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PROGRESS IN RESEARCH AND DEVELOPMENT FOR THE MALAYSIAN OLEOCHEMICAL INDUSTRY

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The Malaysian oleochemical industry began in the early 1980s, and comprised only five companies with a total annual capacity of 150 000 tonnes. By 1988, 17 companies with a total capacity of 735 000 tonnes of oleochemicals had been approved; of these, five companies with a total approved capacity of 277 660 tonnes were in operation: they produced about 167 000 tonnes of oleochemicals in 1987. Now, in 1995, 33 companies have been approved and 15 are in operation; total production is expected to reach almost one million tonnes (*Table 1*), as a result of expanding capacities in existing plants as well as the establishment of new ones.

Most of the Malaysian oleochemical companies are joint ventures with participation by foreign investors who have contributed technology, capital and captive markets for the products.

The Malaysian oleochemical industry is quite able to provide a variety of basic oleochemicals, including fatty acids, esters and their fractionated products, refined glycerine and basic fatty alcohols. Some companies have diversified into the production of soap noodles from fatty acids for local and overseas markets.

As can be seen from *Tables 2* and *3*, Malaysia is expected to have the highest rate of growth in the production of oleochemicals in the ASEAN region in the next decade. The Malaysian industry is forecast to produce close to 1 million tonnes of palm-based oleochemicals by the end of 1995.

By the year 2000, world production of palm oil is expected to exceed 22 million tonnes or 21% of the total production of oils and fats. About 80% of the world's production of palm oil will be from ASEAN countries. There is no doubt that Malaysia, as the world's leading producer of palm oil and palm kernel oil, (and with other advantages as well) is poised to become a major centre for the manufacture of oleochemicals and their derivatives.

Table 1. Total Estimated Capacities of Oleochemical Manufacturers in Malaysia (1994)

Type of Oleochemical	Total Capacity (tonnes)
Fatty acids	564 300
Methyl esters	208 000
Fatty alcohols	115 000
Fatty esters	25 000
Fatty amides	10 000
Metallic stearates	5 000
	927 300

Source : Malaysian Oleochemical Manufacturers' Group.

Table 2. World Oleochemical Production (Thousand Tonnes)

	Region	1985	1990^f	1995^f	2000^f
Fatty Acids	Western Europe	850	900	800	780
	Americas	550	580	500	490
	Pacific Rim	600	625	1033	1223
	Others		25	50	100
	World	**2000**	**2130**	**2383**	**2593**
Methyl Esters	Western Europe	200	225	255	225
	Americas	150	99	99	99
	Pacific Rim	50	126	160	100
	Others			60	100
	World	**400**	**450**	**574**	**524**
Fatty Alcohols	Western Europe	240	265	265	265
	Americas	390	440	440	440
	Pacific Rim	130	120	403	810
	Others		30	60	100
	World	**760**	**855**	**1168**	**1615**
Fatty Amines	Western Europe	125	140	140	140
	Americas	150	175	175	175
	Pacific Rim	50	41	92	142
	Others	25	69	80	80
	World	**350**	**425**	**487**	**537**
Glycerine	Western Europe	200	218	218	218
	Americas	140	144	144	144
	Pacific Rim	190	46	160	258
	Others		149	160	160
	World	**530**	**557**	**682**	**780**
All Oleo-chemicals	World Total	4040	4417	5294	6049

^{f}Forecast
Source: Henkel, Montreux 1986

Palm and Palm Kernel Oil as Raw Materials

The oil palm is one of the world's most economical oil crops. A tonne of fresh fruit bunches (FFB) can yield 200 kg of crude palm oil and 40 kg of palm kernels, which in turn yield about 50% of their weight, or 20 kg, of palm kernel oil. A hectare of land can yield 20–24 tonnes of FFB per year. Thus a hectare yields four to five tonnes of palm oil and 400–500 kg of palm kernel oil annually. *Table 4* shows the average annual yields of some selected vegetable oils.

Tallow and coconut oil are the main traditional feedstocks for oleochemical production. Other oils and fats which are competitive in price are also used including soya bean oil, fish oil, rapeseed oil, sunflower seed oil and others. However, the fatty acid compositions of tallow and coconut oil are quite similar to those of palm oil and palm kernel oil (PKO) respectively (*Table 5*). Hence, technically, the palm products can substitute for the traditional feedstocks. Palm oil and palm kernel oil also offer more flexibility or versatility than tallow and coconut oil since they are both often fractionated to yield 'stearin' and 'olein'.

It is also interesting to note that tallow, with a world production of 6.4 million tonnes in 1987, has been overtaken in volume by palm oil (of which 8.6 million tonnes were produced in 1987) and it is forecast that the production of tallow will remain stagnant or even decline while that of palm oil will increase considerably. Similarly, world output of coconut oil has registered only erratic growth, whereas that of palm kernel oil has increased steadily along with palm oil production. As mentioned earlier, by the year 2000, palm oil and palm kernel oil together are expected to represent about 20% of the world's total production of oils and fats. Hence the availability of palm oil and palm kernel oil as raw materials for future oleochemical production is assured.

