Neurite outgrowth stimulatory effects of mycosynthesized AuNPs from Hericium erinaceus (Bull.: Fr.) Pers. on pheochromocytoma (PC-12) cells

Jegadeesh Raman1
Hariprasath Lakshmanan1
Priscilla A John1,2
Chen Zhijian1
Vengades Periasamy1
Pamela David1,4
Murali Naidu1,4
Vikineswary Sabaratnam1,3
1Mushroom Research Centre, 2Institute of Biological Sciences, Faculty of Science, University of Malaysia, 3Low Dimensional Materials Research Center (LDMRC), Department of Physics, Faculty of Science, 3Department of Anatomy, Faculty of Medicine, University of Malaysia, Kuala Lumpur, Malaysia

Background: Hericium erinaceus has been reported to have a wide range of medicinal properties such as stimulation of neurite outgrowth, promotion of functional recovery of axonotmetic peroneal nerve injury, antioxidant, antihypertensive, and antidiabetic properties. In recent years, the green synthesis of gold nanoparticles (AuNPs) has attracted intense interest due to the potential use in biomedical applications. The aim of this study was to investigate the effects of AuNPs from aqueous extract of H. erinaceus on neurite outgrowth of rat pheochromocytoma (PC-12) cells.

Methods: The formation of AuNPs was characterized by UV–visible spectrum, energy dispersive X-ray (EDX), field-emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM), particle size distribution, and Fourier transform-infrared spectroscopy (FTIR). Furthermore, the neurite extension study of synthesized AuNPs was evaluated by in vitro assay.

Results: The AuNPs exhibited maximum absorbance between 510 and 600 nm in UV–visible spectrum. FESEM and TEM images showed the existence of nanoparticles with sizes of 20–40 nm. FTIR measurements were carried out to identify the possible biomolecules responsible for capping and efficient stabilization of the nanoparticles. The purity and the crystalline properties were confirmed by EDX diffraction analysis, which showed strong signals with energy peaks in the range of 2–2.4 keV, indicating the existence of gold atoms. The synthesized AuNPs showed significant neurite extension on PC-12 cells. Nerve growth factor 50 ng/mL was used as a positive control. Treatment with different concentrations (nanograms) of AuNPs resulted in neuronal differentiation and neuronal elongation. AuNPs induced maximum neurite outgrowth of 13% at 600 ng/mL concentration.

Conclusion: In this study, the AuNPs synthesis was achieved by a simple, low-cost, and rapid bioreduction approach. AuNPs were shown to have potential neuronal differentiation and stimulated neurite outgrowth. The water-soluble biocatalysts could be responsible for the neuroactivity. This is the first report for the biosynthesis of AuNPs using the hot aqueous extract of H. erinaceus.

Keywords: AuNPs, nanoparticles, Hericium erinaceus, PC-12, neurite outgrowth

Introduction
Green chemistry approaches for the synthesis of gold nanoparticles (AuNPs) via biological methods using bacteria, fungi, plant extracts, or purified biomolecules have helped to offer reliable and environment-friendly alternatives to conventional chemical and physical synthesis approaches. These particles not only are ultrasmall in size, but are also biocompatible, have high surface area to mass ratio, and show considerable surface activity along with plasmon resonance bands. The AuNPs are