Highlights of Research on Non-food Uses of Palm Oil and Analytical Aspects

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NON-FOOD USES

Oils and fats are converted into fatty acids and other derivatives for use in lubricants, plastics, resins, soap, surfactants, fuel, cosmetics, toiletries and textile chemicals. The Chemistry and Technology Division has started research in this area to optimize and enhance the usage of palm oil in oleochemicals for the above applications. Among the topics being studied are:

Survey on Characteristics of Malaysian Palm Fatty Acid Distillates (PFAD) and Palm Acid Oil (Soapstock)

The main objective of this project is to characterise the properties of the by-product, PFAD obtained in the physical refining process of palm oil. The PFAD samples received were grouped into four types based on feedstock-namely; palm oil, palm olein, palm stearin and mixed. The parameters analysed are titre value, iodine value, moisture content, alkyl group distribution, saponifiable and unsaponifiable matters. These are generally very much dependent on the starting material of the refining process. A comparatively high concentration of tocopherols and tocotrienols in the PFAD accounts for the loss of these materials from the oil at the deodorisation stage of the process. The PFAD drawn direct from the plant contains very low metal content.

Laboratory Scale Soap Making Process

The main objective is to simulate soap making process using palm oil/palm oil products and to define some of the problems related to the quality of soap produced.

Installation and commissioning of the soap machines have been completed and the machines are now fully operational. The operating manual of the machines has been prepared.

The future activities of this project have been devised and these include standardisation of test methods for quality evaluation of soaps, formulation of soap using palm oil/palm oil products especially palm stearin and solving problems in using palm oil and palm oil derived fatty acids for pure white soap.

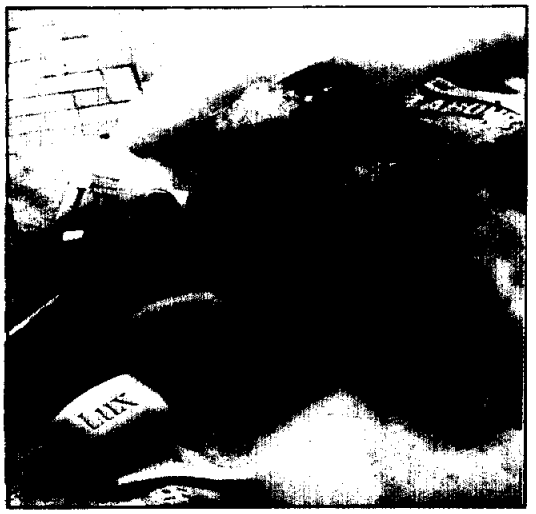
Epoxidised Palm Oil and Palm Stearin as Plastisizers and for Stabilizers.

Two methods of producing the epoxidising reagent have been studied *i.e.* peroxy formic acid and preformed peroxy acetic acid. The latter gives comparatively higher degree of epoxidation than the former. The degree of epoxidation reaches maximum after 3–4 hours. Preliminary studies indicate that a complete oxidation can be obtained using a 5:1 molar ratio of peroxy acetic acid to unsaturation.

The epoxidised products have been sent for evaluation as stabiliser in PVC. Future work includes optimizing conditions for the formation of the peracids and for complete epoxidation, structure determination and the effects of carotenes and other minor components on epoxidation and the epoxidised products.

Production of Methyl Esters from Crude Palm Oil/Palm Oil Products as a Diesel Substitute

Production of methyl esters from crude palm oil and crude palm stearin has been ex-



Some non food uses of palm oil

tended to a pilot plant scale at 60–70 kg/run. The data obtained are consistent with the findings in the laboratory, 100% of the triglycerides have reacted to give more than 95% methyl esters. The separation of glycerine by decantation has been demonstrated and the expected recovery of methanol from the esters could be achieved by vacuum distillation. Work on the construction of a pilot plant with a capacity of 3,000 tonnes per annum is 90% completed.

