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Trans-free plastic shortenings from coconut stearin and palm stearin blends

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ABSTRACT

Coconut oil was fractionated to get 40% and 60% stearins (CSt1 and CSt2), blended with a hard fraction (PSt) from palm oil (10–90%) and its suitability as a plastic fat was studied. Slip melting point increased with increase in the level of PSt and ranged from 25.9 to 49.6 °C. CSt2 did not contain any solids above 20 °C but increased on incorporating PSt and showed the wider melting range required for plastic fats. Melting profiles of the blends containing 30% and 40% PSt were comparable with that of a commercial bakery shortening. Triglyceride composition showed that the blends contained lower and higher molecular weight triglycerides desirable for plastic fats. FTIR spectra showed a distinct peak at 966 cm^{-1} characteristic of *trans* fatty acids in commercial shortening while the peak was absent in blends. This study showed that the blends containing 60–70% CSt with PSt are suitable as *trans*-free plastic fats.

1. Introduction

Coconut oil is principally composed of medium-chain triglycerides (MCT) which have properties different from long-chain triglycerides in their fatty acid composition, digestion, absorption and metabolic fate in the body. MCT are digested more easily and absorbed more rapidly by the body than other fats (Bach & Babayan, 1982). Many animal and human trials have shown that consumption of diets rich in MCT increases energy expenditure and fat oxidation (Dulloo, Fathi, Mensi, & Girardier, 1996; St.-Onge, Bourque, Jones, Ross, & Parsons, 2003). About 50% of the fatty acids in coconut oil is lauric acid which lowers the ratio of total cholesterol to HDL cholesterol more than the other saturates (Mensink, Zock, Kester, & Katan, 2003). Lauric acid also has an additional beneficial function of being a source of the disease-fighting fatty acid derivative, monolaurin. This monoacyl glycerol is reported to have antiviral, antibacterial and antiprotozoal properties (Senanayake & Shahidi, 2007). The saturated character of coconut oil accounts for its stability against oxidative rancidity.

Plastic shortening describes fats that are readily spread, mixed or worked (Swern, 1964). The property of plasticity is highly important in fats used as shortening agents in baked products. Commercially, these are prepared by hydrogenation of oils, during which, some of the double bonds are isomerised into *trans* fatty acids (TFA) from their *cis* configuration. TFA have higher melting points and greater stability against oxidative rancidity than their *cis*-isomers and are important contributors to the functional properties of hydrogenated products (Sommerfeld, 1983). Several published reports have indicated that TFA have adverse effects on serum cholesterol, triglyceride levels and coronary heart diseases (Judd et al., 1994; Willett et al., 1993). The adverse effects of TFA on the ratio of total cholesterol to HDL cholesterol are reported to be twice that of saturated FA (Litin & Sacks, 1993).

In India, there is a gradual increase in the production of hydrogenated fat reported as 1.45 million metric tonnes during 2000–01 (Singhal, 2003), indicating its large amount of usage for various purposes. It is being used in a number of confectionery products, instant mixes and also for frying purposes – mainly for the increased shelf-life of the product (Sandhu, Bal, & Ahluwalia, 2002; Saxena, Kulkarni, Berry, Sehgal, & Beerh, 1996). Various brands of commercial hydrogenated fats were analysed for their physicochemical characteristics and were found to contain 5.9–30% TFA (Jeyarani, 2006; Jeyarani & Yella Reddy, 2005). These fats, when used in food products, might show a still higher level, as there is a heat-induced increase in TFA content (Daglioglu, Tasan, & Tuncel, 2000). Hence, there is an urgent need to develop fats having a wide melting range which crystallise in the β' polymorphic form without the formation of *trans* fatty acids, to meet the requirements of health-conscious consumers.

