Synthesis of White Pepper Oleoresin Mediated Silver Nanoparticles and its Antioxidant Effect

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ABSTRACT

Introduction and Aim: Nanotechnology deals with the synthesis of different types of nanoparticles that can be used in various fields including medicine as they have completely new or enhanced properties based on size, shape, dispersity, and morphology. White pepper (*Piper nigrum* L.), known as "the king of spices," has several properties and can be used as herbal medicines, preservatives, dietary supplements, and fragrances. The present study aimed to synthesize white pepper oleoresin mediated silver nanoparticles and to evaluate its antioxidant activity.

Materials and Methods: White pepper oleoresin mediated silver nanoparticles were synthesized and were characterized by UV-Vis spectroscopy. The antioxidant activity was evaluated by DPPH assay using ascorbic acid as standard.

Results: UV Vis spectroscopy showed a peak at the wavelength of 410 nm, indicating the presence of silver nanoparticles. It was found that at 100µL, the white pepper oleoresin mediated silver nanoparticles showed greater antioxidant activity compared to ascorbic acid.

Conclusion: White pepper oleoresin can be efficiently used in the synthesis of silver nanoparticles as a green route, and since the biosynthesized silver nanoparticles showed good antioxidant properties, it may be used for various conditions with oxidative stress.

Key Words: White pepper oleoresin, Silver nanoparticles, UV-Vis spectroscopy.

INTRODUCTION

Nanotechnology deals with the synthesis of different types of nanoparticles that can be used in various fields including medicine (1) as they have completely new or enhanced properties based on size, shape, dispersity, and morphology. Both nanotechnology and nanoscience provide solutions to different problems in the society like sustainable chemical production and water treatment etc. (2). Nanoparticles can be synthesized by chemical and biological methods with the former involving the use of toxic chemicals and the latter including the usage if microorganisms, enzymes, and plant or plant extracts (4 -7).

White pepper (*Piper nigrum* L.), also known as "the king of spices," helps with digestion and eliminates odor and greasiness (8). White pepper has also been used as herbal medicines, preservatives, dietary supplements, and fragrances (9). It is rich in aromatic oils, oleoresins, and alkaloids (10). An active ingredient in white pepper, piperine (1-piperoyl piperidine), has numerous biological effects such as anti-inflammatory, antimutagenic, antioxidant, and antitumor activities (9, 11). Piperine is also known to promote the bioavailability of drugs such as curcumin, phenytoin, propranolol, and theophylline (12-14).

The usage of plants in the biosynthesis of nanoparticles is economical and straightforward (15). Synthesis of nanoparticles using plants is simple and economical and also faster when compared to the green synthesis of microorganisms (16). Recently the use of metals in the biosynthesis of nanoparticles has gained popularity due to their uniqueness in optical, thermal, chemical, and physical properties which make them different from the other bulk materials (17). Their uniqueness is attributed to their small size and large surface area and hence has a wide range of applications. There are reports on the formation of silver and gold nanoparticles by living plants (18,19). Medicine employs silver and silver nanoparticles in various fields as silver has an inhibitory effect on various microorganisms, including bacterial stains. Silver nanoparticles are well known for their magnetic, electrical conductivity (20) and DNA sequencing (21). The most important property of silver nanoparticles is its antimicrobial effect (22). Thus silver nanoparticles have been used preparation of topical ointments and creams to prevent infection of burns and open wounds. Biosynthesis of silver nanoparticles using Citrus limon leaves extract was reported, and its antimicrobial finish on the fabric was found to be due to the synergistic effect of silver nanoparticles and essential oil components of lemon leaves (15). The present investigation aimed to prepare white pepper oleoresin mediated silver nanoparticles and to evaluate its antioxidant activity using DPPH assay.

MATERIALS AND METHODS

Synthesis of silver nanoparticles solution

1 mM silver nitrate solution was prepared using double distilled water initially.1mL of white pepper oleoresin was dissolved in 19 mL of distiled water. It was then mixed with 80 mL of 1mM silver nitrate solution. The color change was observed visually and photographed. The solution is kept in magnetic stirrer for nanoparticle synthesis.

Characterization of silver nanoparticles

The synthesized nanoparticles solution is preliminarily characterised by using UV-vis spectroscopy 3 ml of the solution is taken in the cuvette and scanned in double beam UV-vis spectrophotometer from 300 nm to 700 nm wavelength. The results were recorded for the graphical analysis.

Preparation of nanoparticles powder

The nanoparticles solution is centrifuged using a dark refrigerated centrifuge. The white pepper oleoresin silver nanoparticles solution is centrifuged at 8000 rpm for 10 minutes, and the pellet is collected and washed with distilled water twice. The final purified pellet is collected and dried at 60 degrees for 24 hours, and finally, the nanoparticles powder is collected and stored in an airtight Eppendorf tube.

DPPH radical assay

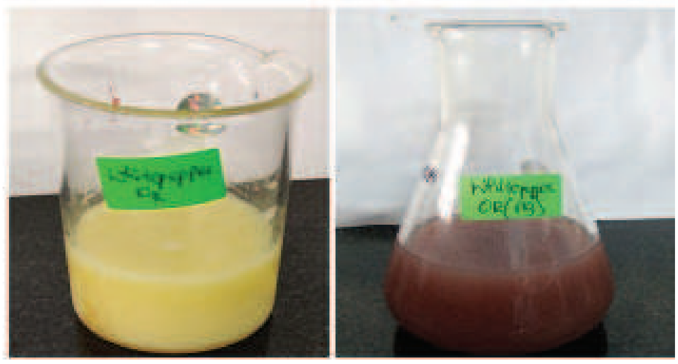
The DPPH free radical scavenging activity of nanoparticles as determined according to the method of Rajeshkumar, 2017. Typically, different concentration (2-10 μg/ml) of plant extract was mixed with 1 ml of 0.1 mM DPPH in methanol solution and 450 μl of 50 mM Tris-HCl buffer (pH 7.4) and incubated for 30 min. After incubation, the reduction in the number of DPPH free radicals was measured based on the absorbance at 517 nm. BHT was used as controls. The percent inhibition was calculated from the following equation:

