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SYNTHESIS AND CHRACTERISATION OF GOLD NANOPARTICLES WITH CITRUS FRUITS EXTRACTS

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ABSTRACT

The aim of this study is to synthesis gold nanoparticles with an ecofriendly method and to characterize it. Gold nanoparticles were prepared by the reduction of HAuCl(4) by using citrus fruits juice extract as the reducing and stabilizing agent. Citrus grapes, Citrus lemon, and Citrus Orange juice extracts were used for the synthesis. Various concentrations of fruit extracts were added with 1.0mM hydrogen tetracholoroaureate (III) hydrate ($HAuCl_4$ $3H_2O$) by sonication method. The gold nanoparticles obtained were characterized by XRD and the sizes of the particles were calculated. The particles were found to be spherical in nature and it varied from 45nm to 70nm. It was found that the size varid with the concentration. UV absorption studies were done to confirm the absorbance range of the nanoparticles. Surface morphological studies were done with FESEM and AFM. This is a novel and simple method for the biological synthesis of gold nanoparticles with potent physical applications.

KEYWORDS: Gold, Citrus Fruits, Concentration, Size

INTRODUCTION

The field of nanotechnology is one of the most active researches in modern material science. Nanotechnology is emerging as a rapid growing field with its applications in science and technology for the purpose of manufacturing new materials at the nanoscale level. The synthesis of new materials with improved properties has forced fast development of nanostructured materials. Thus researches have been focused on investigation of materials at the atomic, molecular and macromolecular level, with the aim to understand and manipulate the features that are substantially different from the processing of materials on micro-scale. Nanoparticles usually ranging in dimensions from 1 to 100 nm have properties unique from their bulk equivalent. With the decrease in dimensions of materials to the atomic level, their properties change. The nanoparticles possess unique chemical, optical and biological properties which can be manipulated suitably for desired applications. In recent years, green synthesis method of preparation of metal nanoparticles is an interesting issue in the field of nanoscience and nanobiotechnology. There is a growing attention to biosynthesis the metal nanoparticles using plants and fruit extaracts. Among these, medicinal fruit extracts seem to be the best candidate and they are suitable for large scale biosynthesis of nanoparticles. Nanoparticles produced by them are more stable, and the rate of synthesis is faster than that in the case of other organisms. Moreover, the nanoparticles are more various in shape and size in comparison with those produced by other organisms [1].

The nanoparticles are of great interest due to their externally small size and large surface to volume ratio, and they exhibited utterly novel characteristics compared to the large particles of bulk material[2]. Nanoparticles of noble metals, viz. gold, silver, and platinum and palladium are widely applied in fast growing consumer goods such as shampoos,

soaps, detergents, shoes, cosmetic products, and toothpaste. But, Gold nanoparticles have been widely used in medicine and drug delivery systems [3].

Gold nanoparticles show strong light absorption in the visible region and this absorption results from nanoparticles' coherent oscillations of the free electrons on the particle surface, which is the surface Plasmon resonance. The surface Plasmon resonance of gold nanoparticles has broad application and has drawn great attention in recent years [4]. The aim of our study is to synthesise gold nanoparticles in an ecofriendly method. We selected citrus fruits of lemon, grapes, orange, and pineapple. The Citric acid in the fruits acts as the reducing agent[6].

Preparation of Fruit Extract

Fruits were cut into pieces and the extracts were filtered with filter paper. The juice was centrifuged for 10 minutes to remove the impurities.

Synthesis of Gold Nanoparticles

The precursors used were hydrogen tetracholoroaureate (III) hydrate ($HAuCl_4$ 3H2O) of 99.9% purity and fruit extracts of Citrus lemon, citrus pineapple, Citrus grapes and Citrus Orange. All glasswares were cleaned 1:3 nitric acid/hydrochloric acid to remove the impurities and to make the beakers clean. 1mM of 50 mL solution of hydrogen tetracholoroaureate (III) hydrate ($HAuCl_4$. $3H_2O$) was stirred with magnetic stirrer till it begins to boil. To this solution various concentrations (1ml, 2ml, 3ml,4ml ,5ml and 6ml) of Citrus lemon, Citrus orange, Citrus grapes extracts were added with it. The colloidal solution was stirred for 20 min through Ultrasonic bath sonicator and then cooled to room temperature. When the fruit extracts were added, the solution slowly changed to purple colour and it was purified by repeated centrifugations at 10,000 rpm for 15 min and was washed with water. A systematic characterization study was done with the material.

