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Green Biosynthesis of Silver Nanoparticles Using 'Polygonum *Hydropiper'* And Study Its Catalytic Degradation of Methylene Blue

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Abstract

The green synthesis of silver nanoparticles with the small size and high stability paved the way to improve and protect the environment by decreasing the use of toxic chemicals and eliminating biological risks in biomedical applications. Plant mediated synthesis of silver nanoparticles is gaining more importance owing its simplicity, rapid rate of synthesis of nanoparticles and eco-friendliness. In this study, focus on biosynthesis of silver nanoparticles using *Polygonum hydropiper* extract and its catalytic degradation of hazardous dye, methylene blue has been highlighted. The rapid reduction of silver (Ag) ions was monitored using UV-Visible spectrophotometer and showed formation of silver nanoparticles within less than one hour with maximum absorption of silver nanoparticles at 430 nm. The major functional groups present in the synthesis responsible for the formation of silver nanoparticles. It was identified by using Fourier Transform Infrared spectrophotometer (FTIR). Field Electron Scanning Microscope (FESEM) was used to characterise the nanoparticles synthesized using *P.hydropiper*. The morphology of silver nanoparticles was predominantly spherical and aggregated into irregular structure with average diameter of 60 nm. In addition, this report emphasizes the effect of the silver nanoparticles on the degradation rate of hazardous dyes by sodium borohydride ($NaBH_4$). The efficiency of silver nanoparticles as a promising candidate for the catalysis of organic dyes by $NaBH_4$ through the electron transfer process is established in the present study.

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*Keywords:*Nanosilver; Biosynthesis; *polygonum hydropiper*

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1. Introduction

In the last decade, the biosynthesis of nanoparticles, as a representative intersection of nanotechnology and biotechnology, has increasing attention due to the growing need to develop environmentally benign technologies in material synthesis. Although many synthetic technologies in material synthesis are well documented the search for suitable biomaterials for the biosynthesis of nanoparticles continues among researchers worldwide. Silver nanoparticles (AgNPs) are important materials that have been studied extensively. Such nanoscale materials possess unique electrical, optical as well as biological properties and are thus applied in catalysis, biosensing, imaging, drug delivery, nanodevice fabrication and medicine[17]. The metal nanoparticles have been synthesized using a variety of methods, including chemical and physical methods. Although nanoparticles can be made using various physicochemical methods, these methods are quite expensive and potentially dangerous to the environment. Other than, chemical methods employ toxic chemicals as reducing agents, organic solvents, or non biodegradable stabilizing agents and therefore potentially dangerous to the environment and biological systems. Thus, this will limit their applications. Use of biological organisms such as microorganisms and plant extracts could be an alternative to chemical and physical methods in an eco-friendly manner and green synthesis[7]. Moreover, the use of plant biomass and extracts for synthesis of nanoparticles is potentially advantageous over microorganisms due to several factors such as simple handling procedures, readily scalability and preclusion of cell culture maintenance. Furthermore, the plant biomass and extract can be obtained easily in due to availability and the abundance of plants that can be found in Malaysia. However, the selection of plant material is very critical in obtaining the best reducing agents in order to produce excellent size and shape of nanoparticles[3]. According to[10], biogenic synthesis is not only reduced environmental impact, but also can produce large quantities of nanoparticles that are free of contamination and have a well-defined size and morphology. Biosynthetic routes can actually provide nanoparticles of a better defined size and morphology than some of the physicochemical methods of production[15]. Due to their amenability to biological functionalization, the biological nanoparticles are finding important applications in the field of medicine. The antimicrobial potential of metal based nanoparticles has led to its incorporation in consumer, health-related and industrial products.Plant contains a complex network of metabolites and enzyme that can be manipulated to synthesize naoparticles. The main chemical constituents of these plants are flavonoids, flavonoids glycosides and phenylpropanoid glycosides. The presence of various chemical compounds in plant such as polyphenols, flavonoids, sterols, triterpenes, reducing sugar like glucose and fructose, and protein could help produce metallic nanoparticles.To achieve that, ‘kesum’ or *polygonum hydropiper*, which is a local herbaceous plant of the family *polygonaceae* will be selected as a medium for the biosynthesis nanoparticles. *Polygonum hydropiper* is a plant of the family *polygonaceae* It grows in damp places and shallow water. It is cosmopolitan plant, found in Australia, New Zealand, temperate Asia, Europe, and North America. It has some use as a spice because of its pungent flavour. *Polygonum hydropiper* has several active ingredients. Two bicyclic sesquiteroenoids are present, polygodial (tadeonal, an unsaturated dialdehyde with a drimane backbone) and waburganal, which has been found responsible for the pungent taste (hence its edibility). This plant is reported exhibit antioxidant activity that is one of the most main criteria in the biosynthesis of metal nanoparticles[14].The plant contains an essential oil (0.5%) which consists of monoterpenoids and sesquiterpenoids: α-pinene, β-pinene, 1,4-cineol, fenchone, α-humulene, β-ceryophyllene, trans-β-bergamotene.carboxylic acids (cinnamic,valeric and caproic acid) and their esters were present in traces. The composition depends strongly on genetic factors.Traditionally, this plant is used as a haemostatic, antimicrobial, anthelmintic and anti cancer agent[9]. Thus, these results are very encouraging and indicate that this herb should be studied more extensively to confirm this result and reveal other potential therapeutic effects

2 .Method & Characterization

The collected *Polygonum hydropiper* was washed thoroughly with distilled water. The dried leaves were powdered to fine particles using mixer grinder. For the preparation of aqueous leaf extract, 10g of leaf *Polygonum hydropiper* powder were dissolved in 100 ml of deionized water followed by boiling 60 ◦C for 10 minute. Leaf extract was then left in room temperature for 25 hours until further use. Finally, it was filtered through Whatman no.1 filter paper to obtain the pure leaf sample extract. The filtrate thus obtained were used as plant extract. For the