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GREEN SYNTHESIS AND CHARACTERIZATION OF COPPER NANOPARTICLE USING ACHYRANTHES ASPERA LEAF EXTRACT AND THEIR BILOGICAL ACTIVITIES

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***Abstract*- The plant of Achyranthes aspera (common names: chaff-flower, prickly chaff flower, devil's horsewhip) is a species of plant in the family Amaranthaceae. It is an invasive species in some areas, including many pacific island environment. Nanotechnology is a convergent science in the sense that it brings together different sciences and technologies into a single field. Nanoparticles having one or more dimensions of the order of 100nm or less have attracted their extraordinary properties, with various applications in the field of medicine. Copper was of a particular interest for this process due to its evocative physical and chemical properties. The aim of the present study was to evaluate the effect of plant synthesized copper nanoparticle (Cu NPs) using aqueous leaf extract of Achyranthes aspera .The synthesized copper nanoparticles were confirmed by the change of colour after the addition of leaf extract into the copper sulphate solution. The synthesized Cu NPs were characterized by UV-Vis spectrum and Fourier transform infrared spectroscopy(FTIR),SEM(Scanning Electron Microscopy),Energy Dispersive X-Ray analysis(EDAX), X-ray diffraction analysis(XRD). Hence, the plant based biosynthesized copper nanoparticle could be used in some biomedical application.**

***Keywords*-Achyranthes aspera, Biosynthesis, copper nanoparticle(Cu NPs)**

1.INTRODUCTION

Nanotechnology refers to an emerging field of science that includes synthesis and development of various nanomaterials. Nanoparticles can be defined as objects ranging in size from 1-100nm that due to their size may differ from the bulk material. In recent years, the applications of nanoparticles(NPs) in medicine has increased and expended to the fields of molecular imaging , drug delivery , diagnosis and treatment of cardiovascular disease, wound healing and development of materials and medical devices with antimicrobial properties . nano particles synthesis is being widely explored, since they exhibit unique size and shape dependent properties for application in optics, electronics, catalytic system, magnetic and biomedical field such as HIV inhibition , cancer cell cytotoxicity and genotoxicity. Nanoparticles can be synthesised chemically or biologically .Eco friendly alternatives to chemical and physical methods are biological ways of nanoparticles synthesis using microorganism, enzymes, fungus, and plants or plant extracts. The plant of Achyranthes aspera which is distributed as weed throughout India, tropical Asia and other parts of the world . Ayurvedic, yunani practitoners and kabirajs use different part of this plant to treat leprosy, asthma, fistula, piles, arthritis, wound, insect and snake bite etc.. . The plant is reported to be used as antimicrobial , larvicidal ,antifertility, diuretic, antinoiceptive, analgesic. Among all the nanoparticle, Cu NPs attracted considerable attention due to their interesting properties and potential application in diverse field , including energy conversion , energy storage, chemical manufacturing, biological application and environment technology. To serve the Cu NPs easily , low cost and scalable methods are highely desirable. There are several methods for synthesis of Cu NPs such as thermal treatment, supercritical condition, atomic layered deposition(ALD), chemical vapour deposition(CVD),sputtering, chemical dealloying and sonochemical, chemical treatment. The development of rapid, environment friendly and suitable for the large scale synthesis of Cu NPs is therefore of great demand consist of a noval and suitable reducing agent with rapid synthesis process for Cu NPs. It is great challenge to achieve a desired size and shape without taking time and stabilizer.

2.METHODS AND MATERIALS

2.1 COLLECTION OF SEEDS

The Achyranthes aspera leaves were collected from wasteland areas of Erode. A freshly collected leaves were washed and dried for 20 days. An dried leaves were in powdered form Fig:1 shows powdered leaves and Fig:2 shows leaves profile.

Fig-1 powder of Achyranthes aspera leaves

Fig-2 Achyranthes aspera leaves

2.2 PREPARATION OF LEAVES EXTRACT

About 10g of leaf powder was taken in 250 ml beaker and 150 ml of distilled water was added and boiled for 30 minutes. After cooling, the extract was filtered using filter paper and stored for further usage.

2.3 SYNTHESIS OF COPPER NANOPARTICLES

1g of Cuso4 solution was madeup into 50ml standard flask . 100ml of aqueous extract was taken in a clean conical flask . The prepared 50ml cuso4 solution was mixed with aqueous leaf extract , the colour of the solution changes from reddish brown into pale green colour . The solution was tightly covered and kept in dark room for 48 hours. After 48 hours the colour change was observed. Stage 1 shows aqueous leaf extract stage 2 shows copper nanoparticle.

STAGE -1 STAGE -2

3. CHARACTERIZATION OF COPPER NANOPARTICLE

The phytofabricated copper nanoparticle were characterized by different methods. A change in colour from reddish brown to pale green colour was observed, indicating the formation of nanoparticles which was further confirmed by following techniques.

