BLENDS OF PALM OIL PRODUCTS AND ANHYDROUS MILKFAT AS SHORTENINGS

Keywords:
Shortenings; Palm oil products; Anhydrous milkfat; Creaming, Baking performance.

NOR AINI IDRIS*, MAMAT @ SHAFIE EMBONG+, AMINAH ABDULLAH+, FLINGOH C H OH* and CHE MAIMON CHE HA*

*Palm Oil Research Institute of Malaysia, P O Box 10620 50720 Kuala Lumpur

+Jabatan Sains Makanan dan Pemakanan, Fakulti Sains Hayat, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor

Blends of anhydrous milkfat (AMF) with various palm oil products were prepared and their solid fat contents determined. Some formulations were selected for pilot plant shortening production. These included 1: 40% palm stearin (PS) and 60% AMF; 2: 80% interesterified palm oil (IEPO) and 20% AMF; and 3: 60% hydrogenated palm oil (HPO) and 40% AMF. Consistency of the shortenings upon storage was measured. Performance evaluations carried out included measurements of creaming properties and cake baking tests. In general, the consistency of shortenings 1 and 2 was stable within the first month but became harder during the second month. On the other hand, shortening 3 steadily became firmer during the 2 months' storage. Creaming performance of the shortenings improved with storage and shortening 2 showed the best performance. Specific volumes of cakes made with shortenings 1, 2 and 3 after 2 weeks of storage were 97% and 102% of the control cake respectively. Among the three shortenings, shortening 3 showed the best baking performance throughout the two-month evaluation period.

INTRODUCTION

Shortenings are formulated and produced to satisfy specific markets or user requirements and therefore their physical characteristics vary according to the requirements. Bakery shortenings generally have a flat solid fat profile and melting points above 38°C. Palm oil is a valuable ingredient for shortening formulations. It stabilizes the shortenings in β' (beta-prime) crystalline form, which is necessary for good performance in cakes. There has been an increase in vegetable oil consumption and a decline in animal fat consumption (Anon, 1982 and Hammond, 1988). The trend towards the more extensive use of vegetable oils is caused by the substitution of margarine for butter and vegetable shortenings for lard. However, butter is still a desirable ingredient in baked products because of the flavour it imparts. There has been a growing trend to buttery blends in spreads and in fact some products of this type are already available in the market. However, not much work has been done on the use of these blends for shortenings.

Palm oil can be used as it is or it can be modified for specific applications. Modification of palm oil can be achieved by fractionation, interesterification, hydrogenation or blending. The objective of this study was to evaluate the characteristics and performance of blends of anhydrous milk fat and palm oil which had been modified by different processes, as shortenings.

MATERIALS AND METHODS

Experimental

The shortening formulations consisted of:

1 : 40% palm stearin (PS) of IV 44 and 60% anhydrous milkfat (AMF).
2 : 80% inter esterified palm oil (IEPO) and 20% anhydrous milkfat (AMF).
3 : 60% hydrogenated palm oil (HPO) (m.p. 41°C) and 40% anhydrous milkfat (AMF).

Anhydrous milkfat was obtained from the New Zealand Dairy Board, Wellington. Palm oil and palm stearin were obtained from a local refinery. The palm stearin was produced by the fractionation process in which the liquid component of palm oil (palm olein) is separated from the solid component (palm stearin). Palm oil was hydrogenated to a melting point of 41.5 °C at the Palm Oil Research Institute of Malaysia (PORIM) pilot plant using hydrogenation conditions as follows: temperature, 180°C; hydrogen pressure, 25 psi; catalyst, Ressan 22 (0.05% nickel); time, 90 min; stirrer speed, 1500 rpm. Interesterified palm oil was prepared using the following conditions: Temperature, 110°C; catalyst, 0.2% sodium methoxide; time, 30 min; stirrer speed, maximum.

The oils and fats were used in the preparation of feedstocks for shortening production. The blends were prepared by mixing the relevant components in the appropriate proportions in a stainless steel vessel to give a total of 30kg of each blend.

