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Review

Traditional oil palm (*Elaeis guineensis* jacq.) and its medicinal uses: A review

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ABSTRACT

The oil palm (*Elaeis guineensis* Jacq.) has been reported to originate along the gulf of the guinea in West Africa. The various parts of the tree have been used locally and traditionally for various medicinal purposes. Some of these uses have been proved by scientific experiments. Palm oil is extracted from the mesocarp of the fruit and is used traditionally for the treatment of headaches, pains, rheumatism, cardiovascular diseases, arterial thrombosis and an atherosclerosis due to its rich phytonutrients. The leaves are also used for the treatment of cancer, cardiovascular diseases, kidney diseases and wound healing. The sap also has been found to be rich in phytonutrients that can be used to treat various diseases. This review therefore seeks to explore many of the uses of the oil palm using the various parts of the oil palm.

Keywords anti-inflammatory, anti-cancer, cardiovascular diseases, *Elaeis guineensis*, medicinal uses, oil palm, rheumatism

INTRODUCTION

It is generally agreed that the oil palm (*Elaeis guineensis* Jacq.) originated from the equatorial tropical rain forest region of Africa, precisely along the gulf of guinea (Naher et al., 2013). It exists in the wild type and cultivated state. It was first introduced to Brazil and other tropical countries in the 15th century by the Portuguese (Corley, 1976). The oil palm fruit is a drupe. The American oil palm, *Elaeis oleifera* is native to tropical Central America and South America.

This review intends to provide information on the documented medicinal uses of oil palm including laboratory studies on the plant. Earlier review by Obahiagbon (2012) was limited to an aspect of the plant. This present review covers both the traditional as well as the scientific uses of the oil. The review however does not extend to the core botanical aspect of the plant. The literatures used for this review were obtained from Medline and Google Scholar search carried out from September, 2013 to April, 2014.

The traditional theory about the uses of oil palm in many parts of Nigeria is that products from oil palm are antidotes that can be used in the treatment of many ailments especially gastrointestinal disorders and poisons.

Oil palm

The African oil palm (*Elaeis guineensis* Jacquin) produces two different kinds of oil namely, palm oil and palm kernel oil (Ekwenye and Ijeomah, 2005). The pericarp consists of three layers: the exocarp (skin), mesocarp (outer pulp containing palm oil), and the endocarp (a hard shell enclosing the kernel or endosperm, which contains oil known as kernel oil) (Naher et al., 2013). Palm oil is extracted from fleshy mesocarp of the fruit either by milling mechanically or by the traditional method (Hartley, 1977; Edem and Akpanabiatu, 2006), which contains 45 - 55% oil, but varies from light yellow to orange-red in color, and melts at 25°C (Duke, 1983). The oil colour is determined by the carotenoids (Cottrell, 1991). The major carotenoids found in palm oil are the beta-carotene (Obahiagbon, 2012). Palm kernel oil is obtained from the kernels enclosed in the endocarp (Ekwenye and Ijeomah, 2005). Palm oil contains saturated palmitic acid, oleic and linoleic acid, giving it a higher unsaturated acid content than palm kernel or coconut oils (Duke, 1983; Edem, 2002). Along with coconut oil, palm oil is one of the few highly saturated vegetable fats. It is semi-solid at room temperature and contains several saturated and unsaturated fats in the forms of glyceryl laurate (0.1%, saturated), myristate (1%, saturated), palmitate (44%, satur ated), stearate (5%, saturated), oleate (39%, monounsaturated), linoleate (10%, polyunsaturated), and alpha-linolenate (0.3%, polyunsaturated) (Cottrell, 1991). Palm oil also has minor constituents including phospholipids (Goh et al., 1983). Currently, palm oil is the world largest edible oil (Naher et al., 2013) and is the main source of domestic or edible oil in Africa (Obahiagbon, 2012; Oluba et al., 2009). As much as palm oil provides energy and fatty acid needs (Oguntibeju et al., 2009), much of the palm oil that is consumed as food is to some degree oxidized rather than in the fresh state, and this oxidation appears to be responsible for the health risk associated with consuming palm oil (Edem, 2002).

