UNIVERSITI PUTRA MALAYSIA

CHARACTERISTICS OF MALAYSIAN, SULAWESIAN AND BRAZILIAN COCOA BUTTERS, THEIR BLENDS AND CHOCOLATE

MANSOOR ABDUL HAMID

FSMB 1997 12

CHARACTERISTICS OF MALAYSIAN, SULAWESIAN AND BRAZILIAN COCOA BUTTERS, THEIR BLENDS AND CHOCOLATE

MANSOOR ABDUL HAMID

MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA

1997

CHARACTERISTICS OF MALAYSIAN, SULAWESIAN AND BRAZILIAN COCOA BUTTERS, THEIR BLENDS AND CHOCOLATE

BY
MANSOOR ABDUL HAMID

Thesis Submitted in Fulfilment of the Requirements
for the Degree of Master of Science
in the Faculty of Food Science and Biotechnology
Universiti Putra Malaysia

July 1997

Dedicated to my beloved:

Abdul Hamid Ag. Min
Momeng Bte. Raya
Marinun and family
Marjanah and family
Kasmah and family
Hassan Abdul Hamid
Mastura and husband
Jumatli Abdul Hamid
Mariah Abdul Hamid
Sapri Abdul Hamid

and all my friends

ACKNOWLEDGEMENT

Bismillahhirrahmannirrahim

Alhamdulillah, first of all I would like to express my utmost thanks and gratitude to Almightly Allah S.W.T who has given me the capability to complete this project and my salawat and salam to His righteous massenger, prophet Muhammad s.a.w.

I would like to take this opportunity to express my appreciation and gratitude to the chairman of my Supervisory Committee, Assoc. Prof. Dr. Jinap Selamat for her invaluable suggestion, guidance. discussion and patience throughout the project. I am also very grateful to the other member of my supervisory committee Prof. Dr. Suhaila Mohamad and Assoc. Prof. Dr. Yaakob Che Man for their constructive comments towards the preparation of this thesis.

My sincere gratitude is also extended to the financial support provided by the IRPA fund for this research, which was awarded to Assoc. Prof. Dr Jinap Selamat. I am also indebted to the General Manager of Malaysian Cocoa Board, Dr. Musa Mohd. Jamil for his faith and release approval to complete this thesis. Acknowledgement is also due to all lecturers and staff of Food Science department for their cooperation. To all my friends and fellow research assistants, thanks for given me the moral encouragement and support to complete my graduate study. It is not possible to list all of their names here but there are a few who deserve special mention are Mr. Chan Tin Wan, Mr. Halim Abdul Rahman, Miss Jem, Mr. Azman, Nek Jaa, Razali Mustaffa (Raj), Kak Izah, Aida Hamimi, Lia, Kenit, Kell, Pokka, Doraemon, Wani, Kak Hus, Asri and his housemate, MCB staff at Inanam Laboratory and at the head quarters, Osman, Zul, Elisyanti and all teachers at SMESH.

Finally, I also wish to express my deepest appreciation to my beloved parents, brothers and sisters who have given me encouragement and support in anyway during the many years of my seemingly never ending pursue for knowledge. I wish for every bead of sweat they produced will be in Allah's barakah. All from Allah and all back to Allah again.

TABLE OF CONTENT

		Page
ACKNOWLEDGMENTS		iii
LIST OF TABLES		ix
LIST OF FIGURES		xii
LIST OF PLATES		xiii
ABSTRACT		xiv
ABSTRAK		xvii
CHAPTER		
1	**GENERAL INTRODUCTION**	1
2	**LITERATURE REVIEW**	6
	Cocoa an Export Crop	6
	Cocoa Composition	7
	Cocoa Butter	8
	Cocoa Butter Properties	13
	Physical Characteristics	13
	Melting Point	13
	Hardness	14
	Chemical Characteristics	16
	Triglycerides	18
	Mono- and Diglycerides	20
	Free Fatty Acid	21
	Glycolipid and Phospholipid	22
	Sterols	22
	Volatile Compound	23
	Tocopherols	23
	Solidification of Cocoa Butter	24
	Factors Effecting the Cocoa Butter Quality	25
	Pre-processing Factors	25
	Temperature	25
	Rainfall	26
	Genetic	27
	Composition	27
	Processing Factors	28
	Raw Material Source	28
	Manufacturing Process	29
	Minor Components, Impurities and Additives	31
	Chocolate Manufacturing	31
	Fat Bloom	33