The feedstocks were melted at a temperature of 50-53°C and processed on the Schroeder Kombinator type VUK B 01: 60 - 400 (Lubeck, FRG) pilot plant. The products were run at a standard pump speed (290 r min $^{-1}$) and a standard back pressure (1.5 kg cm^{-2}), and the refrigeration was adjusted to obtain a standard filling temperature (18°C). After production, the shortenings were stored at room temperature (23°C).

Evaluation

Slip melting point : Slip melting point was measured using the open capillary method according to PORIM Test Methods (1983).

Solid fat content : A Newport Analyzer MK IIIA wideline NMR (Newport Pagnel, UK) with temperature controller was used. The sample in the NMR tube (1.5 g) was first melted at 70°C for 30 min and then chilled at 0°C for 90 min. The tube was held at each measuring temperature for 30 min prior to measurements.

Differential scanning calorimetry (DSC) : A Perkin-Elmer DSC Model 2C with Intra cooler was used. The sample was kept at 293°K for 10 min and then heated at 5°K/min till melt and the thermogram recorded.

Consistency : Consistency was determined by a cone penetrometric method. The cone angle used was 40°C and the penetration time was 5 s.

Creaming Test

A Kenwood Junior mixer was used with a K-beater and a static scraper blade shaped to fit the contour of the bowl (Meara *et al.*, 1974). Icing sugar (260g) and shortening (170g) were mixed sufficiently using a palette knife to avoid sugar being thrown out of the bowl when the Kenwood was started. The two were then mixed using a K-beater for 30 s at speed 1, adding water (14g) during that time. Mixing was continued for 2 min at speed 4. The aerated cream was filled into stainless steel cups of known volume in duplicate, avoiding the inclusion of void spaces during filling. The weight of the cup with cream was taken. This process was repeated at 2 min intervals until creaming time reached 12-14 min. Creaming power was calculated in terms of specific volume of cream (cm^3g^{-1}).

Baking Test

The shortenings were evaluated for their performance in cakes using a Madeira cake formulation (*Table 1*). The performance of the experimental shortenings was compared with that of a standard shortening available in the market and selected for its superior performance. The commercial shortening used as the control comprised a blend of palm oil and palm stearin. The standard cakes were always prepared using the same ingredients (except the fat) and baked at the same time, side by side with the experimental cake.

This particular formulation was chosen because it has a relatively low fat content and therefore the cake performance is sensitive to the properties of the fat. The procedure was as follows : A syrup was made by heating the sugar with the water until the sugar dissolved. The solution was then cooled. Part of the flour (333 g) and the salt, baking powder and skimmed milk powder were mixed to obtain a homogeneous dispersion of ingredients. Shortening was mixed with the remaining flour using a Hobart mixer model N 50 (Hobart Manufacturing Co. London, UK) at speed 1 for 30 s. After scraping the sides, mixing was continued for a further 2 min at speed 3; the sides were scraped again after each minute of mixing. Mixing was continued for 3 min at speed 3. Eggs were beaten and added to the cooled syrup together with colouring and flavouring. The mixture was added to the aerated mix of shortening and flour over 30 s while mixing at speed 1. The blend of the dry ingredients was then added to the batter over 1 min 30 s while mixing at speed 2. The sides of the bowls were scraped and mixing was continued for 1 min 30 s at speed 2. The batter was placed into four round cake baking tins (154 mm i. d.) lined with greaseproof paper. Each baking tin contained 375 g batter. The cakes were baked at 180°C in a Rotary Simon oven for 1 h 15 min. When the cakes had cooled,

TABLE 1.
MADEIRA CAKE FORMULATION

Ingredient	Quantity
Flour	475.0 g
Shortening	160.0 g
Sugar	460.0 g
Egg	236.0 g
Water	230.0 g
Skimmed milk powder	11.0 g
Salt	8.4 g
Baking powder	11.0 g
Colouring	1.0 ml
Flavouring	1.0 ml

their weights and volumes by rapeseed displacement were measured. The specific volume of cake (cm^3 g^{-1}) was then calculated.

