ABSTRACT
Current work describes the synthesis of copper nanoparticles using Acorus Calamus Roots extract as a capping agent. The preparation of copper nanoparticles by using Acorus Calamus extract has desired quality with low cost and convenient methods. The Acorus Calamus extract was mixed with copper salt solution by heating to a temperature of 50-60°C and the reduction reaction was studied by observing the color change. The resulting copper nanoparticles were characterized by UV Visible Absorption Spectrometer, Fourier Transform Infrared (FTIR), The FTIR spectrum analysis has confirmed the presence of functional groups of stabilizer Acorus Calamus in capping the copper nanoparticles. Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) experiments. SEM and TEM results display the formation of copper nanoparticles with an average size of 50-100 nm. Copper nanoparticles exhibit an absorption peak at around 450 nm.

KEYWORDS: Nanotechnology, Nanoparticles, Green Synthesis, Acorus Calamus Roots.

1.0 INTRODUCTION
Nanotechnology is an important successful field for research work.[11] Nanotechnology is the branch of science and technology, which deals with the production of substances in size less
than 100nm scale as nanoparticles. Among other nanoparticles, metal nanoparticles have raised attention over the last few decades because they have larger surface area per weight or to volume and many characteristics; biological, thermal, chemical, dielectric, electrical, physical, mechanical, electronic, magnetic, and optical properties make them attractive tools for research work. Nanoparticles are studied as the building blocks of the next generation of technology with applications in different industrial areas. In particular, metal and metal oxide nanoparticles are receiving optimum attention in a large variety of applications. Nanoparticles of transition metals are an important class of semiconductors, which have applications in magnetic storage media, solar energy transformation electronics, gas sensors, and catalysis. Diagnostic and therapeutic applications, e.g., diamagnetic separation and detection systems, magnetic gene transfection, stem cell engineering, immunoassay, and for immune apt sensors as platforms to Immobilize biocompounds. Moreover, antibacterial properties and the ability to be conjugated with different drugs, ligands, and antibodies proved metallic NPs to be successful antimicrobial agents against multi-drug-resistant organisms and as efficient nanocontainers for precise drug and gene transport. The availability of more than 600 NP-based consumer products in the market reflects a drastic increase in the production of daily-use items with omnipresence of NPs. These products can be divided into eight categories: 1) household appliance; 2) health and fitness goods, such as sporting stuffs, sunscreen, and makeup’s; 3) food and beverage; 4) home and garden stuff including construction materials, home furnishings, and antibacterial paints; 5) automotive parts such as carbon nanotube Spiked tires; 6) electronics and computers; 7) cross-cutting coatings; and 8) goods for children, such as silver NP-coated children’s toys etc. The growing and widespread applications of NPs have also led to concerns regarding their negative impact on human as well as environment health. Thus, nanotechnology can be considered to be a double-edged sword. The released NPs from NP-based items will end up in the atmosphere, water, or soil, when disposed by any means. The exposure of released NPs to biological organisms can be by direct and indirect means. The possible indirect ways include inhalation or digestion for Land-dwelling organisms, and through plants. The direct passage for aquatic organisms is likely through external surface epithelia or gills. When NPs are exposed to the environment, interaction of NPs with the surrounding materials and complex organic fluids could result the creation of corona. The produced corona can affect different functions of biological systems.
2.0 MATERIALS AND METHODS

2.1 MATERIALS

- The, copper Sulphat, was used as received. Used for the synthesis of Copper nanoparticles was procured from ILE Company Limited Madurai, Tamilnadu.
- Acorus Calamus Roots used in this work was collected from the shaping at Seelappadi, Dindigul.

2.2 PREPARATION OF THE ACORUS CALAMUS ROOTS EXTRACT

Indian medicinal plant Acorus Calamus Roots was selected, on the basis of low cost neighborliness, ease of accessibility and medicinal property. Fresh and healthy Roots were collected locally and rinsed methodically first with tap water followed by distilled water to remove all the dust and unnecessary observable particles, cut into small pieces and dried at room temperature. About 5 g of Acorus Calamus powder were weighed separately and transfer into 100 ml beakers containing 50 ml distilled water and boiled for about 10 min Fig [3]. The extracts were then filtered thrice through Whitman No. 1 filter paper Fig [4] to remove particulate matter and to get clear solutions which were then cooled (4°C) in 100 ml Erlenmeyer flasks for further experiments.
2.3 EXPERIMENTAL

For the synthesis of Copper nanoparticles, 1mm Copper Sulphat and roots extract were taken. 10 ml of Acorus Calamus Roots extract was added drop wise to 5 ml of 1 mm Copper Sulphat solution Figure.[5] A different color change was observed after 24 hrs as the solution turned into brown from yellow solution at room temperature suggesting formation of Copper nanoparticles. The initial blue color of the reaction mixture eventually turned to brown-black color after 48 hrs. The reduction of CuNPs was confirmed from SEM and TEM shows the shape and crystal structure as well as size of the particles.

