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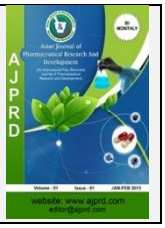

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Research Article

A current Research on the Green Synthesis of Copper Nanoparticles from Herbal Extract

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A B S T R A C T

The study aims to find out the effectiveness of the combination of citral and curcumin as antifungal compounds. *Lemongrass* (Cymbopogon citratus) is a valuable family of grass known due to its flavoring, medicinal, and fragrance application. Haldi (Turmeric) scientifically known as *Curcuma longa* belongs to familthey *Zingiberaceae.* Its polyphenolic compound curcumin has been showing a variety of *antifungal investigations* due to extensive traditional uses and very low side effects.Turmeric has beenutilized in traditional medicine for various diseases counting diabetes, hepatitis, hemorrhoids, hysteria, indigestion, skin disease, inflammation, anorexia, hepatic disorders, cough, and sinusitis. In this formulation substudy combination of two bioactive oils is considered to form an effective *antifungal* spray preparation. The spray preparation is helpful to achieve fast absorption of the drugs through the *transdermal* way of drug administration. The effectiveness and activity rate of spray preparation is more beneficial. *Lemongrass* oil and curcumin are dissolved in ethanol to form a stable, safe, and effective spray formulation.

Keywords: *Lemongrass, Zingiberaceae,* Transdermal, Antifungal

A R T I C L E I N F O: Received 22 April 2023; Review Complete 15 June 2023; Accepted 19 July 2023; Available online 15 Aug. 2023

Cite this article as:

Patil T, Parab M, Bairagi S, Takarkhede S, A current Research on the Green Synthesis of Copper Nanoparticles from Herbal Extract, Asian Journal of Pharmaceutical Research and Development. 2023; 11(4):46-51. DOI: http://dx.doi.org/10.22270/ajprd.v11i4.1289

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INTRODUCTION

The creation of environmentally friendly and human-friendly sustainable technologies relies heavily on nanoparticles. Plant-based nanoparticle synthesis is a green chemistry strategy that links plant biotechnology and nanotechnology. Numerous chemical, biological, and physical processes can produce nanoparticles (NPs). Simple prokaryotic bacterial cells are used in bio-nanotechnology (also known as "green synthesis") to create nanoparticles for complex eukaryotic plants because they don't use or produce any toxic chemicals and can easily handle higher production rates because they don't need energy, temperature, or pressure. NPs may be produced by microorganisms or therapeutic plants. For NP biosynthesis, green synthesis is carried out using natural resources like microorganisms and herbs. Because the plant phytocompounds provide antioxidant and antibacterial activities for the synthesized nanoparticles, the therapeutic value of the NPs produced is increased. Metal ions are bio-reduced to form nanoparticles using plant extracts. Biosynthesized nanomaterials have successfully controlled various endemic diseases with minimal side effects. The use of natural products has become more popular, and active plant extracts are frequently tested for the development of new medicines. As a result, green synthesis, which uses biological molecules derived from plant sources in the form of extracts, outperforms chemical techniques [1].

NANO-SCIENCE

Green nanotechnology is a subset of nanotechnology that improves the sustainability of processes that have an adverse impact on the environment. Making environmentally friendly Nano-products and using them to promote sustainability are both included. Green nanotechnology aims

to reduce potential risks to the environment and human health associated with the use of nanotechnology products and to promote the replacement of current products with more environmentally friendly nano-products. Green nanotechnology is used in water treatment, solar cells, and nano remediation, among other applications. The word "Nano," which means "a billionth," is derived from the Greek word "Dwarf." The diameter of a hydrogen atom is 10 times smaller than that of a nanometer, which is one billionth of a meter, or 250 millionth of an inch, or about 1/80,000 of the diameter of a human hair. It improves the material's speed, size, durability, and strength. Prof. Norio Taniguchi of Tokyo Science University first used the term "Nanotechnology" in 1974 to describe the precise manufacture of materials with nanometer tolerances. Unknowingly, Drexler used the term in his 1986 book "Engines of Creation: The Coming Era of Nanotechnology"[2].

