SPECIALTY FAT PRODUCTS FROM PALM AND PALM KERNEL OILS*

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INTRODUCTION

The three largest oil and fat exporting countries of the world are Malaysia, the USA and Argentina, but Malaysia's exports of palm oil (PO) and palm kernel oil (PKO) exceed the total oil and fat exports of the other two countries taken together. With her production increasing at the rate of 400 000 tonnes per year, Malaysia needs to constantly diversify the use of her oils into new applications. This paper gives a brief description of new oil fractions now being produced in Malaysia from palm and palm kernel oils, and of new varieties of PO with distinctly different compositions, which could be available in world markets before very long.

PALM OIL IN WORLD TRADE

There is no need to discuss at any length the importance of PO in world trade. In 1992 its share of the world's total production of oils and fats reached 14%, second only to that of soya bean oil (SBO) while its share of world exports reached 32%, making it the clear leader (*Table 1*).

DEVELOPMENT IN PO TECHNOLOGY

Two strong advantages PO has over other oils are its low cost of production (lower than any other oil) and in some markets at least, the fact that it is the only naturally solid vegetable fat suitable for general purposes. However this last factor is also a disadvantage because in world terms the solid fat sector of the market is smaller than the liquid oil sector and is also often the lower-priced one. PO therefore has to compete in the liquid sector as well, and fractionation into palm olein (olein) and palm stearin (stearin) was the answer found early in the seventies. It proved highly successful and at present as much olein leaves Malaysia as PO, the mix of products exported consisting of about 40% PO, 40% olein, 15% stearin and 5% palm fatty acid distillate (PFAD). The characteristics of these products are shown in *Table 2*.

A recent development in fractionation is widespread adoption of membrane filters, this has increased the yield of olein from dry fractionation from about 65% to 75% or higher, but the stearin is correspondingly harder. Thus the yields now obtained from dry fractionation are similar to those from detergent fractionation, without the possible objections that could be raised against detergents.

Olein has major uses as a liquid cooking oil in tropical countries, as an industrial frying oil and as a liquid oil component in margarines and shortenings world wide. Stearin is used as an alternative to hydrogenated vegetable oils and for soap and oleochemical production. For certain applications (such as bread fats) its high palmitic acid content (about 60%) is a unique advantage. PFAD has major uses in soap and oleochemical production and as an alternative to tallow greases in compound animal

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TABLE 1. WORLD TOTAL OILS AND FATS, 1992

	Production		Export	
	million tonnes	**% of total**	**million tonnes**	**% total**
Soya bean Oil	17.0	20.3	4.3	16.1
Palm Oil	12.0	14.3	8.6	32.2
Rapeseed Oil	9.4	11.2	1.9	7.1
Sunflower Oil	8.1	9.7	2.5	9.4
Tallow & Greases	6.8	8.1	2.8	10.5
Others	30.5	36.4	6.6	24.7
Total	**83.8**	**100**	**26.7**	**100**

Source: Oil World Annual, 1991

feeds. Its fatty acid composition makes it especially suitable for cattle feeds.

PALM MID FRACTION

In their effort to expand their market further and add value to basic commodities, several Malaysian refineries have recently started producing palm mid fraction (PMF), which is a necessary component of all true cocoa butter equivalents (CBE).

TABLE 2. CHARACTERISTICS OF PALM OIL AND FRACTIONATED PRODUCTS (mean value)

	Palm Olein (n=193)	Palm Oil (n=137)	Palm Stearin (a) (n=150)
IV	58.0	54.5	35.5
SMP (°C)	21.5	36.0	50.5
Cloud Point (°C)	10.4		
Solid Fat Content (%), by NMR			
10°C	37	49	73
20°C	6	22	59
30°C	0	9.5	45
40°C	0	4	32
Major Fatty Acids (wt %)			
C14:0	1)	1.5)	1.5)
C16:0	40) 45.5	44) 50	60) 66.5
C18.0	4.5)	4.5)	5)
C18:1	43)39.5)		26.5)
C18:2	11.5) 54.510.5) 50		7) 33.5
Major Triglycerides (mole %)			
C48	2	8	35
C50	42	42.5	40
C52	46	40.5	21
C54	10	9	4

(a) = The values for palm stearin are normalized mid-range.
n = Number of samples
Source: PORIM Surveys, 1979/80

Until only a few years ago PMF was only produced in the developed countries on a relatively small scale and at high cost, and it was never offered as a commodity under its own name, but rather as a branded product. In nearly all cases it was blended with other fats and sold as branded cocoa butter equivalent. Broadly speaking Malaysia produces two qualities of PMF, one being double (non-solvent) fractionated PO and the other a higher quality version which has been re-fractionated from solvent. The characteristics of typical good PMFs of the two types are shown in *Table 3*.

