PALM OIL Technical Bulletin

Volume 7 No. 3 | May – June 2001

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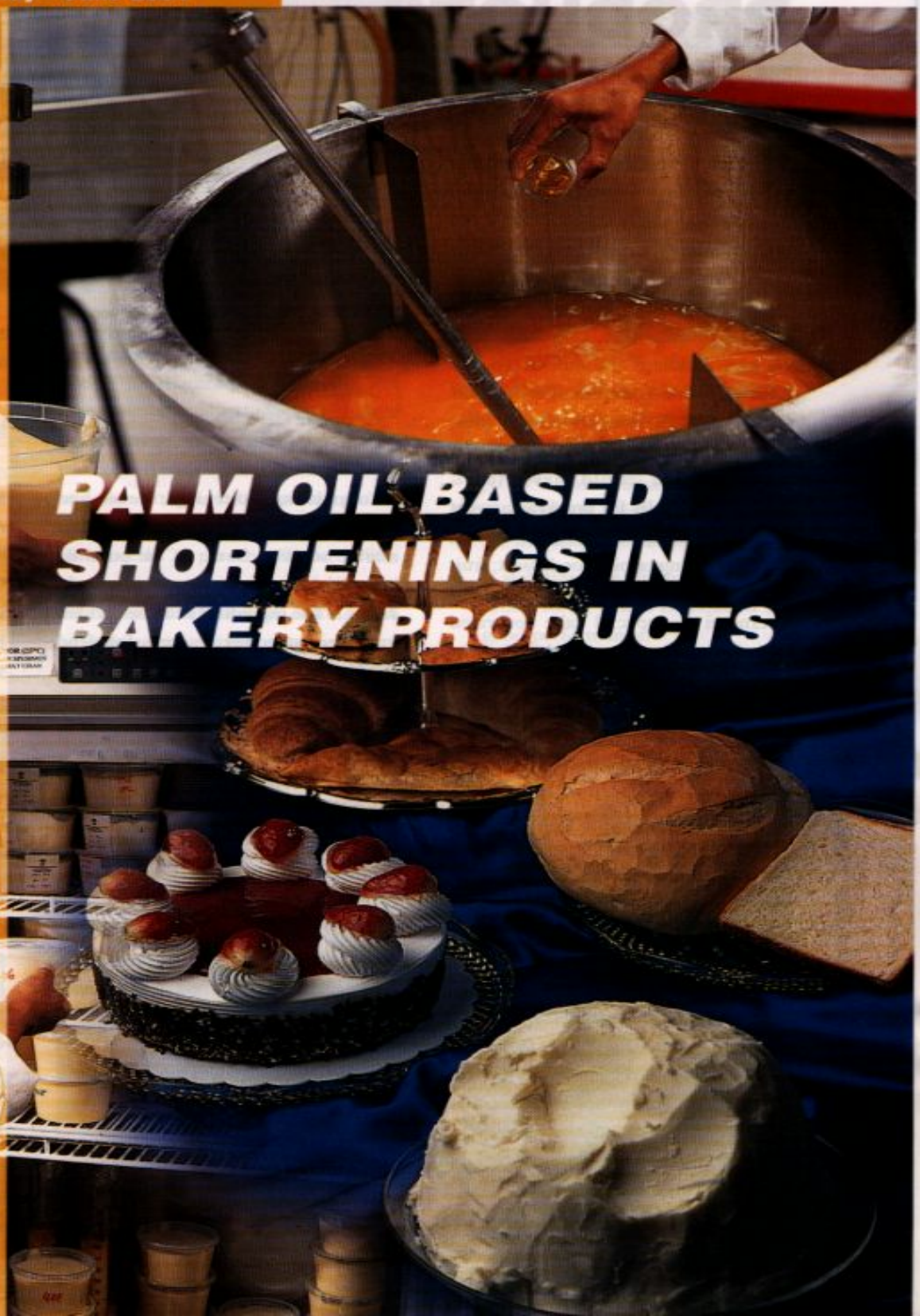


PALM OIL BASED SHORTENINGS IN BAKERY PRODUCTS

PALM OIL BASED SHORTENINGS IN BAKERY PRODUCTS

Contributed by Nor Aini Idris, MPOB

From breakfast to midnight snack, from starter to dessert, and from Sunday brunch to festive delicacies, there are a host of opportunities for you to serve baked items right through the day and right through the year. Bakery products include breads, rolls, cakes, biscuits/ cookies, puddings and various types of pastries. Some examples of food items which are made from pastries are pies, tarts, croissants, Danish and puff pastries. One could have toast, croissants or rolls for breakfast; sweet rolls, sandwiches or pastries for snacks; cakes, pudding or pies for dessert; fruit cake, cookies or Danish pastries for afternoon tea; special cake decorated with icing or toppings and variety of cookies for special or festival occasions.

