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PALM OIL: FRIENDLY FOR POCKET BUT HARMFUL FOR HEALTH

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ABSTRACT

Palm oil is an edible vegetable oil derived from the mesocarp (reddish pulp) of the fruit of the oil palms. The oil is used in food manufacturing, in beauty products, and as biofuel. Palm oil accounted for about 33% of global oils produced from oil crops in 2014. Palm oils are easier to stabilize and maintain quality of flavour and consistency in processed foods, so are frequently favoured by food manufacturers. On average globally, humans consumed 7.7 kg (17 lb) of palm oil per person in 2015. Demand has also increased for other uses, such as cosmetics and biofuels, creating more demand on the supply encouraging the growth of palm oil plantations in tropical countries. The use of palm oil has attracted the concern of environmental groups due to deforestation in the tropics where palms are grown, and has been cited as a factor in social problems due to allegations of human rights violations among growers. An industry group formed in 2004 to create more sustainable and ethical palm oil, through the roundtable on Sustainable Palm Oil. However, very little palm oil is certified through the organization, and some groups have criticized it as green washing.

KEYWORDS: Palmitic acid, Stearic acid, Oleic acid, Linoleic acid, Triglyceride.

Preamble: In 2018, a report by the International Union for Conservation of Nature acknowledged that palm oil is much more efficient than other oils in terms of land and water usage, however deforestation causes more biodiversity loss than switching to other oils.[1-6] The biggest producers of palm oil are Indonesia, Malaysia, Thailand, and Nigeria. Indonesia produces biodiesel prim arily from palm oil. Since agricultural land is limited, in order to plant monocultures of oil palms, land used for other cultivations or the tropical forest need to be cleared. A major environmental threat is then the destruction of rainforests in Indonesia.[7]

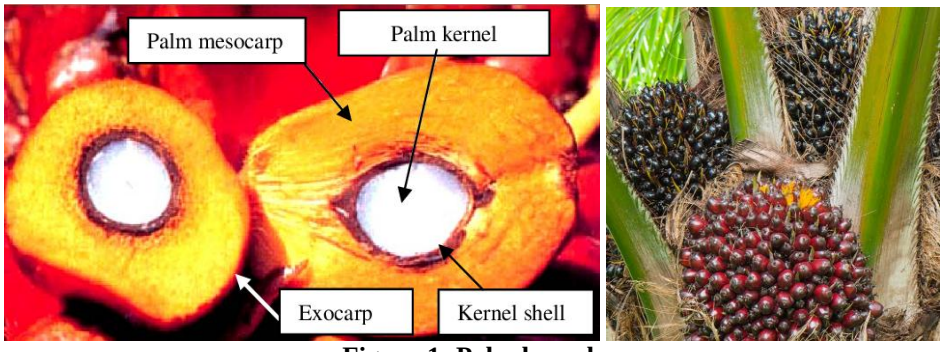


Figure-1: Palm kernel.

History: Humans used oil palms as far back as 5,000 years. In the late 1800s, archaeologists discovered a substance that they concluded was originally palm oil in a tomb at Abydos dating back to 3,000 BCE. Palm oil from *E. guineensis* has long been recognized in West and Central African countries, used widely as a cooking oil. European merchants trading with West Africa occasionally purchased palm oil for use as a cooking oil in Europe. Palm oil became a highly sought-after commodity by British traders for use as an industrial lubricant for machinery during Britain's Industrial Revolution. Palm oil formed the basis of soap products, such as Lever Brothers' (now Unilever) "Sunlight" soap, and the American Palmolive brand. By around 1870, palm oil constituted the primary export of some West African countries, although this was overtaken by cocoa in the 1880s with the introduction of colonial European cocoa plantations.[8]

