Moscow State University of Instrument Engineering and Computer Science

###### Abstract:

“Industrial development of the African countries.”

**Executed:**

МФ-ЭФ2-06-02

Binnat-Zade Elvin

**Checked:**

Valentina Manishova

**Mozhaysk, 2008**

**Contents:**

Introduction

1. History

2. Chemistry and processing

3. Environmental, social and cultural impact

4. Biofuels and bioproducts

5. Regional production

5.1. Malaysia

5.2. Indonesia

5.3. Australia

5.4. Benin

5.5. Kenya

5.6. Colombia

6. Health

6.1. Blood cholesterol controversy

Bibliography

**Introduction**.

Palm oil is a form of edible vegetable oil obtained from the fruit of the oil palm tree. Previously the second-most widely produced edible oil, after soybean oil, 28 million metric tons were produced worldwide in 2004. It may have now surpassed soybean oil as the most widely produced vegetable oil in the world. It is also an important component of many soaps, washing powders and personal care products, is used to treat wounds, and has controversially found a new use as a feedstock for biofuel.

The palm fruit is the source of both palm oil (extracted from palm fruit) and palm kernel oil (extracted from the fruit seeds). Palm oil itself is reddish because it contains a high amount of beta-carotene. It is used as cooking oil, to make margarine and is a component of many processed foods. Boiling it for a few minutes destroys the carotenoids and the oil becomes colourless. Palm oil is one of the few vegetable oils relatively high in saturated fats (like coconut oil) and thus semi-solid at room temperature.

**1. History.**

Palm oil (from the African Oil Palm, Elaeis guineensis) was long recognized in West African countries, and among West African peoples it has long been in widespread use as a cooking oil. European merchants trading with West Africa occasionally purchased palm oil for use in Europe, but as the oil was bulky and cheap, palm oil remained rare outside West Africa. In the Asante Confederacy, state-owned slaves built large plantations of oil palm trees, while in the neighbouring Kingdom of Dahomey, King Ghezo passed a law in 1856 forbidding his subjects from cutting down oil palms.

Palm oil became a highly sought-after commodity by British traders, for use as an industrial lubricant for the machines of Britain's Industrial Revolution, as well as forming the basis of soap products, such as Lever Brothers' "Sunlight Soap", and the American Palmolive brand. By c.1870, palm oil constituted the primary export of some West African countries such as Ghana and Nigeria, although this was overtaken by cocoa in the 1880s.

Palm was introduced to Java by the Dutch in 1848 and Malaysia (then the British colony of Malaya) in 1910 by Scotsman William Sime and English banker Henry Darby. The first plantations were mostly established and operated by British plantation owners, such as Sime Darby. From the 1960s a major oil palm plantation scheme was introduced by the government with the main aim of eradicating poverty. Settlers were each allocated 10 acres of land (about 4 hectares) planted either with oil palm or rubber, and given 20 years to pay off the debt for the land.[citation needed] The large plantation companies remained listed in London until the Malaysian government engineered their "Malaysianisation" throughout the 1960s and 1970s.

**2. Chemistry and processing.**

Palm oil and palm kernel oil are composed of fatty acids, esterified with glycerol just like any ordinary fat. Both are high in saturated fatty acids, about 50% and 80%, respectively. The oil palm gives its name to the 16 carbon saturated fatty acid palmitic acid found in palm oil; monounsaturated oleic acid is also a constituent of palm oil while palm kernel oil contains mainly lauric acid. Palm oil is the largest natural source of tocotrienol, part of the vitamin E family. Palm oil is also high in vitamin K and dietary magnesium.

Napalm derives its name from naphthenic acid, palmitic acid and pyrotechnics or simply from a recipe using naphtha and palm oil.