Shortening is widely used in the preparation of many foods, particularly in the manufacture of bakery products.

All the above baked items use flour and fat as their basic ingredients. Baking fats are of various types and shortening is one of them. Although there are two main types of shortenings, i.e. plastic and pumpable (fluid), the former is more commonly used. Plastic shortening is semi-solid (consistent form) and smooth in texture. Shortening is widely used in the preparation of many foods, particularly in the manufacture of bakery products.

Table 1. Oils and Fats for Shortenings

Liquid Oil	Semi-Solid Fat	Hard Stock
Palm Olein	Palm Oil	Hard fraction from palm oil
Palm Kernel Olein	Butter Oil	Hard fraction from butter oil
Sunflower Oil	Marine oil hydrogenated	Hard fraction from beef fat
Soyabean Oil	Lard	Any hydrogenated oil or fat of melting point ≥ 40°C
Low erucic acid Rapeseed Oil	Any vegetable oil hydrogenated to 32-34°C melting point	
Cottonseed Oil		
Corn Oil		
Groundnut Oil		

In formulating shortenings, the oils and fats may be from vegetable, animal or marine sources. Some of the possible ingredients for shortening are shown in *Table 1*. The ingredients can be divided into three categories. A successful blend can be made by combining one or more ingredient(s) from each group.

Functions of Shortenings in Bakery Products

Shortening contributes to tenderness in various baked products. In breads, the basic ingredients are flour, liquid and yeast. Fat, sugar and salt are added to improve the texture and flavour. An appropriate amount of fat or shortening in bread dough will improve the volume, grain, texture, crust and keeping quality of the bread. Shortening improves the tenderness of bread and makes the dough more elastic.

Palm oil shortening is advantageous because the crystals exist in the beta prime form.

One important function of shortening is to incorporate and hold air, whether beaten in a cake batter or creamed with sugar. This ability to hold air is generally increased by the plastic consistency of the shortening. Air bubbles are suspended in the liquid fat and stabilised by the fat crystals. For optimum creaming ability and to be functional in cakes, the shortening must be stable in the beta prime form. The beta prime form refers to tiny fat crystals about 0.2 to 1μ in size. The tiny crystals are responsible for the smooth texture of the shortening and aid in incorporating numerous air bubbles during the creaming process. In this respect, palm oil shortening is advantageous because the crystals exist in the beta prime form.

As an ingredient in cake manufacture, shortening:

Figure 1. Cookies made with Palm Oil Shortening

- provides aeration to the batter;
- acts as a lubricant for the ingredients;
- provides structure to the finished products;
- improves eating qualities such as moistness and tenderness;
- extends the shelf life of the finished product; and
- from the nutrition standpoint, contributes calories.

In the manufacture of biscuits (as known in the United Kingdom and Malaysia) or cookies (as known in the USA), the principle ingredients are flour, sugar and fat in order of usage volume. There is a spectrum of recipes from those with low fat and high water to those with high fat and low water, both with flour and sugar (Manley, 1983). Their low moisture content differentiates biscuits/cookies and crackers from other baked cereal products such as breads and cakes. Although fats are the third largest component after flour and sugar, they are probably the most important ingredient used in biscuit manufacture since they are relatively more expensive. Addition of fat or shortening to biscuit or cookie dough contributes to the lubricating function and gives the dough its required consistency. Fat retards the gluten network development, that is, the dough will be less cohesive/sticky, less elastic/rubbery and less tough. Little or no gluten network is formed if the percentage of fat exceeds 20 percent (Wade, 1988). Very soft dough is obtained because there is minimal formation of the gluten network and starch swelling and gelatinisation are reduced. The dough is 'short', that is, not extensible, hence the term 'shortening' was coined as an alternative to 'fat'.

Similarly in pastry, fat shortens the strands of gluten and prevents their development, thus producing tenderness. In croissants, Danish or puff pastries, fat not only provides tenderness, excellent keeping quality and richness, but also makes possible the formation of layers which account for the flaky characteristic. The types of fat which can be used in these products are shortening, margarine or sweet butter. Cost is usually the determining factor. A blend of shortening and butter is often used.

Advantages of Using Palm Oil in Shortening Formulations

Palm oil has distinct advantages over other oils and fats in the formulation of shortening products, namely:

- At 20°C, palm oil has 22-25 percent solids and is a valuable ingredient for shortening formulation.
- It stabilizes the shortening in beta prime form, which is required for good performance.
- It does not require hydrogenation, thus reducing processing cost as well as eliminating the formation of *trans* fatty acids. *Trans* fatty acids

Figure 2. Crescent Rolls made with Palm Oil Shortening

Figure 3. Croissants made with Shortening Based on Palm Oil and Palm Stearin

have become a nutritional concern due to their reported negative effects (Mensink and Katan, 1990).