RESULTS AND DISCUSSION

Slip melting points of the shortening (*Table 2*) ranged from 36.2°C (shortening 2) to 38.2°C (shortening 3). The slip melting point of shortening 1 was intermediate (37.3°C).

Solid fat profiles of the shortenings are as shown in *Figure 1*. Shortenings 1 and 2 had somewhat similar profiles while shortening 3 had a higher solid fat content at all temperatures. Shortenings 1 and 2 had flatter tails compared with shortening 3.

During the first month of storage, the yield values of shortenings 1 and 2 increased from *ca.* 36 to *ca.* 40 and from *ca.* 39 to 41 g cm^{-2}, respectively. The relatively small change in yield values indi-

TABLE 2.
SLIP MELTING POINTS OF SHORTENINGS

Shortening	Slip melting point (oC)
1 (40% PS and 60% AMF)	37.3
2 (80% IEPO and 20% AMF)	36.2
3 (60% HPO and 40% AMF)	38.2

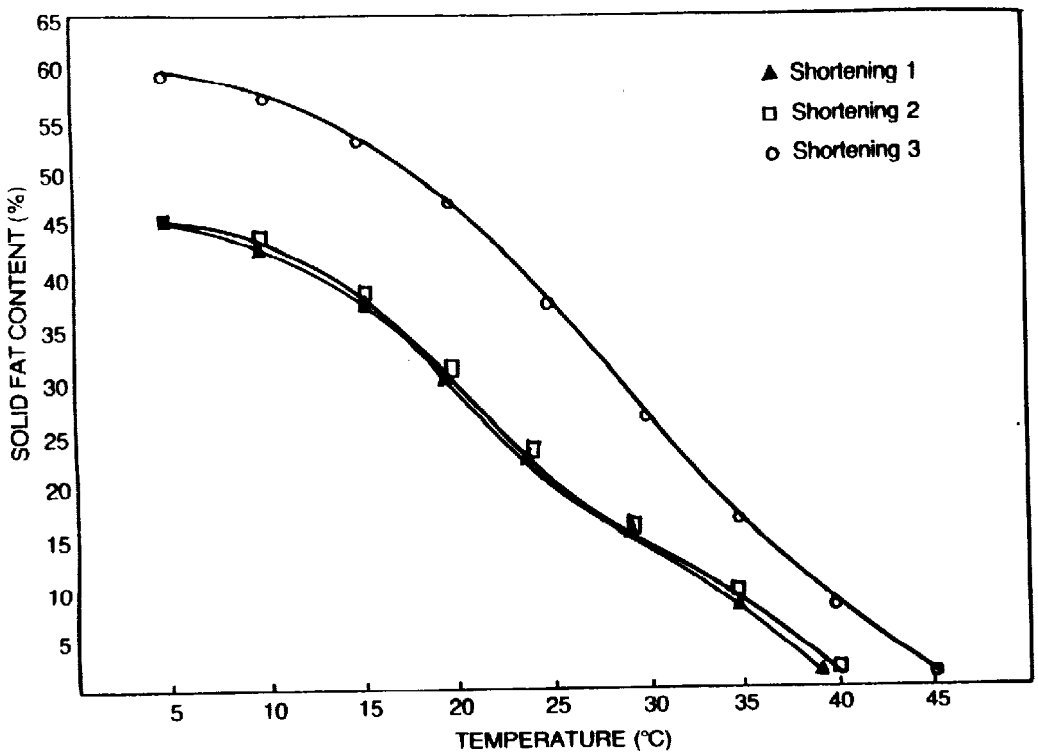

Figure 1.Solid Fat Profiles of Shortenings

cated that the consistency of the shortenings was quite stable during the first month. During the second month, the shortenings became firmer and yield values increased to *ca.* 60 and *ca.* 57 g cm^{-2} for shortenings 1 and 2 respectively. On the other hand, shortening 3 steadily became firmer during the first month and yield values increased from *ca.* 506 to *ca.* 673 g cm^{-2} and during the second month increased to *ca.* 693 g cm^{-2}.