The approximate concentration of fatty acids (FAs) in palm oil is as follows:

Fatty acid content of palm oil

Type of fatty acid pct

Palmitic C16 44.3%

Stearic C18 4.6%

Myristic C14 1.0%

Oleic C18 38.7%

Linoleic C18 10.5%

Other/Unknown 0.9%

Fatty acid content of palm kernel oil

Type of fatty acid pct

Lauric C12 48.2%

Myristic C14 16.2%

Palmitic C16 8.4%

Capric C10 3.4%

Caprylic C8 3.3%

Stearic C18 2.5%

Oleic C18 15.3%

Linoleic C18 2.3%

Other/Unknown 0.4%

Fatty acids are saturated and unsaturated aliphatic carboxylic acids with carbon chain length in the range of C6 up to C24. An example of a fatty acid is palmitic acid

CH3 – (CH2)14 – COOH

Splitting of oils and fats by hydrolysis, or under basic conditions saponification, yields fatty acids; with glycerin(glycerol) as a by-product. The split-off fatty acids are a mixture of fatty acids ranging from C6 to C18 depending on the type of Oil / Fat.

Palm oil products are made using milling and refining processes; first using fractionation, with crystallization and separation processes to obtain a solid stearin, and liquid olein. By melting and degumming, impurities can be removed and then the oil filtered and bleached. Next, physical refining removes odours and colouration, to produce refined bleached deodorized palm oil, or RBDPO, and free pure fatty acids, used as an important raw material in the manufacture of soaps, washing powder and other hygiene and personal care products. RBDPO is the basic oil product which can be sold on the world's commodity markets, although many companies fractionate it out further into palm olein, for cooking oil, or other products.

Palm is also used in biodiesel production, as either a simply-processed palm oil mixed with petrodiesel, or processed through transesterification to create a palm oil methyl ester blend which meets the international EN 14214 specification, with glycerin as a by-product. The actual process used varies between countries and the requirements of any export markets. Second-generation biofuel production processes are also being trialled in relatively small quantities.

**3. Environmental, social and cultural impact.**

Palm oil production is a basic source of income for many of the world's rural poor in South East Asia, Central and West Africa, and Central America. An estimated 1.5 million small farmers grow the crop in Indonesia, whereas about 0.5 million people are directly employed in the sector in Malaysia, plus those connected with spin offs. Not only does the palm represent a pillar of these nation's economies but it is a catalyst for rural development and political stability. Many social initiatives use profits from palm oil to finance poverty alleviation strategies. Examples include the direct financing of Magbenteh hospital in Makeni, Sierra Leone, through profits made from palm oil grown by small local farmers, the Presbyterian Disaster Assistance's Food Security Program, which draws on a women-run cooperative to grow palm oil, the profits of which are reinvested in food security, or the UN Food and Agriculture Organisation's hybrid oil palm project in Western Kenya, which improves incomes and diets of local populations, to name just a few.

As of 2006, the cumulative land area of palm oil plantations is approximately 11 million hectares. In 2005 the Malaysian Palm Oil Association, responsible for about half of the world's crop, estimated that they manage about half a billion perennial carbon-sequestering palm trees. Demand for palm oil has been rising and is expected to climb further.

This rising demand is resulting in tropical forest being cleared to establish new palm plantations. According to UNEP, at the current rate of intrusion into Indonesian national parks, it is likely that many protected rain forests will be severely degraded by 2012 through illegal hunting and trade, logging, and forest fires, including those associated with the rapid spread of palm oil plantations. There is growing concern that this will be harmful to the environment in several ways:

Significant greenhouse gas emissions. Deforestation, mainly in tropical areas, account for up to one-third of total anthropogenic CO2 emissions.

Habitat destruction of certain endangered species (e.g. the orangutans in Borneo, the Sumatran tiger, and Asian rhinoceros.)

Potential extinction of some such species.

Many places that are of interest for growing palm are biodiversity hotspots, increasing the impact of this development on the environment. In addition to environmental impact, the logging and land-clearing by large timber companies that accompany the establishment of palm plantations threatens the livelihood of minority tribes such as the Penan and Iban in Sarawak, Borneo.