Drug-Delivery Technique using Dendrimers.

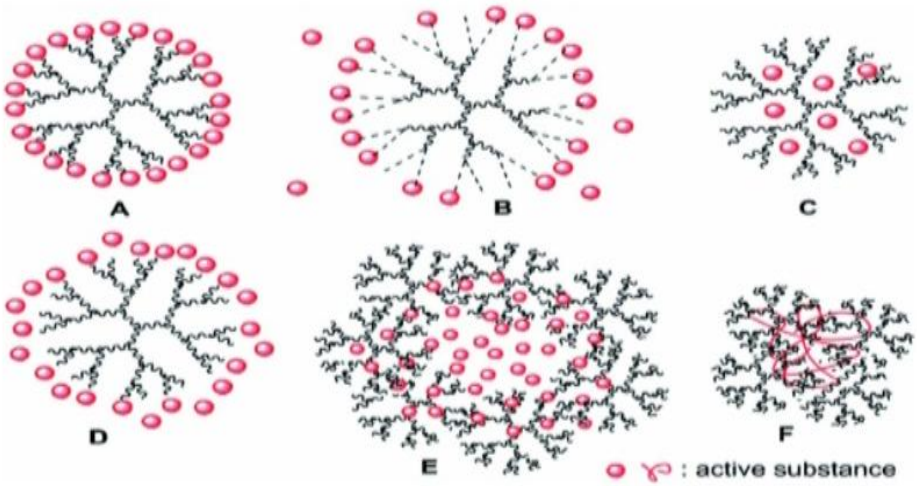

Figure 1: Drug delivery technique using Dendrimers.

Dendrimers are highly branched, star-shaped macromolecules with nanometer-scale dimensions shown in the figure. Dendrimers are specially designedand manufactured for a vastvariety of applications, including thetreatmentofcancer, drug delivery, catalysis, gene transfixion, and energy harvesting and photo activity. Dendrimers carrying different materials and their branches can do several things at one time, such as perceiving diseased cells, diagnosing diseased states (including cell death), drug delivery, describing the location and reporting events of therapy [3].

Material and Methods

Due to their medicinal qualities and properties, many plants have been used in the production of nanoparticles. In this article, we synthesize copper nanoparticles (CuNPs) using extracts from wild cherry bark, lemon grass, and moringa leaves. Due to its medicinal properties and advantages for health, it has been used for centuries.

The Moringaceae family includes Moringa oleifera. The high antioxidant activity and significant antibacterial activity of M. oleifera are related to its medicinal significance. There have been claims that M. oleifera can create terpenoids and flavonoids, two examples of natural bioactive substances. These substances have been found to have antimicrobial potential against pathogenic microorganisms [4].

Citratus Cymbopogon (DC)Stapf, more commonly known as lemongrass is a member of the Poaceae family and contains several bioactive substances, including lemon, citral, mineral, and iso geranial, as well as geraniol, geranyl acetate, citronellal, and citronellol. These substances endow lemon grass with a variety of pharmacological effects, such as antifungal, antibacterial, antiviral, anticancer, and antioxidant properties[5].

Prunus avium L. also referred to as wild cherry barkis a member of the Rosaceae family. phenolic substances found in the bark of wild cherry (Prunus avium L.), both alcoholic and aqueous extracts. While none of the samples demonstrated antibacterial activity against Escherichia coli, alcoholic extract demonstrated superior antibacterial properties than infusion against Staphylococcus aureus, a representative gram-positive bacterium[6].

