

PALM OIL-BASED STRUCTURAL FAT WITH HIGH OIL BINDING ABILITY

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Solid fats are used as hardstocks to develop a widespread range of structuring agents in food formulations (Omonov *et al.*, 2010). Palm solid fractions are natural solid fats which provide improved stability for many types of food that require solid fat functionality (Pande and Akoh, 2013). Traditionally, solid fat in margarine is obtained by hydrogenation of liquid oils. Hydrogenation results in the formation of *trans* fatty acids which has adverse health effects (Pande and Akoh, 2013). Palm oil fractions are highly recommended to replace *trans* fats in margarine formulations, as it is cost efficient, easily available, has high solid fat content (avoiding hydrogenation), high oxidative stability (long shelf life), and contributes to structural hardness (Pande and Akoh, 2013). Palm solid fraction might be appropriately blended and interesterified with liquid oils in order to modify the physical characteristics of the mixture to meet the functional properties and the quality required for margarine preparation (Sellami *et al.*, 2008).

THE TECHNOLOGY

The palm oil-based structural fat was specifically modified to enhance its ability to perform as a crystal matrix creator in the blends with high amount of oils (liquids). The palm oil-based structural fat has excellent oil binding capacity which enables the fat to hold up to 90% liquid oil such as palm olein, soybean oil, canola oil or sunflower oil within its crystal matrix. The fat blends formulated with this palm oil-based structural fat is able to maintain an excellent balance between the solid – liquid phase and these two phases of liquid and solid oils are able to co-exist within the temperature range of 5°C to 30°C. The crystal matrix and the bonding force in the crystal matrix effectively immobilises the liquid oil within the crystal structure in a manner as to prevent oil release. The microstructural crystals are homogeneously dispersed and bonded well by the crystal network. The solid fat content of the blends obtained by blending palm oil-based

structural fat with liquid oils are able to support the desired application of the final product.

PRODUCT CHARACTERISTIC

Palm oil-based structural fat oil binding ability was determined by blending with liquid oil. Palm oil-based structural fat was blended with palm olein at ratios of 2.5%, 5%, 7.5% and 10% and textured in a perfector pilot plant. The structural stability of these blends with high amount of liquids oils were determined with the assistance of a LUMifuge Stability Analyser at 25°C. This phase separation analysis provides a simple and reliable way to quantify the amount of liquid oil released by centrifugal force. The LUMifuge Stability Analyser applies centrifugal force with an in-built near infrared (NIR) detector to measure the amount of free oil released from the fat. This system measures near infrared (NIR) transmission profiles continuously during centrifugation resulting in 255 measurements. Graphical representation of transmission as a function of position presents the transmission profile. Zones of concentrated fats will scatter and absorb light, hence lowering transmission. In contrast, clear liquid will raise the transmission levels. The integral of transmission over the sample length is used to calculate the percentage of oil released (Libster *et al.*, 2009; Kuentz and Rothlisberger, 2003; Mende *et al.*, 2007; Klein *et al.*, 2010; Krause *et al.*, 2009; Sivaruby *et al.*, 2013).

Table 1 shows the percentage of oil released from the blends of palm oil-based structural fat and palm olein and Figure 1 shows the respective transmission profile indicating the amount of oil released. The results shows that 10% of palm oil-based structural fat is able to effectively hold up to 90% of palm olein within its crystal structure.

NOVELTY

This palm oil-based structural fat can be used to produce spreads, margarines, shortenings and cooking fats with high amount of liquid which are functional between 5°C to 15°C.

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TABLE 1. THE PERCENTAGE OF LIQUID OIL RELEASED AND OIL BINDING CAPACITY OF PALM OIL-BASED STRUCTURAL FAT WITH PALM OLEIN

Ratio of palm oil-based structural fat:palm olein	2.5:97.5	5.0:95.0	7.5:92.5	10.0:90.0
Percentage of liquid oil released	13%	6%	4%	<1%
Oil binding capacity	87%	94%	96%	>99%

BENEFITS

- Facilitate the designing and structuring of fat based food formulations such as margarines based on the specific liquid–solid balance stability requirement.
- Minimum amount of 10% and below is required to provide firm and consistent structure.
- Eliminate oil out problems in solid fat food products.
- Replaces the functionality of hydrogenated fats in solid fat food.