Table 3. Oleochemical Production in the Pacific Rim (tonnes)

Country	Oleochemicals	1989	1990 [f]	1995[f]	2000[f]
Malaysia	Fatty acids	105 000	135 000	462 000	560 000
	Glycerine	13 000	24 200	66 450	120 000
	Methyl esters	25 000	63 000	50 000	70 000
	Fatty alcohols	-	30 000	168 000	350 000
	Fatty esters	-	10 000	30 000	40 000
	Fatty amines	-	-	30 000	60 000
	Total	143 000	262 200	806 450	1 200 000
Philippines	Fatty acids	30 000	30 000	60 000	100 000
	Glycerine (C+R)	14 770	19 370	30 000	50 000
	Methyl esters	50 100	63 100	80 000	100 000
	Fatty alcohols	47 500	55 000	100 000	200 000
	Fatty esters	-	-	5 000	10 000
	Fatty amines	-	5 000	10 000	20 000
	Total	142 370	172 470	285 000	480 000
Indonesia	Fatty acids	27 000	27 000	67 000	100 000
	Glycerine	2 700	5 700	17 500	40 000
	Fatty alcohols	-	30 000	95 000	220 000
	Fatty esters	-	-	10 000	20 000
	Fatty amines	-	-	10 000	20 000
	Total	29 700	62 700	199 500	400 000
Thailand	Fatty acids	10 000	10 000	20 000	40 000
	Glycerine	1 000	1 000	2 000	4 000
	Total	11 000	11 000	22 000	44 000

[f]Forecast
C+R : Crude + Refined

Table 4. Average Annual Yields of Selected Vegetable Oils

Oil		Annual Yield
Palm oil	:	4000–5000 kg/hectare
Palm kernel oil	:	400–500 kg/hectare
Coconut oil	:	710 kg/hectare
Soya bean oil	:	389 kg/hectare
Peanut oil	:	875 kg/hectare

Table 5. Fatty Acid Composition of Raw Materials for Oleochemical Manufacture (wt %)

Fatty Acid	Palm Oil	Tallow	Palm Stearin	Palm Kernel Oil	Coconut Oil
Caprylic,8:0	–	–	–	3.7	7.6
Capric,10:0	–	–	–	3.3	7.3
Lauric,12:0	–	–	–	48.7	48.2
Myristic,14:0	0.5 – 0.6	2 – 3	1.0 – 2.0	15.6	16.6
Palmitic,16:0	32 – 45	24 – 37	51 – 74	7.7	8.0
Stearic,18:0	2 – 7	14 – 29	4 – 6	1.7	3.8
Oleic,18:1	38 – 52	40 – 50	16 – 34	15.6	5.0
Linoleic,18:2	5 – 11	–	3 – 9	2.7	2.5

Application of Oleochemicals

As can be seen from *Figure 1* on the manufacture of basic oleochemicals and their derivatives, many products

