PFAD* for Feed

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INTRODUCTION

Consumption of palm oil over the last decade has almost tripled – a faster rate of growth than for any other edible oil. Today, palm oil is the No. 1 traded edible oil in the world, and second only to soyabean oil in terms of contribution to the world's production of oils and fats (*Tables 1* and *2*).

TABLE 1. WORLD PRODUCTION OF OILS AND FATS (million tonnes)

	1978	1988	% Growth
Soyabean oil	11.78	15.45	31
Palm oil	3.10	8.65	179
Rapeseed oil	2.82	7.83	178
Sunflower seed oil	4.41	7.63	73
Cottonseed oil	3.03	3.65	20
Groundnut oil	2.52	3.59	42
Tallow/Grease	5.97	6.74	13
Others	15.90	21.59	–
TOTAL	49.53	75.13	52

Source: *Oil World*

TABLE 2. WORLD EXPORTS OF OILS AND FATS, 1988 (million tonnes)

Palm oil	6.76	(27.4%)
Soyabean oil	3.84	(15.6%)
Rapeseed oil	1.98	
Sunflower seed oil	2.25	
Tallow/Grease	2.76	
Others	7.06	
TOTAL	24.65	(100 %)

Source: *Oil World*

Palm oil as it is traded today is available in approximately 15 different grades, ranging from crude to semi-refined, refined, crude fractionated, and refined fractionated oil and refinery by-products.

The success of palm oil is largely due to this diversity, which makes it an ideal 'ready-to-use' ingredient in many food products. The use of palm oil in non-food products has also been expanding over the last five years or so.

Another sector where palm oil, or to be precise, a by-product from the palm oil refining industry, has made inroads as a cost-effective and suitable ingredient is the feed fat industry. This article gives an overview of the by-products available from the Malaysian palm oil refining industry for the feed fat industry and covers the technical characteristics, trade specification, future availability, handling and storage of the most important of these by-products. A brief introduction to the role of fat in feed and to sources of fat for feed is also given.

ROLE OF FAT IN FEED

The advantages of adding fats to feed, other than their being a concentrated source of energy and for better palatability, are the reduction of dust levels and waste during feed handling and greater ease in producing pellets. Fats are also found to promote better utilization of the feed by livestock (Ohlson, 1981), and they are a source of certain specific nutrients.

In practice, feed mixtures rarely require the addition of more than 2.5% to 3.0% of fat on nutritional grounds. Feed formulations for pelleting may require up to 6% or 7% of fat which is mainly sprayed on to the pellets (Wilson *et al.*, 1985).

SOURCES OF FEED FAT

Because of economic considerations, most feed fats, whether blends or single-source fats, are derived from feed grade tallow, yellow grease or by-products from edible oil refining. Feed grade tallow, produced from rendering, is the lower quality grade usually made from offal. Because of this and of the presence of gut contents during the cooking process, some feed grade tallow is of poor quality and results in feed rejection

* *Palm Fatty Acid Distillate*

(Wilson *et al.*, 1985). Another problem is polythene contamination arising from polythene bags, which are used to pack materials for rendering, and are often not removed before cooking (Wilson *et al.*, 1985).

Yellow grease is waste cooking oil collected from food factories, fast food outlets, restaurants and canteens. Problems related to the use of yellow grease in the feed fat industry are the wide variation in its quality and composition from different sources of supply and the presence of undesirable artefacts resulting from repeated and prolonged heating in the cooking apparatus.

At the present time, by-products of the edible oil refining industry are probably the most cost-effective and reliable feed fats.

BY-PRODUCTS FROM REFINING OF PALM OIL

As in the case of all other edible oils, the processes of harvesting, extraction and handling the crude palm oil result in the formation of free fatty acids (FFA), which need to be reduced to acceptably low levels before human consumption. This is effected by refining, wherein FFA are separated from the edible oil as by-products, either by reaction with caustic soda (termed alkali refining) or by steam distillation (termed physical refining).

Palm Fatty Acid Distillate or PFAD consists of FFA from the physical process while Palm Acid Oil or PAO contains FFA from alkali refining. In Malaysia, where about 58% of the world's palm oil is produced and refined, physical refining is used almost exclusively. Thus, the present availability of PAO in Malaysia is negligible and therefore it will not be highlighted in this article.

Advantages of PFAD

There are several advantages in using PFAD as one of the ingredients of a feed fat formulation.

- It is probably one of the cheapest and most reliable sources of feed fat. Typical ex-tank prices for feed fats in the UK are shown in *Table 3*.

