Food and Nutrition Sciences, 2016, 7, 609-615
Published Online June 2016 in SciRes. http://www.scirp.org/journal/fns
http://dx.doi.org/10.4236/fns.2016.77062

Characterization of Volatile Components of African Breadfruit (*Treculia africana*) Seed Oil

Amarachi G. Emenonye*, Titus U. Nwabueze

Department of Food Science and Technology, Michael Okpara University of Agriculture, Umudike, Nigeria
Email: *Greacy4real@yahoo.com, Teeubueze@yahoo.co.uk

Received 9 March 2016; accepted 26 June 2016; published 29 June 2016

Abstract

Volatile oil was isolated from the seed of *Treculia africana* (Moraceae) by solvent extraction and the chemical constituents were identified by means of GC and GC-MS. A total of twelve (12) components were characterized in the volatile oil. Constituents found inherent were methane; 2H-pyran-2-one, 6-[2-E-(3-107491000159-82-745nyl)ethenyl]-4-methoxy-; S-indacen-1(2H)-one, 3,5,6,7-tetrahydro-3,3,4,5,5,8-hexamethyl; 7H-Dinaphtho[2,3-b:2.3'-h]carbazole; 1,2-Bis[1-(2-hydroxyethyl)-3,6-diazahomoadamantanty dene-9]hydrazine; 3-Nor-3,7-secodichotine,2,7-didehydro-2-deoxy-14-hydroxy-11-methoxy 25-oxo-, (14.alpha.)-; tirucallol; beta-sitosterol; 6-Acetyl-3-chloro-2,4-decanobenzoquinoline; Adenosine, N-(3-methyl-3-butenyl)-2',3',5'-tris-O-(trime-thylsilyl); Zirconium,dichloro-[dimethylbis-methyl-3H-benz[e]indenyl)silane]; Chromone, 7-(3-chloropropoxy)-3-phenyl.

Keywords

African Breadfruit, *Treculia africana*, Moraceae, Volatile Oil, GC-MS

1. Introduction

African breadfruit (*Treculia africana*) constitutes a very important reserve of essential food nutrients that are available at certain critical periods of the year when reliable sources of these nutrients are under cultivation and are very scarce [1]. African breadfruit is from the Mulberry family—Moraceae and is a native to many tropical countries such as the West Indies, Ghana, Sierra Leone, Nigeria and Jamaica [2]. Its seed is commonly called "*Afon*" by the Yoruba, "*barafuta*" by the Hausa, "*Ize*" by the Benin, "*eyo*" by the Igala, [3] and "*Ukwa*" by the Igbos of Nigeria. It is a popular traditional food item [4]. Flavour is considered as the quality index of food and

*Corresponding author.

How to cite this paper: Emenonye, A.G. and Nwabueze, T.U. (2016) Characterization of Volatile Components of African Breadfruit (*Treculia africana*) Seed Oil. *Food and Nutrition Sciences*, **7**, 609-615.
http://dx.doi.org/10.4236/fns.2016.77062

plays an important role in consumer acceptability. Volatile oils are actually combinations of oxygenated compounds and hydrocarbons that have been derived from the plants. Since the oxygenated variety easily dissolves in water as well as alcohol, generally this form establishes the flavour as well as the aroma of these mixtures [5].

Various researches have been carried out on the composition and usefulness of breadfruit seed as food [6] [7]. However, there are limited studies on the volatile constituents of African breadfruit seed oil. Knowledge of the volatile characteristics of the raw seeds will aid in the quality control of the process modification of the flavour, and eventual synthesis of the African breadfruit flavour products for possible use in the seasoning of various factory and even home processed foods. This is important in view of declining production of seeds, due to deforestation and the need to extend use of the appealing aroma of African breadfruit seed in food modification The aim of this study is to identify the volatile oil components of African breadfruit seeds.

2. Materials and Methods

Mature African breadfruit seeds were purchased from Umuahia, Abia state. The seeds were authenticated at the Agronomy Department of the National Root Crop Research Institute (NRCRI), Umudike. The seeds were washed and sorted manually to remove bad ones and extraneous materials (**Figure 1**).

