A study on green reducing agents for gold nanoparticles

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Abstract

The main aim of this research is to propose the various green reducing agents for extract the green gold nanoparticles from Gold Chloride (HAucl4) solution. Green reducing agents are safe and eco-friendly for the extraction of the gold nanoparticles. The green gold nanoparticles were synthesized using plant and fruit extract, and green Gold nanoparticles were characterized using SEM, TEM, and UV-Vis. Spectroscopy. The absorption peak was observed at 530-540 nm, which proved the green gold nanoparticles. Green Gold nanoparticles in the size of 30 nm in the spherical shape were confirmed by transmission electron microscopy. The toxicity of green gold nanoparticles is less than gold nanoparticles. These green gold nanoparticles can be used in various biomedical applications. Green reducing agents are the best alternative for the synthesis of the gold nanoparticles. Copyright © 2017 VBRI Press.

Keywords: Green synthesis, plant extract, fruit extract, Gold nano particle (AuNPs), optimization.

Introduction

Synthesis and characterization of the green gold nanoparticles through green reducing agents is a growing field in scientific research and biomedical applications. The Green gold nanoparticles are more important than other metal particles. Reducing agents play an important role to synthesize of the green gold nanoparticles. To synthesize the gold nanoparticles the green reducing agents are the best alternative to produce the gold nanoparticles [**1**].

The green gold nanoparticles received a great interest for biomedical applications like drug delivery, gene delivery [**2**]. The size, shape and other properties like optical, thermal physical and catalytic properties of the gold nanoparticles depend upon the reducing agents [**3**, **4**]. Synthesis for the gold nanoparticles reducing agents like yeast, fungi, bacteria, came into exist as green reducing agents [**5**, **6**]. In past few years many plants have been used for the synthesis of the gold nanoparticles like neem [**7**], Aloe-Vera[**8**], wheat[**9**], Onion[**10**], Indian plum[**11**], Asoka[**12**], curry leaves[**12**], coriander or dhania[**13**], Nepenthes khasiana[**14**]. The stability of gold nanoparticles is not good because of high surface and extracting agents [**15**]. Coconut shell shows the antibacterial and antiviral activity [**16**]. Some fruits and plants contain polyphenols esters, polyphenols [**17**, **18**].

In this paper, we are going to report green reducing agents (Plants, fruits) for gold nanoparticles. Green gold nanoparticles have been prepared and analyzed through UV-visible spectrometer, SEM and TEM analysis.

Experimental

Synthesis

Tetrachloroauric acid ($HAuCl4.3H_2O$) with 49.0% was purchased by CDH chemical solution India and fresh triple distilled water was prepared in the department of chemistry SHIATS University Allahabad. All the selected plants and fruits were washed and cut into small pieces**,** and it was boiled at 70^0-80^0 c then centrifuged at 5000 rpm, extract was collected by filtrate method by whatman no-1 filter paper. Fruit and plant Extract was used as reducing and stabilizing agents for the green gold nanoparticles. For the Synthesis of gold nanoparticles, 25 mL of 0.01 M of HAuCl4 was added into 15 mL of aqueous extract of plants and fruits, and then mixture was shaken at room temperature to mix the solution, and kept on hot plate for magnetic stir for 50 min. After some time the color change (Ruby red) indicate the gold nanoparticles and all the properties like chemical, physical and biological depend upon the preparation method of the gold nanoparticles.

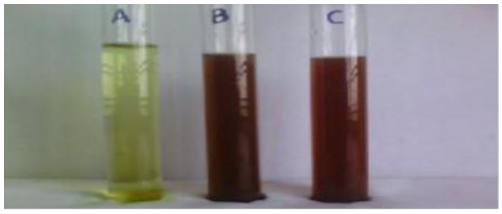

Fig. 1 Tube A- Auric acid, Tube B-Fruit Extract, Tube C- Green gold nanoparticles solution.

UV- visible spectroscopy

Ultraviolet visible spectrometer (Model- Shimadzu UV-1700, Japan) was used to observe the absorption intensity in the range of 400-800 nm.

TEM analysis

Transmission electron microscope, Philips CM-10 was used to analyze the size and the shape of green gold nanoparticles. In the TEM techniques a fine electron beam is emerge out from the specimen

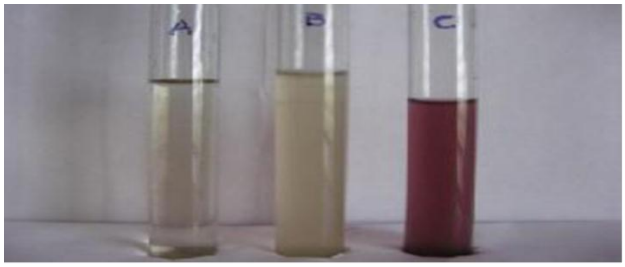

Fig. 2 Tube A- Auric acid, Tube B- Plants extract, Tube C- Green gold nanoparticle solution.

SEM Analysis

The SEM (Joel JSM-6510) was used to observe the size and the shape of green gold nanoparticles.

