GC-MS and FTIR Characterization of essential oil from the fresh leaves of *Pandanus candalabrum* obtained from Bayelsa state, Nigeria.

Ogwuche, C. E. and Edema, M. O.

Department of Chemistry, Federal University of Petroleum Resources Effurun, Delta State, Nigeria.
e-mail: ogwuche.christiana@fupre.edu.ng

ABSTRACT

The potentials of medicinal plants are due to the presence of phytochemicals; among which are the essential oils. Essential oils have been reported to be of great benefit to help protect the body from the onslaught of pathogens and it is used in perfumery and as flavoring agents. Hence, this research work aims at characterizing essential oils that could be possibly found in Pandanus candalabrum and their functional groups. The essential oil characterization of the leaves of Pandanus candalabrum was carried out on the fresh leaves of the plant using steam distillation apparatus. The extracted oil components were further subjected to a GC-MS machine to characterize the extracted essential oil into its chemical constituents. From the GC-MS analysis, it was found that compounds such as Camphene, Cembrene, Phytol, Kaur-16-ene and Phenanthrene were detected at different percentage abundance and molecular weight. Kaur-16-ene has been reported to possess analgesic and anti-inflammatory properties. It was also found that Kaur-16-ene was the most abundant of all the components with the percentage abundance of 84.62% and a molecular weight of 272.468g/mol. The FTIR revealed the presence of prominent peak of carboxylic functional at 2958.08cm^{-1} alkenes at 1598.10cm^{-1} and renes at 1457.86cm^{-1}.

Key words: *Pandanus Candalabrum*, steam distillation, Essential oil, Extraction, GC-MS, Bayelsa

INTRODUCTION

Humanity has benefited greatly from the healing potentials of medicinal plants. Medicinal plant has its body effect on human in many aspects such as the digestive system, nervous system, respiratory system, immune system, circulation, muscles and joints, and mind [1-2]. It is also used in cosmetics, perfumery, medicine, household cleaning products, flavoring food, and drinks. This potentials of medicinal plants are due to the presence of phytochemicals, such as flavonoids, alkaloids, terpenoids, tannins, etc. that are present in the leaves, bark, seeds, buds, root, stem, the vegetative part, flowers, etc. With the continual

infection of viral, bacterial, parasitic and fungal contamination in our world, essential oils are of great benefit to help protect our body and homes from this onslaught of pathogens. The immune system needs support and essential oils can give it. Interest in essential oils has revived in recent decades with the popularity of aromatherapy, a branch of alternative medicine that claims that essential oils and other aromatic compounds have curative effects. Oils are volatilized or diluted in a carrier oil and used in massage, diffused in the air by a nebulizer, heated over a candle flame, or burned as incense. The earliest recorded mention of the techniques and methods used to produce essential oils is believed to be that of an Andalusian physician, pharmacist, and chemist [3]. In an aromatic plant, essential oil composition usually varies considerably because of both intrinsic (sexual, seasonal, ontogenetic, genetics variation) and extrinsic (ecology and environmental aspects) [4].

Pandanus candelabrum, commonly known as screw pine is found in tropical African countries, they grow wild in semi-natural vegetation in littoral habitats throughout the tropical and subtropical pacific. The flower of the male are 2-3 cm long, with fragrance, they are surrounded by narrow white bracts, the female tree produces flowers with round fruits, which is a drupe and merge to varying degree forming a multiple fruits globose structure. It is eaten by animals and humans[5]. Kewra oil is an essential oil obtained from the following *Pandanus* species, *Pandanus fascicularis* and *Pandanus odoratissimus* and has been reported to be used in perfumery and as flavouring agents[6-7]. The juices of the leaves of *Pandanus amaryllifolius* are used in India to treat chest pains, reduce fevers and inflammation from arthritis in humans as well as animals [6-7].

Due to the small quantity of essential oil that is usually extracted from a large mass of medicinal plant parts and high price, essential oils are been adulterated, by mixing the oil with foreign substances. Compounds with similar mass spectral was identified using their retention indices. Essential oil isolation and identification for cases like this, methodologies like GC-MS, FTIR, NMR should be considered [8-9].

