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Original Research Study

Antioxidant Activity of Cumin Oil Mediated Silver Nanoparticles

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ABSTRACT

Aim: The aim of the study was to employ cumin oil in the synthesis of silver nanoparticles and check the antioxidant activity of the cumin oil mediated silver nanoparticles. **Background:** The introduction of Nanoparticles (NPs) has revolutionized every field including medicine, nutrition and energy. The use of nanotechnology in medicine especially for drug delivery is shown to have various benefits. Nanoparticles are being used to reduce toxicity and side effects that drugs may impose to the patient. Cumin (*Cuminum cyminum*) is a common spice used for its distinct aromatic effect. Plant mediated biological synthesis of nanoparticles has been gaining importance due to its simplicity and eco friendliness. This study therefore was aimed to synthesize cumin oil mediated silver nanoparticles and assess its antioxidant activity. **Materials and Methods:** Cumin oil mediated silver nanoparticles were initially synthesised and characterised by UV-Visible spectrophotometer and TEM. Further the cumin oil mediated AgNPs were subjected to DPPH assay to determine the antioxidant activity. **Results:** Cumin oil mediated AgNPs were biosynthesised with ease and showed good antioxidant activity compared to standard. **Conclusion:** This study conclude that cumin seed oil mediated silver nanoparticles have the potential to be used as an effective antioxidant. Hence, it may be employed in large scale production and may be used in many medicinal applications where there is a need for antioxidant.

Key words: Cumin oil, AgNP, Biosynthesis, Nanoparticles, Antioxidant activity.

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INTRODUCTION

Nanotechnology is one of the advancing fields in biotechnology with a vast array of applications. The introduction of Nanoparticles (NPs) has revolutionized every field including medicine, nutrition and energy. The use of nanotechnology in medicine in particular, specifically drug delivery is shown to have various benefits. Nanoparticles are being used to reduce toxicity and side effects that drugs may impose to the patient. Over the past few years, noble-metal nanoparticles have expanded rapidly owing to their superior characteristics. Silver nanoparticles are the most coveted nanomaterial due to their exceptional physicochemical properties such as high ratio of surface area to mass, electric, optical, catalytic and particularly antimicrobial properties.[1] Synthesis of nanosized particles of metals and metal oxides has progressed rapidly in the medicinal field because of the astounding characteristics acquired by these nanoparticles.[2] Metallic nanoparticles may be synthesized by physical, chemical and organic methods. The biological method is preferred among the others as physical method is found to be highly expensive and the chemical method is extremely noxious to the environment.[3] Hence, plant mediated biological synthesis of nanoparticles has been gaining importance due to its simplicity as well as eco friendliness.

Spices have been used as food additives to enhance the taste and the flavor of food from time immemorial.[4] Cumin obtained from the herb *Cuminum cyminum*, is native from East Mediterranean to South Asia and belongs to the family *Apiaceae*. Cumin is a small hairy, brownish in color, boat shaped seed plant that have a spicy sweet aroma property and is slightly bitter and pungent in flavor.[5] Cumin seeds are profusely used in several cuisines of many different food cultures for its distinct aromatic effect. In India particularly, cumin seeds have been used for thousands of years as a traditional ingredient in endless number of dishes and also form an ingredient of several other spice blends.

Cumin seeds have high nutritional content and provide high amounts of fat, protein, dietary fibre, vitamins B and E, several minerals, especially iron in considerable amounts. Cuminaldehyde, cymene, and terpenoids are the major volatile components of cumin.[6] Cumin has a characteristic robust flavour, owing to its essential oil content. The main constituents of aroma compounds in the essential oil are cuminaldehyde and cuminic alcohol. Others include the substituted pyrazines, 2-ethoxy-3-isopropylpyrazine, 2-methoxy-3-sec-butylpyrazine, and 2-methoxy-3-methylpyrazine. Cumin also contains γ-terpinene, safranal, *p*-cymene, and β-pinene.[7]

Cumin, apart from being extensively used as a spice for its distinctive aroma, it is also frequently used in traditional medicine to treat a variety of diseases. Cumin oil has therapeutic effect in conditions such as chronic diarrhoea, acute gastritis, diabetes and cancer, largely owing to its bioactive constituents such as terpenes, phenols, and flavonoids.[8] Cumin has been used in the treatment of mild digestive disorders, as an astringent in bronco-pulmonary disorders and as a cough remedy, as well as an analgesic.[9] The essential oil of cumin seeds also shows a substantial antimicrobial activity against

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K. pneumoniae in vitro.[10] Aforementioned impressive effectiveness of cumin accelerated the current study to consider cumin oil as a prime source to develop silver nanoparticles and assess its antioxidant activity.

