



UNIVERSITI PUTRA MALAYSIA

**EFFECTS OF COCOA BUTTER, PALM FRACTION AND EMULSIFIER
MIXTURES ON THE QUALITY PARAMETERS OF DIFFERENT
CHOCOLATE FORMULATIONS**

BAKTI KUMARA

FSMB 2003 20

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**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA**

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By

BAKTI KUMARA

**Thesis Submitted to the School of Graduate Studies,
Universiti Putra Malaysia, in Fulfillment of the Requirement for
the Degree of Master of Science**

June 2003



Special Dedication

*This Thesis is dedicated to
My beloved wife and son: Husna and Rifqi,
My affectionate parents: Papa & Mamah,
My brothers and sister: Budi, Nuki and Ina
For their patient, love and support*

Abstract of thesis presented to the Senate of Universiti Putra
Malaysia in fulfilment of the requirement for the degree of
Master of Science

**EFFECTS OF COCOA BUTTER, PALM FRACTION AND
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By

BAKTI KUMARA

June 2003

Chairperson : Professor Jinap Selamat, Ph.D.

Faculty : Food Science and Biotechnology

The physico-chemical characteristics of cocoa butter (CB), palm mid-fraction (PMF) and palm kernel stearin (PKS) in fat-based chocolate formulation in the presence of sorbitan tristearate (STS) have been studied. Triacylglycerols (TAGs), fatty acid methyl esters (FAMES), thermal behaviour, polymorphic form, solid fat content (SFC), hardness/texture properties, rheological behaviour, microstructure properties, bloom test, and sensory properties were determined to evaluate quality properties of palm-based chocolate. The results show that the addition of STS into fat system could significantly inhibit the polymorphic transformation during temperature transition. It is due to the significant influence in increasing the crystal stability.



This study showed that the melting profiles of fat mixtures with the presence of STS were different due to the rapid melting at room temperature (30°C), so resulting in the softness of chocolate products. Most of CB, PKS and STS mixtures have a strong tendency to produce two distinctive β and β' polymorphs. These results provide strong evidence to indicate incompatibility between those fats, which causes softness in chocolate and confectionery products. By using response surface methodology (RSM), it was found that a ratio of 90CB:10PMF:2.5STS was the optimum formulation for the best physical and chemical characteristics of fat system.

The concentrations of TAGs of chocolate's fat were changed, causing the polymorphic transformation to take place during storage. However, only the composition of the main TAGs (POP, POS, SOS) significantly influence the type of polymorphic form, whereas fatty acids composition determined the type of TAGs formed. Chocolate containing CB (control) consisted of only β crystals at all times. However, chocolates containing CB and PMF mixtures were found to have both β' and β during storage period. The existing of two crystal forms ($\beta' + \beta$) and the transition of β' into the more stable β crystal had caused bloom formation. STS at 1.25% and 2.5% were found to



inhibit effectively bloom formation during storage. The sensory evaluation of palm-based chocolates showed that texture score was significantly affected by both PMF concentration and onset of melt, but STS did not have any significant effect on each sensory attribute.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN CAMPURAN LEMAK KOKO, FRAKSI MINYAK KELAPA SAWIT DAN PENGEMULSI TERHADAP CIRI KUALITI DALAM FORMULASI COKLAT YANG BERBEZA

Oleh

BAKTI KUMARA

Jun 2003

Pengerusi : Profesor Jinap Selamat, Ph.D.

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Sifat fiziko-kimia lemak koko (CB), fraksi tengah minyak kelapa sawit (PMF) dan kernel stearin minyak kelapa sawit (PKS) dalam formulasi coklat berasas lemak dengan kehadiran sorbitan tristearat (STS) telah dikaji. Triasilgliserol (TAGs), asid lemak metil ester (FAMEs), sifat termal, bentuk polimorfik, kandungan lemak pejal, ciri kekerasan/tekstur, sifat reologi, ciri mikrostruktur, ujian bloom dan ciri sensori telah ditentukan untuk menilai ciri kualiti coklat berasas minyak kelapa sawit. Hasil penyelidikan menunjukkan bahawa penambahan STS ke dalam sistem lemak telah menghalang perubahan polimorfik dengan ketara ketika perubahan suhu. Ini adalah disebabkan oleh pengaruh ketara dalam peningkatan kestabilan kristal.

