

127, 17 27, 17 (20) 77, 17 (20









جامعة عين شمس

التوثيق الالكتروني والميكروفيلم



نقسم بللله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأفلام قد اعدت دون آية تغيرات



يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15-20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of 15 – 25c and relative humidity 20-40 %



ثبكة المعلومات الجامعية





Information Netw. " Shams Children Sha شبكة المعلومات الجامعية @ ASUNET بالرسالة صفحات لم ترد بالأص



Alexandria University Faculty of Agriculture (Saba-Bacha) Food Science Dept.,

STUDIES ON SOME TECHNOLOGICAL PROCESSES FOR COCOA BUTTER-LIKE FATS PRODUCTION FROM VEGETABLE OILS

A THESIS Submitted in Partial of Fulfillment as Requirements for the Degree of

DOCTOR OF PHILOSOPHY IN AGRICULTURAL SCIENCES (FOOD TECHNOLOGY)

Department of Food Sciences

BY

GAMAL ALY SEIF EL-NASR GHIDAN

2010

B 0.49



Alexandria University
Faculty of Agric. (Saba-Bacha)
Food Science Dept.,

STUDIES ON SOME TECHNOLOGICAL PROCESSES FOR COCOA BUTTER-LIKE FATS PRODUCTION FROM VEGETABLE OILS VEGETABLE OILS Presented by

GAMAL ALY SEIF EL-NASR GHIDAN

For the degree of DOCTOR OF PHILOSOPHY (FOOD TECHNOLOGY)

Examiner's Committee:

Prof. Dr. Mohamed Nagib Ahmed Al-Rify

Professor of Food Sciences and Technology, Food Science Departement, Faculty of Agriculture Assiut University.

Prof. Dr. Mohamed Mohamed Mansour Tabikha

Professor of Food Sciences and Technology, Food Science Departement, Faculty of Agriculture El mansoura University.

Prof. Dr. Mohamed Abd El-Hamid Ismaiel

Professor of Food Sciences and Technology, Food Science Departement, Faculty of Agriculture (Saba-Basha), Alexandria University.

Prof. Dr. Omar Mohamed El-Barbary

Professor of Food Sciences and Technology, Food Science Departement, Vice Dean for Education and students Affairs, Faculty of Agriculture (Saba Basha) Alexandria University

Prof. Dr. Ashraf Abd El-Monim Zeitoun

Professor of Food Sciences and Technology, Food Science Departement, Faculty of Agriculture (Saba-Basha), Alexandria University. Approved

In JABtell

M. A. Zeilon

Omer Barbary

Ashbaf

SUPERVISION'S COMMITTEE

Prof. Dr. Mohamed Abd El-Hamid Ismaiel

Professor of Food Sciences and Technology, Food Science Departement, Faculty of Agriculture (Saba-Basha), Alexandria University.

Prof. Dr. Omar Mohamed El-Barbary

Professor of Food Sciences and Technology, Food Science Departement, Vice Dean for Education and students Affairs, Faculty of Agriculture (Saba Basha) Alexandria University

Prof. Dr. Ashraf Abd El-Monim Zeitoun

Professor of Food Sciences and Technology, Food Science Departement, Faculty of Agriculture (Saba-Basha), Alexandria University.

ACKNOWLEDGEMENT

AKNOWLEDGMENT

All Thanks to "Allah" who has lightened my path to accomplish this work.

I would like to express my deep appreciation to Prof. Dr. Mohamed Abd El-Hamid Ismaiel Zeitoun, Professor of Food Industries, Fac. of Agric., Saba-Basha, Alex University, for his great help, suggesting the problems and faithful effort in supervision through the progress of this work and during the writing of the manuscript.

I wish to express my sincere thankfulness to **Prof. Dr. Omar Mohamed El-Barbary** Professor of Food Industries and Vice Dean for Education and students Affairs, Fac. of Agric., Saba-Basha, Alex University for his continuous help, supervision and valuable guidance.

I wish to express my sincere thankfulness to **Prof. Dr. Ashraf Abd El-Monim Zeitoun** Professor of Food Industries Fac. of Agric., Saba-Basha, Alex University for his continuous help, supervision and valuable guidance.

I would like to thank **Mr. Aez El-Din Badwi** Chairman of Extracted Oil and Derivatives Company. Alexandria for allowing me to do part of this work at the company.

Deep thanks are due to **Prof. Dr. Mohamed Rashed** Professor of Engineering geology and head of the geology department and **Mr. Selim Thapet administrator** Fac. of Science, Alex University for offering me the facilities for Polarized light microscopy.

I wish to express my sincere thankfulness to **Dr. Essam Ramdan Shaaban** Physics Department Fac. Of Science, Assiut, Al Azhar University for generous and helping me for doing the differential scanning calorimetry analysis.

I wish to express my sincere thankfulness to **Dr. Mohmed Abd El Rafaa** and the staff members of Mubarak City for Scientific Research, New Borg El Arab City, for helping me during the course of the Scanning Electron Microscopy.

Special thanks are due to all staff members, Fac. of Agric., Saba-Basha, Alex University for their hospitality and for their encouragement.

My great thanks also due to all staff members, Extracted Oil and Derivatives Company, Alexandria for their helping of the laboratory, Gass Chromatography and Nuclear Magnetic Resonance Analysis.

I would like to express my deepest appreciation from my heart to my wife, and all my family for their support, encourabement and patience during the period of my study.