- It is versatile and can be tailor-made to suit a particular application.
- It is stable and has a long shelf life due to the presence of vitamin E which acts as a powerful natural anti-oxidant.

Applications of Palm Oil Based Shortenings in Bakery Products

Shortening based on 100 percent palm oil is suitable for making biscuits/ cookies, breads and rolls *(Figures 1 and 2)*. The use of palm oil products can be maximised by employing modification processes, such as fractionation, blending, interesterification or hydrogenation. The fractionation process yields a liquid fraction, palm olein, and a solid fraction, palm stearin, which is considered a by-product. Palm olein is mainly used as a frying oil. Palm stearin, being a cheaper product, is very economical for shortening formulations, and it helps improve the plasticity of the shortenings. By adding a certain percentage of palm stearin to palm oil, bread with improved volume and texture can be obtained. Such a shortening has also been found to be very good for different types of pastries as well as croissants *(Figure 3)*.

The use of palm oil products can be maximised by employing modification processes, such as fractionation, blending, interesterification or hydrogenation.

In order to get a baked product with a buttery flavour, palm oil and its derivatives can be blended with butterfat (milkfat). In cakes, shortenings based on this combination have shown better performance in terms of volume compared to 100 percent butterfat *(Figure 4)*.

Thus, users get both the benefits of flavour and improved functionality by

Figure 4. Specific Volume of Cakes made with Palm-Butterfat Shortenings

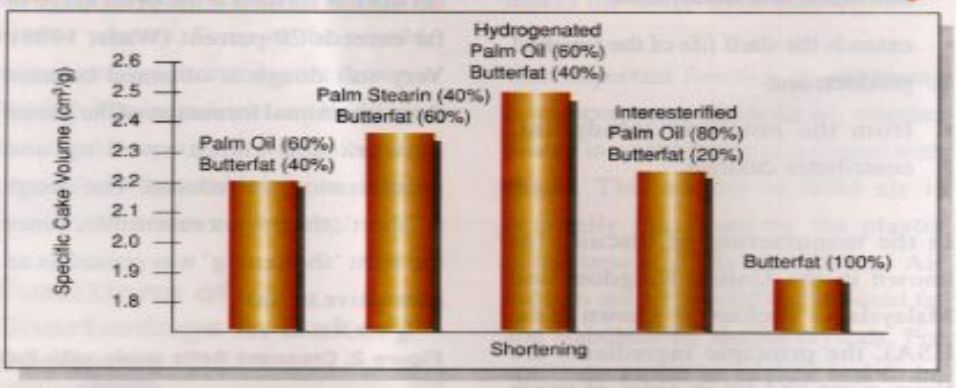
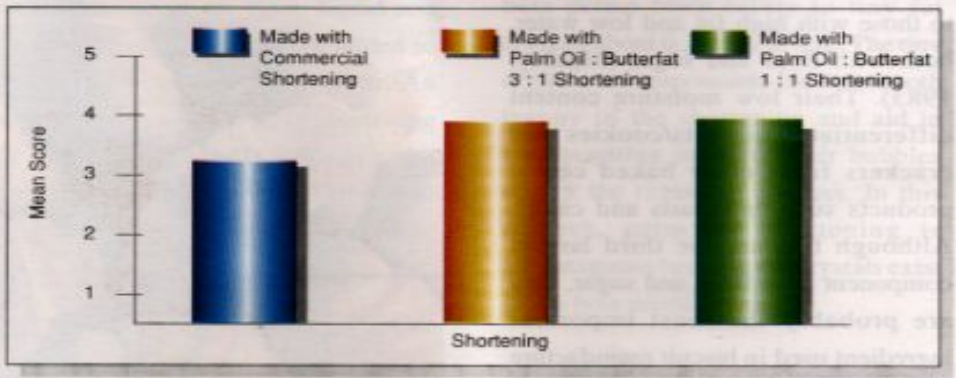


Figure 5. Mean* Panel Score for Flavour of Biscuits made with Different Shortenings using a Hedonic Scoring Method



*n=15, score is from 1 to 5, where 1 = dislike very much and 5 = like very much

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PULP AND PAPER FROM OIL PALM FIBRES

The production of oil from the oil palm generates large amounts of residues, such as empty fruit bunches (the stalks after the oil palm fruits have been stripped), fibre and shell from the fruits after oil extraction, fronds (leaves) from the palms and the palm trunks (stems) when replanting is undertaken.

With 3.3 million hectares of oil palm, Malaysia produces large amounts of oil palm residues.

