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Synthesis of Gold Nano Particles Using Palmyra Sprout Root: An Eco Friendly and Green Approach.

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Abstract- **Eco-friendly green synthesis is one of the promising branches of nanoscience for applications in different biomedical fields. It makes the topic more attractive due to non toxic and very low cost of synthesis. In this present study we deal with the synthesis of eco-friendly and cost effective gold nanoparticles by using Palmyara Sprout root as the reducing agent. The gold nanoparticles are characterized by using UV-visible spectrophotometer, FT- IR, XRD and SEM methods. The anti-bacterial and anti-fungal activity of the synthesized gold nanoparticles were also tested. To the best of our knowledge, this is the first report on the rapid green synthesis of gold nano particles using Palmyra sprout root extract.**

Keywords: Nanoparticle, Palmyra sprout root, UV spectrophotometer, FTIR, XRD, SEM-EDX, anti bacterial and antifungal activity.

1.INTRODUCTION

Nanotechnology is the science that deals with matter at the scale of 1 billionth of a meter (i.e.,10 − 9 m = 1 nm), and is also the study of manipulating matter at the atomic and molecular scale[1]. A nanoparticle is the most fundamental component in the fabrication of a nanostructure, and is far smaller than the world of everyday objects that are described by Newton ' s laws of motion, but bigger than an atom or a simple molecule that are governed by quantum mechanics. The word "nanotechnology" soon caught the attention of various media (TV networks, the internet, etc.) and the imagination and fascination of the community at large. In general, the size of a nanoparticle spans the range between 1 and 100 nm. Metallic nanoparticles have different physical and chemical properties from bulk metals (e.g., lower melting points, higher specific surface areas, specific optical properties, mechanical strengths, and specific magnetizations), properties that might prove attractive in various industrial applications. However, how a nanoparticle is viewed and is defined depends very much on the specific application. Now-a-days biological synthesis of metallic nanoparticles is gaining importance as it is reliable and ecofriendly[2]. In Tamil culture The Palmyra tree is the official tree of Tamil Nadu. In Tamil culture it is called karpaha,"nungu" "celestial tree", and is highly respected because all its parts can be used. The recently germinated seeds form fleshy sprouts below the surface which can be boiled and eaten as a fibrous, nutritious food. The germinated seed's hard shell is also cut open to take out the crunchy kernel which tastes like a water chestnut but sweeter. The ripe fibrous outer layer of the fruits is edible after boiling or roasting. When the fruit is tender, the kernel inside the hard shell is an edible jelly that is refreshing and rich in minerals. When the crown of the tree from which the leaves sprout is cut one can make a cake. In ancient times, dried palm leaves were used to write manuscripts[3-6]. There are several ways of processing palm leaves, these methods differ from region to region. In South India, different method is adopted whereas in Orissa and other Southeast Asian countries different technique is adopted[7-9]. Now a days many researchers preaparing or synthesising nano paricles using plants and their various parts but we try in a new way to synthesisize gold nano particles using Palmyra sprout root extract.

2. METHODS AND MATERIAL

2.1 Materials:
The Palmyra sprout roots were collected from the coastal region of Thoothukudi district of Tamil Nadu.

2.2 Synthesis of gold nanoparticles:
The fresh roots were collected and peel was removed from the roots. The fresh root was washed with distilled water, minced into small pieces and dried in the sun for 7 days. The dried roots were ground thoroughly using mechanical grinder and a fine power was prepared. 2 gram of the fine powder was mixed with 200ml de-ionized water and boiled for 10 minutes at room temperature of about 50oC using a water bath. This was filtered with Whatmann no 1 filter paper to get clear aqueous extract. This extract was stored in a refrigerator for further studies. The filtrate was treated with aqueous 1 mM HAuCl4 solution in an Erlenmeyer flask and incubated at room temperature. As a result, a purple coloured solution was formed; indicating the formation of gold nanoparticles and it was further confirmed by UVVisible spectrum analysis.