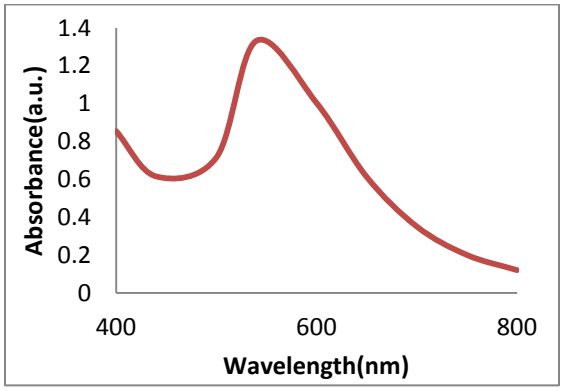

Fig. 3. UV-vis absorption spectra of green gold nanoparticles.

Results and Discussion

UV-vis Analysis

The reduction of green gold nanoparticles from HAuCl4 was observed by UV-Visible spectroscopy. **Fig. 3** shows the UV-vis spectra observed from the mix solution of fruit and plant extract. A strong peak was recorded at 530-540 nm due to the surface Plasmon resonance vibrations.

SEM Analysis

The scanning electron microscopy (SEM) images of green gold nanoparticles are shown in the **Fig. 4**. The SEM images are clearly showing that the size of the green gold nanoparticles is 30 nm in spherical shape.

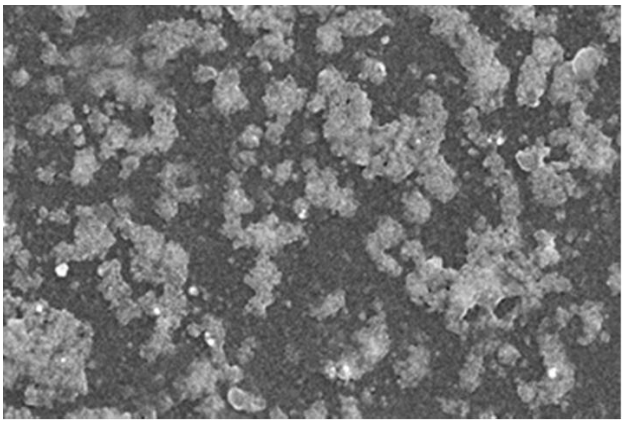

Fig. 4. SEM images of green gold nanoparticles.

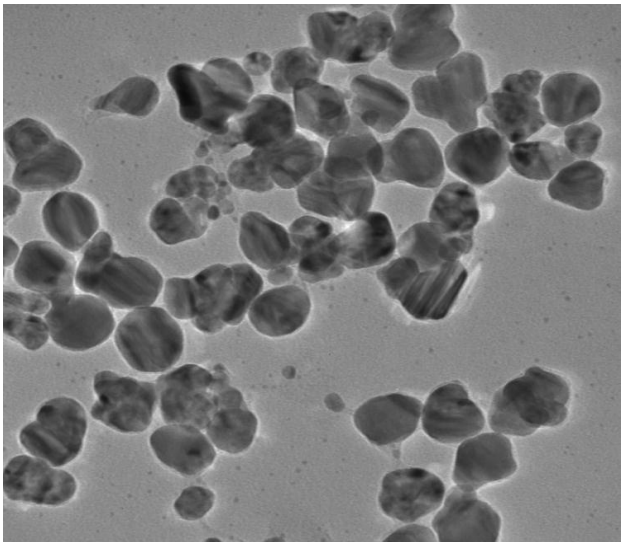

Fig. 5. TEM Image of green gold nanoparticles.

TEM (Transmission Electron Microscopy)

Transmission electron microscopy used to analyze the size and the shape of nanoparticles. **Fig. 5** indicates that the size and the shape of the green gold nanoparticles is 20-30 nm in spherical and cubic shape.

It is observed that some plants and fruits constituents the Phytochemical and these plants and spices extract like essential oils, polyphenols and carbohydrates these compounds contain active groups, such as hydroxyl, and carboxyl aldehyde units play an important role for reduction of HAuCl4 to AuNPs. Green Gold nanoparticles prepared by phytochemical containing fruit or plants or other extract remain stable for certain time. Further plants and fruits mediated stabilized green gold nanoparticles (AuNPs) may cross the barrier of cytotoxicity which is first priority for biomedical application of AuNPs. As the extract was mixed with the solution slowly it started to change the color in ruby red which indicates the gold nanoparticles. When iodine is added to some foods and fruits then it turns blue or black which confirms that the foods or fruits contains the starch.

Conclusion

It is observed that various pants, fruits extract which contains the carbohydrate, phytochemical, glucose and starch can be used as reducing and stabilizing agents for the gold nanoparticles. Fruits and plants extract shows that the color changes from yellow to ruby red of the solution. The green gold nanoparticles were confirmed by UV-vis, SEM and TEM analysis. The UV-visible spectra was recorded at 530-540nm. Green reducing agents like plants and fruits extract are safe and ecofriendly in extraction of the gold nanoparticles. The green gold nanoparticles are nontoxic.

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