



ONTARIO AGRICULTURAL COLLEGE
Department of Food Science

INCORPORATION OF VEGETABLE FATS IN FROZEN DESSERTS

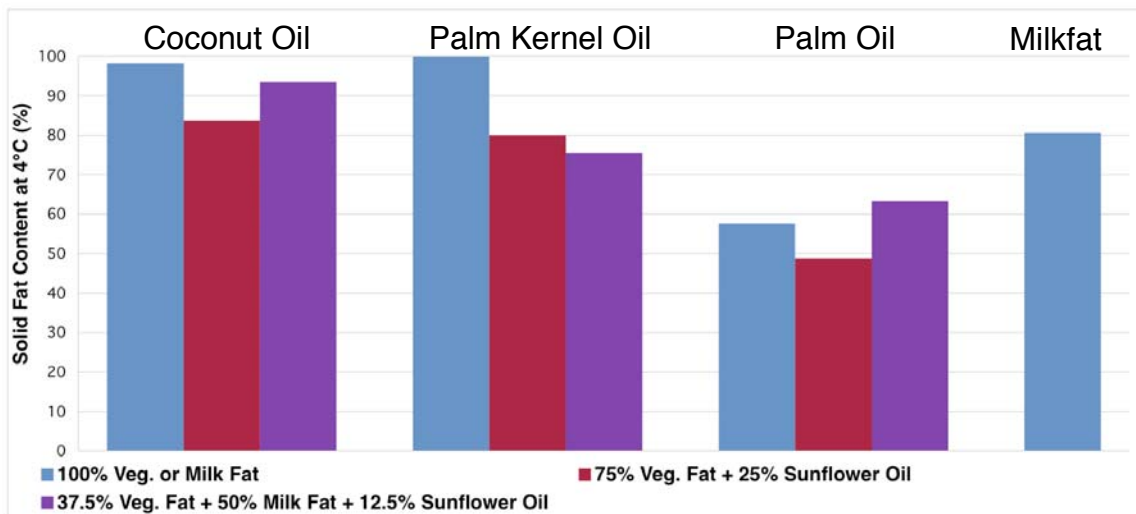
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In Ontario, the repeal of the Edible Oils Act and subsequent modifications to the Milk Act (2005) now allows for the development and sale of frozen aerated desserts that contain vegetable fats and any combination of milkfat and/or non-fat dairy ingredients. These products cannot, however, be called ice cream or frozen dairy desserts. This type of formulation is common in many countries of the world, but to assist the Ontario frozen dessert industry to produce such products, we have recently done formulation and analyses work that may be helpful.

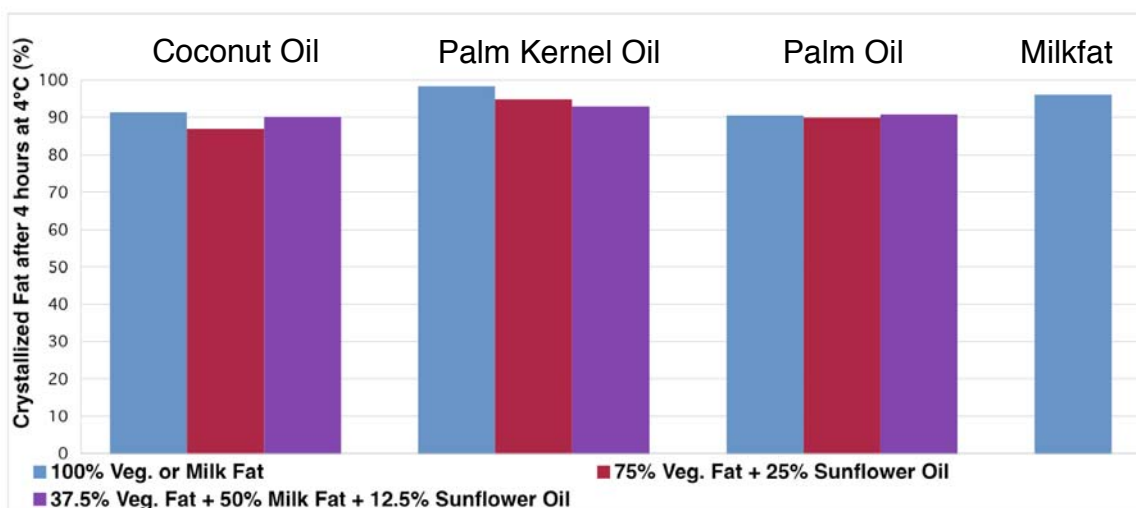
Five types of vegetable fats were utilized: coconut oil (m.p. 26°C, 92% sat. fat), hydrogenated coconut oil (m.p. 44°C, 99% sat. fat), fractionated palm kernel oil (m.p. 33°C, 87% sat. fat), hydrogenated palm kernel oil (m.p. 44°C, 99% sat. fat) and palm oil (m.p. 40°C, 50% sat. fat), all from Nealanders Inc., Oakville, ON. These were formulated either as 100% of the fat source, or as 75% of the fat source with 25% high oleic sunflower oil (Trisun 80, Nealanders), or as 50% of the fat source with 50% milk fat from butter or as 37.5% of the fat source with 50% milkfat and 12.5% high oleic sunflower oil. These were incorporated into frozen dessert recipes consisting of 10% fat, 10% milk solids-not-fat (from skim milk powder), 12% sugar, 4% glucose solids, 0.26% stabilizer/emulsifier (cellulose gum, mono- and di-glycerides, polysorbate 80, carrageenan), and 0.1% vanilla, which were prepared and frozen using conventional ice cream processes.