The African breadfruit seed was dehulled manually without any heat treatment. The sample was sun dried to constant weight, the sample was ground to fine powder with a laboratory mill and sieved with a 2.5 mm mesh sieve. The flour was preserved in an air tight bag at room temperature from which fractions were collected for analysis [8] [9].

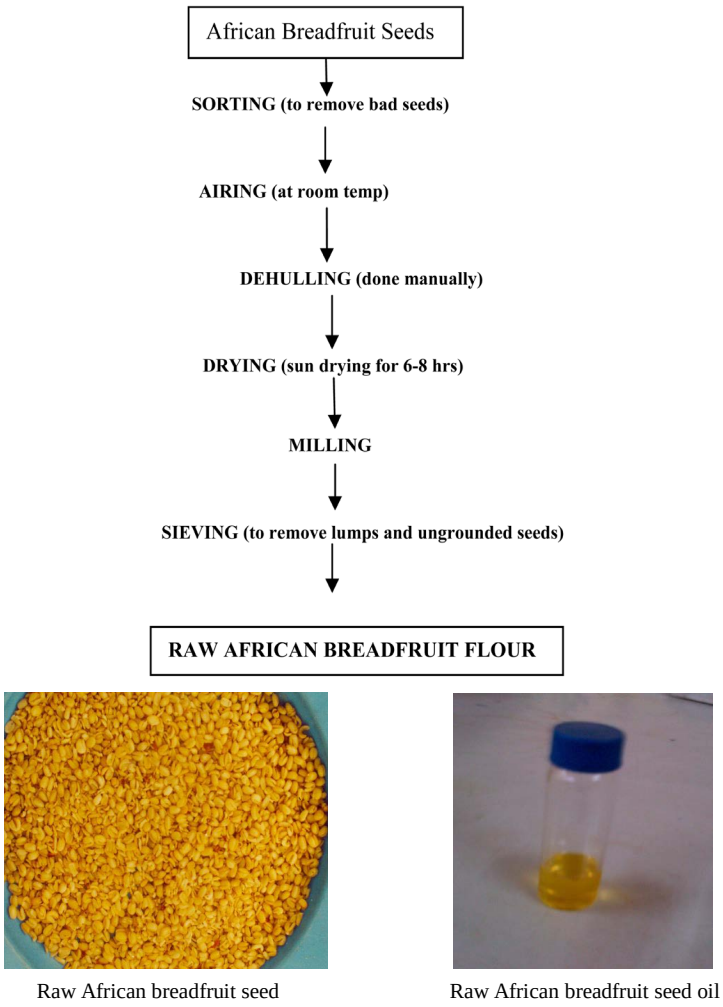


Figure 1. Flow chart for the production of raw African breadfruit seed flour.

2.1. Preparation of Volatile Oil by Solvent Extraction

One hundred gramme (100 g) of previously dried and ground samples of African breadfruit seeds, was wrapped and fixed in a thimble. The thimble was placed in an extraction chamber which was suspended above a flask containing the solvent (n-hexane) and below a condenser. Heat was applied to the flask and the solvent evaporated into the condenser where it was converted into liquid that trickled into the extraction chamber containing the sample [10]. The extraction chamber is made in such a way that when the solvent surrounding the sample exceeds a certain level, it overflows and trickles back down into the boiling flask. The flask containing solvent and lipid was removed at the end of the extraction process. The solvent in the flask was evaporated in a water bath, the flask was then transferred to a desiccator and allowed to cool before being weighed. The drying, cooling and weighing was repeated until a constant dry weight was obtained. The extracted oil sample was sealed in dark brown coloured glass bottle and kept at room temperature for further analysis.

