

THE SOLVENT EXTRACTORS' ASSOCIATION OF INDIA

Coco Butter Equivalents (CBE) From Vegetable Fats

Cocoa butter enjoys a very high status in the chocolate industry due to its property of remaining hard, mouldable, and brittle up to 30° C and suddenly fully and completely melting at 35° C (i.e in the mouth). This has been attributed to its unique glyceride composition having almost 80 percent symmetrical triglycerides Palmito-oleo-palmitin (POP), Palmito-oleo-stearin (POS) and Stearo-oleo-stearin (SOS). In 1950s it was discovered that the physical properties of the cocoa butter could be matched in toto by blending POP and SOS and additionally POS all obtained from different natural sources. Indian tree seed fats like kokum dhupa, mango kernel, sal form a good source of SOS, the Indian source of POP is phulwara fat.

Sal [*Shorea Robusta Gaertn*] Seed Fat

Sal fat is greenish brown. It has a typical odour. Its fatty acid composition shows C₁₆ (4 %), C₁₈ (47%), C_{18:1} (44%), C_{18:2} (0.5%) and C₂₀ (2.8%). These values are mean of some samples. The presence of small amounts of the C₂₀ acid however does not affect the performance of the sal fat fractions as cocoa butter substitute. A recent study of the fatty acid composition revealed the presence of 9,10-epoxy stearic acid, and 9,10 dihydroxy stearic acid. These are undesirable, because the glycerides containing these fatty acids viz., GSEpS (9%) and GSEpU (3%) interfere in the sharp melting characteristics of the cocoa equivalent. Hence in the refined sal fat specification, 3.0% Max. is the limit set for the combined amount of the epoxy and dihydroxy acid glycerides.

A chromatographic process using cogelled silica alumina adsorbent has been described in a patent for removal of such interfering impurities from the sal fat. A two stage acetone fractionation process gives a sal mid-fraction (45 % yield) that is suitable for use in preparing cocoa butter equivalents.

Mango [*Mangifera Indica Linn*] Kernel Fat

Mango Kernel fat is pale yellow or cream in colour. Its fatty acid composition varies considerably due to variety of mangoes grown in India. Range of values recorded has been reported as C₁₆ (16-18%), C₁₈ (24-49%), C_{18:1} (33-53%), C_{18:2} (1-13%) and C₂₀ (1-2.6%). Presence of linolenic acid (C_{18:3}) up to 1.2 % has been reported Iodine value (I.V) of the fat has a wide range : 32-60., but large quantities with I.V. between 45-50 are now available.

Acetone fractionation has been tried out by different groups and suitable SOS fractions for blending with palm mid-fraction have been obtained. It is, however, found that the low I.V. samples give good yield of SOS fraction. Samples having high I.V 55-60 give lower yields.

Kokum [*Garcina Indica Choisy*] Fat

Kokum butter or fat is very clean fat with fatty acid composition C₁₆ (3.4%), C₁₈ (67.4%), C_{18:1} (28.1%), C_{18:2} (0.6%) and C₂₀ (0.3%). It has a very high symmetrical SOS content (83.4%). This has been, therefore useful for direct (without any fractionation) blending with palm mid-fraction for preparing cocoa butter equivalents.

Dhupa [*Simaruba Glauca*] Fat

Dhupa fat is a semi-solid greenish yellow or nearly white fat, having faint pleasant odour. Its fatty acid composition is C₁₆ (9.0%), C₁₈ (46.9%), C_{18:1} (41.4%), C_{18:2} (1.3%) and C₂₀ (1.4%). Acetone fractionation gives 75% yield of stearine with SOS content of 85%. This stearine is used with palm mid-fraction for preparing cocoa butter equivalent.

Phulwara [*Aisandra Butyracea*] Fat

Phulwara fat is light yellow to white in colour. It has a pleasant taste and odour. The fatty acid composition is - C₁₆ (60.8%), C₁₈ (3.2%), C_{18:1} (30.9%), C_{18:2} (4.9%). It is rich in palmitic acid.

The symmetric glyceride POP is 62% and it is possible to obtain POP enriched fraction which can be as good as palm mid-fraction. This fraction therefore is suitable for blending with SOS fractions obtained from sal, mango kernel, kokum and dhupa fats to prepare cocoa butter equivalent

CHEMICAL CHARACTERISTICS, PHYSICAL PROPERTIES, FATTY ACID & MAJOR GLYCERIDE COMPOSITION OF FATS

Chemical Characteristics										
	COCOA BUTTER	SAL	MANGO KERNEL	KOKUM	DHUPA	PMF	PMO	MOWRAH	ILLIPE	SHEA
FFA	1.5	0.5	0.5	0.5	0.5	0.25	0.25	0.5	0.8	1.0
MIV	0.25	0.5	0.5	0.25	0.5	0.1	0.1	0.5	0.2	0.5
IV	33-38	38-43	45-50	32-38	36-43	34-36	60-65	58-71	32-36	65
SAP V	185-195	185-195	185-195	185-195	185-195	190.195	190-195	187-196	185-195	178-190
UNSAF M max	1.2	1.2	1.2	1.2	1.2	1.0	1.0	9.0	1.2	8
PMF = PALM MID FRACTION PMO = PALM OLEIN										

Physical Properties											
	COCOA BUTTER	SAL	MANGO KERNEL	KOKUM	DHUPA	PMF	PMO	MOWRAH	ILLIPE	SHEA	
LOVIBOND } COLOUR } 5 1/4" } CELL }	Y	-	50	50max	40	40	30	30	25	30	30
	R	-	8	8max	5	7	3	3	6	4	3
M.P. °C		33-35	35-37	35-43	40-43	34-40	34-36	35	29-31	34	32-45
S F I											

	20°C	85	70	55	90-95	70-75	70	-	25-30	80	45
	30°C	60	65	54	75-80	60-65	30	-	5-10	64	10
	35°C	0	12	0	60-65	20-25	0	-	0-2	10	4

Fatty Acid Composition

	COCOA BUTTER	SAL	MANGO KERNEL	KOKUM	DHUPA	PMF	PMO	MOWRAH	ILLIPE	SHEA
C₁₆	25.2	4.5	5.5	3.4	9.0	46.0	35.8	23.7	17.5	4.2
C₁₈	35.5	44.2	41.1	87.4	46.9	3.8	4.2	19.3	45.5	40.6
C_{18:1}	35.2	42.2	46.8	28.1	41.4	37.6	44.8	36.3	35.2	47.3
C_{18:2}	0.1	2.8	3.2	0.6	1.3	10.0	15.0	11.6	0.7	5.4
C₂₀	1.0	6.3	2.2	0.3	1.4	NIL	-	-	-	-

Major Glyceride Composition

	COCOA BUTTER	SAL	MANGO KERNEL	KOKUM	DHUPA	PMF	PMO	MOWRAH	ILLIPE	SHEA
POP	6	1	0.6-2	-	7	65-79	43	7-12	8.6	-
POSt	52	7-13	9-14	4.6	17.3	6-20	11	12-16	34.3	6.4
StOSt	19	38-42	20-40	78	47.1	-	NIL	4-7	44.5	20.6
P/StOO	21	22.0	30-45	12.4	22.2	-	32	15-22	5.2	33.7