Processing: Palm oil is naturally reddish in color because of a high beta-carotene content. It is not to be confused with palm kernel oil derived from the kernel of the same fruit or coconut oil derived from the kernel of the coconut palm (*Cocos nucifera*). The differences are in color (raw palm kernel oil lacks carotenoids and is not red), and in saturated fat content: palm mesocarp oil is 49% saturated, while palm kernel oil and coconut oil are 81% and 86% saturated fats, respectively. However, crude red palm oil that has been refined, neutralized, bleached and deodorized, a common commodity called RBD (refined, bleached, and deodorized) palm oil, does not contain carotenoids. Many industrial food applications of palm oil use fractionated components of palm oil (often listed as "modified palm oil") whose saturation levels can reach 90%; these "modified" palm oils can become highly saturated, but are not necessarily hydrogenated. The oil palm produces bunches containing many fruits with the fleshy mesocarp enclosing a kernel that is covered by a very hard shell. The FAO considers palm oil (coming from the pulp) and palm kernels to be primary products. The oil extraction rate from a bunch varies from 17 to 27% for palm oil, and from 4 to 10% for palm kernels. Along with coconut oil, palm oil is one of the few highly saturated vegetable fats and is semisolid at room temperature. Palm oil is a common cooking ingredient in the tropical belt of Africa, Southeast Asia and parts of Brazil.[9]

Figure-2: White Palm oil & Palm tree.

Its use in the commercial food industry in other parts of the world is widespread because of its lower cost and the high oxidative stability (saturation) of the refined product when used for frying. One source reported that humans consumed an average 17 pounds (7.7 kg) of palm oil per person in 2015. Many processed foods either contain palm oil or various ingredients made from it.[10]

Refining: After milling, various palm oil products are made using refining processes. First is fractionation, with crystallization and separation processes to obtain solid (palm stearin), and liquid (olein) fractions. Then melting and degumming removes impurities. Then the oil is filtered and bleached. Physical refining removes smells and coloration to produce "refined, bleached and deodorized palm oil" (RBDPO) and free fatty acids,[which are used in the manufacture of soaps, washing powder and other products. RBDPO is the basic palm oil product sold on the world's commodity markets. Many companies fractionate it further to produce palm oil for cooking oil, or process it into other products.[11]

Figure-3: Red Palm oil.

Red palm: Since the mid-1990s, red palm oil has been cold-pressed from the fruit of the oil palm and bottled for use as a cooking oil, in addition to other uses such as being blended into mayonnaise and vegetable oil. Oil produced from palm fruit is called *red palm oil* or just *palm oil*. It is around 50% saturated fat—considerably less than palm kernel oil—and 40% unsaturated fat and 10% polyunsaturated fat. In its unprocessed state, red palm oil has an intense deep red color because of its abundant carotene content. Red palm oil also contains sterols, vitamin E, and carotenoids such as alpha-carotene, beta-carotene, and lycopene.[12]

White palm oil: White palm oil is the result of processing and refining. When refined, the palm oil loses its deep red color. It is extensively used in food manufacture and can be found in a variety of processed foods including peanut butter and chips. It is often labeled as palm shortening and is used as a replacement ingredient for hydrogenated fats in a variety of baked and fried products.[13]

