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Biosynthesis of Silver Nanoparticles by Bamboo Leaves Extract and Their Antimicrobial Activity

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Abstract

The synthesis of nanoparticles from biological processes is evolving a new era of research interests in nanotechnology. Silver nanoparticles are usually synthesized by chemicals which are quite toxic and flammable in nature. This study deals with an environment friendly and biosynthesis process of antibacterial silver nanoparticles using bamboo leaves. The formation and characterisation of AgNPs were confirmed by UV-Vis spectroscopy, energy-dispersive spectroscopy (EDX), X-ray diffraction (XRD) and transmission electron microscope (TEM). The antimicrobial activities were carried out against *E. coli* and *S. aureus* strains by using disc diffusion method.

Keywords: Silver Nanoparticles; bamboo Leaves; Green Synthesis; Antibacterial

1 Introduction

Recently, metal nanoparticles have gained a lot of attention due to their unique chemical, optical, magnetic, mechanical, and electric magnetic properties. Thus metallic nanoparticles are used in different applications such as electronics, catalysis and photonic [1]. The silver metal has a great toxicity against a wide range of microorganisms, particularly; silver nanoparticle which has promising antimicrobial properties. Silver nanoparticles are found to be effective as anti-inflammatory, anti-angiogenesis, antiviral, anti-platelet activity and against cancer cells which makes them vital [2-7]. Accordingly, an environmental process for the synthesis of silver nanoparticles is important. Plant extract solutions and bio-organisms have been in spot light for their extreme ability to synthesis nanoparticles, including silver and gold nanoparticles.

Biosynthesis of silver nanoparticles has already been reported as clean, cost effective and non-toxic to environmental routes. Green synthesis offers improvement over synthetic, chemical or micro-organisms methods as it is cost effective, environmentally friendly and can easily be scaled up for large scale synthesis. The methods used for the synthesis of silver nanoparticles and toxic

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chemicals are used for the reduction process of substances such as citrates, $NaBH_4$, or ascorbates. Recently, green bio-reduction methods for the synthesis of silver nanoparticles were adapted by many researchers using plant extracts such as Macrotyloma uniflorum [8], Anacardium Mushroom extract [9], Coleus amboinicus lour [10], Medicago sativa [11], and Citrus sinensis peel [12] etc.

The main objectives of this study were to (i) to synthesize the silver nanoparticles using aqueous extract of bamboo leaves Phyllostachys aurea, (ii) to characterize the AgNPs by using UV–vis spectroscopy, (iii) to analyze antimicrobial properties against Gram-positive and Gram-negative bacteria.

2 Experimental

2.1 Materials

The bamboo leaves (Phyllostachys aurea) were collected from their trees available in the Xiasha campus of Zhejiang Sci-Tech University, Hangzhou, China. Silver nitrate ($AgNO_3$) was purchase from Strem Chemicals, Inc. (USA). Throughout the experiments distilled water was used.

2.2 Preparation of Bamboo Leaves Extract

To prepare the bamboo leaves extracts; 20 g of bamboo leaves were washed thoroughly with distilled water and dried for 24hrs at room temperature. The extract solution was prepared by boiling dried leaves in Erlenmeyer flash with 100 ml of distilled water for ten minutes at 100°C. Freshly prepared aqueous extract was used for synthesis. For this study no old extracts were used at any stage.

2.3 Synthesis of Silver Nanoparticles

In the experiment, 5 ml of fresh leaves extract was added to a conical flask containing 5 ml of 3 mM aqueous $AgNO_3$ solution heated at 65°C with continuous stirring. The silver ions were reduced to silver nanoparticles within few minutes by bamboo leaves extract. The quick conversion of solution color showed the formation of silver nanoparticles by observing color change from colorless to yellowish-brown color.

2.4 Antibacterial Assay

Silver nanoparticles biosynthesized from bamboo leaves extract were tested for antimicrobial activity by Kirby–Bauer method against pathogenic bacteria Escherichia coli (Gram-negative) and Staphylococcus aureus (Gram-positive). The pure bacteria cultures were sub cultured on nutrient agar media. Both strains were swabbed evenly onto the single plates using sterile glass rods. After incubation at 37°C for 24 hours, the levels of zone diameter inhibition of bacteria were measured.