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And Scientific ResearchBabylon University College of pharmacy

Green biosynthesis of nanoparticle from herbal sources

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ABSTRACT

Green synthesis of nanoparticles is an eco-friendly and sustainable method for preparing nanoparticles using natural materials such as plants, fungi, and bacteria. This method has gained significant attention in recent years due to its several advantages over traditional methods, including its cost-effectiveness, non-toxicity, and biocompatibility. The green synthesis method involves the reduction of metal salts using plant extracts or other natural materials as reducing agents. This process is facilitated by the presence of various phytochemicals in the plant extracts, such as flavonoids, terpenoids, and phenolic compounds, which act as reducing and stabilizing agents. The resulting nanoparticles have unique physical and chemical properties that make them suitable for various applications in fields such as medicine, electronics, and environmental remediation. The green synthesis method also provides a sustainable approach to nanoparticle production, reducing the environmental impact of traditional methods that involve the use of hazardous chemicals and high energy consumption. Overall, the green synthesis method shows great potential for the large-scale production of nanoparticles with minimal environmental impact and high biocompatibility.

INTRODUCTION

Green synthesis of nanoparticles from plants is an eco-friendly and sustainable approach that has gained significant attention in recent years. The method involves using plant extracts or plant-based materials as reducing agents or stabilizers for the synthesis of nanoparticles, thereby eliminating the use of toxic chemicals and reducing the environmental impact of the process.

Pharmaceutical Applications Of Copper Nanoparticles

Copper nanoparticles have gained significant attention in pharmaceutical applications due to their unique properties, such as high surface area-to-volume ratio, biocompatibility, and antimicrobial activity. Here are some potential pharmaceutical applications of copper nanoparticles:

1. Antibacterial agents: Copper nanoparticles have shown strong antibacterial activity against a broad spectrum of bacteria, including drug-resistant strains, making them a potential alternative to antibiotics. They can disrupt the bacterial cell membrane, inhibit cell division, and induce oxidative stress, leading to bacterial death.

2. Antifungal agents: Copper nanoparticles have also shown antifungal activity against a variety of fungi, including Candida albicans and Aspergillus niger. They can penetrate the fungal cell wall and interfere with its metabolism, leading to fungal growth inhibition.

3. Anticancer agents: Copper nanoparticles have shown potential as anticancer agents by inducing apoptosis or programmed cell death in cancer cells. They can also inhibit cancer cell proliferation and angiogenesis, leading to tumor growth inhibition.

4. Wound healing: Copper nanoparticles have been shown to promote wound healing by stimulating cell proliferation and migration, enhancing collagen synthesis, and reducing inflammation. They can also prevent microbial infection in the wound site, leading to faster healing.

5. Drug delivery: Copper nanoparticles can be used as carriers for drug delivery due to their high surface area-to-volume ratio, biocompatibility, and ability to penetrate cell membranes. They can encapsulate drugs and release them in a controlled manner, leading to improved efficacy and reduced side effects.

Note that while copper nanoparticles have shown promise in various pharmaceutical applications, more research is needed to fully understand their safety and efficacy before they can be used in clinical settings.

Potential Applications Of Iron Nanoparticles In The Pharmaceutical Industry

Iron nanoparticles have unique physical and chemical properties that make them suitable for various pharmaceutical applications. Here are some potential applications of iron nanoparticles in the pharmaceutical industry:

1. Drug delivery: Iron nanoparticles can be used as carriers for drug delivery due to their biocompatibility, small size, and ability to cross cell membranes. They can be used to encapsulate drugs and target specific cells or tissues, leading to improved efficacy and reduced side effects.

2. Magnetic resonance imaging (MRI): Iron nanoparticles can be used as contrast agents in MRI scans due to their magnetic properties. They can enhance the contrast between tissues and improve the visualization of tumors, blood vessels, and other structures.

3. Hyperthermia: Iron nanoparticles can be used in hyperthermia therapy, where they are heated using an external magnetic field to kill cancer cells or other

diseased cells. The heat generated by the nanoparticles can destroy cancer cells without damaging healthy tissue.