MATERIALS AND METHODS

Cumin oil was commercially obtained from Synthite Industries, Kerala. 1 ml of cumin oil was dispersed in 10 mL of distilled water and boiled for 5-10 minutes at 60-70°C.

Synthesis of nanoparticles

90 mL 1 mM AgNO3 solution was mixed with 10 mL of cumin oil extract and the solution was kept in a magnetic stirrer for the formation of nanoparticles. The colour change was observed visually and photographs were recorded (Figure 1). The solution of silver nanoparticles was centrifuged at 8000 rpm for 10 minutes using lark refrigerated centrifuge and the pellets were collected and washed with distilled water twice. The final purified pellet was collected and dried at 60°C for 2 hours and was collected and stored in airtight eppendorff tube.

Characterisation of silver nanoparticles

The synthesised NPs solution was preliminarily characterised by using UV-visible-spectroscopy. 3 ml of the solution was taken in a cuvette and scanned using double beam UV-Vis-spectrophotometry from 300 nm to 700 nm wavelength. The results were recorded for graphical analysis. The prepared nanoparticles were analysed for its morphology by using TEM.

DPPH radical assay

The DPPH (1,1-diphenyl-2-picryl-hydrazil) free radical scavenging activity of cumin oil mediated Silver Nanoparticle was determined according to the method of Rajeshkumar.[11] Different concentrations (2-10 µg/ml) of cumin oil mediated silver nanoparticle 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 minutes. After incubation, the reduction in the number of DPPH free radicals was measured based on the absorbance at 517 nm. BHT was used as control. The percentage inhibition was calculated from the following equation:

$$\%inhibition = \frac{Absorbance\ of\ control - Absorbance\ of\ test\ sample}{Absorbance\ of\ control} x100$$

RESULTS

The addition of cumin oil extract to $AgNO_3$ solution resulted visual color change from colorless to yellow within 5 min because of surface plasmon resonance (SPR) excitation due to the collective oscillation of free conduction electrons induced by an interacting electromagnetic field which is absent in bulk material.[12] indicating the reduction of Ag^+ to Ag^0. Formation of Ag NPs was further confirmed by UV–Visible spectra by recording the absorption spectrum of the colloidal solution (Figure 2A) with a characteristic SPR band at 429 nm with increasing time. The spherical and pseudo spherical shaped nanoparticles with 25 – 45 nm were confirmed using transmission electron microscopy shown in Figure 2B.

The antioxidant activity of biosynthesized Ag NPs was evaluated by DPPH assay with BHT as the standard. In the present study, the synthesized Ag NPs showed comparable free radical scavenging activity to that of the standard (Figure 3).

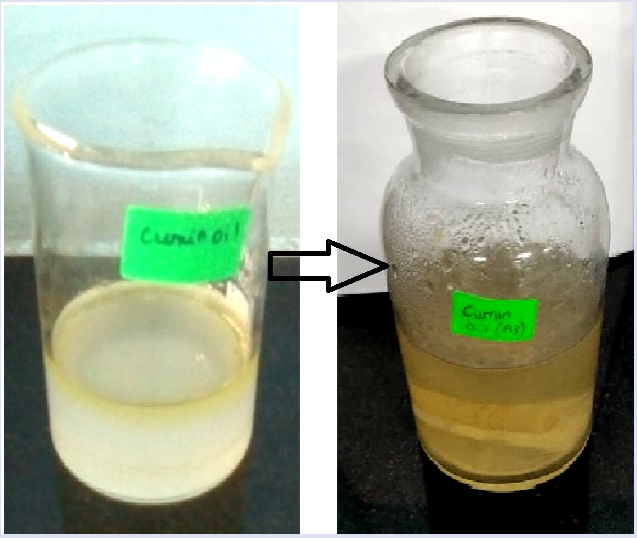

Figure 1: Visual observation of formation of AgNPs.