2.2. Gas Chromatography/Mass Spectrometer Analysis

The volatile oils were diluted in methylene chloride and analyzed with AGILENT GC 7890B/5977C triple ASIX MSD. Three micro litres of the liquid organic sample was injected into the GC where it was swept onto a separation column by an inert carrier gas (helium). The analytes in the mixture were carried through the column by the carrier gas where they were separated from one another by their interaction between the coating (stationary phase) on the inside wall of the column and the carrier gas. Each analyte interacted with the stationary phase at different rates. Those that reacted very little moved through the column quickly and exited into the mass spectrometer before those analytes having longer interaction and retention times. When the individual analytes exited the GC column they entered the ionization area (ion source) of the MS. Here they were bombarded with electrons which formed ionized fragments and accelerated into the quadrapole through a series of mass to charge ratio. This separation was accomplished by applying alternating RF frequency and DC voltage to diagonally opposite ends of the quadrapole, which in turn allowed a specific mass fragment to pass through the quadrapole filter. From here the fragments entered the mass detector (electron multiplier) and were recorded. The MS computer graphed a mass spectrum scan showing the abundance of each ionized mass fragment. A combination of mass spectra of all the components of the unknown analyzed sample was then displayed on the computer screen as printable total ion chromatogram (TIC). A GC/MS system in full scan mode will monitor a range of masses known as mass to charge ratio (abbreviated m/z). A typical mass scan range covers from 35-500 m/z four times per second and will detect compound fragments within that range over a set time period. Identification of the compounds was based on comparison of the corresponding mass spectra with data from the MS library (NIST database) containing mass-spectra of many different compounds and the components identified.

3. Results and Discussion

After extraction of essential oils by solvent extraction, GC/MS was used to identify the volatile compounds in it. The GC-MS analyses indicated that the African breadfruit volatile oil is a complex mixture of twelve (12) identified compounds as shown in the chromatogram (**Figure 2**) which represented about 99.7% of the total oil includes alcohol, ketene, alkanes and aromatic hydrocarbons. The major components were in a decreasing order; Alkane, Aromatic hydrocarbon, and Alcohols. This is in contrast to what was reported in the hydrodistilled oil from the leaves, root bark and stem bark, which comprised a total of 43 components characterized mainly of α-pinene, myrtenal, limonene, camphene and n-hexanoic acid [11].

Table 1 showed the composition and retention time of volatile oil in the raw African breadfruit seed. The raw extract was comprised mainly of hydrocarbons (terpenoids, monoterpenes, triterpenes and diterpenes), esters and alcohol. Hydrocarbons are assumed to be formed from fatty acid by lipoxygenase catalysis [12]. This may explain their abundance as volatile compounds in the African breadfruit seed oil, since the seeds are rich in oil [13]. The raw extract contained Adenosine which is a chemical that is present in all human cells which readily combines with phosphate to form various chemical compounds including adenosine monophosphate (Amp) and adenosine triphosphate (Atp). This is used for the treatment of varicose veins, acute kidney failure, high blood pressure, cold sore, genital herpes and poor blood circulation [14]. It also contains Beta Sitosterol which has been reported to show some cholesterol lowering effects, have immune modulator/Anti-inflammatory effect, improve Urinary symptoms; it is also used in fortifying margarines [14], though the amount present in plants are too small to exert the purported benefits