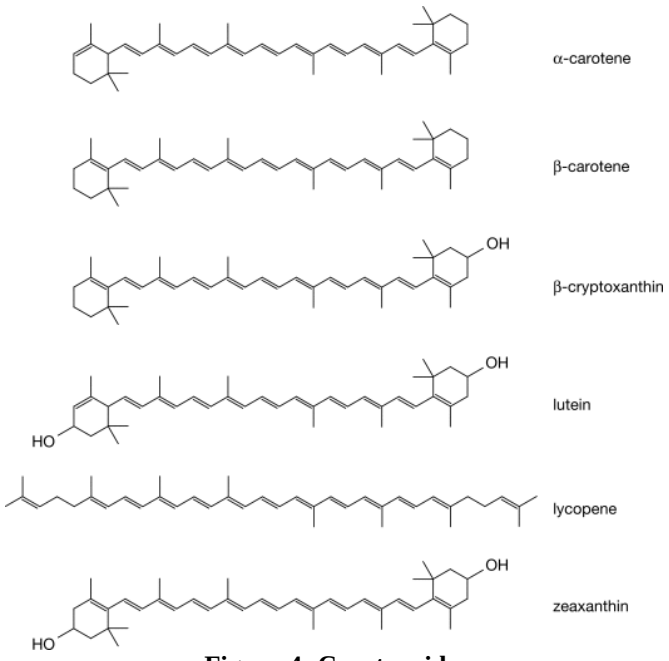


Figure-4: Carotenoids.

Uses

In food: The highly saturated nature of palm oil renders it solid at room temperature in temperate regions, making it a cheap substitute for butter or hydrogenated vegetable oils in uses where solid fat is desirable, such as the making of pastry dough and baked goods. Palm oil is used in West African cuisine such as egusi soup and okra soup. The health concerns related to trans fats in hydrogenated vegetable oils may have contributed to the increasing use of palm oil in the food industry. Palm oil is sometimes used as a minor ingredient in calf milk replacer.

Non-food consumer products: Palm oil is pervasively used in personal care and cleaning products, and it provides the foaming agent in nearly every soap, shampoo, or detergent. Around 70% of personal care products including soap, shampoo, makeup, and lotion, contain ingredients derived from palm oil. However, there are more than 200 different names for these palm oil ingredients and only 10% of them include the word "palm".[14]

Figure-5: Yummy food is ready to go to tummy.

Biomass and biofuels: Palm oil is used to produce both methyl ester and hydrodeoxygenated biodiesel. Palm oil methyl ester is created through a process called transesterification. Palm oil biodiesel is often blended with other fuels to create palm oil biodiesel blends. Palm oil biodiesel meets the European EN 14214 standard for biodiesels. Hydrodeoxygenated biodiesel is produced by direct hydrogenolysis of the fat into alkanes and propane. The world's largest palm oil biodiesel plant is the €550 million Finnish-operated Neste Oil biodiesel plant in Singapore, which opened in 2011 with a capacity of 800,000 tons per year and produces hydrodeoxygenated NEXBTL biodiesel from palm oil imported from Malaysia and Indonesia. Significant amounts of palm oil exports to Europe are converted to biodiesel (as of early 2018: Indonesia: 40%, Malaysia 30%). In 2014, almost half of all the palm oil in Europe was burned as car and truck fuel. As of 2018, one-half of Europe's palm oil imports were used for biodiesel. Use of palm oil as biodiesel generates three times the carbon emissions as using fossil fuel, and, for example, "biodiesel made from Indonesian palm oil makes the global carbon problem worse, not better." There are pressures for increased oil palm production from Indonesian palm-based biodiesel programs. The biodiesel currently contains a 30:70 palm oil to conventional diesel ratio (known as B30) at the gas pumps. The Indonesian government is aiming to produce 100% palm oil biodiesel (or B100) to transition out of using conventional diesel. The Indonesian government has estimated it would need to establish approximately 15 million hectares of oil palm plantations to meet these future demands. The organic waste matter that is produced when processing oil palm, including oil palm shells and oil palm fruit bunches, can also be used to produce energy. This waste material can be converted into pellets that can be used as a biofuel. Additionally, palm oil that has been used to fry foods can be converted into methyl esters for biodiesel. The used cooking oil is chemically treated to create a biodiesel similar to petroleum diesel.[15]

