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Biosynthesis of CuO and ZnO nanoparticles using *Lantana camara* flower extract and screening their antibacterial activity against pathogenic bacteria

A thesis
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Introduction

The World Health Organization (WHO) reports have estimated over 265,000 of mortality occurred every year as a result of burn injuries and wound infections Wounds and burns infections occur when a wide areas of skin are disrupted ,microbial nutrient availability and vascular supply destruction as well as systemic immunosuppression (Jahromi *et al*.,2018).

All over the world, antibiotic resistance is reached extremely high levels, and new resistance mechanisms are also spreading rapidly presenting a threat to our capacity to treat common diseases. The over prescription of medications by medical professionals and veterinarians, as well as the overuse of antibiotics by the general public without physician supervision in healthcare facilities have all contributed to the rise of antibiotic resistance to high levels. Today, antibiotics can be purchased for human or animal use without a prescription in countries without following guidelines of standard treatment (WHO, 2020).

As a result of the antibiotic resistance issue there was an urgent need for alternative drugs to overcome this challenge, the natural alternatives such as medicinal plants and their extracts has become the safest alternatives. *Lantana camara*, Family: Verbenaceae is a medicinal plant which have various traditional uses. Parts of plant extracts are used traditionally in healing of wounds, cuts, skin itches, and eczema. The plant containing many famous phytochemicals such as alkaloids, glycosides, steroids, flavonoids, and tri-terpen glycosides (saponins). It also has various pharmacological activities as an antioxidant, antimicrobial, antibacterial, antifungal, anti-ulcers ,anti-helmintic ,anti-hyperglycemic, anti-inflammatory, analgesic, anticancer, anti-tubercular and insecticidal activity (Kumar *et al*., 2020).

Nanotechnology is a modern field of research since last century that produced materials of various Nanoparticles (NPs) which include particulate with one dimension less than 100 nm (Khan *et al*.,2019).

These NPs characterized by different techniques for the analysis of various physicochemical properties of NPs. These techniques include X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Field Emission Scanning Electron Microscope (FESEM), and Atomic force microscope (AFM)(Khan *et al*.,2019). Many metals and their oxides nanoparticles have been synthesized by various chemical and physical approaches as well as the biological approaches mediated by plants and number of microorganisms ,these nanoparticles include gold (Au), silver (Ag), lead (Pb), platinum (Pt), copper (Cu), iron(Fe), cadmium (Cd), and other metal oxides such as titanium oxide (TiO), zinc oxide (ZnO) and copper oxide (CuO) (Khandel *et al* ., 2018).

Synthesis approaches mediated by plants are found to be more safe and economic route to synthesize these metal NPs . Because of diversity of plants that made the actual mechanisms of the synthetic process is yet to be fully known. Conventionally, NPs are synthesized by chemicals and physical methods using several chemicals but these methods not without the risk of being toxic in general , so that to solve this objective biological approaches is coming up to fill these gaps. Biological synthesis of metallic nanoparticles is inexpensive, one-step, and eco-friendly method (Khandel *et al*., 2018).

The green synthesis technology is biologically safe, cost-effective, and environment-friendly that has revealed the capability of a living system to utilize their intrinsic organic chemistry processes in remodeling inorganic metal ions into NPs.(Zhang *et al*.,2020). Copper oxide is an important metal oxide which has attracted recent researchers because of its low cost, abundant availability as well as their significant properties (Nithya *et al*., 2014).

Copper is highly toxic to bacteria and non-toxic to animal cells, it is considered an effective bactericidal metal. It is also considered safe for human beings for applications such as food package and in water treatment (Devi, 2014).

Zinc oxide nanoparticles is listed by the U.S. F.D administration as safe. It is also biocompatible and non-toxic for human beings and animals (Zhong *et al*.,2018). This metal oxide NPs have unique properties including optical and electrical conductivity, it is also used as filtrating UV and has an antiviral, antibacterial, antifungal and anticancer activities (Qi *et al*., 2017).

This study aimed to biosynthesize of CuO NPs, ZnO NPs by *Lantana camara* flower extract and study their antibacterial activity against antibiotic resistance bacterial strains and this can be done by:

1- Isolation and identification of pathogenic bacteria from wounds and burns infections and determination of their susceptibility to antibiotics
2- Biosynthesis of CuO and ZnO nanoparticles by *L. camara* flower extract and Study their characteristics.
3- Study the antibacterial activity of aqueous and alcoholic flower extract, CuO and ZnO NPs (*in vitro*) and determine the minimum inhibitory concentration (MIC) of the biosynthesized NPs under by micro-dilution method.

Summary

The recent study include the collection of 200 clinical specimens from patients admitted in Baqubah Teaching Hospital/ Diyala province from September 2021 to the end of January 2022 . The clinical specimens were distributed into 145 (72%) wounds and 55 (27.5%) burns specimens. All the surface swabs have been cultured in blood agar , mackonkey agar and mannitol salt agar.

The bacterial isolates were identified morphologically and biochemically which showed that 30(17.6%) and 13(7.64%) belonged to *Staphylococcus aureus, Staphylococcus epidermidis* respectively Whereas 56(32.9%), 32(18.8%), 20(11.7%),8 (4.7%) and 11(6.47) belonged to *Acinetobacter baumannii* , *Pseudomonas aeruginosa*, *Klebsiella* spp., *Proteus* spp. and *Escherichia coli* respectively. Susceptibility test was done on all the bacterial isolates and the identification was confirmed by APiE20 and Vitek- 2 system.

Lantana camara flowers were used in the biosynthesis process of Copper oxide and Zinc oxide nanoparticles by using Copper nitrate and Zinc nitrate as a precursor. The change in color of the mixture indicated the formation of nanoparticles. Characterization of the biosynthesized nanoparticles was done by ultraviolet-visible spectroscopy UV-Vis, X-Ray diffraction XRD, Atomic Force Microscopy AFM, Field Emission Scanning Electron MicrosopeFE-SEM and Foureir transform Infrared spectroscopy FTIR. The results of the characterization of CuO, ZnO NPs showed that the UV peaks were at (384.5,827) nm, the X-ray diffraction showed that the crystallites size were (28.4,22.5) nm which confirm the formatin of pure nanoparticles.

Analysis of FTIR detected the biochemical compound that were responsible for the reduction of the metals salts into nanoparticles, the average particles size of CuO , ZnO NPs estimated by FE-SEM were (42.07, 45.15) nm respctively