

**PROFILING OF DATES ON PHYSICAL CHARACTERISTICS
AND MINERALS COMPOSITION BY CHEMOMETRICS**

Fareha Hamd Younis

UNIVERSITI SAINS ISLAM MALAYSIA

**PROFILING OF DATES ON PHYSICAL CHARACTERISTICS AND
MINERALS COMPOSITION BY CHEMOMETRICS**

Fareha Hamd Younis

(Matric No.: 3130121)

Dissertation submitted in partial fulfillment for the degree of
MASTER OF SCIENCE VIA MIX MODE
(FOOD BIOTECHNOLOGY)

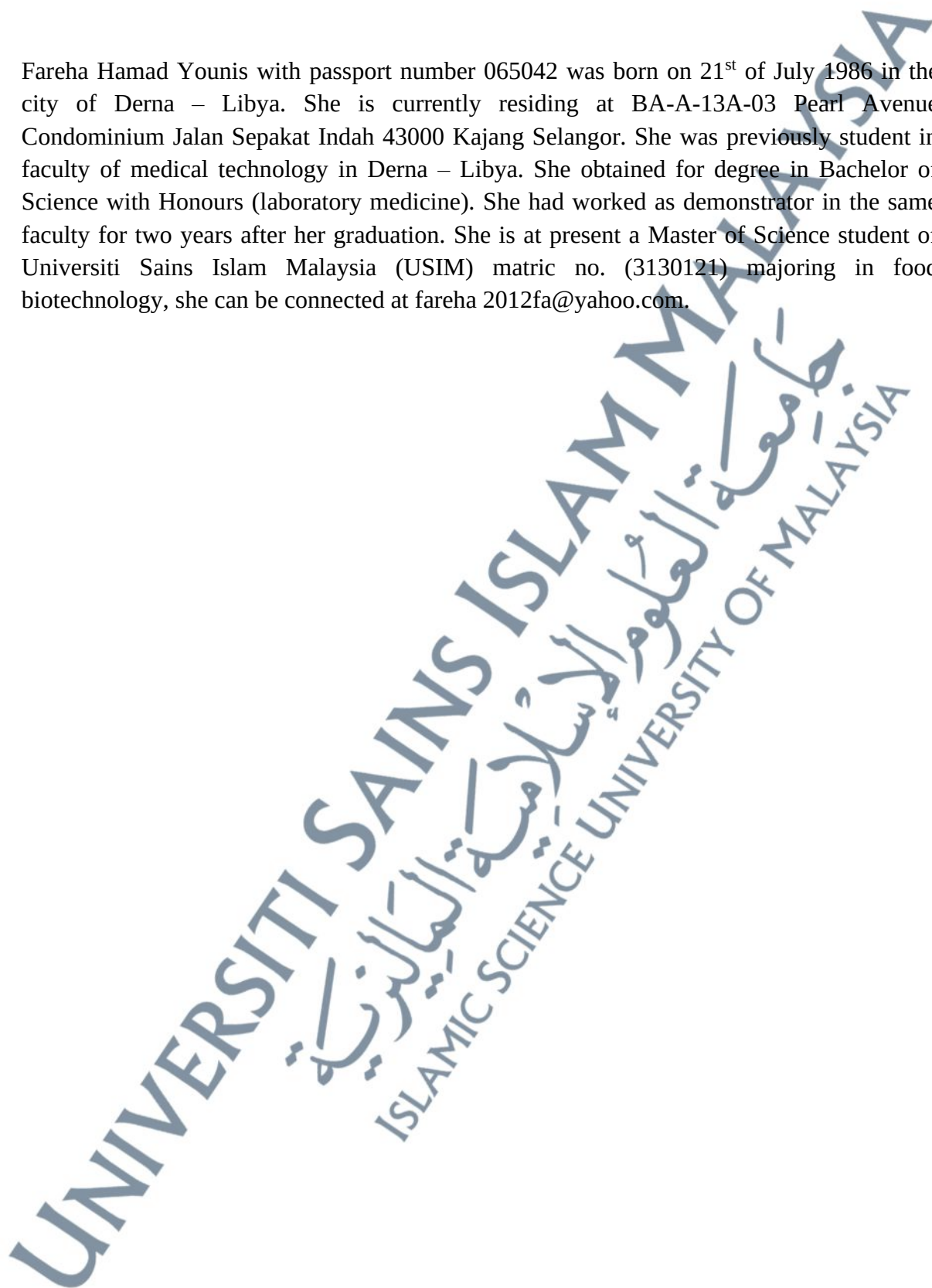
Faculty of Science and Technology
UNIVERSITI SAINS ISLAM MALAYSIA

NILAI

November 2014

BIODATA OF AUTHOR

Fareha Hamad Younis with passport number 065042 was born on 21st of July 1986 in the city of Derna – Libya. She is currently residing at BA-A-13A-03 Pearl Avenue Condominium Jalan Sepakat Indah 43000 Kajang Selangor. She was previously student in faculty of medical technology in Derna – Libya. She obtained for degree in Bachelor of Science with Honours (laboratory medicine). She had worked as demonstrator in the same faculty for two years after her graduation. She is at present a Master of Science student of Universiti Sains Islam Malaysia (USIM) matric no. (3130121) majoring in food biotechnology, she can be connected at fareha 2012fa@yahoo.com.



