INTRODUCTION
Nanotechnology is an emerging branch of applied sciences, which contribute for betterment of human life. It involves nanoparticles of 1-100nm in size. Nowadays, Metal Nanoparticles (MNPs) are in limelight as they are used as detector, catalyst, surface coating agent and antimicrobials. Silver, gold, zinc and palladium are the metals used for preparation of MNPs. In that silver nanoparticles (AgNPs) gained much attention because of its antimicrobial property. MNPs can be prepared by chemical method using solvent like ethylene, glycol and reducing agents like ascorbic acid, hydrazine, sodium borohydride, trisodium citrate. Chemical method has limitations like low yield and requires high energy complicated purification process. Moreover, chemical method is not eco-friendly. So, efforts were geared up to search for clean and safer method, consequently chemical method was replaced by biological one. Nanoparticles of silver, gold, zinc and palladium were synthesized using green synthesis. Biological material is used in green synthesis for synthesis of nanoparticles. It includes use of bacteria, fungi, plants and animals particularly mammals. Use of animals has restriction due to ethical constraints and productivity issues. Bacteria and fungi requireaseptic condition, high cost of isolation and maintenance in culture media. Hence use of plant material is the best option for synthesis of metal nanoparticles (MNPs). It includes use of leaf, bark and seeds for synthesis of MNPs. Chandran and colleagues reported that synthesis of AgNPs using plant material is superior to chemical reducing agents. Literature survey reveals that AgNPs has antimicrobial activity due to binding of silver ions to electron donor group of biological molecules such as sulphur, Nitrogen, oxygen present in protein of enzyme resulting into losing its activity. Another report suggests that free radicle generated by AgNPs breaks function of cell membrane. Of course, mechanism of antimicrobial activity by AgNPs might be issue of debate; little
is understood about its mechanism. In the present study, AgNPs were prepared using leaf extract of Lantana camara. This is because of its easy availability and medicinal value in tribal community to treat rheumatism, wound and asthma. Synthesized AgNPs were characterised by UV-Visible and FTIR spectroscopy. Its antibacterial activity was also checked on one representative of each gram positive and gram negative bacteria. Method followed in the present study is simple, cost effective. Above all, AgNPs synthesized can be used as an antimicrobial agent.

Experimental Details

Preparation of Leaf Extract

Fresh leaves of Lantana camara were collected for experimental purpose. Initially leaves were washed with tap water, then twice with double distilled water. Further, they were chopped into pieces. 10g chopped leaves were taken in beaker containing 70 cm³ double distilled water. This mixture was heated in water bath at 80°C for 20 minutes. It was filtered through muslin cloth to remove coarse biological material. It was then filtered through whatmann filter 1. Final volume was made to 100 cm³. This leaf extract was used for preparation of silver nanoparticles (AgNPs) and for antimicrobial study purpose. It was kept at 4°C and used within one week. Method reported in literature for synthesis of AgNPs using seed extract was used with modification on trial and error basis. 8, 9

Synthesized AgNPs were characterised by UV-Visible Spectral analysis. Antibacterial activity of AgNPs was also studied in terms of zone of inhibition in mm.

RESULTS AND DISCUSSION

AgNPs Synthesized using leaf extract of Lantana camara was characterised by UV-Visible and FTIR spectroscopy. Antimicrobial activity of AgNPs was also studied.

UV-Visible Spectral analysis

When leaf extract of Lantana camara was mixed with 1mM AgNO₃ in 1:9 proportions, colour was changed from colourless to yellow to reddish brown. Formation of stable reddish brown...
colour is due to the surface Plasmon vibration, a unique optical property of noble metals (Silver)\textsuperscript{10}. This is shown in fig B1 and B2. Further, it was confirmed by UV-Visible spectra taken in the range of 200-800nm. UV-Visible spectra are shown in fig. 3. Formation of maximum absorbance at 450 nm indicates confirmation of AgNPs\textsuperscript{11}. In the UV region overlapping of plot of both leaf extract and AgNPs are observed, but in visible range, both has been segregated indicating confirmation of synthesis of AgNPs. FTIR spectra were studied in the range of 4000-600 cm\textsuperscript{-1}. As number of peaks are found in FTIR spectra indicating complex nature of biological compound. IR peak at 3276 cm\textsuperscript{-1} shows N-H stretching indicating primary amine. Peak at 2963 cm\textsuperscript{-1} shows stretching of O-H group indicating presence of carboxylic group. In the same way peak at 2092 cm\textsuperscript{-1} shows stretching of C=O group, 1632 cm\textsuperscript{-1} shows bending of N-H group, 1222 cm\textsuperscript{-1} shows stretching of C-N group indicating presence of aromatic amines. From this, it can be revealed that biological molecules are various amino acids, which polymerise to form protein and even enzyme also. These biological molecules not only give stability to AgNPs, but also are responsible for antimicrobial activity of AgNPs.