With 3.3 million hectares of oil palm, Malaysia produces large amounts of these residues. Following a zero-waste strategy, MPOB has embarked on a research programme for the conversion of these oil palm residues or biomass, into value-added products, such as medium density fibreboard and pulp and paper.

Earlier collaborative research between GIRIS (Government Industrial Research Institute, Shikoku, Japan) and MPOB, and, more recently, between FELDA, Oji Paper and MPOB, has demonstrated that fibres from oil palm fronds (OPF), oil palm trunks (OPT) and empty fruit bunches (EFB) can be used to produce pulp and paper of high quality.

Characteristics of Oil Palm Fibres

Of the three types of oil palm fibres, the fibre from EFB is the shortest, narrowest and smallest *(Table 1)*. The fibre length distribution shows a high amount of short fibres (<0.05mm) in the EFB pulp. Further, the fibre has the narrowest lumen. The morphological properties reveal that the EFB fibre resembles greatly those of the short-fibre hardwoods like eucalyptus. The high number of fibre strands per unit weight indicates that paper made from EFB fibre would have exceptionally good printing properties and good formation. Although the fibre lengths

The high number of fibre strands per unit weight indicates that paper made from EFB fibre would have exceptionally good printing properties and good formation.

of both OPT and OPF are intermediate between hardwood and softwood, this characteristic is affected by the high fines (parenchyma) content: the parenchyma contents in trunk and frond are about 50 percent and 30 percent respectively, versus about 5 percent in the EFB.

Processing into Pulp and Paper

There are many methods of cooking the biomass to release the fibre, but for the purpose here only two are described. The first is Kraft Pulp (conventional method) which involves digestion of the biomass with white liquor (sodium hydroxide and sodium sulphide) at 165°C for three hours. The second is Kraft Anthraquinone (also known as soda AQ), which is conventional pulping incorporating anthraquinone to accelerate the process and improve the strength of the fibre. The duration and temperature of cooking are critical in ensuring the strength of the fibres because both overcooking and overheating will reduce the strength. Cooking dissolves most of the lignin, which is retained in the black liquor. The residual product is the fibre but at this stage still contains some lignin, which is subsequently removed by a sequence of bleaching. The final product is the pulp whose properties must match those of bleached hardwood kraft pulp (BHKP) to produce high quality paper.

Paper Making Properties of Bleached Pulps

Of the three types of pulp from the oil palm biomass (*Table 2*), EFB gives the most promising profile because of the following paper properties:

- Good tear strength
- Good beatibility
- Excellent opacity
- Good bulk and good fold
- Good formation

Table 1. Morphological Properties of Fibres from Oil Palm, Hardwood and Softwood.

	EFB	OPF	OPT	Hardwood	Softwood
Length* (mm)	0.67	1.03	1.37	0.83	2.39
Width of fibre (μm)	12.5	15.1	20.5	14.7	26.8
Width of lumen (μm)	7.9	8.2	17.6	10.7	19.8
Runkel Ratio	0.59	0.84	0.26	0.37	0.35
Area of Fibre (μm²)	75.6	126.2	86.7	79.0	256.1

** Weighted average fibre length*

Table 2. Sheet Properties of Bleached Kraft Pulp (60g/m²)

PFI (rev)		C.S.F (ml)	Opacity (%)	Density (g/m³)	Tear (mNm²/g)	Breaking (km)	Burst (kPam²/g)	Folding (no. of times)	Air Permeability (sec)	Smoothness (sec)	Rigidity (mN)
EFB	CEHD 1000	515	80.6	0.63	11.7	4.8	4.5	107	10	9	0.53
Frond	CEHD 1000	370	85.8	0.65	12.7	7.3	5.6	367	56	5	0.85
Trunk	CEHD 1000	510	68.8	0.60	12.0	6.4	4.6	165	16	2	0.80
Hardwood	CEHD 3500	450	74.1	0.63	9.5	6.5	4.5	58	15	4	0.94
Softwood	CEHD 3300	560	62.7	0.64	13.1	7.9	7.6	1200	22	1.10	

Market for EFB Pulp and Paper

EFB pulp has to compete heavily with BHKP and, to some extent with non-wood producers. BHKP is mainly used for the production of commodity grade paper, which is wood-free. Because the commodity paper producers are integrated as an industry, the market is difficult to penetrate. A more promising option for EFB pulp is specialty paper production. The favourable factors in this market include non-integrated pulp production, high usage of non-wood fibres and a willingness to experiment with non-wood fibres.

The types of specialty paper products that can be produced from EFB pulp include:

- Thin, high quality printing paper
- Cigarette and photographic papers
- Security papers
- Substitute papers for cotton, hemp and kenaf pulp in some paper grades.

A more promising option for EFB pulp is specialty paper production.