MATERIALS AND METHODS

Collection of Plant Materials

The leaves of the plant *Pandanus Canderelabrum* were collected at Olorun Da Development local Government Badagry in Lagos. They were identified and authenticated

in the Department of Botany, Faculty of Sciences, Lagos state University.

Extraction of Essential Oils

The leaves were washed with clean water and thoroughly risen with distilled water so as to remove earth materials and were cut into piece for enablement inside the round bottom flask. 400g pieced leave material was weighed into the flask of the distillation apparatus set-up. Steam was made to pass through the flask containing the plant for 4hours. The hydrosol which contains the extracted oil and the condensed steam was placed in an amber bottle together with ice and was wrapped with aluminum foil to prevent sunlight reaches and was kept in a freezer, this is to prevent the essential oil from sublimation so as to retain the oil in the bottle for further analysis. The essential oil was finally isolated from the condensed steam by placing the hydrosol in a separatory funnel with 100 ml of dichloromethane which extract the oil from the water and was allowed to dry leaving the oil.

Analysis of the essential oils

The analysis of the essential oils was carried out using a GC (Agilent Technologies 7890A) connected to a mass selective detector (VLMSD, Agilent 5975C) equipped with a non-polar Agilent HP-5MS (5 %-phenyl methyl polysiloxane). Identification of components in the volatile oil was based on the comparison of their mass spectra and retention time with literature data and by computer matching with NIST and WILEY library as well as by comparison of the fragmentation pattern of the mass spectral data with those reported in the literature.

RESULTS AND DISCUSSIONS

From the GC-MS analysis that was carried out on the extracted essential oil, Kaur-16-ene has been reported to possess analgesic and anti-inflammatory properties, this was assessed using hot plate test and acetic acid-induced writhing and the anti-inflammatory activity using gleeman induced rat paw oedema method. Kaur-16-ene at doses of 10 and 20mg/kg shows significant analgesic and anti-inflammatory activity [10-11].

Camphene along with vitamin c acts as an antioxidant and helps to repair damage caused by stress. They work together and exhibit a soothing effect on the nerves, thereby reducing blood pressure, inflammation, hyperlipidemia and eventually stress [12].

Phytol is a good antioxidant; it is commercially used in perfumery industries in the making of cosmetics, shampoos, toilet soap and detergent

and likewise in the synthesis of vitamin k and vitamin E. Phyto has been reported to possess in vitro antischistosomal properties using a mouse model[13]. Phytol is a good antioxidant; it is commercially used in perfumery industries in the making of cosmetics, shampoos, toilet soap and detergent and likewise in the synthesis of vitamin k and vitamin E. FTIR recently has become well-accepted method used for the identification of bioactive compounds since it offers simple preparation sample and high analysis speed. FTIR spectroscopic microscopy enables molecular imaging of complex botanical samples and therefore the detection and characterization of the molecular components of biological tissue[14].

The FTIR confirms the presence of arenes, aldehydes, alkenes, alkyl, and carboxylic. The dominant peak is that of the carboxylic acid centered at 2953.08 cm-$^{1.}$. FTIR has been proved to be a reliable and sensitive method for the detection of bimolecular composition.

Table 1: Major components of the Essential oil from leaves extract of *Pandanus Canderelabrum*

Peaks	Rate	Compound	Molecular formula	Molecular mass	Percentage (%)
1	20.464	Camphene	$C_{10}H_{16}$	136.24	2.04
2	20.819	Cembrene	$C_{20}H_{32}$	272.25	1.94
3	21.317	Phytol	$C_{20}H_{40}O$	298.53	2.74
4	22.753	Kaur-16-ene	$C_{20}H_{32}$	272.47	84.62
5	23.853	Phenanthrene	$C_{14}H_{10}$	272.47	7.71