Before the expansion of the Malaysian refining industry, most developing countries such as India and Pakistan, had insufficient refining capacity and had to consume either poorly refined or even crude oils. Similarly with chocolate fats: until recently CBEs were only available to affluent Western Europe and Japan, while the less affluent Eastern Europe and most of Asia had to use either expensive cocoa butter or make do with the very inferior substitutes based on hydrogenated seed oils.

All current CBEs in the world market are based on PMF as their major component (at least 50%) with the balance made up from fats rich in 2-oleo distearin (St-O-St) such as Illipe fat, Shea stearin, Mango stearin, Sal stearin and others.

SUPER OLEIN

A secondary product of PMF production is an olein of higher IV and lower melting points and cloud point than standard olein, commonly referred to as super olein. It will be easily appreciated that the more liquid nature of super olein results from the fact that it is double fractionated; solvent fractionation achieves greater selectivity than dry or detergent fractionation, resulting in a sharper 'cut'. A comparison of solvent fractionated super olein with standard olein is given in *Table 4*.

Broadly speaking, standard olein can be expected to remain clear indefinitely at 30°C, while super olein will probably do so at 25°C. Even at 20°C it will remain clear for several weeks. Super olein is the most appropriate grade to blend with seed oils to produce cooking oils for the retail market in temperate climates. In some countries of the EEC (*e.g.* Portugal) 'oil' are defined as those remaining liquid at 20°C at the time of sale, and blends of super olein with seed oils satisfy this condition provided the temperature was not allowed to drop earlier, causing crystallization: once the more solid triglycerides have precipitated, the oil may not clear when the temperature is raised to 20°C. In some countries (*e.g.* France and Portugal), only oils with a linolenic acid content below 2% are allowed to be described as suitable for frying in the retail market. Clearly this cuts out soya bean oil and rapeseed oil. However, blends of about 80% super olein and 20% soya bean oil, or 85% super olein and 15% rapeseed oil will satisfy this condition and have the advantage of making the super olein more cold-resistant. PMF and super olein bring up to six the number of major palm oil products now available in the world markets; each one has its own distinct field of application.

TABLE 3. TYPICAL CHARACTERISTICS OF PALM MID FRACTIONS (PMF)

	PMF (1)	PMF (2)	Cocoa Butter
IV	41	34	37
SMP	29.5	32	34
Solid Fat Content (%), by NMR			
20°C	62	87	74
25°C	38	75	67
30°C	13	37	38
35°C	-	-	2

Note: PMF (1) is dry fractionated and PMF (2) is solvent fractionated.

PALM KERNEL STEARINS AND OLEINS

Of equal interest to PMF is palm kernel stearin (PKS), which makes the highest quality cocoa butter substitute (CBS) that present technology allows. For those not familiar with the conventions of the confectionery industry, I should explain that cocoa butter equivalents (CBEs) are fats with a similar glyceride composition to cocoa butter, while CBSs are fats which resemble cocoa butter only in physical properties. It is generally acknowledged that palm kernel stearin (PKS) is the best CBS. It can be used either in its natural state with a slip melting point (SMP) of 30°C - 32°C, or hydrogenated to IV 1 and an SMP of 35°C - 36°C.

The secondary product of PKO fractionation is palm kernel olein (PKOo) which has a similar fatty acid composition to PKO but somewhat less lauric acid and is normally offered at a lower price. It can be hydrogenated to a suitable melting point and used to replace hydrogenated palm kernel oil (HPKO) in nearly all its applications, or it can be used without hydrogenation as a replacement for PKO in soap and oleochemical production.