Kajian juga telah menunjukkan bahawa profil melebur campuran lemak dengan kehadiran STS adalah berbeza disebabkan peleburan yang cepat pada suhu bilik (30°C), dan ini menyebabkan produk coklat menjadi lembik. Kebanyakan campuran CB, PKS dan STS mempunyai kecenderungan yang kuat untuk menghasilkan dua polimorf yang berbeza iaitu β dan β' . Keputusan ini memberikan bukti yang kukuh tentang ketidaksesuaian di antara lemak tersebut, yang seterusnya menghasilkan produk coklat dan konfeksi yang lembik. Teknik "response surface methodology" (RSM), telah mendapatkan bahawa kombinasi 90CB:10PMF:2.5STS telah menghasilkan sifat fizikal dan kimia yang terbaik dalam sistem lemak.

Kepekatan TAGs dalam lemak coklat telah berubah dan itu mengakibatkan berlakunya perubahan polimorfik semasa penyimpanan. Walau bagaimanapun, hanya komposisi utama TAGs (POP, POS, SOS) didapati mempengaruhi dengan ketara jenis bentuk polimorfik dan komposisi asid lemak menentukan jenis TAGs yang terbentuk. Coklat yang mengandungi CB (kawalan) didapati hanya mengandungi kristal β pada setiap masa. Sebaliknya, coklat yang mengandungi campuran PMF dan CB mempunyai kristal β' dan β . Kehadiran dua jenis kristal ($\beta' + \beta$) dan perubahan β' kepada kristal β

yang lebih stabil telah menyebabkan pembentukan bloom. STS pada 1.25% dan 2.5% didapati menghalang pembentukan bloom dengan berkesan. Penilaian sensori coklat berasas minyak kelapa sawit menunjukkan bahawa kepekatan PMF dan permulaan melebur yang cepat mempengaruhi dengan ketara skor untuk tekstur. Walau bagaimanapun, STS tidak menunjukkan kesan yang ketara terhadap setiap ciri sensori.

ACKNOWLEDGEMENTS

Alhamdulillah, first of all I would like to express my greatest thanks and gratitude to Almighty Allah SWT who has given me the will, strength and patience to complete this thesis, and *Salawat* and *Salam* to His righteous messenger, Prophet Muhammad SAW.

I wish to express my sincere gratitude to Professor Dr. Jinap Selamat, the Chairman of my Supervisory Committee, for her guidance, patience, understanding, encouragement and supervisions throughout the course of the study until the completion of this thesis. I am also very grateful to other members of the Supervisory Committee, Prof. Dr. Yaakob B. Che Man and Dr. Mohd. Suria Affandi Yusoff of Malaysian Palm Oil Board for their supervision, support and comments.

I would like to acknowledge the financial support provided by the Intensification of Research in Priority Areas (IRPA) fund no. 0102040268 for this research. My sincere appreciation is also extended to my colleagues and friends, Dr. Amin Ismail, Dr. Yusep Ikrawan, Dr. Misnawi, Syidah, Zaibunnisha, Chin Hui Han, Asep Kusnadi, and Tan Teng Ju of “Cocoa & Chocolate Research Groups, UPM” and Dr. Tan Chin Ping, Dr. Irwandi Jaswir, Dr. Mohammed El-Wathig, Gabby and Wanna of “Fats and Oils Research Groups, UPM”.



Not the least but the most important, I wish to express my deepest appreciation to my parents, H. Eddy Sophian & Hj. Yeyeh Adawiyah, brothers, Wendy Setiabudi & Nuki Ardiansyah and sister, Hj. Ina Winarni for their moral support and understanding throughout my studies. I shall forever recognize their sacrifices that they have given, too. Finally, but first in my thoughts, I also owe my special thanks to my beloved wife, Husna Isnadiyah for her encouragement, understanding and patience, most of all, her care and love. I also always remember my little child, M. Rifqi Iskandarsyah for his hilarious in giving the fortitude in my life.



TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAK	vi
ACKNOWLEDGEMENTS	ix
APPROVAL	xi
DECLARATION	xiii
LIST OF TABLES	xviii
LIST OF FIGURES	xxi
LIST OF ABBREVIATIONS	xxv
CHAPTER	
I GENERAL INTRODUCTION	1
II LITERATURE REVIEW	6
Fats and Emulsifier in Chocolate and Confectionery	6
Compatibility of Fats	11
Cocoa Butter	13
Chemical Characteristics of Cocoa Butter	13
Physical Characteristics of Cocoa Butter	17
Specialty Fats	25
Palm Fraction	25
Cocoa Butter Equivalent (CBE)	27
Cocoa Butter Substitute (CBS)	28
Lauric CBS	29
Non-Lauric CBS	32
Emulsifiers	35
Sorbitan Esters	37
Polyglycerol Polyricinoleat (PGPR)	41
Physical Properties of Chocolate	42
Rheological Behaviour	42
Hardness and Melting Properties	47
Texture and Microstructure Properties	49
Sensory Evaluation of Chocolate Products	54
Bloom Formation	56
Causes of Bloom Formation	57
Factors Affecting Bloom Formation	60
Prevention of Bloom	61