4. Antioxidant activity: Iron nanoparticles have been shown to have antioxidant properties, which can help reduce oxidative stress and inflammation. They can scavenge free radicals and protect cells from damage, making them a potential therapeutic option for various diseases, including neurodegenerative disorders.

5. Antibacterial agents: Iron nanoparticles have been shown to have antibacterial activity against a variety of bacteria, including drug-resistant strains. They can disrupt bacterial cell membranes and inhibit bacterial growth, making them a potential alternative to antibiotics.

Note that while iron nanoparticles have shown promise in various pharmaceutical applications, more research is needed to fully understand their safety and efficacy before they can be used in clinical settings. It is important to carefully evaluate the potential risks and benefits of using iron nanoparticles in each specific application.

Experimental Part

Our research depend on the general steps involved in the green synthesis of nanoparticles from plants:

1.Select a suitable plant or plant extract that contains natural compounds with reducing or stabilizing properties, such as polyphenols, flavonoids, terpenoids, and alkaloids.

2.Extract the plant material using a suitable solvent, such as water or ethanol, to obtain a plant extract.

3.Add a suitable metal salt, such as silver nitrate, gold chloride, or copper sulfate, to the plant extract and heat the mixture under controlled conditions, such as a specific temperature and pH, to initiate the reduction of metal ions and formation of nanoparticles.

4.Characterize the synthesized nanoparticles using various analytical techniques, such as UV-Vis spectroscopy, transmission electron microscopy (TEM), X-ray diffraction (XRD), and Fourier-transform infrared (FTIR) spectroscopy.

5.Test the synthesized nanoparticles for their potential applications, such as antibacterial, antifungal, or anticancer agents, and evaluate their toxicity and biocompatibility.

Examples of plants that have been used for green synthesis of nanoparticles include green tea, grapefruit, neem, ginger, green tea, beet root and turmeric. The green synthesis method has several advantages, including low cost, ease of preparation, scalability, and sustainability, making it a promising alternative to conventional methods of nanoparticle synthesis.

The Preparation Of Iron Nanoparticles From Beetroot Can Be Done Using A Simple And Straightforward Method. Here Are The Steps:

1. Cut the beetroot into small pieces and wash them thoroughly to remove any dirt or debris.

2. Boil the beetroot pieces in distilled water for 30-40 minutes until they become soft.

3. Remove the beetroot pieces from the water and allow the water to cool down to room temperature.

4. Add a small amount of iron sulfate or iron chloride to the beetroot water and stir well. The amount of iron salt added should be based on the desired concentration of iron nanoparticles in the final product.

5. Heat the solution to 80-90°C and keep stirring for 1-2 hours. The color of the solution will gradually change from yellow to brown, indicating the formation of iron nanoparticles.

6. Once the solution cools down, filter it through a filter paper to separate the iron nanoparticles from the beetroot residue.

7. Wash the iron nanoparticles several times with distilled water to remove any impurities or residual beetroot material.

8. Finally, dry the iron nanoparticles under vacuum or in an oven at low temperature.

Note that the above method is a general outline, and the details of the preparation process may vary depending on the specific requirements and intended application of the iron nanoparticles. It is important to follow good laboratory practices, including proper handling of chemicals and equipment, to ensure safety and obtain reliable results.

The Preparation Of Copper Nanoparticles From Green Tea Leaves

can be done using a simple and eco-friendly method. Here are the steps:

1. Collect fresh green tea leaves and wash them thoroughly with distilled water to remove any dirt or debris.
2. Dry the leaves at room temperature until they are completely dry.
3. Grind the dried leaves into a fine powder using a mortar and pestle.
4. Add a small amount of copper sulfate or copper chloride to the green tea leaf powder and mix well. The amount of copper salt added should be based on the desired concentration of copper nanoparticles in the final product.

5. Boil distilled water and add it to the green tea leaf powder and copper salt mixture, stirring well until it forms a homogeneous solution.

