# IN VITRO STUDY TO ELUCIDATE THE ANTIBACTERIAL ACTIVITY OF SILVER NANOPARTICLES AGAINST MULTIDRUG RESISTANT PSEUDOMONAS AERUGINOSA

ATHIRAH NUR AMIRULHUSNI ALSHUKOR

UNIVERSITI TEKNOLOGI MARA
AUGUST 2012

# Abstract

The antimicrobial activities of silver have been well known since ancient history. However, the effects of this compound against resistant organism have not been well explored. Multi drug resistant organisms have been taunting the medical world for the last few decades. Even with newly developed antibiotics, new resistant strains emerge soon after in many cases which leads to complications in treatment regiments. Colloidal silver was synthesized by adding an excess of the reducing agent $NaBH_4$ to $AgNO_3$ which reduced the ionic silver into nanoparticle state. Optical characterization of the silver nanoparticles was done using UV-VIS spectroscopy and the particle size was analyzed using scanning electron microscope. Silver nanoparticles of spherical shape, 30 to 70 nm of size was successfully produced. We investigated silver in the form of nanoparticles for its antimicrobial activity against resistant strains of *Pseudomonas aeruginosa.* This organism is one of the most common multi drug resistant, opportunistic pathogens, contributing to the high morbidity and mortality in immune-compromised patients. Five strains of multi-drug resistant *P. aeruginosa* were selected from patients in Hospital Selayang, Malaysia as samples for this study. Antibacterial activity was evaluated by disc diffusion method, broth microdilution method and biofilm inhibition assay. An inhibition zone of 11 mm was observed with 10 μg dose of the nanoparticles. The nanoparticles exhibited MIC of 50 μg/ml when added at the lag phase and the subinhibitory concentration was measured as 100 μg/ml. The $MIC_{50}$ value showed to be 15 μg/ml. Significant biofilm inhibition was also observed at 100 and 200 μg/ml ($p<0.001$ compared to control). This study suggests that silver nanoparticles has the potential to be further developed as an antimicrobial agent, hence decreasing the burden of the multi drug resistance phenomena.

## Acknowledgement

In the name of Allah, the Almighty and the Merciful

My upmost appreciation to;

Dr Navindra Kumari Palanisamy, my supervisor, for her caring support, encouragement and generous guidance all throughout my Advanced Medical Science program. The first lesson she taught me was to never be afraid of making mistakes. Thus I have made them, learned from them and learned a great deal more from her in this invaluable period of time.

Associate Professor Dr Zaini Mohd Zain, my co-supervisor, for her kind assistance and wise advice. For always uncovering other paths to be travelled when it seemed like a dead end.

Professor Dr Nasimul Islam, our Advanced Medical Science program coordinator, whose enthusiasm and abet resides with us from the very beginning right through the end.

Professor Dato Dr Khalid Yusof, dean and Professor Dr Hamim Rajikin, deputy dean for giving birth to the program in the first place, hence created this golden opportunity for us students to take hold of.

My comrades who took this rollercoaster ride of journey alongside of me. With whom I shared delights and disappointments, frustrations and relief, gladness and gratification.

All the lecturers, staffs and technicians whose assistance have aided me considerably all through the year.

Institute of Medical and Molecular Biology (IMMB) and Multi-disciplinary Lab, Faculty of Medicine Universiti Teknologi MARA for the facilities provided.

And last but never the least, my dear parents, my number one believer, my support system.

**Funding statement**: This work was supported in part by the DANA Kecemerlangan Penyelidikan under the project "In vitro Study to Elucidate the Antibacterial Effect of Silver Nanoparticles against Multidrug Resistant *Pseudomonas aeruginosa*". Grant no. 600 - RMI/ST/DANA 5/3/Dst (358/2011)

# Table of Contents

# 1.0 INTRODUCTION

## 1.1 Background

Silver has always been well-known for its anti-microbial properties. In fact it is considered an ancient remedy in treating infections and burn wounds, with documentations dating as far back as the 8th century when Ibn Sina or better known as Avicenna in the west, used silver fillings as "blood purifier", to treat offensive breath and heart palpitation (Akhil Wadhera, 2005). The usage of silver in the pre-antibiotic era was extensive, from treating sinusitis to nervous system disorders, such as epilepsy and tabes dorsalis.

However, the world's attention was shifted from silver when the first antibiotic, penicillin was discovered by Ian Fleming in 1928. In the subsequent years, antibiotics reigned the medical industry. Penicillin became known as the "wonder drug" thus became the standard treatment for infections. Just as the medical world was becoming comfortable, emergence of resistant microbial strains started to appear as early as in 1945, which was temporarily overcome by development of new antibiotics.

The cycle continues, and later, the antibiotic field was exhausted as scientists struggle to stay one step ahead of these continuously evolving organisms, as they become resistant to more and more antibiotics developed.

## 1.2 Problem Statement

*Pseudomonas aeruginosa* causes a wide range of infections. The development of multidrug resistance in this organism poses complication in management of these infections as they limit the available treatment options. This increases the financial burden as well as worsens the prognosis of the patients.