

# SOAP

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## INTRODUCTION

The most crucial components of soap are the C12-C18 fatty acids which contribute to detergency, cleansing power and foamability of the final product. Palm oil and palm kernel oil are the major sources for C16 – C18 and C12 – C14 fatty acids respectively. A combination of palm oil and palm kernel oil in appropriate proportions is necessary to produce a good quality soap.

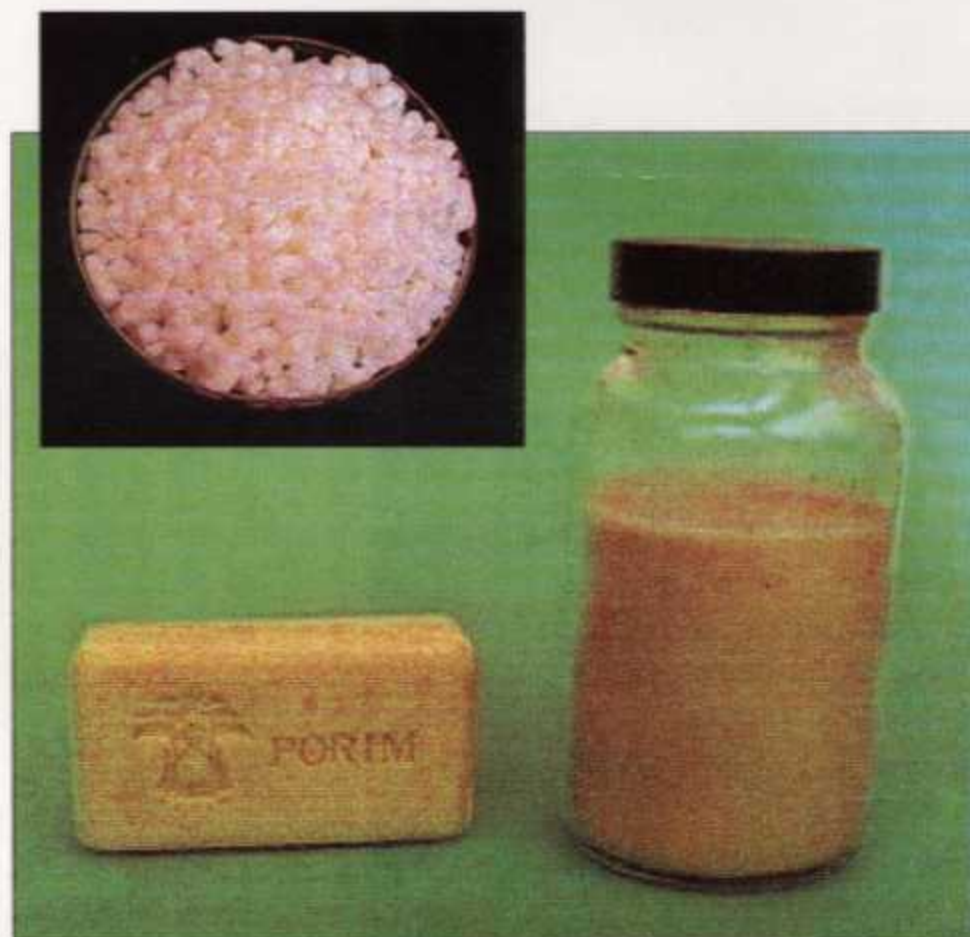
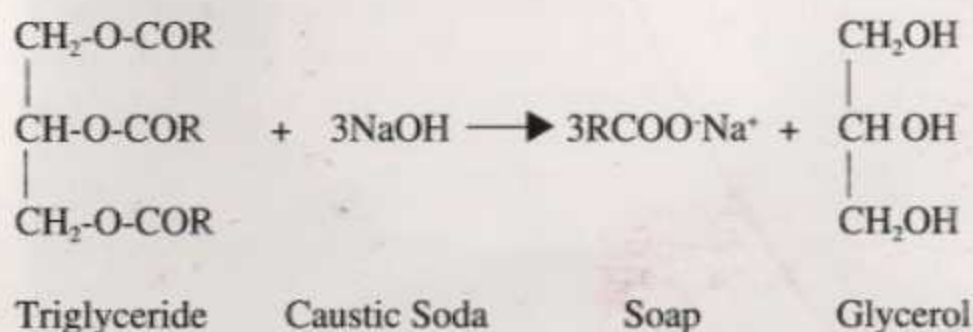
The use of palm oil (PO) and palm kernel oil (PK) in Malaysian soap formulations is well established. Palm stearin (POs), being the cheapest fraction of palm oil, has gained popularity as a raw material in the making of both body and laundry soaps. Due to its nature, palm stearin cannot be used, by itself, to make good body soap because it has a high titre and the soap produced are very hard with poor solubility. Incorporation of POs in toilet soap formulations requires a proper blending of the POs with other oils/fats to obtain finished products of a desired titre. With the growth of the palm kernel oil industry, substantial quantities of palm kernel olein (PKOo) are available as a cheap byproduct from the fractionation of PK for the desired and valuable palm kernel stearin (PKOs). PKOo can also be blended with POs in an appropriate proportion to produce body soap of acceptable quality.

