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BIOSYNTHESIS OF SILVER NANOPARTICLES USING CITRUS FRUITS

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ABSTRACT

Over past few years nanotechnology field has gained impetus of research. In the present study, eco-friendly method was used for synthesis of silver nanoparticles using citrus fruits. One of the widely-studied properties of silver nanoparticles is Surface Plasmon Resonance occurs because the conduction electrons on the metal surface undergo a collective oscillation when excited by light at specific wavelength. Citrus sinesis and Citrus limetta are used for synthesis of silver nanoparticles. These fruits itself act as capping and reducing agent, thus there is no need of any chemical reducing agent. The silver nanoparticles were formed within 2hrs and appeared brown color solution. UV-visible spectroscopy was used for characterization and maximum peak of C. sinesis was found to be 360nm and C. limetta was found to be 340nm. This method is one step, rapid and safe as compared to the other methods.

KEY WORDS

Silver nanoparticles, Eco friendly, C. sinesis, C. limetta, UV- visible spectroscopy.

INTRODUCTION:

Nanoparticles are those whose size ranges 1 nm to 100 nm. They are in different sizes and shape, such as triangular, spherical, irregular, etc [4]. In recent years, nanoparticles synthesis has received considerable attention due to their unique properties and potential applications [2 and 7]. Silver nanoparticles possess very high aspect ratio apart from of their synthesis process which determines surface related properties such as solubility and stability. This property of high aspect ratio of silver nanoparticles is important for different application e.g. catalysis, microbial resistance etc. One of the widely-studied properties of silver nanoparticles is Surface Plasmon Resonance that is the strong interaction of the silver nanoparticles with light occurs because the conduction electrons on the metal surface undergo a collective oscillation when excited by light at specific wavelength [6]. The green synthesis, environment friendly processes are becoming increasingly popular in recent years and are much needed as a result of worldwide problems associated with environmental concerns [3 and 5].

In the conventional methods, toxic reducing agents are used, such as ethanol, hydrazine hydrate, sodium borohydrate, formaldehyde and ethylene glycol. So, to avoid this use of toxic chemicals, natural agents such as flavonoids, tannins and vitamin C can be used, so as to solve problems of price and pollution, among others. Silver nanoparticles are formed due to reduction of silver ions into neutral silver atoms.

Biosynthesis of silver nanoparticles using citrus fruits is bottom up approach where there is reduction involved of silver ions. The peel of *Citrus sinesis* and *Citrus limetta* both are the rich source of flavones and poly methoxylated flavones, which are very rare in plant extract. Citrus fruit extract itself act as a reducing agent to bring about synthesis of nanoparticles. Thus, this method of synthesis is ecofriendly, safe and nontoxic method. The use of environmentally benign materials for the synthesis of nanoparticles offers numerous benefits in pharmaceutical and biomedical applications as toxic chemical substances are not employed in their synthesis [4]. Characterization of silver nanoparticles was done using UV- visible spectroscopy to confirm its synthesis.

Literature Survey-

Green Synthesis of Silver Nanoparticles using Azadirachta indica aqueous leaf extract, Shakeel Ahemd et al, 2016.

Shakeel Ahemd et al, 2016 carried out synthesis of nanoparticles using Azadirachta indica aqueous leaf extract. It was used to prepare silver nanoparticles on the basis of cost effectiveness, ease of availability and its medicinal property. Fresh leaves were collected from university campus (New Delhi) in month of February.Silver nanoparticles were synthesized by varying concentration of AgNO3 (1 mM–5 mM) keeping extract concentration constant (1 mL). Reduction of Ag+ to Ag0 was confirmed by the colour change of solution from colourless to brown. Its formation was also confirmed by using UV–Visible spectroscopy. UV–Visible spectrophotometer showed absorbance peak in range of 436–446 nm. The functional groups present in pant extract that was responsible for reduction of silver ions were investigated by FTIR. Antibacterial activity was carried out against human pathogens.

Green Synthesis of Silver Nanoparticles from Marigold Flower and its Syngeristic antimicrobial potential, Hemali Padlia et al, 2015.

Hemali Padlia et al, 2015 studied silver nanoparticles synthesis using flower broth of Tageteserecta as reductant by a simple and eco-friendly route. The silver nanoparticles were characterized by UV–visible spectroscopy, zeta potential, Fourier transform infra-red spectroscopy (FTIR), X-ray diffraction, Transmission electron microscopy (TEM) analysis. UV–visible spectrum of synthesized silver nanoparticles showed maximum peak at 430 nm. TEM analysis revealed that the particles were spherical, hexagonal and irregular in shape and size ranging from 10 to 90 nm.

Extracellular synthesis of silver nanoparticles by the Bacillus strain CS 11 isolated from industrialized area, Vidhya Lakshmi Das et al, 2014.

In this study soil samples were collected from heavy metal contaminated area of Cochin and used for isolation. The selected isolates were identified by 16srDNA method and used for synthesis of nanoparticles. A colour change was observed from yellow to brown within 24hrs of incubation. This was confirmed by the UV-visible spectrophotometer and peak was obtained at 430nm.