3 THE CHARACTERISTICS OF MALAYSIAN, SULAWESIAN AND BRAZILIAN COCOA BUTTERS

Introduction.. 36
Materials and Methods.. 37
Materials.. 37
Methods.. 37
Cleaning Procedure.. 37
Physical Analysis.. 38
Chemical Analysis.. 40
Sensory Evaluation.. 45
Statistical Analysis.. 46
Results and Discussion.. 46
Physical Analysis.. 46
Crystallization Behaviour.. 46
Melting Behaviour.. 48
Melting Point.. 48
Enthalphy.. 50
Solid Fat Index.. 50
Solid Fat Content.. 52
Chemical Analysis.. 55
Iodine Value (I.V).. 55
Free Fatty Acid (FFA).. 57
Saponin Value (S.V).. 58
Unsaponifiable Matter (USM).. 58
Peroxide Value (P.V).. 60
Refractive Index (R.I).. 62
Fatty Acid Composition (FAC).. 62
Triglyceride Composition.. 64
Sensory Evaluation.. 67
Cocoa Flavour.. 67
Bitter Flavour.. 67
Sour Flavour.. 70
Nutty Flavour.. 70
Oxidized Flavour.. 71
Other Off-Flavour.. 71
Conclusion.. 72

4 PHYSICO-CHEMICAL AND SENSORY CHARACTERISTICS OF BLENDED COCOA BUTTER

Introduction.. 73
Materials and Methods.. 74
Materials.. 74
Methods.. 74
Cleaning Procedure.. 74

Blending Procedure.. 74
Blends of Two Sources of Origins......... 75
Blends of Three Sources of Origins....... 75
Blending Treatment.. 76
Physical Analysis.. 77
Chemical Analysis.. 78
Sensory Evaluation... 78
Statistical Analysis... 78
Results and Discussion... 79
Physical Analysis.. 79
Crystallization Behaviour................................ 79
Melting Behaviour... 83
Melting Point....................................... 83
Enthalphy... 89
Solid Fat Content... 95
Chemical Analysis.. 101
Triglyceride Composition................................ 101
Sensory Evaluation... 103
Flavour Profile... 105
Cocoa Flavour.................................... 105
Bitter Flavour.................................... 107
Sour Flavour....................................... 107
Nutty Flavour...................................... 107
Oxidized Flavour................................. 108
Smokey Flavour................................... 108
Mouldy Flavour................................... 109
Woody Flavour.................................... 109
Straw or Cardboard Flavour................. 109
Oily Flavour.. 110
Bland Flavour...................................... 110
Conclusion... 110

5 **DARK CHOCOLATE PROPERTIES OF BLENDED COCOA BUTTER**

Introduction.. 112
Materials and Methods.. 114
Materials.. 114
Chocolate Preparation..................................... 114
Analysis.. 116
Particle Size....................................... 116
Bloom Test... 116
Hardness.. 117
Colour.. 117
Sensory Evaluation............................. 117
Statistical Analysis.. 118
Results and Discussion.. 118

Particle Size 118
Bloom Test 120
Hardness 123
Colour 123
Sensory Evaluation 125
Hardness 125
Appearance 127
Overall Acceptability 127
Conclusion 127

