



Phytochemical Constituents of Palm Oil

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Abstract

This study evaluated the phytochemical constituents of palm oil. Palm oil is commonly used in nutrition for many reasons. Some people use it as antidote for certain types of poisons. The phytochemical analysis of was carried out with the use of GC (model No. 7890B) and MS detector (model 5977A). Some phytochemical constituents detected in palm oil has been reported to possess various biological, nutritional, pharmaceutical and industrial properties. The presence of some of the constituents showed palm oil will be useful in traditional medicine, synthesis of some pesticides and perfumes, and possess various antimicrobial activity and ability to preserve and improve certain food materials. Palm oil is recommended for many nutritional and industrial purposes.

Keywords: Food additive; Industrial; Nutrition; Palm oil; Phytochemical.

1. Introduction

Elaeis guineensis (oil palm tree) is indigenous to West Africa. It is an unbranched monoecious tree which possesses both female and male inflorescence developed at the axle of the leaves and can grow up to 20-30m. The fruit of the oil palm is oval-shaped drupe found in bunches which is attached to the crown of the tree. When unripened, the fruit is usually blue-black on the bunches, but becomes dark-red when ripened. Palm oil is produced from the ripe palm fruits and is one of the most commonly available and used vegetable oil in the world whose its entire production volume now accounts for 37 % of the total global output of oilseeds, thereby overtaking soybean oil as the leading vegetable oil with Malaysia and Indonesia dominating the world production accounting for about 90 % of global output, while West Africa accounts for just about 3.5 % of the global production [1]. Similarly, the production volume was raised from 15 million tonnes in 1995 to 66 million tonnes in 2017 according to the global production volume of palm oil report of 2012-2018 [2]. In traditional African medicine, Wang, *et al.* [3] reported that different parts of the plant are used for various purposes, including as laxative and diuretic, as a poison antidote, as a cure for some diseased conditions such as gonorrhoea, menorrhagia, and bronchitis, to treat headaches, rheumatism and skin infections.

Palm oil is a traditional remedy for headaches, pains, rheumatism, cardiovascular diseases, arterial thrombosis and atherosclerosis [4]. It is equally known to be effective against various kinds of intestinal disorders, most especially diarrhoea and dysentery in infants [5]. Palm oil contains both unsaturated and saturated fatty acids: 40% oleic acid (monounsaturated fatty acid), 10% linoleic acid (polyunsaturated fatty acid), 45% palmitic acid and 5% stearic acid (saturated fatty acid) [6]. It obtains its characteristics dark red colour from carotenoids such as alpha-carotene, beta-carotene and lycopene [7]. Crude palm oil contains healthy beneficial compounds, such as triacylglycerols (TAGs), vitamin E, carotenoids and phytosterols [8] and is considered the richest natural source of carotenoids, tocopherols and tocotrienols that contribute to its stability and nutritional properties [9]. The antioxidant properties of these compounds mainly exerted against reactive oxygen species play a role in aging, cardiovascular diseases and cancer prevention [10, 11], whereas, tocotrienols have been reported to inhibit the process of cholesterol synthesis [10].

Palm oil is used by many for various reasons, including for nutritional and industrial purposes. It is therefore necessary to evaluate the phytochemical constituents of palm oil to ascertain the various areas of application it may be useful in.

2. Materials and Methods

2.1. Palm Oil used

The palm oil used was obtained from Olokoro in Umuahia, Nigeria.

