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Synthesis Of Copper Oxide Nanoparticles From Tulsi and Neem Leaf Extract And Study their antibecterial effect.

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Abstract:

This research paper explores the green synthesis of copper oxide nanoparticles using leaf extract as a reducing agent and investigates their antibacterial properties. The eco-friendly synthesis method offers a sustainable approach to nanoparticle production, while the antibacterial effects of copper oxide nanoparticles make them promising candidates for applications in the field of antimicrobial materials. The study involves the characterization of the synthesized nanoparticles and the evaluation of their antibacterial activity against common pathogenic bacteria. The results demonstrate the potential of green-synthesized copper oxide nanoparticles as effective antibacterial agents for various biomedical and environmental applications. The synthesis process is facile, cost-effective, and environmentally benign, offering an alternative to conventional chemical methods. The production of the copper nanoparticles through bio-reduction of copper ions by the Tulsi and neem leaf extract and their antibacterial test .Characterization techniques such as UV-Vis spectroscopy were employed to analysed the structural and morphological properties of the synthesized CuO nanoparticles. The results indicate the successful formation of CuO nanoparticles with distinct morphologies and crystalline structures. Furthermore, the potential applications of these green-synthesized CuO nanoparticles in various fields such as catalysis, electronics, and biomedicine are discussed, highlighting their promising prospects as sustainable nanomaterials. The nanoparticles was carried out by agar disc diffusion method against microorganisms.

Keywords: Copper oxide nanoparticles, Green synthesis, Leaf extract, Antibacterial activity, Biomedical applications

1. Introduction

The emergence of antibiotic-resistant bacteria poses a significant threat to public health, highlighting the need for new strategies to combat microbial infections. Nanoparticles have shown great potential as antimicrobial agents due to their unique physicochemical properties and high surface area-to-volume ratio. The CuO nanoparticles were synthesised by bio-reduction of Copper ion through Tulsi and Neem extract. Copper oxide nanoparticles, in particular, have gained attention for their excellent antibacterial activity against a wide range of pathogens. Green synthesis methods utilizing plant extracts offer a sustainable and cost-effective approach to producing nanoparticles with enhanced antibacterial properties.

2. MATERIALS AND METHODS Materials:

2.1 leaf and Chemicals used:

Green synthesis, utilizing natural sources such as plant extracts, microorganisms, and biopolymers, has emerged as a promising alternative to conventional chemical methods. Green synthesis offers several advantages including simplicity, cost-effectiveness, scalability, and environmental friendliness. Among the various natural sources, plant extracts have gained considerable attention as reducing and capping agents for nanoparticle synthesis due to their abundance and diversity. The synthesis process is facile, environmentally benign, and offers a sustainable approach towards nanoparticle production. Because plants contain a wide variety of bioactive substances, entire plants or various part of plant can be used in the synthesis of nano particles i.e. leaf, stem, root , flower and seeds. We have used leaf extract of Tulsi and Neem to synthesied copper nanoparticles.

Neem : It is a tree in mahogany family. It is used in controlling blood sugar level and also clean blood. Products from Neem are believed to be anthelmintic, antifungal, antidiabetic, antibacterial, antiviral.

Tulsi : Ocimum sanctum (local name Tulasi) is a traditional medicinal plant of India has a source of bio-reduction and stabilizers. The constituent of Tulsi are alkaloids, glycosides, tannins, saponins and aromatic compounds. It is used in the treatment of headaches, coughs, diarrhea, constipation, worts, worms and kidney malfunctions.

This research looked into the effectiveness of Tulsi and Neem extract derived CuONPs against antimicrobial effect.Copper Nitrite CuNo2 .2H2O (98 % Pure) from Indian Platinum Pvt Ltd., of analytical grade, were purchased and

used without further chemical treatment and purification. De-ionized water was obtained from Moradia Brothers Chem Pvt. Ltd., India

2.2 Preparation for Copper Nanoparticles (CuNPs):
The neem and Tulsi leaves were collected and washed several times with water and rinsed with deionized water for the removal of impurities. In copper nanoparticles synthesis, the leaf extract is mixed with the aqueous solution of Cu (NO3)2.3H2O in 4:6 proportion. 25ml of prepared Neem leaf and Tulsi leaf extract is mixed with 60ml of Cu(NO3)2. 3H2O . The mixture was stirred continuously at room temperature for 3 hours until color change was observed, indicating nanoparticle formation. The resulting solution was centrifuged at 8000 rpm for 15 minumts to collect the CuO nanoparticles. The collected nanoparticles were washed with deionized water and ethanol to remove impurities. Finally, the CuO nanoparticles were dried a shown in Fig 1.

