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EXTRACTION AND GC-MS ANALYSIS OF OIL OBTAINED FROM RIPE CARICA PAPAYA L. PEELS

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Abstract: Extraction and GC-MS analysis of oil from ripe *Carica papaya* peel was carried out. The *Carica papaya* peels were hand picked from different local fruit markets in Yenagoa Local Government Area, Bayelsa State. The peels were oven dried at 70ºC for 24 hours, ground to powder and 1000g was weighed and soaked with 1.7 lites of n-hexane for 72 hours. The decant was evaporated in a water bath at 35°C to get the oil. The GC-MS analysis using GC-MS Clarus500 version 6.2.0.0:B34 detected and identified 10 different compounds present in the oil. The analysis showed the percentage concentration of each compound with their different retention time (oleic acid 65.82% at 18.42min, Palmitic acid 16.16% at 18.578min, linoleic acid 6.08% at 20.254min, lauric acid 6.05% at 1.012min, stearic acid 4.73% at 1.142min, arachidic acid 0.38% at 15.015min, palmitoleic acid 0.35% at 22.017min, myristic acid 0.2% at 24.089min, margaric acid 0.13% at 25.142min and linoleic acid 0.1% at 20.536min respectively). From the result, the major compounds detected shows that the oil can be useful in the pharmacological, chemical, cosmetic, and agricultural industries. Thus, the potential use of the *Carica papaya* peels for oil production seems favorable. However, further studies should be carried out on the oil to ensure that it is safe for consumption as food.

1. INTRODUCTION

The *Carica papaya L.* is popularly known as pawpaw. The fruit is cylindrical, large and fleshy. It is one of the major fruit crops that is cultivated in tropical and sub-tropical zones, it is usually 3-10m in height and the stem is marked by scars where the leaves have fallen off. *Carica papaya L.* belongs to the *Caricaceae* family. The genus represented in Nigeria is called *Carica papaya L.* (Nyananyo, 2006). According to (FAO, 2008) India and Brazil are the major producers of *Carica papaya* with an annual production of 3.6 and 1.9 million metric tons, respectively.

The *Carica papaya* peel is a major by-product of the pawpaw fruit and it is usually considered to be a waste material. The pawpaw peels can be seen littered along the streets, at dump sites, as well as in major local fruit markets where the pawpaw fruits are sold or bought. When the peels are thrown away carelessly, they become a nuissance to the environment and pose a threat to public health. In Bayelsa State for instance, the popular markets where *Carica papaya L.* peels are commonly found include; Tombia market, Kpansia market, Opolo market, and Swali market located in Yenagoa Local Government Area, Bayelsa state.

(Daiz *et al*., 2006) in their work, showed that the by-products or waste products obtained from *Carica papaya L.* fruits are mostly organic and can easily attract disease-carrying organisms such as rodents and insects. When these waste products are inappropriately disposed, they are capable of contaminating surface water, underground water and the atmosphere (air). The decomposition of these waste products release green house gases (GHGs) such as methane (CH_4) and Carbon (iv) oxide (CO_2) which are major contributors to global warming. As a result, treatment of their after effect is very expensive (Muck and Brass., 2009).

Carica papaya L. in its entirety is a source of carotenoids, vitamin C, vitamin B_6 and vitamin K (Bari *et al*., 2006). According to (Afolabi *et al*., 2011), seed oil obtained from *Carica papaya L.* may be useful as biofuel, for medicinal and industrial purposes. *Carica papaya* has an enzyme contained in it's latex, known as papain. The enzyme is used in food processing to tenderize meat, clarify beer and juice, produce chewing gum, coagulate milk, prepare cereals and produce pet food. Other important uses are seen in the pharmaceutical and cosmetic industries (Morton, 1987).