2.2. Determination of Phytochemical Constituents of Palm Oil

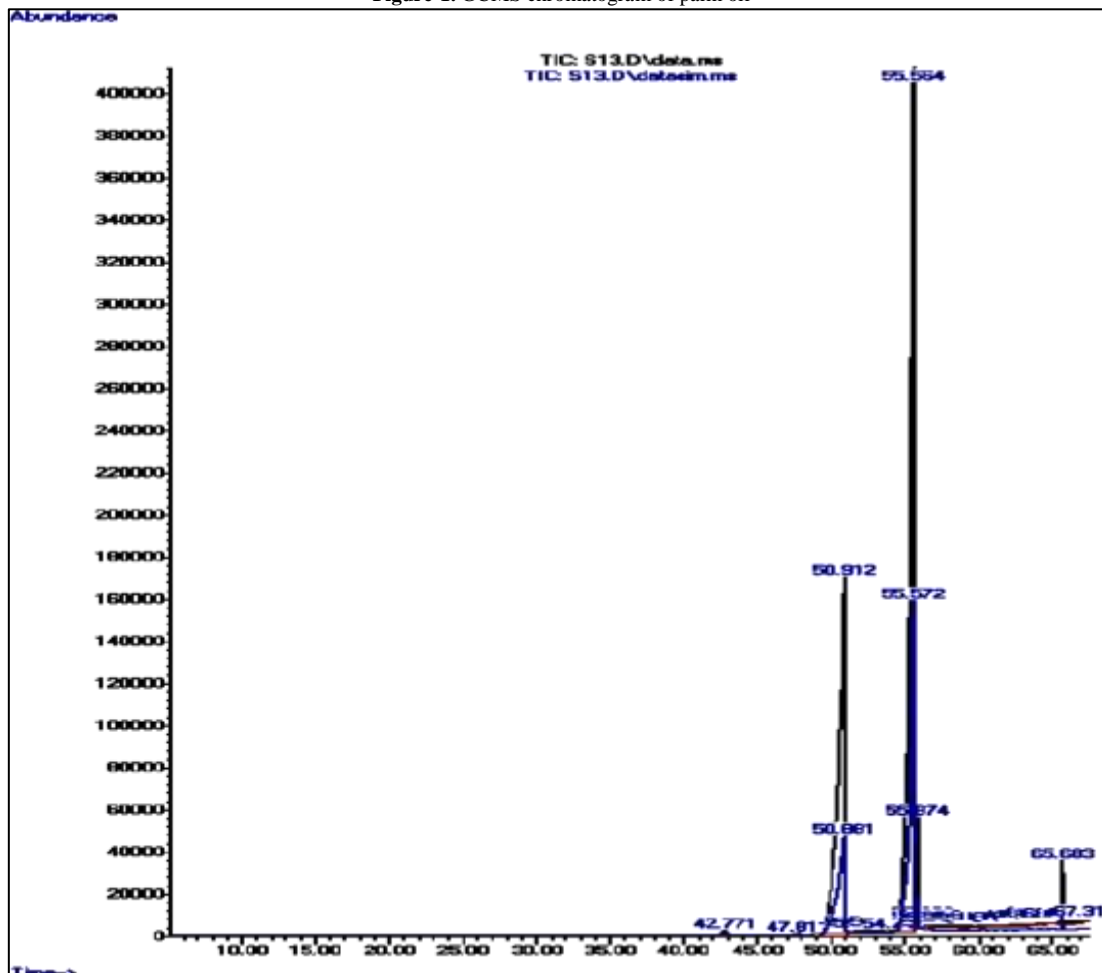
The phytochemical analysis of palm oil was carried out with the use of GC (model No. 7890B) and MS detector (model 5977A) using the method of Imo, *et al.* [12]. The GC-MS was equipped with column: Agilent HP 5MS ultra Inert (350°C) 30 m × 250 µm × 0.25 µm. Helium (He) was used as the gas with flow: 0.7 ml/min, pressure: 4.4867 psi and average velocity: 30.641 cm/seconds. The injection volume was 1 ml with inlet temperature of 250°C, split flow 14 ml/min and split ratio 20:1. Oven temperature of 60°C was used with 1 min equilibrating time, maximum oven temperature of 350°C, and total run time of 35.857 min. The phytochemical constituents in the palm oil were identified by matching the spectra of the phytochemicals which are to be identified with the mass spectra of reference compounds which are contained in the database of National Institute of Standards and Technology (NIST 14). The amount of phytochemicals suggested to be present in the palm oil were then expressed as area percent which is comparable to the total peak area.

