BIOSYNTHESIS OF SILVER NANOPARTICLES FROM FRUIT EXTRACTS OF ANANAS COMOSUS

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Abstract

Biomolecules from various plant components have been used as potential agents for the synthesis of silver and other metal nanoparticles. There are reports on more than hundred different biological sources for synthesizing silver nanoparticles. The bio-reduction of aqueous Ag^{+} ions by the fruit extract of Ananas comosus has been studied. The reduction of silver metal ions by fruit extract leads to the formation of silver nanoparticles of fairly well defined dimensions. The synthesised nanoparticles have been isolated and characterised by UV-Visible and infra red spectral techniques. All the obtained results clearly favour the formation of well defined silver nanoparticles.

Keywords: bio reduction, green synthesis, silver nanoparticles, ananas comosus.

I. INTRODUCTION

The need for biosynthesis of nanoparticles is having huge potential since the physical and chemical processes used today are costly, hazardous and difficult to isolate the nanoparticles formed [1-4]. The green synthetic methods have several advantages over other methods like cost effectiveness, simplicity, usage of less toxic materials etc. [5-7]. Various plant extracts were used for the synthesis of nanoparticles in a greener way [8-12]. The plant extracts have been used as capping and reducing agent for the synthesis of silver nanoparticles due to their reducing properties present in the leaf and fruit extract.

Ananas comosus L. belongs to Bromeliaceae family, a large, diverse family of about two thousand species and is a subtropical fruit native to Thailand, Phillipines, China, Brazil and India. Pineapple has several beneficial properties including antioxidant activity. It contains mixture of protease enzymes which acts as a nutritional supplement to promote digestive health and used as an anti-inflammatory medication. Phytochemicals, especially phenolics, in fruits and vegetables are suggested to be the major bioactive compounds for the health benefits [13]. Polyphenols possess outstanding antioxidant and free radical scavenging properties, suggesting a possible protective role in humans [14-15].

The present paper reports biosynthesis of silver nanoparticles from the fruit extracts of Ananas comosus which belongs to Bromeliaceae family. The synthesised silver nanoparticles were isolated and characterized by UV-Visible and infra red spectral techniques.

II. EXPERIMENTAL

Materials

Fresh ripped pineapple fruits were used to make the aqueous extract. Ripped pineapple fruit weighing 25g were thoroughly washed in doubly distilled water, dried, cut into fine pieces and were crushed into 100 mL sterile distilled water and filtered through Whatman No.1 filter paper (pore size 25 μm). The filtrate was further filtered through 0.6 μm pore sized filter paper. Silver nitrate (0.001 mol dm^3) is prepared by weighing 0.0425 g silver nitrate in an electronic balance and made up to 250 mL using distilled water in standard flask.

Methods

Five different concentration ratios of fruit and metal ions were prepared (1:5, 2:5, 3:5, 4:5 and 5:5) by increasing the concentration of fruit extract in the solution. The resultant solution is kept in dark for twenty four hours and then the colour change is noted and photographed. Then the bioreduced aqueous component was analysed by UV-Visible spectrophotometer. The solution is heated and the dried sample is used for further characterisation.

III. RESULTS AND DISCUSSION

It is well known that silver nanoparticles exhibit yellowish brown colour in aqueous solution due to excitation of surface plasmon vibrations in silver nanoparticles. As the pineapple fruit extracts were mixed in the aqueous solution of the silver ion complex, it started to change the colour from watery yellow to yellowish brown due to reduction of silver ion **(**Fig.1**)**, which indicates the formation of silver nanoparticles.

Fig. 1. Digital photographs of pineapple fruit extract and 1Mm AgNO3

UV-Visible spectral analysis

The UV-Visible absorption of the obtained particles was recorded by Hitachi U-3000 UV-Visible spectrophotometer using 1 cm quartz cell and spectrograde ethanol (Merck, India) as solvent and is given in Figure 2.