## SOAP MAKING PROCESS

Soap making is basically the interaction of caustic alkali or alkali carbonate with neutral oils (saponification) or the direct neutralization of fatty acids. Soap is also produced by saponification of methyl esters of fatty acids.

### Saponification Process

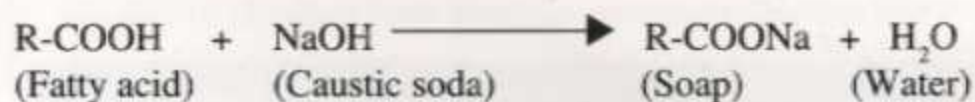
Saponification is the most popular and widely practised process in soap making. Industrially, saponification of oils/fats is carried out either batch-wise in kettles or via more efficient continuous processes.



Soap noodles from palm products

### Neutralization Process

Neutralization of fatty acids with alkali metal hydroxides or carbonates is a straightforward and rapid reaction which can be carried out batch-wise or continuously. The neutralization process follows the pathway:

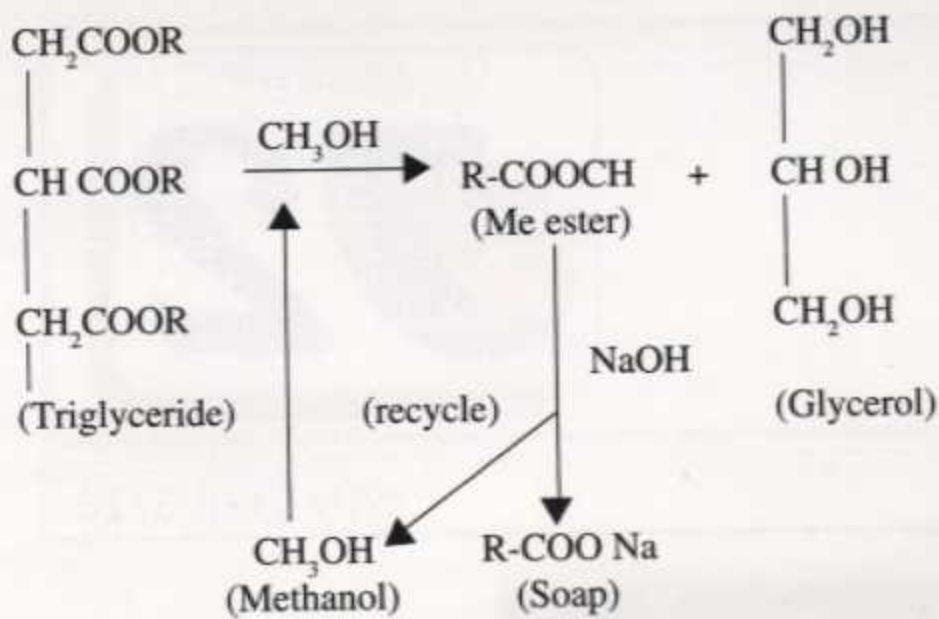


### Saponification of Methyl Esters of Fatty Acids

A few companies have manufactured bath soap from methyl ester of fatty acids using the saponification process. First, methyl esters are obtained by transesterifying of the oils/fats with methanol. The methyl esters are then saponified with sodium hydroxide. The two reactions are schematically shown as follows:-

