# Application of Palm Products in Ice Cream

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## INTRODUCTION

Ice cream is a frozen food product. It can be prepared by freezing a pasteurized mix with agitation to incorporate air. The basic ingredients in ice cream are fats, milk solid non-fat, sugar, emulsifier, stabilizer and water. Each ingredient plays a major role in imparting texture, flavour and stability. The structure of ice cream is complicated. Air is dispersed as small air cells surrounded by a partially frozen emulsion. The ice crystals and solidified fat globules are embedded in the continuous unfrozen liquid phase. The continuous phase contains milk proteins, emulsifiers, stabilizers and sweeteners (Arbuckle, 1986).

In making ice cream, it is very important to choose the right fats or oils. The oils and fats should have a bland flavour and good flavour stability in the finished product. According to Berger (1994), the fat for ice cream should have a low enough solid content to make it soft and stable at 5½C and melt at body temperature (37½C) with a good melting properties.

The desirable physical properties of ice cream are defined mainly in terms of smooth texture at the time of its consumption. The small finely distributed ice crystals produce ice cream having desirable texture when eaten. The product should have a warm eating effect on the palate and melt without greasiness or gumminess.

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Various modified vegetable fats have been used to produce ice cream. The vegetable fat-based ice cream is comparable in quality with dairy ice cream. Other ingredients such as fruits or nuts can be added to the basic formulation to achieve different flavours for example strawberry, corn, yam, hazelnut, almond, *etc.*

In this study, palm oil (PO) and palm kernel oil (PKO) were used as a substitute for milk fat (MF) to produce ice cream. MF-based ice cream was used as the control.

## PREPARATION AND PRODUCTION OF ICE CREAM

PO and PKO were obtained from a local company. MF and spray dried skim milk powder were purchased from New Zealand Dairy Board, Wellington, New Zealand. Emulsifier-stabilizer (Cremodan) was obtained from Danisco (Denmark) and vanilla flavour from Bush Boake Allen (USA). Sucrose and glucose syrup were purchased from local supermarkets.

*Palm-based ice cream.*

A standardized procedure for the production of ice cream was used (Arbuckle, 1986). Ice cream mix was prepared using the formulations in *Table 1* and processed as shown in *Figure 1.*

**TABLE 1. FORMULATION FOR ICE CREAM**

| Ingredient | Percentage |
|---|---|
| Fat | 10.0 |
| Skim milk powder | 11.0 |
| Sucrose | 10.0 |
| Glucose syrup | 5.0 |
| Cremodan | 0.35 |
| Total solid | 36.35 |

Reconstituted skim milk was heated to 40½C in a jacketed vessel before a predetermined amount of PO, PKO or MF was added. The mixture was agitated and heated to 72½C before it was homogenized at 75 kg $cm^{-2}$. The homogenized mixture was then pasteurized at 72½C for 30 min. It was then rapidly cooled to 4½C and aged at this temperature for 24 hr prior to freezing. Vanilla flavour was added during the ageing. The mixture was frozen in a continuous ice cream freezer. The product was packed and stored at –35½C for hardening before evaluation.