Danthine and Deroanne (2003) prepared a plastic shortening by blending low erucic acid rapeseed oil (LERO) with hydrogenated LERO (HLERO) and reported it to be suitable for pie crust applications as the blends were β crystalline in form. Palm oil tends to crystallise in the β' form desirable for shortenings and have been used along with other oils (Jeyarani & Yella Reddy, 2003; Mayamol, Samuel, Balachandran, Sundaresan, & Arumughan, 2004). Hence, it

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was selected along with coconut oil for modification by fractionation and blending. The objective of the present study was to assess the suitability of coconut oil to prepare *trans*-free plastic fat for use in bakery products.

2. Materials and methods

2.1. Material

Palm oil was a gift from M/s Palm Tech. Limited, Mysore, India. Coconut oil and commercial bakery shortening were purchased from local market. Standard fatty acid methyl esters, triacylglycerols and BF_3/methanol were procured from Sigma Chemical Co., St. Louis, MO. HPLC solvents – acetone and acetonitrile – were from M/s Qualigens, Mumbai, India. Other chemicals and solvents used were of analytical grade.

2.2. Refining of fats

The crude fats were analysed for free fatty acids (FFA) content, according to the standard procedure (AOCS, 2003). The oils were heated to 55 °C and the required amount of alkali (14 °Baume), calculated based on FFA, was added slowly. The soap stock was allowed to settle and then removed by centrifuging. The residual soap was removed by repeated washing using hot water and traces of water removed under vacuum (Hodgson, 1996). The refined oil was stored at 4 °C and used for further work.

2.3. Fractionation methodology

Fractionation was carried out in beakers in a thermostatically-controlled circulating water bath (Julabo Labortechnik, Germany). The samples were gradually cooled to a pre-determined temperature and kept in the water bath for various time intervals. Care was taken that the water was above the level of oil in the beaker. The sample was gently stirred and the temperature was constantly monitored using a thermometer kept inside the sample. After a specified time, the partially crystallised mass was filtered, the solid (stearin) and the liquid (olein) fractions were weighed and the percentage was calculated. The conditions used for various fats are described below.

2.3.1. Fractionation of palm oil

Palm oil (100 g) was heated to about 60 °C to destroy all crystal nuclei. The fat was cooled gradually to 31 °C and held at this temperature for 3 h. The partially crystallised mass was then filtered through a Buchner funnel under vacuum to separate the stearin (13.8%; PSt) and the olein fractions.

2.3.2. Fractionation of coconut oil

Coconut oil (100 g) was heated to about 60 °C to destroy all crystal nuclei. The fat was cooled gradually to 14 °C and held at this temperature for 90 min. The solid and liquid fractions were separated by filtration to yield 40% stearin (CSt1). In another experiment, a stearin of 60% yield (CSt2) was obtained by increasing the time of holding to 2 h.

2.4. Preparation of blends

Liquified coconut stearin (CSt1 and CSt2) and palm stearin (PSt) were mixed in different proportions ranging from 10% to 90%, in 10% increments (w/w).

The commercial bakery shortening was found to contain about 16% moisture. This sample was heated to 60 °C in a hot-air oven and the water was removed by decanting. The residual moisture was removed using anhydrous sodium sulphate and the dry fat was used for further studies.

2.5. Slip melting point (SMP)

The slip melting point was measured according to the official AOCS procedure, using an open capillary tube (AOCS, 2003). The sample was melted and a capillary tube with thin walls and 1 mm i.d was dipped to fill with fat to a 10 mm height. The capillary was touched over a piece of ice and the fat was solidified. The capillary was left at refrigerated temperature for about 10 h and then left at 0 °C for 1 h. Two capillaries were attached gently to a thermometer using a rubber band and fixed onto a Thiele tube. The side arm of the tube was heated slowly and the temperature at which the fat slips and rises was noted. Duplicate measurements were made and the average value is reported.

2.6. Iodine value

Standard AOCS official method was followed to determine the iodine value using Wij's solution (AOCS, 2003).