Damage to peatland, partly due to palm oil production, is claimed to contribute to environmental degradation, including four percent of global greenhouse gas emissions and eight percent of all global emissions caused annually by burning fossil fuels, due to the large areas of rainforest that are cleared to make way for palm oil plantations. The pollution is exacerbated because many rainforests in Indonesia and Malaysia lie atop peat bogs that store great quantities of carbon that are released when the forests are cut down and the bogs drained to make way for the palm oil plantations.

NGOs have accused the growth of new palm oil plantations as also being responsible for peat forest destruction in Indonesia and for accelerating global warming. Greenpeace concluded that many food and cosmetics companies, including ADM, Unilever, Cargill, Proctor & Gamble, Nestle, Kraft and Burger King, are driving the demand for new palm oil supplies, partly for products that contain non-hydrogenated solid vegetable fats, as consumers now demand fewer hydrogenated oils in food products that were previously high in trans fat content. Friends of the Earth have concluded that the increase in demand comes from biofuel, with producers now looking to use palm as a source.

Environmental groups such as Greenpeace claim that the deforestation caused by making way for oil palm plantations is far more damaging for the climate than the benefits gained by switching to biofuel. The world's centres for oil palm production are Indonesia and Malaysia where rapid deforestation and the drying out of asssociated peatlands are, Greenpeace claim, releasing huge amounts of carbon dioxide into the atmosphere and thereby speeding climate change.Greenpeace identified Indonesian peatlands, unique tropical forests whose dense soil can be burned to release carbon emissions, that are being destroyed to make way for palm oil plantations. They represent massive carbon sinks, and they claim their destruction already accounts for four percent of annual global emissions. Greenpeace recorded peatland destruction in the Indonesian province of Riau on the island of Sumatra, home to 25 percent of Indonesia's palm oil plantations. There are plans to expand the area under concession by more than 11,000 square miles, which would deforest half of the province. They claim this would have devastating consequences for Riau's peatlands, which have already been degraded by industrial development and store a massive 14.6 billion tons of carbon, roughly one year's greenhouse gas emissions.

Research conducted by Greenpeace through its Forest Defenders Camp in Riau documents how a major Indonesian palm oil producer is engaging in the large-scale, illegal destruction of peatland in flagrant violation of an Indonesian presidential order, as well as national forestry regulations. Palm oil from peatland is fed into the supply chain for global brands. They accuse major multinational companies of turning a blind eye to peatland destruction to supply cheap vegetable oil. FoE and Greenpeace both calculate that forests and peatlands that are replaced as palm oil plantations release more carbon dioxide than is saved by burning biofuels in place of diesel.

In Africa, the situation is very different compared to Indonesia or Malaysia. In its Human Development Report 2007-2008, the United Nations Development Program says production of palm oil in West-Africa is largely sustainable, mainly because it is undertaken on a smallholder level. The United Nations Food and Agriculture program is encouraging small farmers across Africa to grow palm oil, because the crop offers opportunities to improve livelihoods and incomes for the poor.

Environmentalists and conservationists have been called upon to become palm oil farmers themselves, so they can use the profits to invest in their cause. It has been suggested that this a more productive strategy than the current confrontational approach that threatens the livelihoods of millions of smallholders.

Many of the major companies in the vegetable oil economy participate in the Roundtable on Sustainable Palm Oil which is trying to address this problem. Meanwhile, much of the recent investment in new palm plantations for biofuel has been part-funded through carbon credit projects through the Clean Development Mechanism; however the reputational risk associated with unsustainable palm plantations in Indonesia has now made many funds wary of investing there.

**4. Biofuels and bioproducts.**

Palm oil, like other vegetable oils, can be used to create biodiesel for internal combustion engines. Biodiesel has been promoted as a form of biomass that can be used as a renewable energy source to reduce net emissions of carbon dioxide into the atmosphere. Therefore, biodiesel is seen as a way to decrease the impact of the greenhouse effect and as a way of diversifying energy supplies to assist national energy security plans. Scientists have found that biodiesel made from palm oil grown on sustainable non-forest land and from established plantations can effectively reduce greenhouse gas emissions.