CONTENTS

TABLE OF CONTENTS

	Page N
LIST OF TABLES	ïV
LIST OF FIGURES	V
LIST OF ABBRIVIATIONS	VII
I. INTRODUCTION	1
II. REVIEW OF LITERATURE	5
2. 1. Cocoa butter	5
2.1.1. Physical properties .	7
2.1.1.1. Crystallization	. 7
2.1.1.2. Nucleation	10
2.1.1.3. Crystal groth	12
2.1.1.4. Ripening	12
2.1.1.5. Polymorphism	13
2.2. Characteristics of some vegetable oils and fats	15
2.2.1. Liquid oils	15
2.2.1.1. Soybean oil	15
2.2.2. Solid fats	16
2.2.2.1. Palm oil	. 16
2.2.2.2. Palm kernel oil	18
2.3. Modification Process of oils and fats	19
2.3.1. Hydrogenation	21
2.3.2. Blending	23
2.3.3. Interesterification	, 25
2.3.3.1. Chemical interesterification	25
2.3.3.2. Enzymatic interesterification	28
2.4. Physical properties of fats	33
2.4.1. Melting properties	. 33
2.4.1.1. Solid fat content	. 34
2.4.1.2. Differential scanning calorimetry	35
2.4.2. Crystal morphology	36
2.5. Characteristics of coca butter-like fats	39
2.6. A Brief History of Chocolate	42
2.7. Chocolate Manufacture	43
2.8. Sensory properties of chocolate	44

I. MATERIALS AND METHODS	47
3.1. MATERIALS	47
3.1.1.Fats and oils	47
3.1.2. Lipase-catalyzed interesterification	47
3.1.3. Cocoa butter	47
3.1.4. Nickel catalyst for hydrogenation	47
3.1.5. Bleaching earth	47
3.1.6. Celite® Diatomite Filter Aid	47
3.2. Experimental procedure	47
3.2.1. Hydrogenation process	47
3.2.2. Bleaching process	48
3.2.3. Deodorization process	48
3.2.4. Blending	48
3.2.5. Enzymatic interesterification procedure	49
3.3. Analytical Methods	50
3.3.1. Iodine value (IV)	50
3.3.2. Free fatty acids content (FFA)	50
3.3.3 Peroxide value (PV)	50
3.4. Fatty acid composition	50
3.4.1. Gas chromatography analysis (GC)	51
3.5. Melting point (MP)	- 51
3.6. Refractive index (RI)	51
3.7. Solid fat content (SFC)	51
3.8. Crystal Morphology by Polarized Light Microscopy (PLM)	52
3.9. Scanning electron microscopy	. 52
3.10. Thermal analysis by differential scanning calorimeter (DSC)	52
3.11. Chocolate manufacture	53
3.12. Sensory evaluation of chocolate	54
3.13. Costs of produced cocoa butter-like fat	55
RESULTS AND DISCUSSION	56
4.1. Physiochemical properties of oil and fats used for hydrogenation, blendin and enzymatic interesterification	
4.2. Fatty acids composition of oils and fats used for hydrogenation, blending and enzymatic interesterification	56
4.3. Effect of hydrogenation on the physiochemical properties of soybean oil	58
4.4. Effect of hydrogenation on some of the physiochemical properties of palm	n 60
kernel oil 4.5. The effect of enzymatic interesterification on melting point and solid fat content of palm oil and fully hydrogenated soybean oil blends	63
4.6. Physiochemical properties of palm oil with palm kernel oil blends	66

4.7. Physiochemical properties of palm oil with hydrogenated palm kernel oil	68
blends	
4.8. Effect of blending of enzymatic interesterified fat blend with hydrogenated	70
palm kernel oil on some of phsiochemical properties of produced blends	
4.9. Effect of blending of cocoa butter with hydrogenated palm kernel oil on	72
physiochemical properties of produced blends	
4.10. Fatty acids composition of chosen blends	72
4.11. Physical properties of fats and fat blends	75
4.11.1. Melting properties	75
4.11.2. Crystal Morphology	87
4.11.2.1. Crystal Morphology by Polarized Light Microscopy	87
4.11.2.2. Crystal Morphology by Electron Microscopy	94
4.12. Sensory evaluation of chocolate made from selected blends	97
4.13. Cost of produced cocoa butter-like fat	99
VI. SUMMARY AND COCLUSION	100
VII. REFERENCES	104
VIII ARABIC SAMMARY	- •

LIST OF TABLES

ble No.	<u>Title</u>	Page No.
3.1	Blends of palm oil: fully hydrogenated soybean oil used for enzymatic interesterification	49
3.2	The components of the tested chocolate samples	54
3.3	A hedonic scale for chocolate sensory evaluation	55
1	Physiochemical properties of oils and fats used for hydrogenation, blending and enzymatic interesterification	57
2	Fatty acid composition of palm oil, soybean oil, palm kernel oil and cocoa butter	59
3	Effect of hydrogenation on some of the physiochemical properties of soybean oil	61
4	Physiochemical properties of hydrogenated palm kernel produced by different hydrogenation conditions	62
5	Effect of enzymatic interesterification on melting point and solid fat content of palm oil mixed with fully hydrogenated soybean oil of different percentage	65
6	Effect of blending on physiochemical properties of fat blends formed from palm oil with palm kernel oil	67
7	Effect of blending on physiochemical properties of produced blends based on palm oil with hydrogenated palm kernel oil	69
8	Melting point and solid fat content of binary blends between interesterified palm oil/ FHSO (85:15%) and hydrogenated palm kernel oil	71
9	Melting point and solid fat content of cocoa butter blended with hydrogenated palm kernel oil	73
10	Fatty acid composition (%) of selected fat blends	74
11	Calorimetric data for fats, and modified fat blends	77
12.	Mean sensory scores of the chocolate samples based on different produced cocoa butter-like fat	98