ACKNOWLEDGEMENTS

My first and foremost appreciation goes to Allah who in his infinite mercies has guide me aright, preserved my life to this moment and made this work a reality. I would also like to use this medium to express my heartfelt gratitude to several individual who were instrumental to my success in completing this research. To my amiable supervisor, Dr Mohd Sukri Hassan for guidance during the period of my research. I would like to record big thank to you for guiding me in chemometrics and for your words encouragement to complete this research. My thanks would not be adequate without appreciating my husband; Mohamed Mahmoud Rashid who has always been my pillar of support and guidance toward my study. My deepest appreciation also to research assistance Nur Ashiah for her support and guidance especially in the laboratory work. Next, I would also like to thank to all of my colleagues in this facility for their encouragement and help. Special thanks also go to my family in Libya, dearest mom, father, brothers and sisters, thank you for your full motivation and support.

Abstrak

Phoenix dactylifera L. dikenali sebagai pokok kurma adalah tumbuhan purba dan telah ditanam di gurun oasis di tanah Arab selama berabad-abad. Di Timur Tengah, kurma sebagai sumber makanan yang penting sejak dahulu lagi. Kurma (*Phoenix dactylifera L.*), adalah sejenis buah berkhasiat tinggi, dianggap sebagai komoditi makanan yang popular kebanyakan negara dan juga sebagai pemakanan sunnah Nabi Muhammad (SAW). Kurma adalah sumber yang baik untuk gula, vitamin, mineral dan serat. Mineral yang biasa terdapat didalam kurma ialah kalsium, kuprum, ferum, magnesium, mangan, kalium dan zink. Tujuan kajian ini adalah untuk menentukan sifat-sifat fizikal dan kandungan mineral di antara lima belas jenama kurma yang terdapat di pasaran menggunakan instrumentasi Spektrometri Penyerapan Atom (AAS) dan teknik kemometrik. Teknik kemometrik seperti Analisis Komponen Utama (PCA) dan kelompok k-mean digunakan untuk menilai sifat-sifat fizikal dan profil mineral dalam buah-buahan kurma. Keputusan menunjukkan bahawa kurma boleh dikelaskan kepada 4 kumpulan. Ajwa adalah kurma yang paling kecil dan membentuk kumpulannya sendiri. Kalium menyumbangkan kepekatan yang tertinggi diikuti oleh magnesium dan kalsium. Manakala ferum, zink, mangan dan kuprum menyumbangkan pada kepekatan sederhana. Kajian mendapati bahawa jenama yang terbaik di antara kurma yang dipilih adalah Ajwa kerana kepekatan mineral ferum, kuprum, mangan dan magnesium yang tinggi berbanding jenama kurma yang lain.

katakunci: Kurma, Mineral, Spektrometri Penyerapan Atom, Kemometrik

Abstract

Phoenix dactylifera L., is commonly known as the date palm is a primeval plant and has been cultivated for its edible fruit in the desert oasis of the Arab world for centuries. In the Middle East, dates have played a major role for thousands of years as an abundant food source. The dates (*Phoenix dactylifera L.*), a high-energy fruit, is regarded as a popular food commodity in many countries and *sunnah* diet of prophet *Muhammed*. The date fruit is a good source of sugars, vitamins, minerals and fibers. The minerals that normally found in dates are calcium, copper, iron, magnesium, manganese, potassium and zinc. The aim of the study is to determine the physical characteristics ; and minerals composition between fifteen different brands of date that available in the market by Atomic Absorption Spectrometry (AAS) then applying chemometrics techniques such as Principal Components Analysis (PCA) and *k*-mean cluster to evaluate the profiles of dates fruit. The results have shown that dates can be grouped into 4 groups. AJWA is a smallest dates and this create it own group. Potassium is the highest concentration followed by Magnesium and Calcium, while Ferum, Zinc, Manganese and Copper are found at average concentration. It has been found that the best brand among the selected dates is AJWA due to its high concentration of Ferum, Copper, Manganese and Magnesium.

