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Sunlight Irradiated Biofabrication of Gold Nanocubes Using *Punica granatum* Petals Extract

Rohan S. Phatak [1*], Pushpa P. Durgawale [2], Anup S. Hendre[2]

[1]Directorate of Research, Krishna Institute of Medical Sciences Deemed University, Malkapur-415539, Karad, Maharashtra, India, [2]Department of Biochemistry, Krishna Institute of Medical Sciences, Malkapur-415539, Karad, Maharashtra, India

Abstract

In this study, we employed pomegranate flower petals extract induced biosynthesis of gold nanoparticles in presence of sunlight irradiation as a fast and eco-friendly method. *Punica granatum* flower is well enriched phenolics, anthocyanins and flavonoids thus it is potent antioxidant agent. Alcoholic extract of pomegranate flower petals was microwave dried and prepared by maceration method. Sunlight induced green synthesis of gold nanoparticles was performed by treating alcoholic extract with gold chloride solution and exposed to sunlight for a few minutes. Biosynthesized gold nanoparticles produced were characterized by fourier transform infra red spectroscopy, scanning electron microscopy and transmission electron microscopy. The study provides herein a green approach utilizing the sunlight for development of gold nanoparticles using extract; it visualizes potentiating antibacterial effectiveness of gold nanoparticles.

Keywords: Sunlight irradiation, Gold nanoparticles, Pomegranate Petals, *Punica granatum*

INTRODUCTION

Pomegranate (*Punica granatum* L.) is popular fruit for fresh juice or beverages [1]. It possesses a number of polyphenolics, flavonoids and anthocyanins in higher capacity. Fruit juice, peel or grind extracts of pomegranate have been studied since many years; they have been proven as potent antioxidant source and attracted many researchers in a great deal for analyzing and investigating its health benefits. Ethanolic extract of flowers of *Punica granatum* is reported with a dose of 400mg/kg/day for its antidiabetic and hypolipidemic effect [2]. Alcoholic extract of pomegranate flowers has shown its ability to scavenge free radicals like reactive oxygen species (ROS), reactive nitrogen species (RNS), superoxide radicals, hydrogen peroxide radicals and exert hepatoprotective effect [1]. The objectives of this study were to characterize morphological and antibacterial activities of biosynthesized gold nanoparticles. Herein, we report for the first time, sunlight irradiated biosynthesis of gold nanoparticles using alcoholic extract of petals of *Punica granatum.*

MATERIAL AND METHODS

The flower of *Punica granatum* was available in the local area of Malkapur, Karad as shown in Fig.1.

Fig.1: The flower of Punica granatum

Extraction of pomegranate flower petals

Flower petals were dried in the microwave and powdered into crude form. Three grams of dried petals were dissolved in ten ml volume of methanol macerated for forty eight hours and filtered. It was evaporated to get dried extract of flower petals and its percentage yield was 0.18% [3].

Green synthesis

Two ml of methanolic extract of *Punica granatum* L. flower petals was transferred to 48 ml of 0.01mM gold chloride solution in a measuring cylinder and stirred the reaction mixture with a glass of rod. The reaction mixture in measuring cylinder was exposed to sunlight and a change in colour was observed from pale white to reddish brown within a few minutes. Biogenic gold nanoparticles (AuNPs) were centrifuged to remove any excess of extract and unreduced gold ions solution and stored in a suitable container.

Physicochemical characterization

Fourier Transform Infra Red spectroscopy (FTIR)

FTIR analysis of the dried AuNPs was carried out through using Nicklet 380 Thermo, US Fourier Transform Infrared Spectrometer.

Scanning Electron Microscopy (SEM)

Each of the colloidal solution containing biogenic AuNPs was centrifuged at 4,000 rpm for 15 min and the pellets were discarded and the supernatants were again centrifuged at 5,000 rpm for 30 min. Supernatants were discarded and the final pellets were dissolved in 0.1 ml of deionized water. The pellet was carefully placed on a glass cover slip followed by air-drying. The cover slip itself was screened under scanning electron microscopy (SEM) analysis.

Transmission Electron Microscopy (TEM)

The size and of the biogenic synthesized AuNPs were recorded by using transmission electron microscope (Model: Philips CM200). The sample was dropped onto carbon-coated copper TEM grids.