Engine testings on land cruiser, tractor, lorry, taxis and water pump have been carried out using methyl esters obtained from RBD palm oil. Active research in this aspect has indicated that the esters have potential not only as a source of feedstock in the oleochemical industry but also as fuel.

Effective Utilisation of Oils and Fats Produced in Tropical Plants

This project is divided into two parts with the main objectives of studying the novel utilisation of palm oil and its fatty acids and the utilisation of carotenes found in palm oil. RBD palm stearin has been used to study the oxidative cleavage using a small quantity of the different metal exchanged zeolites. It has been found that zeolite-nickel has the best cleaving power of the C_{16} group of the triglycerides. The cleavage of C–O or O–C bonds has been of great interest. Identification of the product(s) is under study in order to have a greater insight into the position of the cleavage and the reaction mechanism.

A molecular distillation apparatus has been set up and work on the separation of carotene from crude palm oil has been attempted. Up to now, about 40% of the carotenes could be recovered. Efforts in higher recovery is in progress.

Survey on Application of Fatty Acids and their Derivatives

The main objective is to gather information on the volume and type of fatty acids, fatty alcohols, fatty amines and their derivatives going into major groups of end products.

A literature survey on the oleochemicals in general has been completed. A preliminary report on the current status of oleochemical industry in Japan has been compiled. An officer involved in this project has spent some time in one of the leading oleochemical companies in Japan to acquire some bench experience in various steps of oleochemical processes. Similar information has been gathered in some of the EEC countries and U.S.A.

ANALYTICAL

The Chemistry and Technology Division has trained staff for research into lipid methodology and analysis using modern equipment. Analyses into the quality, composition and properties of palm oil are also conducted. Among the topics covered are:

Quality Control Crosschecks

The first PORIM Quality Control Crosscheck carried out in December 1982 has been a useful exercise for refineries and millers in assessing the accuracy and the precision of individual laboratories. The second and third trials carried out in 1983 and 1984 included overseas participants. We have also participated in the AOCS Smalley crossheck programmes to ensure that our own performance is internationally accepted.

Effects of Metals and Moisture on Stability of Palm Oil

In order to enhance the keepability of crude palm oil, there is a need to understand the interplay between the metal-catalysed autoxidation and the autocatalytic hydrolysis of the oil. A few studies have been made in the past to elucidate the situation in the open system. Attempts are being made to supplement these data for the closed system.

Physical Measurements

Physical parameters are also currently being determined for various types of oils and their fractions. Density tables are being prepared for crude and refined palm oil. Steps will be taken to determine other physical measurements in the future. Certain measurements could be instrumentalised. An automated cloud point turbidimeter has been designed and fabricated and in general the cloud points determined on the turbidimeter were found to be in good agreement with those determined by the official AOCS method. A multisample turbidimeter equipped with automatic data acquisition and experimental condition control is being devised.

Colour Reversion in Frying Oils

Studies on coloured components in frying oils lead to several conclusions. The different batches of crude oils from the same sources may show significantly different behaviour to colour darkening on refining. The use of different bleaching earths did not affect the rate of colour darkening significantly. It has been found that the colour causing components in crude oils were effectively removed by adsorption onto activated carbon. However, after physical refining these components were modified or changed in such a way that activated carbon could no longer remove them. Water washing of crude palm oil before physical refining is effective in this connection. All heated oils, though highly coloured to the eye, did not absorb with max in the visible region of spectrum but in the 230–300 nm region.

Determination of Metal Content

Atomic absorption spectrophotometry is being used to measure trace metal contents in palm oil and palm oil products. The method is simple, rapid and practical for routine analyses.

Method development for nickel content has been carried out. The possible use of the less sensitive line of nickel, 305 nm for measurement of samples with a high nickel content using flameless method has been investigated. This method not only extends the dynamic range of Ni analysis but is very simple and to some degree, reduces the background absorption due to smoke formation. Analysis of lead by the same technique is currently being studied.