3.1UV-VISIBLE SPECTROSCOPY

Absorption of light in the UV/Visible part of the spectrum (210 – 900 nm). The transitions that result in the absorption of electromagnetic radiation in this region of the spectrum are transitions between electronic energy levels. Generally, the most probable transition is from highest occupied molecular orbital (HOMO) to lowest occupied molecular orbital (LUMO). UV/Vis spectroscopy determines the concentration of the solute in a solution that works towards absorption. As the concentration varies, the absorbance also changes. This is based on the Beer Lambert law that states the absorbance of a solution is directly proportionate to the amount of the absorbing species in the solution. A UV-visible spectroscopy was used to obtain the synthesized copper nanoparticle had spectra λmax at 279 nm.

Fourier Transforms Infra-Red(FTIR) Analysis

The chemical composition of the synthesized copper nanoparticle was studied by using PerkinElmer spectrum FTIR spectrometer. A Fourier Transform Infra-Red(FTIR) spectrometer was used to obtain the infra-red spectra of absorption and emission of the Achyranthes aspera and copper nanoparticle. The dried

powder/particles were characterized in the range 4000-450 cm^{-1} using KBr pellet method.

3.2 X-Ray Diffraction (XRD) analysis

XRD analysis, by way of the study of the crystal structure, is used to identify the crystalline phases present in a material and thereby reveal chemical composition information. Identification of phases is achieved by comparison of the acquired data to that in reference databases. X-ray diffraction is useful for evaluating minerals, polymers, corrosion products, and unknown materials. In most cases, the samples analysed at Element are analysed by powder diffraction using samples prepared as finely ground powders.

The particle size of the prepared samples were determined by Debye-Scherrer's equation showed below

$D = K\lambda/cos\theta$

Scanning Electron Microscopy(SEM) analysis

The surface morphology of the biologically synthesized copper nanoparticle was analysed by means of SEM. 24 hours after the addition of CuSO4 the SEM slide were prepared by smearing the solution on the slide. A thin layer of the platinum or carbon was coated to make the sample conductive . The sample was characterized in the SEM at an accelerating voltage of 20 KV.

3.3 EDAX ANALYSIS

Energy Dispersive X-Ray Analysis (EDX), referred to as EDS or EDAX, is an x-ray technique used to identify the elemental composition of materials. The technique can be qualitative, semi-quantitative, quantitative and also provide spatial distribution of elements through mapping.Energy Dispersive X-Ray Spectroscopy (EDS or EDX) is a chemical microanalysis technique used in conjunction with scanning electron microscopy (SEM). ... The EDS technique detects x-rays emitted from the sample during bombardment by an electron beam to characterize the elemental composition of the analysed volume.

4. RESULT AND DISCUSSION

4.1 UV-Visible spectroscopy

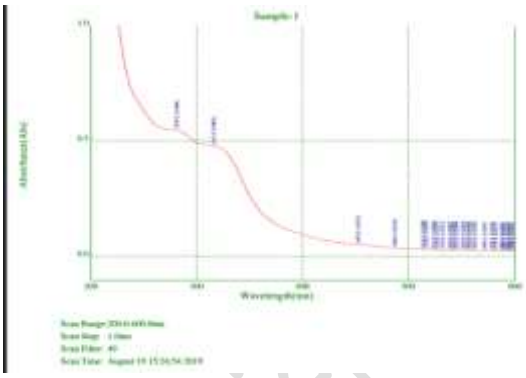

Fig: 3 UV-Visible spectroscopy

The more easily excited electrons (lower energy gap between the HOMO and the LUMO), the longer the wavelength of light it can absorb. There are four possible types of transitions (π-π*, n-π*, σ-σ*, and n-σ*), and they can be ordered as follows: σ-σ*> n-σ* > π-π* > n-π*. In the present study copper nanoparticle was prepared from Achyranthes aspera leaf extract by green synthesis process and the synthesized nanoparticle subjected to UV-Vis spectroscopy method. The synthesized copper nanoparticle had spectra λmax at 279.0 nm. And it is shown in Fig:3

4.2FTIR ANALYSIS

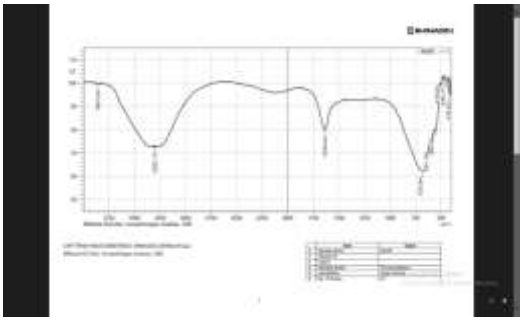

Fig:4 FTIR Spectrum of aqueous extract of Achyranthes aspera

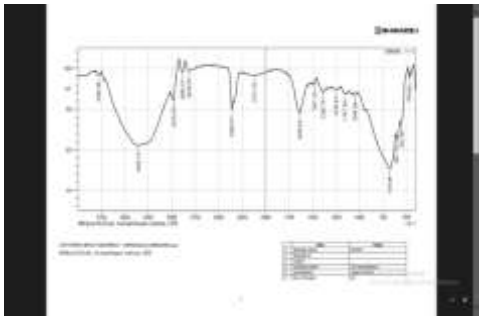

Fig:5 FTIR Spectrum of copper nanoparticle

The FTIR analysis for aqueous extract of Achyranthes aspera leaf contain functional groups such as C-Br stretch at value 555.50, C-Cl stretchat value 601.71, =C-H bending at value 678.94, C=C stretch at value 1635.64,(alcohol)OH stretch 3302.13. The FTIR analysis for copper nanoparticle contain some functional groups such as =C-H bending at value 678.94, C=C stretch at value, N-H stretch at value 3356.14, C-Cl stretch at value 601.79, C-Br stretch at value 555.50.and it is shown in Fig;4,5