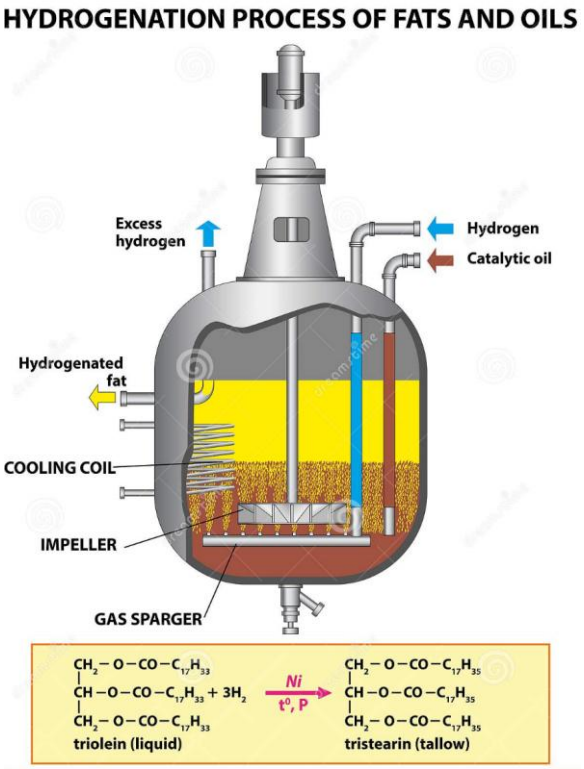


Figure-6: Hydrogenation of oil.

In wound care: Although palm oil is applied to wounds for its supposed antimicrobial effects, research does not confirm its effectiveness.

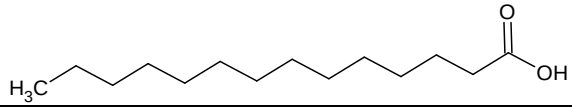
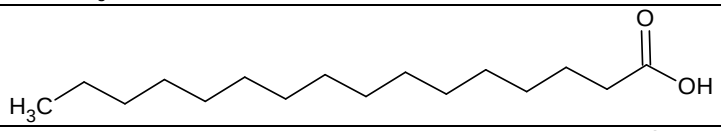
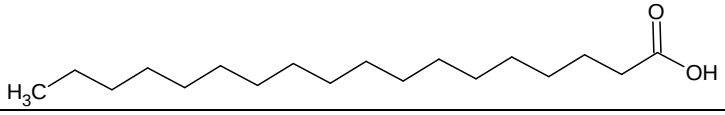
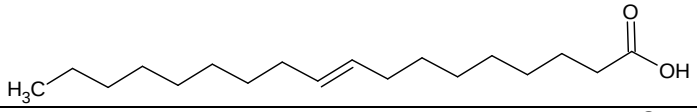
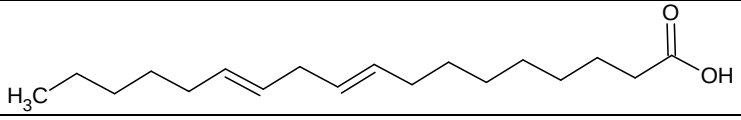
Food vs. fuel: The use of palm oil in the production of biodiesel has led to concerns that the need for fuel is being placed ahead of the need for food, leading to malnutrition in developing nations. This is known as the food versus fuel debate. According to a 2008 report published in the *Renewable and Sustainable Energy Reviews*, palm oil was determined to be a sustainable source of both food and biofuel, and the production of palm oil biodiesel does not pose a threat to edible palm oil supplies. According to a 2009 study published in the *Environmental Science and Policy* journal, palm oil biodiesel might increase the demand for palm oil in the future, resulting in the expansion of palm oil production, and therefore an increased supply of food.[16]

Composition

Fatty acids: Palm oil, like all fats, is composed of fatty acids, esterified with glycerol. Palm oil has an especially

high concentration of saturated fat, specifically the 16-carbon saturated fatty acid, palmitic acid, to which it gives its name. Monounsaturated oleic acid is also a major constituent of palm oil. Unrefined palm oil is a significant source of tocotrienol, part of the vitamin E family.

Table-1: Fatty acid content of palm oil [triglyceride ester].

