

NUTRITIONAL ASPECTS OF PALM OIL

K.V. Joseph

CPCRI Research Centre Palode 695 502, Thiruvananthapuram, Kerala

Oil extracted from the fleshy orange-red mesocarp is known as crude palm oil (CPO) which on refining becomes palm oil. Kernel oil extracted from seeds resembles coconut oil. The palm oil as such is reliably consistent in quality, can be easily refined and is readily acceptable as an edible oil. Its versatility makes it a suitable raw material for many uses both for edible and non-edible purpose.

Edible uses

For making margarine as it has the correct consistency and does not turn rancid easily.

Due to its nonfoaming property it is used as an excellent deep frying medium.

As a shortening agent in manufacture of bakery items.

To make vegetable oil based ice cream.

As a substitute for cocobutter in chocolate making industry.

Non - edible uses

Palm oil is an important source of C16-C18 fatty acid for detergency and is used in manufacturing soap. Basic oleochemicals such as fatty acids, fatty methyl esters, fatty alcohols and fatty nitrogenous derivatives can be produced from palm oil. These products are used to manufacture various formulated oleochemical products especially surfactants and detergents.

Chemical composition of palm oil

Palm oil contains two fractions, the stearin and palmolein fraction. The stearin fraction

contains more saturated fatty acids and is solid at normal temperature while palmolein has more unsaturated fatty acids and is liquid at normal temperature. Palm oil consists of largely triglycerides which are esters of glycerol with fatty acids. The fatty acids are straight chained with usually even number carbon atoms and saturated or unsaturated in C - C linkage. Palm oil contains about 40 per cent each of palmitic acid and mono unsaturated oleic acid with about 10 per cent disaturated linoleic acid, 5 per cent stearic acid and small proportion of other acids like lauric, myristic, palmitoleic and arachidic acid. (Chan, 1983) (Table 1).

Table 1. Composition of fatty acids in Palm Oil (Chan, 1983)

Fatty acids	Carbon No. and No. of double bonds	Percentage
Lauric acid	C - 12	0-0.4
Myristic acid	C - 14	0.6-1.7
Palmitic acid	C - 16	4.1-147.0
Palmitoleic acid	C - 16.1 (9, monoene)	0-0.6
Stearic acid	C - 18	3.7-5.6
Oleic acid	C - 18:1 (9, monoene)	28.2-43.5
Linolenic acid	C - 18:13 (9,12,15 Triene)	0-0.5
Arachidic acid	C-20	0-0.8
Iodine Value		52%

Melting point of palm oil ranges between 50 and 55°C. (Tan ches Hong, 1974). The melting point of triglycerides increased

with increase in length of the fatty acid chain and decreases with increase in unsaturation (Tjang and Olie, 1972). Palm oil has a relative density of 0.8927 and refractive index 1.4553 (MacLellan, 1983). Apart from the triglycerides the palm oil contains a number of minor constituents. Though some of these compounds are negligible in quantity they are very important from nutritional point of view. These minor compounds are carotenoids, tocopherols, triterpenes, phytosterol, phospholipids, glycolipids, aliphatic alcohols, copper and iron. (Gottenhos and Vies, 1983).

Chemical composition of palm kernel oil

Palm kernel oil is one of the main byproducts in palm oil industry. Palm kernel oil and coconut oil are alike in chemical composition and are generally known as lauric acid oils. Palm kernel oil is entirely different from mesocarp oil. It contains high proportion of saturated fatty acids (Chan, 1983) (Table 2).

Table 2. Composition of fatty acids in palm kernel oil (Chan, 1983)

Fatty acids	Carbon No.	Range %
Caprylic acid	C-8	3-5
Caproid acid	C-10	3-7
Lauric acid	C-12	40-52
Myristic acid	C-14	14-17
Palmitic acid	C-16	7-9
Stearic acid	C-18	1-3
Oleic acid	C-18:1	13-19
Linoleic acid	C-18:2	0.5-2.0
Arachidic Acid	C-20	Trace

Nutritional aspect of palm oil

Fats and oils are generally used for making food to make it tastier and palatable. It also provides energy and acts as a medium

of transport of fat soluble Vitamins. Palm oil, provides nine kilocalories of energy per gram compared to four kilocalories for proteins and carbohydrates. No significant difference is noted in digestibility as compared to many other fats.

