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LEAF EXTRACT MEDIATED GREEN SYNTHESIS OF COPPER OXIDE NANOPARTICLES USING *OCIMUM TENUIFLORUM* AND ITS CHARACTERISATION

S. SUMITHA, R. P. VIDHYA, M. SUBA LAKSHMI and K. SHANMUGHA PRASAD*

Department of Chemistry and Advanced Research Centre, S. T. Hindu College, NAGERCOIL (T.N.) INDIA

ABSTRACT

Synthesis of nanostructural materials using plant leaf extract is an eco-friendly, non-toxic and cost efficient approach. In this paper we report the synthesis of copper oxide nanoparticles using copper acetate as precursor and *Ocimum tenuiflorum* leaf extract as a reducing agent. The synthesized copper oxide nanoparticles were characterized by FT-IR, SEM, XRD and EDX. These analytical techniques clearly confirm the formation of copper oxide with monoclinic structure. Our method utilizes an economic, eco-friendly and biocompatible reducing agent for the synthesis of copper oxide nanoparticles.

Key words: Green synthesis**,** Copper oxide nanoparticles, *Ocimum tenuiflorum* leaf extract.

INTRODUCTION

Green chemistry is a rapid emerging field of chemistry, its aim is to reduce the effect of damage caused to the environment by manmade materials and the processes used to produce them[1].The small and tiny particles consisting of large surface area is capable of reacting with various chemical groups to show their efficiency in various application[2]. Among various metal oxides such as Ni, Cu, Zn, Au and Fe, synthesis of copper oxide is considered as important topic of research. Copper (II) oxide has been widely used for diverse applications like active electrode material for Li-ion batteries, field emission emitters, heterogeneous catalysts, gas sensors and solar cells[3,4]. Different chemical methods are available for the synthesis of copper oxide nanoparticles namely wet chemical method[5], direct thermal decomposition method[6], microwave irradiation method[7], sol-gel method[8] etc. Although different methods exist for the synthesis of copper oxide nanoparticles, most of the methods are inefficient, costly and generate toxic wastes to the environment. Therefore there

*Author for correspondence; E-mail: prasad2136@gmail.com

arises an urgent need to develop an eco friendly technique. Recently green synthesis of nanoparticles using plant such as Cassia auriculata[9], Hibiscus rosasinenss[10], Calotropis gigantea[11], Ocimum sanctum[12] and tea leaf[13] have been reported. The presence of bioactive functional elements act as reducing groups in green chemistry[14].

In this paper for the first time we used *Ocimum tenuiflorum* leaf extract for the synthesis of copper oxide nanoparticles. The leaf extract contains eugenol, eugenic acid, caryophyllene, urosolic acid, luteolin, rosmarinic acid, aesculin, limatrol, linalool, apigenin, isothymusin, carotene and ascorbic acid are reported[15,16]. The plant extract can act as reducing agent. The synthesized copper oxide nanoparticles were characterized using FTIR, XRD, SEM and EDX.

EXPERIMENTAL

Preparation of leaf extract

Fresh leaves of *Ocimum tenuiflorum* were collected and washed several times with tap water and later with deionized water. It is then dried and powdered. Leaf extract was prepared by adding about 0.5 g of powdered leaf to 50 mL of deionized water followed by 30 mins stirring, which is then filtered using whatmann filter paper.

Synthesis of copper oxide nanoparticles

200 mL of copper acetate solution was treated with 20 mL of aqueous leaf extract and stirred magnetically at room temperature for 30 mins until the light blue color changes to light green color, which indicates the preliminary formation of copper nanoparticles.

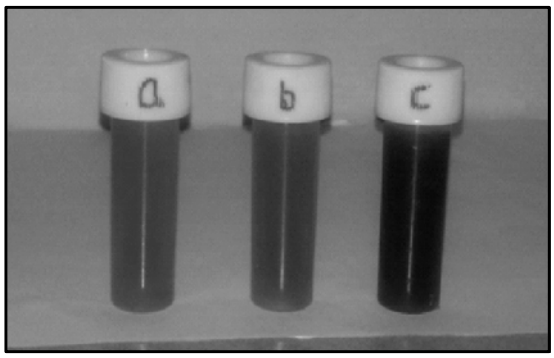

Fig. 2 shows the various stages involved in the synthesis of copper oxide nanoparticles (a) 2% Copper acetate solution, (b) Copper acetate mixed with leaf extract, (c) Formation of copper oxide nanoparticles after heating at 80°C

The green colored solution was stirred for 3 hrs magnetically and then heated at 80^{o}C for 2 mins. Drop wise addition of 1 M NaOH changes the green mixture to brown precipitate, which indicates the formation of water soluble copper oxide nanoparticles. The brownish black precipitate was washed repeatedly with deionized water followed by ethanol to remove the impurities. The brownish black powder was obtained after drying at 60^{o}C.