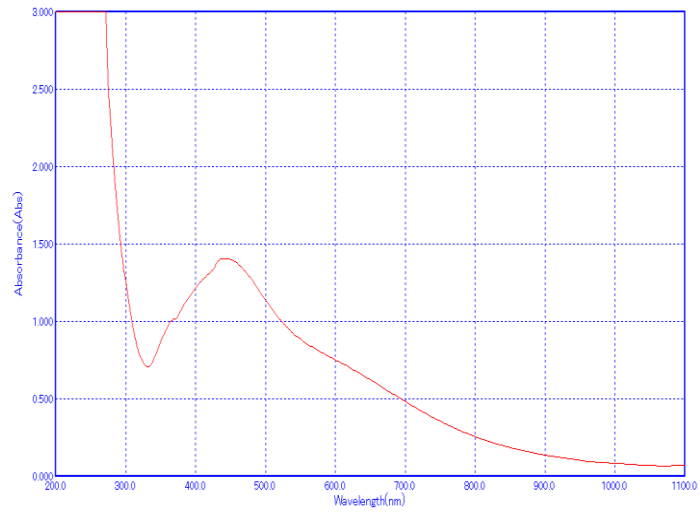

Fig. 2. UV-Visible spectrum of AgNP of pineapple fruit extract

The UV absorption peak of silver nanoparticles ranges from 400 nm – 450 nm. UV-Visible spectrum shows maximum absorption approximately at 420 nm, clearly indicating the formation of spherical AgNPs in the plant extract. The occurrence of the peak at 420 nm is due to the phenomenon of surface plasmon resonance, which occurs due to the excitation of the surface plasmons present on the outer surface of the silver nanoparticles which gets excited due to the applied electromagnetic field.

IV.INFRA RED SPECTRAL ANALYSIS

The infra red absorption spectrum of Ananas comosus was recorded from KBr pellets using Jasco FT-IR 4100 spectrophotometer (Japan) and is shown in Figure 3.

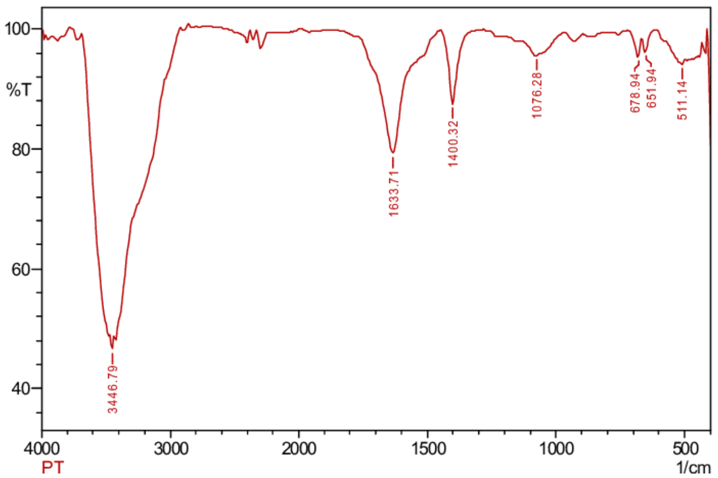

Fig. 3. FT-IR spectrum of AgNP of pineapple fruit extract

The FTIR analysis was carried out between 4000 cm^{-1} and 600 cm^{-1} to identify the functional groups responsible for capping and stabilizing the silver nanoparticles. The broad peak at 3446 cm^{-1} could be assigned to OH stretch while the sharp peak at 1633 cm^{-1} was assigned to the C=O stretching in carbonyl group. The peak at 1400 cm^{-1} belongs to C=C stretching. All these peaks clearly shows the presence of phyto constituents such as flavonoids, alkaloids and terpenoids that might be responsible for the reduction of silver ions to silver nanoparticles due to their capping and reducing capacity.

IV. CONCLUSIONS

All the observations obtained from UV-Visible and infra red spectral techniques proved the formation of silver nanoparticles. In the synthesis of silver nanoparticles using Ananas comosus, the formed nanoparticles have shown strong peaks within the range 400-450 nm. FT-IR results revealed the functional groups and morphology of the silver nanoparticles.

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