Because they are a promising alternative for the future, CuNPs are replacing gold and silver nanoparticles. However, CuNPs are also highly oxidant, have a high melting point and electrical conductivity, low electrochemical migration behaviour, are small and oxidation-resistant, have a high surface-to-volume ratio, and are inexpensive. Because of their superior strength, excellent optical, electrical, and thermal properties, use as sensors and catalysts, and bactericidal effect as antimicrobial and antifungal agents, copper nanoparticles are among the metal nanoparticles that have the potential to be attractive. Due to its high toxicity to bacteria (including E. coli, Staphylococcus aureus, and Pseudomonas aeruginosa) and lack of toxicity to animal cells, copper is regarded as a highly effective bactericidal metal. It is also regarded as being safe for use around people

in applications like food packaging and water treatment. Because copper nanoparticles are less expensive than noble metals like Ag, Au, and Pt, they are appealing to many researchers.

Materials

All the reagents used in this experiment are Copper sulphate, NaOH as an indicator and Distilled Water.

Filtration was established using Whatman no 1 filter Papers. Glasswares used for the complete reaction were washed with distilled water and dried in a hot air oven.

Preparation of leaf extract

Plant leaf extracts of Moringa leaf, lemon grass leaf and wild Cherry Bark wereprepared separatelyby decoctionmethod. Firstwash the leaves and Bark Surface with running tap water followed by distilled water. The leaves and barkWere then dried in the oven and crushed in powder form. To prepare the Plant broth solution, 5 g powders of Moringa and lemon grassleaves and wild Cherry bark were taken in a separate 250 ml beaker with 100 ml of distilled water. Stirred vigorously andboiled the solution for 20 minutes at 80°C. The extract was filtered Through Whatman No. 1 filter paper. The filtrate thus obtained was Stored in the refrigerator for further experiments[7].

Synthesis of copper nanoparticles

Physical and chemical synthesis

The preparation of metal nanoparticles should be done by using the appropriate method to obtain a particulate size of nanoparticles, as the use of a particular method reduces the size of the particle and stabilizes it. Copper nanoparticles are gently in attention due to their profuse amount availability and low cost in comparison to gold and silver, so large-scale production of copper nanoparticlesis using in various physical and chemical methods the major method to produce nanoparticles is the physical method and the chemical method state liquid state, gas phase, biological method and many others [8].

Green synthesis

Green synthesis is an environmentally friendly method presenting different way without using toxic or harmful chemical an alternative method for the synthesis of nanoparticles is "Green synthesis" which is a very simple method and cost-effective and reproducible and give a stable product. The bottom-up approach for green synthesis is similar to that of chemical reduction of NPs, the difference is chemical reducing agents are replaced with extracts of plant leaves and bark of trees. This method does not require high energy, pressure, temperature or any toxic chemical.

Synthesis of CuNPs using Moringa and lemon grass leaf extracts and wild Cherry Bark extracts

Prepare 20mg of Copper sulphate solution and Do the titration using extracts as a reducing agent. It shows the color change which indicates the formation of CuNPs. Moringa leaves extract changesitscolorto Dark Brown. Lemon grass extract changes color into Greenish yellow and wild Cherry bark extract changes color to Reddish Brown. The CuNPs thus Obtained were purified by repeated centrifugation method at 9000 rpm for 30 minutes followed by redispersion of the pellet in distilled water [9][10].

The formation of CuNPs was strongly inferred by visual observation followed by ultraviolet-visible (UV-Vis) spectrum, scanning electron microscope (SEM).