6. Heat the solution at 80-90°C for 2-3 hours, stirring continuously.

7. The color of the solution will gradually change from green to brown, indicating the formation of copper nanoparticles.

8. Once the solution cools down, filter it through a filter paper to separate the copper nanoparticles from the green tea residue.

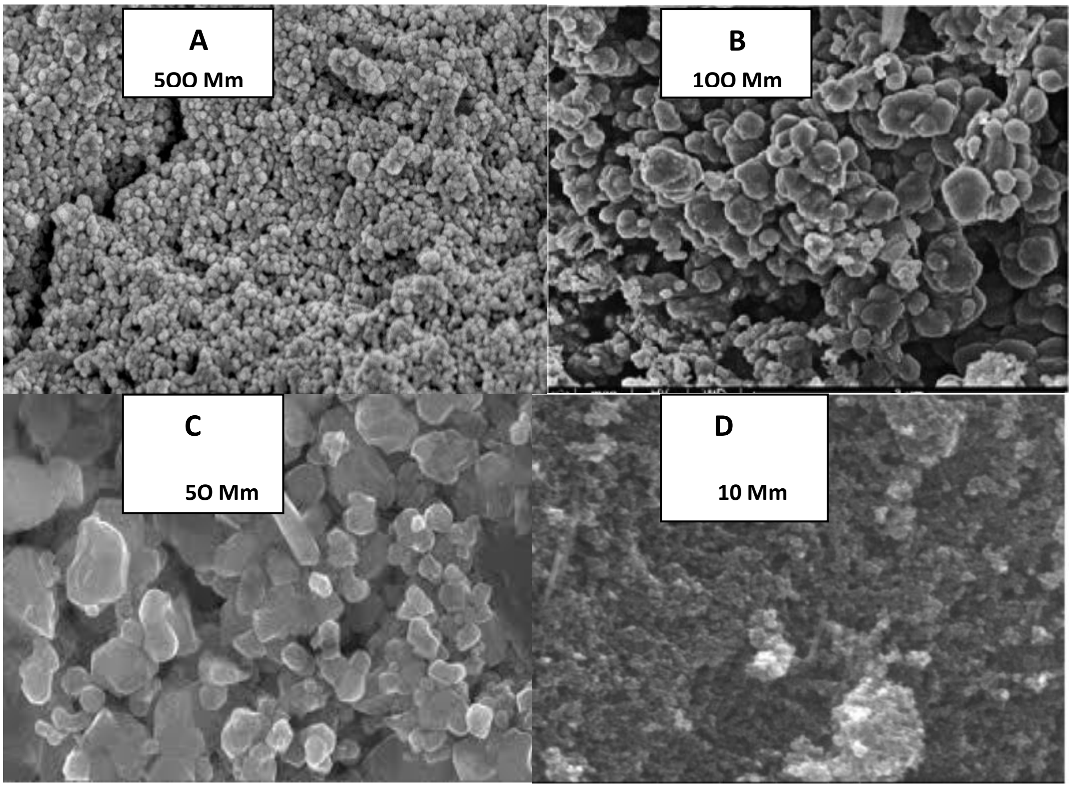
9. Wash the copper nanoparticles several times with distilled water to remove any impurities or residual green tea material.