Pulp hand sheets: precursor to paper produced from oil palm fibre

Extracted from: Kamaruddin Hassan, Mohd Basri Wahid, Mohd Nasir Hj. Amirudin, Jalani Sukaimi, Ariffin Darus and Ridzuan Ramli, Pulp And Paper From Oil Palm Fibres, Palm Information Series No:67, PORIM TT No:47, June 1997.

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PALM OIL BASED SHORTENINGS IN BAKERY PRODUCTS

blending butterfat with palm oil or its derivatives. Furthermore, this product is a value-added product as it can be sold at a higher price than 100 percent palm oil shortening. Nevertheless, its price is still lower than 100 percent butterfat. Thus it has an economic advantage. Shortenings based on palm oil and butterfat are also very suitable for making biscuits/cookies. A sensory panel gave a high score to biscuits made with palm oil-butter fat blends *(Figure 5)*. Alternatively, diacetyl, a flavouring ingredient, can be added to 100 percent palm oil shortening to give the buttery flavour to biscuits.

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Wade, P.(1988). *Biscuits, Cookies and Crackers, Vol. 1.* Elsevier Applied Science, London.

MOZAMBIQUE

Mozambique is a country of 783,965 sq. km. on the southeastern coast of the African continent. It is south of Tanzania and east of Malawi, Zambia, Zimbabwe and South Africa. As a country that has recently emerged from a civil war, it is among the least developed countries in the world. Recent floods had also hit the country badly. However, economic reform has been instituted and more than 900 state enterprises privatized. Since 1996, inflation has been low and economic growth about 10 percent a year.

Oils and fats situation

The country is generally dry and agriculture is limited. Only about 100,000 – 130,000 tonnes of oilseeds are produced a year. The volume is declining despite efforts to cultivate sunflower. Even the coconut industry is down due to low copra prices.

The per capita consumption is very low at only 4.5 kg/year, comprising mainly liquid oils.

Most of the oilseeds are crushed locally to produce about 45,000 tonnes of oil. This is insufficient for its requirements and another 35,000 to 60,000 tonnes are imported, mainly soyabean oil, tallow and palm oil. Exports are negligible.

The per capita consumption is 4.5 kg/ year of mainly liquid oils.

There are a few oil factories to refine oil (mainly sunflower and soyabean), crush oilseeds and produce soap. The refined oils are packed as cooking oil as there is no edible fat production or large oil related food industry. Soap is made using coconut oil, tallow and PFAD as raw materials.

Palm oil situation

Palm oil is one of the main oils imported. *Oil World* places it at 20,100 tonnes out of 38,800 tonnes of oils and fats imported in 2000. The Malaysian contribution is rather modest at only about 6,000 tonnes a year.

Competition in the local market is fierce. The small local production for the market does not give rise to the economy of scale and imports of finished products from the industrial giant next door - South Africa - appear to be more competitive. Recently, there has been an influx of cooking oil imports in 20 kg jerry cans. And in the even smaller fat sector, the only margarine company had closed down due to cheaper imports.

There are reasonable prospects for palm oil especially in the liquid oil market and two major producers of cooking oil are considering importing palm olein.

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SOUTH KOREA

South Korea is situated on the southern part of the Korean Peninsula, which is between East China and Southern Japan. It has an area of 98,480 sq. km. with a (2000) population of 47.5 million. As the country is mostly between latitudes 35°N to 40°N, it has a temperate climate with cool winters and warm summers.

Oils and Fats Situation

South Korea is generally hilly and therefore short of arable land with only about 20 percent of its area cultivable. With its dense population, it produces only about half its requirements of edible oils and fats, or approximately 400,000 tonnes. The major oilseed grown is soyabean but its production has declined from 160,000 tonnes in 1995/96 to 116,000 in 1999/2000. Sesame is the distant second oilseed crop. Its seed production has also declined from 32,000 tonnes to 24,000 tonnes in the same period.

In terms of oil, soyabean is the major oil, accounting for 50 percent of local production. Other vegetable oils constitute about 22 percent, with the remainder contributed by animal fats - lard (13 percent), butter (10 percent) and tallow (4 percent).

With a per capita oils and fats consumption of 21 kg/year, the country is only 48 percent self-sufficient.

