

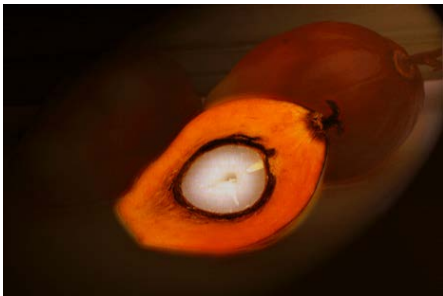
# About *Palm Oil*



## PALM OIL

### General Description

Palm oil is extracted from the mesocarp of the fruit of an oil palm species called *Elaeis guineensis*. In Malaysia, the high yielding tenera, which is a cross between dura and pisifera species, is the most commonly cultivated palm tree. The Malaysian palm oil contributes to about 13% of total vegetable oil production in the world in 2011. Basically, there are two main products of the palm oil industry – palm oil and palm kernel oil. Out of these, many products could be derived. Crude palm oil is normally processed by a physical refining process in which the oil is turned into a golden yellow refined oil for further end use applications.



### Properties of Palm Oil

Palm oil has a balanced fatty acid composition in which the level of saturated fatty acids is almost equal to that of the unsaturated fatty acids. Palmitic acid (44%-45%) and oleic acid (39%-40%) are the major component acids, with linoleic acid (10%-11%) and only a trace amount of linolenic acid. The low level of linoleic acid and virtual absence of linolenic acid make the oil relatively stable to oxidative deterioration. Several surveys conducted by MPOB have showed that the Malaysian palm oil has a narrow compositional range. The specifications for the palm oil are given in Malaysian Standard MS814:2007 (Table 2).

TABLE 2: IDENTITY CHARACTERISTICS FOR CRUDE PALM OIL

Item No.	Identity Characteristics	Observed min. to max.
(i)	Apparent density, g ml <sup>-1</sup> at 50°C	0.8889 to 0.8896
(ii)	Refractive index n <sub>D</sub> : 50°C	1.4521 to 1.4541
(iii)	Saponification value, mg KOH g <sup>-1</sup> oil	194 to 205
(iv)	Unsaponifiable matter, % by weight	0.19 to 0.44
(v)	Fatty acid composition, (wt% as methyl esters)	
	C12:0	0.0 to 0.5
	C14:0	0.9 to 1.5
	C16:0	39.2 to 45.8
	C16:1	0.0 to 0.4
	C18:0	3.7 to 5.4
	C18:1	37.4 to 44.1
	C18:2	8.7 to 12.5
	C18:3	0.0 to 0.6
	C20:0	0.0 to 0.5
(vi)	Iodine value (Wijs)	50.4 to 53.7
(vii)	Slip melting point (°C)	33.8 to 39.2
(viii)	Total carotenoids as (β-carotene), mg kg <sup>-1</sup>	474 to 689

*Note: The identity characteristics of processed palm oil do not differ significantly from those of crude palm oil, with the exceptions of carotenoids which are destroyed during refining.*

*Source: MS814:2007*

Palm oil is unique among vegetable oils because it has a significant amount of saturated acids (10%-15%) at the two-position of its triglycerides. The appreciable amounts of disaturated (POP and PPO) and monosaturated (POO, OPO and PLO) allow it to be easily separated into two products; palm olein and palm stearin. A wide range of fractions with different properties to suit requirements of the food industry is made available through dry fractionation.

## PALM OLEIN

### General Description

Palm olein is the liquid fraction obtained from fractionation of palm oil. The fractionation process involves a physical process of cooling the oil under controlled conditions to low temperatures, followed by filtration of the crystals through membrane press. The liquid olein and solid stearin are products of fractionation, and they are the major products exported.

Palm olein is fully liquid at ambient temperature in warm climates. It can be blended with various vegetable oils in different proportions to obtain liquid oils which can withstand lower temperatures. For example, blends of palm olein with more than 70% soft oils such as soyabean oil, corn oil or canola oil remain clear at 0°C for at least 5 hr. Oxidative stability of soft oils are also extended and improved by the palm olein. Basically, there are two major grades of palm olein: standard olein and super olein (iodine value greater than 60). The standard olein has an iodine value of about 56-59 and cloud point of 10°C max. The specifications are given in Malaysian Standard MS816:2007 (Table 3). Super olein is more suited to cooler climates and has cloud points of about 2°C-5°C.