10. Finally, dry the copper nanoparticles under vacuum or in an oven at low temperature.

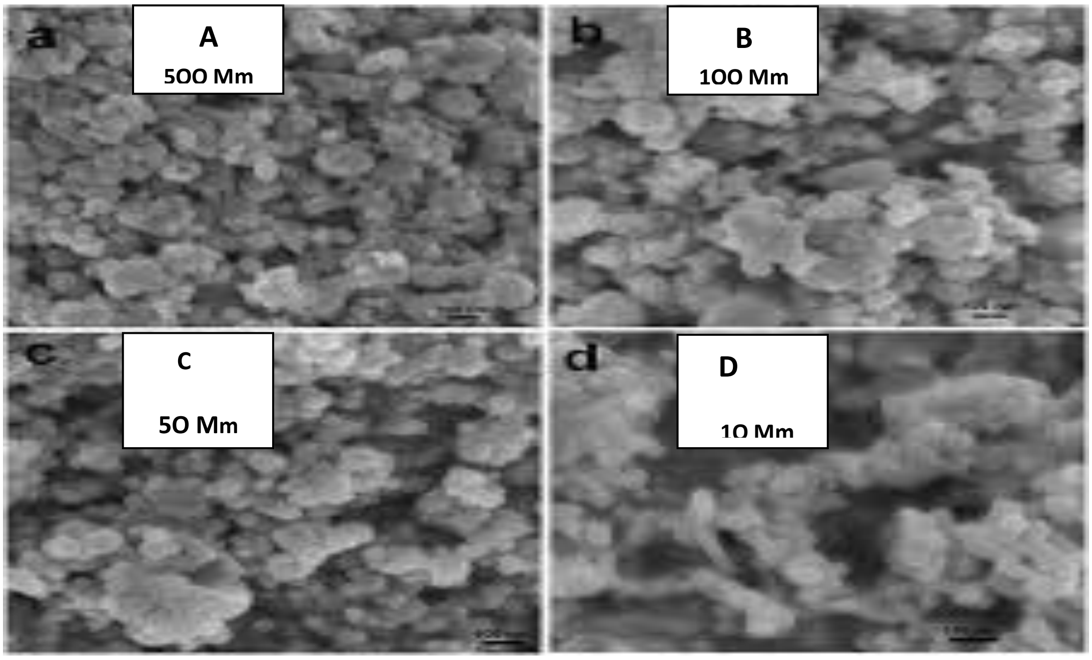
Scanning Electron Microscopy.

It is a powerful imaging technique that uses an electron beam to create high-resolution, three-dimensional images of a sample's surface. In SEM, a sample is coated with a thin layer of conductive material, such as gold or carbon, to make it conductive and prevent charging during imaging. Then, the sample is placed in a vacuum chamber, and an electron beam is scanned over the sample's surface. As the beam interacts with the sample, it produces secondary electrons and backscattered electrons that are detected by a detector, creating a high-resolution image of the sample's surface.

SEM allows researchers to study the morphology and surface features of a wide range of materials, including metals, ceramics, polymers, and biological samples. The high-resolution images produced by SEM can provide information about a sample's structure, composition, and properties, which is essential for understanding its behavior and performance. SEM is widely used in various fields, including materials science, nanotechnology, biology, and geology, among others.



SEM for iron oxide nanoparticles



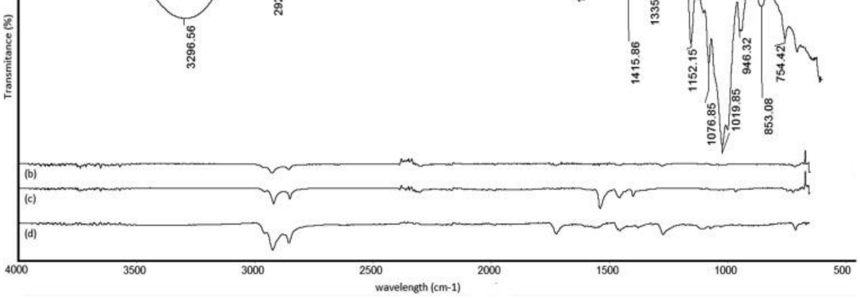
SEM for copper oxide nanoparticles

Fourier Transform Infrared Spectroscopy.