The following results were found:

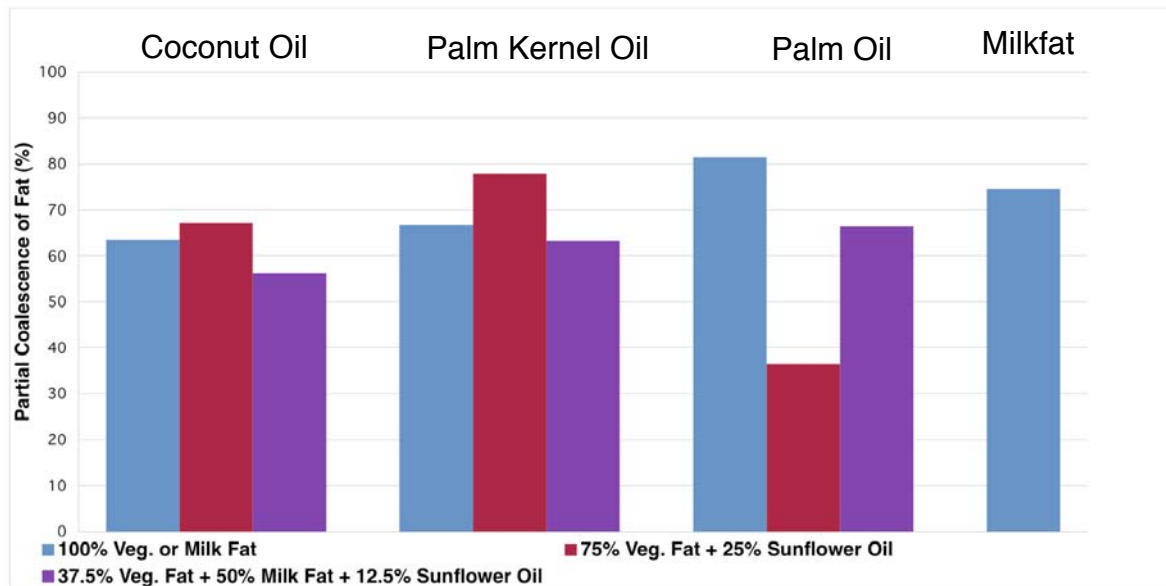
- Coconut oil and fractionated palm kernel oil are very hard fats (more solid fat) compared to milkfat. Palm oil, on the other hand, is softer than milkfat (more liquid oil). This is shown in the figure below. By adding high oleic sunflower oil to the coconut oil or fractionated palm kernel oil, the solid fat content at 4°C was brought down to approach that of milkfat. The blends of coconut oil or fractionated palm kernel oil with milkfat were similar to their corresponding 75% fat / 25% high oleic sunflower oil blends and to the 100% milkfat product.



