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Green synthesis and characterization of copper nano particles using *Carica Papaya* leaf extract

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Abstract
The Nano technology has become the back bone of the science department. Nanoparticles due to its size and reactivity contributes much in the research field. When added to plastics, coatings, and textiles, copper Nano particles play a critical role because of their anti-biotic, anti-microbial, and anti-fungal properties. The research work focus on the cost effective synthesis of copper Nano particle in an eco-friendly technique using papaya leaves. The Nanoparticles were prepared using copper chloride, and then the sample was sent for UV, IR characterization followed by the SEM and TEM characterization to study the nature of the copper nanoparticles.

Keywords: papaya leaf extract, copper nano particles, green synthesis, UV, IR spectroscopy SEM and TEM microscopy

Introduction

Nanotechnology is a part of Chemistry. Currently, nanotechnology is an important enabling technology for the production and control of matter at the molecular level, on ranges ranging from 1 to 100 nanometres [1]. Everything that was tough in the past is now simple thanks to technology. Technology is difficult to limit to one side. Every field, in fact, has numerous sections and categories. Nanotechnology is one of the most essential technologies in the world, as we all know. It has numerous uses in a variety of sectors, including energy, nanotechnology, Nano fabrics, and Nano biotechnology [2].

Nanotechnology is primarily concerned with the creation of nanoparticles of various sizes, shapes, chemical compositions, and controlled dispersion, as well as their potential applications in human health [3]. The new drug delivery system is based on the encapsulation of nanoparticles into micro particles, which results in properties that are distinct from those of individual components. It produces drug loads, protects against physical and chemical instability, improves encapsulated agent release, decreases burst effect, and targets specific cells [4]. There are three key factor in the reducing process of copper nanoparticles (CUNps); the solvent medium, the reducing agent, and the capping agent [s]. Copper nanoparticles could be used in lubricants, Nano fluids, conductive coatings, and antibacterial agents, as well as in optics, electronics, and medicine. Copper nanoparticles are preferred over silver nanoparticles because to their lower cost, physical and chemical stability, and ease of mixing with polymers [6].

Copper (cu) is the eighth most prevalent metallic element in the Earth's crust; once solubilized, it cannot be generated or destroyed, hence its homeostatic regulation is tightly controlled [7]. Copper is a transition metal with atomic number 29, atomic mass 63.546, and a density more than 5 g cm-3. It has a unique red-orange colour and metallic shine. It possesses a number of desirable characteristics, including good ductility, malleability, high thermal and electrical conductivity, high corrosion resistance, and poor chemical resistance [8, 9]. Copper Nanoparticles are classified as highly flammable solids and must be stored away from ignition sources. They're also known to be extremely harmful to aquatic life.

Now a days when a research work is carried out everyone wants to add the word Nano in one or the other way this has enkindled in me the interest to study about the Nano particles.as a result I have carried out my work based on Nano particles preparing copper nanoparticles using carica papaya leaf extract.

Importance of Copper in Plants

Copper (Cu), a micro element from block D and period 4 of the periodic table, is necessary for plant development. Under physiological conditions, it occurs as Cu^{2+} and Cu^{+}. The concentration required for proper plant development is between 10-14 and 10-16 M [10].Cu toxicity, growth suppression, photosynthesis interference, photo respiration, and increased oxidative stress all result from higher Cu concentrations. Cu deficiency in plants is difficult to diagnose since it causes yield losses with little symptoms. Cu shortage may become more common in the future, as applications made 10 to 30 years ago will run out, and increased nitrogenous fertiliser use may exacerbate Cu deficit [11].

Information about the Plant

It was domesticated for the first time in Mesoamerica, which is now southern Mexico and Central America [12]. The papaya is a small sparsely branching tree that grows from 5 to 10 metres (16 to 33 feet) tall, with spirally arranged leaves limited to the top of the trunk. The leaves are enormous, measuring 50 to 70 centimetres (20 to 28 inches) [13].

Benefits of Papaya Leaves

Papaya leaves have several health benefits, including

- The ability to alleviate dengue fever symptoms.
- Enhance blood sugar balance.
- Assist digestive function.
- Has anti-inflammatory properties.
- Supports hair growth and promotes skin health.
- May have anti-cancer properties.

Materialsand Methods

1. Plant material: Fresh carica papaya leaves.
2. Chemicals: Copper Chloride, distilled water.
3. Glass wares: Chopping knife, conical flask, Beaker, Funnel.

Sample Collection

The fresh carica papaya leaves were collected from the surrounding place for the synthesis of copper Nano particles.

Preparation of Leaf Extract

The collected fresh carica papaya leaves were first washed with water to remove the dust present in it. Again it is washed with distilled water to remove the impurities. s50g of the leaf was chopped into fine pieces again washed with distilled water and transferred to 250 ml beaker and 200 ml of distilled water was added. Then it was boiled at 110 c for 30 minutes. The filter paper was used to filter the sample and collected in the beaker then it was covered and kept.

Synthesis of Copper Nano Particles

The prepared papaya leaf extract was added to 20 ml of copper chloride then it was boiled at 50 -60 c with constant stirring then it was allowed to cool. The colour was changed from blue to dark brown. Then the formed particles were filtered using what Mann filter paper then burned in the silica crucible finally the sample of copper Nano particles were collected.

Results and Discussion

Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM).

SEM Analysis

A few drops of the solution containing copper nanoparticles prepared were placed on a glass plate and dried. Then SEM was recorded. SEM image of copper nanoparticles shown in (Figure 1).