It is a powerful analytical technique used to identify and quantify the functional groups present in a sample. FTIR works by measuring the interaction between infrared radiation and a sample. Infrared radiation in the mid-infrared range (4000 to 400 cm^-1) is passed through the sample, and the resulting absorption spectrum is measured. The absorption spectrum reflects the types of chemical bonds present in the sample, which can be used to identify and quantify the functional groups. FTIR is widely used in various fields, including chemistry, materials science, and biology, among others. It is a non-destructive technique that can be used to analyze a wide range of materials, including solids, liquids, and gases. FTIR is particularly useful for identifying and quantifying functional groups in organic compounds, such as alcohols, carbonyls, and amines. It can also be used to study the structure and composition of polymers, proteins, and other biomolecules. FTIR is a valuable tool for understanding the chemical properties of a material, which is essential for designing and optimizing new materials with specific properties and functions.

Typically, the FTIR spectrum of copper nanoparticles will show broad bands in the 4000 to 2500 cm^-1 region, corresponding to the O-H and N-H stretching vibrations of surface functional groups such as hydroxyl and amino groups. In addition, bands in the 1700 to 1500 cm^-1 region can be attributed to the stretching vibrations of C=O and C=N groups from organic coatings. The presence of peaks in the region between 1200 to 1000 cm^-1 may indicate the presence of C-O and C-N bonds.

The FTIR spectrum of copper nanoparticles can provide information about the types of functional groups present on the surface of the nanoparticles and the nature of the coating materials. This information can be useful for understanding the stability, biocompatibility, and other properties of the nanoparticles, and for optimizing their performance for various applications in fields such as biomedicine and environmental remediation.



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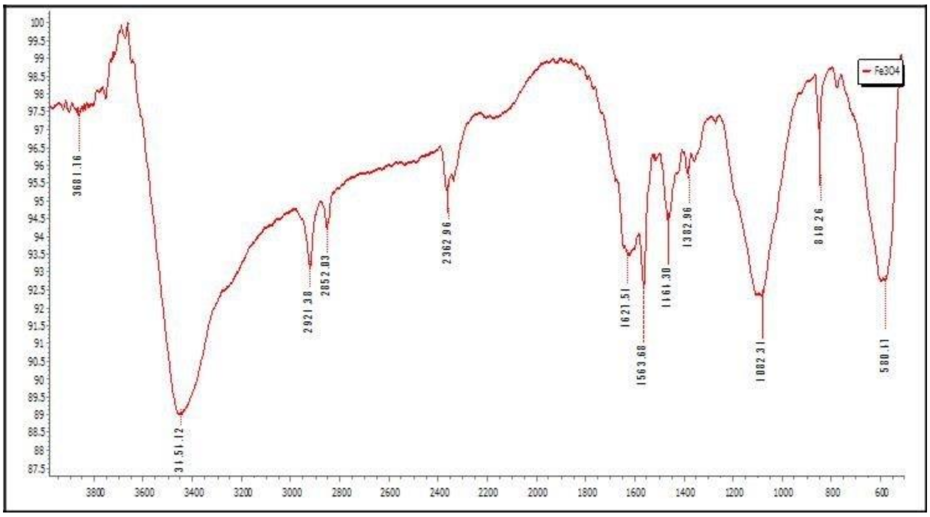

CONCLUSION

Green synthesis of nanoparticles using plant extracts and other natural sources has emerged as an eco-friendly and sustainable approach for producing nanoparticles. The use of plant extracts as reducing and capping agents has gained much attention due to their cost-effectiveness, availability, and ease of use. Green synthesis of nanoparticles also offers several advantages over conventional synthesis methods, such as low toxicity, high biocompatibility, and reduced environmental impact.

Studies have shown that green synthesis of nanoparticles can produce nanoparticles with controlled size, shape, and surface chemistry, making them suitable for a wide range of applications in fields such as biomedicine, catalysis, and environmental remediation. Moreover, green synthesis of nanoparticles has also been shown to have antibacterial, antifungal, and anticancer properties, making them promising candidates for use in drug delivery and therapeutic applications.

In conclusion, green synthesis of nanoparticles using plant extracts and other natural sources represents a promising approach for the production of nanoparticles with unique properties and potential for various applications. The eco-friendly and sustainable nature of this approach also makes it an attractive alternative to conventional synthesis methods, offering benefits to both the environment and human health.

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