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CONFECTIONERY FATS FROM TUCUM (ASTROCARYUM VULGARE MART) AND PINDO (ARECASTRUM ROMANOZOFFIANUM) KERNEL FATS

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Analytical characteristics, fatty acid composition and cooling characteristics of tucum fat, its fractions from acetone crystallization, and pindo fat have been determined. These characteristics have been compared with those of the palm kernel and coconut stearings.

Fractionation of tucum fat (slip point 32.0°C) gave two fractions; a higher melting fraction (yield 36.7%, slip point 34.0°C). Tucum fat and its fractions had slip points, saponification values and iodine values similar to those of palm kernel stearins while pindo fat had a lower slip point and saponification value.

Tucum fat fractions had faster solidification than whole tucum fat, pindo fat, palm kernel stearin and coconut stearin. Cooling characteristics of tucum kernel fat its fractions and pindo fat were similar to those of palm kernel stearin.

Tucum fat and pindo fat had fatty acid composition similar to that of palm stearin. Relative to the whole fat, tucum fractions had less lauric acid; the first fraction contained more myristic while the unsaturated fatty acids oleic and linoleic were enhanced in the second fraction.

Key words: Astrocaryum vulgare, Arecastrum romanozoffianum, Fat.

INTRODUCTION

Lauric fats offer a wide range of hard butters with different ranges of physical properties [1-4]. These confectionery fats are made primarily from palm kernel oil and coconut oil [1]. There are in addition several minor varieties of lauric fats such as babassu, tucum, and ouricuri. These *oils are* however seldom encountered in international trade [1].

Palm kernel and coconut oils have narrow melting ranges, which make them suitable for the manufacture of a variety of fatty foods. However the melting points and solid contents of the oils at room temperature are rather low for confectionery coatings and couvertures, a drawback which is alleviated by fractional crystallization and separation of the harder and softer components. The harder stearins are suitable for certain confectionery applications as complete subsititues for cocoa butter. Here they exhibit excellent flavour release, mouthfeel, texture "snap", and good gloss. They also possess excellent oxidative stability, all at moderate cost [2].

Tucum and pindo kernel fats are somewhat brittle, firm, creamy white solids which consist mainly of saturated triglycerides of which myristo-dilaurins constitute the dominant type [3]. Due to its special properties, tucum kernel fat is a valuable confectionery fat [4] and claims a premium over palm kernel oil [5]. Pindo kernel fat is not exploited at the moment for confectionery use.

In the present study, the properties of tucum kernel fat, its fractions from acetone crystallization and pindo kernel fat are compared with those for palm kernel oil, stearin and olein, and coconut stearin.

EXPERIMENTAL

Extraction of fat. Tucum kernel ground in a christy mill was extracted for 24 hours with hexane in a soxhlet extractor of 5L capacity. The fat was isolated after filteration of the hexane solution and recovery of the solvent under reduced pressure.

Crystallization. Tucum kernel fat (200g), was completely melted at 50°c and dissolved in analytical grade acetone (600ml). The mixture was held at room temperature (23.5°c) for 24 hr. and transferred to a refrigerated incubator at 20°c. The termperature of the incubator was lowered at the rate of 3°c/24 hr. to 7°c. The mixture was held at 7°c for 70 days and filtered under vacuum using vacuum using a Buchner funnel precooled to 7°. The fractions were freed of solvent by distillation oat steam bath temperature under which condition the precipitate (Fraction 1) was completely desolventised. For the second fraction (the mother liquor obtained after filteration of fraction 1), residual solvent was removed under vacuum in a rotary evaporator.

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Analytical procedures. Saponification value, iodine value, and slip point were determined according to official methods [6].

Cooling characteristics were determined according to the modified Jensen's solidification test using 10g of fat, in a 6 in x ¾ in test tube, supported in a larger tube, 3 cm in diameter, and a bath temperature of 17° 5. The following were recorded; The "standard time", the interval from the standard temperature reached); the "crystallization times", the interval from the minimum termperature to the solidification point, and the temperature rise on supercooling.

Whole tucum kernel fat, fractions, and pindo fat were converted to their corresponding methly esters by acid catalysed methanolysis [7]. The esters were extracted with analytical grade hexane, washed with distilled water, dried over anhydrous sodium sulfate, concentrated and injected into the gas chromatograph. (PYE UNICAM 104, equipped with flame ionization detectors). Gas chromatography of methyl esters was carried out at 190°c using a 1.82m x 2.4mm i.d glass column packed with 10% polyethylene glycol adipate (PEGA) on 100/120 mesh Diatomite C. AW Carrier gas nitrogen flow rate was 35.5 ml/min.