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Glycerine of about 60% purity is recovered and purified into a valuable byproduct while the methanol is recycled. The soap obtained from this process is of high quality because almost all the unsaponifiable matter is eliminated in sediment. Since the overall process is carried out at a relatively low temperature, the soap produced is less prone to oxidation.

### Cold Process

This is a traditional method of soap making in which fat is reacted with excess alkali to ensure complete saponification. The soap mass is allowed to solidify to the final product containing lye, nigre and neat soap. As no glycerine is recovered, the process is not economical. Moreover, the impurities are not removed and the product is of variable quality, unlike soap made by the full boiled process. This method is generally used for making lauric soaps.

## PROCESSING OF NEAT SOAP

Processing of neat soap into soap bars involves the following steps:

- Drying the neat soap to moisture content of 12%-15%.
- Milling the neat soap into refined pellets.
- Plodding and compacting of the refined pellets into a continuous billet free from entrapped air.
- Cutting the continuously extruded slug into a predetermined length.
- Stamping the predetermined length of soap into desired shape.



Mixture of fatty acids from palm products and the resulting soaps.



Soap from blend of distilled 40% palm oil, 40% palm stearin and 20% palm kernel oil fatty acids.

### Parameters for Soap Raw Material

- *Saponification colour value (SCV)*

This measures the colour of saponified oil in a colorimeter using a 5¼ inches Lovibond cell and indicates the whiteness of the finished product. For refined, bleached and deodorized palm oil, the SCV ranges from 5 – 9 R. The SCV for distilled palm-based fatty acids is generally < 3 R. The recommended maximum SCV for pure white soap is 3 R.

- *Saponification/Acid value*

This is the amount of alkali required for complete saponification/neutralization of fats/oils or fatty acids respectively.

- *Iodine value*

This measures the degree of unsaturation, and is mainly due to oleic, linoleic and linolenic acids in the oil/fat. The degree of unsaturation influences the solubility, hardness and resistance of soap against oxidative deterioration.

- *Titre*

It is the solidification point of fats/oils or fatty acids. The titre gives an idea of the hardness of the soap and its foaming quality



Neat soap from palm products.

(hard soaps foam less). The titre of body soap is usually lower than that of laundry soaps. Tallow-based soaps have titres of less than 40°C compared to palm-based soaps which have titres of 40°C – 45°C. However, the titre of palm-based soaps can be reduced by blending with other oils in the process soap making.

- *Unsaponifiable Matter*

This indicates the amount of non-fatty acid material in fats and oils. This material cannot be neutralized and its presence affects the quality of the final product.

## PALM SOAP BASES

### Commercial Samples

Palm-based soaps commonly found in the Malaysian market are made from blends of palm oil and palm kernel oil or distilled palm oil and PK fatty acid. The ratios of the blends are either 80 PO: 20 PK or 85 PO: 15 PK fatty acid. The characteristics of this soap are shown in *Table 1*. However with the availability of palm stearin, another popular blend is 40PO:40POs:20PK or 70POs:30PK.