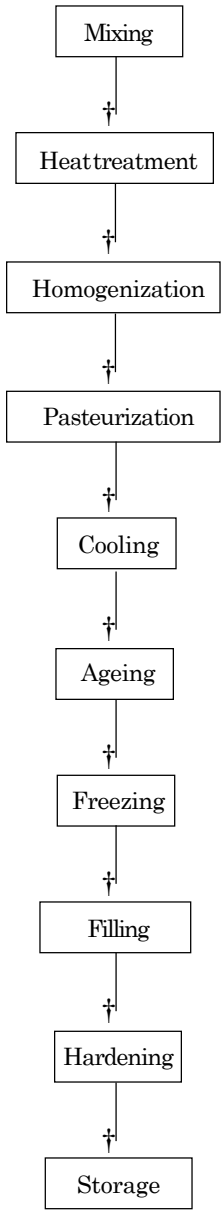


*Figure 1. Processing steps for production of ice cream.*

## CHARACTERISTICS OF FATS IN ICE CREAM FORMULATION

*Table 2* shows the physico-chemical characteristics of fats used in this study. All the samples had melting point below body temperature. The slip melting point of PO was 36.4½C, PKO 27.7½C and MF 34.2½C. The low slip melting point of PKO was characterized by a high content of medium chain triglycerides (MCTs), *i.e.* lauric acid (C12:0) at 46.8% and myristic acid (C14:0) at 16.2%. According to Madsen (1984), hardened coconut oil or PKO having melting point in the range of 30½C to 33½C is suitable for ice cream. Various types of triglycerides ranging from short chain to medium chains, as well as long chains are present in MF. MF contains high amounts of palmitic (C16:0) and oleic (C18:1) acids, at 31.2 % and 20.4% respectively. On the other hand, PO has a high content of long chain triglycerides (LCTs), 44.9% palmitic acid and 38.8% oleic acid. Hence, its semi-solid characteristic and higher slip melting point (Wan Rosnani *et al.*, 1997). High proportion of triacyglycerol containing palmitic acid in PO provides hardness to the product without addition of any hydrogenated fat, and therefore the fats used in ice cream are free of *trans* fatty acid (Wan Rosnani *et al.*, 1997).

*Figure 2* shows the solid fat profiles of the fats used in ice cream. PKO has a very steep

**TABLE 2. PHYSICO-CHEMICAL CHARACTERISTICS OF PO, PKO and MF USED IN ICE CREAM**

| | PO | PKO | MF |
|---|---|---|---|
| Slip melting point (½C) | 36.4 | 27.7 | 34.2 |
| Fatty acid composition (%) | | | |
| C6:0 | - | 0.3 | 1.0 |
| C8:0 | - | 3.7 | 1.3 |
| C10:0 | - | 3.3 | 3.3 |
| C12:0 | 0.2 | 46.8 | 3.7 |
| C14:0 | 0.9 | 16.2 | 12.5 |
| C16:0 | 44.9 | 8.5 | 31.2 |
| C18:0 | 4.2 | 2.0 | 13.6 |
| C18:1 | 38.8 | 15.2 | 20.4 |
| C18:2 | 10.2 | 3.6 | 2.5 |
| C18:3 | 0.4 | - | 0.9 |

cream made with PO recorded higher viscosity than one made with PKO. Among the three samples evaluated, ice cream made with MF showed the highest viscosity. A high viscosity value is a function of the stickiness of the mixture.

**TABLE 3. PHYSICAL PROPERTIES OF ICE CREAM FORMULATED WITH PO, PKO AND MF**

| Physical properties | PO | PKO | MF |
|---|---|---|---|
| Viscosity of unfrozen mix (cps) | 117.0 | 98.8 | 128.0 |
| % Overrun | 100.4 | 104.7 | 104.4 |
| % Fat destabilization | 97.2 | 88.3 | 82.3 |
| % Glossiness | 81.6 | 59.7 | 24.9 |

Note: cps = centipoise.

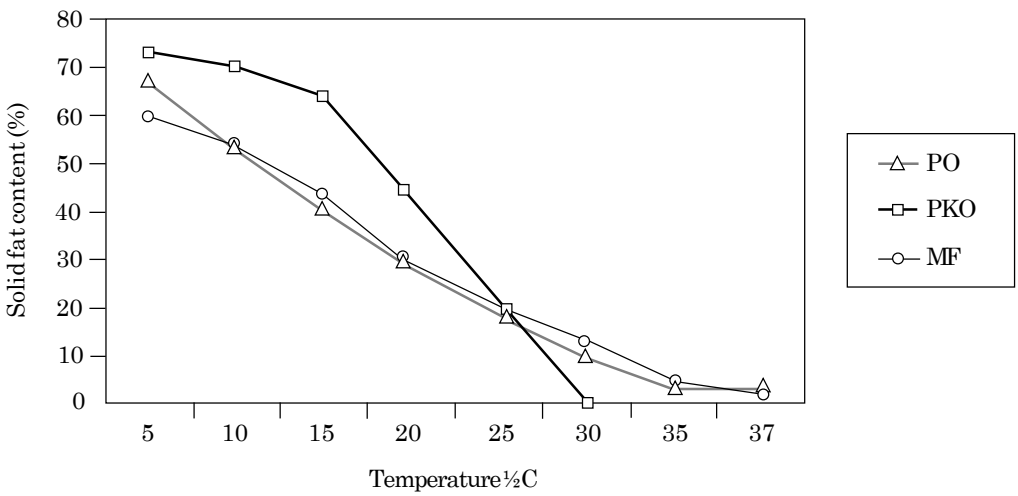


*Figure 2. Solid fat profile of ice cream fat.*

solid fat profile compared to PO and MF. It has high solid contents between 5½C and 20½C and melts sharply at 30½C. Although MF showed a slightly flatter solid fat curve than PO, their profiles are almost similar. PO and MF had much wider plastic range compared with PKO. At 35½C, PO and MF had about 4% solid but none in PKO.