RESULTS AND DISCUSSION

Several methods exist for lauric oil fractionation. Notable among them are fractionation in solvents such as acetone, hexane, or 2-nitropropane, dary fractionation, and we fractionation employing a detergent [1]. Crystallization from solvents is the most easily understood and most convenient for small laboratory trials and was the method of choice in this study. Due to the effect of cooling rate on crystal morphology, a low cooling rate was employed to induce supersaturation and hence crystallization. The rate of cooling employed gave compact crystals which had good filterability and a good yield of crystals (Fraction 1, yield 36.7%). Chemical and physical properties of separated fractions depend on fractionation conditions and on the yields sought. In the present study, crystallization was slow and to achieve a good yield of fraction 1, a long fractionation time was required.

Table I presents analytical characteristics for tucum kernel fat, its fractions from acetone crystallization, and pindo kernel fat. Included for comparison are published characteristics for palm kernel stearin and olein.

Tucum fat, its fractions and pindo fat had solidification points, saponification values and iodine values within

Table 1. Analytical characteristics of tucum kernel fat and its fractions, in comparison with values for palm kernel fractions and pindo fat.

	Tucum				Palm Kernel[c]		Pindo[d]
	First Fraction 1	Whole 1[a]	2[b]	Second Fraction 2	Stearins	Oleins	Whole
Slip point (°C)	34.0	32.0	30.0	31.0	29-35[e]	23.26[e]	27.0
Solidification Point (°C)	30.8	27.7	—	28.8	26.5-32	21-24	27.3
Saponification Value	251.1	250.7	232.1	250.4	249.252	244-246	237.0
Iodine Value	8.9	13.5	14.5	19.2	4-14.5	19-30	13.6
Free Fatty acid (% as lauric)	0.03	0.1	1.85	0.48	0.2-6.0	5-20	1.6
Consistency at room temperature	Solid	Solid	Solid	Solid	Solid	Liquid	Solid
Effect on palate	← Non sticky Quick melting Cool sensation on melting →				Non stick Quick melting Cool sensation on melting		Nonsticky Quick melting Cool sensation on melting
Yield (%)	36.7	—	—	63.30	—		

[a]Present study, used for fractionation. [b]Oboh and Oderinde [3]. [c]Williams [5]. [d]Previously reported (inpress, Food Chemistry).
[e]Wiley melting point (°C). complete fusion.

the melting range for palm kernel stearins. Slip points were within the melting range for palm kernel stearins except in the case of pindo fat which was slightly lower. Tucum kernel fat, its fractions, and pindo kernel fat were quick melting solids which gave a cool sensation on the palate on melting. Tucum kernel fat and its fractions had low free fatty acid content.

The fatty acide composition of whole Tucum fat and its fractions and pindo kernel fat are presented in Table 2. Included for comparison are the compositions of palm kernel oil, stearin and olein.

Table 2. Fatty acid compositions of tucum kernel fat, its fractions, and pindo kernel fat in comparison with typical values for palm kernel oil, stearin and olein.

	Fatty Acids (wt%)							
Fat	8:0	10:0	12:0	14:0	16:0	18:0	18:1	18:2
Tucum kernel fat[a]	1.9	3.0	53.7	23.3	5.5	1.9	8.8	1.9
Tucum kernel fat[b]	2.0	2.4	45.5	21.3	8.5	3.1	13.6	4.4
Fraction 1[a]	0.6	1.2	44.8	31.8	7.6	3.8	8.6	1.6
Fraction 2[a]	1.3	1.9	48.5	20.4	6.9	4.1	12.6	4.5
Pindo fat[a]	1.7	2.0	55.5	20.4	6.6	1.7	10.2	1.7
Palm kernel oil[c]	C_{6_7}-C_{10}		48.0	16.0	9.0	2.0	15.0	2.0
Palm kernel stearin[c]	6		53.0	21.0	9.0	2.0	8.0	1.0
Palm kernel olein[c]	9		45.0	13.0	9.0	3.0	19.0	2.0

[a]Present Study. [b]Oboh and Oderinde [3]. [c]Rossel [1].