2.7. Fatty acid composition

The fatty acid composition of the samples was determined by analysing the fatty acid methyl esters by gas chromatography. The methyl esters were prepared using 14% BF_3/methanol (Morrison & Smith, 1964) and were analysed using a Shimadzu GC-15A (Shimadzu, Kyoto, Japan) equipped with a flame ionisation detector attached to a CR-4A data processor. The operating conditions were: column length 3 m × 3.3 mm; stainless steel packed with 15% diethylene glycol succinate (DEGS) coated on Chromosorb W (60–80 mesh); column temperature 180 °C; injector temperature 220 °C; detector temperature: 230 °C; carrier gas, nitrogen at a flow rate of 40 ml/min. The peaks were identified by comparing the retention times with those of authentic standards and reported as relative percentage of individual fatty acids.

2.8. Triacylglycerol composition

The triacylglycerol composition of the samples was determined by high-performance liquid chromatography using a Shimadzu LC-10A with system controller CBM-10A and refractive index detector RID-10A. A C-18 column (Shimadzu ODS; 25 cm × 4.6 mm i.d; 5 μm particle size) maintained at 36 °C was used. The mobile phase was a mixture of acetone/acetonitrile (63.5:36.5, v/v) at a flow rate of 1 ml/min. Samples were purified by passing through a silica gel column and eluting with hexane. The solvent was evaporated, the pure triglycerides dissolved in chloroform and 10 μl was injected into the HPLC. The peaks were identified by comparing the retention times with those of authentic standards, and with literature values (Laureles et al., 2002; Tan & Che Man, 2002) and reported as relative percentages for individual triglycerides.

2.9. Solid fat index

The percent solids at different temperatures was determined using dilatometers, according to a standard method (Paquot & Hautfenne, 1987). A circulatory water bath was used to control the temperature (±0.1 °C).

2.10. Fourier transform infrared spectroscopy

FTIR studies were carried out using an FTIR spectrometer (Perkin–Elmer Spectrum 2000, Norwalk, CT). The samples were melted and

smeared onto KBr windows and the spectra were recorded from 400 cm^{-1} to 4000 cm^{-1}.

2.11. Statistical analysis

Values are expressed as the arithmetic means ± standard deviation (SD). Statistical significance of the difference between the groups was evaluated by one-way analysis of variance and Student's *t*-test. Differences were considered significant when $p < 0.05$.

3. Results and discussion

3.1. Iodine value

Various blends containing stearins of coconut oil and palm oil were screened based on iodine value and slip melting point (Table 1). Iodine value is an important parameter used in the hydrogenation industry and oils with a high-iodine value are more susceptible to oxidation and usually less stable. The iodine value of coconut stearin was 10.9. After blending with a hard fraction from palm oil, there was an increase in iodine value which increased further on increasing the palm stearin content in the blends (Table 1).

3.2. Slip melting point (SMP)

There was a gradual increase in the SMP from 25.9 °C to 49.6 °C with increase in palm stearin content in the blends (Table 1). In India, hydrogenated fat should have an SMP between 31 °C and 41 °C (PFA, 2008) and the commercial bakery shortening showed an SMP of 39.6 °C (Table 1). The SMP of the blends containing coconut stearin of 40% yield (Blend I) was slightly higher than that of 60% yield (Blend II).

There was no significant difference ($p > 0.83$) in the iodine value and slip melting point of the blends. In order to utilise a higher quantity of coconut oil, blends prepared using coconut stearin of 60% yield (CSt2) were selected for further characterisation.