With a per capita oils and fats consumption of 21 kg/year, the country

Figure 1. South Korea: Oils and Fats Consumption, 2000

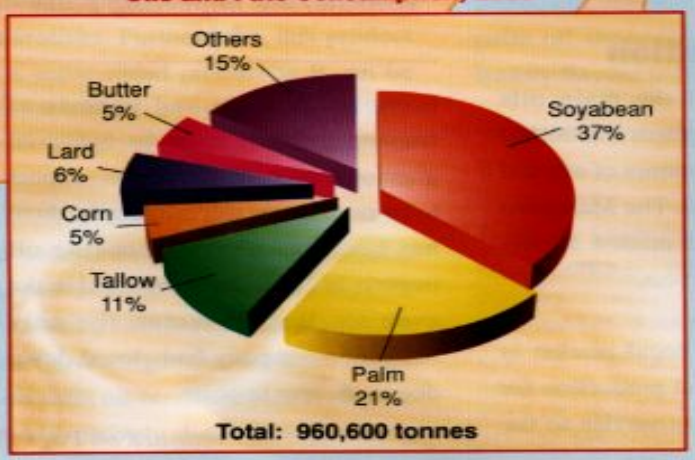
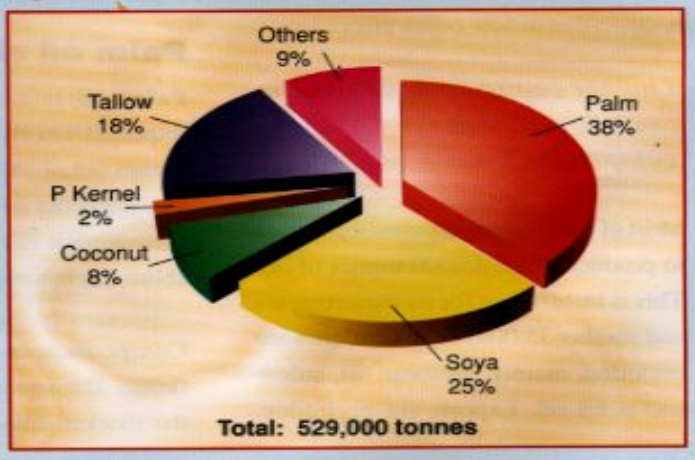


Figure 2. South Korea: Oils and Fats Imports, 2000



is only 46 percent self-sufficient. With a total oils and fats consumption of over 960,000 tonnes, palm oil is the second most consumed oil (21%), behind soyabean (37%) as shown in *Figure 1*.

Palm Oil Situation

Palm oil constitutes more than a third of imports with a volume of almost 200,000 tonnes in recent years (*Figure 2*). The other major imports are soyabean (25%) and tallow (18%). Almost all the palm oil products imported are of Malaysian origin. The breakdown of palm oil imports is 51 percent Refined Bleached Deodorised (RBD) palm oil (mainly for instant noodles), 26 percent RBD palm olein (mainly for snacks) and 18 percent RBD palm stearin (soap and oleochemicals). Other uses for the oil include confectionery, margarine and shortening. The country is a large consumer of instant noodles with 3.7 billion packs a year, or 78 packs a head. As palm oil is the preferred oil for the noodles, there is tremendous scope for it if noodle production and consumption increase, which is likely with exports to North Korea as trade and political ties improve.

As palm oil is the preferred oil for instant noodles, there is tremendous scope for it if noodle production and consumption increase.

With a much higher standard of living, compared to three decades ago, the Korean national diet has improved. Meat consumption has also increased considerably. As a result, its livestock industry has grown substantially and, with it, the demand for animal feed. Palm kernel cake is increasingly used in the formulation of cattle feed with 106,730 tonnes of cake imported from Malaysia in 2000.

Tariffs

In line with its WTO obligations, South Korea is liberalizing its trade policy and lowering tariffs on imported goods. The average tariff is now 8 percent compared with 24 percent in 1983. The tariffs on edible oils and fats are being lowered as well and at present CPO is taxed at 3 percent and *Other Palm Oils* at 2 percent. Palm kernel oil is subject to 8 percent duty, and palm nuts/kernels and meals of oilseeds 3-5 percent.

Extracted and updated from: Teah YK and Wong SK, MPOB TAS Country Study on South Korea, 2000.

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MOZAMBIQUE

There are reasonable prospects for palm oil. In the liquid oil market, the two major producers of cooking oil are considering importing palm olein - that is, provided it can compete with the cheaper imported packed oleins which they believe are brought in with unreasonable or no duty. There may be some problem with cloudiness in the cooler months but the country is not too cold and this can possibly be overcome by blending. In soap making, PFAD and palm stearin can be substituted for tallow. At present, about 18,000 tonnes of tallow are imported for the purpose. However, the prospects for palm oil in the solid fats sector is limited due to the very small volumes involved.

Tariffs

The main reason for the low imports of Malaysian palm oil lies in the differential import tariffs for refined and crude oils. At present, crude oils are taxed at only 2.5 percent and refined oils at 30 percent. The tariff structure is expected to be modified by the end of 2001, but the differential between crude (expected 0 percent duty) and refined (expected 25 percent duty) oils is expected to remain.

