

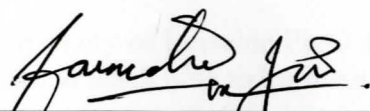
**ACCUMULATION OF NICKEL IN RUBIACEAE
HYPERACCUMULATOR PLANTS IN KINABALU
NATIONAL PARK, SABAH**

MUHAMMAD IRFAN RIFNUR BIN ARIFFIN

**Final Year Report Submitted in
Partial Fulfilment of the Requirements
Degree of Bachelor of Science (Hons.) Biology
In the Faculty of Applied Sciences
Universiti Teknologi MARA**

JANUARY 2019

This Final Year Project Report entitled “**Accumulation of Nickel in Rubiaceae Hyperaccumulator Plants in Kinabalu National Park, Sabah**” was submitted by Muhammad Irfan Rifnur bin Ariffin, in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Biology, in the Faculty of Applied Science, and was approved by



Madam Farnidah Binti Jasnir
Supervisor
B. Sc. (Hons.) Biology
Faculty of Applied Sciences
Universiti Teknologi Mara
Kota Kinabalu
Sabah



Mr. Ajimi Bin Jawan
Project Coordinator
B. Sc. (Hons.) Biology
Faculty of Applied Sciences
Universiti Teknologi Mara
Kota Kinabalu
Sabah



Ajis Bin Lepit (Ph.D)
Head of Programme
B. Sc. (Hons.) Biology
Faculty of Applied Sciences
Universiti Teknologi Mara
Kota Kinabalu
Sabah

Date: _____

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENT	iii
TABLE OF CONTENT	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	ix
ABSTRACT	x
ABSTRAK	xi
CHAPTER 1 INTRODUCTION	
1.1 Background of Study	1
1.2 Problem Statement	3
1.3 Significance of Study	4
1.4 Objective of Study	6
1.5 Scope of the Study	6
CHAPTER 2 LITERATURE REVIEW	
2.1 Heavy Metal	8
2.1.1 The presence of heavy metals in soil	9
2.1.2 The importance of heavy metals	10
2.1.2.1 The uses of heavy metals in plants	11
2.1.3 Nickel metal	12
2.1.3.1 The presence of nickel in plant	13
2.2 Ultramafic Soil	14
2.2.1 The ultramafic soil in the Sabah	15
2.3 Hyperaccumulator plants	18
2.3.1 Nickel hyperaccumulator plants	19
2.3.2 The vessel of nickel hyperaccumulator plant	21
2.4 The Rubiaceae Family of Plant	22
2.4.1 The hyperaccumulator species of Rubiaceae in Sabah	23
2.5 Phytomining Technology	23
2.6 The Portable X-Ray Fluorescence (pXRF)	25
CHAPTER 3 METHODOLOGY	
3.1 Materials	26
3.1.1 Raw materials	26
3.1.2 Instruments	26
3.2 Determination of Nickel Hyperaccumulation in Rubiaceae Plants	27
3.2.1 DMG paper analysis	27

LIST OF FIGURES

Figure	Caption	Page
2.1	The necrotic lesion at the tips of the leaf of soybean	14
2.2	The ultramafic soil at Sabah marked in red	16
2.3	The ultramafic soil at Kinabalu Park	17
3.1	The impregnated nickel - specific colorimetric - reagent dimethylglyoxime (DMG) white test paper.	28
3.2	The pXRF scanned the herbarium specimens	29
3.3	The 99.5% Titanium plate used for better reflection of pXRF rays that increase the accuracy of pXRF	29
3.4	The setup during pXRF scanning of leaf length	30
3.5	The entrance of Mount Tombuyukon and Hyperaccumulator Nursery	30
3.6	The drying and pressing process done to preparing the specimen before analysing with pXRF	31
3.7	The setup of soil preparation before analysing with pXRF	32
4.1	Boxplot of the nickel intensity in all leaves of 68 genus of Rubiaceae family obtained at National Kinabalu Park Herbarium.	34
4.2	The box plot of nickel intensities (Cps/ua) of all Psychotria species scanned at Kinabalu Park Herbarium.	35

ABSTRACT

ACCUMULATION OF NICKEL IN RUBIACEAE HYPERACCUMULATOR PLANTS IN SABAH

The ultramafic soil is fundamental element in producing hyperaccumulator plant due to its high metal concentration. The Rubiaceae family is well distributed over ultramafic soil has a very high potential recognize as a hyperaccumulator plant. Thus, the hyperaccumulator plant is very useful in phytomining technology because their ability to accumulate metal and live in the high metal concentration soil. This green technology was established because has potential to replace conventional mining hence reducing the pollution caused by conventional mining. Nickel is one of the valuable metal among other metal. Therefore, nickel hyperaccumulator plant is promising in phytomining technology. The use of portable X-Ray Fluorescence was fully utilized to scan the plant specimen and determine its metal concentration without destructing the specimen. Thus, scanning of the herbarium specimen is very efficient to find potential hyperaccumulator plants. A total of 2556 Rubiaceae herbarium plant specimens in Kinabalu Park, Sabah was scanned and found that *Psychotria sarmentosa* and *Urophyllum sp.* are nickel hyperaccumulator plants. This is a new report of *Urophyllum sp.* as a new nickel and cobalt hyperaccumulator plant. Moreover, the three samples of fresh *Psychotria sarmentosa* was collected at Mount Tombuyukon to determine its nickel concentration in different plant parts and leaf size. It is found that, *Psychotria sarmentosa* accumulate most of the nickel in its leaf (50567.29 ± 1042.22 ppm) and middle range size of leaf ($34.04\text{cm} < L < 51.11\text{cm}$) has most nickel (37269.86 ± 923.06 ppm) than other sizes. Therefore, two species of Rubiaceae from Kinabalu National Park are hyperaccumulators. The nickel is concentrated on the middle size leaf. However, further research is eminent to authenticate and to determine their potential in phytomining.