RESULTS AND DISCUSSIONS

Structural Characterization

The materials were characterised with XRD and the measurement was done with Bruker AXS-D8 advance instrument operating at a voltage of 40 KV and current of 20 mA with Cu Kα radiation.. The average size of the nanoparticles was estimated using the Debye–Scherrer equation:

$$D = k\lambda / \beta\cos\theta \quad \text{----------(1)}$$

where

D = thickness of the nanocrystal,

k = the shape factor which usually takes a value of about 0.9

λ = wavelength of the radiation

β = the breadth of the diffraction line at its full width half intensity maximum(FWHM).

The particle sizes varied from 45 – 70nm when the concentrations were varied. The Size of the particle increases when the concentration is increased. The intensity of the peak increases with the increase of concentration and the XRD spectra broadens when the concentration is increased. The peaks corresponding to the cubic phase (111), (200) and (220) reflections were observed. Bragg reflections of gold identified in the diffraction pattern agree with those reported

for gold nanocrystals [5]. XRD pattern for the prepared gold nanoparticles with citrus grapes, citrus orange and citrus lemon are shown in figure 1, figure 2 & figure 3.The lattice parameters calculated was 4.102 and it confirms that they are cubic in nature.

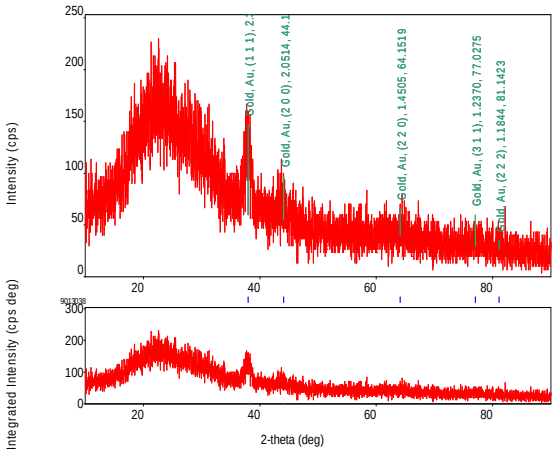

Figure 1: XRD for Au Nanoparticles with Grapes Extract

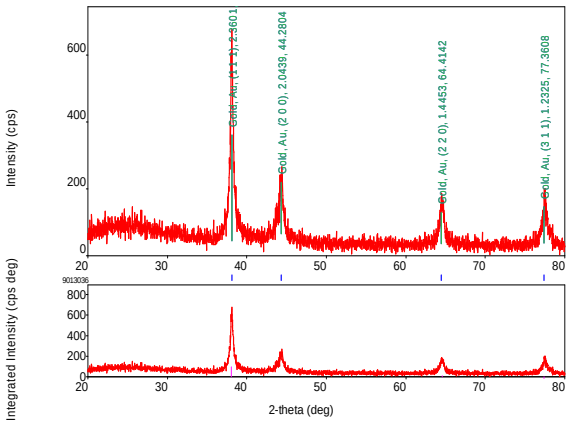

Figure 2: XRD for Au NP with Orange Extract

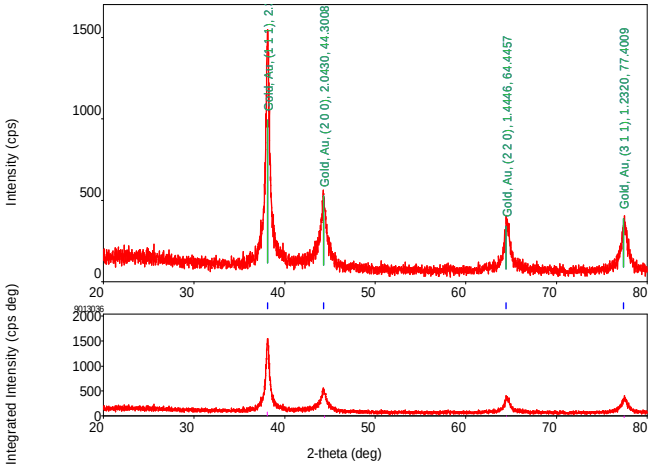

Figure 3: XRD for Au NP with Lemon Extract

EDAX Studies

Energy dispersive analysis studies were carried out to confirm the presence of Gold particles in the colloidal solution. EDAX studies showed the presence of gold particles with some impurities of $CaCo_3$ and SiO_2. Figure 4 shows the EDAX spectrum of the colloidal solution obtained with citrus lemon extract.