RESULTS AND DISCUSSION

In the present study, FTIR spectra were useful to identify the potential bioactives in the extract responsible for capping biosynthesized AuNPs. FTIR spectrum is used to probe the chemical constitution on the surface of AuNPs [4]. In Fig. 2, FTIR spectrum of phytosynthesized AuNPs showed the two strong IR bands of hydroxyl and phenols (3447.69 cm-1), whereas C=C stretch of benzene and amide-I linkage (1638.26cm-1) and other IR bands of (2075.70 cm-1) and (555.62 cm-1). Absorption peak (1638.26 cm-1) in the infrared region of the electromagnetic spectrum exhibits the binding of amide linkage with AuNPs which may be assigned to the carbonyl stretch in proteins and clearly indicates the presence of protein as capping agent for AuNPs. Proteins have stronger affinity to bind AuNPs which increases the stability of synthesized nanoparticles [5]. These results confirmed that carbonyl group of amino acid residues has strong binding ability with metal leading to the formation of layer adsorbed on the surface metal nanoparticles as capping agent to prevent agglomeration [5].

Phytosynthesized AuNPs as polycrystalline structure were revealed as shown in Fig.3. Structural analysis by SEM showed 10 µm in size of AuNPs.

Fourier Transform Infra Red spectroscopy (FTIR)