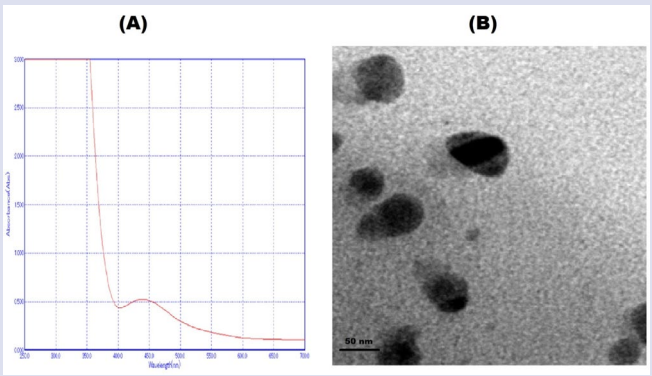

Figure 2: UV-vis spectroscopy and TEM image.

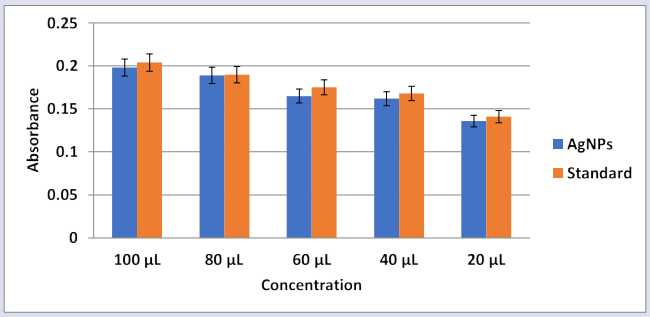

Figure 3: Antioxidant activity of AgNPs.

DISCUSSION

Former studies reported that AgNPs can be synthesized by plants such as Cymbopogon citratus,[13] *Garcinia mangostana* bark extract,[14] *Mucuna pruriens* seed,[15] *Kalanchoe pinnata* leaf,[16] *Acorus calamus root*,[17] *Chrysanthemum indicum*.[11] In the current study, aqueous silver ions were reduced to AgNPs after mixing with cumin oil extract followed by incubation. The color turned yellow to reddish brown and this change in color has been previously observed by several investigators.[18-20] These authors suggested that the color change appeared due to the surface plasmon- resonance of deposited AgNPs.

In the current study, the mechanism by which the cumin oil could mediate AgNPs may be explained by the higher total phenolics content in it. These plant phenolics are strong antioxidants with high reducing capacity[21] which can be used for AgNPs synthesis.[22] The higher content of total phenolic content in *C. cyminum* oil extract facilitates the reduction of silver ions to nano-sized silver particles due to the electron donating ability of these phenolic compounds. Furthermore, the quinoid compound produced due to the oxidation of the phenol group in phenolics can be adsorbed on the surface of nanoparticles, accounting for their suspension stabilization.[23] It is well documented that the phenolic compounds may contribute directly to anti-oxidative action.[24] This antioxidant activity is attributed to the phenolic contents in plants probably due to their redox properties, which allow them to act as reducing agents, hydrogen donors, and singlet oxygen quenchers.[25]

Nanoparticles have application in vascular alteration, especially in endothelial dysfunction related to oxidative stress.[26] This condition can lead to a reduction in nitric oxide (NO) bioavailability, consequently affecting vascular tone regulation and endothelial dysfunction, which is the first phase in the development of cardiovascular diseases. Hence, nanoparticles with antioxidant properties synthesized in the present study may be employed to improve vascular dysfunction associated with hypertension, diabetes mellitus, or atherosclerosis.

CONCLUSION

The present study revealed that silver nanoparticles can be synthesized in a simple, eco-friendly method using *C. cyminum* oil extract. These cumin oil mediated nanoparticles have the potential to be used as an effective antioxidant. Hence, it can be employed in large scale production and may be used for targeted drug delivery to improve vascular dysfunction associated with hypertension, diabetes mellitus or atherosclerosis.

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CONFLICTS OF INTEREST

Nil.

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