6 CONCLUSION AND RECOMMENDATIONS

General Conclusion 128
Recommendations 139

BIBILIOGRAPHY 131
APPENDICES 141
BIOGRAPICAL SKETCH 157

LIST OF TABLES

Table		Page
1	Chemical Composition of Cocoa Beans	9
2	Standards for Important Characteristics of Pressed Cocoa Butter	11
3	Fatty Acid Composition (wt/%) of Cocoa Butter	17
4	Triglycerides Composition (%) of Cocoa Butter	19
5	Fat Bloom in Chocolate	35
6	Crystal Percentage of Malaysian, Sulawesian and Brazilian Cocoa Butter	47
7	Melting Point and Enthalphy Malaysian, Sulawesian and Brazilian Cocoa Butter	49
8	Solid Fat Index of Malaysian, Sulawesian and Brazilian Cocoa Butter	51
9	Solid Fat Content of Malaysian, Sulawesian and Brazilian Cocoa Butter	53
10	Iodine Value and Free Fatty Acid Conent of Malaysian, Sulawesian and Brazilian Cocoa Butter	56
11	Saponification and Unsaponifiable Matter of Malaysian, Sulawesian and Brazilian Cocoa Butter	59
12	Peroxide Value and Refractive Index of Malaysian, Sulawesian and Brazilian Cocoa Butter	61
13	Fatty Acid Composition (%) of Malaysian, Sulawesian and Brazilian Cocoa Butter	63
14	Triglycerides Composition (%) of Malaysian, Sulawesian and Brazilian Cocoa Butter	65
15	Mean Score Value for Sensory Evaluation of Malaysian, Sulawesian and Brazilian Cocoa Butter	68

16 Response Percentage for Flavour Profile of Cocoa Butter Samples from Malaysia, Sulawesi and Brazil............................. 69

17 Blend Proportion Using Cocoa Butter Samples from Malaysia, Sulawesi and Brazil... 75

18 Blend Proportion Using Cocoa Butter Samples from Malaysia, Sulawesi and Brazil... 76

19 Crystal Percentage of Blended Cocoa Butter Using Malaysian and Brazilian Cocoa Butter.. 80

20 Melting Point of Blended Cocoa Butter Using Malaysian and Sulawesian Cocoa Butter.. 84

21 Melting Point of Blended Cocoa Butter Using Malaysian and Brazilian Cocoa Butter.. 85

22 Melting Point of Blended Cocoa Butter Using Sulawesian and Brazilian Cocoa Butter.. 87

23 Melting Point of Blended Cocoa Butter Using Malaysian Sulawesian and Brazilian Cocoa Butter................................... 88

24 Enthalphy of Blended Cocoa Butter Using Malaysian and Sulawesian Cocoa Butter.. 90

25 Enthalphy of Blended Cocoa Butter Using Malaysian and Brazilian Cocoa Butter... 91

26 Enthalphy of Blended Cocoa Butter Using Sulawesian and Brazilian Cocoa Butter.. 92

27 Enthalphy of Blended Cocoa Butter Using Malaysian Sulawesian and Brazilian Cocoa Butter................................. 93

28 Solid Fat Content of Blended Cocoa Butter Using Malaysian and Sulawesian Cocoa Butter... 97

29 Solid Fat Content of Blended Cocoa Butter Using Malaysian and Brazilian Cocoa Butter... 98

30 Solid Fat Content of Blended Cocoa Butter Using Sulawesian and Brazilian Cocoa Butter... 99

31	Solid Fat Content of Blended Cocoa Butter Using Malaysian, Sulawesian and Brazilian Cocoa Butter	100
32	Triglycerides Composition (%) of Blended Cocoa Butter Using Malaysian and Brazilian Cocoa Butter	102
33	Mean Score Value for Sensory Evaluation of Cocoa Butter Samples	104
34	Response Percentage of Trained Panel for Flavour Profile of Cocoa Butter from Malaysia, Sulawesi and Brazil	106
35	The Particle Size, Bloom Cycle and Hardness of Dark Chocolate Made from Blended Cocoa Butter	119
36	The Colour Value of Dark Chocolate Made from Blended Cocoa Butter	124
37	Mean Score Value for Sensory Evaluation of Dark Chocolate Made from Blended Cocoa Butter (Hedonic)	126