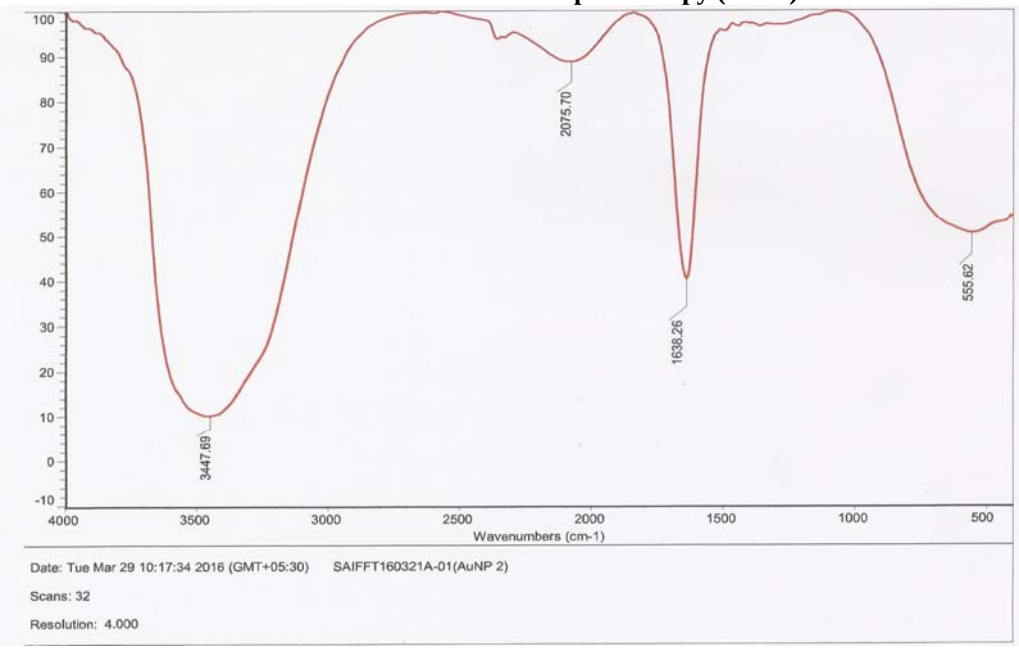

Fig. 2: FTIR image of gold nanoparticles

Scanning Electron Microscopy

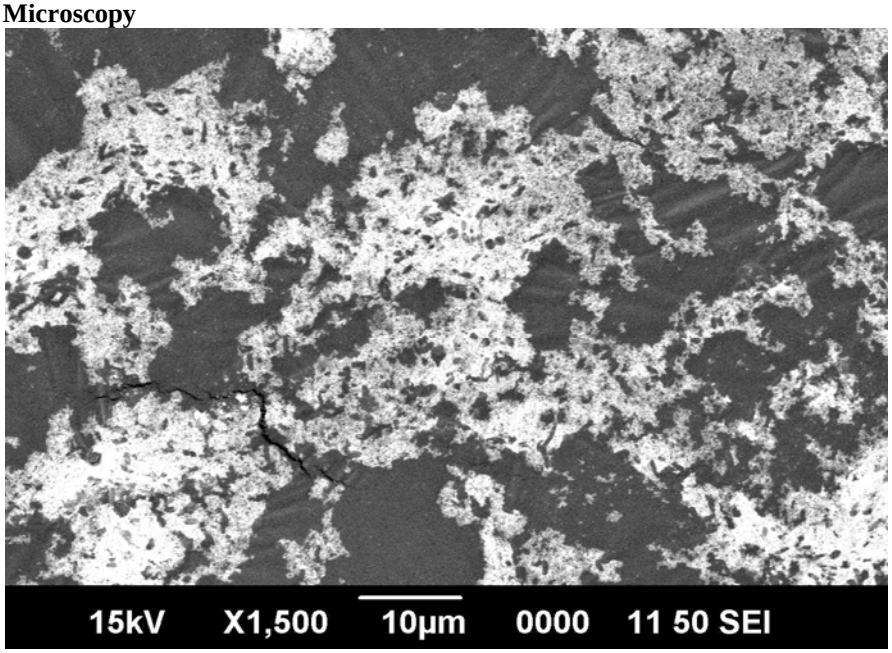

Fig. 3: SEM image of gold nanoparticles

Transmission Electron Microscopy

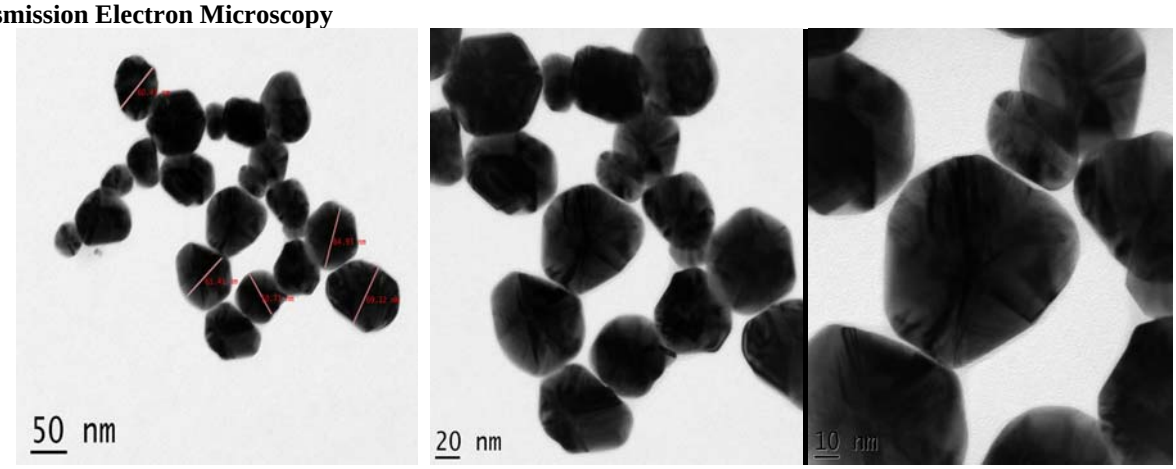

Fig. 4: TEM image of gold nanoparticles in different dimensions (50nm, 20nm, 10nm)

Morphology of AuNPs was investigated by TEM in fig. 3. TEM images have shown AuNPs 50 nm, 20 nm and 10 nm in average diameter and spherical cube shape.

In our previous studies, we have used sunlight irradiation to induce green synthesis of silver nanoparticles by using *Kalanchoe pinnata* extract [6] and found synergistic activity [7] when it was conjugated with antibiotic ciprofloxacin against bacterial strains. In future, it will be carried out the antibacterial activity of AuNPs conjugated with antibiotic in the bacterial culture.

CONCLUSION

From remarkable results in the present study, it is concluded that gold nanoparticles can photosynthesized by flower petals extract as an alternative to physical and chemical synthesis. Sunlight irradiation is useful as catalyst to accelerate the process of biosynthesis of nanoparticles.

ACKNOWLEDGEMENT

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CONFLICT OF INTEREST STATEMENT

Authors declare that there is no conflict of interest.

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