Ekwenye and Ijeomah (2005) reported that traditionally, palm oil has been used in the South Eastern Nigeria for the treatment of various diseases and skin infections. This was confirmed by their experiment carried out at the Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria using five microorganisms namely; *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas areuginosa*, *Candida albicans*, and *Aspergillus niger* known to cause some infections treatable with palm oil and palm kernel oil. In this experiment,

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0.04 ml of 100% concentration palm oil and palm kernel oil extracts was impregnated into the sterilized discs according to the method of Ekpa and Ebana (1996). The anti-microbial test was done using the disc diffusion method of Brauer et al. (1996) was adapted using nutrient agar, sabouraud dextrose agar, and the impregnated discs. Palm oil has also been reported to be anodyne, anti-dotal, aphrodisiac and a diuretic (Irvin, 1985; Sasidharan et al., 2012). It is folk remedy for headaches, pains, rheumatism, cardiovascular diseases, arterial thrombosis and an atherosclerosis (Ekwenye and Ijeomah, 2005; Honstra, 1986; Irvin, 1985; Sasidharan et al., 2012). The palm oil is known to be effective against many forms of intestinal disorders, especially diarrhoea and dysentery in infants (Ekpa and Ebana, 1996.). The fruit mesocarp oil and palm kernel oil are administered as poison anti-dote and used externally with several other herbs as lotion for skin diseases. Palm kernel oil is applied to convulsing children to regulate their body temperature. Folk remedies of oil palm also include treatment for cancer and liniment (Irvin, 1985; Sasidharan et al., 2012).

Anti-oxidant activity

Palm oil provides a rich source of beta-carotene and vitamin E, namely tocopherols and tocotrienols which are recognized nutritional anti-oxidants that act as scavengers of the oxygen atom or free radicals (Chong and Ng, 1991; Ekwenye and Ijeomah, 2005; Goh et al., 1985). The oxygen atom or free radicals can arise during the body's normal oxidative metabolism or from the action of toxic pollutants that contaminate our food and have been implicated in ageing, heart disease and cancer (Ekwenye and Ijeomah, 2005). *E. guineensis* is also used as a wound healing agent among the natives of Africans and as therapeutic agent in other parts of the World (Sasidharan et al., 2010; Sasidharan and Vijayarathna, 2012). The palm oil is also used for biofuels and some manufactured products (Naher et al., 2013). Carotenoids are potent anti-oxidants. Packer et al. (1992) showed that alpha-carotene is a more potent anti-oxidant than beta-carotene. Red palm oil is rich in natural phytonutrients that are important for health. These phytonutrients (i.e. tocotrienols and carotenes) are also powerful anti-oxidants that help maintain the stability of the oil during cooking process and may extend the shelf life of food prepared with red palm oil

Research has shown that consumption of red palm oil significantly enhanced vitamin A levels in humans, and it is beneficial in preventing vitamin A deficiency (Manorama and Rukmini, 1991; Roo, 2000; Solomons, 1998) and it is used for combating vitamin A deficiency in developing countries (Rukmini, 1994). Additionally, some workers have advised that nursing mothers should take red palm oil as supplement with their food in order to prevent vitamin A deficiency (Lietz et al., 2000). Vitamin A deficiency may lead to blindness, skin disease and weakened immune function. The vitamin A content of the red palm oil plays important roles in growth, development and in visual process (Edem, 2009). The human body is able to convert provitamin-A carotenoids (alpha- and beta-carotene) when there is a deficiency, hence it is safer to supplement with carotenes than consuming vitamin A (retinoids) directly. Excessive consumption of retinoids may lead to toxicity with symptoms ranging from mild, such as headache, nausea and dry, itchy skin to severe, such as liver damage (Solomons, 1998).