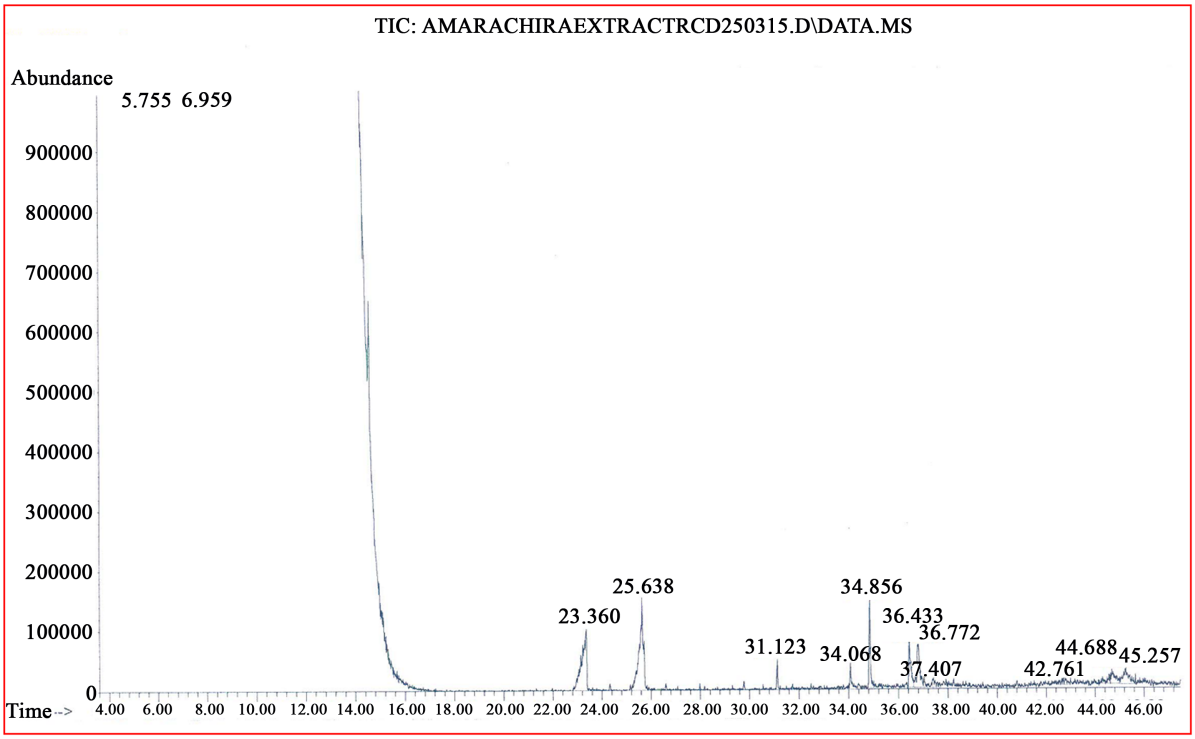


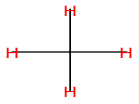
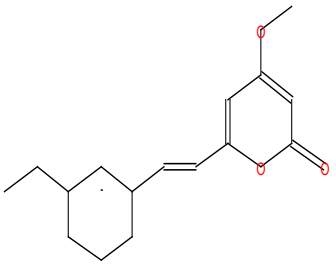
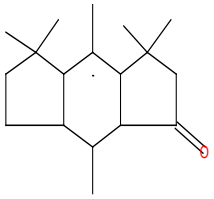
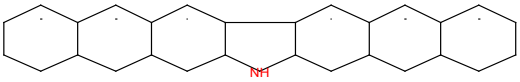
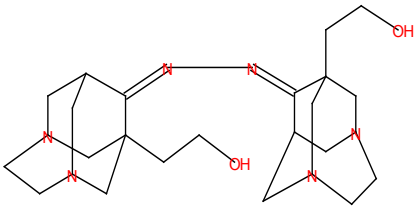
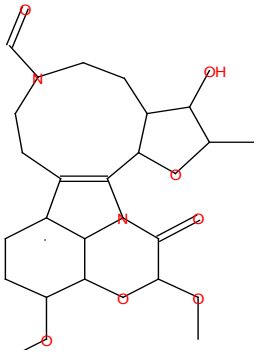
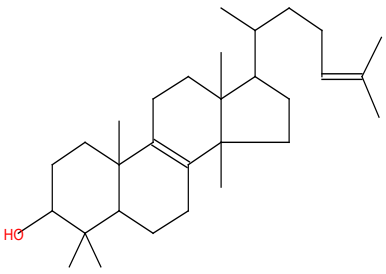
Figure 2. Chromatogram of volatile compounds of African breadfruit seed oil.

Table 1. Composition of the volatile oil from raw African breadfruit seed oil.