DSC Thermogram

The DSC melting thermograms were as shown in *Figures 2(a) (b)* and *(c)*. Each shortening had a minor melting peak around 298°K due to the AMF component. The other components in the shortenings resulted in different peaks in the major melting profiles. Shortenings 1 and 2 both had doublet peaks while shortening 3 had only a single peak and it melted more sharply.

Creaming Performance

The creaming performance of the shortenings was better during the second month of storage than in the first month (*Figure 3(a), (b)* and *(c)*). Shortening 2 showed the best creaming performance followed by shortening 3. Shortenings of good creaming ability have been associated with the β' crystalline form where the crystals are normally smaller than β crystals. We found that interesterified palm oil products showed very good creaming performance and this result is in agreement with our past experience.

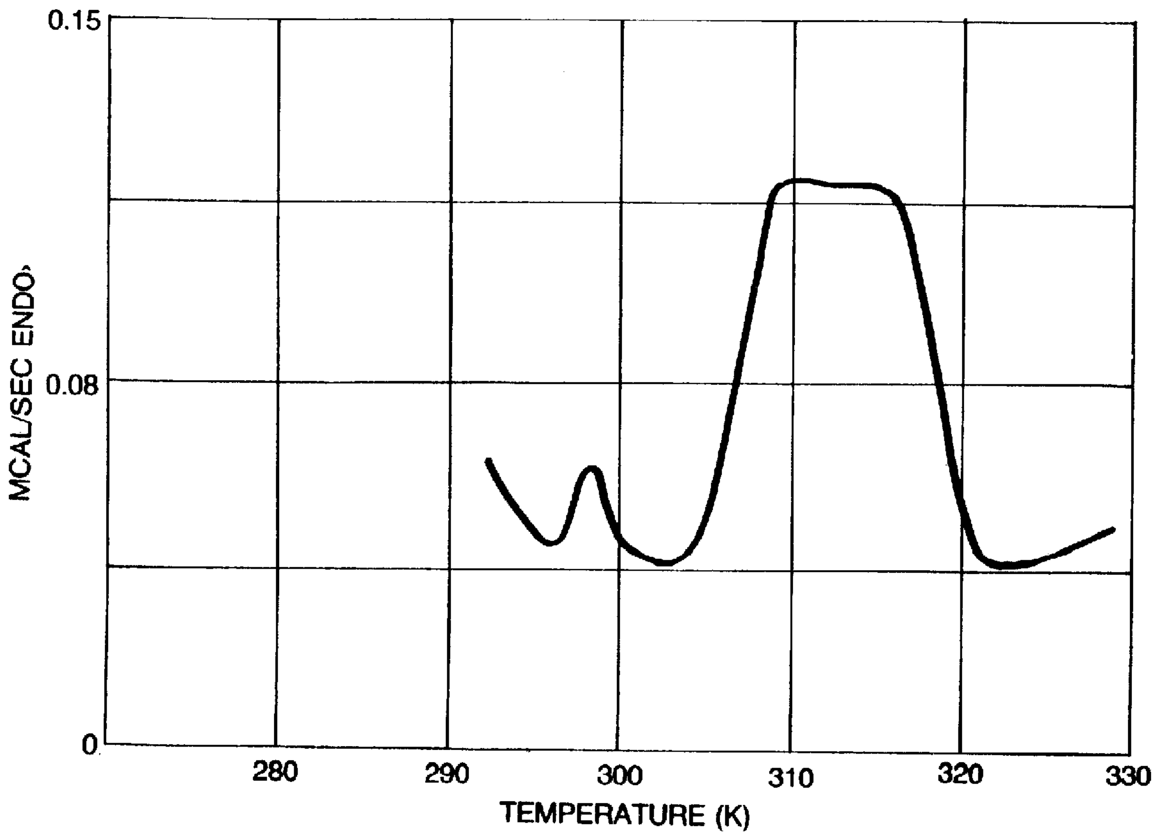

Figure 2 (a).
DSC Thermogram Shortening 1: 40% PS + 60% AMF

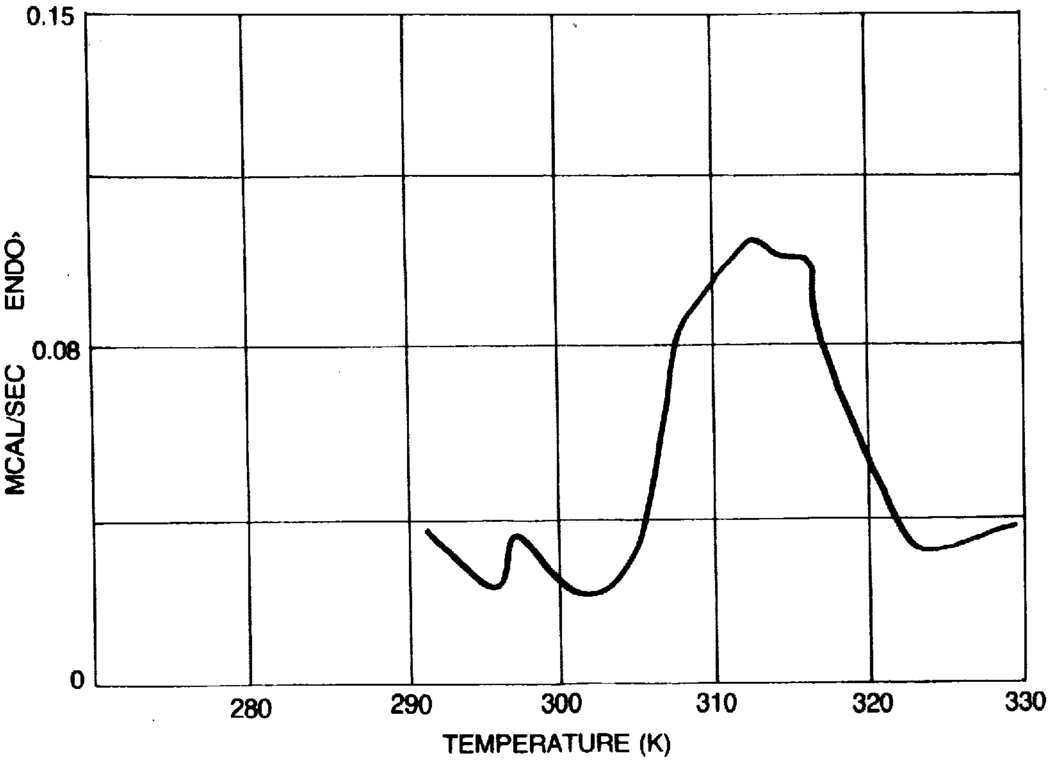

Figure 2 (b).
DSC Thermogram of Shortening 2 : 80% IEPO + 20% AMF

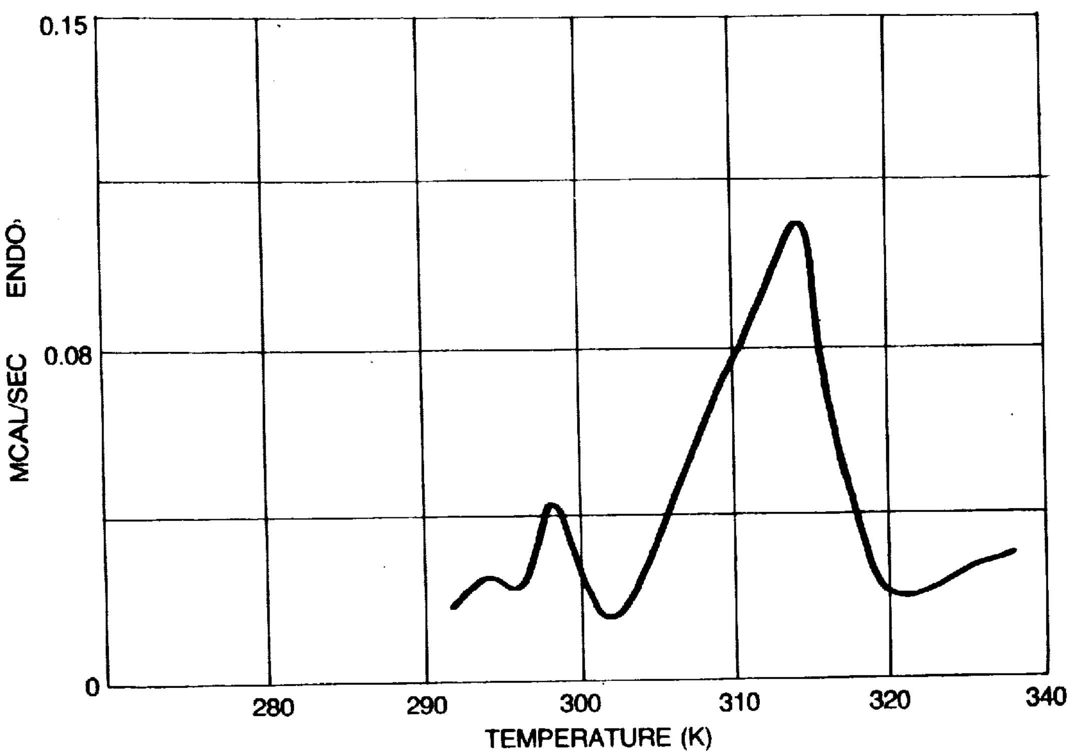

Figure 2 (c).
DSC Thermogram of Shortening 3 : 60% HPO + 40% AMF

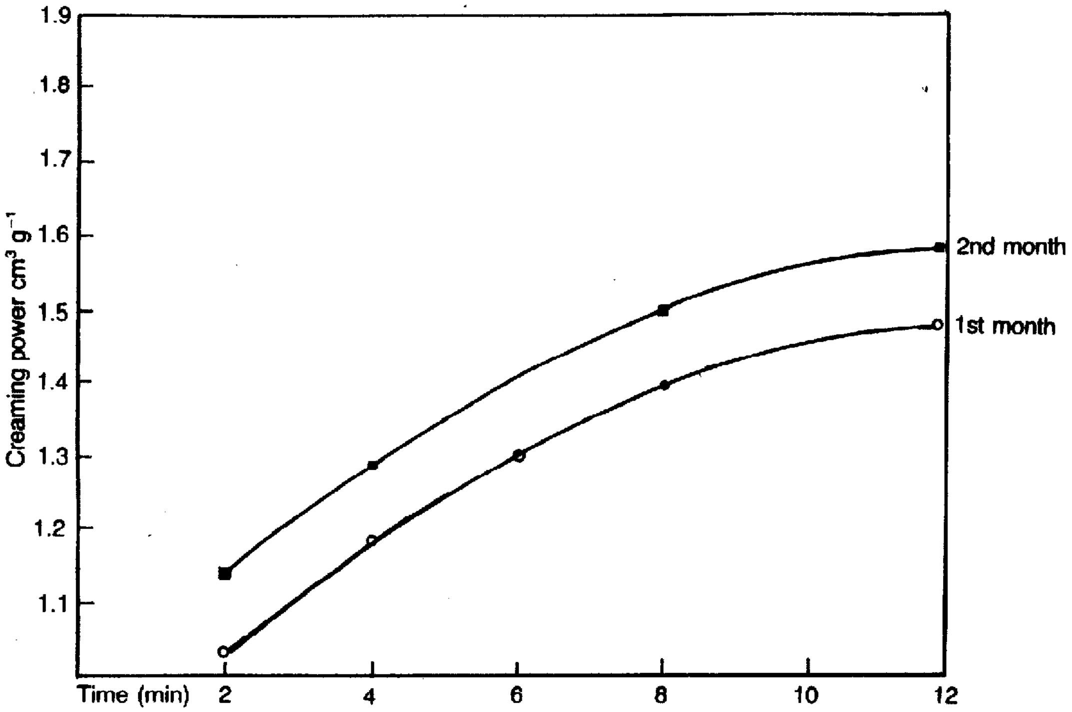

Figure 3 (a).
Creaming Performance of Shortening 1

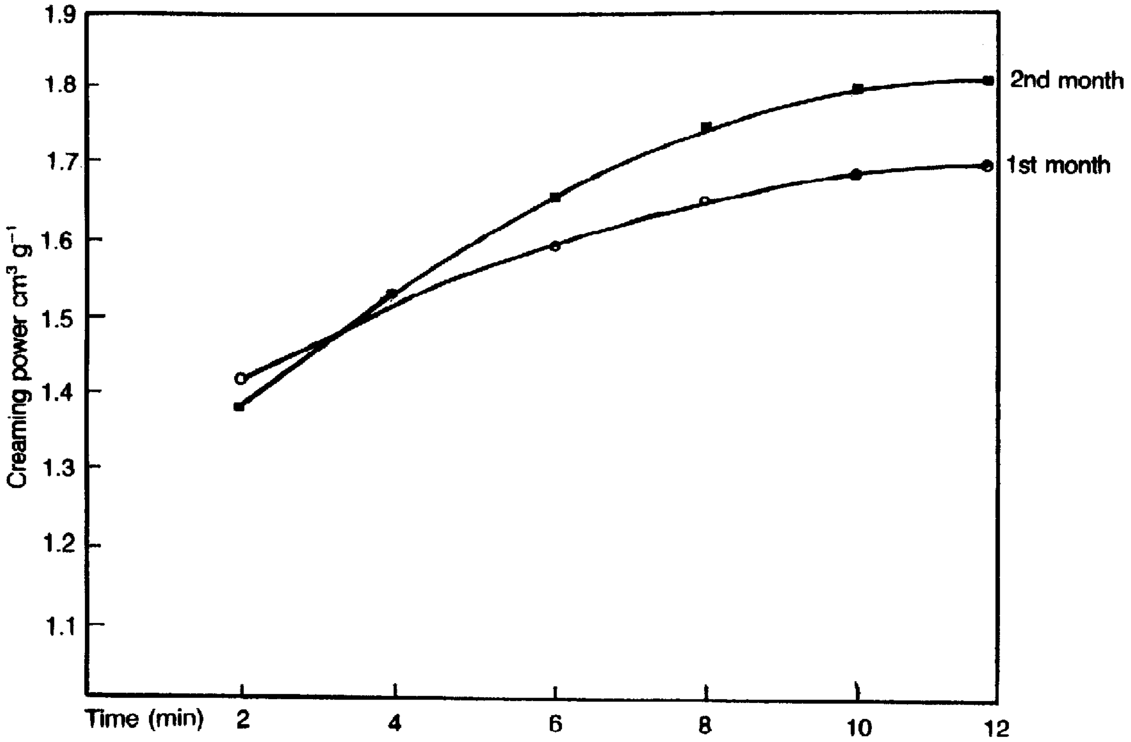

Figure 3 (b).
Creaming Performance of Shortening 2

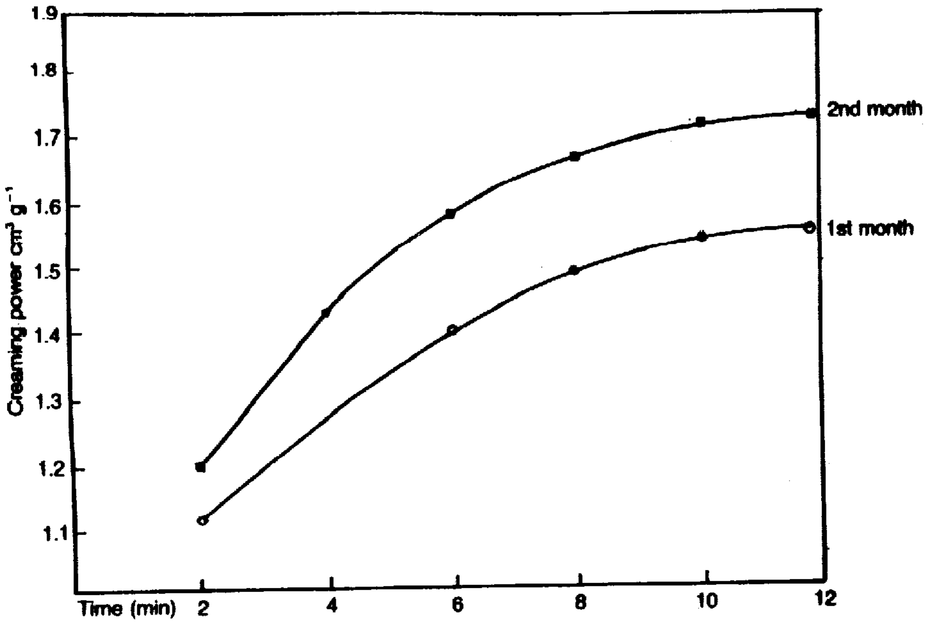

Figure 3 (c).
Creaming Performance of Shortening 3

Baking Performance

The specific volume of experimental cakes obtained from baking tests ranged from 91 to 102% of the control cake (*Table 3*).

Two weeks after the shortening production, the specific volumes of cakes made with shortenings 1, 2 and 3 were 97%, 95% and 102% of the control