NEW PALM OILS ON THE HORIZON

It has already been explained that fractionation of palm oil enables it to compete with the more expensive liquid oils but the profitability of the operation depends very greatly on the olein yield obtained, which in turn depends on the degree of unsaturation of the PO feedstock. Current standard palm olein obtained at a yield of about 75% has a cloud point of 8°C - 10°C, but with an SMP of about 22°C it does not remain clear in temperate climates; double fractionation to produce super olein adds to costs; clearly the answer is to breed oil palms giving a more unsaturated oil. Such PO would give greater yield of more unsaturated olein and would also be considered nutritionally superior by many people.

The biggest obstacles to achieving this development is the fact that the oil palms of South-east Asia (*Elaeis guineensis*) have a very narrow genetic base and show little variation. It seems almost incredible but the vast plantations of this region including 2 million hectares (18 000 sq km) in Malaysia, originate from only four palms which came from Mauritius and were planted in the botanic gardens in Bogor in Java. Since the end of the Second World War, many workers have collected oil palm genetic material from other parts of the world and carried out field trials. Prominent among these have been the French

TABLE 4. SPECIFICATIONS OF MALAYSIAN PALM OLEINS

	Palm Olein (PORAM Standard)	Super Olein (PORAM Standard)	Super Olein (a) (Solvent Fractionated)
IV	56 min	60 min	64 min
MPT (AOCS Cc 3-25)°C	24 max	19 max	18 max
Cloud Point (°C)	10 max[a]	8 max[a]	4 max

(a) = Typical values, but not part of the PORAM specification.

laboratory IRHO which prospected in Dahomey, Ivory Coast, West Cameroons and other places, and Unilever, which carried out extensive work elsewhere. Since 1973, the Malaysian Agricultural Research and Development Institute (MARDI) and later PORIM have done extensive prospecting in South America, Nigeria, Zaire, Sierra Leone, Angola, Tanzania and Madagascar.

The palm species *E. oleifera* indigenous to the Amazon basin in South America, gives a much more unsaturated oil than does *E. guineensis* (IV over 80) but yields per tree are low. PORIM found that hybrids from crosses with *E. guineensis* produced oils with intermediate unsaturation but fruit yields were low and the plants had excessive vigour which is a disadvantage, because it leads to tall trees and more expensive harvesting. Research on this topic is continuing.

More interestingly PORIM recently found in the Nigerian selection, some *E. guineensis* palms with a yield of 10-12 tonnes of oil per hectare per year, which is more than double the current yield obtainable in Malaysia from this species. Some palms also gave oil with IV over 60, much higher than the present Malaysian average of 53, and higher even than the present typical olein (58). After fractionation, olein with an IV over 70 and a cloud point of - 5°C was obtained, which could probably be marketed as a table oil in temperate climates, without any need to blend it with any other oil.

While the main emphasis is placed on greater unsaturation, one should not overlook palms yielding oils with compositions interesting for other applications, *e. g.* high stearic acid for cocoa butter substitutes, low palmitic for oleochemicals and so on.

Another desirable attribute for the plant is that it should be short, in order to minimize harvesting costs and allow longer periods before replanting, and it should of course be high yielding. With conventional breeding methods, it would probably take three generations or 30 years to combine all these three desirable characteristics in a single palm. With the development of tissue culture technique, the time could be shortened to perhaps 10 years. The last 20 or so years have been very exciting for palm oil, but it seems that the next 20 years will be even more exciting.

REFERENCES

Oil World, February 10 (1989). ISTA Mielke GambH, Hamburg, pp.1-5.

TAN, B K and OH, F C H (1981). Malaysian Palm Oil. *PORIM Technology No. 3*, PORIM.

TAN, B K and OH, F C H (1981). Oleins and Stearins.*PORIM Technology No. 4* , PORIM.

Intercontinental Specialty Fats, Port Klang Malaysia. Product Specifications.

Anon (1984). *PORIM Bull.* Special Issue, November 1984, pp. 5.

RAJANAIDU, N, RAO, V, ABDUL HALIM and ONG, S H (1988).Lecture at AETFAT Congress, Hamburg, West Germany, 4-10 September 1988.

Marc Kokken, Extraction De Smet Engineering IMIQ/PORIM Seminar, Guadalajara, Mexico, 17 November 1989.

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