TABLE 3: IDENTITY CHARACTERISTICS FOR PALM OLEIN

Item No.	Identity Characteristics	Observed min. to max.
(i)	Apparent density, g ml <sup>-1</sup> at 40°C	0.8969 to 0.8977
(ii)	Refractive index n <sub>D</sub> <sup>40</sup> 40°C	1.4589 to 1.4592
(iii)	Saponification value, mg KOH g <sup>-1</sup> oil	194 to 202
(iv)	Unsaponifiable matter, % by weight	0.3 to 1.30
(v)	Fatty acid composition, (wt% as methyl esters)	
	C12:0	0.2 to 0.4
	C14:0	0.9 to 1.2
	C16:0	38.2 to 42.9
	C16:1	0.1 to 0.3
	C18:0	3.7 to 4.8
	C18:1	39.8 to 43.9
	C18:2	10.4 to 12.7
	C18:3	0.1 to 0.6
	C20:0	0.2 to 0.5
(vi)	Iodine value (Wijs)	56.0 to 59.1
(vii)	Slip melting point (°C)	19.2 to 23.6
(viii)	Total carotenoids as (β-carotene), mg kg <sup>-1</sup>	500 to 1200

*Note: The identity characteristics of processed palm olein do not differ significantly from those of crude palm olein, with the exceptions of carotenoids which are destroyed during refining.*

Source: MS816:2007

### Properties of Palm Olein (standard grade)

Both normal palm olein and super olein are suitable as cooking oils, especially for deep fat or shallow frying. The high stability of the oil makes it exceptionally suitable for frying purposes. A high content of tocotrienols is generally present in oleins, being partitioned preferentially into this phase during fractionation. Solid fat content shows that the oil is liquid at 20°C-25°C.

### Properties of Super Olein

Super olein has a higher iodine value of 60 or above. These oleins have better clarity and lower tendency to turn cloudy compared to normal olein. Solid fat content data shows that the olein is generally clear at 17°C. It is interesting that super oleins with iodine value above 62 have much lower solid fat content. These oleins are also suitable as cooking and frying oils. Blending normal or super olein with unsaturated oils results in mixtures with different compositions and clarity to cater for different market requirements.

## PALM STEARIN

### General Description

Palm stearin is the solid fraction from the fractionation of palm oil. It can be used for obtaining palm mid fractions (PMF) and also in blends with other vegetable oils to obtain suitable functional products such as margarine fats, shortenings, vanaspati and others. Palm stearin is a useful natural hard stock for making trans-free fats. Besides edible usage, palm stearin also possesses suitable properties for making soaps and formulating animal feeds. It is also an excellent feed stock for oleochemicals. Specifications are given in Malaysian Standard MS 815:2007 (Table 4).

TABLE 4: IDENTITY CHARACTERISTICS FOR PALM STEARIN

Item No.	Identity Characteristics	Observed min. to max.
(i)	Apparent density, g ml <sup>-1</sup> at 50°C	0.8813 to 0.8844
(ii)	Refractive index n <sub>D</sub> 50°C	1.4482 to 1.4501
(iii)	Saponification value, mg KOH g <sup>-1</sup> oil	193 to 205
(iv)	Unsaponifiable matter, % by weight	0.30 to 0.90
(v)	Fatty acid composition, (wt% as methyl esters)	
	C12:0	0.1 to 0.3
	C14:0	1.1 to 1.7
	C16:0	49.8 to 68.1
	C16:1	<0.05 to 0.1
	C18:0	3.9 to 5.6
	C18:1	20.4 to 34.4
	C18:2	5.0 to 8.9
	C18:3	0.1 to 0.5
	C20:0	0.3 to 0.6
(vi)	Iodine value (Wijs)	27.8 to 45.1
(vii)	Slip melting point (°C)	46.6 to 53.8
(viii)	Total carotenoids as (β-carotene), mg kg <sup>-1</sup>	300 to 500

Note: The identity characteristics of processed palm stearin do not differ significantly from those of crude palm stearin with the exceptions of carotenoids which are destroyed during refining.