The *Carica papaya* fruit is rich in phytochemicals, especially carotenoids and polyphenols (Sancho *et al*., 2011). All the nutrients of *Carica papaya L.* as a whole also enhaces the function of the cardiovascular system, prevents heart attack, stroke and colon cancer. Oil extraction adds economic value to a large quantity of the waste materials that are generally discarded, because they posses high sources of potential anti-oxidant activities than the edible parts (Okonogi *et al*., 2007). Generally oils are known to be liquids at room temperature, and a lot of literatures have been published on the extraction, properties and uses of essential oils.

Malacrid *et al*., (2011) In his studies evaluated the physicochemical characteristics, fatty acid, tocopherol, and carotenoid composition of the oil extracted from papaya *Carica papaya L.* seeds. The oil yield from the seeds was 29.16%. The data obtained for the analytical indexes showed that it was in agreement with those of other edible oils. The oil obtained, recorded high oxidation resistance (77.97 hours) and the major fatty acids present were were oleic acid (71.30%), palmitic acid (16.16%), linoleic acid (6.06%), and stearic acid (4.73%). The α and δ-tocopherol were the predominant tocopherols with 51.85mg/kg and 18.89mg/kg, respectivelly. The β-cryptoxanthin (4.29mg/kg) and β-carotene (2.76mg/kg) were the carotenoids quantified, and the content of total phenolic compounds was 957.60mg/kg. Salud *et al*., (2011) Carried out the GC-MS analysis of a chloroform seed extract of *Carica papaya* 19 compounds were identified: with oleic (45.97%), palmitic (24.1%) and stearic (8.52%) acids being the main components. The insecticidal and insectistatic activities of the extract and the three main constituents were tested and revealed that the larval duration increased by 3.4d and 2.5d when the extract was used at 16,000ppm and 9,600ppm respectively, whereas the pupal period increased by 2.2d and 1.1d at the same concentrations. The larval viability values recorded were 0%, 29.2%, and 50% when the extract was applied at 24,000ppm, 16,000ppm, and 9,600 ppm respectively; the pupal viability was recorded as 42.9% and 66.7% at 16,000ppm and 9,600ppm; and the pupal weight recorded reductions by 25.4% and 11.5% at 16,000ppm and 9,600ppm. The larval viability of the main compounds became 33.3%, 48.5%, and 62.5% when exposed to 1,600ppm of palmitic acid, oleic acid, or stearic acid, respectively. Syed *et al*., (2011) Showed that *Carica papaya* seed oil could be extracted using solvent extraction method. The study showed percentage of seed oil to be 30.1% . The chemical composition of the *Carica papaya* seed oil was found to be protein (28.1%), Ash (8.2%), Crude fiber (19.1%) and total carbohydrate (25.6%).The papaya seed oil comprises of iodine value (65.5), saponification value (155.5), unsaponifiable matter (1.37%) and free fatty acid (0.32%). Mohamed *et al*., (2014) Evaluated that *Carica papaya* has potential natural medicinal source. Extracts from different parts of *Carica papaya* plant showed protective effects against diseases such as intestinal worms infection and different types of wounds. The extracts also showed positive effects when used as antiparasitic, antiseptic, antimicrobial. The extracts of both ripe and unripe fruit showed antiulcer characteristics in laboratory animals. *Carica papaya* is also used to treat several diseases such as tumors, nervous pain, asthma and wounds. Igwe, (2015) Showed that the leaves of *Carica papaya* can be used in herbal medical practices to treat malaria and typhoid fever. The solvent used for the extraction is isopropanol. The GC-MS analysis identified 6 compounds which include hexahydro-1-aH-naphtho [1,8a-b]oxiren-2(3H)-one (2.17%), 3,7- dimethyloct-7-en-1-ol (8.08%), 3-methyl-4-(phenylthio)-2-enyl-2,5-dihydrothiophene-1,1-dioxide (11.78%), cyclopentaneundecanoic acid methyl ester (12.02%), 3,7,11,15-tetramethyl-2- hexadecen-1-ol (37.78%) and 9-octadecenamide (28.18%). These compounds exhibited pharmacological profiles and showed antimicrobial activity against Staphylococcus aureus, streptococcus faecalis, Escherichia coli and Proteus mirabilis. Eman and El-Zaher., (2015) Evaluated that aqueous *Carica papaya* seed extract has inhibitory activity against Aspergillus flavus with inhibition zones ranging between 11-16mm. Aspergillus flavus cells surviving ratio was reduced with increase in the *Carica papaya* seed extract concentrations from 25-200mg/ml. It was shown that treating the organism with *Carica papaya* seed extract led to external changes, irregular cell shape and disintegration of the fungus cell wall under transmission electron microscope. *Carica papaya* had antioxidant characters and the GC-MS analysis revealed at least 15 components.