cake. After two months of storage of the shortenings, specific cake volumes were 95% (shortening 1), 97% (shortening 2) and 100% (shortening 3) of the control cake. If experimental cake volumes are greater than 95% of the control cake, results are considered promising. Even though interesterified palm oil shortening had the best creaming performance, its baking performance in terms of specific cake volume was less than that of shortening 3. This trend is similar to earlier findings that good creaming performance does not necessarily ensure good baking performance in cake (Nor Aini *et al.*, 1988). Among the three shortenings, shortening 3 showed the best baking performance throughout the two–month evaluation period.

CONCLUSIONS

The experimental shortenings had slip melting points below 40°C. The DSC melting thermogram of each shortening showed a minor melting peak around 298°C due to the AMF component and a major melting peak due to the palm oil component. With increase in consistency, there was improvement in creaming performance of the shortenings. Shortening 2 consisting of 80% IEPO and 20% AMF showed better creaming performance than the other two shortenings. It was found that there was no direct relationship between creaming power and baking performance. Shortening 3 consisting of 60% HPO and 40% AMF seemed to be very promising for application as a cake shortening.

ACKNOWLEDGEMENTS

Assistance given by Suria Affandi Yusoff, Teah Yau Kun, Miskandar Sahri, Hanirah Hassan, Zaliha Omar and Tang Ting Sue is appreciated. The authors are grateful to the Director-

TABLE 3.
BAKING PERFORMANCE OF SHORTENINGS

Storage period	Shortening	Specific cake volume E/C x 100 (%)
2 weeks	1	97
2 weeks	2	95
2 weeks	3	102
1 month	1	99
1 month	2	91
1 month	3	99
2 months	1	95
2 months	2	97
2 months	3	100

General of PORIM for permission to publish this paper.

REFERENCES

ANON (1982). Food Fats and Oils. Institute of Shortening and Edible Oils, Inc., Washington D.C.

HAMMOND, E G(1988). Trends in fats and oils consumption and the potential effect of new technology. *Food Technology. 42* (1) 117-120.

MEARA, M L; EVANS, G G; JEWELL, G G and DAVIES D P (1974). Studies on Creaming Power of Fats. Leatherhead Food RA Research Report No. 204.

NOR AINI IDRIS; CHE MAIMON CHE HA and HANIRAH HASSAN (1988). Physico-chemical characteristics and performance of some commmercial shortenings. *Proceedings of the Seminar on Advances in Food Research in Malaysia - II*. Faculty of Food Science and Biotechnology, Universiti Pertanian Malaysia, Serdang, Selangor, Malaysia.

PORIM Test Methods for Palm Oil and Palm Oil Products (1983). Palm Oil Research Insititute of Malaysia, Bangi, Selangor, Malaysia.