Extracted and updated from: Abdullah Ariffin, MPOB TAS Country Study on Mozambique, 2000

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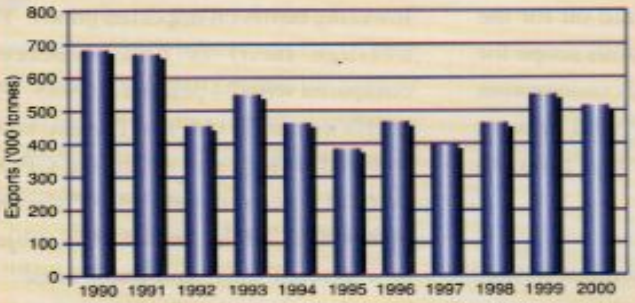
Short Takes

Malaysian Exports of Palm Kernel Oil

Malaysia: Total Palm Kernel Oil Exports 1990-2000



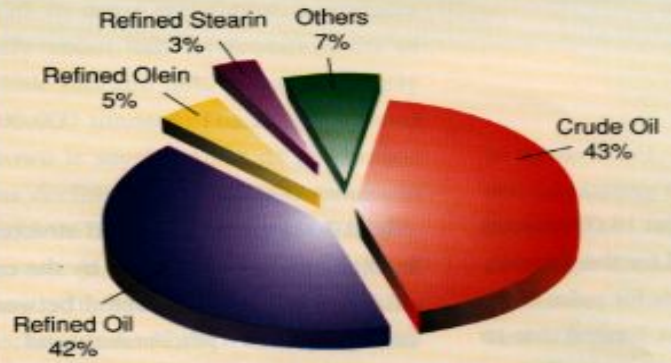
SYRIA: TARIFF CHANGES

In March, the authorities in Syria imposed a levy of Syrian pounds 15 per kg (US$ 326 per tonne) on the import of vegetable ghee (packed products). This step was taken to protect the emerging local edible oil refining industry in the country from imported packed products. The local industry is now thought to be able to meet the country's requirement for vegetable ghee.

Late last year, the Syrian government removed a levy of US$ 200 per tonne on the bulk import of vegetable oils intended for use in the manufacture of vegetable ghee. With these policy changes, the Syrian edible oil industry is well positioned to compete with imported packed products. Imports of vegetable ghee products from the Gulf States, East Asia and Turkey are expected to decline tremendously, while those of bulk vegetable oils, mainly palm oil products, to increase to fill the deficit.

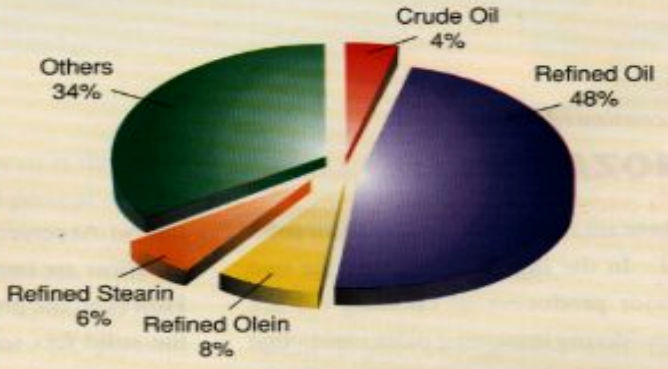
Source: Iftikhar Ahmad, 2001

Malaysia: Export Shares of Palm Kernel Oil Products, 1990



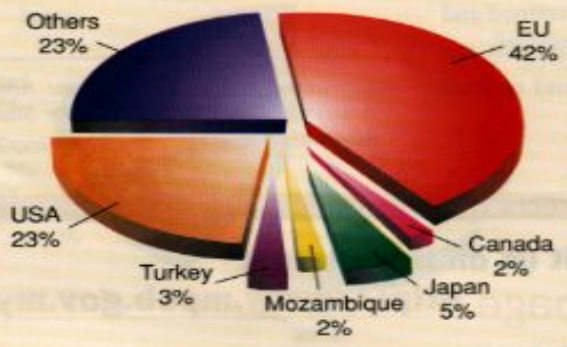
Total: 689,727 tonnes

Malaysia: Export Shares of Palm Kernel Oil Products, 2000



Total: 520,280 tonnes

Malaysia: Export Shares of Palm Kernel Oil by Destination, 1990



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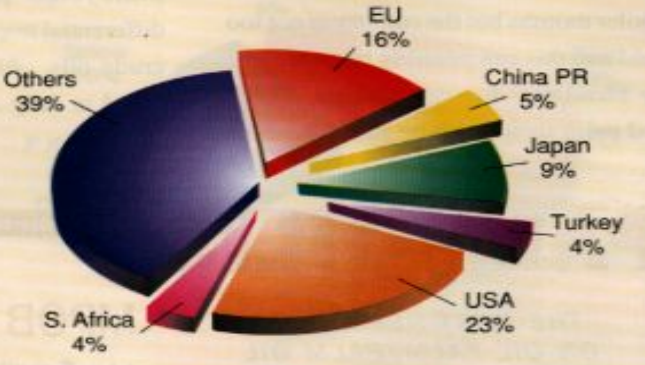