LIST OF FIGURES

Figure		Page
1	Crystallization Behaviour of Malaysian (I, II, III, IV and V), Sulawesian (S) and Brazilian (B) Cocoa Butter........................	142
2	Melting Behaviour of Malaysian (I, II, III, IV and V), Sulawesian (S) and Brazilian (B) Cocoa Butter.....................	143
3	Crystallization Behaviour of Blended Cocoa Butter Using Malaysian (M) and Brazilian (B) Cocoa Butter......................	144
4	Melting Curve of Blended Cocoa Butter Using Malaysian (M) and Sulawesian (S) Cocoa Butter..	145
5	Melting Curve of Blended Cocoa Butter Using Malaysian (M) and Brazilian (B) Cocoa Butter..	146
6	Melting Curve of Blended Cocoa Butter Using Sulawesian (S) and Brazilian (B) Cocoa Butter..	147
7	Melting Curve of Blended Cocoa Butter Using Malaysian (M) Sulawesian (S) and Brazilian (B) Cocoa Butter.........................	148
8	Solid fat Content of Blended Cocoa Butter Using Malaysian (M) and Sulawesian (S) Cocoa Butter..	149
9	Solid fat Content of Blended Cocoa Butter Using Malaysian (M) and Brazilian (B) Cocoa Butter...	150
10	Solid fat Content of Blended Cocoa Butter Using Sulawesian (S) and Brazilian (B) Cocoa Butter..	151
11	Solid fat Content of Blended Cocoa Butter Using Malaysian (M), Sulawesian (S) and Brazilian Cocoa Butter................................	152

LIST OF PLATES

Plate		Page
1	The Bloom Test on Dark Chocolate at Fifth Cycle....................	122
2	Crystallization Bahaviour of Blended Cocoa Butter Using Malaysian (M) and Sulawesian (S) Cocoa Butter......................	153
3	Crystallization Bahaviour of Blended Cocoa Butter Using Malaysian (M) and Brazilian (B) Cocoa Butter..........................	154
4	Crystallization Bahaviour of Blended Cocoa Butter Using Su!awesian (S) and Brazilian (B) Cocoa Butter..........................	155
5	Crystallization Bahaviour of Blended Cocoa Butter Using Malaysian (M), Sulawesian (S) and Brazilian (B) Cocoa Butter..	156

Abstract of the Thesis Presented to the Senate of Universiti Putra Malaysia in Fulfilment of the Requirement for the Degree of Master of Science

CHARACTERISTICS OF MALAYSIAN, SULAWESIAN AND BRAZILIAN COCOA BUTTERS, THEIR BLENDS AND CHOCOLATE

By

MANSOOR ABDUL HAMID

July, 1997

Chairman : Assoc. Prof. Dr. Jinap Selamat

Faculty : Food Science and Biotechnology

This study was conducted with three fold objectives, (i) to determine the physico-chemical and sensory characteristics of cocoa butter commercially produced by grinders in Malaysia with Sulawesian and Brazilian cocoa butter were used as a comparison, (ii) to determine the physico-chemical characteristics of blended cocoa butter and (iii) to determine the compatibility and acceptability of the chocolate quality made therefrom.

Static crystallization for Malaysian and Sulawesian cocoa butter was found not to be significantly different ($P>0.05$); however they were significantly different ($P<0.05$) from that of the Brazilian cocoa butter. The same observation was made on the melting behaviour and the percent of solid fat content.

Iodine values (I.V) of all Malaysian and Sulawesian cocoa butter (34.75 - 36.15) were not significantly different (P>0.05) but they were significantly lower (P<0.05) than that of Brazilian cocoa butter (40.31). The free fatty acids (FFAs) for all samples were in the standard range (<1.75%) except for the sample from Brazil and two samples from Malaysia .

All cocoa butter samples had saponification value (S.V) in the standard range (188 -198); however S.V for the Brazilian cocoa butter samples (193.57) was significantly higher (P<0.05) than other samples. All samples have unsaponifiable matter (USM) within the standard range (<0.35%) except for the Brazilian cocoa butter sample. Only Malaysian II sample had the Peroxide Value (P.V) within the standrad range (<4.0). The study found that there was no significant difference (P>0.05) in the refractive index (R.I) among all samples. All the values were within the standard range.