Palm oil contains about 50 per cent saturated, 49 per cent monounsaturated and 10 per cent polyunsaturated fatty acids. The oleic acid and linoleic present in the palm oil are essential for human as well as animal nutrition. About 43 per cent of oleic acid present in the palm oil is effective in lowering the blood chlesterol, 10 per cent linoleic acid present will provide the essential fatty acid requirement and hence palm oil could be used as a sole source of fat in human nutrition. Over and above palmitic acid which is the principal saturated fatty acid present, palm oil is considered to possess a less cholesterol raising effect than short chain lauric and myristic acid which are present only in traces.

Minor components of palm oil

Nutritive value of palm oil mainly depends on the presence of minor components. The main minor components in unprocessed palm oil are carotenes, the vitamin E (tocopherols and tocotrienols), the sterols, the phospholipids and the glycolipids and triterpinoids and squalene. (Table 3)

However, in the refined palm oil, all the components except the carotenoids are present. The carotenoids are generally removed or destroyed while refining. As an antioxidant, the tocopherols and tocotrienols, the unsaturated analogues of vitamin E plays an important role in nutrition (Abdul Halim Hassan, 1987).

Table 3. Minor components of crude palm oil.

Main minor components	Unrefined palm oil (ppm)	Refined palm oil (ppm)
Carotenoids	500-800	—
Vitamin E	800-1000	360-610
Sterols	360-620	100-160
Lipids		
Phospholipids	5-130	traces
Glycolipids	1000-3000	traces
Aqualene	429-929	184-364

Carotenoids

Among the edible oils, palm oil has by far the highest concentration of carotenoids of which alpha and beta carotenes constitute about 90 per cent. These carotenoids are precursors of vitamin A, the vitamin that prevents night blindness, aids the maintenance of the epithelial tissue and promotes growth. The carotenes are compounds containing long chain isoprenoid units containing conjugated double bonds with a beta-ionone ring. Beta-carotene is a symmetrical molecule in which both halves have the retinene configuration so that the cleavage of beta carotene results in the formation of two molecules of retinal which is reduced to retinol. So the beta-carotene is the most efficient provitamin A since the beta-ionone ring is present at both the ends of the molecule. Other carotenes have vitamin A activity but they have only half potency.

The average range of carotenes in palm oil is in the range of 500-700 ppm. It is a rich source of provitamin A and can be supplemented for vitamin A deficiency diet. (Ooi, Ong and Ooi, 1985). It has been observed that a daily dose of 4.0 ml palm oil given to children at the

age of 1 to 5 years, decreased Xerophthalmia significantly from 7 to 3 per cent. Recent reports show the dietary beta-carotene reduces human cancer rates (Ooi, Ong and Ooi, 1985).

Table 4. Vitamin A potency of carotenoids

Carotenoids	Potency (lu/hg)
Alpha-carotene	0.90
Beta-carotene	1.66
Gamma-carotene	0.72
Lycopene	Nit

Vitamin E

This is a fat soluble vitamin comprising mainly the tocopherols and tocotrienols. Vitamin E acting as an antioxidant, arrests the oxidative deterioration of cellular membrane. It is not limited to a single compound but is associated with eight derivatives, four of which are saturated phytyl side chain and others are unsaturated prenyl side chain.

Sterols

Sistosterols, campostanol and cholesterol are the sterols found in palm oil which serve as a minor dietary source of steroidal hormones.

Lipids

Phospholipids and glycolipids are the two lipid components present in the palm oil where glycolipid is more predominant. These compounds serve as the lipid components of cell membrane. Phospholipids are not antioxidant synergistic in the presence of tocopherol and tocotrienols because of this property phospholipids are sometimes added to oil to promote its oxidative stability.

Squalene

Squalene has been found to be able to arrest the formation of cholesterol by inhibiting the cholesterol forming enzyme activity.