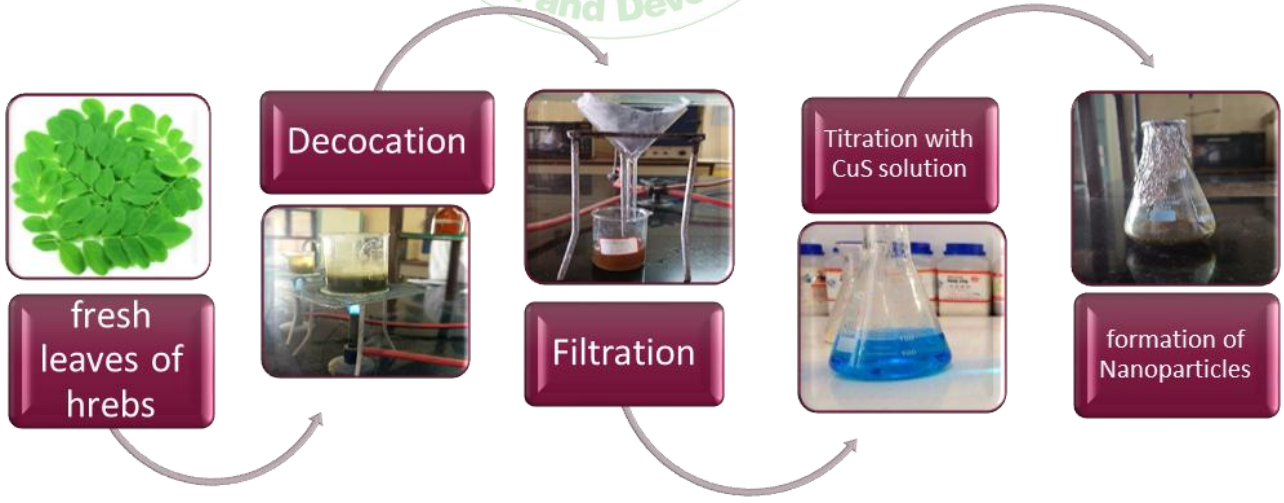

Figure 2: Process of Formation of Nanoparticles

Nanoparticles of moringa leaf

Nanoparticles of lemon grass leaf

Nanoparticles of wild cherry bark

CHARACTERIZATION

The range of wavelength at which it reveals the synthesis of copper nanoparticles is 240 to 337nm by the surface Plasmon analysis (SPA).UV-Vis spectroscopy, Antibacterial evaluation, and analysis of nanoparticles. Characterization of nanoparticles reveals about the different shapes and sizes and the biological activity of nanoparticlesplaysan important role in many applications such as drug delivery and the smaller the particle size larger the surface which could be targeted for drug delivery or release[11].

UV-ANALYSIS

UV-Vis spectroscopy measures the extinction (scatter + absorption) of light passing through a sample UV-Vis spectral analysis was done by using a UV double-beam spectrophotometer at are the solution of 1nm between 200 and 600nm using 10nm quartz cuvettes. The reduction of cu ions was done by using UV-Vis Spectrophotometer for the metal ions stability. The synthesized copper nanoparticles were Characterization through UV-Vis Spectrophotometer HITACHIU2300. The reduction of copper nanoparticles was monitored by UV-Vis Spectrophotometer range of absorbance from 240 to 337nm [12].

NPs have unique optical properties that are sensitive to the size, shape, concentration, agglomeration state, and refractive index near the NP surface, which makes UV-Vis a valuable tool for identifying, characterizing and studying Nanomaterial which makes UV-visible a valuable tool for identifying, characterizing and studying nanoparticles the spectroscopic analysis of synthesized CuNPs showed the maximum absorbance 337nm indicating the presence of biosynthesized CuNPs in the reaction mixture absorbance is 4[13].