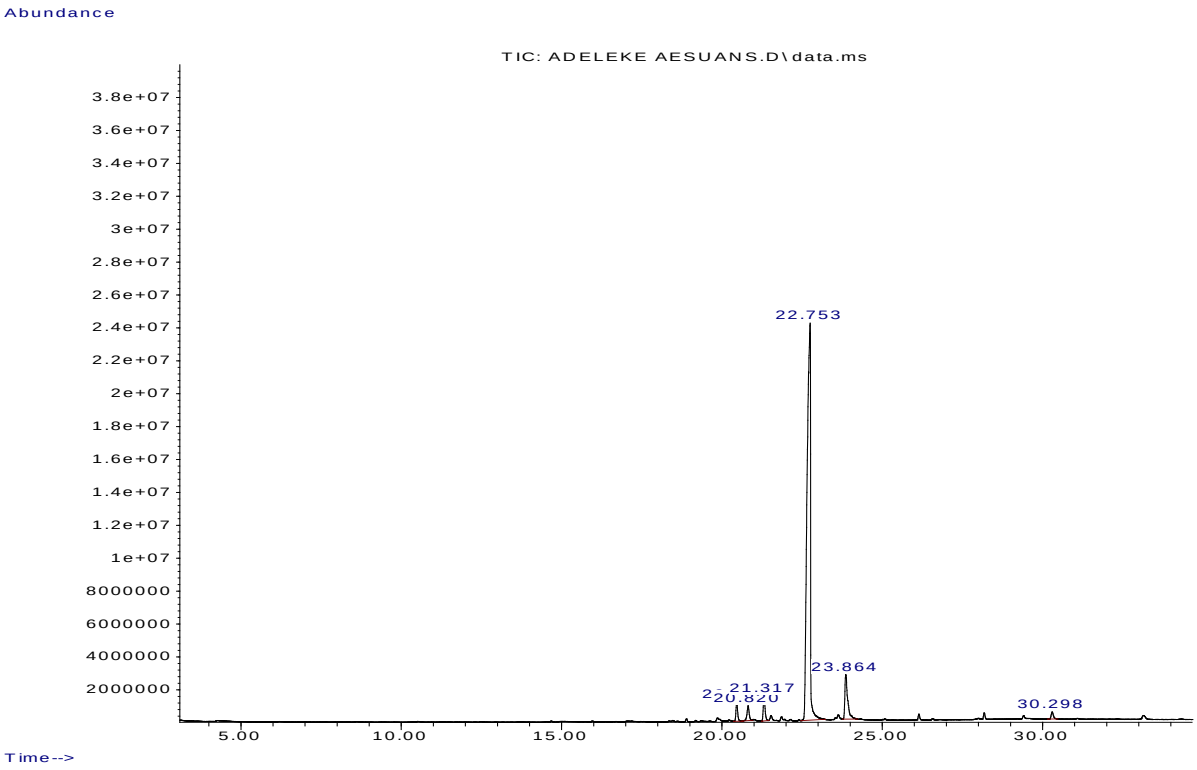

Fig 1: GC-MS chromatogram of the extract of essential oil from *Pandanus Canderelabrum*