Palm Oil in India

Palm oil for edible purpose is being increasingly used in India recently. The first oil palm cultivation in India was started in 1962 at Thodupuzha, Kerala State. This was followed by large scale cultivation by Oil Palm India. But the oil produced at these centres were not used for edible purposes. The one available in Indian market is the refined "Palmolein" imported from Malaysia. A small scale palm oil extraction unit which is suitable for Indian condition has been designed and installed at CPCRI Research Centre at Palode. This pilot plant is completely fabricated with indigenous know how and has a capacity of one ton Fresh Fruit Bunch (FFB) per hour.

Preliminary analysis of the crude palm oil extracted by the pilot plant indicated that the free fatty acid content (FFA) is less than one per cent, the carotene is 700 ppm, and moisture and other impurities are less than 0.2 per cent. It is also a good source of vitamin E, the tocopherol content is being 800 ppm. (Arumughan et al. 1989). A sensory evaluation experiment was conducted on CPO from which it was found to be acceptable for direct consumption. The only demerits indicated were thick consistency, red colour and high smoke point. Hence the CPO was further purified in a private factory and was subjected to sensory evaluation. The purified product had a wide acceptance compared to CPO since it has a fairly good colour, flavour and consistency. The product can be sold in the open market on its inclusion in the list of

consumable oils under the food act. However, in India much more research work on the quality as well as on the nutritional aspect of CPO has to be undertaken.

Palm oil and health

It reduces the value of total cholesterol, triglycerides, VLDL - Cholesterol, LDL Cholesterol level and increases the 'protective' HDL level

It decreases the blood cholesterol level, probably due to the presence of two unsaturated hypocholestermic fatty acid namely oleic acid and linoleic acid which are present at a level of 44 and 10 per cent respectively in refined palm oil. Another explanation is that both crude and refined palm oil contain significant amount of tocotrienols which are reported to inhibit the cholesterol synthesising enzyme (Chong, 1989, Abdul Halim Hassan, 1988).

Saturated fatty acids, in particular palmitic acid, are said to promote platelet and predispose to thrombosis formation. But, contrary to this explanation, palm oil which is rich in palmitic acid is anti-thrombotic and reduces platelets aggregation like polyunsaturated oils (Chong, 1989).

Palm oil possesses a distinct tumor inhibiting effect compared to polyunsaturated oils.

The recommendation of the usage of oils which are rich in polyunsaturated fatty acids for lowering the blood cholesterol has now been questioned and cautioned against excessive consumption of diet rich in linoleic acid and pointed out that the following difficulty may be associated with such a diet. It may be

promoting cancer development, suppressing the immune development, depressing the 'protective' HDL and increasing the risk of formation of gall stone. So current dietary recommendation now stipulate that polyunsaturated fatty acid content should not exceed 10 per cent of the total calories.

In conclusion palm oil which contains saturated and unsaturated fatty acids in equal amounts and also a good source of vitamin A and E can be used as dietary fat. It is equivalent or better than all other fats which are now available in the market.

REFERENCES

- Abdul Halim Hassan, 1987. Palm oil and health. *The Planter*, **64**: 505-519.
- Arumughan C; Sundaresan, A; Prasad, K.V.S.V.; Damodaran, A.D. and Nampootheri, K.U.K. 1989. Studies on the extraction and evaluation of raw palm oil for edible use. *J. F. Sci. Technol.* **26**: 277-282.
- Chan, A.H.G. 1983. Palm oil quality, refining and end uses Casual paper on oil palm 1-27 Published by Incorporated Society of Planter, Kuala Lumpur, Malaysia.
- Chong, Y.H. 1989. Dietary fats, classification and cholestermic effect. *The Planter*, **65**: 563-571.
- Gottenbos, J.J. and Vles, R.O. 1983. Nutrition value of palm oil. PORIM - Occasional paper on Nutrition Ed. Kurt-G. Berger 5-11.
- Mackllan, M. 1983. Palm Oil, *Jacos*, **60**: 368-373.
- Ooi, T.K.; Sh. Ong and Ooi, G.K. 1985. Nutritional value of B. carotene. "PORIM Bull" 1985.
- Tan Chee Hong, 1974. Palm oil fractionation. *Planter*, **50**: 126-131.
- Tjang, T.D. and Olie, J.J. 1972. Some notes on fractionation of palm oil. *Planter*, **48**: 201-206.