The fatty acid compositions (FAC) of Malaysian and Sulawesian cocoa butter samples were not significantly different (P>0.05); however, both were significantly different (P<0.05) from the Brazilian sample There was no significant difference (P>0.05) in triglyceride composition for all Malaysian cocoa butter samples. There was a significant difference (P<0.05) in the content of PLiO, PLiP, POP and SOA between Malaysian and Sulawesian cocoa butter. The triglyceride composition of the Brazilian cocoa butter sample was significantly different (P<0.05) from the two samples. All the samples contained many flavour descriptives which were objectionable to the panelist.

The Malaysian, Sulawesian and their blended cocoa butter showed the same melting profile and hardness. The melting behaviour and hardness of Brazilian cocoa butter, and its mixture with either Malaysian or Sulawesian cocoa butter were affected more by the amount of Brazilian cocoa butter in the blend. Increasing the Brazilian cocoa butter by 20% has significantly ($P<0.05$) decreased the melting point, enthalphy and the hardness values. Based on the physico-chemical characteristics, 40% of Brazilian cocoa butter was the minimum level accepted to be incorporated in a good quality blended cocoa butter. Good quality chocolates were obtained from a blend containing 60% of Malaysian cocoa butter and 40% of Brazilian cocoa butter. This findings were based on the chocolate resistance to bloom, glossiness, hardness and sensory evaluation.

Abstrak Tesis yang Dikemukakan Kepada Senat Universiti Putra Malaysia Sebagai Memenuhi Keperluan Untuk Ijazah Master Sains.

CIRI-CIRI LEMAK KOKO MALAYSIA, SULAWESI DAN BRAZIL, CAMPURANNYA DAN COKLAT

oleh

MANSOOR ABDUL HAMID

Julai, 1997

Pengerusi : Prof. Madya Dr. Jinap Selamat

Fakulti : Sains Makanan dan Bioteknologi

Kajian ini dijalankan dengan tiga objektif utama iaitu (i) menentukan ciri-ciri lemak koko yang dihasilkan secara komersial oleh pengilang-pengilang di Malaysia dengan menggunakan lemak koko dari Sulawesi dan Brazil sebagai perbandingan, (ii) menentukan ciri-ciri lemak koko campuran dan (iii) menentukan kesesuaian dan penerimaan coklat yang dihasilkan dari lemak koko campuran.

Perlakuan penghabluran secara statik bagi lemak koko Malaysia dan Sulawesi tidak menunjukkan perbezaan bererti ($P>0.05$) tetapi corak penghabluran kedua-dua lemak koko ini menunjukkan perbezaan bererti ($P<0.05$) dibandingkan dengan lemak koko Brazil. Keputusan yang sama diperolehi dari perlakuan peleburan dan peratus kandungan pepejal lemak (SFC).

Nilai-nilai iodin (I.V) bagi semua sampel lemak koko Malaysia dan Sulawesi (34.75 - 36.15) menunjukkan tiada perbezaan ketara ($P>0.05$)tetapi I.V ini lebih rendah dengan ketara ($P<0.05$) dibandingkan I.V bagi sampel lemak koko Brazil (40.31). Kandungan asid lemak bebas (FFA) bagi semua sampel lemak koko di dalam julat piawai (<1.75%) kecuali lemak koko Brazil dan dua sampel lemak koko Malaysia.

Semua sampel lemak koko mempunyai nilai saponin (S.V) di dalam julat piawai (188 - 198); walau bagaimanapun, S.V bagi sampel lemak koko Brazil (193.57) lebih tinggi dengan ketara ($P<0.05$) dibandingkan sampel-sampel lemak koko lain. Semua sampel mempunyai nilai bahan bukan saponin (USM) dalam julat piawai (<0.35%) kecuali lemak koko Brazil. Hanya sampel lemak koko Malaysia II mempunyai nilai peroksida (P.V) berada dalam julat piawai (<4.0). Kajian didapati tiada perbezaan yang ketara ($P>0.05$) dalam nilai indeks biasan (R.I) antara semaua sampel. Semua nilainya berada di dalam julat piawai.