Taken 10 ml of Acorus Calamus Roots extract was added drop wise to 5 ml of 1 mm Copper Sulphat solution.
3.0 CHARACTERIZATION OF COPPER NANOPARTICLES
The FTIR spectra were recorded using FTIR spectrometer. A known amount of sample was ground with KBr and the pellet form of the samples was analyzed with FTIR instrument. The green synthesis of copper nanoparticles was monitored by UV-Vis spectroscopy. All spectra were corrected against the background spectrum of water as reference. Morphology and size of copper nanoparticles were investigated using scanning electron microscopes and transmission electron microscopes (SEM and TEM).

4.0 RESULTS AND DISCUSSION
4.1 UV-VIS SPECTROSCOPY
UV-Vis absorption spectra of the copper nanoparticles are shown in Fig.6. The copper nanoparticles prepared using copper sulphat salts and Indian medicinal plant Acorus Calamus Roots extract stabilizer display an absorption peak at around 450 nm. This peak can be assigned to the absorption of copper nanoparticles. The broadness of the absorption peak probably stems from the wide size distribution of nanoparticles.

![Figure 6](attachment://figure6.png)

Figure [6]: Spectra obtained from Copper Nanoparticles UV-visible absorbance.

4.2 FOURIER TRANSFORM INFRARED (FTIR)
The FTIR spectrum analysis has confirmed the presence of functional groups of stabilizer Acorus Calamus Roots extract in capping the copper nanoparticles. FTIR measurement was carried out to identify the possible molecules responsible for capping and reducing agent for the copper nanoparticles synthesized using plant Acorus Calamus Roots extract stabilizer.
FTIR spectra of copper nanoparticles synthesized using copper sulphate salts stabilized by Acorus Calamus extract are shown in Fig. 7. The broad bands observed at around 3313 cm⁻¹ to 532 cm⁻¹ illustrates a peak at 3313 cm⁻¹ results due to the stretching of the N–H bond of amino groups and indicative of bonded hydroxyl (-OH) group. The strong absorption peak at 2913 cm⁻¹ could be assigned to –CH stretching vibrations of –CH₃ and –CH₂ functional groups. The shoulder peak at 1701 cm⁻¹ assigned for C=O group of carboxylic acids. The peak at 1635 cm⁻¹ indicates the fingerprint region of CO, C–O and O–H groups, the absorption peaks at 1361 cm⁻¹ could be attributed to the presence of C–O stretching in carboxyl. The intense band at 1018 cm⁻¹ can be assigned to the C-N stretching vibrations of aliphatic amines present in the surface of the copper nanoparticle.

![Figure 7: Fourier Transform Infrared (FTIR).](image)

**4.3 SCANNING ELECTRON MICROSCOPY (SEM)**

SEM images of copper nanoparticles stabilized by Indian medicinal plant Acorus Calamus Roots extract prepared using Copper Sulphate are shown in Fig. [8]. Copper nanoparticles by this method show nearly monodispersed distribution of particle sizes. The average particle size of the Cu nanoparticles is around 80-100 nm.
4.4 TRANSMISSION ELECTRON MICROSCOPY (TEM)

Transmission electron microscopy (TEM) has been employed to characterize the size, shape and morphology of synthesized copper nanoparticles. Copper sulphate is found to be the best precursor that gives better result among other salts used for the synthesis of CuNPs, i.e., good particles size control along with Indian medicinal plant Acorus Calamus Roots extract as capping agent. The TEM image of copper nanoparticles synthesized using copper Sulphat stabilized by Indian medicinal plant Acorus Calamus Roots extract is shown in Fig. [9], the average size of copper nanoparticles is around 20-50 nm. The sample studied reveal monodispersity of the metal particles.

5.0 CONCLUSION

Copper nanoparticles (CuNPs) were fruitfully obtained from bio diminution of copper sulphat solutions using Acorus Calamus Roots extracts. Green chemistry approach towards the
synthesis of nanoparticles has much compensation such as, ease with which the process can be scaled up and economic viability. We have inhabited a fast, environmental and convenient method for the amalgamation of Copper nanoparticles using Acorus Calamus Roots extracts with a diameter range of 20nm. The FTIR spectrum analysis has confirmed the presence of functional groups of stabilizer Acorus Calamus in capping the copper nanoparticles. These particles are monodispersed and spherical. Flush change occurs due to surface plasmon resonance during the reaction with the ingredients present in the plant Roots extract results in the manufacture of copper nanoparticles which is well-established by UV–Vis, SEM, TEM, having average mean size of 50 - 100nm had FCC configuration.

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7.0 REFERENCES


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