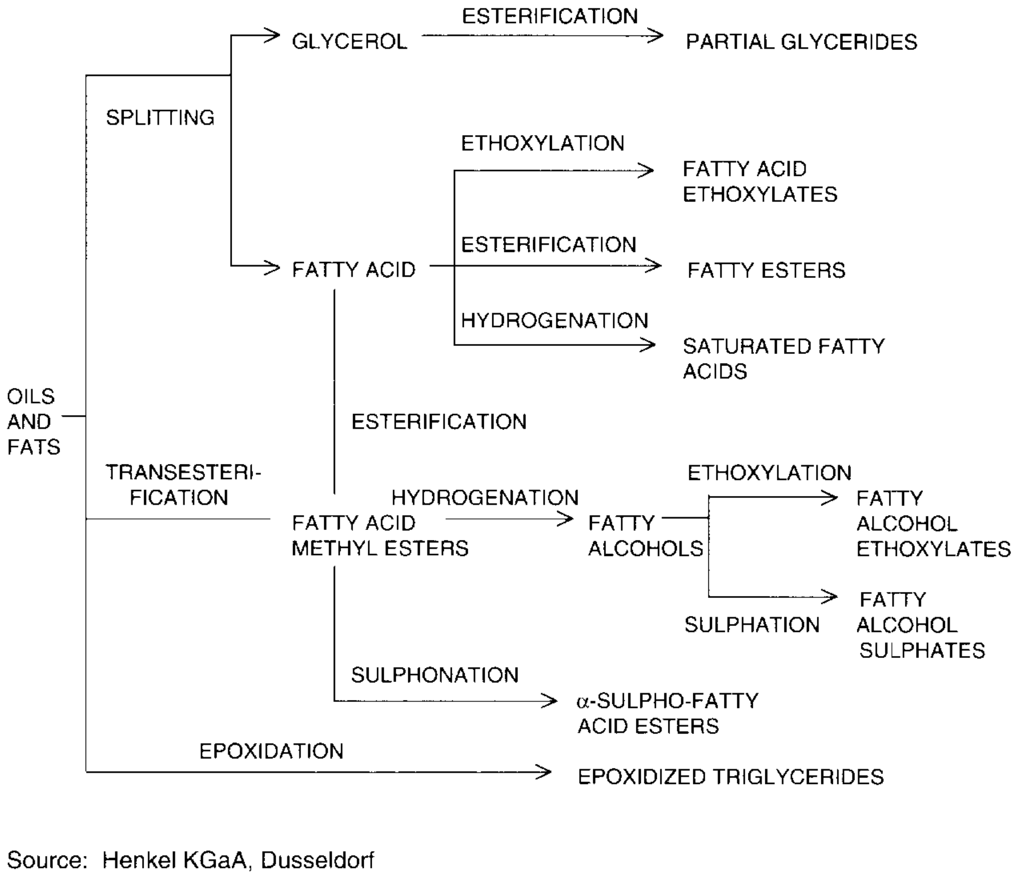

Figure 1. Some of the Routes Used in Manufacture of Oleochemical Derivatives

with different properties can be obtained through various types of chemical reactions and these find applications as surfactants, cosmetics and toiletry products, pharmaceuticals, and other industrial chemicals. *Table 6* summarizes some of the applications of the oleochemicals and their derivatives. Despite the diversity of products, the majority of oleochemicals are still used in the surfactant or detergent industries.

PORIM's Advanced Oleochemical Technology Centre (AOTC)

PORIM's Advanced Oleochemical Technology Centre was officially established on 1 September 1994. A total of twenty-four staff, including researchers and supporting staff, had been recruited recently. AOTC's role is to assist the Malaysian oleochemical industry through research on the use of basic oleochemicals and their derivatives for downstream activities; the aims of the work include increasing the percentage of palm oil used, improving efficiency, diversifying end uses and the development of products with high added value. Emphasis will be on products that are environmentally friendly and processes that are less energy intensive and more economical. The Centre will provide technical advisory services to the oleochemical industry and related sectors.

Various research programmes have been identified and implemented, among them several in the areas of :

- soaps and detergents
- personal care products, cosmetics and toiletries
- industrial and agrochemical products
- lubricants and greases
- polymers

A new PORIM – Oleochemical Industry committee has been established to scrutinize the research programmes and monitor the progress of the Centre's work. The members of the committee, which meets twice a year, include representatives of the local oleochemical industry. PORIM's Programme Advisory Committee (which meets once a year) will also be responsible for monitoring the progress of all the research activities of the AOTC.

Progress in Research and Development

A few of the current research projects will be highlighted here.

Soaps

One of the most important non-food applications for palm oil and its products is still the manufacture of soaps. Research carried out at PORIM (Kifli *et al.*, 1987) shows that palm and palm kernel fatty acids can be blended in the right proportions to obtain the desired properties of stability, solubility, ease of lathering and detergency in a finished soap. Studies (Kuntom *et al.*, 1987; Kuntom *et al.*, 1990) also indicate that palm-based soap has certain advantages, such as better retention of perfume and whiteness than tallow-based soap.

Polyols and Polyurethanes

The raw materials currently used for the production of polyurethanes are polyols and isocyanates, which are usually petrochemical-based. Studies at PORIM (Hassan *et al.*, 1993; Ahmad *et al.*, 1995) indicated that palm oil and palm oil products could be used to prepare polyols. The hydroxyl values of the polyols produced could be varied by changing the types of palm oil and palm oil products used or by changing the various formulations. The range of hydroxyl values obtained indicated that various types of polyurethane foams, from flexible (semi-rigid) to rigid, could be prepared from these polyols, and this was confirmed by further work.

[illegible]

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Printing inks

The four major ingredients of an ink are solvents, resins, pigments and additives. The amounts of these which are required depend on the type of ink to be produced. The results of a collaborative research project by PORIM and a local multinational ink manufacturer (Ooi *et al.*, 1993) showed that palm oil based ink had better tack and print stability than conventional petroleum ink. The colour of the printed images was also brighter and cleaner. *Table 7* compares the performance of the two types of inks. At present, the manufacturer is producing the palm-based inks commercially and supplying them to several publishers in both Malaysia and Singapore.

Selective hydrogenation

So far, the most common method for the production of fatty alcohols is by high temperature and high pressure hydrogenation of fatty methyl esters using a copper-chromite catalyst in a fixed-bed reactor. If the unsaturation present in the molecule needs to be preserved, then a catalyst containing zinc is used.