Source: MS815:2007

All the palm oil products mentioned above are traded according to PORAM 's specifications (Table 5)

TABLE 5: THE PALM OIL REFINERS ASSOCIATION OF MALAYSIA (PORAM)  
Standard Specifications for Processed Palm Oil

1. Neutralised Palm Oil	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc3-25)	0.25% max 0.1% max 50-55 33-39
2. Neutralised & Bleached Palm Oil	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25) # Colour (5 ½" Lovibond cell)	0.25% max 0.1% max 50-55 33-39 20 Red max
3. Refined, Bleached & Deodorised (RBD)/Neutralised, Bleached & Deodorised (NBD) Palm Oil	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25) # Colour (5 ½" Lovibond cell)	0.1% max 0.1% max 50-55 33-39 3 or 6 Red Max
4. Crude Palm Olein	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25)	5.0% max 0.25% max 56 min 24 max
5. Neutralised Palm Olein	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25)	0.25% max 0.1% max 56 min 24 max
6. Neutralised & Bleached Palm Olein	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25) # Colour (5 ½" Lovibond cell)	0.25% max 0.1% max 56 min 24 max 20 Red max
7. Refined, Bleached & Deodorised	* FFA (As Palmitic)	0.1% max

(RBD)/Neutralised, Bleached & Deodorised (NBD) Palm Olein	M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25) # Colour (5 ¼" Lovibond cell)	0.1% max 56 min  24 max  3 or 6 Red Max
8. Double Fractionated Palm Olein	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25) # Colour (5 ¼" Lovibond cell)	0.1% max 0.1% max 60 min  19 max  3 Red Max
9. Crude Palm Stearin	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25)	5.0% max 0.25% max 48 max  44 min
10. Neutralised Palm Stearin	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25)	0.25% max 0.15% max 48 max  44 min
11. Neutralised & Bleached Palm Stearin	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc3-25) # Colour (5 ¼" Lovibond cell)	0.25% max 0.15% max 48 max  44 min  20 Red max
12. Refined, Bleached & Deodorised (RBD)/Neutralised, Bleached & Deodorised (NBD) Palm Stearin	* FFA (As Palmitic) M&I I.V (Wijs) + M.Pt degrees C (AOCS Cc 3-25) # Colour (5 ¼" Lovibond cell)	0.2% max 0.15% max 48 max  44 min  3 or 6 Red Max
13. Palm Acid Oil	Total Fatty Matter  M&I * FFA (As Palmitic)	95% min (basis 97%) 3% max 50% min
14. Palm Fatty Acid Distillate	Saponifiable Matter  M&I * FFA (As Palmitic)	95% min (basis 97%) 1.0% max 70% min

- + : Slip Point, Softening Point or Rising Point  
\* : Molecular Weight of Palmitic Acid is taken as 256  
# : Colour measurement based on Tintometer  
Model 'E' AF 900 and Model 'D' AF 702  
: Specifications for palm stearin depend on the processed used  
: Specifications are shipped quality final  
: For double fractionated palm olein, specifications can be adjusted if required for selected customers' specifications.

## PALM MID FRACTION

### General Descriptions

Palm mid fraction (PMF) is a fraction of palm oil which is high in POP triglyceride. It is obtained through re-fractionation, either from the palm olein or palm stearin. The high POP content results in a sharp melting profile and a slip melting point of about 35°C-36°C. This enables the oil to be utilized in confectionery fats.

## PALM KERNEL OIL

### General Description

Palm kernel oil is obtained from the kernel of the oil palm fruit. Its composition and properties differ significantly from palm oil. Palm kernel oil is similar to coconut oil in terms of composition, and is produced by mechanical extraction of the kernels which are pre-dried in palm oil mills through a partial vacuum process. The quality of the oil is excellent, with free fatty acids of the crude oil generally below 2%. It is light yellow in colour and is refined physically to produce a very light coloured oil used for both edible and inedible purposes. The oil is also semi-solid at ambient temperatures. It can be

further fractionated to yield a high value fraction - such as palm kernel stearin with good melting properties. The sharp melting profile also indicates that the oil is highly suitable for confectionery applications. Due to its rapid crystallization behaviour, it is often used in enrobing or dipping products. The composition of the oil is shown in Tables 6 & 7.

TABLE 6: CHEMICAL CHARACTERISTICS OF PALM KERNEL OIL

Characteristics	Range	Mean	Std. dev.
Iodine Value (Wijs)	16.2 to 19.2	17.8	0.6
Saponification value, mg KOH g <sup>-1</sup> oil	243 to 249	245	1.4
Unsaponification matter %, by weight	0.1 to 0.8	0.3	0.16
Fatty acid composition (wt%) as methyl esters			
C6:0	0.1 to 0.5	0.3	0.07
C8:0	3.4 to 5.9	4.4	0.47
C10:0	3.3 to 4.4	3.7	0.24
C12:0	46.3 to 51.1	48.3	0.94
C14:0	14.3 to 16.8	15.6	0.33
C16:0	6.5 to 8.9	7.8	0.36
C18:0	1.6 to 2.6	2.0	0.19
C18:1	13.2 to 16.4	15.1	0.74
C18:2	2.2 to 3.4	2.7	0.22
Others	Trace to 0.9	0.2	0.09