Relative to the whole fat, tucum fractions contained less 12:0, more 14:0 in fraction 1 andmore 18:1 and 18:2 in fraction 2. Whole tucum fat, and pindo fat had fatty acid compositions similar to that of palm kernel stearin.

Palm kernel oil and olein have relatively low levels of 14:0 and high levels of 18:1 and the short chain acids of chain length C_{10} and below [1].

Cooling characteristics of tucum fat and its fractions and those for pindo kernel fat are presented in Table 3. Included for comparison are typical values for coconut and pelm kernel stearins.

Tucum fat and pindo fat had standard times similar to those for coconut and palm kernel stearins. Tucum fractions had shorter standard times indicating a higher solidification rate for these fats. Tucum fat, its fractions and pindo fat had shorter crystallization times than coconut and palm kernel stearins. Temperature rise on solidification was higher for fractions than for whole tucum fat and pindo fat (Table 3 , Figs.1 and 2).

Whole tucum fat, and pindo fat had solidification points similar to that of coconut stearin which had a somewhat lower minimum tempearture and hence a higher temperature rise [5]

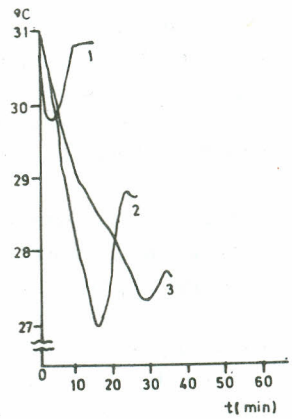

Fig. 1 Cooling curves for tucum kernel fat and fractions. (1). Tucum kernel fractional 1. (2) Tucum kernel fraction 2. (3). Whole tucum kernel fat.

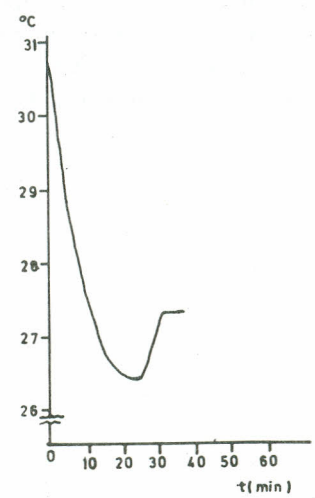

Fig. 2. Cooling curve for pindo kernel fat.

Table 3. Cooling Characteristics of tucum kernel fat, its fractions, and pindo kernel fat in comparison with typical values for palm kernel stearin and coconut stearin.

	Std Time	Crystalli-zation Time (min)	Minimum Temp (°C)	Solidifi-cation Point (°C)	Tem-pera-ture rise
Tucum fat[a]	33.00	6.0	27.30	27.70	0.40
Fraction 1[a]	9.00	5.0	29.75	30.80	1.05
Fraction 2[a]	23.00	8.0	27.00	28.80	1.80
Pindo fat[a]	30.00	9.0	26.65	27.30	0.90
Coconut stearin[b]	35.00	12.0	25.70	27.00	1.30
Palm kernel stearin[b]	34.00	16.0	27.20	29.80	2.60

[a]Present study: Cooling characteristics by the Jensen solidification test [5]. [b]Williams [5]: Cooling characteristics by the Jensen Solidification test. (Results from the Jensen and modified solidification Tests are usually good agreement [5].

Tucum fraction 2 had a minimum temperature similar to that of palm kernel stearin but had a somewhat lower solidification pont and hence a lower temperature rise. Tucum fraction 1 had higher minimum temperature and solidification point and a lower temperature rise than palm kernel stearin.

Fractionation improved that characteristics of tucum kernel fat by increasing the rate of solidification, raising solidification temperature and improving temperature rise on solidification.

Unlike the case of palm kernel and coconut oils, where fractionation leads to the production of liquid oleins [1], the secondary fraction from tucum fat fractionation was a fat with properties similar to those of palm kernel stearin, with the added advantage of a faster rate of solidification. However due to seasonal variation int he composition of tucum kernel fat (Tables 1 and 2), the yields and properties of fractions from the fat are expected to vary considerably.

Where quick 'getaway' and smooth palatability are desired, tucum kernel fat, pindo kernel fat, and the second fraction from tucum kernel fat should find suitable application, while the higher melting fraction from tucum kernel fat would be suitable for formulations that should withstand higher temperatures.

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