% Inhibition = [Absorbance of control – Absorbance of test sample/Absorbance of control] ×100

RESULTS AND DISCUSSION

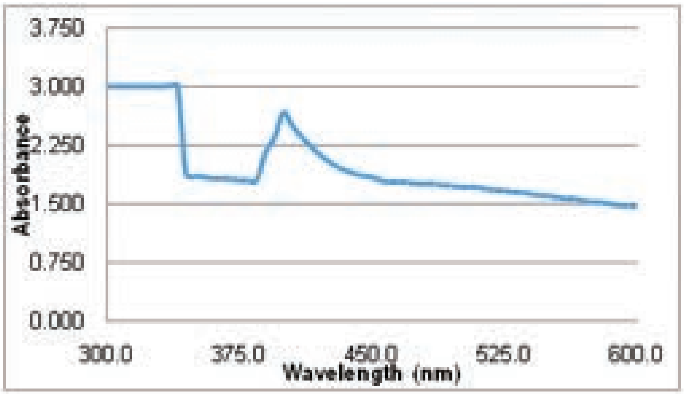
Visual observation

Figure1: Colour change indicating the presence of silver nanoparticles



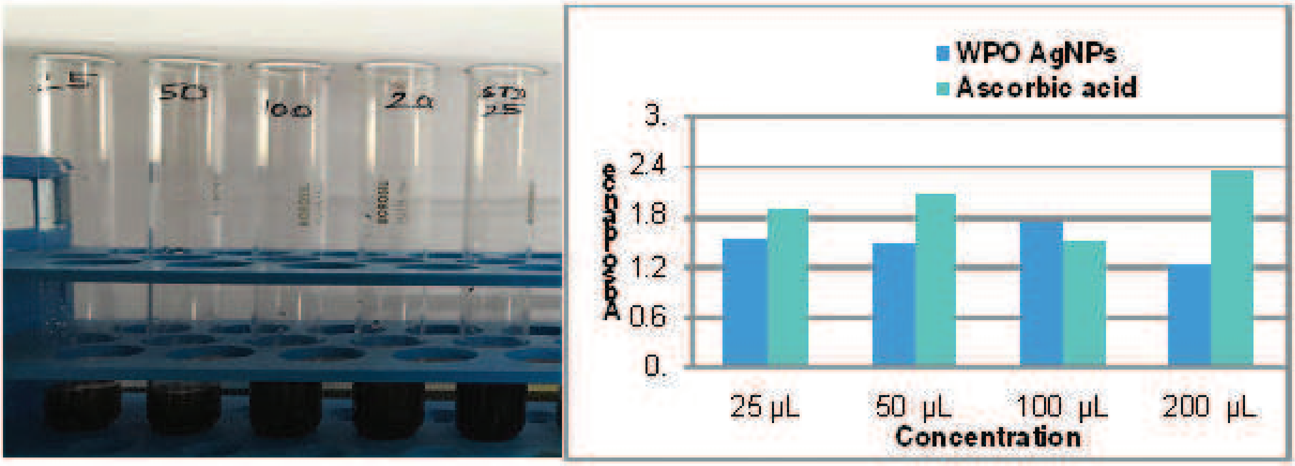
The silver nanoparticles exhibit a yellowish brown color in aqueous solution due to excitation of the surface Plasmon vibrations in silver nanoparticles. The appearance of a yellowish brown color confirms the existence of silver nanoparticles in the solution (Figure1)

Figure 2: UV-vis spectroscopy



The silver nanoparticles were characterized using UV-Vis spectroscopy, which is one of the widely used techniques for the structural characterization of silver nanoparticles (23). The absorption spectrum of the yellowish brown, silver nanoparticles solution showed a surface Plasmon absorption band with a peak at 410 nm, which indicates the formation of silver nanoparticles (Figure 2).

Figure 3: Antioxidant activity at different concentrations



A change of color to reddish brown was observed because of the reaction between white pepper oleoresin and silver nitrate solution indicating the formation of silver nanoparticles and was further confirmed by a peak at 410 nm in UV –visible spectroscopy. .

The different concentrations of white pepper oleoresin mediated silver nanoparticles such as 25µL, 50µL, 100µL, 200µL showed a concentration-dependent antioxidant activity. The silver nanoparticles at a concentration of 100 µL have shown the highest radical scavenging activity (Figure 3). White pepper oleoresin mediated silver nanoparticles promoted DPPH radical scavenging activity. The reason why antioxidants scavenge DPPH radicals is likely due to their ability to donate hydrogens and easily incorporate electrons which is possible due to the presence of the host lipophilic radicals.

CONCLUSION

Nanoparticles synthesized by using plants have yielded great results in biomedical applications. The use of silver nanoparticles is known to be of great importance in the medical field. Silver nanoparticles have the potential to function as therapeutics with diverse clinical and pharmacological properties. They are known to have a wide range of applications, including their role as anticancer agents or bactericidal agents which can be used during surgery or recovery. The shape, size, and size distribution of AgNPs can be controlled by modifying synthesis conditions. In this study, a simple, biological, and low-cost approach for the synthesis of silver nanoparticle was used and its antioxidant property was proved using DPPH Assay technique.

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Conflict of Interest: Nil

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