of C. Sinensis were boiled in 100ml of dilstilled water. Then 2.5 ml of ammonium solution was added to 5ml of 1mM AgNO3 solution, followed by adding plants extracts from 1ml-10ml. The dark brown colour indicates the presence of Silver nanoparticles [29].

(vi) Finely chopped 25g fresh leaves of Carica papaya were boiled in 250 ml conical flask with 200ml distilled water for 10 minutes. The filterate of Carica papaya leaves were mixed with 1Mm silver nitrate solution in the ratio 1:4 and heated on a sand bath at 600C for 30 min. The change in colour indicated the formation of Silver nanoparticles [30].

Characterization Techniques

UV-vis spectroscopy: UV-vis spectroscopy is a technique which is used to quantify the light that is absorbed and scattered by a sample. A sample is placed between a light source and a photodetector and the intensity of a beam of light is measured before and after passing through the sample [31]. It is an important technique to determine the formation and stability of Silver nanoparticles in aqueous solution [32]. Light wavelengths from 300-800nm are generally used for characterizing various metal nanoparticles in the size range of 2 to 100nm [33]. It is an important technique indicating the formation of metal nanoparticles.

SEM: Scanning electron microscopy is one of the important technique which gives information about the external morphology (texture), chemical composition and crystalline structure of the sample. SEM is a technique that uses electrons instead of light to form an output image [34]. The SEM micrograph of Silver nanoparticles showed relatively spherical shape formed with diameter range from 0 to 50 nm [35]. SEM images showed cubical and relatively uniform shape of nanoparticles formation with diameter range 20-40nm [26]. The formation of silver nanoparticles asa well as their morphologyin the SEM analysis demonstrated that the average size was form 5-20nm with interparticle distance, giving spherical shape [24]. The SEM micrograph also indicates the purity and polydispersity of resulting AgNPs [33].

TEM: Tunneling Electron Microscopy provides morphologic, compositional and crystallographic information of the samples. TEM measurements are conducted in order to estimate the particle size and size distribution of synthesized AgNPs [35].TEM is a useful real- space analysis method and helps to observe the particle size of material in nanoscale and to study the crystal structure meticulously with highest resolution [36]. TEM images of silver nanoparticles gives triangular, spherical, ellipsoidal and many other shapes [27].

CONCLUSIONS

Green synthesis of Silver nanoparticles from plants extract is ecofriendly, cost effective approach. The natural compound present in plants can act as reducing and stabilization agents. Plants extract reduces the Silver ions to silver nanoparticles. Green synthesis of Silver nanoparticles from plants extract is a single step process. It is concluded that Silver nanoparticles synthesized from plants have variety of applications in different fields. In this review synthesis of Silver nanoparticles from different medicinal plants are articulated.

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