UNIVERSITI TEKNOLOGI MARA

BIOSYNTHESIS OPTIMIZATION AND CHARACTERIZATION OF SILVER NANOPARTICLES FROM *IMPERATA CYLINDRICA*

AFIZA BINTI AHMAD FAIRUZI

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
(Materials Science and Technology)

Faculty of Applied Sciences

January 2020

ABSTRACT

Biosynthesis of nanoparticle has gained great attention towards the economic and environmentally friendly process. However, there is a limited number of studies that describe the parameters for tuning the dimension and geometry of nanoparticle in the biosynthesis process. In this study, the aqueous extract of *Imperata cylindrica* (*I. cylindrica*) was used as a green reducing agent to produce silver nanoparticles from silver nitrate solution. The biosynthesis parameters were optimized by varying the synthesis condition to produce monodisperse silver nanoparticles. The particles were characterized by visual observation; colour changes, UV-visible spectroscopy, dynamic light scattering (DLS), field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectroscopy (EDX) and X-ray diffraction (XRD). Changing the parameters such as plant extract concentration, silver salt concentration, the temperature of biosynthesis and pH of reaction mixture influence the size and dispersion of the nanoparticles. Characterization using FESEM revealed the presence of excessive biogenic material from plant extract encourage agglomeration. The formation of silver nanoparticles began as early as 10 minutes at 60°C, compared to the synthesis carried out at 30°C. However, at higher temperatures (100°C) nanoparticles started to grow larger. Modification of pH disturbed the reducing and stabilizing ability of *I. cylindrica* extract which lead to the formation of large and highly polydisperse particles. The optimum parameters for synthesizing silver nanoparticles are 10% of aqueous extract, 10 mM of silver nitrate, pH 5.7 with a reaction temperature of 60°C. The optimized silver nanoparticles (sample AG05) are in spherical with an average diameter of 29.34nm. The X-ray diffraction result shows that the silver nanoparticles formed through the reduction of Ag^{+} ions by *I. cylindrica* extract are crystalline in nature. Energy dispersive X-ray spectroscopy analysis exhibited a strong signal in the silver region confirmed the presence of elemental silver. The phytochemical compound presence in *I. cylindrica* was determined by using the phytochemical test and Fourier transform infrared spectroscopy (FTIR). The reduction reaction by *I. cylindrica* might be caused by the phytochemical compounds which are alkaloids, tannins, and flavonoids. The degradation of aqueous methylene blue was used as the model system to monitor the catalytic activity of the biosynthesized silver nanoparticles. The degradation recorded was up to 82.49% in 2 minutes. The outcome of this study suggests that silver nanoparticles synthesized using the aqueous extract of *I. cylindrica* have the potential to be used as a catalyst. The biosynthesis parameter optimization enables the production of silver nanoparticles with uniform shape and narrow size distribution.

ACKNOWLEDGEMENT

In the Name of Allāh, the Most Gracious, the Most Merciful

This thesis has become a reality with the kind support and assistance of many individuals. I would like to extend my sincere thanks to all of them who have been the catalyst for completing this endeavour.

First and foremost, all praise is indeed due to Allah s.w.t, for the wisdom he has bestowed upon me, the strength, peace of mind, and good health to complete this research.

I would like to express my gratitude to my parents, Ahmad Fairuzi Ismail and
who have sacrificed so much for my academics, and I pray that one day you will reap the benefits. To my supportive siblings Aliaa and Aina, thank you for your continuous support and kind understanding.

I would like to express my special thanks to my main supervisor, Dr. Noor Najmi Hj. Bonnia, for all the support and guidance she has given me throughout my postgraduate journey.

My co-supervisors, Dr. Mohd Azri Ab Rani and Mdm. Rabiatuladawiyah Md. Akhir for imparting their knowledge and valuable suggestions for this study.

My thanks and appreciations also go to friends and people who have willingly helped me out with their abilities.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Background of Study

Imperata cylindrica (Figure 1.1) commonly known as cogon grass in English and "lalang" in Malay language. The young leaves of this plant are light green while older leaves are brown in colour. This invasive grass has been listed as one of the most problematic weeds in the world (Hallie et al., 1998). Unlike several types of grass species, *I. cylindrica* is not suitable for forage due to the sharp edged of mature leaves. Although *I. cylindrica* is sometimes planted for soil stabilization, its ability to spread and displace other plants is troublesome and outweighed its contribution. Nevertheless, the phytoconstituents of this plant catch the attention of researchers as this plant was claimed by folklore to have antibacterial and medicinal properties. It was used in traditional medicine for the treatments of dysentery, gonorrhoea, and diarrhoea (Parkavi, Vignesh, Selvakumar, Mohamed, & Ruby, 2012).

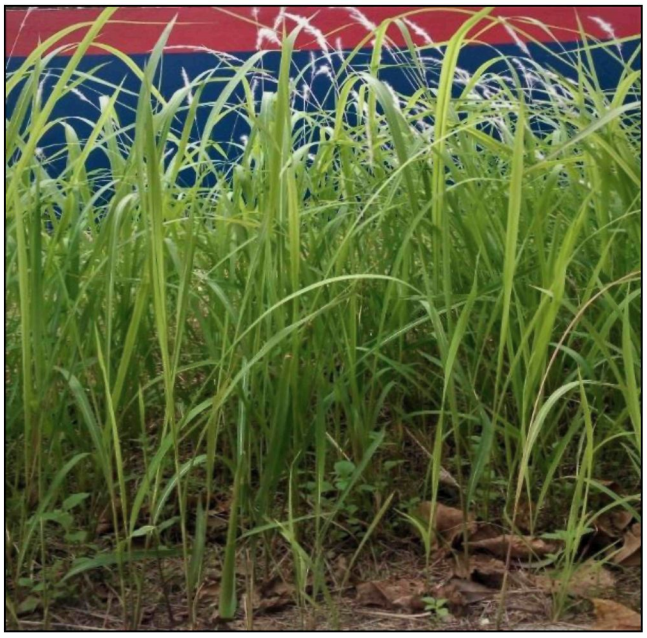

Figure 1.1 *Imperata cylindrica*