TABLE 3. PRICES EX-TANK UK, OCTOBER 1989 (£/tonne)

Soya acid oil	240
Edible tallow	220
Rice bran oil	200
Feed tallow	180
PAO/PFAD	170
Mixed acid oil	190
Yellow grease	185
Distillation residue	100
Fish acid oil	85

(Lowe, 1989)

- It is consistent in quality and composition (Hamirin, 1983).
- It is a source of essential fatty acids (EFA): PFAD contains about 10% of linoleic acid (C18:2).
- It is less prone to rancidity than some other fats, because of the near absence of linolenic acid (C18:3).
- The level of stearic acid (C18:0), which is very poorly digested by poultry, is less than 5% well below the suggested maximum limit of 10% (Lowe, 1989).
- It contains high levels of Vitamin E, which is a powerful antioxidant: PFAD has 2160 - 4240 ppm of Vitamin E (Ab Gapor, 1981).
- PFAD has a high level of FFA, usually more than 80 per cent. High levels of FFA are believed to have positive benefits in energy value in ruminants (Lowe, 1989).
- It is a hard fat, with long chain fatty acids and about 50% saturation and, as such, is particularly suited to ruminants (Lowe, 1989).
- According to Pantzaris (1987), the most popular fat used in the UK in calcium soap supplements for the feed industry is PFAD, because of its high FFA content and ease of reaction with calcium hydroxide, as well as its better odour.

PFAD/PAO was the most preferred fat used in the animal feed industry in the UK in 1988 (Lowe, 1989) (*Table 4*).

TABLE 4. FATS IN UK FEEDS 1988

Product	'000 tonnes used	'000 tonnes imported
PFAD/PAO	90	82
Tallow	60	0
Recovered vegetable oil	40	0
Mixed acid oil	25	5
Fish acid oil	15	5
Soya/Sunflower/Maize Distillation	10	9
Residue	10	0
Soya oil]	35	8
Rice bran oil]		
Yellow grease]		
Fish oil	15	0

(Lowe, 1989)

Availability of PFAD and PAO from Malaysia

In 1988, crude palm oil production in Malaysia stood at five million tonnes. As mentioned above, almost all of it was refined physically, which resulted in an estimated 195 000 tonnes of PFAD as a by-product of this; 180 000 tonnes or 92% was exported.

The availability of PFAD in the year 2000 is forecast at 300 000, CPO production being expected to touch eight million tonnes.

The characteristics of Malaysian PFAD are given in *Table 5*.

Trade specifications for PFAD and PAO are given in *Table 6*.

TABLE 6. PORAM[a] Standard Specifications for PFAD and PAO [*]

	PFAD	PAO
Saponifiable matter % min	95	95
Moisture and impurities % min	1.0	3
Free Fatty Acid % min (as palmitic acid)	70	50

[a]Palm Oil Refiners' Association of Malaysia.
[*]PORAM Technical Brochure

PFAD is available for export in bulk or in new 200–litre steel drums. Current market prices for PFAD are shown in *Table 7*.

TABLE 7. PRICES OF PFAD (US$/tonne FOB Malaysian ports[a])

Bulk	205
New Drums	290

[a]Prices for January 1990.

TABLE 5. PHYSICAL AND CHEMICAL PROPERTIES OF MALAYSIAN PFAD [*]

	Range n = 162	Mean
Titre (°C)	40.7 – 49.0	46.3
Iodine Value	51.2 – 57.4	55.3
Free Fatty Acid (%) (as palmitic acid)	72.3 – 89.4	83.3
Moisture content (%)	0.05 – 0.15	0.08
Unsaponifiable matter (%)	1.5 – 3.4	2.5
Saponification Value	190.7 – 203.5	198
Fatty Acid Composition (Wt %)		
C12 : 0	0.1 – 0.3	0.2
C14 : 0	0.9 – 1.5	1.2
C16 : 0	42.9 – 51.5	47.1
C18 : 0	4.1 – 4.9	4.5
C18 : 1	32.8 – 39.8	36.6
C18 : 2	8.6 – 11.3	9.6
C18 : 3	0.2 – 0.6	0.47

* (Based on a survey done by Hamirin, 1983)

HANDLING AND STORAGE OF PFAD

The guidelines given in 'Recommended Practices for Storage and Transport of Edible Oils and Fats' (1983) for PFAD are as in *Appendix I.*

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APPENDIX I

RECOMMENDED PRACTICES FOR STORAGE AND TRANSPORT OF EDIBLE OILS AND FATS

Storage tank capacity	:	generally 500 tonnes or larger where turnover is large. Insulation recommended.
Storage tank material	:	mild steel not suitable. Fibre glass or 316 stainless steel recommended. Aluminium satisfactory for many grades. Heating coils must be stainless steel.
Pipelines and pumps	:	316 stainless steel recommended. Preferably lagged with heating.
Temperatures during storage and transit	:	55°C maximum 52°C minimum
Temperatures during unloading and transfer	:	70°C maximum 55°C minimum