Keywords: Dates, Minerals, Atomic Absorption Spectrometry, Chemometrics

CONTENT PAGE

Contents	Page
DECLARATION OF THESIS AND COPY RIGHT	i
BIODATA OF AUTHOR	ii
AKNOWLEDGMENTS	iii
ABSTRAK	iv
ABSTRACT	v
CONTENT PAGE	vi
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF APPENDIXS	x
ABBREVIATION	xi
CHAPTER I: INTRODUCTION	
1.1 Background of Study	1
1.2 Problem Statement	2
1.3 Objectives	3
CHAPTER II: LITERATURE REVIEW	
2.1 Botanical of the Date Palm	4
2.2 Origin of Date Palm	5
2.3 Date Products	6
2.4 Date Palm Fruit	8
2.4.1 Maturity Stages of Palm Date Fruits	9
2.4.2 Vitamins, Minerals and Phytochemical Components in Dates	11
2.5 Importance of Date Palm	12
2.6 Atomic Absorption spectroscopy (AAS)	13
2.6.1 Flame Atomic Absorption spectroscopy	14
2.7 Multivariate Data Analysis	16
2.7.1 Principal Component Analysis (PCA)	17
2.7.1.1 Eigenvalue	20
2.7.1.2 Scores and loadings	21
2.7.2 k-Means Cluster	21

2.7.3 Review of Research Works on Principle Component Analysis (PCA) Clustering.	23
CHAPTER III: MATERIALS AND METHODS	
3.1 Materials	25
3.2 Instrument	26
3.3 Methods	26
3.3.1 Physical Measurement	26
3.3.2 Preparation of Date Fruits for Analyses	26
3.3.3 Determination of Minerals Content by Atomic Absorption Spectroscopy	26
3.4 Statistical analysis	27
CHAPTER IV: RESULTS AND DISCUSSION	
4.1 Physical Characteristics	29
4.2 Minerals Content of dates	30
4.3 Principle Component Analysis (PCA) of dates	32
4.3.1 Physical Characteristics	32
4.3.2 Minerals Composition	35
4.4 k mean cluster of Dates	39
4.4.1 Physical Characteristics	39
4.4.2 Minerals Composition	39
CHAPTER V: CONCLUSION AND RECOMMENDATION	
REFERENCES	42
APPENDIXS	47

LIST OF TABLES

	Page
Table 1 : The 15 different brands of dates using in this study	24
Table 2 : Calibration Standard for 7 Minerals	26
Table 3 : Physical properties of differnt date fruit brand	28
Table 4 : Mineral contents in date from 15 different brands determined by Using Atomic Absorption spectroscopy (AAS)	30
Table 5 : Loadings of 3 significant Principal Components (PCs)	31
Table 6 : Scores of 3 significant Principal Components (PCs)	31
Table 7 : Loadings of 4 significant Principal Components (PCs)	34
Table 8 : Scores of 4 significant Principal Components (PCs)	35
Table 9 : <i>K- means</i> cluster results from 15 different brands according to physical Characteristics	38
Table10: <i>K-means</i> cluster results from 15 different brands of dates according to Minerals content	39

LIST OF FIGURES

	Page
Figure 1: Formation and Ripening of the Dates	9
Figure 2: Flame Atomic Absorption Spectroscopy (FAAS)	15
Figure 3: Explained variance from 15 different brands of dates for physical Characteristics	32
Figure 4: Scores plot of PCA from 15 different brands of dates for physical Characteristics	33
Figure 5: Loadings plot of PCA from 15 different brands of dates for physical Characteristics	33
Figure 6: Explained variance 15 different dates brand for minerals content	36
Figure 7: Scores plot of PCA from 15 different brands of dates by using AAS	37
Figure 8: Loadings plot of PCA from 7 minerals by using AAS	37

LIST OF APPENDIXS

	Page
APPENDIX A: Normalization raw date for 15 different dates brand	47
APPENDIX B: <i>K</i> means cluster classes for physical characteristic of different Brands of dates	48
APPENDIX B: <i>K</i> means cluster classes for minerals content of different Brands of dates	49

ABBREVIATIONS

AAS	Atomic Absorption spectroscopy
FAAS	Flame Atomic Absorption spectroscopy
PCs	Principle components
PCA	Principle component Analysis
CA	Cluster Analysis
HCL	Hollow Cathode Lamp
LDL	low density lipoprotein
HCL	Hydrochloric Acid
R ²	Coefficient
Std	Standard
Ppm	parts per million
RSD	Relative Standard Deviation
CONC	Concentration
K	Potassium
Mg	Magnesium
Mn	Manganese
F	Ferum
C	Copper
Zn	Zinc
Ca	Calcium
Ni	Nickel
Pb	Lead
SDS-PAGE	Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis
HCL	Hydrochloric acid
HNO ₃	Nitric acid