III	GENERAL MATERIALS AND METHODS	64
	Materials	64
	Methods	66
	Chemical Analyses	66
	Fatty Acids Analysis	66
	Triacylglycerols Analysis	67
	Physical Analyses	67
	Solid Fat Content (SFC)	67
	Polymorphic Form Analysis	68
	Texture Analysis (Hardness)	69
	Statistical Analysis	69
IV	THERMAL BEHAVIOUR AND MELTING PROFILES OF COCOA BUTTER-PALM MID- FRACTION MIXTURES WITH THE PRESENCE OF EMULSIFIER	70
	Introduction	70
	Materials and Methods	72
	Materials	72
	Experimental Design	73
	Methods	74
	Chemical Analysis	74
	Thermal Analysis	75
	Solid Fat Content (SFC) analysis	75
	Statistical Analysis	76
	Results and Discussions	77
	Chemical Composition of Cocoa Butter and Palm Mid-fraction	77
	Thermal Behaviour of Fat and Emulsifier Mixtures	79
	Melting Profiles of Fats and Emulsifier Mixtures	92
	Summary	96
V	PHYSICO-CHEMICAL CHARACTERISTICS OF COCOA BUTTER AND PALM FRACTION MIXTURES AND THEIR INTERACTION WITH EMULSIFIER IN FAT SYSTEM	97
	Introduction	97
	Materials and Methods	99
	Materials	99
	Experimental Design	100
	Methods	101
	Chemical Analysis	101
	Thermal Analysis	101
	Polymorphic Form Analysis	102
	Isosolid Diagram	102
	Statistical Analysis	102



	Results and Discussions	103
	Chemical Characteristics of Lauric and Non-lauric Fats	103
	Thermal Behaviour of Lauric and Non-lauric Fats	110
	Polymorphic Transformation in Fats System	117
	Eutectic Effect of Fats Mixtures	120
	Summary	126
VI	TRIACYLGLYCEROLS AND POLYMORPHIC CHANGES IN FAT BLOOM OF CHOCOLATE DURING STORAGE	127
	Introduction	127
	Materials and methods	131
	Materials	131
	Methods	131
	Development of Fat Bloom	131
	Colour Measurement using Hunterlab	132
	Colour Measurement using Digital Image	133
	Sample Preparation	136
	Chemical Analysis	136
	Polymorphic Form	136
	Statistical Analysis	137
	Results and Discussions	137
	Comparison of Colour Measurement Techniques Used in Fat Bloom Studies	137
	Chemical Composition of Fats upon Storage	143
	Observation of Bloomed Surface	150
	Polymorphism of Fats in Bloomed Chocolates	154
	Summary	159
VII	PHYSICAL CHARACTERISTICS, FAT BLOOM STABILITY, AND SENSORY PROPERTIES OF PALM-BASED CHOCOLATE	162
	Introduction	162
	Materials and Methods	164
	Materials Preparation	164
	Rheological Behaviour	165
	Thermal Behaviour	167
	Texture Analysis (Hardness)	167
	Solid Fat Content (SFC)	168
	Microstructure Analysis	168
	Sensory Analysis	169
	Statistical Analysis	170

Results and Discussions	170
Rheological Behaviour	170
Thermal Behaviour	175
Texture Analysis	176
Hardness vs. Solid Fat Content	178
Microstructure Analysis	179
Sensory Analysis	185
Summary	188
VIII GENERAL CONCLUSIONS AND RECOMENDATIONS	191
General Conclusions	191
Recommendations	194
REFERENCES	196
APPENDICES	209
BIOGRAPHICAL SKETCH	232