Recently, novel catalysts, Ru-Sn and Re-Sn, have been developed by the National Institute of Materials and Chemical Research of Japan and PORIM(Cheah *et al.*, 1992); these can be used to hydrogenate fatty acids or

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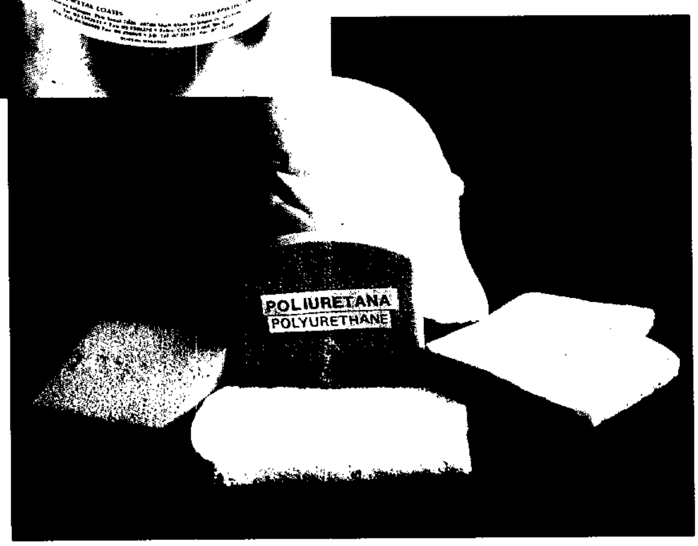

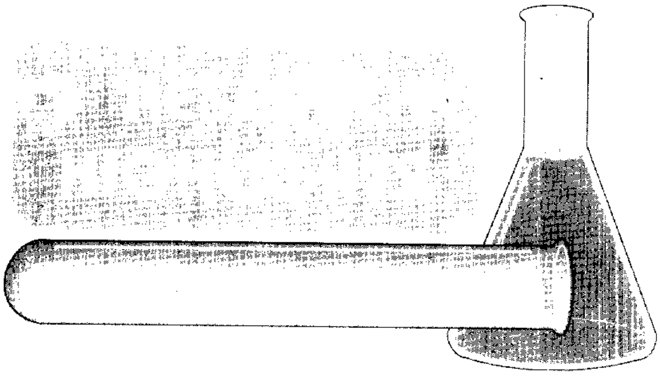

A LIPID-BASED STRATEGY IN TREATING ALCOHOLIC LIVER INJURY

Contributed by
Dr N. Chandrasekharan

Professor AA Nanji and colleagues from the Department of Pathology, Harvard Medical School, Boston, report a novel treatment for alcoholic liver disease (ALD), based on laboratory studies using palm oil, in the latest issue of *Gastroenterology* (109:547–554, 1995). The findings have been significant enough to merit editorial comment in the same journal and this is understandable, as the problem of treating alcoholic liver injury has been intractable. Nanji's work is also of interest to us in Malaysia, as it explores the therapeutic potential of palm oil.

The mechanism of liver damage caused by alcoholism has not been well elucidated. New understanding of the pathogenesis of alcoholic liver disease has come from epidemiological studies on the per capita consumption of fat as related to the frequency of cirrhosis in various countries. Experimental studies have shown that dietary fat must contain polyunsaturated fatty acids (PUFA) including linoleic acid for liver pathology to develop. Lipid peroxidation may be important in the pathogenesis of alcoholic liver disease. Polyunsaturated fatty acids potentiate alcohol induced liver injury by inducing the cytochrome enzyme P4502E1 (CYP2E1), which results in an increase in lipid peroxidation in lever microsomes; polyunsaturated fatty acids support this process. CYP2E1 may also cause cell injury by increasing oxygen derived radicals that lead to lipid peroxidation and protein adduct formation.

Alcohol may alter fatty acid metabolism by decreasing arachidonic acid and peroxysomal proliferating activation receptor levels.

Nanji *et al.* demonstrated fatty infiltration, inflammation and necrosis in rats fed fish oil (rich in PUFA) and ethanol for six weeks. These changes were reversed when ethanol was discontinued and the animals were given a palm oil-dextrose diet for two weeks. There was almost complete normalization of the liver histology.

Palm oil was effective in the treatment of ALD because it is composed mainly of saturated and monounsaturated fatty acids with a low level of linoleic acid. Saturated fatty acids are not targets for free radical attack, and this minimizes lipid peroxidation with its consequences. A diet containing palm oil would also be expected to reduce the concentration of PUFA in the liver and thereby diminish the availability of substrates for lipid peroxidation.

CYP2E1 levels and the fatty acid composition of the liver are sensitive to dietary manipulation. The amount and type of fatty acids in the diet can also influence a wide variety of metabolic processes, including eicosanoid synthesis and xenobiotic metabolism. Palm oil feeding modulates eicosanoid metabolism in a manner in which the prostacylin/thromboxane ratio is increased, and this change is associated with decreased liver injury in the experimental model. Thus it is recognized that dietary fatty acids may have pharmacological effects in addition to being a source of calories. Further, palm oil contains tocopherols and tocotrienols which inhibit lipid peroxidation because of their antioxidant properties.

The results from this study indicate that treatment with palm oil was associated with a marked improvement in liver pathology and a reduction in lipid peroxidation during ethanol withdrawal.

From a practical point of view, the prevention and treatment of ALD will require a diet high in protein and calories in which the source of dietary fat is low in PUFA as suggested by Nanji *et al.* However, as with all experimental studies, one has to be cautious in extrapolating animal data to humans even though the findings are exciting.