Tao and Weijun ., (2017) Showed that the inhibitory activity of the *Carica papaya* seed extract on was determined using method known as turbidimetry method. The inhibitory mechanisms were also evaluated from the prospective of reactive oxygen species generation, mitochondrial membrane potential reduces, and the activities of four complex enzymes in mitochondria respiratory chain. The results showed an effective inhibitory activity on *Candida albicans* and induced significant accumulation of reactive oxygen species and collapse of mitochondrial membrane potential. The Complexes I and III shows significant decrease in mitochondrial enzyme activity assays, but the Complexes II and IV activities were not positively correlated. In addition, the GC-MS analysis showed that the *Carica papaya* seed extract may be responsible for the mitochondrial dysfunction. Jyoti, (2018) Stated that *Carica papaya* has antioxidant effects and anticancer features that are capable of improving heart health, fighting inflammation, improving digestion and helping to maintain an overall health and wellness. It is known that *Carica papaya* seeds are small, black colored, round, and housed in a gel-like coat. The seeds are rich in fibre (22g%) which is effective for fighting constipation and other digestive problems. It was also shown that the product was highly nutritious with the shelf life gradually increases in subseuent weeks. Spoilage begins after 2weeks indicating reduction in quality showing that the product is safe for only 2 weeks.

2. MATERIALS AND METHODS

2.1 MATERIALS

Sample bottle, masking tape drying oven, electric blender, electric weighing balance, refrigerator, measuring cylinder, beaker, water bath, Thermometer, Gas Chromatography- Mass Spectrometer (GC-MS) Clarus500 version 6.2.0.0:B34.

2.2 Reagent: The reagent used was n-hexane

2.2.1 Plant used: Ripe *Carica papaya L*. peels.

2.3 METHOD

The method employed for extracting the oil is known as the "Cold Extration method".

2.3.1 Sample collection

Ripe pawpaw peels were collected from the local markets in Yenagoa, Bayelsa State, Nigeria in large quantities using a sac.

2.3.2 Sample preparation

Enough quantity of *Carica papaya L.* peels were collected, cut into smaller sizes, air dried and finally put into the oven to ensure proper drying of the *Carica papaya* peels. The well dried sample was ground to powder, using an electrical blender inorder to increase the surface area before storing in an air-tight sample container at room temperature prior to the extraction process with n-hexane.

2.3.3 Extraction

1000g of the powdered *Carica papaya L.* peel was measured and weighed using an electric weighing balance and 1.7 litres of n-hexane was used to soak the sample for a period of 72 hours (3 days). The n-hexane was used as the organic solvent for extraction. The method employed for the entire process is called cold extraction technique. The pawpaw peel extract was collected by means of decantation into a beaker, after which the beaker was transferred into a water bath containing a thermometer to ensure that the temperature was maintained at 35^{o}C. This was done so as to remove the n-hexane while the oil remains in the beaker. The oil obtained was then stored in a refrigerator, prior to the Gas Chromatography-Mass Spectrometry (GC-MS) analysis.