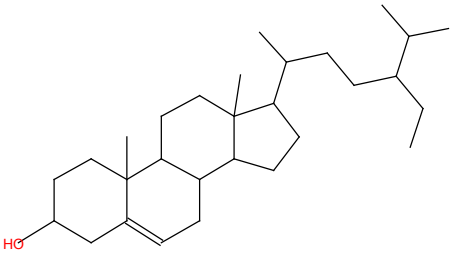
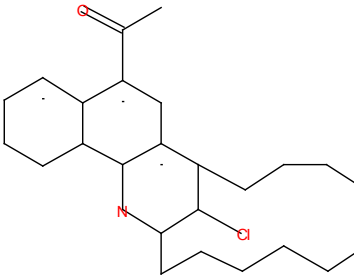
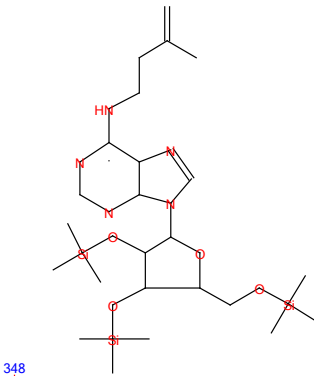
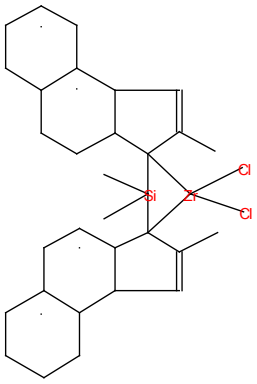
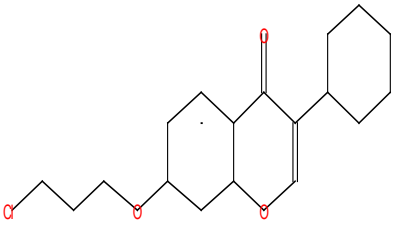
S/N	Retention time	Compound	Composition (%)
1.	6.959	Methane	95.73
2.	23.360	2H-Pyran-2-one, 6-[2-E-(3-ethylphe 107490 1000159-82-7 45 nyl)ethenyl]-4-methoxy-	0.97
3.	25.637	s-Indacen-1(2H)-one, 3,5,6,7-tetrahydro-3,3,4, 5,5,8-hexamethyl-	1.18
4.	31.123	7H-Dinaphtho[2,3-b:2',3'-h]carbazole	0.10
5.	34.068	1,2-Bis[1-(2-hydroxyethyl)-3,6-diazahomoadamantanty dene-9]hydrazine	0.15
6.	34.856	3-Nor-3,7-secodichotine, 2,7-didehydro-2-deoxy- 14-hydroxy-11-methoxy25-oxo-, (14.alpha.)-	0.35
7.	36.433	Tirucallol	0.32
8.	36.772	Beta-Sitosterol	0.47
9.	37.407	6-Acetyl-3-chloro-2,4-decanobenzoquinoline	0.11
10.	42.761	Adenosine, N-(3-methyl-3-butenyl)- 2',3',5'-tris- O-(trimethylsilyl)-	0.11
11.	44.688	Zirconium, dichloro-[dimethylbis-methyl-3H-benz[e] indenyl)silane]	0.24
12.	45.257	Chromone, 7-(3-chloropropoxy)-3-phenyl-	0.27

Another component of health benefit in the raw extract is chromone. This has been reported to have potent effects in preventing early and late asthmatic responses to inhaled allergens, reduce air way reactivity to a range of inhaled irritants like sulfurdioxide and cold air [15]. The various structures of the compounds found inherent in the oil is displayed in **Table 2**.

Table 2. The structures of the compounds found in the African breadfruit seed oil.

Methane	
2H-Pyran-2-one, 6-[2-E-(3-ethylphenyl)ethenyl]-4-methoxy	
s-S-Indacen-1(2H)-one, 3,5,6,7-tetrahydro-3,3,4,5,5,8-hexamethyl-	
7H-Dinaphtho[2,3-b:2',3'-h]carbazole	
1,2-Bis[1-(2-hydroxyethyl)-3,6- Figure 12: Tirucallol Diazahomoadamantantydene-9]hydrazine	
3-3-Nor-3,7-secodichotine, 2,7 didehydro-2-deoxy-14-hydroxy-11-methoxy-2 25-oxo-, (14.alpha)-	
Tirucallol	

