ANTIBACTERIAL ACTIVITY OF NANOPARTICLES SYNTHESIZED FROM CORIANDRUM SATIVUM LINN FRUIT

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ABSTRACT
The antibacterial activity of methanol extract and nanoparticle synthesized using methanol extract of fruit of Coriandrum sativum Linn were tested against Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp. The in vitro antibacterial activity was performed by agar well diffusion method. The zone of inhibition in mm was compared with the standard drug i.e. ciprofloxacin. The zone of inhibition for methanol extract were found to be 11 mm,10 mm,7 mm,none and 9 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The zone of inhibition for Silver nanoparticles were found to be 12 mm,12 mm,12 mm,11 mm and 12 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The zone of inhibition for Zinc nanoparticles were found to be 11 mm,8 mm,11 mm, none and 7 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The zone of inhibition for magnesium nanoparticles were found to be 7 mm,10 mm,8 mm, 8 mm and 8 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The minimum inhibitory concentration[MIC] for Bacillus subtilis was 2 mg, 100,250 and 50 µg/ml; MIC for Staphylococcus aureus was 2 mg,100,100 and 250 µg/ml; MIC for Proteus vulgaris was 2 mg, 100, 500 and 100 µg/ml; MIC for E.coli was none, 100, none and 100 µg/ml and MIC for Klebsella spp was 2 mg,50, 500 and 100 µg/ml for methanol extract, silver nanoparticle, zinc nanoparticle and magnesium nanoparticle...
respectively suggesting the antibacterial activity of *Coriandrum sativum* and nanoparticle synthesized.

**KEYWORDS:** *Coriandrum sativum*, silver nanoparticles, zinc nanoparticle, magnesium nanoparticle, antibacterial activity, zone of inhibition, minimum inhibitory concentration.

**INTRODUCTION**

*Coriandrum sativum* (Apiaceae) is important medicinal plant also known as coriander, cilantro, Arab parsley, Chinese parsley and Dhania.\(^1\) Although, all parts of the plant are edible, its fresh leaves and dried seeds are most frequently used in many cultures.\(^2\) *C. sativum* is widely used in traditional medicine to treat anxiety, dizziness, headache, edema, fever, digestive disorders, respiratory diseases, allergies, and burns.\(^3, 4\) The fruits are used as astringent, anthelmintic, emollient, stomachic, antibilious, digestive, appetizer, constipating, diuretic, antipyretic, refrigerant, tonic, expectorant, anodyne, antidiabetic and dyspepsia. The phytochemical screening of *Coriandrum sativum* showed that it contained essential oil, tannins, terpenoids, reducing sugars, alkaloids, phenolics, flavonoids, fatty acids, sterols and glycosides. It also contained high nutritional values including proteins, oils, carbohydrates, fibers and wide range of minerals, trace elements and vitamins. The previous pharmacological studies revealed that it possessed anxiolytic, antidepressant, sedative-hypnotic, anticonvulsant, memory enhancement, improvement of orofacial dyskinesia, neuroprotective, antibacterial, antifungal, anthelmintic, insecticidal, antioxidant, cardiovascular, hypolipidemic, anti-inflammatory, analgesic, antidiabetic, mutagenic, antimutagenic, anticancer, gastrointestinal, deodorizing, dermatological, diuretic, reproductive, hepatoprotective, detoxification and many other pharmacological effects.\(^5, 6\)

Silver nanoparticles were synthesized using methanol and aqueous extract of fruit of *C. sativum* and its antioxidant activity were reported.\(^7, 8\) However there is no report on antibacterial activity of nanoparticle synthesized from this plant. In the light of the above information, the present investigation was under taken to evaluate the antibacterial potential of methanol extract and nanoparticle synthesized from the fruit of *C. sativum* Linn.

**MATERIALS AND METHODS**

**Plant material:** The *Coriandrum sativum* fruits were collected from local market in Bangalore, Karnataka, India and it was identified and authenticated by Botanist, Natural Remedies Pvt Ltd., Bangalore. A voucher specimen was deposited in The Oxford College of
Pharmacy, Bangalore. The fruits were dried in shade and powdered coarsely, passed through sieve no. 40 and stored in air tight container for further use.

**Preparation of fruit extract:** Coarsely powdered fruits of *C. sativum* 50 g were boiled with Methanol [200 ml] for 30 minutes and filtered and make up the volume to 100 ml with methanol. The solution is preserved for further use.

**Synthesis of silver, zinc and magnesium nanoparticles**

1mM aqueous solution of silver nitrate was prepared for synthesis for silver nanoparticles. 9 ml of 1 mM solution was added to 0.2 ml methanol extract of the fruit of *C. sativum* to obtain silver nanoparticles. Zinc nanoparticles were prepared by adding zinc acetate dihydrate (0.219 g) add 0.2 ml of methanol extract. 2 M sodium hydroxide was added and pH was adjusted to 12 and stirred for 2 hours, filtered, washed with water, then with ethanol and dried at 60°C under vacuum. Magnesium nanoparticles were prepared by adding magnesium chloride solution (300 ml) and 20 ml of methanol extract and stirred well. 1 M sodium hydroxide was added and pH was adjusted to 12 - 14 and stirred for 2 hours, filtered, washed with water, then with ethanol and dried at 60°C under vacuum.