LIST OF TABLES

Table		Page
1	Lipid compositions (wt %) of cocoa butter	14
2	Fatty acids distribution (wt %) of cocoa butter	14
3	Triacylglycerol compositions (%) of cocoa butter	16
4	Nomenclature and assignment of polymorphs	18
5	Classification and temperature (°C) of cocoa butter crystallization forms	21
6	Types of specialty fats and their acylglycerol compositions	27
7	Fatty acids compositions (wt %) of palm fractions	33
8	Triacylglycerol compositions (wt %) of palm fractions	33
9	Emulsifier functions	36
10	Flow characteristics of plain chocolate with added surface-active lipids at 50°C	46
11	Appearance, causes, and prevention of bloom formation in chocolate surface	63
12	Combination ratios of cocoa butter, palm mid-fraction and sorbitan tristearate	74
13	Fatty acids and triacylglycerols compositions (wt %) of cocoa butter and palm mid-fraction	78
14	Partial melting enthalpy (ΔH_f) of fats and emulsifier mixtures combinations at different heating rate variations using DSC	81
15	Transitions temperature (T_1 and T_2) of fats and emulsifier mixtures combinations at different heating rate variations using DSC	82
16	Regression coefficients, R^2 and P of F values for % ΔH - β' form, T_0 , T_1 and T_2 of fats and emulsifier mixtures at different heating rates	89



17	Effect of fats and emulsifier mixtures on polymorph transitions at heating rate of 10°C as reflected by regression coefficients and R ² for %ΔH _α , %ΔH _β , T ₀ , T ₁ and T ₂	91
18	Solid fat content (SFC) of cocoa butter, palm mid-fraction and emulsifier mixtures at different temperature	93
19	Combination ratios mixtures of cocoa butter, palm fraction and sorbitan tristearate	100
20	Fatty acids and triacylglycerols compositions (wt%) of CB, PMF and PKS	104
21	Triacylglycerols compositions of non-lauric fat (PMF), cocoa butter and emulsifier mixtures	108
22	Regression coefficients for triacylglycerols of cocoa butter, palm mid-fraction and emulsifier mixtures in fat system	110
23	Melting enthalpy and temperature transition of polymorphic form of CB, PMF and STS mixtures measured by DSC	112
24	Melting enthalpy and temperature transition of polymorphic form of CB, PKS and STS mixtures measured by DSC	113
25	Effect of lauric, non lauric fats and emulsifier mixtures on polymorph transitions as reflected by regression coefficients and R ² for %ΔH _β	116
26	X-ray diffraction pattern of CB, PMF and STS mixtures measured by X-ray diffractor after stabilization (at 26°C for 40 h)	118
27	X-ray diffraction pattern of CB, PKS and STS mixtures measured by X-ray diffractor after stabilization (at 26°C for 40 h)	121
28	Fatty acids compositions (wt %) changes of extracted fat from chocolate surface at different days of storage	144
29	Triacylglycerols compositions (wt %) changes of extracted fat from chocolates surface at different days of storage	145



30	Pearson correlation coefficient ($n=3$) and kinetic movement (k) between triacylglycerols composition and storage time	148
31	X-ray diffraction pattern of fat mixtures and emulsifier addition. Measured by X-ray diffractor after stabilization (at 26°C for 40 h) at different days of storage	155
32	Two-way ANOVA: F values and significance level for the effect of fat mixtures and STS on triacylglycerols and whiteness index of chocolates during storage	160
33	Casson viscosity and yield values at different temperature treatments and activation energy (E_a) of chocolate samples	171
34	Hardness value of chocolate samples at different storage time	177
35	Solid fat content (SFC) of palm-based chocolates at different temperatures	180
36	Microstructure analysis and fat-bloom stability of chocolate samples after 21 days at temperature cycles during storage	184
37	Sensory characteristics of palm-based chocolates	186

LIST OF FIGURES

Figure		Page
1	Schematic Orientations of α , β' , and β Forms of the Saturated-monoacid Triacylglycerol Packed in Double-chain-length Fashion (<i>ca</i> plane), Hydrocarbon Close Packing (<i>ba</i> plane) and the Difference in Chain Direction (<i>cb</i> plane)	20
2	Micrographs Illustrating the Crystals of Cocoa Butter from Ivory Coast at Different Absorbance	23
3	Isosolid Phase Diagram for Cocoa Butter and Cocoa Butter Equivalent (CBE; e.q. Coberine)	29
4	Isosolid Phase Diagram for Cocoa Butter and Lauric CBS	31
5	Isosolid Phase Diagram for Cocoa Butter and Non-lauric CBS	34
6	Chemical Formula of Sorbitan Tristearate	38
7	Different Type of Rheogram: (1) Newtonian; (2) Bingham; (3) Pseudoplastic (e.g. Chocolate)	44
8	Melting Profile of Hard butters (e.q. Cocoa Butter)	50
9	Scanning Electron Micrographs of Milk Chocolate after Fat has been Solvent-extracted	52
10	Polymorphic Transitions of CB (Cocoa Butter) and PMF (Palm Mid-fraction) at Different Heating Rate Variations Using DSC	80
11	Kinetic Rate of Polymorphic Transition (α -form) of Cocoa Butter and Palm Mid-fraction, with and without the Presence of Sorbitan Tristearate at Different Heating Rate Variations Using DSC	85
12	Kinetic Rate of Polymorphic Transition (β' -form) of Cocoa Butter and Palm Mid-fraction, with and without and the Presence of Sorbitan Tristearate at Different Heating Rate Variations Using DSC	86