## PRODUCTEVALUATION

*Table 3* shows the physical properties of ice cream made with PO, PKO and MF. Ice

Overrun is the terms used to indicate the volume of air incorporated during the freezing operation. The more air added, the greater is the volume of ice cream produced and the higher is the overrun. Overrun of ice cream containing PKO was higher than one containing PO. Ice cream made with MF had similar overrun value to ice cream made with PKO.

PO showed the highest fat destabilization compared with PKO and MF. Appropriate level (95%) of fat destabilization is required to give a smooth, dry product that aerates

properly, it is resistant to shrinkage and gives satisfactory melt down characteristics. Overrun is directly affected by the extent of fat destabilization. Fat destabilization can occur during aeration and freezing. Fat destabilization produces an increased level of free fat in the product as well as clumping of the fat globules, both of which have important impacts on ice cream structure and quality. Destabilization leads to the production of a smoother ice cream with good melting resistance due to the enhanced structure of the foam caused by the fat network (Goff *et al*., 1987).

PO showed the highest gloss reading (80%) compared to PKO and MF. The gloss reading of MF was 25% while PKO was 60%. Usually ice cream with a gloss reading above 20% will be quite shiny and has a wet appearance. Ice cream with a gloss reading below 10% is considered very dry (Kloser and Keeney, 1959).

A marked difference in melt down was observed in ice cream made with different fats (*Figure 3*). Ice cream made with PKO showed the fastest melting as compared with PO and MF. The faster melting of ice cream made with PKO is due to the steeper solid content profile (*Figure 2*). *Figure 4* shows that all ice cream samples prepared from PO, PKO and MF had almost similar hardness properties. The hardness of ice cream is related to the viscosity, solid fat profile and melting properties of the fat used.

The results of sensory evaluation of ice cream are given in *Figure 5*. Sensory evaluation showed that ice cream containing PO