Figure1: Visual observation of gold nano particle synthesis

(A-Palmyra sprout extract B-salt solution C- reaction mixture)

2.3 Characterisation of synthesized nano particles:

i) UV-Visible spectrophotometer:

The gold nano particles were confirmed by colour changes and confirmed by UV Visible spectrophotometer.

ii) Fourier Transform Infra Red Spectroscopy:

The Fourier Transform Infra Red Spectroscopy used for the analysis of reduced gold. The spectrum was taken in the mid-IR range of 500 to 4000 cm-1. With 25 scan speed.

iii) XRAY diffraction:

The gold nano particles of Palmyra sprout root was purified and get pure crystals. The composition of nano particles were analysed by XRD.

iv)Scanning electron microscopy(SEM) and EDAX analysis:

Scanning electron microscopy (SEM) analysis was done by using VEGA3TESCAN machine.

v) Cyclic Voltammetry analysis:

Analysis of the sample through cyclic voltammetry(CV) confirmed the presence of elemental gold signal of gold nanoparticles. The change in the oxidation state of the metal ion was studied by CV technique, using platinum electrode.

vi)Antimicrobial activity study:

Kirby-Bauer method was followed for disc diffusion assay[10,11]. In vitro antimicrobial activity was screened by using Mueller Hinton Agar (MHA) obtained from Himedia (Mumbai). The MHA plates were prepared by pouring 15 ml of molten media into sterile petriplates. The plates were allowed to solidify for 5 min and 0.1 % inoculum suspension was swabbed uniformly and the inoculum was allowed to dry for 5 min. The same procedure has been followed for the fungi using Sabouraud dextrose agar. The different concentrations of extracts (1, 2 and 4 mg/disc) were loaded on 5 mm sterile individual discs. The loaded discs were placed on the surface of medium and the compound was allowed to diffuse for 5 min and the plates were kept for incubation at 37°C for 24 h. Negative control was prepared using respective solvent. Gentamycin (10 µg/disc) was used as positive control. At the end of incubation, inhibition zones formed around the disc were measured with transparent ruler in millimeter. These studies were performed in triplicate.

3.RESULTS AND DISCUSSION

3.1 UV visible spectrophotometer:

The reduction of aqueous HAuCl4 ions during the reaction with root extract of Palmyra sprout root was followed by UV Visible spectroscopy. A strong absorption peak at 557 nm which confirms the presence of gold nano particles as shown in figure2.

Figure 2: UV –visible spectrum of synthesized Au NPs showed peak at 557nm

3.2 FT-IR studies:

FT IR analysis can provide information about functional groups present in the synthesized gold nano particles for understanding their transformation from simple inorganic HAuCl4 to elemental gold by action of the different phytochemicals present in the Palmyra sprout root extract. These phytochemicals acts as capping agent for the nano particles. FTIR spectra of the palmyra sprout root extract and the synthesized gold nanoparticles, as shown in Fig. 3a, can offer information regarding the chemical change of the functional groups involved in the reduction. The FTIR spectrum of the palmyra sprout root extract showed band at 3,385, 2,882, 1,641, 1,419 and 1,154 cm-1. The strong broad absorbance at 3,415 cm-1 is the characteristic of the hydroxyl functional group in alcohols and phenolic compounds. The band at 2,924 cm-1 can be assigned to the functional group in alkanes. The FTIR spectrum of the gold nanoparticles showed bands at 3,385, 2,882, 1,641, and 1,408 cm-1. The band at 3,385 cm-1 corresponds to the hydroxyl functional group in alcohols and phenolic compounds. The band at 2,882 cm-1 corresponds to the C– H stretch of alkanes. The band at 1,641 corresponds to the –C=C stretch of alkenes. The band at 1,408 cm-1 can be assigned to the C–C stretch(in ring) aromatic compounds. Also the figure 3 illustrates the successful bio fabrication gold nano particles mediated by the Palmyra sprout root extracts.