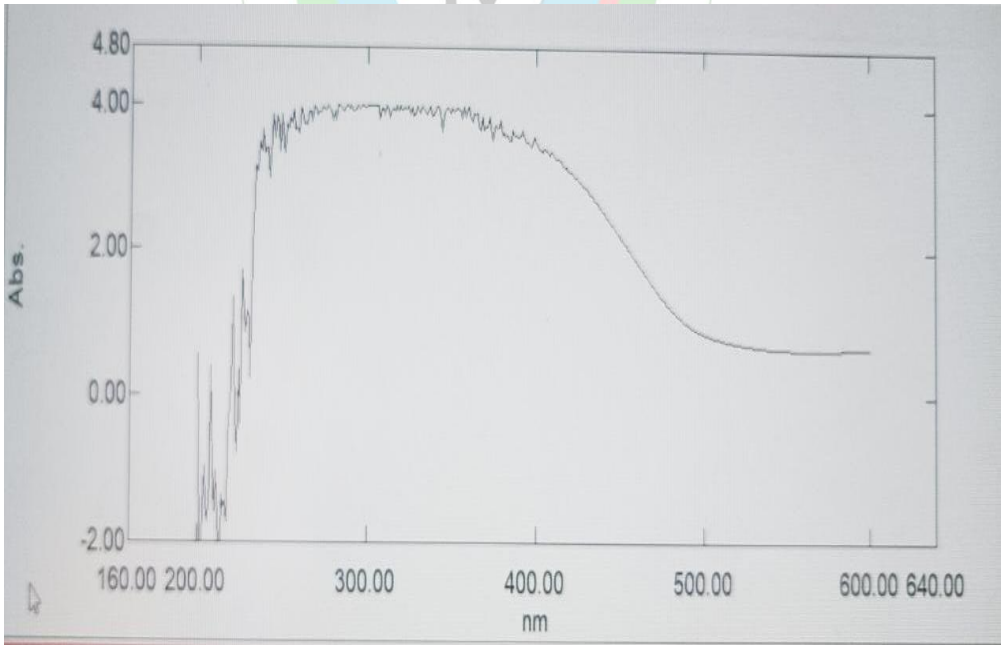

Figure 3: Ultraviolet-visible Spectrum of copper nanoparticles

Antibacterial activity

Method of Antibacterialevaluation the in vitro antibacterial activity of CuNPs was evaluated using an agar disc diffusion method against selected two gram-positive and gram-positive and gram-negative bacteria. The copper nanoparticle presencehas good bactericidal activity so in this work the two different organisms like Escherichia coli and Staphylococcus aureus. Antibacterial moringa, lemon grass leaves and bark[14] [15].

Nutrient agar medium was prepared and poured into the petri dish which allowed them to solidify. Then make a hole with the help of a borer. Then it was inoculated with the help of loop inoculation of bacteria in a zig-zag manner then poureda small amount of sample was at each hole to show the bacterial growth. The plate was incubated at 37-degreeCelsius for 24hrs for observing the inhibition rate biosynthesized CuNPs showed a clear zone of inhibition in the activity as shown in a graphical representation that Moringa leaves, and wild cherry bark shows the maximum antibacterial activity than the lemon grass leaves extract[16][17].

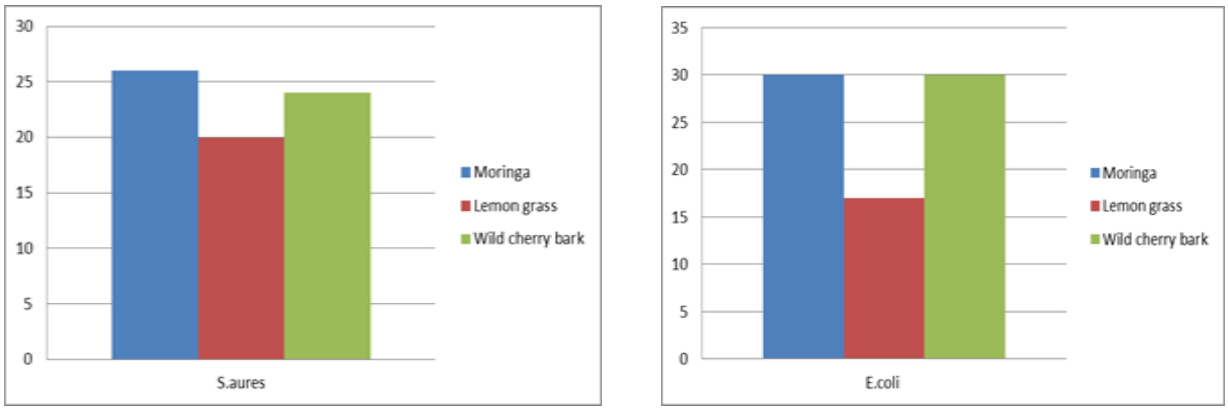

Figure 4: Graphical representationof BiosynthesizedCuNPs against Pathogens at different concentrations