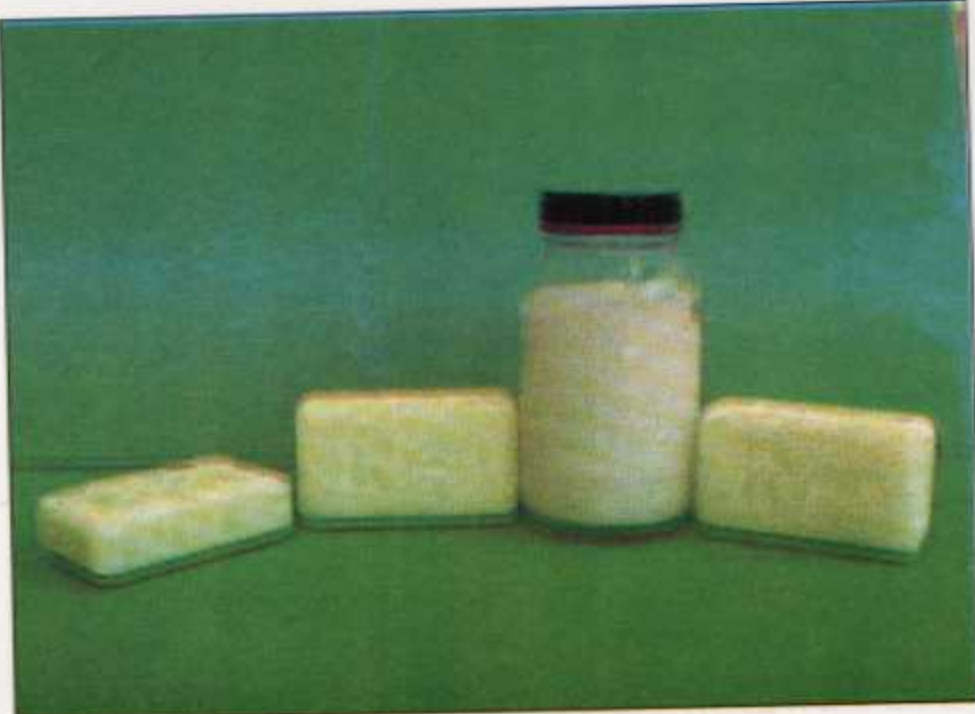
### Palm Oil (PO)

The C12 – C14 fatty acid content of soaps made from a blend of distilled PO and PK fatty acids increases with increasing amount of distilled palm kernel fatty acid used, and, similarly, the content of C16 – C18 fatty acid increases with the amount of distilled palm oil fatty acid used. The acid value of the soaps increases with increasing amounts of PK, while the reverse is observed for iodine value and titre. Soap hardness increases with increasing PK, and the foamability or lathering properties increases with the amount of PK (C12 – C14) fatty acids in the blends. The total fatty matter of the blends ranges from 76% for 100% PK to 85% for a blend of 70 PO: 30 PK, free caustic is 0.1% and sodium chloride content is 0.3% – 0.4%.

### Palm Stearin (POs)

Besides palm oil, palm stearin is another cheap raw material for soap making. In a study on soaps made from blends of distilled POs and PK fatty acids, the acid values of the blends decrease linearly with the amounts of distilled POs fatty acids while the reverse is observed for the titre and iodine values. The colour of the refined, bleached distilled fatty acids blends range between 0.1R-0.3R and the saponification colour value between 0.6R – 1.2 R.

The degree of whiteness of the soap blends ranges from 85% - 88%, while the limit for a good pure white soap is 80%. Free caustic is 0.1, total fatty matter is greater than 80% which is higher than required in some countries. The sodium chloride content is 0.3%. The volume of initial foam is good and the foam increases with an increasing amount of PK. POs/PK soap blends are slightly harder than PO/PK soap. However, this hardness can be tempered by blending the POs with other soft oils or tallow to produce a less hard soap. The best POs/PK blend is in the ratio of 60POs:40PK which has properties almost similar to commercial samples.



*Distilled fatty acids from palm products and the resulting soaps.*

In an earlier study by Hamirin *et al.* (1988) blending palm stearin with tallow (T) and PK showed that a blend of 40POs:40T:20PK gave a titre of 41°C and a foamability comparable to that of 80T:20PK. In a separate study, palm stearin was blended with palm oil and palm kernel oil. The blend 40POs:40PO:20PK has a higher titre (45°C) than a similar blend using tallow (41°C) instead of PO. However the soap produced is of good quality. In another study, soaps made from blends of POs and palm kernel olein (PKo), showed that a blend of 50POs:50PKo gave a titre of 40.4°C and has the highest volume of foam among all the soaps.