3.3. Solid fat index (SFI)

The SFI of a fat is mainly responsible for many of its characteristics, including general appearance, organoleptic properties, oil exudation and functional properties. Under ambient conditions, coconut oil is a heterogeneous slurry of crystals admixed

Table 1
Iodine value and slip melting point of coconut stearin and palm stearin (CSt:PSt) blends

% CSt:PSt (w/w)	Iodine value*		Slip melting point (°C)**	
	Blend I[a]	Blend II[b]	Blend I[a]	Blend II[b]
90:10	12.7 ± 0.3	13.4 ± 0.3	27.0 ± 0.2	25.9 ± 0.2
80:20	16.2 ± 0.4	15.6 ± 0.3	31.7 ± 0.2	29.1 ± 0.2
70:30	18.5 ± 0.2	18.7 ± 0.4	34.3 ± 0.3	33.3 ± 0.4
60:40	22.0 ± 0.4	22.5 ± 0.5	41.5 ± 0.4	39.5 ± 1.3
50:50	25.5 ± 0.3	26.7 ± 0.3	44.1 ± 0.8	41.9 ± 0.6
40:60	27.3 ± 0.4	28.4 ± 0.5	44.6 ± 0.4	45.0 ± 0.4
30:70	32.4 ± 0.5	32.9 ± 0.4	46.3 ± 0.3	46.6 ± 0.2
20:80	32.8 ± 0.8	34.7 ± 0.3	48.0 ± 0.6	48.6 ± 0.6
10:90	37.5 ± 0.6	38.7 ± 0.6	49.6 ± 0.6	49.6 ± 0.6
Commercial sample	–		39.6 ± 0.5	

Values are mean ± SD ($n = 4$).
* F_{data} 0.034 < F_{Table} 4.49.
** F_{data} 0.047 < F_{Table} 4.49.
[a] Coconut stearin of 40% yield with palm stearin.
[b] Coconut stearin of 60% yield with palm stearin.

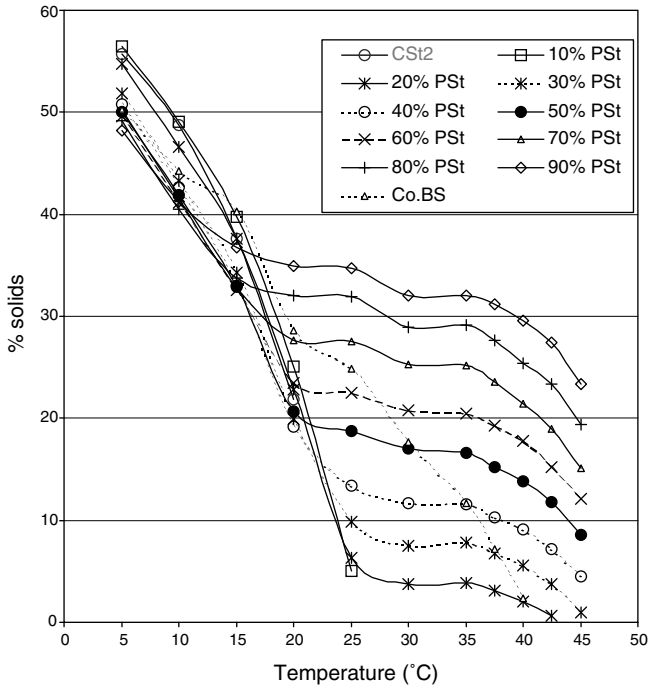

Fig. 1. Solid fat index of coconut stearin/palm stearin blends ($n = 3$). (CSt2 – coconut stearin of 60% yield, PSt – palm stearin, Co.BS – commercial bakery shortening.)