Fatty Acid	Structure	Fraction [%]
Myristic saturated C14		1
Palmitic saturated C16		43.5
Stearic saturated C18		4.3
Oleic monounsaturated C18:1		36.6
Linoleic polyunsaturated C18:2		9.1
Other/unknown		5.5

Carotenes: Red palm oil is rich in carotenes, such as alpha-carotene, beta-carotene and lycopene, which give it a characteristic dark red color. However, palm oil that has been refined, bleached and deodorized from crude palm oil (called "RBD palm oil") does not contain carotenes.

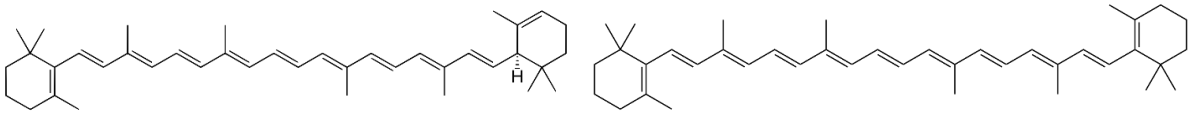


Figure-7: Alpha & Beta carotenes.

Polyunsaturated fatty acids (PUFAs) are fatty acids that contain more than one double bond in their backbone. This class includes many important compounds, such as essential fatty acids and those that give drying oils their characteristic property. Polyunsaturated fatty acids can be classified in various groups by their chemical structure:
Methylene-interrupted polyenes, conjugated fatty acids, other PUFAs.

Based on the length of their carbon backbone, they are sometimes classified in two groups:
Short chain polyunsaturated fatty acids (SC-PUFA), with 18 carbon atoms, long-chain polyunsaturated fatty acids (LC-PUFA) with 20 or more carbon atoms.[17]

Comparison to other vegetable oils
Table-2: Vegetable oil comparison.

The nutritional values are expressed as **percent (%) by mass of total fat**.									
Type	**Processing treatment**	**Saturated fatty acids**	**Monounsaturated fatty acids**		**Polyunsaturated fatty acids**				**Smoke point**
			Total	**Oleic acid (ω-9)**	**Total**	**α-Linolenic acid (ω-3)**	**Linoleic acid (ω-6)**	**ω-6:3 ratio**	
Avocado		11.6	70.6	52–66	13.5	1	12.5	12.5:1	250 °C (482 °F)

The nutritional values are expressed as **percent (%) by mass of total fat**.									
Brazil nut		24.8	32.7	31.3	42.0	0.1	41.9	419:1	208 °C (406 °F)
Canola		7.4	63.3	61.8	28.1	9.1	18.6	2:1	238 °C (460 °F)
Coconut		82.5	6.3	6	1.7				175 °C (347 °F)
Corn		12.9	27.6	27.3	54.7	1	58	58:1	232 °C (450 °F)
Cottonseed		25.9	17.8	19	51.9	1	54	54:1	216 °C (420 °F)
Cottonseed	hydrogenated	93.6	1.5		0.6	0.2	0.3	1.5:1	
Flaxseed/linseed		9.0	18.4	18	67.8	53	13	0.2:1	107 °C (225 °F)
Grape seed		10.5	14.3	14.3	74.7	–	74.7	very high	216 °C (421 °F)
Hemp seed		7.0	9.0	9.0	82.0	22.0	54.0	2.5:1	166 °C (330 °F)
Olive		13.8	73.0	71.3	10.5	0.7	9.8	14:1	193 °C (380 °F)
Palm		49.3	37.0	40	9.3	0.2	9.1	45.5:1	235 °C (455 °F)
Palm	hydrogenated	88.2	5.7		0				
Peanut		16.2	57.1	55.4	19.9	0.318	19.6	61.6:1	232 °C (450 °F)
Rice bran oil		25	*38.4*	38.4	*36.6*	2.2	34.4	15.6	232 °C (450 °F)
High-oleic safflower oil		7.5	75.2	75.2	12.8	0	12.8	very high	212 °C (414 °F)
Sesame		14.2	39.7	39.3	41.7	0.3	41.3	138:1	
Soybean		15.6	22.8	22.6	57.7	7	51	7.3:1	238 °C (460 °F)
Soybean	partially hydrogenated	14.9	43.0	42.5	37.6	2.6	34.9	13.4:1	
Walnut oil	unrefined	9.1	22.8	22.2	63.3	10.4	52.9	5:1	160 °C (320 °F)
Sunflower		8.99	63.4	62.9	20.7	0.16	20.5	128:1	227 °C (440 °F)