However, NGOs such as Greenpeace have concluded that the current "first generation" biodiesel extracted from new palm oil plantations may not be a genuine counter to global warming. If forests are cleared for palm plantations, and the wood is not used for bioenergy but burned, it may take decades before biodiesel from palm oil reduces as much carbon dioxide as the pristine forests originally sequestered in the form of carbon. However, if the wood is used for the production of bioenergy, the palm plantations as well as the biodiesel from palm oil starts to sequester and reduce greenhouse gas emissions from the first year onwards.

Although palm oil has a comparatively high yield, the problems that organisations such as Greenpeace have linked to palm cultivation on newly-cleared plantations have encouraged research into alternative vegetable fuel oil sources with less potential for environmental damage, such as jatropha. Although palm requires less manual labor to harvest a given amount of oil than jatropha, the latter grows well in more marginal areas and requires less water.

Other scientists and companies are going beyond merely using the oil from oil palm trees, and are proposing to convert the entire biomass harvested from a palm plantation into renewable electricity, cellulosic ethanol, biogas, biohydrogen and bioplastic. Thus, by using both the biomass from the plantation as well as the processing residues from palm oil production (fibers, kernel shells, palm oil mill effluent), bioenergy from palm plantations can have an effect on reducing greenhouse gas emissions. Examples of these production techniques have been registered as projects under the Kyoto Protocol's Clean Development Mechanism.

By using all the biomass residues from palm oil processing for renewable energy, fuels and biodegradable products, both the energy balance and the greenhouse gas emissions balance for biodiesel from palm oil is improved. For each tonne of crude palm oil (CPO) produced from fresh fruit bunches, the following residues, which can all be used for the manufacture of biofuels, bioenergy and bioproducts, become available: around 6 tonnes of waste palm fronds, 1 ton of palm trunks, 5 tons of empty fruit bunches (EFB), 1 ton of press fiber (from the mesocarp of the fruit), half a ton of palm kernel endocarp, 250kg of palm kernel press cake, and 100 tonnes of palm oil mill effluent (POME). In short, a palm plantation has the potential to yield a very large amount of biomass that can be used for the production of renewable products.

However, regardless of these new innovations, first generation biodiesel production from palm oil is still in demand globally and will continue to increase. Palm oil is also a primary substitute for rapeseed oil in Europe, which too is experiencing high levels of demand for biodiesel purposes. Palm oil producers are investing heavily in the refineries needed for biodiesel. In Malaysia companies have been merging, buying others out and forming alliances in order to obtain the economies of scale needed to handle the high costs caused by increased feedstock prices. New refineries are being built across Asia and Europe.

**5. Regional production.**

**5.1. Malaysia.**

In 2004, Malaysia produced 14 million tons of palm oil from more than 38,000 square kilometres of land, making it the largest exporter of palm oil in the world. The majority of its crops goes towards its traditional markets for personal hygiene and food use. The Malaysian Sime Darby conglomerate is its largest plantation operator, with 524,626 hectares of oil palms, mainly across Peninsular Malaysia, Sarawak and Sabah in Malaysia. It also operates plantations in Sumatera, Kalimantan and Sulawesi in Indonesia, as well as production plants and refineries.

The IEA predicts that biofuels use in Asian countries will remain modest. But as a major producer of palm oil, the Malaysian government is encouraging the production of biofuel feedstock and the building of biodiesel plants that use palm oil. Domestically, Malaysia is preparing to change from diesel to bio-fuels by 2008, including drafting legislation that will make the switch mandatory. From 2007, all diesel sold in Malaysia must contain 5% palm oil. Malaysia is emerging as one of the leading biofuel producers with 91 plants approved and a handful now in operation, all based on palm oil. Most are aimed at supplying regional demand, though exports to Europe are also planned, with China currently the main importer of Malaysian products for biodiesel.