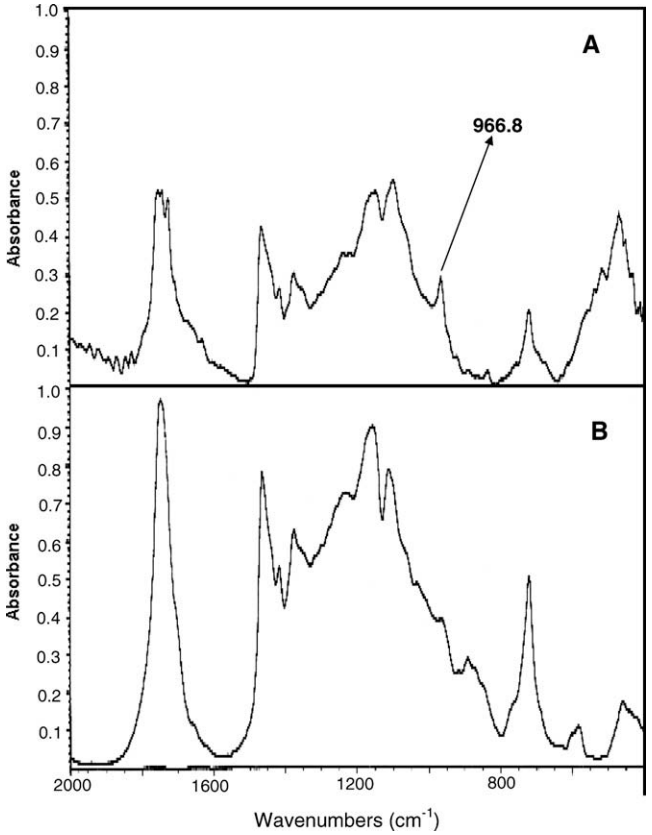

Fig. 2. FTIR spectra of (A) commercial bakery shortening indicating the peak corresponding to *trans* fatty acids, and (B) coconut stearin (CSt2) and palm stearin (60:40) blend.

Table 2
Fatty acid composition (%) of coconut oil, palm oil, stearins[a] and the blends[b]

Samples	8:0	10:0	12:0	14:0	16:0	18:0	18:1	18:2
Coconut oil	8.5 ± 0.5	6.0 ± 0.2	47.3 ± 0.8	17.9 ± 0.5	9.6 ± 0.1	0.7 ± 0.1	6.8 ± 0.4	2.4 ± 0.2
CSt1[a]	7.2 ± 0.8	6.0 ± 0.5	51.7 ± 1.2	20.2 ± 1.4	7.7 ± 0.4	1.0 ± 0.1	4.3 ± 0.2	1.7 ± 0.2
CSt2[a]	8.0 ± 0.6	5.9 ± 0.4	48.0 ± 1.1	18.7 ± 0.7	8.4 ± 0.5	0.5 ± 0.1	5.6 ± 0.3	2.1 ± 0.1
Palm oil	ND	ND	0.1 ± 0	1.0 ± 0.2	51.0 ± 1.3	1.6 ± 0.1	35.1 ± 1.8	11.1 ± 0.6
Palm stearin	ND	ND	7.2 ± 0.6	2.1 ± 0.1	62.0 ± 1.6	2.0 ± 0.1	19.6 ± 0.5	6.0 ± 0.1
Bl 2[b]	5.9 ± 0.1	5.4 ± 0.1	46.6 ± 1.5	16.4 ± 0.6	14.5 ± 0.5	1.1 ± 0.2	6.3 ± 0.1	2.3 ± 0.1
Bl 3[b]	5.1 ± 0.4	4.8 ± 0.6	42.4 ± 1.8	15.6 ± 1.2	19.8 ± 0.9	1.3 ± 0.6	7.8 ± 0.4	2.8 ± 0.2
Bl 4[b]	4.2 ± 0.1	4.0 ± 0.2	38.8 ± 1.4	14.2 ± 0.6	25.1 ± 0.8	1.4 ± 0.2	8.7 ± 0.6	3.1 ± 0.1
Bl 5[b]	3.7 ± 0.1	3.5 ± 0.2	32.7 ± 1.4	13.3 ± 0.6	29.8 ± 1.4	1.5 ± 0.2	11.2 ± 0.6	3.4 ± 0.6
Bl 6[b]	3.2 ± 0.4	2.8 ± 0.6	25.0 ± 1.2	10.0 ± 0.5	36.1 ± 1.8	1.8 ± 0.6	15.6 ± 1.2	4.2 ± 0.1
Bl 8[b]	2.6 ± 0.2	1.9 ± 0.4	16.8 ± 0.6	7.6 ± 0.4	45.8 ± 1.7	2.0 ± 0.1	17.8 ± 0.6	4.9 ± 0.2