2.3 Characterization
The synthesized CuO nanoparticles were characterized using various techniques.The UV-Vis spectrum of the synthesized CuO nanoparticles exhibited a characteristic absorption peak at around 256 nm, as shown in Fig 2(a) confirming the formation of CuO nanoparticles and We got energy band gap for synthesis nanoparticles is 1.73ev as shown in Fig 2(b) which is good agreement with available data.

2.4. Antimicrobial Activity of copper nanoparticles:
The disk diffusion method was used to study the antibacterial activity of CuO NPs against gram-positive and gram-negative pathogenic bacteria such as B. subtilis, S. aureus, and E. coli as shown in Fig. 3. In laboratories, nutritional broth has been commonly utilized for sustaining live pathogens of bacteria cultivated overnight at 37 °C.The fresh bacterial culture was swiped evenly on sterilized Petri dishes with nutrient agar. On the clean disks, synthesized CuO NPs (15, 20 and 25 µL) and an leaf extract (25 µL) was poured. As a positive control, 25 mL of chloramphenicol disks were maintained, and all plates were incubated overnight at 37 °C for 24–48 h to identify the development of bacterial inhibition zone surrounding the surface of the disk.

3 Result and Discussion :
By green synthesis method we have successfully grown CuO nano particles. From Optical study we got energy band gap for synthesis nanoparticles is 1.73ev which is good agreement with available data. The results revealed that the CuO NPs has showed antibacterial activity against the bacteria, Bacillus subtilis. It has recorded 13.0 mm zone of inhibition at the concentration of 25 µl. However, there was no zone recorded for the bacteria, Escherichia coli and Staphylococcus aureus. The antibacterial activity mechanism of copper oxide nanoparticles is dependent on the size, structure, and concentration of copper oxide. The three major ways that antibacterial activity follows are as follows. (1) Degeneration of the cell wall and membrane, (2) Infiltration and cellular disruption, and (3) Oxidation stress.

3 .Conclusion
The green synthesis of copper oxide nanoparticles was efficaciously performed using copper Nitrate as a precursor and Neem and Tulsi plant leaf extract as a powerful reducing/oxidizing chelating agent. The applied biosynthetic technique is undemanding and easily biodegradable due to the presence of phytochemicals and is carried out in a shorttime. The visible green color indicates the production of copper oxide nanoparticles, further demonstrating the reduction of Cu ions in copper oxide nanoparticles using ultraviolet-visible spectroscopy. The ultraviolet spectroscopic absorption peak is at 236 nanometers Characterization studies confirmed the formation of crystalline CuO nanoparticles with distinct morphological and structural properties. The synthesized CuO NPs has antibacterial activity against Bacillus subtilis, Escherichia coli, and Staphylococcus aureus. According to the results, CuO NPs is more effective than the other two against Bacillus subtilis. This study suggests that the synthesized CuO NPs could be employed in the biomedical, fuel cell, battery and food storage industries. However, more study should be done on minimize the toxicity of CuO NPs though maintaining and improving their biological efficiency in order to promote the biomedical uses of CuO NPs.

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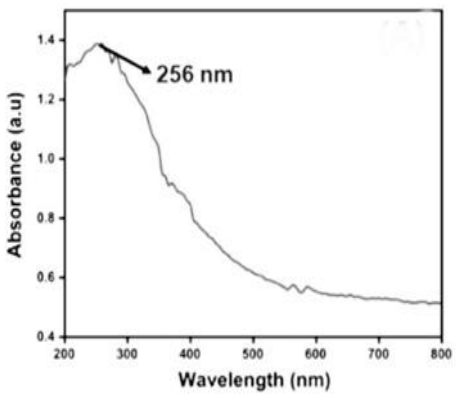
Fig. 1. CuO nanoparticles

Fig 2 Uv -Visible spectroscopy

Fig 2(a) UV–VIS absorption spectrum. **Fig 2(b) Band gap energy of CuO nanoparticles.**



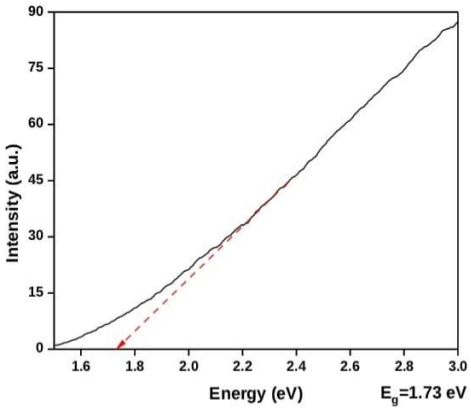


Fig.3. Antimicrobial effect of CuO nanoparticles