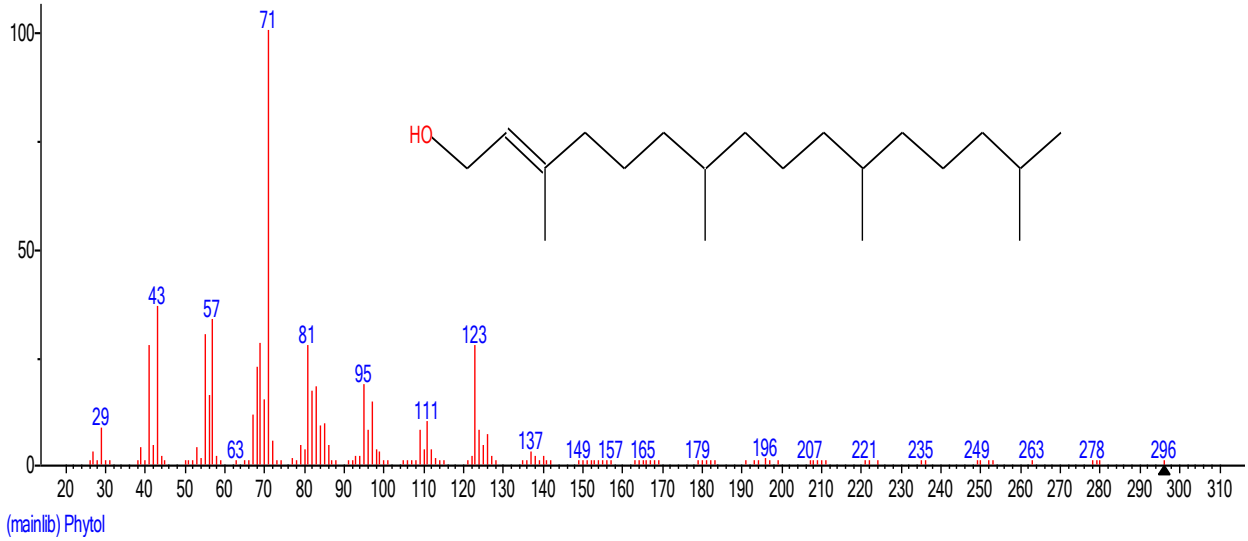

Fig 3.2: Spectrum of phytol

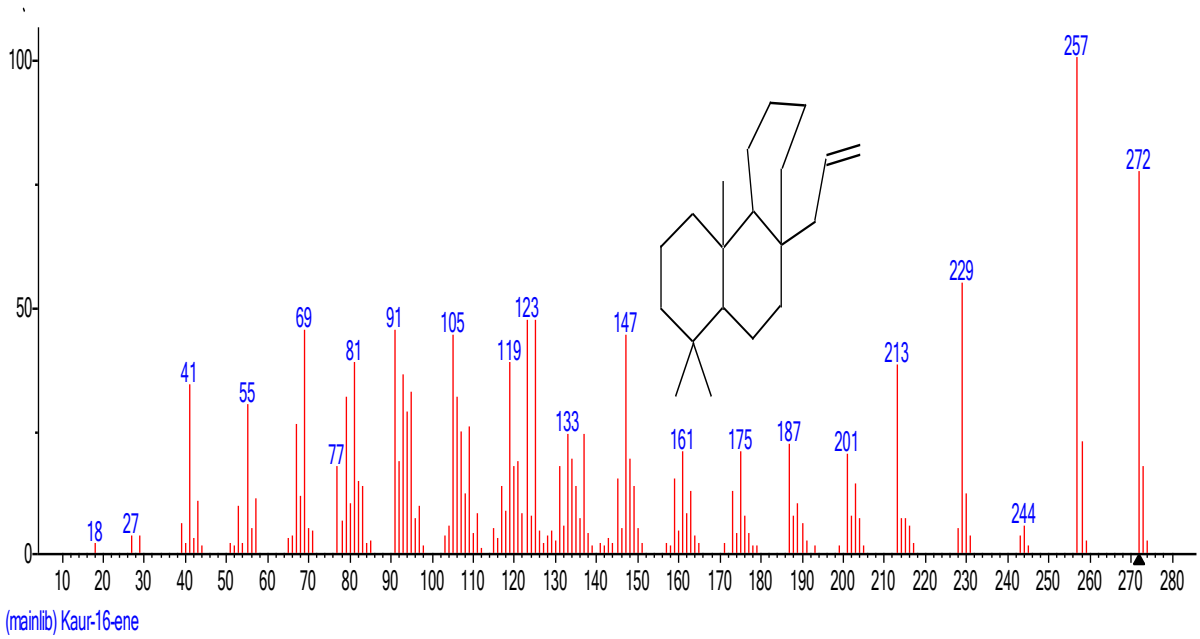

Fig 3.3: Spectrum of kaur-16-ene