POTENTIAL PHARMACEUTICAL USE OF *CIS*-OCTADECENOAMIDE

Contributed by
Mr Tang Thin Sue

A recent article in the journal *Science* (268: 1506, 1995) reports that *cis*-9,10-octadecenoamide could have potential use as a sleep-inducer for treating insomnia, with no side effects. The authors discovered a build-up of this chemical in the brain and spinal fluids of cats deprived of sleep. This fatty amide has also been identified as one of the natural constituents in the cerebrospinal fluid of humans.

When a synthetic version of this amide was injected into rats it was observed that at doses of 5 mg and above, the rats closed their eyes and fell asleep. No side effects were found during the experiments, as the rats could still respond to noises when asleep as they normally do. The length of time the rats slept appeared to be related to the dosage applied. Rats injected with 5 mg, 10 mg and 20 mg of the amide became active again after 1 hour, 2 hours and 2.5 hours of sleep respectively. At a higher dosage (50 mg), the sleeping period was also observed to be only 2.5 hours. The rats

BETA-CAROTENE AND VITAMIN E REDUCE LUNG CANCER RISK: NEW EVIDENCE

Contributed by
Dr B.A. Elias and T.P. Pantzaris

Consumption of beta carotene, vegetables, fruit, hard cheese and Vitamin E, may reduce the risk of lung cancer in non-smoking men and women, according to a large new survey by the University of Wisconsin, reported in the *Journal of the National Cancer Institute*, on 2 January 1995. Although smoking is the foremost risk factor in the causation of lung cancer, non-smokers account for approximately 15% of all lung cancer deaths in the United States.

The survey was designed to examine the association between lung cancer risk and dietary factors in non-smokers and was claimed by the authors to be the largest on this topic. It was based on 413 individually matched pairs of subjects in the State of New York in the period 1982 to 1985.

The survey found that intake of beta carotene and vitamin E were significantly associated with risk reduction. Consumption of vegetables, fresh fruit and cheese was also associated with a significant dose-dependent reduction in lung cancer risk. In the study, intakes of beta carotene and retinol were calculated from the monthly consumption of different food items. Surprisingly, the protective effect of cheese was only apparent in women and not in men, but this may be due to other dietary factors.

In regard to Vitamin E intake, the researchers found that the protective effect applied also with Vitamin E supplements – a result which many other studies had failed to show in the past. In view of that, the authors recommend further examination of this finding.

The authors state that the strong points of their study were the large number of non-smoking patients studied, the inclusion of both men and women, the population-based design and the rapid interviewing of the subjects who filled the questionnaires. A limitation, they admit, was that they did not enquire about the overall diet and consequently they could not assess other dietary factors.

MUTANT OIL PALMS COME TO THE AID OF THE MARGARINE AND SOAP INDUSTRIES

The margarine and soap industries could benefit from British research into improving techniques for the harvesting of oil palm fruit in Malaysia and elsewhere in South-East Asia.

Scientists at the Open University's Oxford Research Unit have been granted funding of £155 000 by the Biotechnology and Biological Sciences Research Council to collaborate with Unilever and the University of Western Australia to find how to stop palms shedding fruit when the bunches are cut, which results in the loss of some of the harvest. The leader of the research, Daphne Osborne, said 'Economically it is particularly valuable to Malaysia's vast oil palm plantations, which have become more important than the more expensive, traditional rubber plantations. But the British economy is also affected as companies like Unilever have some of their largest plantations there and many of their products rely on these palms – the most obvious being 'Palmolive soap.'

The research centre has been studying the general shedding process in plants with particular interest in oil palms, whose bunches can weigh from 5 kg to 45 kg and contain hundreds of fruit.

Professor Osborne's team will use mutant oil palms and plants that cannot shed their leaves or fruits like certain bean seedlings and mutant fodder lupins to identify the enzymes which break down cell walls and thereby promote shedding. Retaining the fruit on the palm for longer could mean that they would continue to accumulate the valuable oil.

Hereward Corley, co-ordinator of Unilever's Plant Breeding International Centre in Cambridge, said that palm oil is now the world's most important vegetable oil in terms of volume and that it made up 40% of the global market. Although Unilever has some plantations it relies on the open market for its purchases of oil.

Scientists at the University of Western Australia are also working with the British, because the fodder lupin is vital to the Australian agricultural and feed industry, and it is hoped that understanding the mutant lupins that do not shed fruit will aid their research.

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awoke refreshed with no signs of grogginess or disorientation.

It is interesting to note that the *trans*-isomer, though possessing the same pharmacological effect, was far less potent. With a 10 mg dose the rats slept for only about 1 hour compared with 2 hours for the *cis*-isomer.

The carbon chain length and position of the unsaturation in the fatty amide also have an important role in the sleep-inducing property of the compound. Shifting the position of the unsaturation from the C9 position or lengthening the chain to C22 reduces the sleep-inducing potency.

The above report is indeed very exciting as oleic acid (*cis*-9, 10-octadecenoic acid) is an important product of palm oil oleochemical plants. The successful development of *cis*-1, 2-octadecenoamide as a high added-value pharmaceutical product from natural resources (which could take several more years) may prove to be another potential use for Malaysian oleic acid. Currently Malaysia produces commercial oleic acid with about 75%–80% of *cis*-9, 10-octadecenoic acid, the balance being mainly linoleic acid. Commercial oleylamide is an important nitrogen derivative of oleic acid and finds use as an antiblock and antitack agent in polyethylene film manufacture. It is also used extensively in printing inks where it helps in improving dye solubility and controlling viscosity. Oleylamide is also an important additive in lubricants.

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methyl esters to fatty alcohols at high temperature but medium pressure (50 bar): the unsaturation present is maintained, and the presence of tin has been found to be instrumental in this. Ru-Sn supported on alumina was found to be most selective when it was prepared by the solution-gel method.

Medium Chain Triglycerides

When palm kernel oil is used as a raw material in the oleochemical industry, the medium chain fatty acids, *i.e.* C_6–C_{10}, are stripped off, since they are known to cause skin irritation, and originally they were considered waste products. However, early results of experiments by Leong *et al.* (1994) in PORIM have shown that medium chain triglycerides (MCTs) can be synthesised from glycerol and medium chain fatty acids. MCTs can also be obtained by fractional distillation of palm kernel oil (Leong *et al.*, 1994), and lately they have been gaining greater importance, with their applications including infant foods, flavour and fragrance products, and cosmetics, as well as use in the surface treatment of confectionery products and for lubricating machines.

Dibasic Acids

Dicarboxylic acids with long carbon chains are important chemicals, used mainly as raw materials for the preparation of plasticizers, polyamides, polyurethanes, lubricants and perfumes. The oxidative cleavage of palm oil products into dibasic acids and low molecular weight monobasic acids by liquid phase oxidation has been carried out successfully (Ooi *et al.*, 1991). In this study it was found that the major dibasic acids formed in the reaction were suberic and azelaic acids, which could be concentrated and purified. The highest purity of azelaic acid achieved was 78 per cent. In another study, diesters of long chain fatty acid were prepared by a metathesis reaction on ethyl oleate. The diesters were then used as raw materials for the synthesis of civetone, a musking agent for perfumes. The other product from the reaction, a hydrocarbon 9-octadecene, was then used for the synthesis of a 'star-shape' lubricant.

Palm-based Metallic Soaps for Rubber Compounding

Processing aids are often used in the preparation of rubber formulations. A processing aid can play one or more roles when incorporated into a rubber compound, such as speeding up the rate and controlling the degree of polymer breakdown, helping to disperse the other compounding ingredients, helping to reduce 'nerve' within the compound, reducing shrinkage during subsequent processing, and imparting building tack to the compound.

In another study at PORIM (Mohamed *et al.*, 1989), zinc and calcium soaps based on palm stearin fatty acids, palm oil fatty acids and palmitic acid were prepared and were evaluated as processing aids in rubber compounding. The suitability of these soaps for this purpose with natural rubber (NR) was shown by their effectiveness in reducing the viscosity, the mastication and mixing energy, and the extrusion stress of both unfilled and filled unvulcanized NR compounds during extrusion, and improving the surface smoothness of the extrudates.

The use of these metallic soaps does not have adverse effects on the properties of vulcanizates of typical carbon black-filled formulations. However, differences were observed between the behaviour of zinc- and calcium-based soaps.

The study showed that palm-based metallic soaps are suitable as processing aids for rubber.

Surfactants and Detergents

Recently, α-sulphonated methyl esters (α-SMEs), a new class of anionic surfactants, have received a lot of attention as ingredients for washing and cleaning products for several reasons (Yamane *et al.*, 1989). Some of these are:

- The products have good detergency, especially in hard water and in the absence of phosphates;
- α-SMEs with C_{16} to C_{18} have been found to exhibit especially good detergency;
- The biodegradation characteristics of α-SMEs are good.

The findings of PORIM (Ahmad, 1993) indicate that less costly sources of raw materials such as palm stearin and palm fatty acid distillate can be used for the production of α-SMEs. The detergency properties of α-SMEs derived from these sources are comparable with those of linear alkyl benzene sulphonates (LAS). It is expected that α-SMEs will play a significant role in detergent formulations in future since the Malaysian Government started to ban the use of branched alkyl benzene sulphonates (BAS) in all detergent products from July 1995.

A related topic which has been investigated is the synthesis of palm-based imidazolines (Idris *et al.*, 1994). Recently, manufacturers in developed countries have been reducing or stopping the use of quaternary ammonium compounds (Quats) in softeners and conditioners in view of findings that Quats may not be completely biodegradable. One alternative to Quats is imidazolines; another is ester quats. Both of these are being studied.

Recovery of Valuable Minor Components

Carotenoids and tocols (tocopherols and tocotrienols, *i.e.* vitamin E) are two valuable minor components present in crude palm oil. Crude palm oil contains on average 600 ppm of carotenoids and 800 ppm of tocols. Because carotenoids and tocols, particularly tocotrienols, are likely to grow in importance and value, the recovery of these components from palm oil and its by-products is important.

A process for the concentration and recovery of carotenoids has been developed by PORIM (Ooi *et al.*, 1991), which involves, firstly, the conversion of crude palm oil into methyl esters under mild reaction conditions. The methyl esters are then distilled to be used as a valuable oleochemical or as a diesel substitute, and the valuable minor components such as carotenoids and tocols can then be recovered and concentrated to high purity.

Another project on the recovery of tocopherols and tocotrienols is based on the conversion of palm fatty acid distillate (a by-product from the physical refining of palm oil) into methyl esters (Gapor *et al.*, 1985). After the distillation of the methyl esters, a concentrate of tocols remains, which is then processed to yield a mixture of tocopherols and tocotrienols of 95–99% purity.

In another study (Ooi *et al.*, 1994), sterols were found to be present in significant amount in a palm kernel oil methyl ester residues from an oleochemical plant. The unsaponifiable matter present in the residues amounted to about 4.2%, and the sterol fraction constituted about a third of the total unsaponifiables. Sterols could be recovered successfully from this fraction.

Cosmetics, Personal Care and Toiletry Products (CPTs)

Formulations for CPTs based on palm oil and palm oil products have been studied.

Various hand and body lotion formulations using palm oleochemicals were investigated. Some of these have been acquired by a local cosmetics company to produce hand and body lotions on a commercial scale. The interesting characteristics of this lotion include easy rub-in, non-greasiness and mildness.

Biotechnology Studies

Enzymatic or microbiological routes to many oleochemical derivatives are likely to be expensive but may offer certain advantages.

In one study in this area, several microorganisms were isolated from the sludge pond and buffer pond of a system treating palm oil mill effluent (POME). These microorganisms were screened for their ability to assimilate and biotransform fatty acids. From these tests, some microorganisms were found to have the ability to desaturate palmitic acid to palmitoleic acid (Yeong *et al.*, 1994), an interesting result since palmitic acid is the major saturated fatty acid in palm oil.

Biodegradability Studies

In view of the increasing environmental awareness world-wide in regard to the production, consumption and disposal of chemicals, evaluation of the biodegradability of a raw material is of paramount importance. Data on the biodegradability of a chemical are needed in determining its acceptability in the market. PORIM plans to establish a facility for studies on the biodegradability of products derived from palm oil and palm kernel oil. Besides carrying out standard OECD biodegradation studies, the laboratory will be able to engage in other activities (such as developing methods) and provide technical advisory services to the local oleochemical manufacturers and users.

Waste Water Management for the Oleochemical Industry

The management of wastes is one of the major problems facing the oleochemical industry. The disposal of

the effluents it generates in an environmentally safer manner has become a serious concern of the industry itself, the general public and the Government. Since the volume and characteristics of the oleochemical effluents vary greatly according to the products and the production processes, the choice of a treatment system will depend very much on the composition of the effluent involved. PORIM therefore attempts to identify, characterize and collate the effluents generated by the various processes, and with this information, to advise on the selection of the most cost-effective system for treatment in each case.

Recently, a more compact and simple-to-operate batch aerobic system, known as the Sequencing Batch Process (SBR), has been tested and developed in the oleochemical industry (Ma, 1995). This system has been successfully developed for the treatment of various types of waste water, including palm oil refinery effluents.

Oleochemical Quality and Analytical Services Laboratory

In order to support the R&D activities of the AOTC, an analytical laboratory has been set up; its objectives are to carry out services such as:

- Analyses of oils and fats using PORAM's specifications;
- Analyses of both basic oleochemicals & derivatives;
- Some specialized analyses, *e.g.* on surfactants, cosmetics, biofuels and other oleochemical based products; the chick edema test, *etc.*;
- Acting as the reference laboratory for the Customs Department, if necessary, and for small and medium scale industries (SMIs).

Miscellaneous

Other areas of research which are being investigated include the synthesis of lubricants and grease, formulations for pesticides and herbicides, product handling and development of new applications and new products from the basic oleochemicals, their derivatives and their by-products.

CONCLUSION

Hitherto, there has been little product research and few application laboratories in the oleochemical industry in Malaysia. Some companies may have access to know-how from their overseas partners but this is of course not available to others. The need for research and information will increase as we go into manufacturing more 'downstream' oleochemicals such as esters, amines, amides, *etc.* In this context, the contribution from R&D in PORIM's Advanced Oleochemical Technology Centre will be of significant importance to the technological development of the Malaysian oleochemical industry.

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IN BRIEF

15TH PALM OIL FAMILIARIZATION PROGRAMME

(25 September – 6 October 1995)

Contributed by Norihan Abdul Majid

This year's Palm Oil Familiarization Programme (POFP) is the fifteenth in the series organized by PORIM and the Ministry of Primary Industries of Malaysia since 1982.

A total of 43 participants from Brazil, China, Egypt, India, Iran, Iraq, Jordan, Kuwait, Myanmar, Nepal, Pakistan, Romania, South Africa, Sweden, Syria, the Netherlands, Turkey, Uzbekistan, Venezuela and Vietnam attended this year's programme.