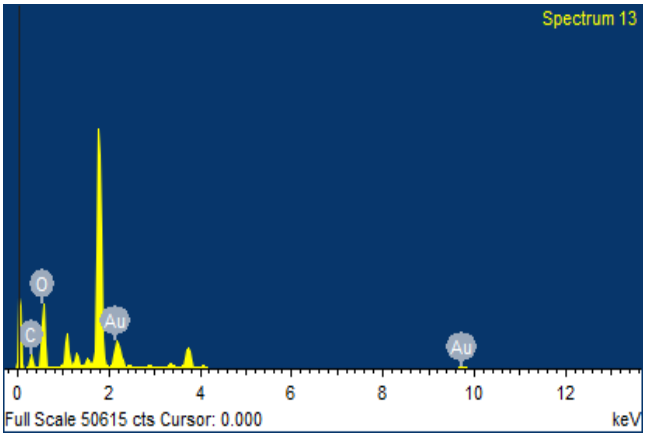

Figure 4: EDAX

Surface Morphology

Surface morphological studies were done with Field Emission Scanning Electron Microscopy, JEOL,JSM-6700F, Japan. The surface micrographs of the particles are shown in figure 5, Figure 6 & figure 7. It shows that the particles were cubic and there is almost uniform distribution of particles when the concentration of extract is high.

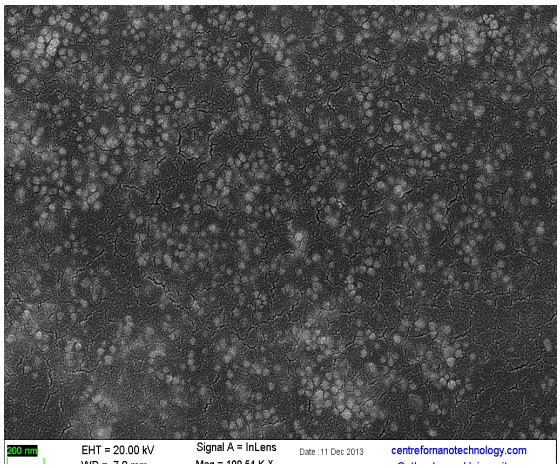

Figure 5: SEM of Au NP with Grapes Extract

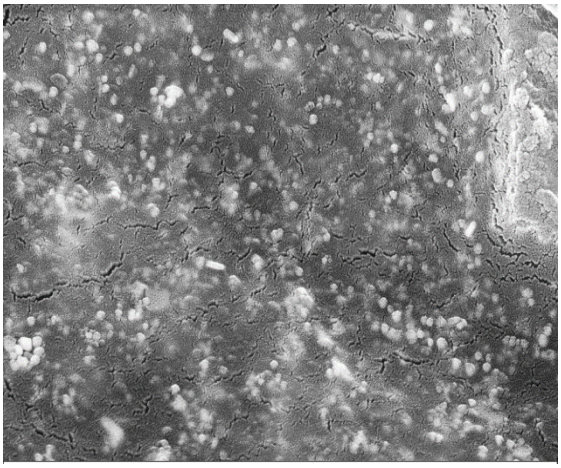

Figure 6: SEM of Au NP with Orange Extract

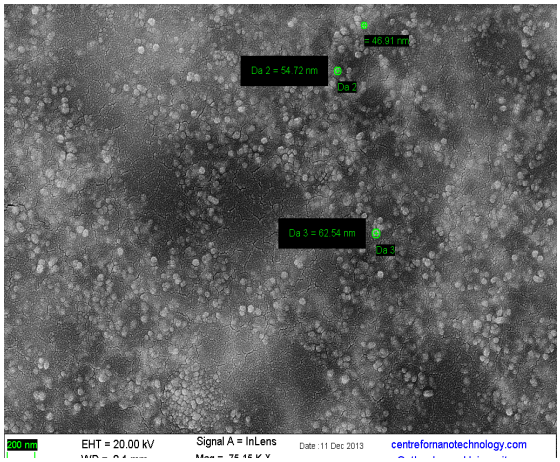

Figure7: SEM of Au NP with Lemon Extract

UV- Spectral Analysis

The colloidal solution mixture of Hydrogen tetrachloroaureate(III)Hydrate with citrus fruits extract was turned into brown colour within 5 min incubation indicates starting of synthesis of gold nanoparticles. Reduction of gold ions present in the samples have been seen by the UV-Vis spectroscopy and found that UV-Vis spectrograph of the colloidal solution of gold nanoparticles has been recorded as a function of time. Maximum absorbance was seen at 535nm,for each sample due to grapes, orange and lemon are shown in figure 8, figure 9 & figure 8 indicating that the formation of spherical gold nanoparticles.