Source: PORIM Technology No. 6 (1986)

TABLE 7: PHYSICAL CHARACTERISTICS OF PALM KERNEL OIL

Characteristics	Range	Mean	Std. dev.
Refractive index n <sub>D</sub> 30°C	1.4500 to 1.4518	1.4509	0.0005
Slip melting point °C	25.9 to 25.8	27.3	0.33
Solid fat content by NMR (%)			
5°C	68.0 to 76.8	72.8	1.77
10°C	60.1 to 71.2	67.6	2.12
15°C	50.5 to 60.0	55.7	2.31
20°C	34.2 to 45.5	40.1	2.54
25°C	10.2 to 21.5	17.1	2.18
30°C	NIL	-	-

Source: PORIM Technology No. 6 (1986)

## PALM KERNEL OLEIN

### General Description

Palm kernel olein is the liquid fraction of palm kernel oil obtained when the oil is fractionated. The chemical characteristics are given in Table 8. The solid fat profile shows that the olein melts by about 25°C, compared to palm kernel oil which melts at 28°C–30°C. The oil can be hydrogenated, giving a sharper melting profile, enabling its use in coating fats. The oil is also very useful for margarine fats when interesterified with palm stearin.

TABLE 8: CHEMICAL CHARACTERISTICS OF PALM KERNEL OLEIN

Characteristics	Range	Mean	Std. dev.
Iodine Value (Wijs)	20.6 to 25.3	23.0	1.30
Saponification value, mg KOH g <sup>-1</sup> oil	231 to 244	239	3.70
Unsaponification matter %, by weight	0.26 to 0.72	0.36	0.13
Fatty acid composition (wt%) as methyl esters			
C6:0	0.2 to 0.4	0.2	0.06
C8:0	3.6 to 5.0	4.3	0.36
C10:0	3.2 to 4.5	3.6	0.21
C12:0	42.1 to 46.3	44.7	1.04
C14:0	12.3 to 15.5	14.0	0.70
C16:0	7.4 to 10.6	8.3	0.57
C18:0	1.8 to 2.7	2.3	0.22
C18:1	14.6 to 21.3	19.2	1.39
C18:2	2.6 to 3.8	3.3	0.28
C20:0	0 to 0.2	0.1	0.06

Source: PORIM Technology No.16 (1995)

## PALM KERNEL STEARIN

### General Description

Palm kernel stearin is the high premium product from the fractionation of palm kernel oil. The sharp solid fat content (SFC) profile indicates its suitability for use in confectionery fats. The products produced in Malaysia are consistent in quality and properties. They can be utilized directly or after further improvement by hydrogenation to an even firmer product. Palm kernel stearin, as with other palm kernel products, forms eutectic mixtures with pure cocoa butter, and thus can be mixed with the latter in confectionery products in small amounts. The characteristics of palm kernel stearin are shown in Table 9.

TABLE 9: CHEMICAL CHARACTERISTICS OF PALM KERNEL STEARIN

Characteristics	Range	Mean	Std. dev.
Iodine Value (Wijs)	5.8 to 8.1	7.0	0.51
Saponification value, mg KOH g <sup>-1</sup> oil	245 to 254	248	4.08
Unsaponification matter %, by weight	0.22 to 0.60	0.32	0.18
Fatty acid composition (wt%) as methyl esters			
C6:0	0 to 0.1	0.1	0.04
C8:0	1.5 to 2.3	1.9	0.17
C10:0	2.5 to 2.9	2.7	0.12
C12:0	54.8 to 58.2	56.6	0.84
C14:0	21.1 to 24.1	22.4	0.77
C16:0	7.2 to 8.6	8.0	0.27
C18:0	1.3 to 2.2	1.8	0.20
C18:1	4.6 to 6.8	5.6	0.56
C18:2	0.6 to 1.1	0.8	0.10
C20:0	0 to 0.2	0.1	0.06

Source: PORIM Technology No. 16 (1995)