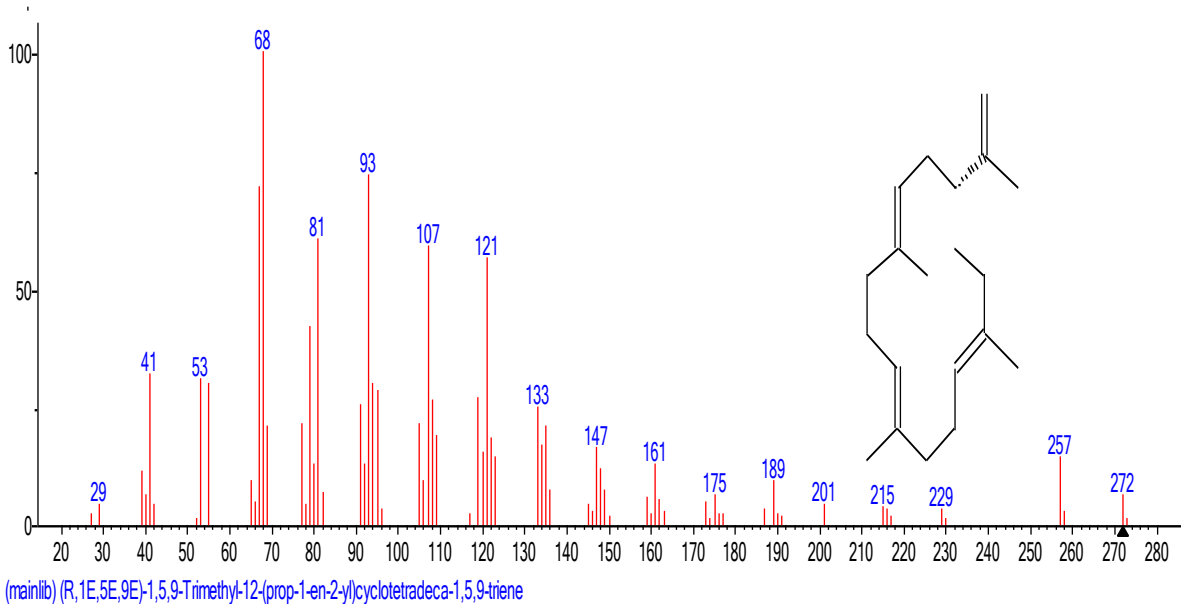

Fig 3.4: Spectrum of (R, 1E, 5E, 9E) – 1,5,9 – Trimethyl –12– (prop–1- ene-2) cyclotetradeca-1,5,9-triene