Values are mean ± S.D (n = 3); ND, not detected.
[a] CSt1 and CSt2: coconut stearin of 40% and 60% yield.
[b] Bl 2, 3, 4, 5, 6 and 8: CSt2 blended with 20%, 30%, 40%, 50%, 60% and 80% palm stearin, respectively.

Table 3
Triacylglycerol (TAG) composition (%) of coconut oil (CNO), palm oil (PO) and the blends

TAG species[c]	ECN[d]	CNO	CSt2[a]	PO	Palm stearin	Bl 2[b]	Bl 4[b]	Bl 5[b]	Bl 6[b]	Bl 8[b]
CpCLa	30	0.2 ± 0	1.5 ± 0.2	ND	ND	1.9 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.2 ± 0	0.2 ± 0
CCLa	32	8.2 ± 0.4	11.5 ± 0.6	ND	ND	10.1 ± 0.6	1.8 ± 0.2	1.1 ± 0.1	1.2 ± 0.1	1.6 ± 0.2
CLaLa	34	16.8 ± 1.2	17.0 ± 1.2	ND	ND	14.5 ± 1.0	6.1 ± 0.4	5.1 ± 0.3	4.4 ± 0.4	2.9 ± 0.1
LaLaLa	36	26.0 ± 0.8	23.4 ± 1.3	ND	ND	18.4 ± 1.0	13.6 ± 0.8	10.4 ± 0.7	7.8 ± 0.2	3.7 ± 0.2
LaLaM	38	24.4 ± 0.9	20.8 ± 0.7	ND	ND	15.2 ± 0.8	13.4 ± 0.6	10.4 ± 0.7	7.5 ± 0.4	3.3 ± 0.1
LaLaO	38	0.5 ± 0.1	ND	ND	ND	0.2 ± 0	ND	0.1 ± 0	ND	0.6 ± 0.2
LaMM	42	8.9 ± 0.4	16.5 ± 0.8	ND	ND	4.8 ± 0.2	3.1 ± 0.1	1.6 ± 0.1	1.4 ± 0.2	1.9 ± 0.2
LaMO	42	2.0 ± 0.1	0.5 ± 0.1	ND	ND	0.7 ± 0.2	0.3 ± 0	0.3 ± 0	0.1 ± 0	0.1 ± 0
LaMP	42	6.7 ± 0.2	3.5 ± 0.1	ND	ND	2.6 ± 0.1	2.3 ± 0.1	3.1 ± 0.2	1.3 ± 0.1	0.3 ± 0.2
MMM	42	ND	ND	0.7 ± 0.1	0.2 ± 0	ND	ND	ND	ND	ND
MPL	44	ND	ND	3.9 ± 0.1	1.6 ± 0.1	ND	ND	ND	ND	ND
MOO	46	1.9 ± 0.2	0.8±0.1	ND	ND	ND	0.3 ± 0.1	ND	ND	ND
OOL	46	ND	ND	0.3 ± 0.1	0.1 ± 0	0.7 ± 0.1	0.6 ± 0.1	0.3 ± 0	0.2 ± 0	0.2 ± 0
MPO	46	2.8 ± 0.2	1.9 ± 0.2	ND	ND	ND	ND	ND	ND	ND
MMP	46	ND	ND	2.3 ± 0.2	1.0 ± 0.1	2.1 ± 0.2	1.2 ± 0.1	0.4 ± 0	0.3 ± 0	1.5 ± 0.3
PLO	46	0.8 ± 0.2	0.4 ± 0.1	14.2 ± 0.8	6.9 ± 0.6	2.7 ± 0.2	4.8 ± 0.4	3.0 ± 0.2	4.2 ± 0.2	7.6 ± 0.8
PPL	46	0.7 ± 0.1	0.8 ± 0.2	12.0 ± 0.9	6.8 ± 0.5	2.9 ± 0.1	5.3 ± 0.3	4.2 ± 0.1	5.4 ± 0.2	7.5 ± 0.8
OOO	48	ND	ND	1.7 ± 0.1	2.6 ± 0.2	1.8 ± 0.1	0.9 ± 0.1	2.5 ± 0.2	3.8 ± 0.2	3.8 ± 0.4
POO	48	ND	ND	18.8 ± 0.6	11.7 ± 0.5	5.0 ± 0.2	10.0 ± 0.6	10.0 ± 0.8	14.3 ± 0.8	13.9 ± 0.6
POP	48	ND	ND	28.7 ± 1.0	24.4 ± 1.2	7.5 ± 0.2	17.2 ± 0.8	18.8 ± 0.9	22.4 ± 1.0	23.0 ± 1.2
PPP	48	ND	ND	4.6 ± 0.2	26.3 ± 0.6	5.5 ± 0.1	10.5 ± 0.8	17.1 ± 1.0	16.0 ± 0.8	18.2 ± 0.8
SOO	50	ND	ND	3.9 ± 0.1	1.1 ± 0.1	ND	0.9 ± 0.1	0.5 ± 0	0.3 ± 0	0.3 ± 0
POS	50	ND	ND	8.2 ± 0.3	6.5 ± 0.2	1.4 ± 0.1	4.0 ± 0.2	4.8 ± 0.3	4.6 ± 0.4	4.5 ± 0.3
SOS	50	ND	ND	1.0 ± 0.1	7.8 ± 0.4	1.5 ± 0.1	3.0 ± 0.2	4.9 ± 0.2	4.4 ± 0.1	3.6 ± 0.1