Tocotrienols are members of the vitamin E family. In the body, vitamin E acts as an anti-oxidant that protects lipid from peroxidation and help quench free radicals. However, there is a difference in anti-oxidant potency between tocotrienol and its sibling tocopherol. Tocotrienol has been shown to be 40 to 60 times more potent than tocopherol as an anti-oxidant. Palm oil is the only vegetable oil available on the world market that naturally contains tocotrienols (Cottrell, 1991; Ebong et al., 1999; Elson, 1992; Van Rooyen et al., 2008) and is the richest natural source of beta - carotene (500 - 700 mg/l) which is responsible for the characteristic colour of the oil. Similar to the tocopherols, tocotrienols consist of 4 members: alpha, beta, gamma, and delta isomers (Serbinova, 1991). Alpha toco pherols and gamma tocotrienols have anti-oxidative effects on lipid peroxidation, in the presence of a xenobiotic metabolizing enzyme that induces lipid peroxidation (Zuzana et al., 2005). The vitamin E, particularly the tocotrienol present in palm oil can suppress the synthesis of cholesterol in the liver (Mcintosh et al., 1991; Qureshi et al., 1991; Qureshi et al., 1980). Some scientists in South Africa have been able to establish that oxidative stress plays a role in inflammatory and chronic disease such as HIV/AIDS and TB and contribute significantly to depletion of immune factors, micronutrients and progression of disease and that red palm oil could potentially retard the process because of rich anti-oxidants (Oguntibeju et al., 2009).

Anti-diabetic action

Studies have indicated that the potential mechanism of action for the improvement in glucose metabolism with *E. guineensis* involves inhibition of the enzyme dipeptidyl peptidase-4 (DPP-4; Abdullah, 2009) the effect of which is to prevent degradation of gastric inhibitory polypeptide, which itself stimulates insulin secretion, suppresses glucagon secretion and slows gastric emptying. *E. guineensis* is rich in catechins and polyphenols (Jaffri, 2011). Prior studies in streptozotocin-induced hyper glycemic rats showed that *E. guineensis* improved proteinuria and reduced oxidative stress levels (Rosalina Tan, 2011; Yamabe, 2006). This suggests a potential benefit for the pre-diabetic and diabetic states. Administration of tocopherol, Vitamin E or tocotrienol-rich fractions of palm oil, have been shown to recover glycemic status, inhibit oxidative damage; prevent DNA damage in animal studies and prevent glycosylation of end-products in serum and decrease in diabetic rats (Budin et al., 2006; Nazaimoon and Khalid, 2002; Obahiagbon, 2012)

Cardiovascular activities

Peer review journals have documented palm tocotrienol complex's promising hypocholesterolemic properties (Qureshi et al., 1991, 1995). Also, the daily consumption of tocotrienols-enriched fraction of palm oil (200 mg palmvitee capsule) can result in a significant reduction of serum cholesterol, Low Density Lipoprotein cholesterol, APOB, thromboxane, platelet factor 4 and glucose of hyper cholesterolemic subjects within four weeks of administration (Qureshi et al., 1991; Packer, 1992; Song and DeBose-Boyd, 2006). A number of human feeding studies reported that palm oil diets showed a reduction of blood cholesterol values ranging from 7 to 38% (Mattson and Grundy, 1985; Bonanome and Grundy, 1988). A comparative study in young Australian adults showed that the total blood cholesterol, triglycerides and High Density Lipoprotein (HDL) - cholesterol levels of those fed on palm oil (palm olein) and olive oil were lower than those fed on the usual Australian diet (Choudhury et al., 1995). A number of studies have also shown that palm oil increased HDL cholesterol and Apo A-1 levels (Sundram et al., 1992; Truswell et al., 1992). Other studies have also shown the beneficial effects of palm oil on the cholesterol level of the body (Marzuki et al., 1991; Ng et al., 1992, 1991; Zhang et al., 1997). The position of the saturated and unsaturated fatty acid chains in a triglyceride backbone of palm oil molecule determines whether the fat will elevate cholesterol level in the blood

(Kritchevsky, 1988, 1996). High blood pressure or hypertension is one of the major risk factors of cardiovascular diseases and strokes. In a human clinical trial, patients supplemented with palm tocotrienol complex for two months resulted in significant reduction in aortic systolic blood pressure (Rasool et al., 2006). In an earlier review by Obahiagbon (2012), he pointed out that Tocotrienol-rich Fraction (TRF) of palm oil exhibited cardio-protective ability in animal trials (Das et al., 2008). The cardio-protective effects produced by the isomers of tocotrienol were of the order of: $\gamma > \alpha > \delta$. The inhibition of normal cellular gene, C-Src activation and proteosome stabilization were found to be reasons behind the cardio-protective properties of TRF (Das et al., 2008). Feeding experiments using various animal models have highlighted that red palm oil is beneficial to health by reducing oxidative stress (Ebong et al., 1999). Many studies have demonstrated the protective effects of red palm oil in an ischemia/reperfusion model of oxidative stress (Bester et al., 2006; Engelbrecht et al., 2006; Esterhuyse et al., 2005)