(a). Fresly collected *Carica papata L*. peels

(b). Oven dried *Carica papaya L*. peels

(c). Ground *Carica papaya L*. Peels

(d). *Carica papaya L*. peels soaked with n-hexane

(e). Decante obtained after 72 hours

(f). Evaporation of decant *Carica papaya* peel

(g). *Carica papaya* peel oil

Figure 1 PHOTO GALLERY SHOWING THE EXTRACTION PROCESS

2.3.4 Instrumentation

Figure 2 GC-MS Clarus500 version 6.2.0.0:B34.

The Gas Chromatographic- Mass Spectroscopy is an analytical technique which uses both the characteristics of gas chromatography and mass spectrometry to identify different substances within a test sample (David *et al*., 2011). The GC-MS of the oil obtained from *Carica papaya L*. Peels showed that 11organic components were detected- except one “UNIDENTIFIED” component. 1ml of the Carica papaya peel oil was injected into the injection column by means of a syringe. At the injection column, the oil is changed to vapour and carried by the carrier gas (Helium) into the detector column where the compounds present the sample are separated according to their different retention times. The amplifier helps to then amplifies the presence of the compounds detected and the peaks obtained are read from the read out. The base lines in the chromatograph shows that no compound was detected.

3. RESULT and DISCUSSION

The GC-MS analysis of *Carica papaya L*. peel revealed that 11 compounds were detected. 10 were fatty acids except for 1 was unidentified compound. The fatty acids detected in their order of descending concentrations and with retention time are; oleic acid (65.82%) at 18.42min, Palmitic acid (16.16%) at 18.578min, linoleic acid (6.08%) at 20.254min, lauric acid (6.05%) at 1.012min, stearic acid (4.73%) at 1.142min, arachidic acid (0.38%) at 15.015min, palmotoleic acid (0.35%) at 22.017min, myristic acid (0.2%) at 24.089min, margaric acid (0.13%) at 25.142min, and linoleic acid (0.1%) at 20.536min. However, the main components of *Carica papaya L.* peels oil are the oleic acid[18:1] (65%), palmitic acid[16.0] (16.16%), linoleic acid[18:2] (6.08%), lauric acid[12:0] (6.05%), and stearic acid[18:0] (4.73%). The order of appearance of the copmounds detected in the *Carica papaya* peel is as result of their different retention times. Examination of the chromatograph showed that the highest peak was recorded by oleic acid constituting 65.82% of the oil, while the lowest peak was recorded by linoleic acid making about 0.10% of the oil.