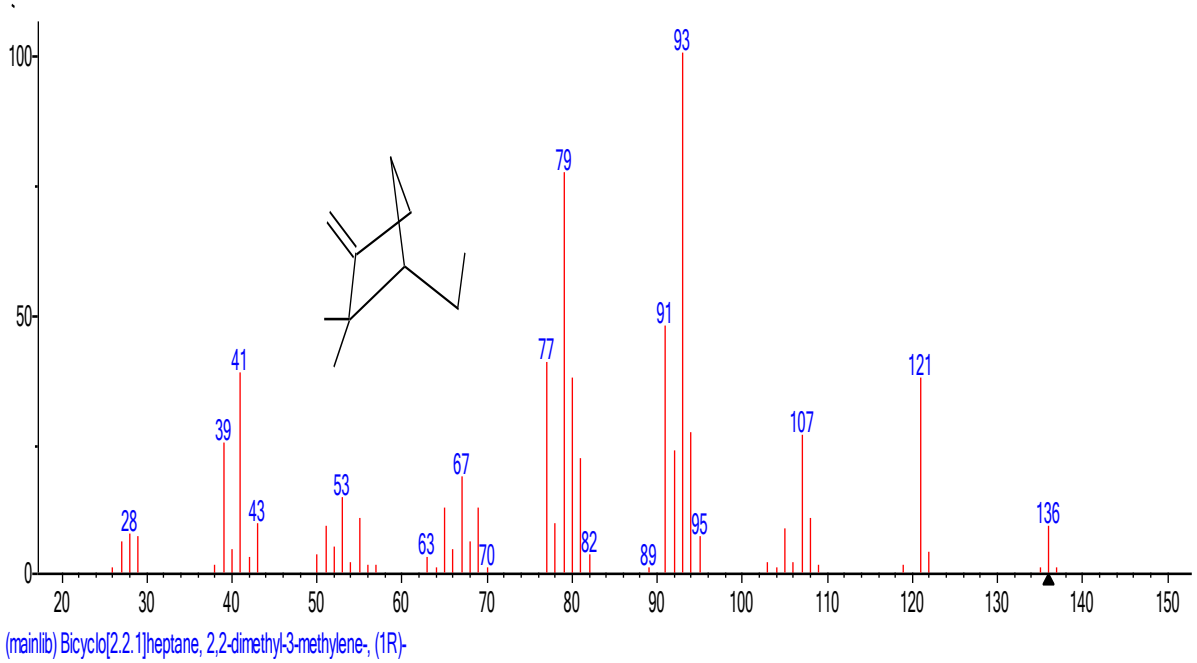

Fig.3.5: Spectrum of Bicyclo [2 2 1] heptane,2,2-dimethyl-3-methylene-,(1R)