4.3 XRD ANALYSIS

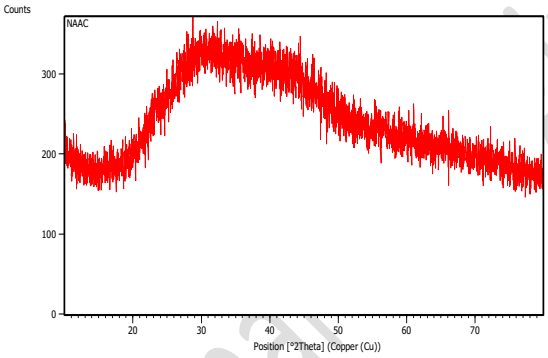

Fig: 6 XRD Analysis

The sizes of the synthesized copper nanoparticles were calculated from powder XRD pattern using Debye - Scherrer's formula,

$D=k\lambda/\beta \cos\theta$

In the present study the size of the synthesized copper nanoparticle from copper(II)sulphate pentahydrate using Achyranthes aspera leaf extract was found to be Amorphous in nature. And it is shown in Fig:6

4.4 SEM ANALYSIS

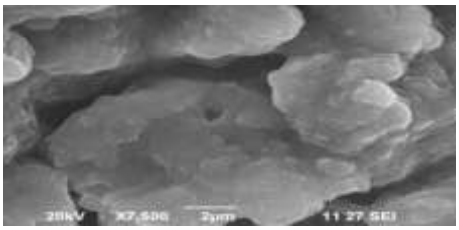

Fig: 7 SEM Analysis

In this present study the shape of the copper nanoparticles synthesized from copper(II)sulphate pentahydrate using Achyranthes aspera leaf extract was analyzed using scanning electron microscope. The image obtained by SEM for the synthesized copper nanoparticle showed floral shaped nanoparticles. And it is shown in Fig:7

4.5 EDAX ANALYSIS

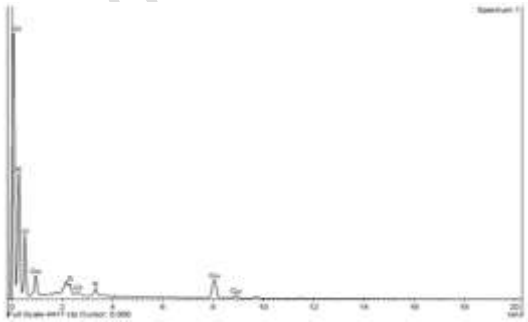

Fig: 8 EDAX Analysis

Energy Dispersive X-Ray Analysis (EDX), referred to as EDS or EDAX, is an x-ray technique used to identify the elemental composition of materials. EDAX was used to predict the components which is present in the synthesized copper nanoparticle from copper(II)sulphate pentahydrate using Achyranthes aspera leaf extract .The energy dispersive X-ray analysis (EDAX) analysis of green synthesized coppernanoparticles. This represent the elemental composition in green synthesized copper nanoparticles through EDAX . And it is shown in Fig:8

5.CONCLUSION

In biosynthesis, the formation of copper nanoparticles was indicated by the change in colour of the mixture (copper(II)sulfatepentahydrate and Achyranthes aspera in aqueous leaf extract) from colourless to pale green after the addition of copper(II)sulfatepentahydrate into Achyranthes

aspera in aqueous leaf extract.UV-Vis spectroscopy showed λmax value for the synthesized copper nanoparticle using copper(II)slfatepentahydrate at 279.0 nm.FTIR analysis for copper nanoparticle showed the peak values at 3356.14 cm-1 (N-H stretching frequency), 1635.64 cm-1 (C=C stretching frequency), 678.94 cm-1 (=C-H bending frequency), 601.79cm-1(C-Cl Stretching frequency), 555.50 cm-1 (C-Br Stretching frequency).The FTIR analysis for aqueous extract of Achyranthes aspera leaf contain functional groups such as C-Br stretch at value 555.50, C-Cl stretchat value 601.71, =C-H bending at value 678.94, C=C stretch at value 1635.64,(alcohol)OH stretch 3302.13.XRD data showed the amorphous in nature the synthesized copper nanoparticle from copper(II) sulphate pentahydrate using Achyranthes aspera leaf extract ,SEM image showed that the shape of the synthesized copper nanoparticle was floral in shape. EDAX showed that the elemental composition of the synthesized copper nanoparticles.

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