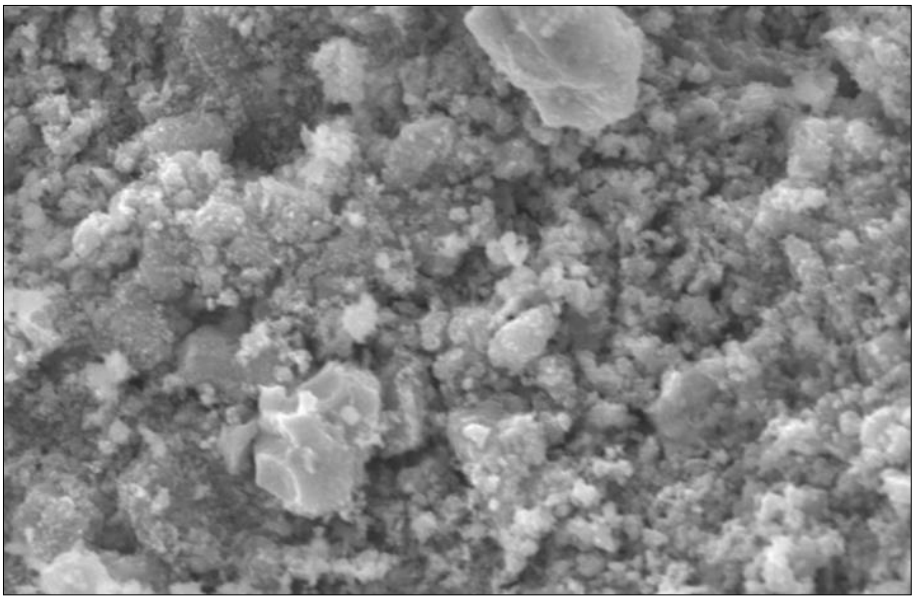

Fig 1: SEM image of copper nanoparticles.

TEM Analysis

Transmission electron microscopy (TEM) has been used to identify the size, shape and morphology of nanoparticles. The organic layer appeared to separate the TEM pictures, which were not physically in contact. Therefore, TEM images clearly indicate the coating of Cu nanoparticles with an organic layer. It demonstrates that the copper nanoparticles are well disseminated and generally spherical in shape, with some NPs having irregular shape structures, as seen in (Figure 2). The particle average size around 42 nm.

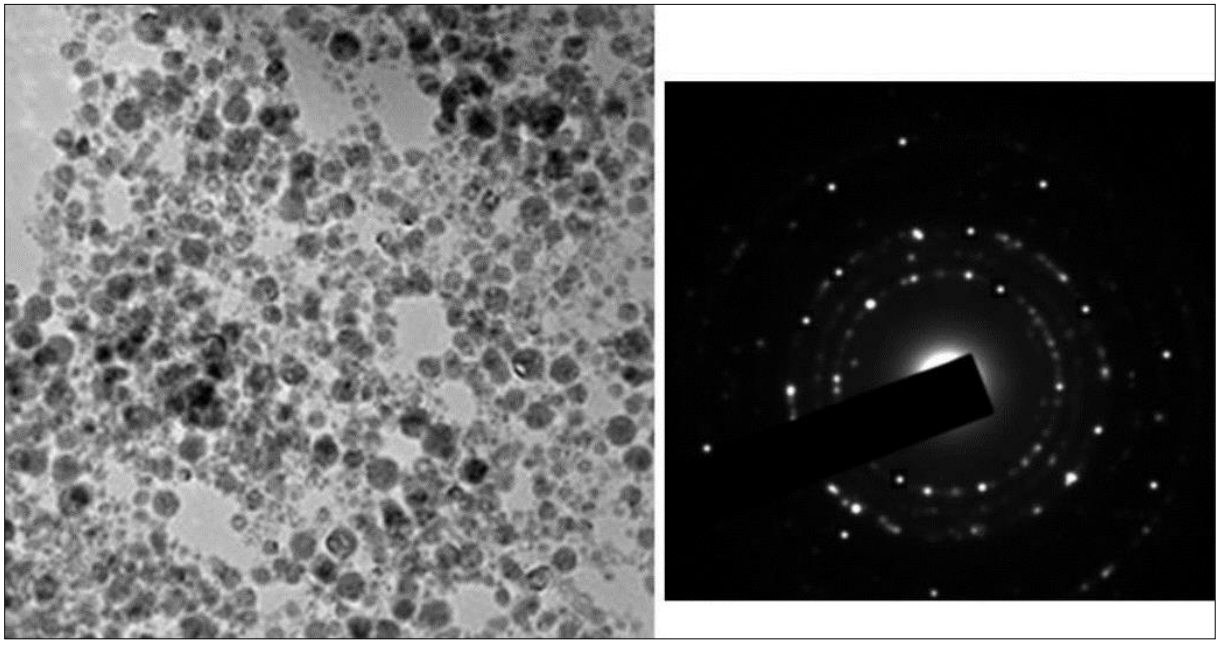

Figure 2: TEM image of copper nanoparticles.

The average size of Cu nanoparticles produced using carica papaya corroborated this information. Previous research has shown that the small size of Cu nanoparticles makes it easier for them to penetrate bacteria's outer walls, enter the body, damage the respiratory chain, and therefore block cell respiration, resulting in bacterial death.

Conclusion

Cu nanoparticles can be produced using medicinal plants, specifically aqueous extracts of fresh leaves of Carica papaya. The colour change of carica papaya extract from green to yellowish green indicated the development of Ag nanoparticles in the extract. The appearance of colour variations indicates the formation of Cu particles. Because of the higher concentration of copper chloride solution, the Cu particles formed grew in size, although the average size is still 42 nanometers..

The presence of nanoparticles was confirmed by characterization data acquired from SEM and TEM examinations, demonstrating that the plant extract was not only effective in reducing the copper salt to copper nanoparticles, but also in stabilising the nanoparticles created.

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