Palm oil has been shown to possess anti-clotting effect and it prevents the formation of thrombus in the blood vessels (Oguntibeju et al, 2010). A human study (Kooyenga et al., 1997) showed that tocotrienol (from palm oil) supplementation can reduce stenosis of patients with carotid atherosclerosis. Vitamin E in palm oil has been linked with inhibition of platelets from sticking to each other. Other reports showed that palm oil diets increases the production of prostacyclin or thromboxane (Ng et al., 1992; Sundram et al., 1990). Thus scientific evidence indicates that the palm oil diet is anti-thrombotic. Studies in animals confirmed that palm oil do not promote the formation of plaques in the arteries. A study was conducted on rabbits to test the effect of palm oil on atherosclerosis. After feeding the rabbits for one and a half years, palm oil and sunflower oil diets caused the lowest degree of atherosclerosis in comparison with fish oil, linseed oil and olive oil. Similarly, the effects of palm oil was also compared with other types of plants derived oils and at the end of the 14-month feeding period, coconut oil fed rabbits had the most atherosclerosis lesions, while in palm oil-fed rabbits; the number of lesions was no different from that with the other oils (Oguntibeju et al., 2010).

Anti-bacterial

The anti-bacterial activity of this plant extract against different micro-organisms and anti-oxidant activity have already been reported (Manjunatha, 2005; Sasidharan et al., 2009). Moreover, Chong together with Sasidharan and some others (Chong et al., 2008) described the potential of *E. guineensis* leaf methanol extract as an infected wound healing agents. They observed that the bacterial count in the *E. guineensis* extract treated rats was significantly reduced to 102 CFU/g tissues on day 16. In a further study, Sasidharan tested wound healing activity without infection and the expression of matrix metalloproteinases (Sasidharan et al., 2012).

Toxicity

Several studies have been conducted to confirm the non-toxicity of different parts of *E.guineensis* at normal doses (Rajoo et al., 2010; Syahmi et al., 2010). Syahmi et al. (2010) evaluated the acute oral toxicity of methanol extract of the leaves using a dose of 5g and found no toxicity. They also use the brine shrimp bioassay and also reported no toxicity. Also, Anyanji et al. (2013) showed that the ethanol extract of the palm leaves do not cause any toxicity at 2 g/kg but it appears toxic at 5 g/kg based on a single administration after seven days. However, the indices of toxicity were partially reversed after 14 days of administration.

Conservation and preservation

Several literature have reported the use of palm oil in preservation purposes from various parasites including cowpea weevil, *Callosobruchus maculatus* (Law-Ogbomo and Egharevba, 2006), *Sitophilus zeamais* and *Callosobruchus maculates* (Abulude et al., 2007).

Anti-cancer action

Studies have shown that tocotrienols fractions of palm oil were able to induce an inhibitory action on the human breast cancer cells, whereas the alpha-tocopherols were not able (Nesaretnam et al., 2004, 2008; McIntyre et al., 2000). Palm oil has been reported to be with wide range of protective properties against disease, aging as well as being modulators for cellular processes / functions where photo oxidative processes predominate by acting as scavengers of oxygen and peroxyl radicals (Van Rooyen et al., 2008). It has been shown that fresh palm oil has no adverse effect on body weight and morphology of body tissues, lowers the level of serum lipids and inhibits tumour growth (Kritchevsky, 2000), enhances intestinal uptake of protein and the metabolism of sulphur-amino acids and promotes reproductive capacity (Ebong et al., 1999). Several researches have been conducted on cancer with the view to finding a lasting solution to the disease. Sundram and his colleagues (1989) were able to conduct an experiment to show that RPO significantly reduce tumor incidence in some experimental rats compared with the control groups. RPO, when compared with saturated fats and oils, may help fight cancer, especially breast cancer (Nesaretnam, et al., 1992). This may be due to tocotrienols (Nesaretnam, 1998: Elson, 1992) or other phytonutrients (Guthrie et al., 1997) present in palm oil. Indeed, Professors K. K. Carroll of the Centre for Human Nutrition at the University of Western Ontario and David Kritchevsky of the Wistar Institute recently concluded that evidence from animal and in vitro studies indicate that tocotrienols of palm oil are effective anti-cancer agents and provide adequate justification for clinical trials in human cancer patients (Nesaretnam, 1998). This oil has equally been shown to reduce the incidence of azoxymethane-induced aberrant crypt foci in rats and may therefore have a beneficial effect in reducing the incidence of colon cancer (Boateng et al., 2006).