2.3. Results

Table-1. Phytochemical constituents of palm oil

Name of compound	Retention time (min)	Area %
sec-Butylamine	42.771	0.32
Acetamide	47.811	0.07
Heptanoic acid	50.912	35.18
1-Propene, 3,3'-oxybis-	51.649	0.05
Thiirane	52.036	0.05
4-Heptanol, 3-methyl-	52.308	0.05
1-Propanol	53.316	0.13
Carbonyl sulfide	54.014	0.05
o-Allylhydroxylamine	54.246	0.05
1,5-Hexadiene, 2-methyl-	55.564	56.31
D-Allose	55.874	2.63
1-Butene, 4-cyclopropyl-	56.068	0.20
Hexane, 1,6-dichloro-	56.223	0.15
Oxirane, 2,2'-(1,4-butanediyl)bis-	56.572	0.07
1,3-Butadiene	57.270	0.09
Propanedioic acid, propyl-	57.852	0.10
2-Pentyn-1-ol	58.239	0.21
1,5-Hexadien-3-ol	58.898	0.12
4-Cyclopentene-1,3-diol, trans-	59.208	0.18
Urea	59.480	0.08
2-Methyl-2-vinyloxirane	59.906	0.04
4-Methyl-5-hexen-2-ol	60.216	0.39
3-Octen-1-ol, (Z)-	60.914	0.13
Propionic acid, 3-tetrazol-1-yl-	61.108	0.05
4-Fluorohistamine	61.224	0.05
2-Propanamine, N-hydroxy-	61.457	0.11
3,4-Altrosan	61.651	0.04
3-Penten-1-ol, (Z)-	62.271	0.12
1-Hexene, 6-bromo-	62.387	0.04
1,7-Heptanediol	62.543	0.05
1-Cyclohexyl-1-propyne	62.891	0.15
2-Amino-1,3-propanediol	63.124	0.09
2-Nonynoic acid	63.551	0.09
10-Azido-1-decanethiol	63.744	0.13
Furan, 2,5-dihydro-3-methyl-	64.985	0.09
19,19-Dimethyl-eicosa-8,11-dienoic	65.218	0.06
Trifluoroacetyl-lavandulol	65.683	1.03
Aminoacetonitrile	66.303	0.07
Carbitol, TMS derivative	66.458	0.04
9-Octadecenal	66.768	0.10
Cyclobutanone, 2-methyl-2-oxiranyl	66.962	0.07
Cyclohexaneacetic acid	67.311	0.14

Figure-1. GCMS chromatogram of palm oil



3. Discussion

The chemical constituents suggested to be present in palm oil (table 1 and figure 1) possess various biological, nutritional and industrial properties. Sec-Butylamine detected in palm oil has been reported to be a white liquid with an odour of ammonia and its contact with the eyes can cause lachrymation, conjunctivitis, burns and corneal edema, while contact with the skin can cause irritation, burns and dermatitis [13]. Yoshikawa, *et al.* [14], reported that sec-Butylamine at 5 mM inhibited the oxidation of pyruvate by mitochondria isolated from hyphae of *Penicillium digitatum*. Sec-butylamine is a fumigant fungicide with a high potential for bioaccumulation, it is not approved for fungicidal use in the European Union, however, it has a role as an antifungal agrochemical. It is also documented as a primary aliphatic amine and an aliphatic nitrogen antifungal agent [15]. This means that palm oil may be used as an antimicrobial agent.

o-Allylhydroxylamine is reported to be a useful intermediate; e.g. cyclization of *o*-allyloximes to give pyridines [16]. Acetamide is found in red beetroot. Acetamide (acetic acid amide or ethanamide) is produced by dehydrating ammonium acetate. Acetamide has been reported to exhibit certain important properties such as anti-microbial, anti-arthritis, anti-inflammatory and antibiotic. Acetamide belongs to the family of primary carboxylic acid amides [17, 18]. These functions of acetamide, in synergy with that of sec-Butylamine supports the fact that palm oil will be a good antimicrobial agent.