\textbf{FTIR Spectral Analysis}

AgNPs synthesized from leaf extract were analysed for FTIR spectral analysis using its dry power. FTIR spectra are shown in Fig 4. Stability of synthesized AgNPs and Chemical nature of biological molecule are analysed by FTIR spectra. Again, biological molecules present in leaf extract were responsible for reduction of Ag\textsuperscript{+} to Ag\textsuperscript{0} during formation of AgNPs. It can be analysed by various functional groups from corresponding peaks in FTIR. Wave number, vibrations and corresponding functional groups are shown in Table 1.

\textbf{Table 1

<table>
<thead>
<tr>
<th>Wave number</th>
<th>Vibrations</th>
<th>Functional groups</th>
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<tbody>
<tr>
<td>1222.65</td>
<td>C-N stretch</td>
<td>Aromatic amine</td>
</tr>
<tr>
<td>1287.25</td>
<td>C-X</td>
<td>Alkyl halide</td>
</tr>
<tr>
<td>1404.8</td>
<td>M-CS</td>
<td>Transition metal thio carbonyl</td>
</tr>
<tr>
<td>1634.38</td>
<td>N-H bending</td>
<td>Primary amine</td>
</tr>
<tr>
<td>2092.32</td>
<td>C-O stretching</td>
<td>Terminal C-O covalently bonded with metal atoms</td>
</tr>
<tr>
<td>2312.12</td>
<td>P-H phosphine</td>
<td>Phosphorus function</td>
</tr>
<tr>
<td>2360.44</td>
<td>Si-H silane</td>
<td>Silicon function</td>
</tr>
<tr>
<td>2384.55</td>
<td>P-H phosphine</td>
<td>Phosphorus function</td>
</tr>
<tr>
<td>2963.09</td>
<td>O-H stretching</td>
<td>Carboxylic acids/alkyl group</td>
</tr>
<tr>
<td>3276.47</td>
<td>N-H stretching</td>
<td>Primary amine</td>
</tr>
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\textbf{Antimicrobial activity study}

Synthesized AgNPs using leaf extract of Lantana camara was tested for its antimicrobial activity. Here well diffusion method was used. Representative of human pathogen Staphylococcus aureus (Gram Positive) and Escherichia coli (Gram negative) were tested for antimicrobial activity of AgNPs. As explained in antimicrobial assay two plates each containing two wells, one for bacteria and another for leaf extract were used to test antibacterial activity. Observation was counted in terms of diameter of zone of inhibition in mm after incubation of 24 hours at 37°C. Results are shown in Table 2. In both of the plate’s zone of inhibition was not found around the wells where leaf extract was loaded, while it was 8 mm for \textit{E. coli} and 5 mm for \textit{S. aureus}. Obtaining zone of inhibition means some chemical has been diffused around well leading to prevention of growth of bacteria. Of course that chemical is nothing but silver nanoparticles (AgNPs). Mechanism of antimicrobial activity may be issue of debate. Probable explanation lies in the thickness of cell wall of both the bacteria. Peptidoglycan layer in cell wall of gram positive bacteria is thicker than gram negative bacteria. \textit{S.aureus} is gram positive showing 5mm diameter of zone of inhibition, while \textit{E. coli} is gram negative showing 8mm diameter of zone of inhibition. Thick peptidoglycan in \textit{S.aureus} creates difficulty in penetration of AgNPs through cell wall and hence diameter of zone of inhibition is less than gram negative \textit{E. coli} bacteria. Literature survey suggests that silver ions gets attached to negative part of bacterial cell wall and enters inside the cell inhibiting protein (enzyme) involving DNA replication. As DNA synthesis is hampered, metabolism of cell get disturbed leading to death bacterial cell.\textsuperscript{12, 13} Again, it is speculating that plant Lantana...
**Table 2**

<table>
<thead>
<tr>
<th>Plant extract - diameter of zone of inhibition in mm</th>
<th>Escherichia coli</th>
<th>Staphylococcus aureus</th>
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</thead>
<tbody>
<tr>
<td>AgNPs- diameter of zone of inhibition in mm</td>
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<td></td>
<td>08</td>
<td>05</td>
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**CONCLUSION**

Synthesis of AgNPs using leaf extract of *Lantana camara* is simple, safe, cost effective and one step eco-friendly method. Biological contents in leaf extract acts as bio-reductant, which reduces Ag⁺ into Ag⁰ in AgNPs and gives stability to AgNPs. Further, there is no need addition of any special chemicals or surfactants. Easy availability of leaf of *Lantana camara*, its medicinal value, simple and easy steps of the synthesis of AgNPs are the some highlights of this method. In a nutshell, synthesized silver nano particles were characterised by UV-Visible and FTIR spectral analysis. Results of characterisations are pretty good. Above all, its results of antimicrobial activity is speculative one and can be better alternative to antibiotics in near future.

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**References**


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