Nutrition and health: Contributing significant calories as a source of fat, palm oil is a food staple in many cuisines. On average globally, humans consumed 7.7 kg (17 lb) of palm oil per person in 2015. Although the relationship of palm oil consumption to disease risk has been previously assessed, the quality of the clinical research specifically assessing palm oil effects has been generally poor. Consequently, research has focused on the deleterious effects of palm oil and palmitic acid consumption as sources of saturated fat content in edible oils, leading to conclusions that palm oil and saturated fats should be replaced with polyunsaturated fats in the diet. A 2015 meta-analysis and 2017 advisory from the American Heart Association indicated that palm oil is among foods supplying dietary saturated fat which increases blood levels of LDL cholesterol and increased risk of cardiovascular diseases, leading to recommendations for reduced use or elimination of dietary palm oil in favour of consuming unhydrogenated vegetable oils.[18]

Glycidyl fatty acid esters (GE), 3-MCPD [monochloro propanediol] and 2-MCPD [monochloro propanediol], are found especially in palm oils and palm fats because of their refining at high temperatures (approx. 200°C (392°F)). Since glycidol, the parent compound of GE, is considered genotoxic and carcinogenic, the EFSA didn't set a safe level for GE. According to the chair of the CONTAM (EFSA's expert Panel on Contaminants in the Food Chain), "The exposure to GE of babies consuming solely infant formula is a particular concern as this is up to ten times what would be considered of low concern for public health". The EFSA's tolerable daily intake (TDI) of 3-MCPD and its fatty acid esters was set to 0.8 micrograms per kilogram of body weight per day (µg/kg bw/day) in 2016 and increased to 2 µg/kg bw/day in 2017, based on evidence linking this substance to organ damage in animal tests and on possible adverse effects on the kidney and on male fertility. According to the EFSA, there is not enough data to set a safe level for 2-MCPD.[19]

Palmitic acid: Excessive intake of palmitic acid, which makes up 44% of palm oil, increases blood levels of low-density lipoprotein (LDL) and total cholesterol, and so increases risk of cardiovascular diseases. Other reviews, the World Health Organization, and the US National Heart, Lung and Blood Institute have encouraged consumers to limit the consumption of palm oil, palmitic acid and foods high in saturated fat.

Potential Risks of Palm Oil: Because palm oil is a dense source of nutrition, it may have negative effects on some people. Consider the following before using palm oil in your cooking:

