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Hydroxyethyl Cellulose Stabilized Copper Nanoparticles and its Antibacterial Activity

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ABSTRACT

In this study, we report the green synthesis of copper nanoparticles (CuNPs) by reduction of copper nitrate ($Cu(NO_3)_2$) using ascorbic acid as reducing agent and hydroxyethyl cellulose (HEC) dissolved in water which acts as stabilizing agent. The formation of copper nanoparticles was studied by optimizing the reaction condition using different parameters such as concentration of $CuNO_3$, concentration of HEC, temperature and reaction time. The presence of copper nanoparticles was assured by characterization of UV-vis spectroscopy. The complete reduction of copper ions to copper nanoparticles is revealed by the surface plasmon resonance peak at 550-600 nm. The synthesised copper nanoparticles showed good antibacterial activity. The antibacterial property against the bacteria such as *Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa, Enterococcus faecalis* and *Staphylococcus aureus* were evaluated by agar well diffusion method and minimum inhibitory concentration method. This study presents a feasible green method to synthesize copper nanoparticles which had antibacterial activity and promising for various applications.

Keywords: Hydroxyethyl cellulose; aqueous medium; copper nanoparticles; antibacterial activity; environmentally friendly synthesis.

INTRODUCTION

The introduction of transition metallic nanoparticles has extensively spread throughout worldwide due to their application in chemical, biological and environmental science. It has a high surface to volume ratio with diameters in the range of 1-100 nm. The size and the shape are the key factors for their unique properties. Among all the nanoparticles, copper nanoparticles is the most widely used material in the world because copper is the one most important metal used in modern technology [12,7]. Among various metal particles, copper nanoparticles have attracted more attention because of their optical, electrical, catalytic, antibacterial and antifungal applications [11]. Copper nanoparticles is a semiconducting compound that has attracted particular attention in the industry due to its interesting properties and the cost. This nanoparticle are widely used in the field of electronics, solar energy transformations, catalysis, magnetic storage media, gas sensors, batteries and antimicrobial agent [6].

Copper nanoparticles can be synthesized using various routes, including hydrothermal and solvothermal methods, chemical reduction, electrolytic synthesis, sonochemical methods, sol-gel preparations, micro-emulsion techniques, wire explosion, and vacuum vapour deposition. Those synthesizing methods require a complicated reaction and involving expensive equipment. It also uses toxic chemicals and reducing agents like organic solvents. All these production methods, not only increases the cost of production, but also develop hazardous chemical synthesis and thus increase the toxicity issues as well as environmental issues [14] Hence, in this study green synthesis method was introduced to produce copper nanoparticles.

Green synthesis method is a process of synthesizing nanoparticles by using various plants, algae, bacteria, yeast, fungi and polysaccharides [3]. This method is an ecologically friendly, cost

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