According to NCI Thesaurus version 20.03e [19] (released 2020), Heptanoic acid which is detected in palm oil is reported to be an aliphatic carboxylic acid, also known as enanthic acid, which is used in the synthesis of esters for products such as fragrances and artificial flavour preparations. Also, the Chemical Entities of Biological Interest (ChEBI) database [20] documented that heptanoic acid is a C7, straight-chain fatty acid which contributes to the odour of some rancid oils. It is also used as an additive in cigarettes and has a role as a plant metabolite. This confirms palm oil as a food additive and also suggest it as a raw material for fragrance and cigarette industries.

Various thiiranes and fused thiiranes are reported to possess cytotoxic properties. The vapours of simple thiirane is reported to possess better disinfecting properties than oxirane and are also able to destroy *Bacterium globigii* even at lower concentrations. Thiiranes are also used as antimicrobial (fungicides) and also as insecticides. A thiirane derivative known as chlorocyclopropane sulfide is used as a nematocide [21]. These functions of thiirane corroborates the antimicrobial properties of palm oil. Isolation of thiirane from palm oil will be useful for many industrial processes involving the production of fungicide, nematocide, insecticide, etc. The major use of 1-propanol is as a multi-purpose solvent in industry and in the home. It is used in flexographic printing ink and textile applications. It is also used in some products such as cosmetics and lotions, polish and antiseptic formulations.

Carbonyl sulfide is reported to be a potential alternative fumigant [22] to methyl bromide and phosphine. These functions suggest that palm oil may be useful in cosmetic industries and also in the production of fumigants.

d-Allose has been reported to have about 80% sweetness relative to table sugar, but it has ultra-low calorie and is non-toxic, and are able to take the place of table sugar in food products. Chen, *et al.* [23], reported that d-Allose displays unique health benefits and physiological functions in different fields such as food systems, clinical treatment and the health care. This suggests the importance of palm oil in nutrition.

1,3-Butadiene is a colourless gas which is easily condensed to a liquid and is important industrially as a monomer in the production of synthetic rubber. Malonic acid (also known as propanedioic acid) is used for pharmaceuticals and in veterinary medicine. It has been reported that resorption of bone tissue in broiler chicks caused by disturbance of photoperiodism can be prevented by the addition of malonic acid to feed [24]. Malonic acid injected into rats or rabbits is reported to be excreted largely unchanged, but also causes increased excretion of citric and alpha-ketoglutaric acids [25]. Aminoacetonitrile derivatives are useful antihelmintics. They act as nematode specific ACh agonists [26] causing a spastic paralysis and rapid expulsion from the host. This suggests palm oil will be beneficial in veterinary studies and production of certain pharmaceuticals.

Urea has also been studied as a diuretic. In a 2010 study, urea was used to treat euvolemic hyponatremia and was reported to be safe, inexpensive and simple [27]. Z)-3-octen-1-ol is considered to be a fatty alcohol lipid molecule which possess certain industrial properties which includes as surfactant and emulsifier. 2-Nonenoic acid and 9-Octadecenal are food additives which are used as flavouring agents. Lavandulol and its esters are used in the perfume industry and have also been identified as insect pheromones [28]. According to Human Metabolome Database HMDB [29], cyclohexanecarboxylic acid is a flavouring agent, surfactant and an emulsifier. These properties of some of the constituents of palm oil also corroborate the application of palm oil in food processing.

4. Conclusion

This study showed that palm oil contains various phytochemical constituents that are important in nutrition as food additives and in the industries for fragrance and production of pharmaceuticals and other important chemical substances. This study also showed that palm oil will be useful in traditional medicine, synthesis of some pesticides and perfumes, and possess various antimicrobial activities and ability to preserve and improve certain food materials.

Conflicts of interest

The author declares no conflicts of interest.

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