13	Paths for $\alpha - \beta'$ Transformation During Heating Treatments	88
14	Contour Maps of $\% \Delta H_{\alpha}$ and $\% \Delta H_{\beta'}$ of Fats and Emulsifier Mixtures Treated at Heating Rate of $10^{\circ}\text{C}/\text{min}$ Using DSC	90
15	Contour Maps of T_1 and T_2 of Fats and Emulsifier Mixtures Treated at Heating Rate of $10^{\circ}\text{C}/\text{min}$ Using DSC	92
16	Contour Maps of SFC Values of Fat and Emulsifier Mixtures at Temperatures of 20 and 25°C	95
17	Contour Maps of SFC Values of Fat and Emulsifier Mixtures at Temperatures of 30 and 35°C	95
18	Scattering Diagram of Triacylglycerols (TAGs) Distribution of Cocoa Butter (CB), Palm Mid-fraction (PMF), Sorbitan Tristearate (STS) and Their Various Combination Mixtures	105
19	Scattering Diagram of Triacylglycerols (TAGs) Distribution of Cocoa Butter (CB), Palm Kernel Stearin (PKS), Sorbitan Tristearate (STS) and Their Various Combination Mixtures	106
20	Contour Maps of The Effect of PMF and STS on Concentration of POO, POP, POS and SOS	109
21	Melting Thermogram and Polymorphic Form of Cocoa Butter (CB), Palm Mid-fraction (PMF) and Palm Kernel Stearin (PKS) at Heating Rate of $10^{\circ}\text{C}/\text{min}$ of Unstabilized Sample	111
22	Melting Thermogram and Polymorphic Form of Cocoa Butter (CB), Palm Mid-fraction (PMF) and Palm Kernel Stearin (PKS) at Heating Rate of $10^{\circ}\text{C}/\text{min}$ of Stabilized Sample	111
23	A Contour Map of $\% \Delta H_{\beta'}$ of Lauric Fat (PKS), Cocoa Butter and Emulsifier Mixtures Treated at Heating Rate of $10^{\circ}\text{C}/\text{min}$ Using DSC	117
24	Isosolid Diagram Showing Solid Fat Content (SFC) for Mixtures of Cocoa Butter (CB), Palm Mid-fraction (PMF) and Various Combinations without the Presence of Sorbitan Tristearate (STS)	122



25	Isosolid Diagram Showing Solid Fat Content (SFC) for Mixtures of Cocoa Butter (CB), Palm Mid-fraction (PMF) and Various Combinations with the Presence of Sorbitan Tristearate (STS)	122
26	Isosolid Diagram Showing Solid Fat Content (SFC) for Mixtures of Cocoa Butter (CB), Palm Kernel Stearin (PKS) and Various Combinations without the Presence of Sorbitan Tristearate (STS)	125
27	Isosolid Diagram Showing Solid Fat Content (SFC) for Mixtures of Cocoa Butter (CB), Palm Kernel Stearin (PKS) and Various Combinations with the Presence of Sorbitan Tristearate (STS)	125
28	Digital Imaging System for Colour Measurement of Chocolate Fat Bloom	134
29	Relationship of Whiteness Index (WI) Between Instrument and Digital Image Technique of Bloomed Chocolates	139
30	Relationship of Lightness L* Value Between Instrument and Digital Image Technique of Bloomed Chocolates	140
31	Effect of PMF to CB Ratio on Percentage of Main Triacylglycerols in Chocolates During Storage	147
32	Bloom Development of Chocolate Samples Containing Fat Mixtures During Storage	151
33	Bloom Development of Chocolate Samples Containing Fat Mixture and 1.25% STS During Storage	152
34	Bloom Development of Chocolate Samples Containing Fat Mixture and 2.5% STS During Storage	153
35	Changes of Viscosity and Shear Stress at Different Shear Rates and Temperatures of Dark Chocolate	173
36	Polarized Light Microscopy (PLM) of Cocoa Butter and Palm Mid-fraction	181