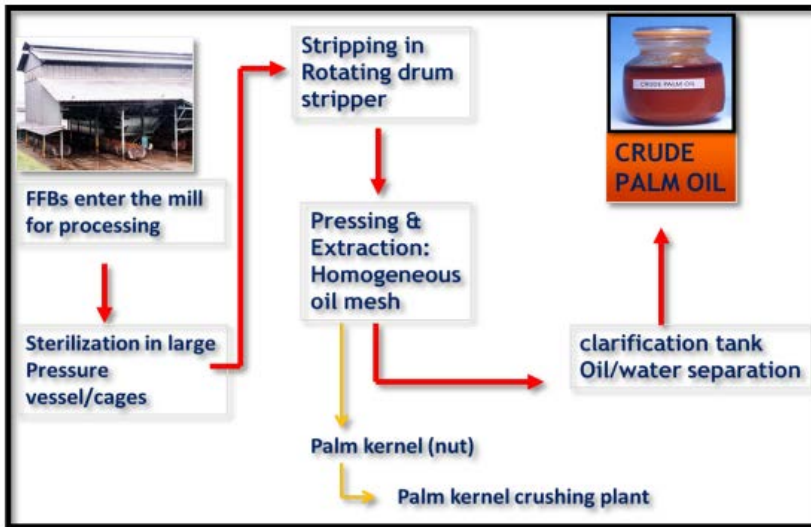
All the palm kernel oil products mentioned above are traded according to MEOMA's specifications (Table 10).

**TABLE 10: THE MALAYSIAN EDIBLE OIL MANUFACTURERS' ASSOCIATION (MEOMA) STANDARD  
SPECIFICATIONS FOR PALM KERNEL PRODUCTS**

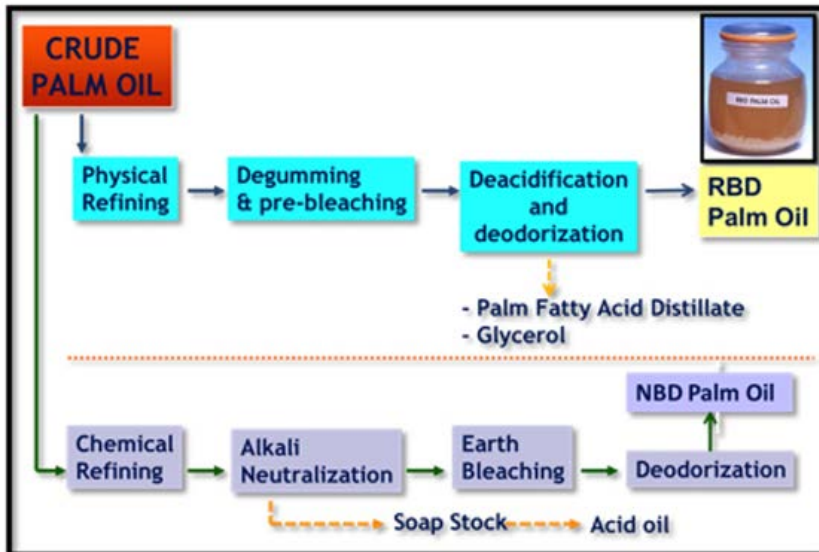
**Standard Specification for Processed Palm Kernel Oil**

1. Crude Palm Kernel Oil	FFA (as Lauric Acid) M&I Iodine Value (Wijs)	5.0% max 0.5% max 19 max at time of shipment
2. Crude Palm Kernel Olein	FFA (as Lauric Acid) M&I Iodine Value (Wijs)	5.0% max 0.5% max 21 min
3. Crude Palm Kernel Stearin	FFA (as Lauric Acid) M&I Iodine Value (Wijs)	5.0% max 0.5% max 8 max
4. RBD Palm Kernel Oil	FFA (as Lauric Acid) M&I Iodine Value (Wijs)  Colour (5 ¼ Lovibond cell)	0.1% max 0.1% max 19 max at time of shipment Red 1.5 max
5. RBD Palm Kernel Olein	FFA (as Lauric Acid) M&I Iodine Value (Wijs) Colour (5 ¼ Lovibond cell)	0.1% max 0.1% max 21 min Red 1.5 max
6. RBD Palm Kernel Stearin	FFA (as Lauric Acid) M&I Iodine Value (Wijs) Colour (5 ¼ Lovibond cell)	0.1% max 0.1% max 8 max Red 1.5 max
7. Palm Kernel Expellers	Fair Average Quality Profat Moisture	21% min 10% max at time of shipment
8. Palm Kernel Extraction Pellets	Fair Average Quality Profat Moisture	15% min 13% max at time of shipment
9. Palm Kernel Fatty Acid Distillate	FFA (as Lauric Acid) M&I TFM	5.0% min 1% max 95% min
10. Distilled Palm Kernel Fatty Acid (From Oleochemical Plants)	Acid Value Sap Value Titre Iodine Value Colour (Gardner)	238-253 240-255 20-28 16-20 3G max
11. Lauric Acid 95% (From Oleochemical Plants)	Acid Value Sap Value Titre Iodine Value Colour (5 ¼ Lovibond cell)	278-284 279-285 41-44 0.5 max 0.5 R 5 Y
12. Myristic Acid 95% (From Oleochemical Plants)	Acid Value Sap Value Titre Iodine Value Colour (5 ¼ Lovibond cell)	243-249 244-250 52-54 0.5 max 0.5 R 5 Y