On 16 December 2007, Malaysia opened its first biodiesel plant in the state of Pahang, which has an annual capacity of 100,000 tonnes and also produces by-products in the form of 4,000 tonnes of palm fatty acid distillate and 12,000 tonnes of pharmaceutical grade glycerine. Neste Oil of Finland plans to produce 800,000 tonnes of biodiesel per year from Malaysian palm oil in a new Singapore refinery from 2010, which will make it the largest biofuel plant in the world, and 170,000 tpa from its first second-generation plant in Finland from 2007-8, which can refine fuel from a variety of sources. Neste and the Finnish government are using this paraffinic fuel in some public buses in the Helsinki area as a small scale pilot.

**5.2. Indonesia.**

Growers in Indonesia are also increasing production of palm oil to meet the global demand spurred by biofuels, with the government looking for it to become the world's top producer of palm oil.

In additional to servicing its traditional markets, it is looking to produce biodiesel. There are new mills and refineries being built by major local companies, such as PT. Asianagro (150,000 tpa biodiesel refinery), PT. Bakrie Group (a biodiesel factory and new plantations), Surya Dumai Group (biodiesel refinery) and global companies such as Cargill (sometimes operating through CTP Holdings of Singapore, building new refineries and mills in Malaysia and Indonesia, expanding its Rotterdam refinery to handle 300,000 tpa of palm oil, acquiring plantations in Sumatra, Kalimantan, Indonesian Peninsula and Papua New Guinea) and Robert Kuok's Wilmar International Limited (with plantations and 25 refineries across Indonesia, to supply feedstock to new biodiesel refineries in Singapore, Riau, Indonesia, and Rotterdam)

However, fresh land clearances, especially in Borneo, are contentious for their environmental impact. NGOs and many international bodies are now warning that, despite thousands of square kilometres of land standing unplanted in Indonesia, tropical hardwood forest are being cleared for palm oil plantations. Furthermore, as the remaining unprotected lowland forest dwindles, developers are looking to plant peat swamp land, using drainage that unlocks the carbon held in their trees and begins an oxidation process of the peat which can release 5,000 to 10,000 years worth of stored carbon. Drained peat is also at very high risk of forest fire, and there is a clear record of fire being used to clear vegetation for palm oil development in Indonesia. Drought and man-made clearances have led to massive uncontrolled forest fires over recent years, covering parts of Southeast Asia in haze and leading to an international crisis with Malaysia. These fires have been variously blamed on a government with little ability to enforce its own laws while impoverished small farmers and large plantation owners illegally burn and clear forests and peat lands in order to reap the developmental benefits of environmentally-valuable land.

**5.3. Australia.**

On 23 November 2006 Australia's first palm oil based biodiesel plant opened in Darwin, using Lurgi AG's biofuel refinery technology. The plant has a capacity to produce 122,500 t of biodiesel, and 12,250 t of glycerine annually. The same company is also building a 600,000/60,000 tpa biodiesel/glycerine facility with cogeneration in Singapore, scheduled to come into full production in mid-2008.

**5.4. Benin.**

Palm is native to the wetlands of Western Africa and south Benin already hosts many palm plantations. Its government's 'Agricultural Revival Programme' has identified many thousands of hectares of land as suitable for new oil palm plantations to be grown as an export crop. In spite of the economic benefits, NGOs such as Nature Tropicale claim this policy is flawed as biofuels will be competing with domestic food production in some existing prime agricultural sites. Other areas comprise peat land, whose drainage would have a deleterious environmental impact. They are also concerned that genetically-modified plants will be introduced for the first time into the region, jeopardizing the current premium paid for their non-GM crops.

**5.5. Kenya.**

Kenya's domestic production of edible oils covers about a third of its annual demand, estimated at around 380,000 metric tonnes. The rest is imported at a cost of around US $140 million a year, making edible oil the country's second most important import after petroleum. Since 1993 a new hybrid variety of cold-tolerant, high-yielding oil palm has been promoted by the Food and Agriculture Organization of the United Nations in western Kenya. As well as alleviating the country's deficit of edible oils while providing an important cash crop, it is claimed to have environmental benefits in the region, as it does not compete against food crops or native vegetation and it provides stabilisation for the soil.