Continued

Beta-Sitosterol	
6-Acetyl-3-chloro-2,4-decanobenzoquinoline	
Adenosine, N-(3-methyl-3-butenyl)- 2',3',5'-tris-O-(trimethylsilyl)-	
Zirconium, dichloro-[dimethylbis-methyl-3H-benz[e] indenyl)silane]	
Chromone, 7-(3-chloropropoxy)-3-phenyl-	

4. Conclusion

The general compositional profiles of the volatile oil from the seed of African breadfruit add to its biochemical and phytochemical data, thus increasing its industrial use. From the study, it is discovered that African breadfruit seed oil contains components ranging from hydrocarbon (mainly monoterpenes, terpenoids, etc.), alcohol and ketene which could be said to be responsible for its unique flavour.

References

[1] Nwabueze, T.U. and Okocha, K.S. (2008) Extraction Performances of Polar and Non Polar Solvents on the Physical and Chemical Indices of African Breadfruit (*Treculia africana*) Seed Oil. *African Journal of Food Science*, **2**, 119-125.

[2] Ejiofor, M.A.N., Obiajulu, O.R. and Okafor, J.C. (1988) Diversifying Utilities of African Breadfruits as Food and Feed. *International Tree Crops Journal*, **5**, 125-134.

[3] Badifu, G.I. and Akubor, P.I. (2001) Influence of pH and Sodium Chloride on Selected Functional and Physical Properties African Breadfruit (*Treculia africana* Decne) Kernel Flour. *Plant Foods for Human Nutrition*, **56**, 105-115. http://dx.doi.org/10.1023/A:1011194927947

[4] Adeparusi, E.O. (2001) Effect of Processing on Some Minerals, Anti-Nutrients and Nutritional Composition of African Yam Bean. *Journal of Subsistence Agric and Environment*, **3**, 101-108.

[5] http://doterra.com/US/en/

[6] Graham, H.D. and DeBravo, E.N. (1981) Composition of the Breadfruit. *Journal of Food Science*, **46**, 535-539. http://dx.doi.org/10.1111/j.1365-2621.1981.tb04904.x

[7] Adebowale, S.A., Sanni, S.A. and Oladapo, F.O. (2008) Chemical, Functional and Sensory Properties of Instant Yam-Breadfruit Flour. *Nigerian Food Journal*, **26**, 1-12

[8] Fasisi, O.S., Eleyinmi, A.F., Fasisi, A.R. and Karim, O.R. (2003) Chemical Properties of Raw and Processed Breadfruit (*Treculia africana*) Seed Flour. *African Crop Science Conference Proceedings*, **6**, 547-551.

[9] Ifeoma, I., Ijeh., Chukwunonso E.C.C. Ejike., Obinna M. Nkwonta., Bryan C. Njoku (2010) Effect of Traditional Processing Techniques on the Nutritional and Phytochemical Composition of African Breadfruit (*Treculia africana*) Seed. *Journal of Applied Sciences and Environmental Management*, **14**, 169-173.

[10] Onwuka, G.I. (2005) Food Analysis and Instrumentation Theory and Practices. Napthali Prints, Lagos, 140-176.

[11] Ekundayo, O., Aboaba, S.A. and Omikorede, O. (2007) Constituents of Breadfruit Tree (*Treculia africana*) Leaves, Stem and Root Barks. *Journal of Essential Oil Bearing Plants*, **10**, 189-193.

[12] Belitz, H.D., Grosch, W. and Schieberle, P. (2009) "Aroma Compounds" in Food Chemistry. 4th Edition, Springer, Berlin, 340-400.

[13] Irvine, F.R. (1961) Woody Plants of Ghana. Oxford University Press, London.

[14] https://www.drugs.com/

[15] Holgate S.T. and Edwards A.M. (2003) The Chromones: Cromolyn Sodium and Nedocromil Sodium. In: Adkinson, N.F., Yunginger, J.W., Busse, W.W., *et al*., Eds, *Middleton's Allergy: Principles and Practice*, 6th Edition, Mosby, St. Louis, 915.