### Superfatting

Soap hardness and cracking are two important phenomena which have to be avoided. Raw materials with low iodine value tend to have a high titre and the tendency to produce hard soap. Cracking in soaps is because of a few factors, such as bar design, degree of distortion during stamping, efficiency of the finishing soap line and nature of additives. There are two types of cracking, namely, dry and wet crackings. Dry cracks are due to fissures formed by air trapped in the soap at the final extrusion. Wet cracks are fissures which develop in soap bars when submerged in water during in-wash usage.

These two phenomena can be overcome by superfatting the neat soap. Superfatting is the addition of soap raw materials, either oils/fats or distilled fatty acids, in excess of the stoichiometric needs of the neutralising alkali. This will improve the texture of soap and minimize cracking by imparting a plastic effect. Superfatting also improves other soap properties.

The addition of superfatting agents, such as coconut oil, palm kernel olein, glycerine, olive oil and canola oil to palm stearin soap bases of 40 PO:4 POs: 20 PK and 70 POs: 30 PK gave better quality soaps free from wet and dry crackings. The optimum amount of superfatting agent was 2%. Adding more than 2% glycerine caused the neat soap to become sticky and difficult to handle.

### Perfuming Palm-Based Soap

In general, a freshly made good quality palm-based soap from neutral fats/oils has a sharp/clean odour while a soap from fatty

acids has a sharp/fatty odour (Davies, 1990). Even an odourless soap base may develop malodour upon ageing and therefore it is necessary to mask this odour through perfuming. Besides masking base odour, perfuming of soap is also to meet the consumers' demand for a soap which gives a nice, clean and healthy scent.

In PORIM, the effect of perfume on palm-based soaps is evaluated by storing the perfumed soap and control at 0°C, 25°C (ambient temperature), 40°C and 60°C. Three tests are normally carried out to observe the effect of perfume incorporation.

- The intensity of the perfume in soaps is assessed on a score of 1-9. The intensity ranges from absence to slight, moderate and strong. Perfumed soap stored at 0°C is used as a standard, representative of a fresh sample.
- Besides perfume intensity, perfume performance is also evaluated using the magnitude estimation test. In this test, each panel member is asked to take a short sniff of each bar and to assign numbers proportional to the pleasantness of the scent in each soap.
- The change of colour of palm-based soap with time is monitored using a Colour and Colour Difference Meter because the difference is impossible to detect by normal eye. The result is expressed as Hunter whiteness. The unperfumed soap is used as control to detect any colour changes during storage.

Study on the effect of perfume in soaps made from blends of distilled PO/PK and tallow/coconut fatty acids showed that the intensity was higher in palm-based soap than in tallow-based soap, indicating that palm base has less base odour. The perfume incorporated in palm-based and tallow-based soaps has comparable effect on the Hunter whiteness during storage at the three chosen temperatures.

In summary, the quality of body soaps made from palm products

**TABLE 1. CHARACTERISTICS OF SOME PALM-BASED SOAPS**

Fatty Acid Composition (wt %)		Quality Parameter	
8:0	< 1	IV	39 - 43.8
10:0	< 1	Titre (°C)	39.2-43.2
12:0	7-14	Free caustic/acid	< 0.1
14:0	3.5 - 6	Moisture (%)	6 - 9
16:0	37-44.7	Hardness	19 - 32
16:1	0.05-0.2	NaCl (%)	< 1
18:0	30-33.6	Total Fatty matter (%)	83 - 86
18:1	30-33.6	Foamability (ml)	460/295*
18:2	6.5-7.5	Hunter whiteness	81.4 - 86.4
18:3	~ 0.1		
20:0	< 0.5		
others	~ 0.2		

\*Volume of foam (ml) measured after five minutes

is very high as can be seen from the properties of the commercial samples in *Table 1*. Soap made from palm stearin is hard but when palm stearin is mixed with other soft oils can produce a reasonably good quality body soap. Perfume performance and retention in palm-based soap is comparable to that in tallow-based soaps.

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