Values are mean ± SD (n = 3); ND, not detected.
[a,b]For abbreviations see Table 2.
[c]Cp, caprylic; C, capric; La, lauric; M, myristic; P, palmitic; S, stearic; L, linoleic; O, oleic acids.
[d]ECN, equivalent carbon number of the triglyceride which is equal to carbon number – 2n (n is the number of double bonds in the fatty acids).

in liquid oil. There were no solids above 20 °C in coconut stearin (CSt2). However, the solids content increased on increasing the palm stearin content (Fig. 1). The blends containing 30% and 40% palm stearin (experimental blends) were found to have a wider melting range required for plastic fats and the melting profiles were comparable with the commercial bakery shortening (Fig. 1). At lower temperatures (5–20 °C), these blends showed a solids content similar to commercial bakery fat, while in the middle melting region (25–35 °C), it was slightly lower (7.5–13.4%). An SFC of 15–25% at the temperature of working is desirable for better creaming performance in cakes (Danthine & Deroanne, 2003). At 40 °C, a higher solids content (5.6–9.1%) was observed for the experimental blends and is advantageous for use in cake manufacture as they can retain the air incorporated during baking (Nor Aini, Embong, Abdullah, & Oh, 1992). The blends containing 50% and higher percentage of palm stearin also had a wide melting range (Fig. 1), but were not suitable as plastic fats, as they contained too high-solids (15.2–29.4%) at body temperature (37.5 °C) and would leave a waxy mouthfeel (Mayamol et al., 2004).