**Lyophilization procedure for the reluctant sample mixture**

After the desired reaction period, the solution containing nanoparticles were lyophilized. The reluctant samples were centrifuged 10,000 rpm for 15 minutes. After 15 minutes, discard the supernatant and collected the pellet and freeze dried. The lyophilized samples were kept in the freezer at 4°C for further analysis.

Methanol extract was used as 500 µg/ml, 1 mg/ml, 2 mg/ml and 5 mg/ml concentration in DMSO for antibacterial studies. Nanoparticles were suspended in DMSO to give 10, 50, 100, 250, 500 and 1000 µg/ml concentrations.

**Microorganisms used**

All the microbial cultures, used for antimicrobial screening were procured from National centre for Industrial Microorganisms (NCIM), Pune, India and from The Oxford College of Science, Bangalore. The bacterial culture were maintained on Muller Hinton agar slants which were stored at 4°C.

**Antibacterial activity:** Determination of minimum inhibitory concentration (MIC): The extract and nanoparticles were screened for their antibacterial activity *in vitro* by Agar well
diffusion method\textsuperscript{10} using *Bacillus subtilis*, *Staphylococcus aureus*, *Proteus vulgaris*, *Escherichia coli* and *Klebsella spp* as test organism. Agar cultures of the test microorganisms were prepared. Three to five similar colonies were selected and transferred to 5 ml broth with a loop and the broth cultures were incubated for 24 h at 37\textdegree C and suspension was checked to provide approximately 10\textsuperscript{10} colony forming units per ml. 0.1 ml of organism’s suspension were spread evenly on the agar plates. For screening, well were made in each plate with borer and 50 µl of different concentration of extract, nanoparticle and standard were added to each well. DMSO solvent was used as negative control. The plates were incubated at 37\textdegree C for 24 h. After incubation for 24 h, the results were recorded by measuring the zones of inhibition surrounding the well and the lowest concentration of each extract which is showing inhibition of growth of bacteria was determined as MIC. Ciprofloxacin (1000 µg/ml) was used as standard.

**RESULTS AND DISCUSSION**

Table 1: MIC values of methanol extract, silver nanoparticle, zinc nanoparticle and magnesium nanoparticle synthesized from *Coriandrum sativum*

<table>
<thead>
<tr>
<th>Microorganism used</th>
<th>MIC with concentration of extract [µg/ml]</th>
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<tbody>
<tr>
<td></td>
<td>Methanol extract</td>
</tr>
<tr>
<td><em>Bacillus subtilis</em></td>
<td>2000</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>2000</td>
</tr>
<tr>
<td><em>Proteus vulgaris</em></td>
<td>2000</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>-</td>
</tr>
<tr>
<td><em>Klebsella sp.</em></td>
<td>2000</td>
</tr>
</tbody>
</table>

Table 2: Zone of inhibition values (mm) in methanol extract, silver nanoparticle, zinc nanoparticle and magnesium nanoparticle synthesized from *Coriandrum sativum*

<table>
<thead>
<tr>
<th>Microorganism used</th>
<th>Zone of inhibition (mm) of extracts and standard</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Methanol extract</td>
</tr>
<tr>
<td><em>Bacillus subtilis</em></td>
<td>11</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>10</td>
</tr>
<tr>
<td><em>Proteus vulgaris</em></td>
<td>7</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>-</td>
</tr>
<tr>
<td><em>Klebsella sp.</em></td>
<td>9</td>
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</tbody>
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The antibacterial activity of *Coriandrum sativum* methanol extract and nanoparticles synthesized were studied by employing well diffusion method against *Bacillus subtilis*, *Staphylococcus aureus*, *Proteus vulgaris*, *Escherichia coli* and *Klebsella spp*. The results of minimum inhibitory concentration and zone of inhibition are given in Table 1 and Table 2.
It is clear from the Table 1 and 2, methanol extract and nanoparticles synthesized were effective against Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp. The zone of inhibition for methanol extract were found to be 11 mm, 10 mm, 7 mm, none and 9 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The zone of inhibition for Silver nanoparticles were found to be 12 mm, 12 mm, 12 mm, 11 mm and 12 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The zone of inhibition for Zinc nanoparticles were found to be 11 mm, 8 mm, 11 mm, none and 7 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The zone of inhibition for Magnesium nanoparticles were found to be 7 mm, 10 mm, 8 mm, 8 mm and 8 mm for Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli and Klebsella spp respectively. The minimum inhibitory concentration [MIC] for Bacillus subtilis was 2 mg, 100, 250 and 50 µg/ml; MIC for Staphylococcus aureus was 2 mg, 100, 100 and 250 µg/ml; MIC for Proteus vulgaris was 2 mg, 100, 500 and 100 µg/ml; MIC for E. coli was none, 100, none and 100 µg/ml and MIC for Klebsella spp was 2 mg, 50, 500 and 100 µg/ml for methanol extract, silver nanoparticle, zinc nanoparticle and magnesium nanoparticle respectively suggesting the antibacterial activity of Coriandrum sativum and nanoparticle synthesized.

CONCLUSION

Silver nanoparticles are very effective when compared to methanol, zinc and magnesium nanoparticles. The above experiment confirms the antibacterial activity of methanol and nanoparticles synthesized from this.

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REFERENCES