Anti-inflammatory effects

The TRF of palm oil has been shown by Wu et al. (2008) to possess anti-inflammatory activities in a study involving the injection of lipopolysaccharide-induced inflammatory response. The mediators of cellular inflammation such as nitric oxide (NO), prostaglandin E2, and transcription of pro inflammatory cytokines were significantly reduced. The following were equally blocked; inducible NO, cyclooxygenase 2 expression and NF-kappa B expression.

Leaves of palm oil

A review of the health benefits of the leaf extracts of oil palm has been provided extensively by Mohammed (2014), however, the present review is to provide additional information.

Anti-cancer activities

Methanolic oil palm (*Elaeis guineensis*) leaf extract is rich in polyphenols (Runnie et al., 2003; Jaffri, 2011).The methanolic leaf extract of *E. guineensis* has also been shown to possess anti-cancer activities (Sasidharan and Vijayarathna, 2012). Studies have observed the presence of a large number of bioactive compounds in the methanolic extracts of this plant

including tannins, alkaloids, steroids, saponins, terpenoids, and flavonoids which exhibit various biological activities (Sasidharan et al., 2010; Gulecha and Sivakuma, 2011; Kumar et al., 2011). These compounds are present in a number of food items and hold great potential as drug candidates due to their safety, low toxicity and wide acceptance amongst the public.

Wound healing

Sasidharan et al. (2012) reported in their article that in traditional medicine, the leaf of *E. guineensis* is squeezed and the juice that is obtained is placed on wounds to promote healing (Irvin, 1985). They tried to establish this in an experimental research conducted in Malaysia which showed that *E. guineensis* leaf extract had potent wound healing capacity as evident from the better wound closure ($p < 0.05$), improved tissue regeneration at the wound site, and supporting histopathological parameters pertaining to wound healing (Sasidharan et al., 2012). The wounds were treated topically with 10% formulated crude extract (5 g of the extract in 50 g of yellow soft paraffin), while the control rats were treated only with yellow soft paraffin for 16 days. The decrease in wound diameters during the healing process was measured with an analytical perimeter. The wounded animals were kept for 25 days for further observations (Sasidharan et al., 2012). Although the leaf of the oil palm is a waste product, the alcohol extract of the leaf contains large amounts of phenolic compounds (Sasidharan et al., 2009; Soundararajan and Sreenivasan, 2012) that reportedly promote vascular relaxation and anti-oxidant activity in vitro. A pooled methanolic extract was dried under vacuum using a rotary evaporator and the resultant waxy residue collected, freeze dried, flushed with nitrogen and stored at –20℃. For vascular function studies, a stock solution (100 mg/ml) was prepared using a 1:1 v/v mixture of methanol: saline and serially diluted. Aliquots (25 – 50 µL) were added directly in a cumulative fashion to the bath (aortic rings) or injected intraluminally (mesenteric vascular bed (Abeywardena et al., 2002). In a recent study of streptozotocin (STZ)-induced hyperglycemic rats, *E. guineensis* leaf extract reduced glycemia and lipid oxidation in a dose-dependent manner, possibly by inhibiting dipeptidyl peptidase-4 (DPP-4) secretion (Tan et al., 2011).