3.4. FTIR spectroscopy

FTIR spectroscopy is a rapid analytical technique that measures the vibrations of bonds within functional groups. The *trans* absorption region is 995–937 cm^{-1} with a peak at 966 cm^{-1} (Sedman, Vande Voort, & Ismail, 1997). Hydrogenated fats show a characteristic peak at 966 cm^{-1} for TFA, which can be detected at 0.2% level and quantified at 1.0% level (Mossoba, Yurawecz, & McDonald, 1996). The commercial fat sample (Fig. 2A) showed a distinct peak at 966 cm^{-1}, indicating the presence of TFA while the experimental blend did not show the peak (Fig. 2B) confirming the absence of

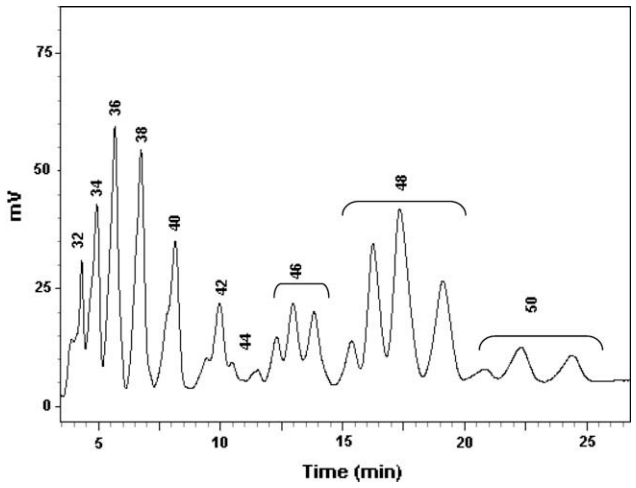

Fig. 3. HPLC chromatogram of coconut stearin (CSt2) and palm stearin (60:40) blend (peak top number represents ECN of the triglyceride group).

any TFA. While analyzing various commercial hydrogenated fats, bakery shortenings designed for puff, cake and biscuit were found to contain 17.5–28.9% TFA (Jeyarani, 2006).

3.5. Fatty acid composition

Table 2 shows the fatty acid composition of the oils, stearins and the blends. Coconut oil contained 8.5% caprylic (C_8), 6% capric (C_{10}) and 47.3% lauric acid and the palm oil contained 51.7% palmitic acid (Table 2). Lauric acid and palmitic acid contents were higher in the stearins, compared to coconut oil and palm oil, respectively (Table 2). Palmitic acid has no adverse effect on serum lipoprotein profiles, in the presence of a sufficient amount of essential fatty acids from dietary intake (Clandinin, Cook, Konrad, Goh, & French, 1999).

The blends containing 30% and 40% palm stearin, which showed melting profiles similar to commercial bakery shortening, were found to contain 19.8–25.1% palmitic acid and 38.8–42.4% lauric acid (Table 2). It is reported that the palmitic acid content was above 17% in β' tending margarines and below 11% in β tending margarines (D'Souza, deMan, & deMan, 1991). Thus the experimental blends favour the β' polymorph desirable for plastic fats and also are rich in medium-chain fatty acids.

3.6. Triglyceride composition

Bakery products require fats having wide melting range, which is achieved by using fats containing heterogeneous type triglycerides. In the blends studied, there was a wide distribution of lower and higher molecular weight triglycerides (Table 3 and Fig. 3). The blend containing 40% palm stearin (Bl 4) contained 41.4% triglycerides having medium-chain fatty acids (ECN 32–46) and 58.6% high-melting triglycerides with ECN 48 and 50 (Table 3). Fats containing both medium and long-chain fatty acids, because of the fairly complex packing at the molecular level, produce smaller crystals and are more suitable as plastic fats (Floter & Van Duijn, 2006).

4. Conclusion

Coconut oil and palm oil were subjected to dry fractionation to get coconut stearin of 40% and 60% yield and palm stearin of 13.8% yield. Various blends were prepared using these stearins and were found to have slip melting points ranging from 25.9 °C to 49.6 °C. The blends containing 60% and 70% coconut stearin had the wider melting range required for plastic fats and the melting profiles were comparable with that of a commercial bakery shortening. These blends contained 47–52.3% medium-chain fatty acids which are reported to have various health benefits. Thus, MCT-rich *trans*-free plastic fat suitable for use in bakery products can be prepared utilising coconut oil.

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