Hindawi
Journal of Nanomaterials
Volume 2021, Article ID 6696995, 11 pages
https://doi.org/10.1155/2021/6696995

Research Article

Highly Effective Degradation of Nitrophenols by Biometal Nanoparticles Synthesized using *Caulis Spatholobi* Extract

Van Thuan Le,[1,2] Van-Cuong Nguyen,[3] Xuan-Thang Cao,[3] Tan Phat Chau,[4] Thi Dung Nguyen,[5] Thi Lan-Huong Nguyen,[6] and Van-Dat Doan[3]

[1]*Center for Advanced Chemistry, Institute of Research and Development, Duy Tan University, 03 Quang Trung, Da Nang 550000, Vietnam*
[2]*The Faculty of Environmental and Chemical Engineering, Duy Tan University, 03 Quang Trung, Da Nang 550000, Vietnam*
[3]*Faculty of Chemical Engineering, Industrial University of Ho Chi Minh City, 700000 Ho Chi Minh City, Vietnam*
[4]*Institute of Applied Science & Technology, Van Lang University, Ho Chi Minh City 700000, Vietnam*
[5]*Division of Food Biotechnology, Biotechnology Center of Ho Chi Minh City, Ho Chi Minh City 700000, Vietnam*
[6]*Institute of Biotechnology and Food Technology, Industrial University of Ho Chi Minh City, Ho Chi Minh City 700000, Vietnam*

Correspondence should be addressed to Van-Dat Doan; doanvandat@iuh.edu.vn

Received 26 October 2020; Revised 5 December 2020; Accepted 8 March 2021; Published 22 March 2021

Academic Editor: Hassan Karimi-Maleh

The green biosynthesis of metal nanoparticles (MNPs) has been proved to have many advantages over other methods due to its simplicity, large-scale production, ecofriendly approach, and high catalytic efficiency. This work describes a single-step technique for green synthesis of colloidal silver (AgNPs) and gold nanoparticles (AuNPs) using the extract from *Caulis Spatholobi* stems. Ultraviolet-visible spectroscopy measurements were used to optimize the main synthesis factors, including metal ion concentration, reaction time, and reaction temperature via surface plasmon resonance phenomenon. Fourier-transform infrared spectroscopy showed the possible functional groups responsible for reducing and stabilizing the synthesized MNPs. The powder X-ray diffraction and selected area electron diffraction analysis confirmed the crystalline nature of the biosynthesized MNPs. High-resolution transmission electron microscopy revealed the spherical shape of MNPs with an average size of 10-20 nm. The obtained MNPs also exhibited the enhanced catalytic activity in the reduction of 2-nitrophenol and 3-nitrophenol.

1. Introduction

Noble metal nanoparticles (MNPs) are considered as an important class in the next generation of nanomaterials for catalytic degradation of organic pollutants due to their extraordinary large surface area and great dispersion in aqueous solutions [1]. Among them, silver and gold nanoparticles (AgNPs and AuNPs) have received great attention for their applicability in many fields, especially in catalysis [2]. Therefore, many different approaches for the synthesis of AgNPs and AuNPs have been developed, including physical, chemical, and biological methods [3]. However, the drawbacks of physical and chemical methods may be the low production efficiency, requirement of expensive equipment, usage of toxic reductants, and the long-time reaction, which might affect the cost of obtained products [4]. Compared with the traditional chemical methods, biogenic synthesis of AgNPs and AuNPs using herbal plant extracts is an ecofriendly solution due to its sustainable nature and environmentally benign [5]. The first use of plant extract for the synthesis of MNPs was recorded by Gardea-Torresdey et al. in 2003 [6]. It was reported that the formation of MNPs using plant extract from *Alfalfa* sprouts could be accomplished under normal conditions in a short period of contact time. Since then, extracts from different parts of plants such as leaves [7–10], flowers [11–14], stems [15–18], latex [19–21], roots [22, 23], and seeds [24–26] are intensively utilized for MNP synthesis. The organic molecules in plant extracts, including