

UNIVERSITI TEKNOLOGI MARA

**DEVELOPMENT OF FUNCTIONAL
BEVERAGES FROM BLENDS OF
Ficus deltoidea LEAVES AND BROWN
RICE POWDERS**

NUR AIN SABRINA BINTI AZMI

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
(Biology)

Faculty of Applied Sciences

July 2022

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student : Nur Ain Sabrina binti Azmi

Student I.D. No. : 2019873724

Programme : Master of Science (Biology) – AS750

Faculty : Applied Sciences

Thesis Title : Development of Functional Beverages from Blends
of *Ficus deltoidea* Leaves and Brown Rice Powder

Signature of Student :

Date : July 2022

ABSTRACT

Functional foods and beverages offer a promising opportunity to improve healthcare awareness of people among Malaysian. *Ficus deltoidea* (Ficus: Moraceae) has great potential as a functional food or beverage. Administration of this herb has been reported to reduce hyperglycemia and increase insulin secretion in diabetic rats and humans. However, the potential benefits of adding *F. deltoidea* to food or beverage products such as brown rice remain to be investigated. Brown rice is a wholegrain food used as functional food or beverage in Asian nations to meet dietary and nutritional needs. The study primarily aimed to develop a new beverage formulation with the addition of *F. deltoidea* into brown rice and to examine the phyto-physicochemical profile, antioxidant properties, safety and consumer acceptance of the formulation. The new beverage formulations were prepared by mixing the *F. deltoidea* leaves powder with a commercial brown rice beverage product in two different ratios (2.5:32.5 and 5.0:30.0 g). The formulated beverages were subjected to physicochemical and phytochemical analyses. The antioxidant properties of the formulated beverage were measured using FRAP and DPPH assays. The acute toxicity study was conducted for 14 days to determine the safety of *F. deltoidea*-added formulations. Consumer acceptance on the appearance, color, aroma, taste, aftertaste and overall acceptability was assessed utilising a 9-point hedonic scale. The results showed, for the first time, that adding *F. deltoidea* to brown rice beverage significantly decreased ($p < 0.05$) the pH and increased ($p < 0.05$) the moisture content, ash, and viscosity. The formulation with higher *F. deltoidea* was associated with lighter, greener and yellower in color. The total phenolic, flavonoid, and tannin content have also significantly increased ($p < 0.05$) in *F. deltoidea*-added formulations. Adding *F. deltoidea* to a brown rice beverage caused a significant increase ($p < 0.05$) in antioxidant activity. The oral LD₅₀ of *F. deltoidea*-added formulation was higher than 2000 mg/kg body weight. The sensory evaluations showed that the new formulation beverages were accepted by the consumer with the value of mean scores range for each parameter were higher than 5.0. In conclusion, these results suggest that adding *F. deltoidea* leaves to brown rice is safe to consume and improved the phyto-physicochemical profile, antioxidant activities, and consumers' acceptance of the products.

ACKNOWLEDGEMENT

Alhamdulillah, all praises to Allah for giving me strength and good health throughout my research work. First and foremost, it is a genuine pleasure to express my deep sense of thanks and gratitude to my lovely supervisor, Dr. Nurdiana binti Samsulrizal, for her supervision and continuous support. Her expertise, timely advice, dedication, and keen interest above all her overwhelming attitude to help her students had been solely and mainly responsible for completing my work.

I owe a deep sense of gratitude to both Dr. Siti Aimi Sarah binti Zainal Abidin from Universiti Teknologi Mara and Professor Dr. Goh Yoh Meng from Universiti Putra Malaysia, who were members of my supervisory committee, for their inspiration, guidance, comments, and suggestions to complete my thesis.

I thank profusely all the laboratory staff in the Faculty of Applied Sciences, Universiti Teknologi Mara for the use of facilities and technical assistance. Also, thanks to the staff in Laboratory Animal Facility and Management (LAFAM), Universiti Teknologi Mara for the postoperative care of animals.

I am highly indebted for financial support from the Ministry of Higher Education (MybrainSc20). My appreciation also goes to my friends, Noor Syaffinaz binti Noor Mohamad Zin and Ahmad Solihin bin Uda Shehor for the stimulating discussion, invaluable guidance, and help.

Last but not least, I am extremely grateful to my parents, Azmi bin Ismail and Noriani binti Hasan, for their love, prayers, caring and sacrifices for educating and preparing me for my future. This piece of victory is dedicated to both of you. Alhamdulillah.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
LIST OF NOMENCLATURE	xv
CHAPTER ONE: INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Significance of the Study	4
1.4 Objectives of the Study	5
1.5 Scope and Limitation of the Study	5
CHAPTER TWO: LITERATURE REVIEW	6
2.1 Functional Food and Beverage	6
2.1.1 Market Growth of Functional Food and Beverage	7
2.1.2 Plant-Based Functional Food and Beverage	9
2.1.3 Physicochemical	11
2.1.4 Phytochemicals	11
2.1.5 Antioxidant Activities	12
2.1.5.1 Ferric Reducing Antioxidant Power (FRAP)	17
2.1.5.2 1,1-Diphenyl-2-Picrylhydrazyl (DPPH)	17
2.2 <i>Ficus deltoidea</i>	18
2.2.1 Botanical and Common Name	18
2.2.2 Botanical Description and Distribution	20