Copper oxide nanoparticles synthesis and characterization using UV-vis spectrophotometer and TEM

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ABSTRACT
To synthesise Copper oxide nanoparticles and study it’s characterisation using UV-vis spectrophotometer and TEM. Copper oxide nanoparticles are eco-friendly, cost-efficient and diverse utilisation all over the medical field. The shape of the CuO nanoparticles are spherical, and its characterisation is done using TEM, and UV-vis techniques. The size of the nanoparticles mediated in each plant extract differs from one another. Collection and Preparation of Plant extracts, Synthesis Of CuONPs, Characterization of copper nanoparticles, preparation of nanoparticles powder. The plant extract is in green colour, and the CuO nanoparticles are seen in light yellowish in colour. The particle size ranges from 2-100 nm and shape is spherical. The graph reached its peak at the wavelength of 300 nm. The TEM shows spherical shape, dispersion and versatile nanoparticles. They appear to be arranged in a cluster, open and quasi-linear superstructures. This research shows that CuO nanoparticles shows excellent biocompatibility. The particles which are smaller in size shows great immunity. Hence the nanoparticles are expected to be used in future for effective drug systems.

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INTRODUCTION
Copper is used since several years as a magical element, as it is known to possess anti-microbial, anti-inflammatory, and angiogenic properties used in the treatment of skin ailments, most importantly wound healing. (Agarwal et al., 2017) Nanotechnology, in the present century has it’s own importance in several fields owing to its intrinsic properties and it’s applications in several fields such as photochemical catalysis, biosensing and electrochemical sending, gas sensor, and solar energy conversion (Rajeshkumar and Bharath, 2017; Santhoshkumar et al., 2017; Menon et al., 2017; Rajeshkumar, 2017). They also possess several other unique properties such as high specific surface area, good electrocatalytic activity, and promotes electron transport reactions at a lower overpotential (Devi et al., 2018).

Copper oxide nanoparticles, an important semiconductor with a bandgap of 2.1 eV, is of much importance in the current days owing to its intrinsic properties and it’s applications in several fields such as photochemical catalysis, biosensing and electrochemical sending, gas sensor, and solar energy conversion (Rajeshkumar and Bharath, 2017; Santhoshkumar et al., 2017; Menon et al., 2017; Rajeshkumar, 2017). In the study conducted by Sivaraj et al. (2014) copper oxide nanoparticles were synthesised by biological method using aqueous extract of Acalypha indica leaf and was characterised by TEM analy-
sis which showed that the copper oxide nanoparticles established best antimicrobial and anti-cancer activity, and the characterisation of copper oxide nanoparticles was done by using UV visible spectroscopy, XRD, FT-IR, SEM TEM and EDX analysis and was found out that the synthesised particles were spherical in nature and the particle size was in the range of 26-30 nm. (Sivaraj et al., 2014). The wound healing capacity of copper oxide nanoparticles was shown in the study conducted by (Tiwari et al., 2016) where the antimicrobial activity of copper oxide nanoparticles and copper sulphate were compared against Escherichia coli, Bacillus subtilis, Pseudomonas aeruginosa and staphylococcus aureus by agar diffusion and broth dilution methods. (Tiwari et al., 2016).

There are several routes to synthesise the copper oxide nanoparticles, such as sonochemical, microwave irradiations, alkoxide based route, sol-gel technique, one step solid-state reaction at room temperature, electrochemical methods. Several studies have shown that biosynthesis of the metallic nanoparticles is more useful for its biological application (Rajeshkumar and Rinitha, 2018; Joerger et al., 2001).

In this present investigation, we have used Aloe vera and Azadirachta indica based herbal formulations, and its mediated copper oxide nanoparticles. The synthesised nanoparticles characterised using UV visible spectrophotometer and morphologically using a transmission electron microscope.

**MATERIALS AND METHODS**

**Collection and Preparation of Plant extract**

Neem and Aloe vera leaves were collected from Chennai. The collected leaves were washed 3-4 times using distilled water. Then dried it in the shade for 7-14 days. The well-dried leaves were made into a powder by using mortar and pestle. The collected powder was stored in an airtight container. One gram of neem and aloe Vera powder was dissolved in distilled water and boiled for 5-10 minutes at 60-70 degrees. The solution was filtered by using Whattman no.1 filter paper. The filtered extract was collected and stored in 4 degrees for further use.

**Synthesis Of CuONPs**

One milli molar of copper acetate dissolved in 80 ml of double-distilled water. The plant extracts of neem and aloe Vera added with the metal solution and was made into 100 ml solution. The colour change was observed visually and photographed. The solution is kept in magnetic stirrer for nanoparticles synthesis.

**Characterization of copper nanoparticles**

The synthesised nanoparticles solution is preliminarily characterised by using UV-vis-spectroscopy 3 ml of the solution is taken in the cuvette and scanned in double beam UV viz spectrophotometer from 300 nm to 700 nm wavelength. The results were recorded for the graphical analysis.

**Preparation of nanoparticles powder**

The nanoparticles solution is centrifuged using lark refrigerated centrifuge. The copper oxide nanoparticles solution is centrifuged at 8000 rpm for 10 minutes, and the pellet is collected and washed with distilled water twice. The final purified pellet is collected and dried at 100-150 degrees, and finally, the nanoparticles powder is collected and stored in air-tight eppendorff tube. The nanoparticles powder is analysed for its morphological character using TEM. The size and shape of the nanoparticles is clearly analysed using this technique.
RESULTS AND DISCUSSION

Visual observation
The plant extract is in green colour, and the CuO nanoparticles are seen in light yellowish in colour. (Figure 1)

UV-vis spectroscopy
UV-spectra of CuO particles synthesised from with and without ALE at room temperature. It is generally recognised that UV-vis spectra could be used to examine the size and shape-controlled nanoparticles in aqueous solution with 200-800 nm wavelength range. The particle shape is spherical and size in a range of 2-100. The optical absorption spectra of noble metal nanoparticles are known to exhibit unique optical properties due to the property of surface plasmon resonance (SPR), which proceeds to longer wavelength with increasing particle size. (Figure 2)

TEM studies show spherical shape, dispersion and versatile CuO nanoparticles prepared with Neem and aloe vera plant formulation extract. The nanoparticles appear to be arranged into open, quasi-linear superstructures. They show FCC crystalline structure of CuO nanoparticles. (Figure 3)

CONCLUSIONS
This research shows that CuO nanoparticles synthesized using a green method. The particles which are smaller in size may be used in many applications. Hence the nanoparticles are expected to be used in future for effective drug systems and biomedical applications.

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