

**F**illed milk is a milk substitute made by combining non-dairy fats or oils with milk solids. It is used to replace fresh milk products in regions where there is inadequate storage facilities or where milk is little or not produced. The properties of reconstituted milk more closely resemble those of homogenized milk than whole milk. Much of the filled milk in the market contains coconut oil, which is inexpensive and more resistant to oxidation than milk fat. In addition, its melting characteristics mimic that of milk fat.



Figure 1. Palm oil.

## INGREDIENTS AND PROCESSING

The major ingredients in palm-based reconstituted filled milk (palm-based RFM) are palm-based oil, milk protein and water (Figure 2). A food emulsifier is added to make the emulsion homogenous.

The dry and liquid ingredients are reconstituted with water and heated to 40°C in the processing



Figure 2. Palm-based reconstituted filled milk.

vessel. The mixture is homogenized, then pasteurized at 72°C for 30 min. The palm-based reconstituted filled milk is packed in suitable containers. The product should be shaken well before use.

## PRODUCT CHARACTERISTICS

The physical properties of palm-based RFM are shown in Table 1 and Figure 3. The viscosity ranged from 43 to 53.2 mPas vs. 43 mPas for the control. The viscosity of Formulation 2 (F2) was comparable to that of the control, while the viscosities of Formulations 1 (F1) and 3 (F3) were higher. The pH of palm-based RFM was 6.6 to 6.8, and for the control, 6.7. Brix was 12.9% to 17.5%, while for the control 13.2%. The F1 had pH and brix comparable to those of the control. The sensory evaluation scores (Figure 4) indicated that palm-based RFM prepared from milk powder (MP1) was preferred over MP2 or MP3. Palm-based RFM prepared from MP1 and palm-based oil scored higher for appearance and creaming property than the other experimental samples (Figure 5). Palm blend 1 was comparable to palm-based oil 3 in terms of appearance and suitable to be produced as palm-based RFM.

**TABLE 1. PHYSICAL PROPERTIES OF PALM-BASED RECONSTITUTED FILLED MILK**

Product	pH	Brix (%)
F1	6.6	12.9
F2	6.8	16.3
F3	6.6	17.5
F4	6.7	13.7

Note: F1 = Milk powder 1  
 F2 = Milk powder 2  
 F3 = Milk powder 3  
 F4 = Commercial sample

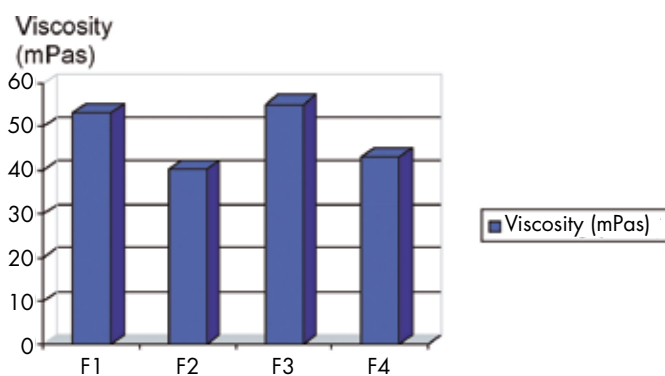


Figure 3. Viscosity of palm-based reconstituted filled milk.

Note: F1 = Milk powder 1  
 F2 = Milk powder 2  
 F3 = Milk powder 3  
 F4 = Commercial sample

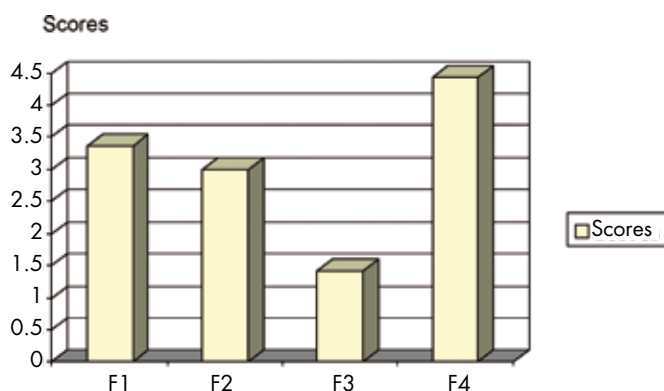


Figure 4. Sensory scores for palm-based reconstituted filled milk.

Note: F1 = Milk powder 1  
 F2 = Milk powder 2  
 F3 = Milk powder 3  
 F4 = Commercial sample

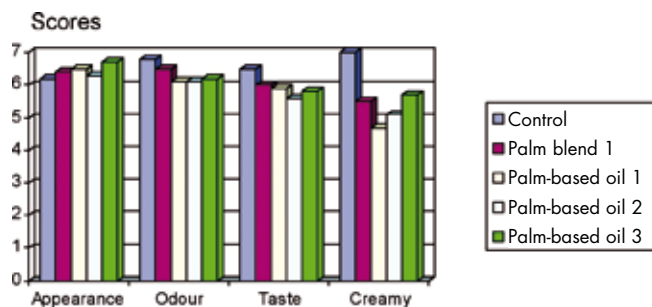


Figure 5. Sensory scores for palm-based reconstituted filled milk made from different fats.

## NOVELTY

Palm-based RFM is an alternative to milk. It is in liquid form and is always ready for use.

## ECONOMIC EVALUATION

The commercial production of palm-based RFM is expected to require an investment of RM 286 000. Producing 48 000 kg yr<sup>-1</sup> at a long-term price of RM 5.5 kg<sup>-1</sup> will earn a pre-tax income of RM 84 955. The unit cost of production is estimated to be about RM 4.23 kg<sup>-1</sup>. Using a 10% discount factor and a product price of RM 5 kg<sup>-1</sup>, the investment is attractive with a payback period of 5.3 years. The venture is expected to yield a B:C ratio of 1.17, NPV of RM 237 287 and IRR of 30.23%. As the B:C is greater than unity, NPV positive and IRR higher than the opportunity cost of capital; the investment is financially viable.

## MARKET POTENTIAL

The users of palm-based RFM are fast food restaurants, catering services and retailers.

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