Biosynthesis of Silver Nanoparticle using Murraya Koenigii and Acacia Gum

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ABSTRACT

Silver nanoparticles of murraya koenigii were synthesised using acacia gum as the stabilizing agent. Silver nitrate was used as the silver precursor while the plant served as a reducing agent. At 30 minutes of the reaction under constant stirring at 60 C, the suspension changed from yellow to reddish brown. UV readings at 430nm also confirmed the formation of nanoparticles. The nanoparticle was further used for antimicrobial studies. Microorganisms tested include Escherichia coli, Staphylococcus aureus and Pseudomonas aeruginosa. Significant difference (P< 0.05) was observed between the sensitivity of the nanoparticle and crude extract of the plants.

Keywords: silver nanoparticles, Murraya koenigii, synthesis, microorganisms and stabilizer

INTRODUCTION

Recently, biosynthetic methods have been investigated as a new way for the production of Ag-NPs. Biological methods are currently gaining importance because they are eco-friendly, cost effective, and don’t involve the use of any toxic chemicals for the synthesis of nanoparticles [1–3]. The biosynthesis of inorganic nanomaterials has been performed using eukaryotic organisms such as fungi to produce nanoparticles of gold and silver [4,5]. Synthesis of nanosilver particles using ascorbic acid and citrate as reducing agents has recently been reported [6]. An earlier study showed that Shewanella algae was found able to reduce gold ions, forming 10–20 nm gold nanoparticles [7]. There have been several reports on the synthesis of Ag-NPs using medicinal plants such as Basella alba, Helianthus annus, Saccharum officinarum, Oryza sativa, Sorghum bicolour, Zea mays [8], Aloe vera [9], Medicago sativa (Alfalfa) [10], Capsicum annum [11], Magnolia kobus [12], Cinnamomum camphora leaf [13], and Geranium sp. [14] for pharmaceutical and biological applications. A green synthesis of nanosilver particles using a methanolic extract of Eucalyptus hybrida leaves was reported [15]. Another study related to the synthesis of nanoparticles from Vitex negundo L. leaf extract in water solution with heat treatment [16]. A profile of bioactive compounds of Vitex negundo has been reported, which revealed that the plant contained a high amount of total phenolic compounds and flavonoids, which are considered to be potent natural antioxidants [17,18].

The objective of this research was to evaluate the antimicrobial activities of silver nanoparticles prepared from Murraya koenigii extract and acacia gum.

MATERIALS AND METHODS

Materials

Curry leaf (Murraya koenigii) Silver nitrate (Sigma Aldrich, USA), Gum Acacia (India), Nutrient broth

- Microorganisms: Staphylococcus aureus, Streptococcus pneumonia, Escherichia coli, Pseudomonas aeruginosa, Candida albicans

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Methods

Silver Reduction

Preparation of Murraya Koenigii Extract

Fresh leaves of Murraya koenigii were collected from the local farm in Uyo, Akwa Ibom State in Nigeria.

First the leaves were washed with tap water followed by distilled water and then finally cut into small pieces.

10g of finely cut leaves was weighed into 300ml Erlenmeyer and 100ml sterile double distilled water and boiled for 5 minutes after which it was allowed to stand for 24 hours.

The obtained extraction was filtered using Whatman No.1 filter paper and the filtrate was collected in 250ml Erlenmeyer flask and stored at room temperature for further use.

Preparation of Silver Nitrate Solution

1g of silver nitrate was weighed and transferred to a beaker. Double distilled water was added to make 100ml of 1%w/v of silver nitrate solution.

Preparation of Acacia Suspension

1% and 2.5% suspension of gum Acacia was prepared.

Preparation of Silver Nanosuspension

To the silver nitrate solution in the Erlenmeyer flask, 50ml of the plant extract (reducing agent) was measured and added to the silver nitrate solution and transferred to a hot plate with magnetic stirrer, after 5 minutes the 1%w/v acacia suspension was added to the above solution and the reaction was allowed for 30 minutes when the yellowish brown colour changes occurred indicating the formation of nanoparticles.

The above procedure was repeated using 2.5% w/v acacia suspension.