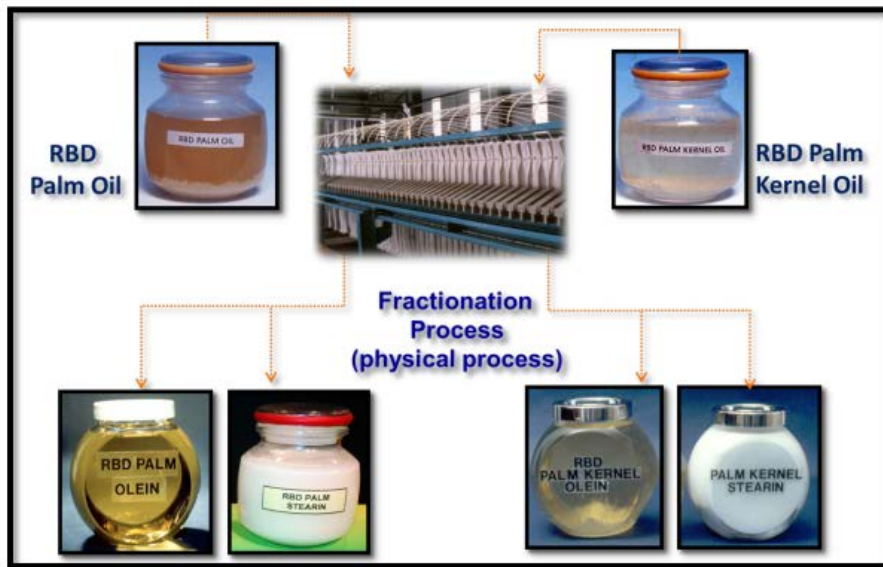




Palm oil milling process

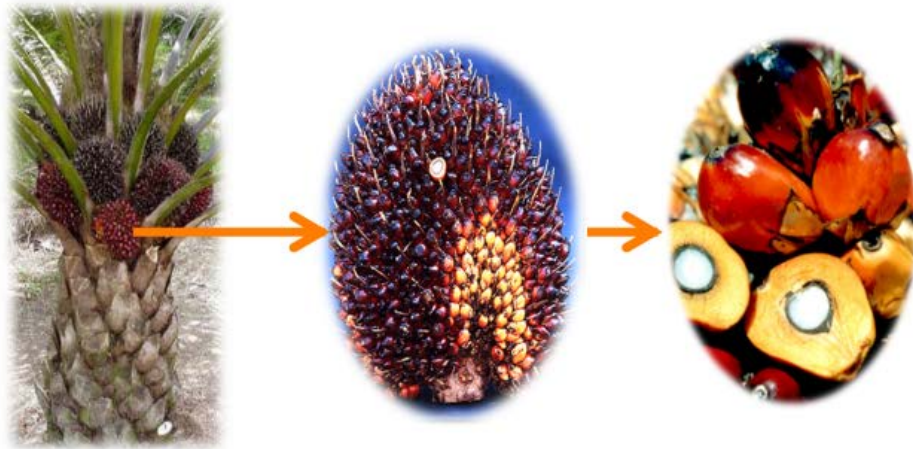


Palm oil refining process



Palm oil fractionation process

### Palm Fruits at a Glance



Species: *Elaeis guineensis*  
 Type: Tenera (DXP)  
 Planting density: 148 palm/ha  
 Nursery period: 24 months  
 Economic Life: 25 years

Bunch weight: 10-15 kg  
 Fruitlets/bunch: 1000-3000  
 Oil/bunch: 22-25%  
 Kernel/bunch: 4%  
 Kernel production/year: 8kg  
 Oil production/year: 42.5 kg

Bunch weight: 10-15 kg  
 Fruitlets/bunch: 1000-3000  
 Oil/bunch: 22-25%  
 Kernel/bunch: 4%  
 Kernel production/year: 8kg  
 Oil production/year: 42.5 kg