Figure3: FT IR spectrum of synthesized Palmyra sprout root extract

3.3 XRD analysis:

The exact nature and size of the synthesized nano particles was studied through XRD analysis. Figure 4 shows the strong and narrow diffraction peaks indicated that the product have well crystalline. The XRD peaks at 38.6o ,44.1 o ,64.2 o and 74.2 o can be index to the (111),(200),(220) and (311) Bragg’s reflection of cubic structure of metallic gold respectively. A strong diffraction peak located at 38.1o was ascribed to the (111) facets of face centered cubic metal gold structure, while diffraction peaks of other facets were much weaker. The broadening of Bragg’s peaks provided additional indication for the information of gold nano particles. The width of the (111) Bragg’s reflection was determined for calculating the mean size of Au nano particles by using Debye Scherer’s equation which was found to be around 10.75 m.

Figure4: X-ray diffraction patterns of synthesized Au NPs.

3.4 SEM-EDX:

To determine the shape, size and distribution of the nanoparticles, SEM Images were also recorded(figure5). The SEM analysis confirmed the synthesized gold nanoparticles to be in nanometer size. They were square shape and the size of the gold nanoparticles found to be uniformly distributed. The average size of synthesized gold nano particle is 12 nm.

Figure 5: SEM images at different magnifications

Figure6. EDX spectrum of gold NPs capped with Palmyra sprout extract

Table:1

EDX micro analysis of the gold NPs capped with Palmyra sprout extract

Element	Weight %	Atom %
Au	48.56	8.19
O	19.8	41.41
Cl	5.28	4.53
K	10.16	7.90

3.5 cyclic voltametric analysis:

In cyclic voltammetric analysis the Palmyra Sprout root extract free solution makes all the metal ions are reduced to lower oxidation state, since there is no possibility for the formation of NPs. Upon addition of Palmyra sprout root extract in the reaction medium, the cathodic peak shifted towards the negative potential direction, implying that the reduced gold NPs are stabilized by Palmyra sprout root extract (Fig. 5). The extent of decrease in anodic peak current is greater than that of the cathodic peak current due to the fact that the rate of reduction of gold ion may be greater than its oxidation. This might be because of the electron donating methoxy, hydroxyl and amine groups containing Palmyra sprout root extract can provide a suitable environment for the formation of nanoparticles. The cyclic voltammogram of AuNPs shows the peaks observed at-0.3 and 0.6V.

Figure 7 Cyclic voltammograms of gold nanoparticles

3.6 Antimicrobial activity study:

The antibacterial activity of gold nanoparticle was tested against the following microorganism, viz; E.Coli, Staphylococus aureus, klebsiella sps, pseudomonas aeruginonosa ,Enterobacter sps and candida by using disc diffusion method and the results were tabulated in the table 2. The gold nanoparticle has shown antibacterial activity against all tested microorganism and maximum zone of inhibition was found against candida.

Figure 8 Antimicrobial activity Gold NPS

s.no	Micro organism	media	Zone of inhibition (mm)
1	E.Coli	Muceller Hinton agar	18.0
2	Staphylococus aureus		25.0
3	Klebsiella sps		25.0
4	pseudomonas aeruginonosa		28.0
5	Enterobacter sps		19.0
6	candida	SDA	30.0

Table2 Antimicrobial activity Gold NPS

Figure9 Antibacterial activity of gold nanoparticle.

4.CONCLUSION

The present green synthesis is a low cost approach, capable of producing Au NPs at room temperature. The size and structures of the synthesized NPs were characterized by SEM,EDX and XRD. Moreover, this Palmyra spout root mediated synthesis represents a considerable improvement for the preparation of Au NPs because it allows better control over their nanostructures. The synthesized Au NPs have significant antibacterial activity. This kind of study may also make a possible platform in future for preparing nanomedicines for bacteria-related diseases. In our future studies, the synthesized nanoparticles will be applied with food preservative agents in order to prepare the antimicrobial packaging system and maintain food safety by reducing the growth rate of microorganisms. It is confirmed that Au NPs are capable of rendering high antibacterial efficacy and hence has a great potential in the preparation of drugs used against bacterial diseases.

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