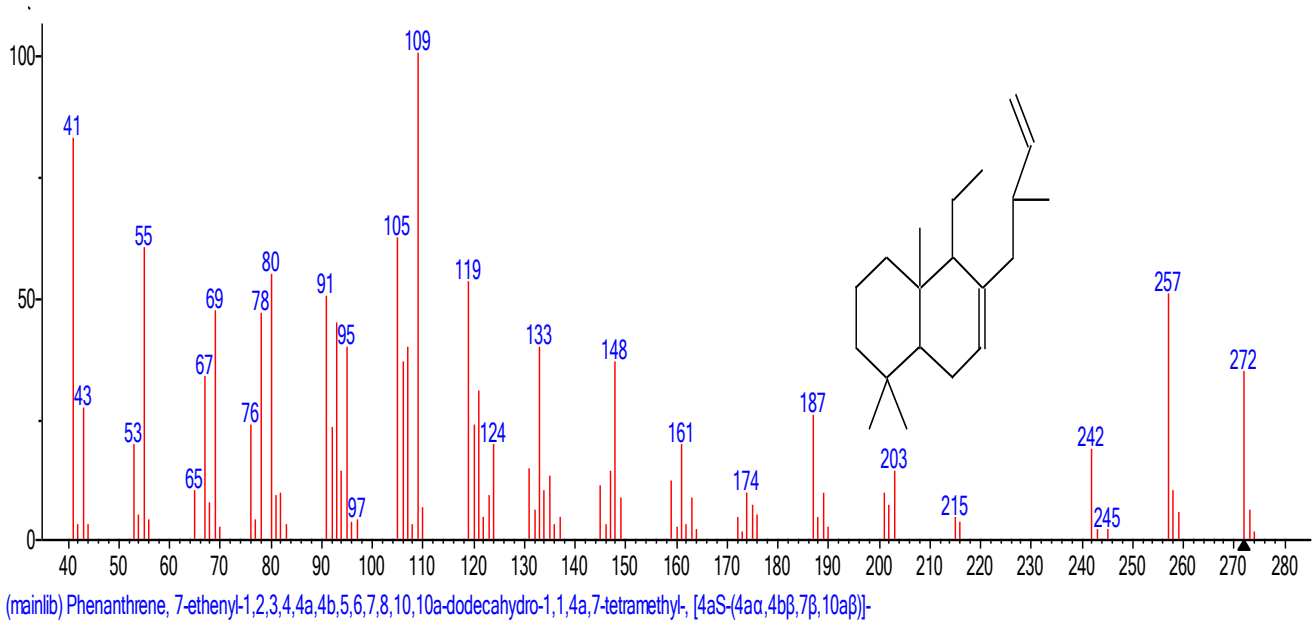

Fig 3.6: Spectrum of Phenanthrene

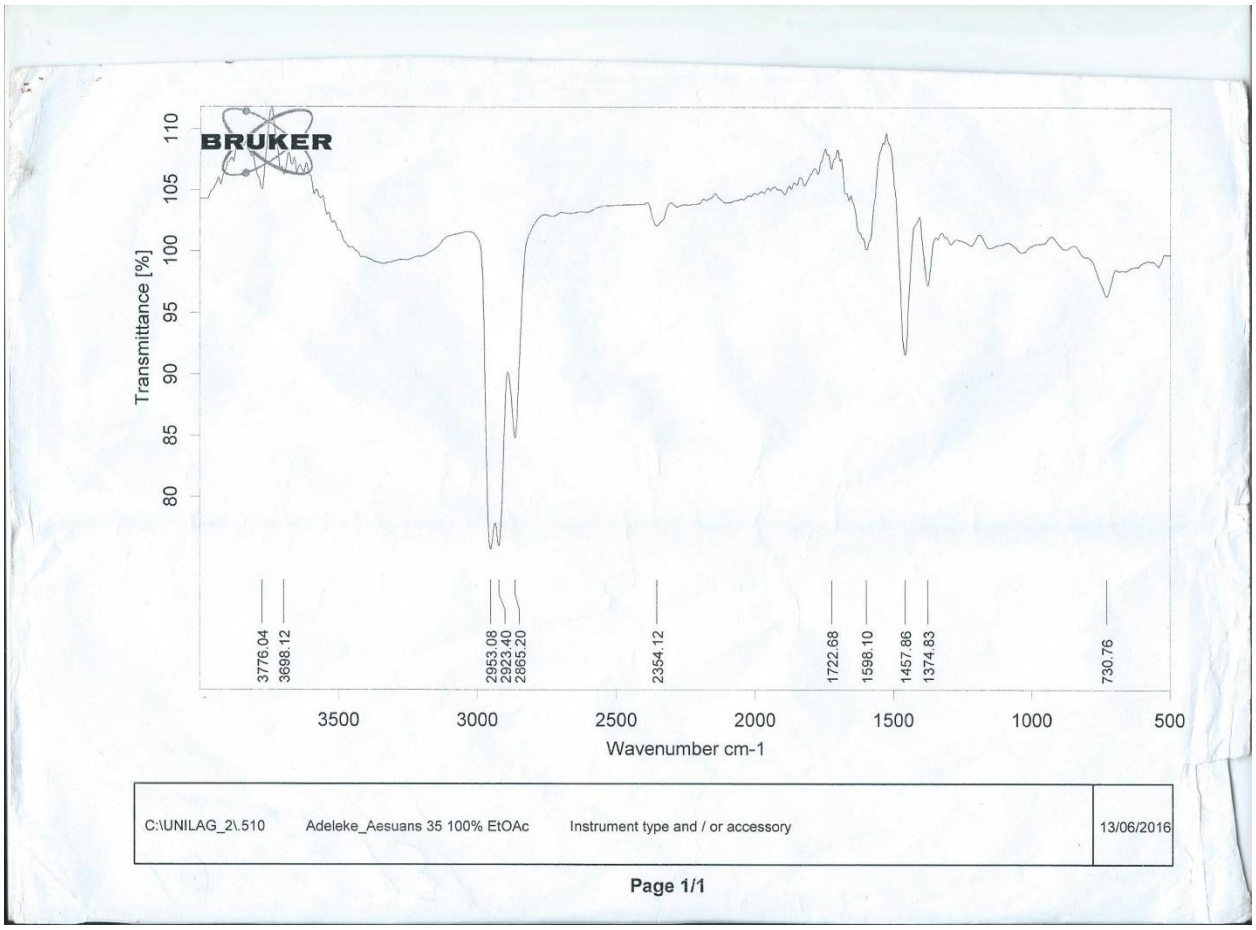

Fig 3.7: Fourier Transform infrared spectrophotometer

Table 3.2: showing functional groups in the extract of Pandanus Canderelabrum

Frequency (cm-1)	**Wave number (ccm-1)**	**Functional group**
3200 – 2900	2953.08	Carboxylic acid
2960 - 2650	2923.40	Alkyls (CH_3, CH_2, CH)
2900 – 2700	2865.20	Aldehydes
1737 – 1715	1722.68	Aldehydes
1600 – 1590	1598.10	Alkenes
1600 – 1450	1468.86	Arenes
1380 – 1370	1374.83	Methyl
770 – 730	730.76	Benezene