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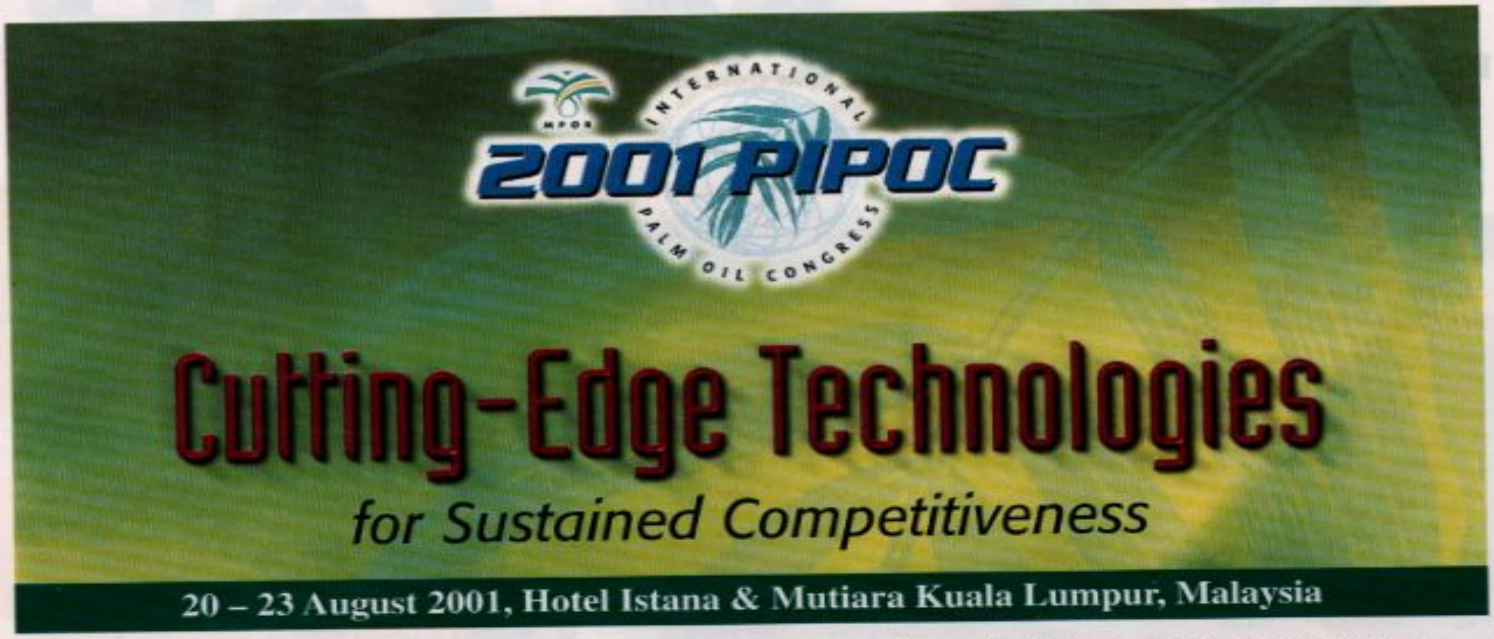

This is the world's premier meeting for keeping up to date on developments in the oil palm/palm oil industry.

OBJECTIVES

- To discuss demand driven and strategic research and development (R&D) in all facets of the palm oil industry
- To enhance technology promotion and commercialisation
- To explore and assess emerging technologies and business opportunities, and
- To discuss issues related to the economics and marketing challenges of vegetable oils and fats in the 21st century

WHO SHOULD ATTEND

2001 PIPOC is designed for those involved in palm oil and other oils and fats, including engineers, scientists, planters, millers, traders, processors, manufacturers, economists, policy makers, academicians, etc.

The congress will be especially useful for networking with your peers in the oil palm / palm oil industry while exchanging views and sharing new ideas.

EVENTS & CONFERENCES

There are five conferences and a day of technical tours.

Agriculture	**20 - 22 August**
Chemistry & Technology	**20 - 22 August**
Food Technology & Nutrition	**20 - 22 August**
Oleochemicals	**20 - 22 August**
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Technical Tours	**23 August**
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For registration and enquiries, please contact:

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The **Palm Oil Technical Bulletin** is published six times a year and informs readers on technical and market developments to promote the trade and use of Malaysian oil palm-based products.

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ISSN 1394 - 4983

A Publication of the Malaysian Palm Oil Board (MPOB)
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia