From the results shown in Table XIII, we concluded that the formation of free fatty acids and peroxides is retarded by silicone oil at such a high temperature, 220 C.

We also presented the changes of AV, POV and AOM values by different frying temperatures in Figure 3.

FRIED PEANUTS

Generally, oils used for frying peanuts are partially hydrogenated coconut or palm kernel oils and partially hydrogenated oils derived from palm oil.

Hydrogenated coconut and palm kernel oils have good stability to oxidation of over 400 hr in AOM values. Furthermore, setting rates of these oils after frying are high, and the surface of peanuts is not sticky.

On the other hand, these oils are apt to be hydrolyzed by moisture and microorganisms and to cause soapy flavors. Another fault with coconut and palm kernel oils is a vigorous, foamy nature in the frying process which may be caused by interaction of the oil with eluted substances from the beans.

In contrast with coconut and kernel oils, partially hydrogenated oil derived from palm oil is not so easily hydrolyzed and does not cause soapy flavor and bubbles in the frying process. As concerns oxidation, refined palm oil has 60 hr AOM values and is improved to 400 hr by partial hydrogenation.

Table XIV shows some results of frying tests using partially hydrogenated palm and coconut oils. It is clear that the increase in acid and peroxide values of the palm oil is slow compared with the coconut oil.

Polymerization of the palm oil during frying is less than that of the coconut oil. Palm oil does have a tendency to increase color, but this does not affect products negatively.

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Palm Oil: Quality Requirements from a Customer's Point of View

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ABSTRACT

The quality specifications for partly and fully processed oils sold to the European Edible Fats industry are discussed. The industry generally has regarded quality specifications as giving some guarantee of parameters such as FFA, moisture, impurities, iodine value and solids content. However, the availability of processed oils leads us to consider other aspects of quality apart from those normally required. In particular, potential hazards associated with refining and transport procedures become increasingly significant if the European industry is to consider using fully refined oils directly in products. As long as suppliers are unable to make the necessary guarantees, Unilever companies in Europe will be unable to take full advantage of the potential benefits offered by the palm oil industry. The above topics, together with a description of the specification required for the specific product applications, are discussed in this paper.

INTRODUCTION

Numerous fully and partly processed palm oils are now available in the world market. The objective of this paper is to discuss opportunities and problems which these new materials present to the European edible fat industry. Conversely, what do the suppliers of palm oil need in order to guarantee qualities to the edible fat industry so that it can take full advantage of these processed oils (1,2)?

The views presented in this paper are specifically those of the major Unilever companies in Europe, which have experience with palm oils delivered in different process stages from crude to partly and fully refined. The latter varieties are becoming more and more important due to their increased availability.

In the past the European edible fat industry was concerned mainly with upgrading crude oils and fats to make them suitable for human consumption. The industry obviously is now facing a new situation due to the introduction of processed Palm oils.

When using crude oils the refiners are able to adapt their processes to correct for crude oil quality as measured on arrival. However, when the refiner wants to use partially or fully processed palm oils and apply more simplified refining techniques, he has to rely on the regular quality-consciousness of the local producer and the transport organization. In this respect the use of inferior raw materials or incorrect processes at origin could have serious consequences for his business.

It is obvious that in the latter situation, quality aspects other than those normally stipulated in contracts under the general indication GMQ (Good Merchantable Quality), are of importance. Depending on the process applied by the receiving industry and the end application, these more specific requirements may become much more relevant.

In this paper we first discuss the general quality aspects which are relevant to all palm oil applications and second the quality aspects which are more applicable to specific end uses.

QUALITY STANDARDS APPLICABLE TO ALL EDIBLE PALM OIL APPLICATIONS

According to the Unilever standards good refined palm Oils can generally be specified as indicated in Table I. Although in many studies no statistical correlation could be found between crude oil and refined oil characteristics, it is felt that with a proper refining procedure (such as Table II), the above specification should be met using good quality crude oils.

TABLE I

Specification for Good Quality Refined Oils

Characteristic	Maximum level
FFA	0.05%
P	4 mg/kg
Cu	0.05 mg/kg
Fe	0.1 mg/kg
Totox	10
Dimer	1%
Color (Lov. R 5¼")	3

TABLE II

Good Refining Practice for Crude Oils. FFA 3.5%

Alkali refining	Physical refining
1. Temp. 95 C	1. Pretreat with 0.05-0.1% dilute (30%) phosphoric acid and 1% earth.
2. Disperse hot water on oil (3 X lye volume)	2. Physically refine at 240 for ≤2 hr or 260-270 hr ≤30 min.
3. Add 25 C excess 4M NaOH	3. For certain applications apply post-refining with dilute lye.
4. Settle, wash with dil. NaOH	
5. Bleach with 1-3.5% active earth at up to 135 C.	
6. Filter at 95 C.	
7. Deodorize.	

Crude palm oils fulfilling the following requirements should lead to good refined Palm oils.

FFA < 3%—Free fatty acids on their own are not the major problem (Levels up to 5% can be removed easily in a commercial refinery process). Too high a level, however, will result in high Fe and Cu levels, picked up during transport and storage. This in turn will result in acceleration of oxidation and lead to too high Totox values which cannot be sufficiently reduced during refining. In general FFA's below 3% also give some guarantee that fresh, unbruised fruits were used and that the oil derived from it was stored and transported under good conditions.

Moisture < 0.1%—At moisture contents of below 0.1% the FFA increase becomes negligible under practical conditions.

Metals: Fe < 3 ppm; Cu < 0.02 ppm—Again, the metal levels on their own are not the major problem, as they can be efficiently removed by using an adequate pretreatment in the refining process. Too high levels, however, will result in the formation of high levels of pro-oxidants or oxidized products which are difficult to remove during refining and will lead to refined oils with a poor stability. Cu levels are especially important because Cu is about 10 times more active as a pro-oxidant than is Fe. A low Fe content also indicates that the fruit was carefully extracted and not contaminated with dirt or palm fruit fines.

Totox max. 10—Our practical experience is that if proper refining, storage and transport procedures are used, about the same Totox value will be found for the refined oil as in the crude oil before shipment. The former is determined mainly by the anisidine value, the latter by the peroxide value. In general, low Totox values for crude palm oil will also lead to refined oils with a good color stability.

The requirements for oxidative and color stability can be met if palm oils are used which meet the above-mentioned values. This means that good housekeeping is almost the prime factor to guarantee a good refined palm oil.

Semi- or fully processed palm oils obviously can be used as feedstocks for the production of good quality refined oils as specified above. The actual requirements for the feedstocks will depend greatly on the process routes used by the European refiners.

There are a number of possible options, as shown in Table III. So in principle we have three possibilities:

- Processed palm oils are blended directly in final products, because the quality is acceptable and the process flow allows it.
- Processed palm oils are blended before deodorization, because the quality is acceptable, but the process flow does not allow blending into final products.
- Processed palm oils are re-refined, because the quality is unsatisfactory.

From this overview it already follows that, in general, quality is not always the major criterion. The inflexibility of process flows can lead to a situation in which fully refined palm oils or fractions still are regarded as partially refined edible oils, notwithstanding the fact that they are sold as fully refined.

The requirements for semi or fully processed palm oils are, however, that the same good quality crude oil, as defined before should be used. On arrival in Europe the requirements in Table IV should be met.

Clearly it is very important that these specifications be fulfilled, as it gives the refiner some confidence that good qualities are supplied. However, we also want to stress that the use of a good quality crude palm oil is of the utmost importance. The specifications mentioned mainly guarantee good refining procedures and transport/storage conditions, but in no way do they guarantee keepability of the oil.

The current Unilever experience is that refiners using good quality crude palm oil can easily fulfill the require-

TABLE III

Routes for Using Partially and Fully Refined Oils

Process stage	Oils available	Possible application Europe
RBD NBD (fully refined)	Palm oil Palm oleins Palm stearins Dry fractionated Palm mid-fractions	A. Blend directly (no post refining) B. Blend and deodorize (because of process flow or insufficient quality). C. Re-refine (because of insufficient quality).
Neutralized and dried or neutralized/bleached (caustic)	Palm oil Palm oleins Palm stearins	A. Blend and deodorize B. Re-refine before blending (because of insufficient quality).

TABLE IV

Requirements for Partially and Fully Refined Oils Entering Europe

Characteristic	Caustic neutralized still to be dry bleached and deodorized	RBD to be blended as such
Feedstock/crude	see earlier	see earlier
FFA	0.1%	0.05%
Cu	0.05 mg/kg	0.05 mg/kg
Fe	0.1 mg/kg	0.1 mg/kg
Totox	10	10
Color/bleaching test (Lov. R 5¼")	bleaching test 3R[a]	3
Moisture	0.7%	0.05%
Taste	Not specified	Neutral, no off flavor

[a]Specific bleaching test. 150 C, 60 min. 5% earth.

TABLE V

Potential Hazards*

Process stage	Health hazard risk factor	Crude PO	Caustic refined	RBD PO
Processing at origin	Pesticide residues	–	–	–
	Aflatoxin	–	–	–
	Chemical changes	–	–	+/–
	Contamination with heat medium	–	–	+/–
Transport	Cross contamination	+/–	+/–	+/–

*Ability to Correct: –, easy to difficult to correct: +, possibly unable to correct.

ments for FFA, Fe, Cu and color. The Totox values, however (or more precisely oxidation during transport), seem to be a major area of concern. This is partly because transport conditions are governed more by commercial requirements than by quality requirements. In many cases this obliges the European refiner to treat the processed oil as a crude feedstock, the low FFA level being the only advantage.

So far we have considered only "general" requirements according to the Unilever European experience, for crude and processed Palm oils to be refined in Europe.

SAFETY ASPECTS

The problem is that even when the above specifications are met, no guarantee is given about health hazards for the customer. This is a rather complicated situation when fully processed palm oils are used. The European refiner will have to rely on the safety measures taken by the supplier at origin for the processes applied and on the shipper for the transport conditions used. The health hazards for the consumer in using different types of palm oil are as defined in Table V.

Pesticides

Pesticide residues are no real problem as they are hardly used in palm oil production. The deodorizing step of the refining process also reduces possible traces to a safe level.

Aflatoxins

Aflatoxins have not been observed so far in palm oil.

Chemical Changes

Chemical changes can occur when excessive temperatures are applied for long periods during deodorization or physical refining. The main concern here is the formation of thermal dimers, as a result of the dimerization of oxidized or unsaturated triglycerides.

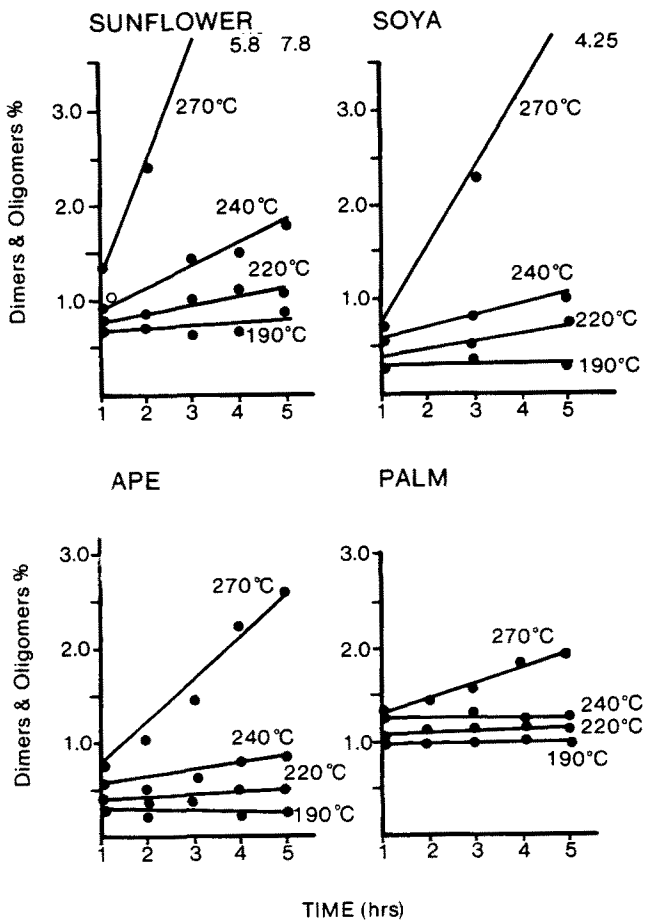

FIG. 1. The generation of dimeric and higher polymeric triglycerides under pilot-plant steam stripping conditions at high temperature (Eder, 1982).

However, dimers are formed at high temperatures much more slowly in palm oil than in other oils. The preferred practice is to apply high temperatures for a certain time during physical refining to come to an optimum heat-bleaching effect. According to Unilever expertise (3), dimers should be below 1%. This can be guaranteed when using deodorization or physical refining temperatures of no more than 240 C. There is, however, a substantial dimer formation at 270 C which easily can rise to 2.5% when residence times above 30 min are used (Fig. 1).

Unilever would, therefore, recommend that palm oils be deodorized at a maximum temperature of 240 C and with a maximum residence time of 2 hrs. Alternatively, a temperature of 270 C with a maximum residence time of 30 min might be acceptable.

Heat Exchange Oils

Unilever also is concerned about the possible contamination of oils with heat exchange media. This arises from the use of thermal heating oils during deodorization or physical refining with a possible risk of leakage during processing (4).

As far as we know the two types of heating oil used are eutectic mixtures of biphenyl and biphenyl oxide and less well-defined mixtures of aromatic and/or aliphatic hydrocarbons.

Although in general, deodorizers using thermal oils are operated safely, there have been incidents in which thermal oils have leaked into refined oils. The Japanese incident (4) is the worst example of such an event, although here a different heating medium was used and to our knowledge is no longer used anywhere in the world. However, the incident illustrates that the risk of contamination exists. Furthermore, the analytical detection methods available are specific to each type of heating medium and therefore cannot be used to screen generally for contamination. The methods are difficult to apply routinely and, even if applied, levels of contamination of up to 100 ppm still could go undetected.

Our major concern in this area is the use of aromatic/aliphatic hydrocarbon type oils. Our investigations have shown that such oils are unstable in use. Polymerized products are formed and their level can be between 10 and 40% after 6 mo at temperatures of about 220 C. There also is a build-up of significant levels (1,000 ppm or more) of polyaromatic hydrocarbons. Because thermal oils of this type are different from each other in composition and because they will be used under different conditions it is not possible to predict concentrations of the degradation products in such oils.

Similar analyses done by our Research Laboratory on heating oils of the biphenyl/biphenyl oxide type indicate that these types of heating oils are stable in use with very low levels of polymer formation. Furthermore, biphenyl/biphenyl oxide mixtures have a well-defined composition, are more easily detected and have an extremely pungent odor.

If leakage occurs, it is likely that the major components of the heating oils will be removed during deodorization. However, it is unlikely that the higher molecular weight artifacts will be removed. On this basis, biphenyl/biphenyl oxide oils appear to be the preferred type (Table VI).

In view of our current knowledge, new deodorizers installed by Unilever are based on high pressure steam. We therefore strongly advise that the whole oils and fats industry adopt high pressure steam. Until such a position is achieved throughout the industry, a strong case can be made for purchasing RBD oils only from those suppliers using high pressure steam.

Transport

A last area of concern is cross contamination, which could occur during transport. This is not a problem just for palm oil (6). The introduction of processed palm oils and the subsequent use of simpler refining procedures by the receiver increase the risk that traces will not be removed. Unless dedicated tanks are used, it is our experience that contamination cannot be avoided.

The main problem seems to be that edible fats are transported in bulk and in ship tanks. Generally these ships have transported industrial materials on previous shipments. Unilever's experience is that when the previous cargo contained fat soluble chemicals they always can be found in the main cargo of fat after shipment, even when the normal stringent cleaning precautions have been taken. These conclusions are based on analyses made during 1983 on various shipments associated with one of our Unilever factories in Europe (7).

For example, the presence of volatile aromatic hydrocarbons was determined in oils where the previous cargo was known to be an aromatic hydrocarbon. From Table VII it follows that of the limited samples checked, minimal contamination has occurred.

Based on our present evidence of the levels of contamination currently encountered, we can say that full post-refining will reduce these to safe levels. However, if processed palm oils are purchased with the intention of applying a simplified refining procedure at the receiving site, much greater attention needs to be paid to both the ships' previous cargoes and to the cleaning procedures of the ships' tanks.

TABLE VII

Trace Contaminants in Palm Oils Arriving by Ship in Europe

Palm oil	Volatile aromatics ppm
Sumatra (crude)	1.4
Sumatra (crude)	2.57
Malaysian	0.08[a]

[a]RBD Palm oil.

TABLE VI

Characteristics of Thermal Oils

Property	Biphenyl/biphenyl oxide type of thermal oil	Aromatic hydrocarbons/aliphatic type of thermal oil
Volatility	High	Low
Thermal stability	High	Generation of polycylic aromatics
Detectability	100 ppm	Difficult at low levels
Effect of deodorization	Removed	P.A.H. formed are difficult to remove

TABLE VIII

Specifications Prior to Interesterification

Characteristic	Specification
FFA	0.01%
H_2O	0.01%
Fe	3.00 mg/kg
Cu	0.05 mg/kg
Color	3.50 R, 5¼" cell
Peroxide value	2.00 in eq.

The previous sections have dealt with the general requirements for crude and processed palm oils arriving in Europe in order to obtain oils of good general quality with acceptable refining yields and having little or no health hazard for the consumer.

The more specific applications of palm oil in the edible fats industry and the extent to which specifications can be defined is discussed in the following section.

PRODUCT APPLICATIONS

Margarines and Shortenings

Taking into account the climatic conditions and the housewives' preference in Europe, heat-resistance is no major problem. Convenience, such as spreadability, workability, flexibility, etc. are the major attributes for European margarines/shortenings.

It is well known that palm oil rich formulations will show post-hardening on storage. In general this can be overcome by interesterification with lauric or soft oils.

It is obvious that for this application the main requirements are a low FFA and moisture content. Any good crude, or neutral dry, palm oil as defined before, can be used for these applications.

For interesterification the specifications shown in Table VIII could be applied.

TABLE IX

Effect of Minor Components on Refined Oil Quality*

Minor component	Color	Frying or oxidative stability
Fe Cu	–	–
Tocopherol		+
Carotene	0	–
Oxidized carotene	–	– (?)
Oxidized lipids	–	– (?)
Phosphorus compounds	–	0 (?)
Partial glycerides	0	0/–
Soap	–	–
Bleaching earth (traces)	–	–

*Detrimental effect –; little or no effect 0; positive effect +.
These are only indications; a quantification of the effects is difficult to make.

Frying Fats

The quality of frying fats in Europe, particularly in the distributive trade, is judged in terms of good frying properties and color. For the latter the fat needs to be as white as possible and, therefore, we describe this edible fats area as the "white" fats area as distinct from the yellow fats for margarines. Obviously the main problem regarding the quality of refined palm oil for this application is the color of the frying fat.

Based on our experience, refined palm oils to be used as white frying fats should fulfill the following requirements:

- Color (Lov R 5¼")–1.
- Flavor–no off flavor after heating to 180 C.
- Smoke point–220 C after 40 hrs of frying at 180 C.

Unfortunately, little is known about the relationship between the quality of crude palm oil, refining methods and the color/frying properties of the refined palm oil.

It is assumed that oxidized lipids and their secondary products as well as oxidized carotenes have negative effects on the color of the refined oil. Carotenes, if not oxidized, can be removed effectively or decomposed by earth or by

TABLE X

Alkali Refining/Earth Bleaching Versus Physical Refining

	Alkali	Physical
Pretreatment	Not essential	"Degumming" to remove phospholipids and possibly other minor components
Chemical modifications of triglycerides	No	Possible
Removal of tocopherols (8)	29-72% remaining	43-99% remaining[a]
Carotenes (9)	Mainly chemisorbed by earth bleaching	Thermally degraded, mainly removed as volatile by-products
Other minor components	Range of components removed including water soluble contaminants	Volatile and thermally degradable volatile components removed
Color	Effective bleaching over a wide range of oil qualities by earth treatment after refining	Very effective with good quality oils. Generally not as effective as alkali
Flavor stability	Good, possibly slightly better than physical	Good
Refining factor	1.3	1.1

[a]Further complicated if these oils have to be post-refined.

TABLE XI

Requirements for Crude Palm Feedstocks Prior to Solvent Fractionation

Characteristic	Limits
FFA	≤3%
Fe	≤3 ppm
Cu	≤0.03 ppm
Totox	≤10
PPO	≤5
Diglycerides	≤5%

TABLE XII

Preferred Refining Conditions

		Deodorization	
Process	Soap level	Temp. C	Residence time
Caustic refining	50 ppm	240	60 min
Physical refining	–	270	30 min

heat bleaching and probably cause only minor problems, based on our current understanding.

One could estimate the effect of minor components in crude or semi-refined palm oils on refined oil quality characteristics for frying oils as shown in Table IX.

The only conclusion which can be drawn at present is that, again, the use of fresh, good quality palm oil is the main target for this application. Whether processed palm oils can be widely used depends on transport and storage conditions, reduction of Fe/Cu pickup, oxidation kept to a minimum and the refining process used.

For the last of these it is interesting to compare the effects of alkali versus physical refining, as in Table X.

For the industrial trade the quality of refined frying fats is judged mainly by using an accelerated oxidative stability test such as the Swift or Rancimat in order to determine the induction time.

For refined palm oils in general a Rancimat induction period of 35 hr at 100 C is seen as the minimum requirement.

Unfortunately, we have not found any correlation between the induction periods of crude and refined palm oils. The only "reasonable" correlations found were between the peroxide value of the crude oil and the Anisidine value of the bleached oil.

As far as we can judge at the moment, crude palm oils with a maximum Totox value of 10 appear to fulfill the induction period requirements. This assumes that the oil is refined correctly and transported with a minimum pickup of Fe and Cu.

Similar considerations are reflected in the use of palm olein as a frying oil.

Feedstocks for Fractionated Products

One of the main criteria here is that during processing the triglyceride composition should not change. Crude palm oils normally have a PPO content of below 5%, which should stay at that level before fractionation.

The main reason is that during solvent fractionation we aim to increase the symmetrical triglycerides in the palm mid-fraction as much as possible. Any increase in the asymmetrical triglycerides (PPO), due to interesterification, will lead to an increase of PPO in the mid-fraction which in turn will have a negative effect on quality.

Another factor that could have a negative influence on the quality of the mid-fraction is the presence of too high a level of partial glycerides. Although the use of acetone as solvent will result in a transfer of the major part of the partial glycerides into the palm olein, high levels in the feedstock will, nevertheless, lead to high levels in the mid-fraction. A side effect of this is that even when acceptable levels of partial glycerides are reached in the mid-fraction, too high levels could be obtained in the palm olein, degrading this fraction for use as a frying oil.

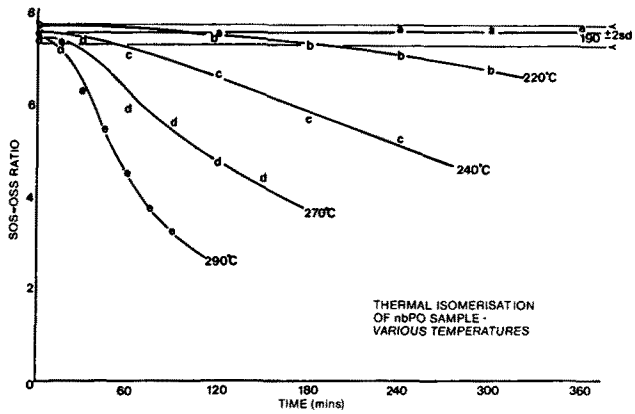

FIG. 2. Effect of time and temperature on the SOS:SSO ratio of palm oil (B. Jeffrey, Internal Unilever Paper).

Last but not least, as specialty fats are incorporated into food products for which long shelf lives normally are required, their oxidative stability should be excellent. This means that only palm oils of excellent quality can be used and measures should be taken to avoid the take up of oxidative catalysts, such as Fe and Cu, during transport prior to their use.

Good crude palm oil to be used in solvent fractionation for the production of palm mid-fraction is described in Table XI. Such a feedstock can be replaced by processed palm oils for this application. However, as already indicated special care has to be taken to avoid interesterification occurring during the refining process, leading to too high a level of unsymmetrical (PPO) triglyceride.

To avoid this, deodorization temperatures and residence times need to be limited. Prior to deodorization or physical refining it is necessary to ensure that interesterification catalysts such as soap or bleaching earth particles are not in the pretreated oil. Based on our experience, interesterification can be avoided when the process parameters shown in Table XII are applied.

As can be seen from Figure 2, longer residence times at these temperatures will result in interesterification, making the processed palm oil unacceptable for production of palm mid-fraction (10).

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Session IX discussion

The following questions, answers and comments were made at the informal discussion held the final day of the conference.

Q: Assuming endorsement of the recommended practice by various international associations, what role does PORIM plan to implement or play in future regarding updating the recommended practices?

Berger: It is intended to be a continuous thing by printing the recommended practice when endorsed by international agencies. It will be reviewed every two years and also offered to Codex for its approval.

Q: When will the guidelines on tanks, pipelines and operations be available?

Berger: They have been published and available since 18 months ago from PORIM. New guidelines can be obtained in about six months.

Q: What should be done when large quantities of water are found in bulk shipments of crude oil? Shipper refuses to take any liability although oil was sampled and analyzed at loading point by independent surveyors.

Berger: It is important to establish the type and amount of water present and then to take up arbitration. These procedures are commonly adhered to in the commercial world. Excess water results in excess weight, and the insurers must at least be held answerable.

Subramaniam: The quantity of water must be determined and arbitrated for a proper solution.

Q: Can the guidelines proposed for producers, transporters and storage warehouses also include disclosures of antioxidant used in the edible oils and industrial grade oils of commercial value? As a point of fact saturated oils and fats including cocoa butter substitutes fare better during transportation when protected by antioxidants.

Berger: The addition of antioxidants to saturated oils will improve stability. The seller must declare the addition of any antioxidants in accordance with the prevailing food laws.

Q: What are the antioxidant mechanisms of tocopherol, lecithin and the lecithin-citric acid additives? What levels of tocopherols are present in palm oil? Do you need antioxidant in CPO?

Berger: Lecithin is a metal chelating agent. It can act as a pro-oxidant in certain conditions. Chemical antioxidants interrupt the free radical mechanism of oxidation. Tocopherol content is 500 ppm in palm oil. Citric acid is added to CPO for better keepability.

Comment, B. Chapman: Addition to CPO is beneficial. However, contractually, addition can be disputed if not requested by the buyer.

Q: Are analytical methods available for the detection of palm olein in palm kernel oil?

Fujii: This is easily detected by gas chromatography which is fairly precise in identifying these admixtures.

Q: It is said that the palm oil users in USA prefer a colorless oil. Why do they need such an oil and how can such an oil be produced?

Berger: The light colored palm oil is required in USA mostly as a comparative replacer for hydrogenated SBO. To produce such a light oil one must start with a good crude oil since bleachability relates to oxidation and, in turn, oxidation to iron contamination. Iron content can be reduced by redesigning the oil mill, for example by the use of magnetic traps in the pipeline leading to oil storage. Low iron content is particularly important in the fractionation of stearin.

Q: Is there a danger of inspectors entering nitrogen filled tanks which contain insufficient oxygen to sustain life when nitrogen sparging is used? As nitrogen has no smell or color, the inspectors would be unaware of the danger and perhaps not afterward have the strength to climb out. How can these dangers be avoided?

Subramaniam: No danger, since the ship has to produce a gas free certificate before inspector goes into the tank.

Q: What should a buyer do when a difference in invoice weight and weight after unloading is noticed? Cargo was surveyed both at loading and unloading point for both quality and quantity. As usual, material was purchased against L.C. and the supplier is not prepared to take any liability in case of shortages reported by buyer. As far as tonnage is concerned it is an approximate measure of volume, never giving correct figures.

Subramaniam: Normal shortages are to be expected in any shipments. Abnormal shortages then must have a reason. Shipments which are short must be investigated individually and case by case. This is based on shore weights which are reasonably accurate. Landed weights are accounted for when recovery from insurance for shortage is claimed.

Q: Can Mr. Subramaniam elaborate on the storage of samples, after they are taken, so that the samples do not deterioriate or change, and become unrepresentative of the bulk oil? FOSFA contracts require independent surveyors' samples taken on behalf of both buyer and seller. This aspect seemed not to be mentioned in the talk. Please give your views.

Subramaniam: Samples immediately sent for analysis after bottling in glass bottles. Store the samples in a dark and cool place to avoid deterioration. The views of both the independent surveyors will be taken into consideration under such circumstances.

Q: In certain end product applications, a color of max 1 red in 5¼" cell is required. How can this be achieved from imported RBD oil, as the color will not have been substantially fixed during the original processing?

Sakata: We carry out the instrument of refining process, degumming process, under vacuum in pretreatment unit, neutralization and bleaching processes. The limitation of color of the refined oil is less than 1.3 red. The color of deodorized oil is approximately 1.0 red.

Q: Please explain good manufacture quality (GMQ) from consumer's point of view in some detail. I would also like to hear PORIM's view on GMQ.

Willems: Purchaser stipulates GMQ to safeguard himself since he cannot stipulate all the quality aspects. For example, if a shipment of palm oil has been adulterated, the buyer would not be able to foresee the adulteration, accidental or otherwise, and hence has to arbitrate on the basis of GMQ only.

Berger: The trade accepts GMQ in trade contracts but GMQ does not provide the quantitative limits for measurements.

B. Chapman: The more details you have in the contract the more difficult it becomes to arbitrate on quality. From the buyer's point of view GMQ acts as a safeguard and hence is employed in all quality disputes.

Rossell: Efforts to quantify GMQ in a list of suitable criteria are not sufficient, as it may be that some contaminant may be left out of the list. The case of methyl acrylate which combined chemically with the oil and was not detectable by normal tests is mentioned as a good example.

Q: If the oil needs re-refining in Europe is there any point in refining to FFA 0.1% max and color 3 red? Would it not be better to refine in Malaysia to a moderate FFA e.g. 0.2%-0.5% with the aim to produce an oil which can be cheaply reprocessed to the European oil specifications?

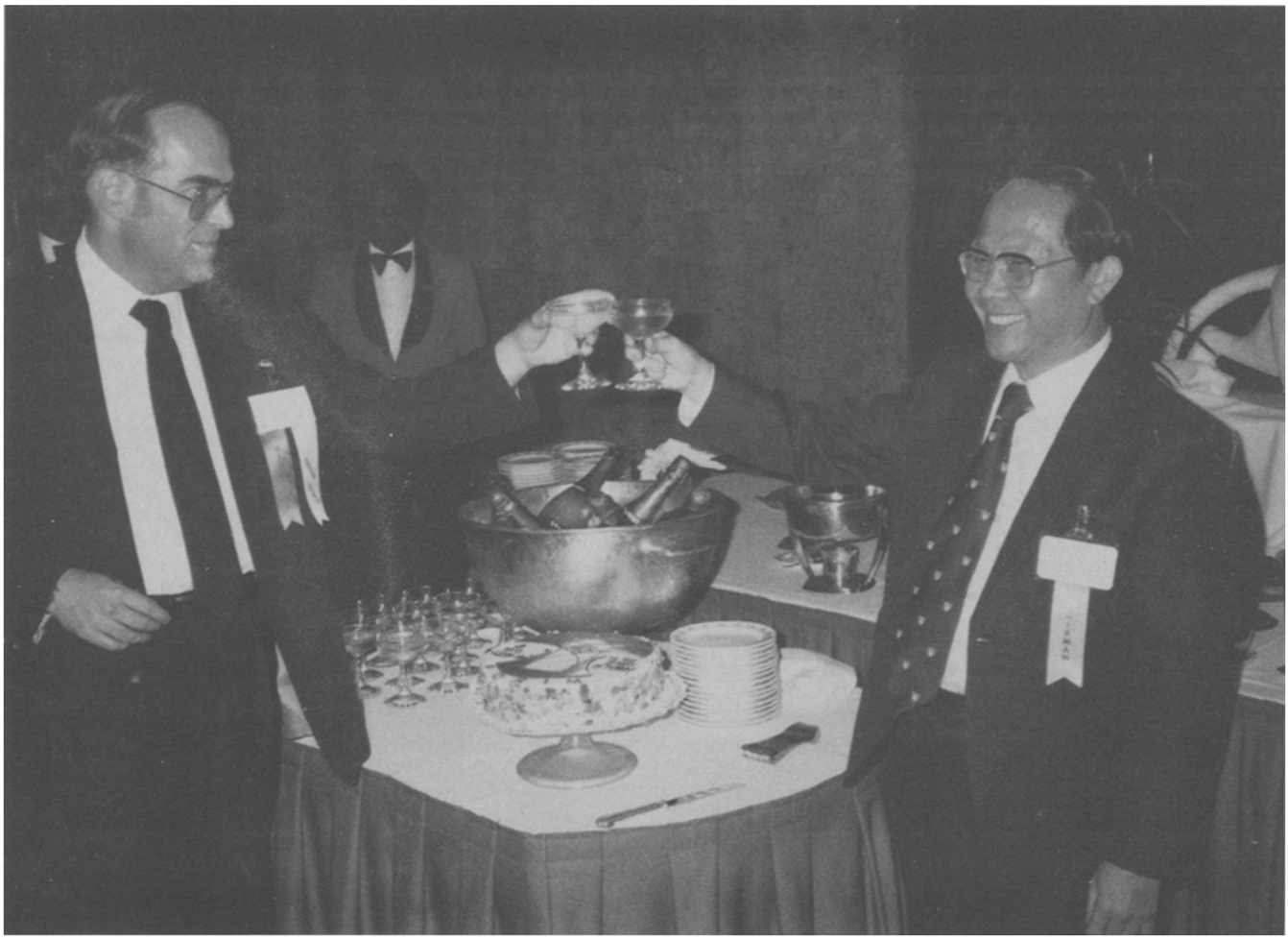
Willems: European users will consider the benefits of re-refining the imported oil to best fit their commercial application. Re-refining may be required since it is possible that the oil had picked up metal contamination during transport.

B. Chapman: The buyers, unfortunately, do not usually indicate the exact end use of the oil. If duly informed,the refiner can aim to meet the landed specifications of the buyer.

Berger: The chain of export is often complex but when help is offered to the buyers to assure quality, it is often sadly neglected.

Taylor: The European refiner is often subjected to constant rejection of his oil supply by the European end user if the oil is a few days old. In moving the oil across to Europe, the oil often has to be re-refined. The customer has to do with what the seller has to offer.

Rossell: A variety of deodorization and physical refining conditions were used, and guidelines for safe processing were drawn up. There were not more than 30 minutes at 280 C and not more than 2 hrs at 260 C.



Program cochairman David Tandy and closing speaker Augustine Ong exchange toast at conclusion of conference

Closing Address

AUGUSTINE S.H. ONG
Palm Oil Research Institute of Malaysia

We have now come to the end of a full week of lectures, discussions and social interactions and the state-of-the-art on the processing technology of palm, palm kernel and coconut oil. The conference theme has restricted the discussion on current established technology and it is of course very important to all of us. The question now is "Quo vadis?" I would like to attempt to outline the world scenario on the oils and fats situation and the anticipated scientific and technological developments in the near future. The world population is expected to increase to 6.1 billion by the year 2000 and, assuming that the consumption of oils and fats is 15.6 kg per capita per year, the world will require 94.7 million tons of oils and fats. This represents an increase of 29.1 million tons of oils and fats required to meet the additional need and, assuming that 13 million tons will come from palm oil and palm kernel oil, one would have to increase the hectarage of oil palm to 3.0 million hectares assuming a yield of 4.4 tons/ha/year. The cost of developing 3.0 million hectares of oil palms would be U.S. $7.5 billion.

With an increase in population it is expected that the usage of soaps and detergents will increase, particularly if there is a concomitant increase in the standard of living of the people. The overall surfactant market for the United States, Western Europe and Japan is about 5 million tons in 1982 with a growth rate of 2-3% per year. The annual consumption per capita is 5 kg in Western Europe and Japan and 11 kg in the U.S.A. If the average world consumption by the year 2000 is 2 kg/caput/yr the total consumption is expected to reach 12.3 million tons per year. This opens up opportunities for both palm and lauric oils.