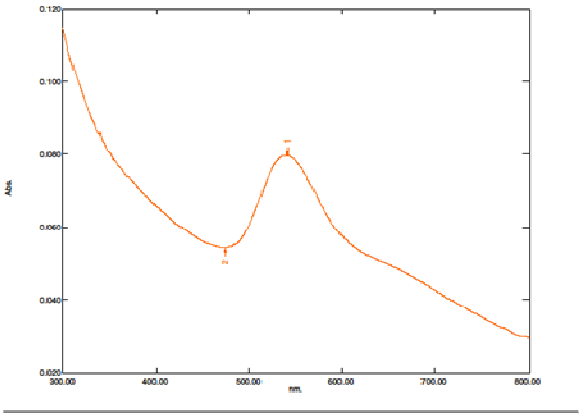

Figure 8: UV Spectra of Au NP with Grapes Extract

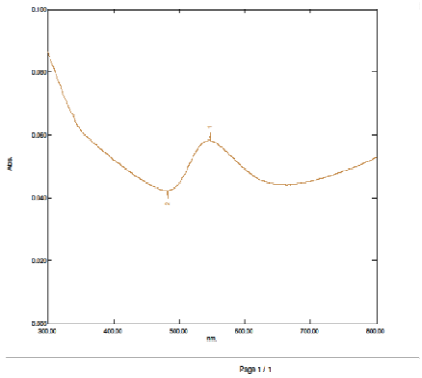

Figure 9: UV Spectra of Au NP with Grapes Extract

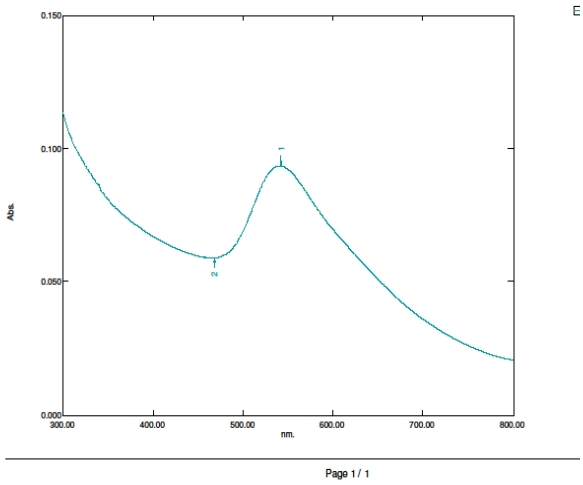

Figure 10: UV Spectra of Au NP with Lemon Extract

CONCLUSIONS

Gold nanoparticles were prepared with citrus fruit extract and it was found that the citric acid and the concentration of the fruit are the reducing agents of the particle size. Systematic studies were done on the material and found that the particle size varied from 45-70nm when the concentrations of the fruits extracts were varied. The lattice parameters calculated and the SEM confirms that they are cubic in nature. The absorbance peak was at 535nm. Depending on the size of the particle, it can be used for potent applications. As no chemicals were used, this can be used in the preparation of drug delivery systems.

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REFERENCES

1. S.Iravani, (2011), Green synthesis of metal nanoparticles using plants, Green Chemistry, 13: (10), 2638–2650.
2. H. Korbekandi., S. Iravani, and S. Abbasi, (2009), Production of nanoparticles using organisms production of nanoparticles using organisms, Critical Reviews in Biotechnology, 29:(4), 279–306.
3. S.P. Chandran., M. Chaudhary., R. Pasricha., A.Ahmad and M. Sastry, (2006), Synthesis of gold nanotriangles and silver nanoparticles using Aloe vera R.Feynman, (1991), There's plenty of room at the bottom. J Sci, 254:1300-1301
4. Plant extract, Biotechnol. Prog , 22: (2) 577−583.
5. J. Perez., L. Bax., C and A. Escolano, (2005), Roadmap Report on Nanoparticles; Willems & van den Wildenberg (W&W) Espana sl: Barcelona, Spain
6. Mohanan V. Sujitha, Soundarapandian Kannan (2013) Green synthesis of gold nanoparticles using Citrus fruits (Citrus limon, Citrusreticulata and Citrus sinensis) aqueous extract and its characterization