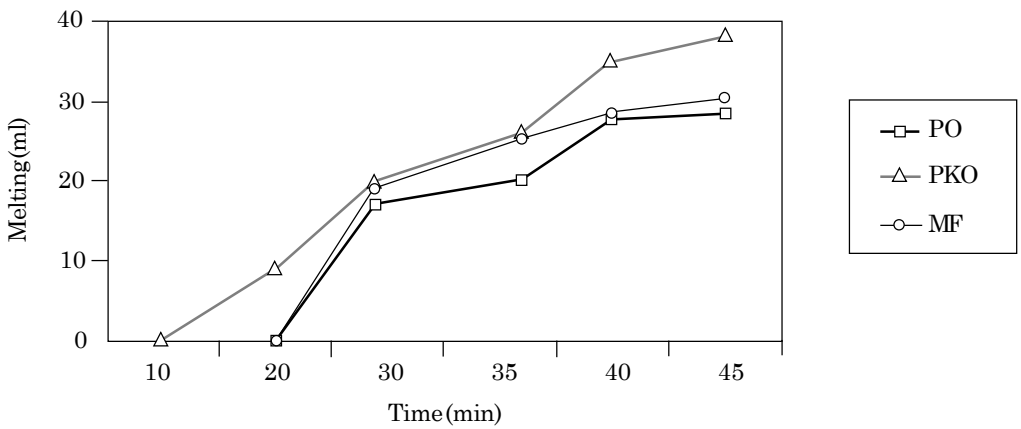


*Figure 3. Melting properties of ice cream made with PO, PKO and MF.*

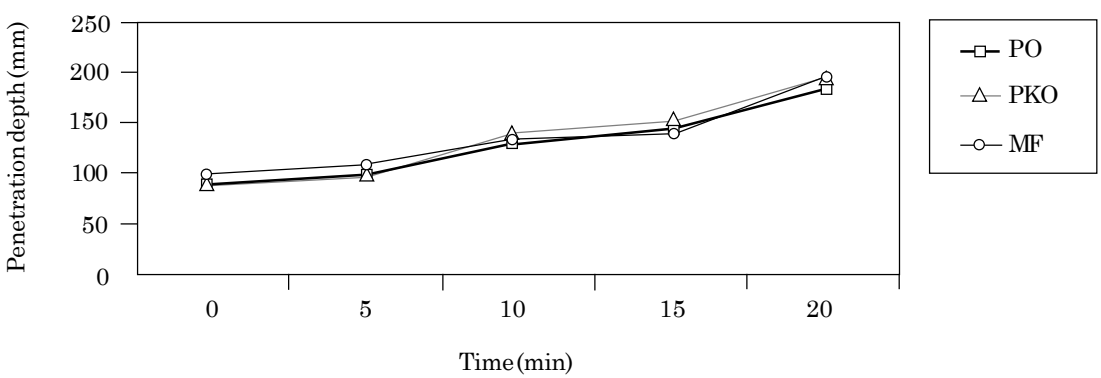


*Figure 4. Hardness properties of ice cream made with PO, PKO and MF.*

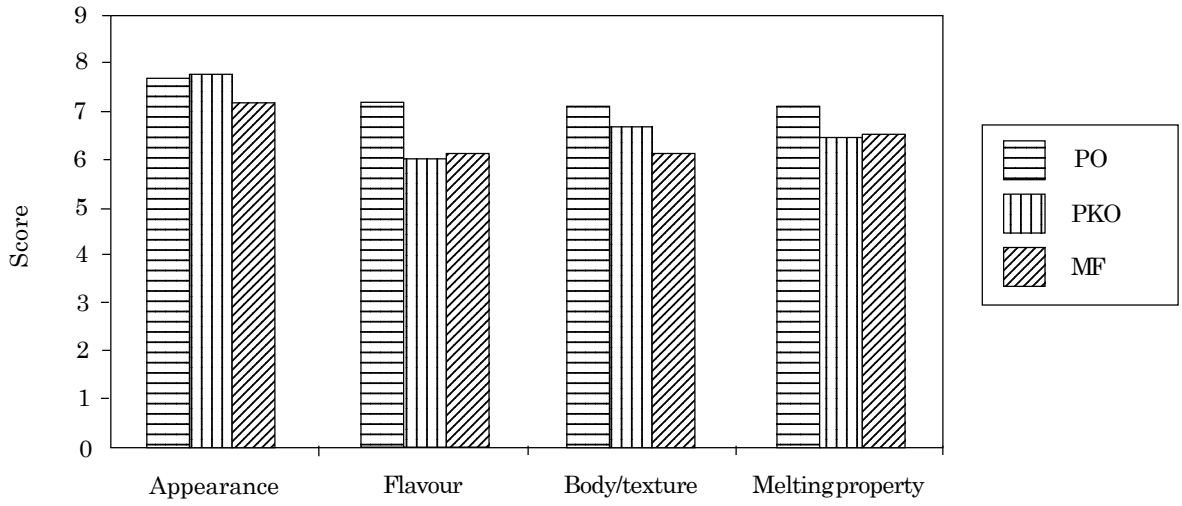


*Figure 5. Mean scores for appearance, flavour, body and texture as well as melting property of ice cream made with PO, PKO and MF.*

and PKO received significantly higher scores than MF in terms of body and texture. The scores for appearance were comparable among the three samples. In terms of flavour, panellist scored ice cream made with PO slightly higher than the other two samples. Some panellists did not like the buttery flavour of ice cream made with MF. Ice cream made with PO also received the highest score for melting property. The results indicated that good quality ice cream can be made using both PO and PKO.

## CONCLUSION

The study demonstrates that PO and PKO are suitable ingredients for the production of ice cream. PO is suitable for hard ice cream due to its higher viscosity and hardness properties while PKO is more suitable for soft ice cream due to its lower viscosity value and its faster melting properties. PO and PKO are suitable as a fat ingredient for ice cream manufacture and the products were comparable with MF in terms of appearance, body/texture and melting properties.

## ACKNOWLEDGEMENT

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