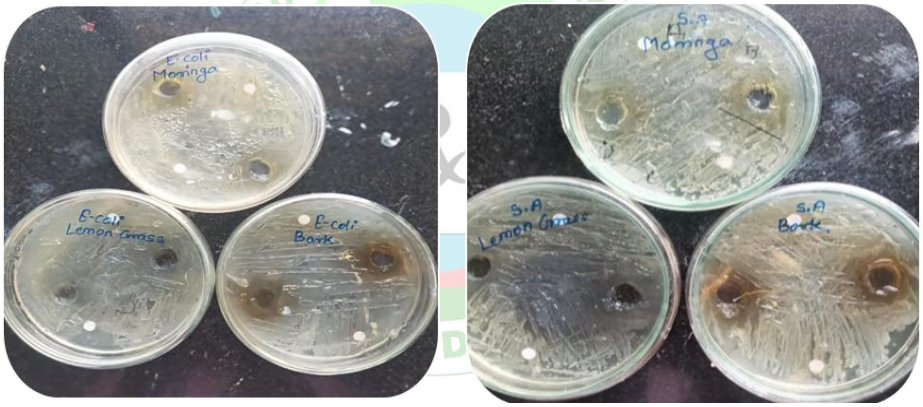

Figure 5: Effect of Biosynthesized CuNPs from extracts against bacteria E. coli and S. aureus

Biology application

Copper NPs shows antimicrobial activity towards Escherichia coli, staphylococcus aureus copper ions are capable of the damaging cell membrane, DNA, RNA and other molecules, thus Cu Nps have shown profound effect against viruses such as human influenza and many more including COVID-19 Viruses reducing its viability and half-life[18]. The wound healing property of CuNpS with a significant increase in the concentration of fibrocytes eventually forming collagen for repairingand wound contraction was seen in vitro study on mice. Cutaneous wound healing was also studied in vivo by synthesis. Antibacterial activities of copper nanoparticles have improved antioxidant enzymes with the decline of pro-stimulant arthritis in rats proving anti-inflammatory and anti-arthritic potentials[19].

Textile

A developing multidisciplinary technology known as nanotechnology is frequently viewed as a fresh industrial solution. The primary players in the nanotechnology clothing market are NanoTextile, Shanghai Huzheng Nano Technology, and UK-based manufacturer Promethean Personal Protective Equipment. These companies are developing fabric containing nano copper into polymers fibres like nylon through a melt extrusion process, as well as developing antimicrobial evaluation against Escherichia coli and Staphylococcus aureus, both of which are used in the textile industry[20].

Other application

Copper Nps have also been shown in food packaging and agriculture for crop improvement. Thus, copper

Nanoparticles showa wide range of applications in the field of biological, physical, and chemical science.

CONCLUSION

Using aqueous leaf extract from moringa leaves, wild cherry bark, and lemon grass, CuNPs were produced using the green synthesis method. For the synthesis of CuNPs, the leaf extract of Moringa leaves, wild cherry bark, and lemon grass was found to be effective. This method has advantages over other ones that have been reported, such as easy access to starting materials and low cost. Excellent antibacterial activity is displayed by the biologically produced CuNPs in the reaction mixture.

ACKNOWLEDGEMENT

The research was supported by Ideal College of Pharmacy and Research Kalyan, we are greatly thankful to Dr.Shriram Bhairagi sir for informative guidance on this topic[21].

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