Recent phenomenon has surfaced which indicates that the energy required by the world should come from renewable sources. Nobel Laureate Melvin Calvin indicated in his recent address in Taiwan that there is a buildup of carbon dioxide layer in the atmosphere resulting in an increase in temperature which has caused a significant impact on the climatic conditions of the world. He has proposed that carbon dioxide emitted from combustion engines should be recycled. This can be achieved if energy is derived from renewable resources such as plants. One possibility is to use methyl esters from palm oil which has been shown in the preliminary study by PORIM to be suitable for current diesel engines without any modification. Further, the Cetane index is about 50, which is acceptable. The quality of diesel fuel in some countries of the world has been going down with a Cetane index of 30. There are other advantages in

using methyl esters in terms of environmental pollution. If the world turns to vegetable oil, particularly palm oil, for its fuel needs, then the development of the oil palm industry will be astronomical.

If all the above needs are met by the oil palms and coconuts, the industry will provide opportunities for employment to the people. In countries where oil palms and coconuts can be cultivated, and these happen to be the developing countries of the world, this possible development will be very beneficial to the Third World.

I would like to do some crystal ball gazing with regard to the scientific and technological developments in oils and fats.

Biotechnology is considered to have much relevance to the oil palm and coconut industries. Tissue culture propagation of oil palm and coconut already has been successful, and in the case of oil palm great progress has been made. However, efforts are being made to apply the technique of genetic engineering to the oil palm with the objective of further improvement in terms of yields and quality of the palm oil as well as the qualities of the palms. A start in this direction already has been taken in a collaborative research program by PORIM and the University of Malaya in attempting to unravel the pathways in the biosynthesis of palm oil and in the isolation of protoplasts from the mesocarp of the palm fruit.

The conference has indicated the potential of enzymatic reactions in the processing of palm oil and other vegetable oils such as splitting of oils and fats by immobilized lipase and interesterification of oils and fats in producing specialty products. In the area of effluent treatment, advances in the anaerobic digestion are anticipated and development in the utilization of biogas for production of energy and other useful products is actively pursued. Study on the conversion of sterilizer condensate from palm oil mills into microbial protein and exoenzymes which could be used in the extraction of palm oil at the mill has been initiated.

Palm oil milling technology offers much opportunity for improvement, particularly in automation and conservation of energy. A review paper has been presented to the conference which points to future development in this area. It is imperative that automation be used so that greater efficiency of operation and higher quality of product can be ensured.

There is much opportunity for mechanization in the harvesting of the fruits and in field transportation. Initial effort has been made in improving the harvesting pole but significant developments are yet to come. Do robotics have a role in this area?

The processes used in the palm oil industries have been imported, and these were developed for other vegetable oils and fats. Greater understanding of the properties of palm oil and its behavior in the unit processes are likely to indicate the optimum conditions for treatment resulting in better efficiency of operation and higher quality of product. Some new processes are expected in the refining industry including those where energy could be saved. Supercritical fluid extraction technology has been applied successfully to extraction of caffeine from green coffee beans, fruits, aroma oils, flavors, spice oils, pharmaceuticals, mineral oils and vegetable fats and oils. Claims have been made for extraction of carotene from palm oil and vitamin E from palm leaves. Hence, possibilities of application to palm oil, palm kernel oil, coconut oil and the plant tissues exist.

Efforts directed at improving the present quality of palm oil have been made with vigor and enthusiasm. However, an holistic approach to quality assurance is being considered, and the implementation of this scheme could be interesting; its effects are likely to be known in the next few years.

Indications have been forthcoming to show that carotenes and phytoenes have possible anti-cancer properties. These are present in palm oil. Further, palm oil has been demonstrated by Limburg University in Holland to be anti-atherosclerotic and anti-thrombotic. Further experimentation is required, and if these findings are confirmed, palm oil could be looked upon as a health food.

Using palm oil as a renewable resource for diesel fuel has been undertaken by Malaysia and, if proven to be viable, this would open a tremendous area for application.

In the oil palm industry, less than 20% of the biomass is extracted. Efforts are being directed to optimum utilization of these by-products by conversion to sources of energy, chip boards, sources of pharmaceuticals, media for mushroom cultivation, etc.

If most of these ideas come to fruition in the next few years, ladies and gentlemen, I am sure you will agree with me that we have good reasons to have another conference on palm, palm kernel and coconut oils and, if I may add, cocoa, in this region.

Finally, on behalf of our Conference Honorary President Y.B. Tan Sri Datuk Dr. Anuwar B. Mahmud, I would like to take this opportunity to thank the American Oil Chemists' Society again for choosing Malaysia for this world conference. I also would like to thank:

—The Technical Committee for arranging the excellent program.

—The Local Program Committee and AOCS and PORIM staff for the hard work and efforts put into the local organization.

—The co-chairmen of sessions for conducting the discussion so ably.

—The speakers from overseas and from the local institutions, without whose contribution there would be no conference.

—The various organizations which supported us through the exhibition and which have been providing information on the latest technology.

—Donors who contributed various items for the conference.

—Last but not least, to all participants, both local and overseas, who have made this conference a success, we look forward to your continued support in our future activities.

—Finally all those who have contributed in one way or another to the conference.

To sum up our feelings, may I recite a poem (pantun) well known in our culture.

Pisang Emas Dibawa Belayar
Masak Sebiji Di atas Peti
Hutang Emas Boleh Dibayar
Hutang Budi Dibawa Mati

With gold bananas away we sail,
One banana ripens on the way,
Debt in gold can we repay,
Debt in gratitude will forever stay.

Ladies and gentlemen, it is with great pleasure that I declare this conference closed.