MATERIALS

1. *Citrus sinesis* (Orange peel) from local market
2. *Citrus limetta* (Sweet Lime) from local market

Methods:

Preparation of Citrus fruits extract-

***Citrus sinesis* extract-**

Fresh *C. sinesis* (orange) fruit was brought from local market. The peels were removed, washed with distilled water and then allowed to dry partially. The peels were cut into small pieces. Weigh about 4g of peels and add 40mL distilled water in 250mL of beaker. Boil the extract for 2 minutes. Then filter the extract using Whatmann filter paper. Collect the filtrate and stored at 4°C for further use [1].

***Citrus limetta* extract-**

Fresh *C. limetta* (sweet lime) fruit was brought from local market. The peels were removed, washed with distilled water and then allowed to dry partially. The peels were cut into small pieces. Weigh about 4g of peels and add 40mL distilled water in 250mL of beaker. Boil the extract for 2minutes. Then filter the extract using Whatmann filter paper. Collect the filtrate and stored at 4°C for further use [1].

Preparation of 1mM Silver Nitrate-

Silver nitrate was brought from Lobachemie. Weigh 0.0169gm of silver nitrate and dissolve in 100mL of distilled water in amber coloured bottle.

Synthesis of Silver Nanoparticles-

3mL of prepared extract was added to 40mL of silver nitrate solution in 100mL conical flask. Incubate at room temperature for 2- 3 hours. Control is made containing only 40 mL of silver nitrate solution.

Characterization of Silver Nanoparticles-

Then synthesis of silver nanoparticles was checked in UV-Visible spectroscopy at the wavelength of 300-700nm.

RESULTS:

1) Synthesis of silver nanoparticles-

The colour of extract was yellow in colour. After the addition of extract into silver nitrate solution the colour was changed to colourless. After incubation, the colour was changed from colourless to brown within 2hours

(Fig. 3). This indicates that the silver nanoparticles were synthesized using both the extracts.

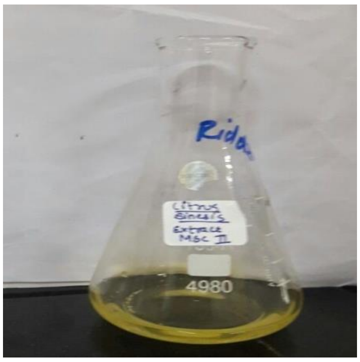

Fig. 1- *C. sinesis* (orange) peel extract

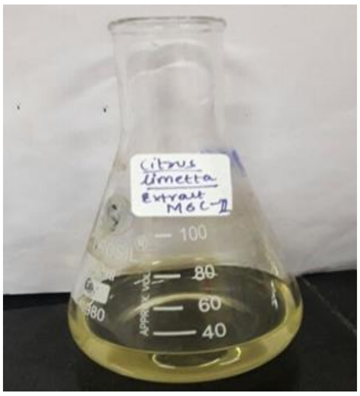

Fig.2- *C. limetta* (sweet lime) peel extract

Fig. 3- Formation of Brown colour solution

2)UV-Visible Spectroscopy-

The synthesis of silver nanoparticles was confirmed using UV-Visible spectroscopy at 300-700nm of wavelength. The maximum peak of absorption of silver nanoparticles using *C. sinesis and C. limetta* was observed at 360nm and 340nm respectively (Fig. 4 and 5). The silver nanoparticles have free electrons which give rise to surface plasmon resonance band [1].

Fig.4 – Reading of Synthesis of Silver Nanoparticles using *Citrus sinesis* Extract

Wavelength(nm)	***Absorbance***
360	0.670
380	0.408
400	0.355
420	0.373
440	0.397
460	0.382
480	0.347
500	0.311
520	0.266
540	0.233
560	0.201
580	0.173
600	0.149

Fig. 5- Reading of Synthesis of Silver Nanoparticles using *Citrus limetta* Extract

Wavelength(nm)	***Absorbance***
340	0.840
360	0.675
380	0.547
400	0.432
420	0.400
440	0.379
460	0.372
480	0.360
500	0.347
520	0.319
540	0.292
560	0.263
580	0.235
600	0.207

DISCUSSION:

For synthesis of nanoparticles standard protocol of the author Praphulla Rao was adapted. The addition of *C.sinesis* and *C. limetta* peel extract into silver nitrate solution developed the colour change to brown colour solution. This reduction was of silver ions was due to surface plasmon resonance [6]. UV-visible spectroscopy is useful technique for confirmation of synthesis of silver nanoparticles. Reduction of silver ions due to presence of contents in citrus fruit peel observed by UV-visible spectroscopy showed that it is correlated with spectroscopy. The formation was within 2hrs of incubation in dark. The surface plasmon resonance band of absorption of silver nanoparticles using *C. sinesis* and

C. limetta was observed at 360nm and 340nm respectively.

CONCLUSION:

Silver nanoparticles were synthesized using *C. sinesis* and C*. limetta* peel extract by green synthesis method. The synthesis was effective in terms of stability and time of reaction. It does not involve any use of chemical reducing agent. The synthesized silver nanoparticles were characterized using UV-visible spectroscopy. The maximum peak of absorption of silver nanoparticles using *C. sinesis* and *C. limetta* was observed at 360nm and 340nm respectively. This method of synthesis is cost effective, rapid, ecofriendly and safe.

FUTURE PROPSECTS:

In future, optimization can be carried out at different conditions. Also, as it plays a role in environment and biomedical research, it can be used for dye degradation or as antimicrobial agent.

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