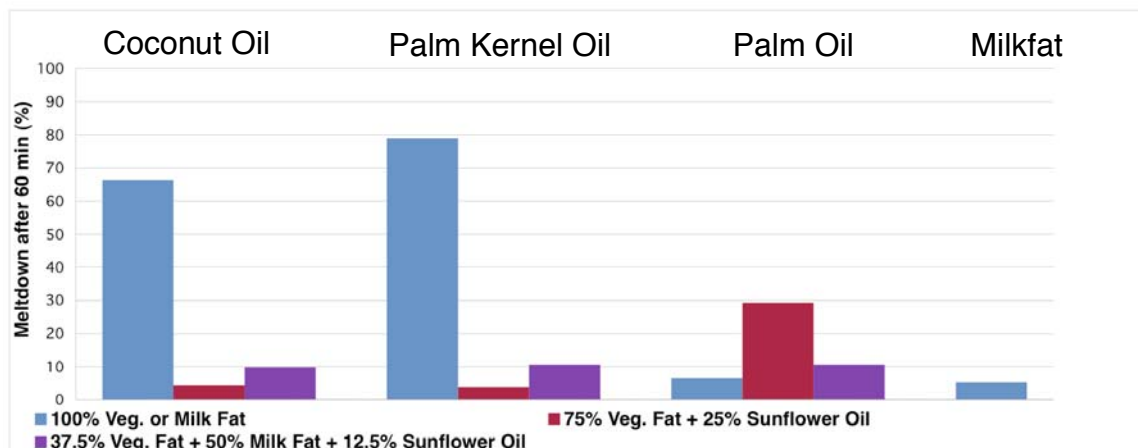
➤ Milkfat crystallizes very readily when cooled to and aged at 4°C. It is desirable to ensure sufficient fat crystallization within a short aging time, so the amount of solid fat at 4°C after 4 hours was compared. Coconut oil and palm oil crystallized more slowly than milkfat whereas fractionated palm kernel oil was almost fully crystallized after 4 hours, similar to milkfat, as shown in the figure below. The addition of high oleic sunflower oil slowed down the crystallization of the fractionated palm kernel oil slightly, but it was still comparable to milkfat.



- Partial coalescence of fat is a very good indicator of the contribution of fat to structure of frozen aerated desserts. Products made with 100% coconut oil or fractionated palm kernel oil achieved a lower level of partial coalescence compared to milkfat, as shown below. Palm oil at 100%, on the other hand, showed a similar level of partial coalescence to milkfat. The addition of 25% of high oleic sunflower oil to coconut oil or fractionated palm kernel oil increased the level of partial coalescence comparable to milkfat, as it reduced the hardness of the fats as shown above. On the other hand, the addition of 25% of high oleic sunflower oil to the palm oil resulted in an excessive amount of coalesced fat, as the fat mixture had now become too soft to develop optimal levels of partial coalescence in the whipped and frozen products.



- One attribute that is greatly affected by partial coalescence of fat is meltdown. In the figure below, it can be seen that products made from 100% of coconut oil or fractionated palm kernel oil melted very quickly, due to the lack of structuring from the fat. However, the addition of 25% high oleic sunflower oil greatly improved meltdown characteristics and brought the melting rate comparable to milkfat. Palm oil at 100% showed a slow meltdown similar to milkfat, but as discussed above, the addition of 25% oil to the palm oil caused this product to lose structure and thus melt down more quickly.



- The frozen desserts made with fractionated palm kernel oil or coconut oil obtained the best flavor and texture acceptability from a trained taste panel. Since these fats contribute very little to flavour, the products were characterized by their sweetness, vanilla and non-fat milk solids components. The introduction of high oleic sunflower oil did not affect the flavour or texture acceptability. Palm oil was least acceptable in flavour and texture, compared to any of the others. The dairy flavour notes were retained in the 50% milkfat, 50% vegetable fat/oil blends.
- It was concluded from this study that very acceptable products can be made if substituting milkfat partially or completely by vegetable fats, provided that the fats have clean flavour, crystallize rapidly and contribute positively to structure. With all these considerations, the best products were made with a blend of 75% fractionated palm kernel oil and 25% high oleic sunflower oil or 50% milkfat, 37.5% fractionated palm kernel oil and 12.5% high oleic sunflower oil. Coconut oil in similar blends was also acceptable, but would require sufficient aging time for complete crystallization before freezing (> 8 hours). No specific benefit was seen from hydrogenation of the coconut or palm kernel oils.