The POFP extends over ten days and consists of a series of lectures, field trips, meetings and interactions with refiners and members of various sectors of the industry. Thus, the programme is intended to cover the entire story of the palm oil industry from the plantation to the production and processing of the oil and right up to the point of export. The lectures are meant to introduce participants to the technicalities of the palm oil industry in Malaysia and to lay the groundwork for field visits to the mills and refineries. Field trips, on the other hand, give the participants a change and allow them to actually see the processes involved. The interactions with leading members of the Malaysian industry are meant to familiarize participants with them and their activities.

Apart from establishing contact with members of the industry and the various organizations in Malaysia, participants also had an excellent opportunity to exchange views among themselves.

Feedback received from the participants indicates that the programme has achieved its objective, *i.e.* to create awareness about Malaysian palm oil amongst potential and existing consumer countries. It is heartening to note that most of the participants were confident that the uptake of palm oil and palm products would continue to increase in their respective countries.

PORIM is glad to see a growing number of participants wanting to attend the POFP each year, and this is certainly a clear sign of the success and popularity of the programme and of the fact that 'Palm Oil is the Excellent Choice'. The next POFP is scheduled for September 1996.

With the completion of this year's programme, a total of 449 participants from 65 countries have taken part in the programmes.

Distribution of POFP Participants 1982 – 1995

Year/ programme	Number of Participants	Number of countries
1982 (1st)	12	8
1982 (2nd)	14	5
1983 (3rd)	20	10
1984 (4th)	18	10
1985 (5th)	23	10
1986 (6th)	30	10
1987 (7th)	25	19
1988 (8th)	33	15
1989 (9th)	29	18
1990 (10th)	38	17
1991 (11th)	39	20
1992 (12th)	45	17
1993 (13th)	36	20
1994 (14th)	44	27
1995 (15th)	43	21

PRODUCTION AND USES OF USA TALLOW

Contributed by Dr B. A. Elias and T. P. Pantzaris

Tallow is the major fat used in non-edible applications in the USA and Europe, for products such as animal feeds, oleochemicals and soap. Also, because tallow has a broadly similar consistency to palm oil, its edible grades compete strongly with palm oil in international markets, especially when subsidized overtly or covertly, under various export enhancement schemes, low interest loans, aid projects, *etc.*

Although overall figures on the tallow trade are published regularly in trade journals, such as the excellent *Oil World* of Hamburg, details about its various grades and applications, are not easy to obtain. *Tables 8* and *9*, published by the National Renderers' Association (NRA), will therefore be of interest to palm oil traders even though they refer only to the USA.

From *Table 8*, it can be seen that the total production of all grades is only expanding by 1.5% p.a., although production of inedible grades is expanding faster, at about 5% per annum, while that of the edible grades is declining rapidly. It seems that if this trend continues, US edible tallow will be a spent force before very long.

Table 9 reveals some further interesting facts. As in the European Union, so in the USA, the use of fats in animal feeds exceeds any other use; in fact in the USA, it exceeds all other uses combined. Rather surprisingly, production of oleochemicals appears to be falling, as also is that of soap. Assuming 60% fatty matter and 86% tallow in the fat charge, the estimated soap production in USA comes to only about 283 000 tonnes per annum.

Table 8. Production of US Tallow and Grease ('1000 tonnes)

	1994	1992	Average Annual Change(%)	
Inedible tallow	1638	1604	1.1	} 5.2
Inedible grease	1247	1003	11.5	
Edible tallow	686	859	-10.6	
TOTAL	**3571**	**3466**	**1.5**	

Source : NRA, July 1995

Table 9. Inedible Tallow and Grease, USA Domestic Disappearance ('000 tonnes)

	1994	1992	Annual Change(%)
Animal feeds	992	887	5.7
Fatty acids	287	299	-2.0
Soap	136	152	-5.4
Lubricants	37	28	15.0
Other inedible	22	18	10.6
TOTAL	**1474**	**1394**	**2.8**

Source : NRA, July 95

HALF A MILLION TONNES OF OIL TO EGYPT AND 13 EGYPTIAN FACTORIES

Egypt imports half a million tonnes of palm oil yearly and has 13 factories for oil products, seven of them belonging to the public sector with more than 10 000 workers. Palm oil products vary from ghee, which is preferred by Egyptians, to natural palm oil with no chemical additions. About the reliability of palm oil an official from Egypt said that there are institutes in more than six countries in Europe, America and Egypt in addition to several international conferences, which have discussed research on palm oil and have endorsed its benefit to the human body.

UAE is the largest palm oil importer in the Middle East, followed by Egypt, Saudi Arabia, Turkey and Jordan.

In Egypt there is a plan to export refined palm oil to Gaza and Palestine. There are also exports to Syria through Egyptian companies in both the private and the public sectors. Exports are also made to Libya, and Egypt is opening a new market for, refined palm oil in Russia.

Source : Al-Ahran News, Cairo

L—PNMB., K.L.