I. INTRODUCTION

Nanotechnology is principally an attractive area of research related to the production of nanoparticles in varying sizes, shapes, chemical compositions and its possible application of human benefits (Javad Karimi and Sasan Mohsenzadeh, 2013). Nanotechnology proceeds by three processes separation, consolidation and deformation of two materials by one atom or molecule (Taniguchi et al., 1974). It has a very important role in modern research and is the most capable technology that can be applied in almost all fields (Saranyaadevi et al., 2014). Nanoparticles are sub- nanosized colloidal structures composed of synthetic or non- synthetic polymers. Nanoparticles are building blocks of nanotechnology and are referred to as natural, incidental or manufactured material containing particles (Pattanayak et al., 2014). It is solid particles at the nanoscale that can drastically modify physico- chemical properties compared to the bulk material. It can explicate actions depending on the chemical composition, biological actions, size and shape (Shobha et al., 2014).
Nanoparticles are abundant in nature and are produced in many natural processes, including photochemical reactions, volcanic eruptions, forest fires and simple erosion by plants and animals. It has expressed significant advances owing to a wide range of applications in the field of biomedical, sensors, antimicrobials, catalysts, electronics and optical fibers, agricultural, biolabelling and in other areas (Kavitha et al., 2007). Industrial pollutants and charcoal burning, natural events such as dust storms, volcanic eruptions and forest fires can produce such vast quantities of nanoparticulate matter that profoundly affects the ecosystem (Cristina Buzea et al., 2007).

Nanoparticles have positive impact in improving many sectors of the economy including consumer products, energy, transportation, cosmetics, pharmaceuticals, antimicrobial agents and agriculture. The composites prepared using metal nanoparticles and polymers can find better utilization due to the enhanced antimicrobial activity. Nanoparticles play a vital role in the production of food products against microbial contamination. It also acts as carrier vehicles of nutrients, nutraceuticals, enzymes, food additives, and also improves the physical, chemical and nutritional quality of feed and its respective ingredients by application of nanotechnology in the different steps for manufacturing (Erkan Can et al., 2011).

As water is an essential component in ecosystems and natural vehicle for pollutant migration, the data and behavior of synthetic Nps in different types of natural waters as well as their potential eco-toxicity effects are essential for evaluation of the environmental risks of nanotechnologies (Blinova et al., 2010). Some of the nanoparticles such as silver, titanium dioxide, zinc oxide and copper oxide are receiving considerable attention as antimicrobials and additives in consumer, health-related and industrial products.

Among the numerous metal oxide nanoparticles, copper oxide has attracted significant attention because it is a superconductor (Yip and Souls, 1992). It has chemical and physical properties which include high thermal conductivity and electrical conductivity, low corrosion,
alloying ability and an aesthetically pleasing appearance. These properties make it one of the most important metals. Further, it can be used as an antimicrobial, antibiotic and antifungal agent when incorporated in coatings, plastics and textiles etc. (Raja Naika et al., 2015 and Rohit Guin et al., 2015). Due to antibacterial property, copper oxide nanomaterials are being incorporated into a variety of medical, skin coatings and wallpapers in hospitals as antimicrobials and the active ingredient for dermatological applications in creams, lotions and ointments (Ravishankar Rai and Jamuna Bai, 2011). It has been also utilized for the treatments of infection, cancer, allergy, diabetes and inflammation (Saranyaadevi et al., 2014). Copper oxide nanoparticles are used to develop a good sensor, because of its highly specific area, good electrochemical activity and promoting the electron transfer reaction at a lower voltage and hence used in gas sensors, photovoltaic cells, in catalyst applications and in heat transfer nanofluids. CuO Nps are studied intensively because its toxicity is particularly pronounced compared to other Nps (Matthew S. P Boyles et al., 2016). They are most potent regarding cytotoxicity and DNA damage. The toxicity was explained by Cu ions released into the cell medium (Hanna L.Karlsson et al., 2008).

Generally, the nanoparticles are synthesized by physical, chemical and biological by using top-down and bottom-up strategies (Balantrapu and Goia, 2009). In a top-down approach, the bulk materials are gradually broken down to nanosized materials, whereas in the bottom-up approach, atoms or molecules are assembled to molecular structures in the nanometer range. The bottom-up approach is commonly used for chemical and biological synthesis of nanoparticles (Neveen Abdel Raouf et al., 2013). Methods used to synthesize copper oxide nanoparticles are the microemulsion, reverse micelles, gamma irradiation, ultraviolet irradiation, simple precipitation, thermal decomposition, laser irradiation, chemical reduction microwave-assisted and also biological methods using living organisms such as plants and microorganisms (Khodashenas and Ghorbani, 2014).
Among the different methods, green technology is an emerging and powerful technology for the development of innovative, reliable and sustainable solutions to address global issues through research, development and innovation. Indeed, green nanotechnology is based on lowering the risk of producing and applying nanomaterials. Biosynthesis strategies show desirable characteristics under the sustainability perspective that are eco-friendly and are simple and rapid to produce biocompatible, biodegradable, low cost and high yield products (Luciano Paulino Silva et al., 2015). The preparation of nanoparticles is established either by nanoparticle synthesis or by processing of nanomaterials into nanostructure particles (Arun et al., 2013). The bioreduction of metal oxide nanoparticles by a combination of biomolecules found in plant extracts (enzymes, proteins, amino acids, vitamins, polysaccharides, and organic acids such as citrates) and the respective role of phytochemicals (Shobha et al., 2014). Among the medicinal plants, Hyptis suaveolens (L) Poit and Ocimum sanctum belonging to family Lamiaceae contains alkaloids, terpenes, phenols, flavonoids and volatile oils and is anti-inflammatory, antinociceptive, antiulcer, antioxidant, insecticidal and has antibacterial properties too. Plant leaves are traditionally used as a stimulant, antispasmodic and against colds and diarrhoea. Also it contains basic food nutrients such as protein, carbohydrates, fats, fiber and phytonutrients such as alkaloids, tannins, saponins, flavonoids and terpenoids. The plant is also rich in some mineral elements like potassium (K), calcium (Ca), magnesium (Mg), nitrogen (N), sodium (Na) and phosphorus (P) (Umedum Ngozi et al., 2014).

The biologically synthesized nanoparticles are unique and have physico-chemical, optical and biological properties, which can be manipulated suitably for desired applications. Biosynthesis methods are more efficient over other classical synthesis procedures. Recently the biologically synthesized nanomaterials have been found to have potential applications indifferent areas such as treatment, diagnosis, development of surgical nanodevices and
commercial product manufacturing. Nanomedicine makes a huge impact on the health care sector in treating various chronic diseases. Consequently, green synthesis of nanoparticles helps to control various diseases and considered as the basis for forthcoming generations (Kuppusamy et al., 2014).

CuO Nps are often present in industrial wastewaters that may become extremely toxic for aquatic animals as their concentration in water increase. At high concentrations, it becomes hazardous to the aquatic ecosystem and pose possible human health risks. According to FAO maximum permissible concentrations of copper in fish is 30 mg/g. Besides, it is toxic, harmful to organisms living in water, accumulate in the food chain and may affect humans too (Pourkhabbaz Alireza et al., 2011). The nanoparticle contamination may have devastating effects on the ecological balance of the recipient environment and diversity of aquatic organism. Among animal species, fishes are the inhabitants that cannot escape from the detrimental effect of these pollutants. The amount of protein, lipid and carbohydrate in fishes is used for the determination of their nutritive value in fish and hematological analysis of blood parameters are considered physiological indicators of the whole body and therefore are important in diagnosing the structural and functional status of fish exposed to nanoparticles. Hematological parameters such as Hematocrit (Hct), hemoglobin (Hb) and red blood cells (RBCs) are used to assess the functional status of oxygen carrying capacity of the blood stream and have been used as an indicator of metal pollution in the aquatic environment (Rajendra Shejwal et al., 2014).

Histopathological studies showed that copper oxide nanoparticles caused organ injuries including aneurysms, hyperplasia, necrosis in the secondary lamellae of the gills, and mucosa layer and vacuole formation in the gut. These data can be useful in aquatic toxicity management and environmental safety (Mahboobe Khabbazi et al., 2014). Bacteria are serious and potentially life-threatening agents, capable of promoting infectious diseases. CuO
nаноцистали ар опциян ин контраст аз антибактериал реагентс и позе ар антибактериал аквитиви ин север биомедикал аппликашн, суах ас медицина, ген деливир, тиси инжиниринг, ин аймининг (Gina V. Vimbelа et al., 2017). Антиоксиданты ар предвентив агентс ар кун брикалдас и дэлп ап диминиш ин отсидвентив прессю инстагит харм. (Saikat Sen and Raja Chakraborty, 2018). The биологически и химически синтезированные купер оксид наночастицы имеют электрохимические свойства, которые могут быть использованы в области медицины, рыбоводства и для изготовления биозенсора. The studies related to the impact of biologically and chemically synthesized copper oxide nanoparticles on biochemical, hematological and histopathological analysis of freshwater fish Cyprinus carpio and application of nanoparticles are totally wanting. Hence the present study was carried out.

The objectives of the present study:

- To collect and selection of medicinal plants based on antioxidant and antibacterial activities.
- To biologically and chemically synthesize copper oxide nanoparticles and its characterization.
- To assess the toxicity of copper oxide nanoparticles in freshwater fish Cyprinus carpio (LC₅₀ and Sub Acute).
- To examine the biochemical, hematological and histopathological changes in Cyprinus carpio.
- To study the antibacterial, antioxidant activity and biosensor properties of biologically and chemically synthesized CuO Nps for sensing melatonin hormone in the blood sample.