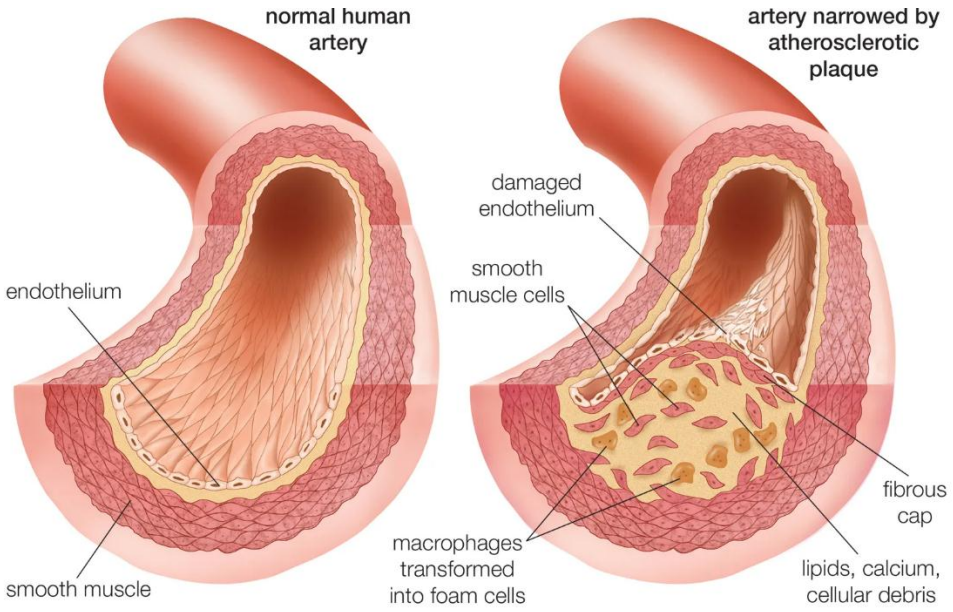


Figure-8: Atherosclerosis.

Increased Cholesterol Levels: While some studies suggest that palm oil decreases cholesterol levels, others suggest that it may raise "bad" cholesterol levels. These studies compared palm oil to other liquid oils such as olive oil, and generally found that palm oil performed worse than alternatives. One study found that palm oil increased cholesterol in healthy individuals. Palm oil is likely healthier than butter, but you should not add palm oil on top of other types of oil.[20]

Linked to Atherosclerosis: Fresh palm oil and older palm oil show significantly different levels of tocotrienol. Because of this, reheated palm oil shows far fewer benefits than fresh palm oil. In fact, reheated palm oil may not just lose the heart benefits of fresh palm oil, it may actually increase your risk of heart disease such as atherosclerosis. If you are at risk for heart disease, avoid eating reheated palm oil or foods containing reheated palm oil.

High in Saturated Fats: Compared to other liquid oils, palm oil is relatively high in saturated fats. Palm oil is about 34% saturated fat, while olive oil is less than half of that. Saturated fats are linked to an increased risk of heart disease and chronic health conditions.

CONCLUSION

Palm oil is an edible oil that is extracted from the fruit of the palm tree. It is a vegetable oil that is used for cooking in many countries worldwide because of its many health benefits. However, research shows that it can hurt our health as well. Palm oil is an edible vegetable oil that is extracted from the fruit of oil palm trees. Two types of oil are produced: crude palm oil is the oil that comes from squeezing the fleshy fruit and palm kernel oil is produced from crushing the kernel or the stone found in the middle of the fruit.

Side effects of palm oil:
Increase cholesterol levels- Excessive consumption of palm oil increase cholesterol levels.

Yellow Skin- Unregulated consumption of palm through food can sometimes turn our skin yellow because of the presence of high levels of carotenes in the oil.
Red and irritated skin- Applying red palm oil as a topical to treat skin conditions can cause the skin to become red and irritated.
Stained clothes- Even though palm oil has several benefits for the skin and hair, it is important to realize that they stain clothes very easily.
Cause weight gain Palm oil is naturally rich in palmitic acid, a fatty acid that increases our chance of weight gain and obesity. According to a 2005 issue of the American Journal of Clinical Nutrition, a diet high in palmitic acid leads to lower fat oxidation rates and a decrease in metabolism. The researchers also concluded that this may increase insulin resistance and the chances of obesity.
High in saturated fats and calories- Palm kernel oil and palm oil are 117 calories and 120 calories per serving. They also have 13.6 grams of fat per serving. Regularly using palm oil can significantly raise your saturated fat and cholesterol intake.
Increases risk of stroke- Palm oil is rich in triglycerides. Regular and excessive consumption of palm oil tends to harden and thicken the arteries. This increases our risk of developing heart disease and also our chances of stroke.
Since palm oil is used to make a lot of packaged food and is even favored for home cooking because of its high smoking point, therefore, nutrition experts recommend using a different vegetable oil for cooking to regulate and reduce your intake of palm oil.

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