**5.6. Colombia.**

In the 1960s about 18,000 hecatares were planted with palm. Colombia has now become the largest palm oil producer in the Americas, and 35% of its product is exported as biofuel. In 2006 the Colombian plantation owners' association, Fedepalma, reported that oil palm cultivation was expanding to a million hectares. This expansion is being part-funded by the United States Agency for International Development in order to resettle disarmed paramilitary members on cultivatable land, and by the Colombian government which proposes to expand land use for exportable cash crops to 7m hectares by 2020, including oil palms. However, while Fedepalma states that its members are following sustainable guidelines, there have been claims that some of these new plantations have been appropriated on land owned by Afro-Colombians driven away through poverty and civil war, while armed guards intimidate the remaining people to depopulate the land, while coca production and trafficking follows in their wake.

**6. Health.**

Palm oil is a very common cooking ingredient in the regions where it is produced.

Its heavy use in the commercial food industry elsewhere can be explained by its comparatively low price, being one of the cheaper vegetable or cooking oils on the market, and by new markets in the USA, stimulated by a search for alternatives to trans fats after the Food and Drug Administration required food labels to list the amount of trans fat per serving. Identifying the exact source of an oil can be complicated by labelling, as palm oil is often described on food labels simply as "vegetable oil".

Red palm oil is known to be healthier than refined (discolored) palm oil. This is a result of several mitigating substances found in the red palm oil. These compounds are:

betacarotenes (present in higher amounts than in regular palm oil)

co-enzyme Q10 (ubiquinone)

squalene

Vitamin A

Vitamin E

Palm oil is applied to wounds, just like iodine tincture, to aid the healing process. This is not just done for its oily qualities; like coconut oil, unrefined palm oil is supposed to have additional antimicrobial effects, but research does not clearly confirm this.

**6.1. Blood cholesterol controversy.**

The palm oil industry emphasizes that palm oil contains large quantities of oleic acid, the healthful fatty acid also found in olive and canola oil, and claims that palmitic acid also affects cholesterol levels much like oleic acid. Many health authorities counter that palm oil promotes heart disease, citing research and metastudies that go back to 1970.

For many years now, it has been established that the primary cholesterol-elevating fatty acids are the saturated fatty acids with 12 (lauric acid), 14 (myristic acid) and 16 (palmitic acid) carbon atoms with a concomitant increase in the risk of coronary heart disease. Monounsaturated fatty acids such as oleic acid is as effective in reducing serum total and low-density lipoprotein (LDL) cholesterol levels as polyunsaturated fatty acids such as alpha-linoleic acid. The World Health Organization in its report states there is convincing evidence that palmitic oil consumption contributes to an increased risk of developing cardiovascular diseases. Research in the US and Europe support the WHO report.

In a response to the WHO report, the Malaysian Palm Oil Promotion Council has argued that there is insufficient scientific evidence to produce general guidelines for worldwide consumption of palm oil and cited research a study in China comparing palm, soybean, peanut oils and lard (all of which contain saturated fat) showing that palm oil increased the levels of good cholesterol and reduced the levels of bad cholesterol in the blood, and that palm is a better solid fat to use in products where trans fats would otherwise be chosen.

An older study by Hornstra in 1990 also supported the claims of the Malaysian Palm Oil Promotion Council.

A study by the Departments of Agricultural, Food and Nutritional Science and Medicine, University of Alberta showed palmitic acid to have no hypercholesterolaemic effect if intake of linoleic acid was greater than 4.5% of energy, but that if the diet contained trans fatty acids, LDL cholesterol increases and HDL cholesterol decreases.

The studies supporting the Malaysian Palm Oil Promotion Council only addressed the issue of the effect of palm oil on blood cholesterol levels and not its total effect regarding cardiovascular diseases.

**Bibliography:**

1) “English on economics”, С.А.Шевелева, 2001.

2) “Английский для студентов экономических специальностей”, Е.В.Глушенкова, Е.Н.Комарова, 2003.

3) “Учебное пособие по деловому английскому языку на базе сборника диалогов «Business Connections»”, О.Б. Андреева, 2005.