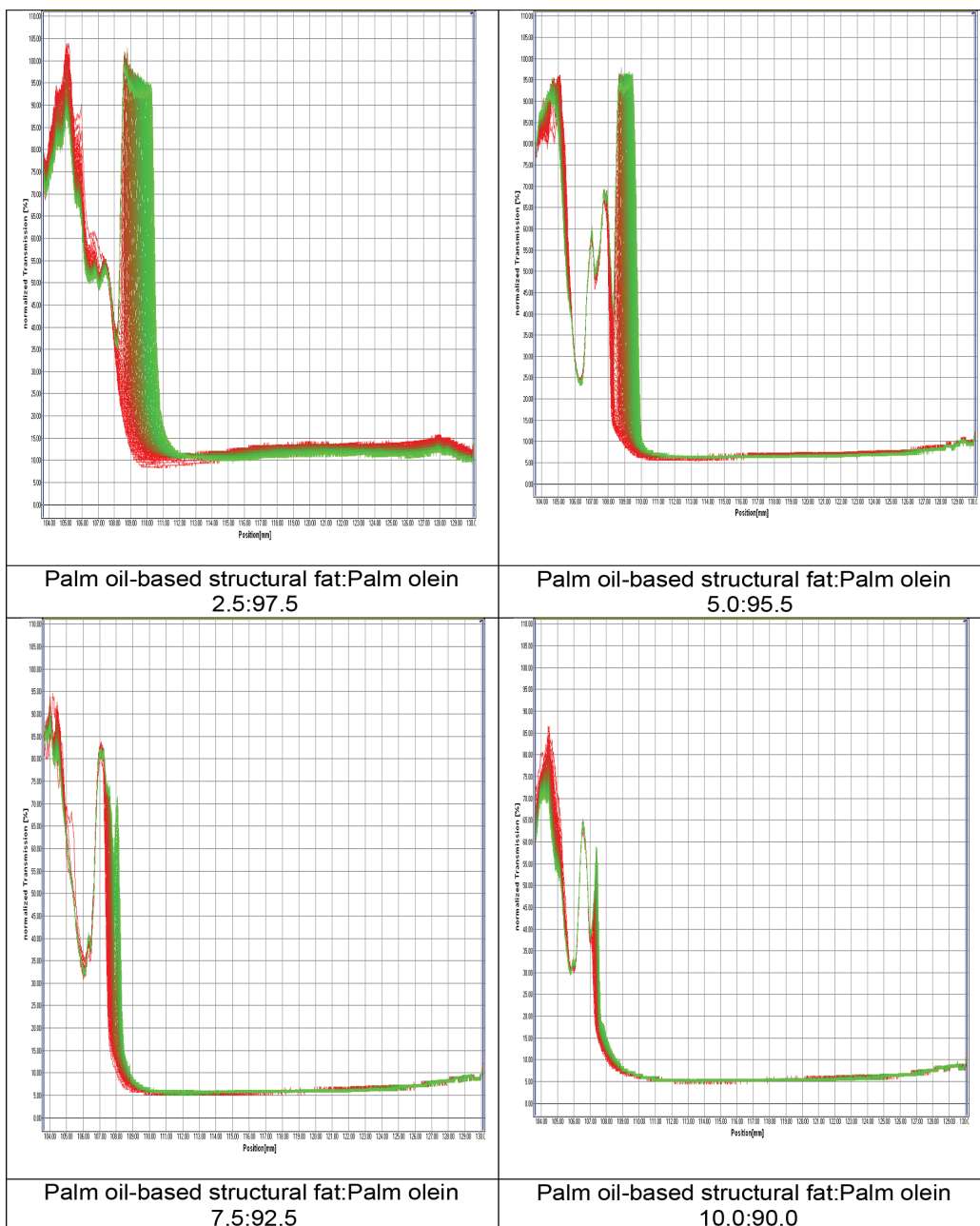


Figure 1. Stability Analyser LUMifuge's near infrared transmission profiles indicating amount of oil released from blends of palm oil-based structural fat and palm olein.

Note: Transmission is absent in zones with solid fat as light is scattered and absorbed. Zones with liquid oil allows light through hence elevating the transmission levels.

TARGET MARKET

Manufacturer of commercial and retail margarine, spreads, cooking fats and shortening. The product improves stability in terms of oil binding ability to form a homogenous and stable structure.

ECONOMIC EVALUATION

The estimated expenditure and other economic parameters are as shown in *Table 2*.

TABLE 2. ESTIMATED EXPENDITURE AND ECONOMIC VALUES

Item	Value
Capital expenditure	RM 50 000 000
Production capacity	500 t day ⁻¹
Payback period	3 years
Internal rate of return (IRR)	20%
Return on investment (ROI)	53.76

CONCLUSION

Palm oil-based structural fat is able to provide excellent crystal matrix for binding of high amount of liquid oil. The palm oil-based structural fat has an impressive oil binding capacity which enables the fat to hold up to 90% liquid oil such as palm olein, soybean oil, canola oil or sunflower oil within its crystal matrix.

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