CONCLUSION

The result showed that the major constituents of the essential oil extracted from the leaves of *P. candelabrum* are diterpenes. The essential oils extracted and analyzed in this research work conforms with those that have already been reported in the literature for the management of analgesic and anti-inflammatory cases. The result of this study is an insight into the types of essential oil components present in this species of the *Pandanus* family. From the analyses and results, it revealed that *P. canderelabrum* is an important medicinal plant with antioxidant potentials, antimicrobial, antischistosomal and anti-inflammatory potentials as reported in the literature. Hence further investigation and proper isolation of more active principles should be carried out.

ACKNOWLEDGMENT

Authors wish to thank Federal University of Petroleum Resources Effurun-Nigeria, for providing an enabling laboratory environment for this research work. We wish to thank Mr. Odeja Kayode for helping out in the analysis.

COMPETING INTEREST

The authors declare that there are no competing interests concerning this research work.

REFERENCES

1. Lawless, J. (1995). The illustrated encyclopedia of essential oils: the complete illustrated guide to the use of oils in aromatherapy and herbalism. Shaftesbury, Dorset, UK: Element.

2. Lawless, J. (2013). The Encyclopedia of essential oils: the complete guide to the use of aromatic oils in aromatherapy, herbalism, health, and well being. Conari Press.

3. Ponce, A.G.; del Valle, C.E. and Roura, S.I. Natural essential oils as reducing agents of peroxidase activity in leafy vegetables. *Lebensmittel-Wissenschaft und-Technologie*.2004;37: 199-204.

4. Fichi, G.; Flamini G.; Giovanelli, F.; Otranto, D. and Perrucci, S. (2007). Efficacy of an essential oil of *Eugenia caryophyllata* against *Psoroptes cuniculi*. *Experimental Parasitology*. 115: 168-172.

5. Meyen, Franz Julius Ferdinard (1846) outlines of the Geography of plants: Cultureand uses of principal cultivated plants volume 7

6. Ten loo choo, Shen T. C., Goh, S. H. (1979). The flavouring Compound of Leaves of *Pandanus amaryllifolius*, Economic Botany, New York botanical Garden, NY-10458; 33(1):72-74.

7. Altafhusain N. and Rahul Z. (2012). Indian pandanacea-an Overview, Springer India Heildelberg, New York,Dordrecht, London, 129-131.

8. Gomes, N. G. M; Campos, M. G.; Órfão, J. M. C. and Ribeiro, C. A. F. (2009). Plants with neurobiological activity as potential targets for drug discovery. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*. 33: 1372-1389.

9. Thompson, M. and Ali, M. (2003). Garlic [*Allium sativum*]: a review of its potential use as an anti-cancer agent. *Current Cancer Drug Targets*. 3: 67-81.

10. Chamorro, C. (2008). Chemical composition of essential oil from Tagetes minuta L. leaves and Flowers.*J.Arg.Chen.Soc*.; 96:80-86.

11. Cheng, S. S.; Liu, J. Y.; Tsai, K. H.; Chen, W. J. and Chang, S. T. (2004). Chemical composition and mosquito larvicidal activity of essential oils from leaves of different *Cinnamomumosmophloeum* provenances. *J. Agric. Food Chem.*; 52: 4395-4400.

12. Loanna V., Nikolaos P., Panayotis P., and Margarita H. C. (2011). Camphene, a plant-Derived Monoterpene, Reduces Plasma Cholesterol and Triglycerides in HYperlipidemic Rat independently of HMG-CoA Reductase Activity. *J. Plos*.; 6(11).

13. Jouse M., Rosimerire N. O. and Pedro L. S. P. (2014). Phytol, a Diterpene Alcohol from Chlorophyll, as a drug against Neglected Tropical Diseases Schistosomiasis Mansoni. *Plos Negl Trop Dis*.; 8(1)

14. Christian, H. (2014). Advances of Infrared Spectroscopy in Natural Product Research. *Phyto Letters*; 11:384.