UNIVERSITI TEKNOLOGI MARA

A STUDY OF NATURAL DYES EXTRACTED FROM ACTINOMYCETES ISOLATES ON SILK FABRICS

WAN MOHD FATHIL BIN WAN YUSOFF

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Sciences

July 2019

ABSTRACT

Natural dyes extracted from microorganism offers many advantages such as exhibit better biodegradability, have higher compatibility with the environment, lower toxicity and allergic reaction to users. Thus, increases the interest among researcher to replace natural dyes with commonly used synthetic dyes. Synthetic dyes are known to have hazardous effects such as carcinogenicity, possibility of ambient pollution and potential allergies to the user. This thesis is an attempt to study the extraction of dyes from actinomycetes using Ultrasound Assisted Extraction (UAE), Boiling Water Extraction (BWE), Microwave Assisted Extraction (MAE) and Water Extraction (WE). Analyzing the strength and colourfastness of the dyes on silk fabrics and to identify selected actinomycetes based on morphology and 16S rRNA gene analysis. Good colourfastness of the dyed substrate to washing, perspiration, rubbing was observed for mordanted samples giving rating from 4 to 5. Good rating for light fastness was also recorded for mordanted samples in between rating 5 to 7. However, lower rating was recorded for unmordanted samples which gave rating lower than 3. The CIEL*a*b* showing L* values of mordanted dyed fabrics gave lower value compared with unmordanted, for instance G1A39 recorded lowest L* of 60.43. As for K/S and ΔE value, the results recorded showing mordanted gave higher values than unmordanted with G1A6 have the highest K/S value of 3.146 and G2A24 record the highest ΔE value of 36.28. This showing the mordant treatment increased the strength of dyes on the fabrics. Three samples namely G1A39, G1A45 and L4E3 were selected for species identification due to excellent results in term of their colourfastness and colour strength. The morphology study showed these samples have typical characteristic of Streptomyces such as spore formation, colony elevation, wrinkled colony and spore chain formation. Moreover, these samples were identified through the alignment of 16S rRNA gene using BLAST tool showing the species for G1A39, G1A45 and L4E3 are *Streptomyces diastaticus*; strain NBRC 15402, *Streptomyces thermocarboxidus*; strain NBRC 16323 and *Streptomyces spp.* CCM_MD2014, complete genome. As conclusion, UAE and MAE methods are seen as the most effective method for extracting dyes from actinomycetes based on color volume and color strengths. This method also offers lower cost production and can produce dyes in large quantities. Hence, these two methods have great potential to be exploited in the production of dyes from microorganism.

ACKNOWLEDGEMENT

First and foremost, I thank Allah for His guidance to make this work possible and to give me the ability and patience to complete this research. It is a pleasure for me to acknowledge the precious help and support provided to me by my research supervisor Assc. Prof. Dr. Sharifah Aminah Syed Mohamad. Her guidance, advice and productive criticism have been invaluable in the shaping and synthesis of this research work. In addition, I also would like to thank my two advisors Dr. Suhaidi Ariffin and Dr. Anis Low Abdullah for their guidance and support during each stage of my research.

I wish to express my warm and sincere thanks to my fellow students and other department staff at the Faculty of Applied Science for their help and support during this research. Finally, to my family, your love and thoughts have been my strength and inspiration and would always remain.

Thank you all.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF STUDY

Most microorganisms produce unlimited sources of novel compounds with many medicinal, agriculture and industrial applications. Actinomycetes for example hold a prominent position due to their ability to a produce variety of metabolites such as antibodies, enzymes and inhibitors (Xu et al., 2005). Actinomycetes are almost similar to fungi but their cellular and genetic organization have categorized them as bacteria (Salahuddin et al., 2011). Conventionally, actinomycetes are identified based on the characteristics of their physical appearance on the agar medium for instance, the colour of aerial and substrate mycelium, the spore arrangement observed under microscope as well as their biochemical properties. The analysis of partial 16S rRNA gene sequence offers a practical alternative method for identification purposes up to species level (Michel et al., 2000). Different species have different set of 16S rRNA gene sequence and this gives high variability to each of the microorganisms (Janda and Sharon, 2007). The characterization of actinomycetes species follow the recommendation by International *Streptomycetes* Project (ISP) based on morphological, biochemical, cultural and physiological features such as formation of aerial and substrate mycelium as well as arrangement of spores on mycelium (Remya and Vijayakumar, 2008).

Pigment is known as a colouring agent and produce by living organisms or chemical reagent. For decades, both natural dyes and synthetic dyes have been extensively used in various fields of everyday life such as food production, textile industries, paper production, agricultural practices and researches, water science and technology (Tibor, 2007). However, the use of synthetic dyes is more extensive than natural dyes. There are huge interests of replacing the use of synthetic dyes with natural sources due to awareness of toxicity issues. Thus, extensive researches are being accomplished to determine which production and use of natural dyes would meet high environmental and safety requirements (Georgeta et al., 2004). Microorganism is one of the biological natural sources with high potential to produce