Cardiovascualar activities

The polyphenol-rich leaf extract of *E.guineensis* showed vasodilative properties on noradrenaline-preconstricted rat aorta and mesenteric arterial bed, mainly via endothelium-dependent mechanisms (Abeywardena et al., 2002). It also effectively inhibited low-density lipoprotein oxidation better than other edible plant extracts (Salleh et al., 2002). Also, in a 12-week study conducted by Jaffri et al. (2011) on rats, the leaf extract showed good anti-hypertensive and anti-oxidant effects under NO deficiency, it was not hypotensive to normal rats and produced no chronic cardiovascular toxicity in any of the rats throughout the study.

Hepatoprotective effects

Sasidharan et al. (2009) demonstrated the hepatoprotective effects of E. guineensis against paracetamol induced liver damage by looking at the histopathology of mice liver. This was subsequently followed up by a serum analysis in which the same authors (Sasidharan et al., 2012), reported that the methanol extract of the leaves of the plant also offer hepatoprotection against paracetamol induced-liver damage in mice by reducing serum markers of liver injury such aspartate aminotransferase, alanine aminotransferase, and billirubin.

Anti-diabetic effects

Kalman et al. (2013) reported that the ethanol-derived leaf extract of *E. Guineensis* provided a clinically significant, positive effect on fasting plasma glucose levels in individuals with pre-diabetes who were treated with the leaf extract in a dose dependent manner in human subjects. A 500 mg low dose of *E. guineensis* was shown to have had a more consistent effect on reducing glycemia than the higher 1000 mg dose over an eight week period.

Anti-inflammatory activity

Oil palm ethanolic leaf extract (OPLE) at 150 mg/kg body weight showed significant pro-inflammatory activity with enhanced 46% late phase inflammation recovery effects. While at high dose, inflammation was significantly suppressed prior to the sixth hour compared to other groups, and did not require much inflammation suppression between the 18th and 48th hour. OPLE 150 mg/kg decreased lymphocyte counts, but was not as severely as dexamethasone treatment. This result suggests that OPLE extract possess strong in-vivo inflammatory-regulatory effects (Anyanji et al., 2013).

The main problem for the use of oil palm leaf extract as food in its natural form is its high content of insoluble fibre. The OPLE effectively reduced blood glucose and lipid oxidation in Type II diabetic humans and diabetes-induced rodents. The optimum dose in animal studies is equivalent to consuming 5 cups of 1% palm leaf extract for diabetic humans, to prevent liver and kidney damage (Mohammed, 2014).

Sap of oil palm

Multiple actions

The oil palm sap or wine can be descried as the exudates that flow when the palm is tapped (Obahiagbon, 2012). The sap of this plant is also used as a laxative and the partially fermented palm wine is administered to nursing mothers to improve lactation (Sasidharan et al., 2012). The sap has also been recorded to be involved in malaria, jaundice and measles treatment. Just like the sap of other palms like *Raphia*, researches conducted by authors like Obahiagbon and Oviasogie (2007), and Obahiagbon et al. (2007) have shown that the sap contains numerous phytonutrients which plays significant roles in human health. Soap prepared with ash from fruit-husk is used for the preparation of a soap used for skin infections (Sasidharan et al., 2012).

Roots of oil palm

Multiple actions

A root decoction is used in Nigeria for headaches. The pulverized roots are added to drinks for gonorrhea, menorrhagia and as a cure for bronchitis (Sasidharan et al., 2012; Irvin, 1985). Chong et al. (2009) demonstrated the in vitro anti-microbial activity and fungitoxicity of syringic acid, caffeic acid and 4-hydroxybenzoic acid which are found in oil palm root. They also showed that of the three substances, syringic acid was the most fungitoxic against *G. boninense*.

CONCLUSION

Oil palm (*E. guineensis*) parts and products have been used in various parts of the world for different purposes. The traditional uses of the different parts of the plant have been well documented in this review. Virtually all the different parts of the plant have one or more therapeutic effects. The plant has

been used extensively in local treatment of various ailments while the scientific uses of the plants have also been documented. The therapeutic effects of this plant have been attributed to the abundant anti-oxidants present in various parts of the plant. However investigations on the actual mechanisms by which the anti-oxidants perform their functions are still ongoing. Also, this review shows that products obtained from oil palm are safe for consumption at moderate doses in humans and rodents.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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