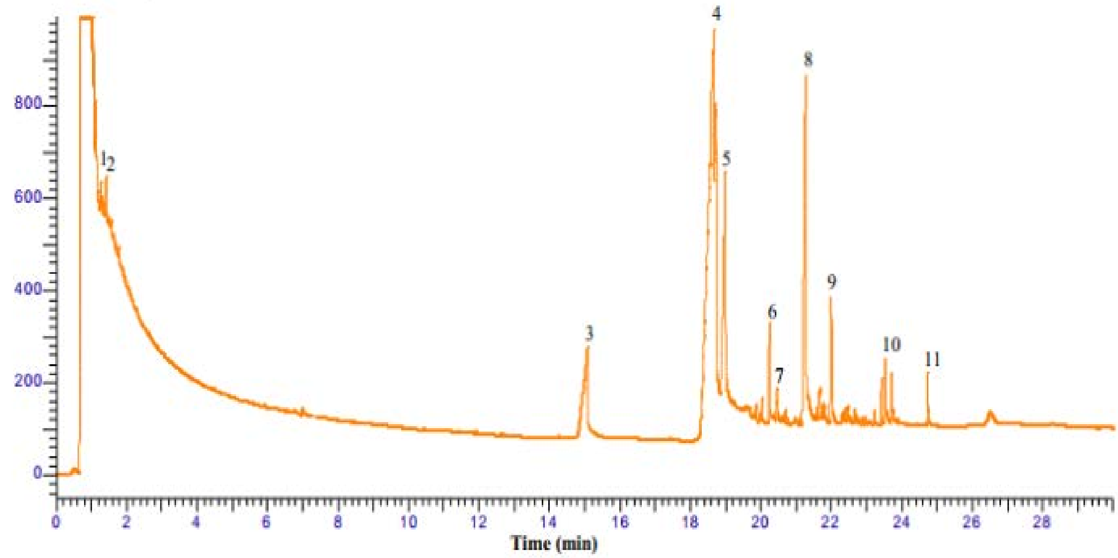


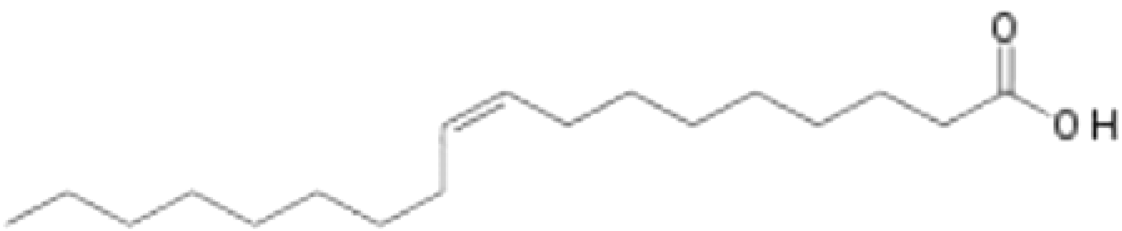
Figure 3 CHROMATOGRAPHIC DATA OF *CARICA PAPAYA* PEEL OIL

Peak No	Component Name	Time (min)	%
1	Lauric Acid	1.012	6.05
2	Stearic Acid	1.142	4.73
3	Arachidic acid	15.015	0.38
4	Oleic Acid	18.422	65.82
5	Palmitic Acid	18.578	16.16
6	Linoleic Acid	20.254	6.08
7	Linoleic Acid	20.536	0.10
8	UNIDENTIFIED	21.119	-
9	Palmitolieic Acid	22.017	0.35
10	Myristic Acid	24.089	0.20
11	Margaric Acid	25.142	0.13

Figure 4 MAJOR COMPONENTS OF *CARICA PAPAYA* PEEL OIL

The *Carica papaya* peel oil was light-brown in colour and has a very low viscosity. All the compounds detected and identified in the oil were found to be fatty acids of different percentage concentrations. The major compounds and their uses are highlighted below:

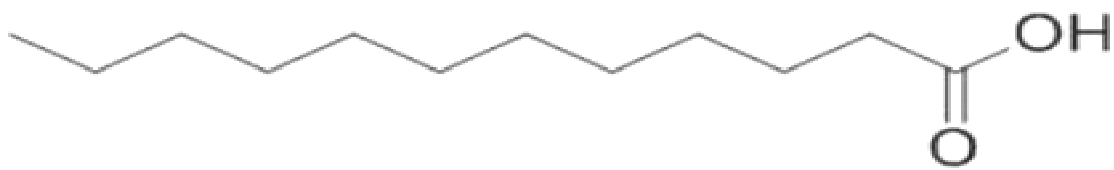
OLEIC ACID: It is a mono unsaturated fatty acid known as octadecenoic acid with the molecular formula $C_{18}H_{34}O_2$. Its percentage concentration in *Carica papaya* peel oil was found to be 65.82%. It is useful in hormone responsiveness and ineffectivity of pathogens in the body. In the cosmetic industry it is used for making lipstick and body cream. In the food industry, it is used in baking and for extending the shelf life of foods such as cakes, pies, bread, etc. In the agricultural industry, it is used in making fungicide, insecticide and germicide. Other uses include the making of adhesives, carbon papers, detergent, disinfectant, paints, ink, plastics, and polishes.