RESULTS AND DISCUSSION

The present study reveals the use of *Ocimum tenuiflorum* leaf extract for the synthesis of copper oxide nanoparticles. The leaf extract acts as a reducing agent in the synthesis of copper oxide nanoparticles. Studies show that biomolecules like protein and flavanoids not only play a role in reducing the ions to the nano size, but also play an important role in the capping of the nanoparticles[17,18].

EDX identifies the elemental composition of the prepared materials. EDX of the prepared copper oxide nanoparticles show peaks corresponding to copper and oxygen and shows the uniform distribution of copper and oxygen.

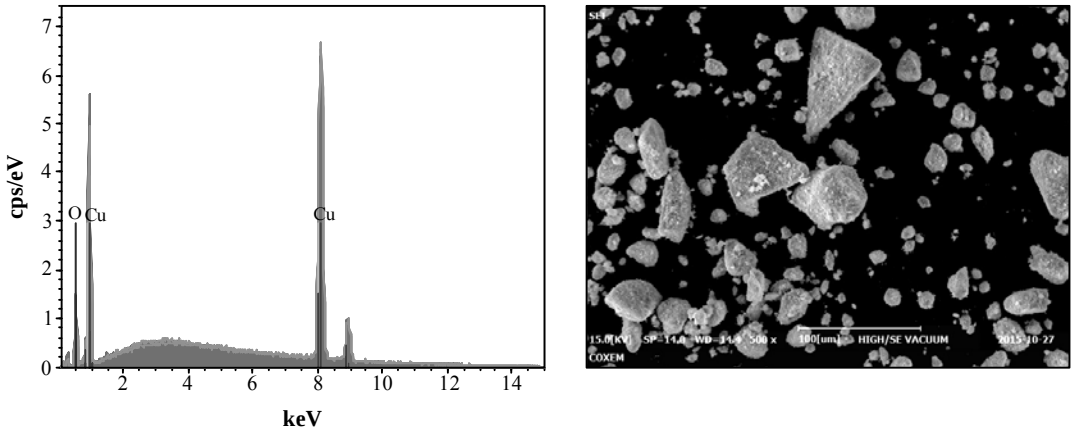

Fig. 2 and 3: Shows EDX and SEM images of synthesized copper oxide nanoparticles

The surface morphology and size of the nanoparticles were obtained by SEM. The SEM image confirms the presence of crystalline copper oxide nanoparticles of nearly similar shape.

X ray diffraction spectroscopy analysis determines the crystalline nature of the particles and the quality of compounds. The major peak positions at 2θ values of 35.5 and 38.64 in the high angle XRD of copper oxide nanoparticles indicate the existence of

crystalline nature of nanoparticles. The major peak positions closely matches with the Joint committee for powdered X-ray diffraction standard (JCPDS no 02-1225) and also matches with the values of monoclinic phase copper oxide nanoparticles reported by Toonani et al.[19] and Rahman et al.[20]

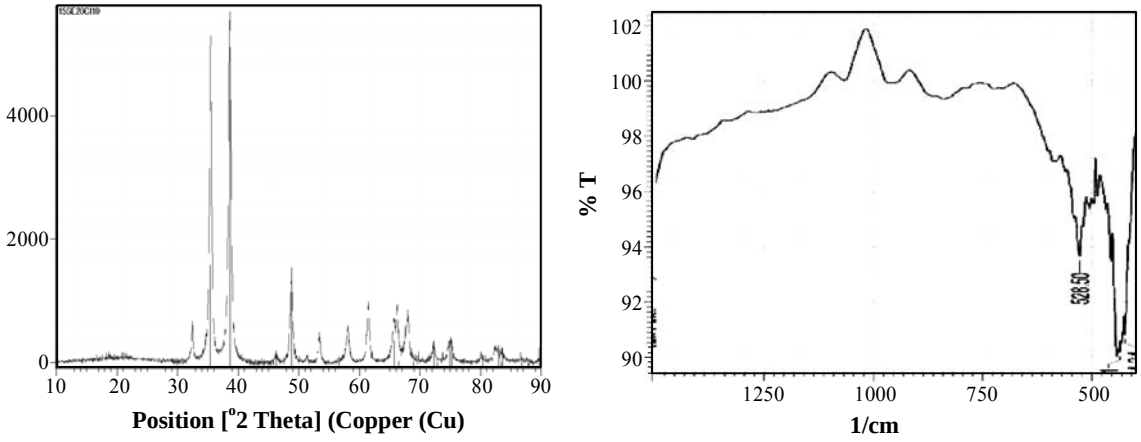

Fig. 4 and 5: Shows XRD and FTIR images of synthesized copper oxide nanoparticle

The FT-IR absorption peak observed at 424, 440 and 528.50 cm^{-1} in the IR spectra of synthesized copper oxide nanoparticles corresponds to Cu-O stretching in the monoclinic phase of CuO[21]. The peak positions confirmed the presence copper oxide nanoparticles. The present study reveals the use of *Ocimum tenuiflorum* leaf extract for the synthesis of copper oxide nanoparticles. The carbohydrate, flavanoids and poly phenol constituents present in leaf extract act as the surface active stabilizing molecules for the synthesis of copper oxide nanoparticles.

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