Antimicrobial Studies of Silver Nanosuspensions

Preparation of Nutrient Agar

- 2.8g of nutrient agar was weighed into a conical flask. 100ml of water was added and sterilized at 121°C in an autoclave and which the temperature was allowed to fall to 45°C before opening.
- The 10 Petri dishes were labeled with the different microorganisms with 2 plates for each microorganism.
- To each of the plates the microorganisms were inoculated to the plates after which the nutrient agar was introduced and allowed to cool.
- A hole was created in the middle of the plates using cork borer, 3μl of crude extract was introduced into the hole.
- The same procedure was carried out for the silver nanosuspension.
- The plates were closed and put into the incubator and incubated at a temperature of 37°C for 24 hours.
- After 24 hours, the zone of inhibitions were measured and recorded.

RESULTS AND DISCUSSION

Silver Nanoparticle Formation

It is well known that silver nanoparticles exhibit yellowish brown colour in aqueous solution due to excitation of surface plasma vibrations in silver nanoparticles (19). Silver nitrate is used as the precursor to produce the silver nanosuspension. Silver has good distinctive properties such as conductivity, catalytic and chemical stability.

The leave extract (Murraya koenigii) acted as the reducing agent. The acacia gum was used as a stabilizer to prevent aggregation of nanoparticles in the nanosuspension.
The aqueous silver ions when exposed to the herbal extracts were reduced in solution thereby leading to the formation of the silver particles. The time duration of change in colour varies from plant to plants. As the Murraya koenigii leaf extract was mixed with aqueous solution of the silver nitrate, it started to change colour from yellow to brown due to the reduction of silver ions which indicates the formation silver nanoparticles. The change was observed after 30 min. The flasks were observed periodically for change in colour from yellow to different shades of yellow to different shades of yellow and brown.

The appearance of yellowish dark brown confirms the existence of silver nanoparticles.

UV- Vis Spectroscopy

The silver nanoparticles were characterised by UV-visible spectroscopy, one of the most widely used techniques for structural characterization of silver nanoparticles (21).

The absorption spectrum of the yellowish-brown silver nanoparticle suspension prepared with the proposed method showed a surface Plasmon absorption band with a maximum of 430nm indicating the presence of spherical silver nanoparticles.

ANTIMICROBIAL STUDIES OF SILVER NANOSUSPENSION

The zone of inhibition of the green synthesized silver nanosuspension was examined using five microorganism of which consists of 2 gram positive micro organism (Staphylococcus aureus, streptococcus pneumoniae) and 2 gram negative organisms (Escherichia coli, Pseudomonas aeruginosa) and fungus (Candida albicans).

The crude leaf extract showed significantly (P<0.05) zone of inhibitions when compared to the silver nanosuspension containing the nanoparticles as seen in table 1 below

<table>
<thead>
<tr>
<th>Name of microorganism</th>
<th>Ampicillin (3 uL)</th>
<th>Fluconazole (3 uL)</th>
<th>Crude leaf extract (3 uL)</th>
<th>Leaf AgNO₃ (3 uL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>15</td>
<td>-</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>14</td>
<td>-</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>14</td>
<td>-</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>15</td>
<td>-</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>18</td>
<td>15</td>
<td>12</td>
<td>14</td>
</tr>
</tbody>
</table>

CONCLUSION

The present study included the bio reduction of silver ions through Murraya koenigii plant extract and testing for its antimicrobial activity. The aqueous silver ions when exposed to the extracts resulted in the synthesis of silver nanoparticles which was confirmed by the changes of colour of plant extract from yellow to yellowish brown.

These ecofriendly silver nanoparticles were further confirmed by using UV-Vis spectroscopy. The results indicated that silver nanoparticles have good antimicrobial activity against different microorganisms. Silver nanoparticles are capable of rendering high antibacterial and antifungal efficacy and hence has a great potential in the preparation of drugs used against infection.

The result also suggest that silver nanoparticles can be used as effective growth inhibitors in various microorganisms making them applicable to diverse medical devices and antimicrobial control systems.

REFERENCES

Tenderwealth Clement Jackson “Biosynthesis of Silver Nanoparticle using Murraya Koenigii and Acacia Gum”