PALMITIC ACID: It is a saturated fatty acid called hexadecanoic acid with the molecular formula of $C_{16}H_{32}O_2$. The percentage concentration present in the oil is 16.16%. It is useful in the production of cosmetics products such as soaps and skin make-ups, it is also use in making margarine, emulsifiers and surfactants.

LINOLEIC ACID: It is a poly unsaturated fatty acid called octadecenoic acid with the molecular formula $C_{18}H_{32}O_2$. The percentage concentration in the oil is 6.08%. Linoleic acid is useful in making cosmetic products, oil paints and vanishes.

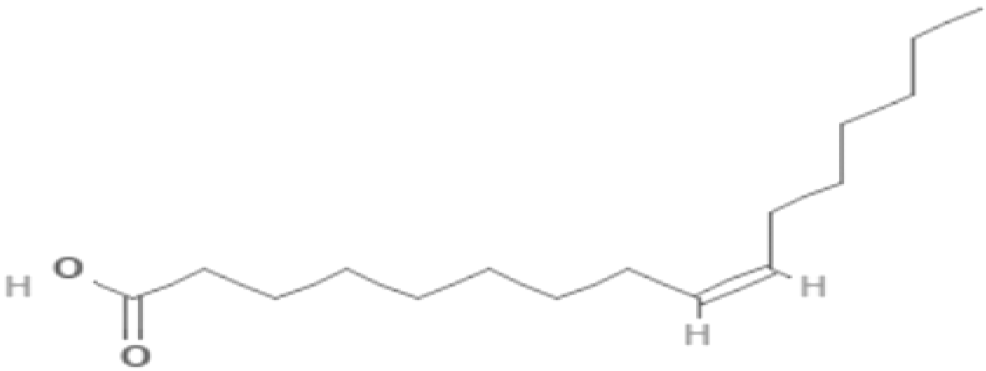
LAURIC ACID: It is a saturated fatty acid called dodecanoic acid with the molecular formula ($C_{12}H_{24}O_2$). Its concentration in *Carica papaya* peel oil is 6.05%. Lauric acid is useful in treating bronchitis and in making cosmetic products such as shaving creams, shampoos and soaps.



STEARIC ACID It is an octadecanoic acid with the molecular formular of $C_{18}H_{36}O_2$. the concentration in Carica papaya peel oil is 4.73%. Its useul in making of candles, cement, cosmetics, detergent, soaps, plasticizers and textile. It is also used as hardners in food processing.

ARACHIDIC ACID: It is a saturated fatty acid called eicosanoic acid with the molucular formula of $C_{20}H_{40}O_2$ with a percentage concentration of 0.38%. Arachidic acid is used in the pharmaceutical industry, cosmetics industry and food industry.

PALMITOLEIC ACID: It is a mono unsaturated fatty acid called hexadecenoic acid with the molecular formula $C_{16}H_{30}O_2$. Palmitoleic acid is useful in the pharmaceutical industry for preventing stroke, and regulating heamostasis.



MYRISTIC ACID: It is a saturated fatty acid called tetradecanoic acid with a molecular formula of $C_{14}H_{27}O_2$. The concentration of myristic acid in *Carica papaya* peel oil is 0.20%. It is used in the cosmetic industry for making fragrance, soap and surfactant.

MARGARIC ACID: It is a heptadecanoic acid with molecular formula of $C_{17}H_{34}O_2$. The concentration of margaric acid in *Carica papaya* peel oil is 0.13%. It is useful in the making of paints.

4. CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

The major major compounds in *Carica papaya L.* peel oil were found to be oleic acid (65.82%), Palmitic acid (16.16%), linoleic acid (6.08%), lauric acid (6.05%), and stearic acid (4.73%). From the result obtained, it can be said that, the *Carica papaya L.* peel oil has pharmacological, chemical, cosmetic, and medical benefits with respect to the fatty acids identified.

4.2 RECOMMENDATION

The extraction of *Carica papaya* peel oil seems favourable. However, further studies should be carried out to determine if the oil is safe for domestic consumption as food.

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