Komposisi asid lemak (FAC) bagi semua sampel lemak koko Malaysia dan lemak koko Sulawesi tidak menunjukkan perbezaan yang ketara ($P>0.05$) walau bagaimanapun FAC ini berbeza dengan ketara ($P<0.05$) dibandingkan dengan lemak koko Brazil. Tiada perbezaan ketara ($P>0.05$) dalam komposisi trigliserida bagi semua sampel lemak koko Malaysia tetapi terdapat perbezaan yang ketara ($P<0.05$) dibandingkan dengan lemak koko Sulawesi bagi komponen PLiO, PLiP, POP dan

SOA. Komposisi triglycerida bagi sampel lemak koko Brazil berbeza dengan ketara ($P<0.05$) dibandingkan dengan sampel-sampel yang lain. Semua sampel memgandungi banyak perisa yang tidak diingini dan mempengaruhi penerimaan panel.

Lemak koko Malaysia, Sulawesi dan campuran dari kedua-duanya menunjukkan perlakuan peleburan dan kekerasan yang serupa. Perlakuan peleburan dan kekerasan lemak koko Brazil dan campuran sama ada dengan lemak koko Malaysia mahupun Sulawesi lebih memberi lebih kesan terhadap kandungan lemak koko Brazil dalam campuran tersebut. Setiap tambahan 20% lemak koko Brazil dalam campuran akan memberikan penurunan yang ketara ($P<0.05$) pada takat peleburan, nilai tenaga peleburan dan kekerasan. Berdasarkan ciri-ciri fiziko-kimia, tahap minimum menggunakan 40% lemak koko Brazil dalam campuran diterima sebagai lemak koko campuran yang berkualiti memberikan perbezaan tidak ketara ($P>0.05$) dibandingkan lemak koko Malaysia dan Sulawesi. Coklat yang berkualiti dihasilkan dari campuran 60% lemak koko Malaysia dan 40% lemak koko Brazil. Hasil ini berdasarkan ketahanan coklat terhadap 'bloom', ciri permukaan yang bersinar, kekerasan yang sesuai dan penilaian deria.

CHAPTER 1

INTRODUCTION

The cocoa tree originated from the South America and it belongs to the genus *Theobroma*. There are twenty species in the genus but only *Theobroma cocoa* is cultivated widely. Among the subspecies of the *Theobroma cocoa*, only three are of commercial value: the Forestero, the Criollo and a cross between the two, that is the Trinitrio (Wood and Lass, 1985). The Mayan Indians and the Aztecs of Central America considered cocoa to be a valuable product and believed the cocoa tree to be of divine origin, hence it was given the name Theobroma meaning `food of the gods' (Minifie, 1989).

Cocoa trees are cultivated in the Tropical regions of western Africa, Brazil and many other location within 20° north or south of the equator (Minifie, 1989). A mature cocoa bean can store up to 700 mg of cocoa butter. A single tree may produce as many as 2,000 seeds per year or a yield up to 1.5 kg of cocoa butter annually (Lauren and Fritz, 1987). The cocoa beans are processed by fermentation, drying, roasting, breaking, winnowing and grinding to produce cocoa liquor. Cocoa liquor is then pressed to obtain cocoa butter and cocoa powder.

Cocoa butter is the most valuable ingredient of the cocoa bean and accounted for 50% to 55% of the cocoa nibs. It is a fat obtained from the seed of *Theobroma* *cocoa* before or after roasting, derived by pressing cocoa nibs, either by hydraulic or expeller presses. Other types of cocoa butter are produced by solvent extraction using petroleum ether or hexane.

About 95% of total cocoa butter production is used in confectionery chocolate manufacturing; the rest are for cosmetic and pharmaceutical manufacturing. Due to the high price of cocoa butter (US$2.50 to US$3.00/ Ib), it is important that this vital ingredient is used to its maximum benefits (Dimick, 1991). Cocoa butter contributed 30% to 40% by weight of finished chocolate (Haumann, 1984). The physico-chemical characteristics of cocoa butter such as hardness, heat resistance, mouthfeel and flavour release determine the final quality and behaviour of the chocolate made there from (Chin, 1985). Its solidification affects the physical properties of the finished chocolate. The crystallization of cocoa butter is controlled by tempering to produce the right and stable polymorphic form (β-form), which melt just below body temperature and has excellent effect to the chocolate properties such as surface glossiness and snap (Musser, 1973). If the cocoa butter crystals present in chocolate products are not in a stable form, mouthfeel, hearing and sight are affected in an undesirable manner (Manning and Dimick, 1985). The unstable cocoa butter crystal formed in chocolates also caused a bloom (Timms, 1984). Furthermore, cocoa butter is extremely stable against oxidative deterioration and development of rancidity (Chin, 1985).

Triglyceride is the major chemical component in cocoa butter contributing 94% to 96% of total fat present; the minor components include monoglyceride, diglyceride, sterol, fat soluble vitamin and free fatty acids (Dimick, 1991). Generally, monounsaturated triglyceride is the major triglyceride in cocoa butter. Various combinations with oleic acid in the middle and three major combinations in cocoa butter are 2-oleo-dipalmitic (POP), 2-oleo-distearin (SOS) and oleo-palmitostearin (POS) which has close structure and polymorphism characteristics.

Cocoa butter from different sources of origin have different physical and chemical characteristics. Dimick (1991) found the quality of cocoa butter varies depending upon the area where the cocoa is grown and is also affected by processing, climatic and seasonal factors. Malaysia and other countries with high temperature environment, high and constant rainfall produce good quality and harder cocoa butter whereas countries with low temperate environment and less rainfall such as Brazil produce softer cocoa butter (Chin and Zainuddin, 1984).

Malaysian cocoa butter is categorized as a hard cocoa butter (Chaiseri and Dimick, 1989). It has rapid nucleation rate, higher melting point and solid fat content than Ghanian, Ivory Coast and Brazilian cocoa butter. Weyland (1992) found Malaysian cocoa butter contained higher concentration of monounsaturated triglyceride than those from Africa and Brazil. Shukla et al. (1983) found that Malaysian cocoa butter contained 87.0% monounsaturated whereas the Brazilian contained 72.4%. Chin et al. (1984; 1985) also found cocoa butter from Malaysia is better quality than that from Ghana. On the other hand, Brazilian cocoa butter is categorized as soft cocoa butter with slow nucleation and low solid fat content (Chaiseri and Dimick, 1989). Brazilian cocoa butter also contains low percentage of monounsaturated triglyceride (Weyland, 1992) but higher in iodine value (Chin, 1985). These qualities contribute to the poor quality of chocolate, less resistant to bloom and easy to melt in extreme environment.

In 1995, Malaysia exported 40,292 tonnes of cocoa butter valued at RM330,510,880.00. United States of America was the major importer with 10,876 tonnes valued at RM89,940,595.00 followed by the Netherlands with 8,262 tonnes valued at RM64,830,548.00 (MCB, 1996). In the past ten years, many countries from Far East regions especially Indonesia, Thailand, Philippine and Papua New Guinea become new cocoa producer and exported the dry cocoa beans to Europe. However, the European manufacturers claimed that cocoa butter from this region has become softer (De Zaan, 1992). The price of Malaysian cocoa butter is therefore very much affected by this situation.

Since 1995, Malaysia cocoa planting has dropped 9.4% from the previous year and caused a decrease in production. Currently, ten cocoa grinders in Malaysia has taken an alternative to import cocoa beans from other sources to maintain their production. From our studies, Sulawesi capacity was chosen because it is the nearest to Malaysia, therefore contributes to much lower transportation cost. Indonesia is one of the most productive cocoa producer and has becomes the third cocoa world