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Comparative Study of the Fatty Acid Profile of Different Gourd Seed Oils: Ash, Bottle and Ornamental Gourds

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Abstract

Certain components of fats and oils are among the required nutrient for human and animals, and these oils also serve as carriers of fat soluble vitamins. Therefore this paper seeks to study the fatty acid profile of three gourd family seed oils using standard methods. Samples of oil seed were extracted using soxhlet extractor and the oil was analysed for fatty acids using GC—Ms (Agent Technology Model). The result of the samples show the present of saturated and unsaturated fatty acids. The palmitic acid ranged between 15.94±0.03% - 35.59±0.02%, stearic acid: 10.56±0.1% - 11.28±0.02%, arachidic 0.11±0.02% --- 0.54±% with the presence of myristic acid in ash gourd only. The unsaturated acids indicated the presence of oleic acids ranged between 7.12±0,04% -- 18.95±0.02%, linoleic: 21.33±0.12% - - 60.99±0.02%, linolenic acid: 0.96±0.02% - 1.19±0.02%. Other compound observed were aldehyde aromatics, ketone and amine. Myristic acid was present in ash gourd and ornamental gourd seed oils but absent in bottle gourd seed oil. The margaric acid, lignoceric acid and behenic acid were absent in the all samples. In conclusion, fatty acid which are responsible for effective functions in human body and the observed results are comparable to common vegetable oils found in the market, such as olive oil, power oils.

Keywords: Fatty Acid Profile Composition, Gourd Seeds Oil, FAME, and GC –MS Analysis

Introduction

Nigeria is a country endowed with a lot of natural resources, one of such is the gourd in bushes, by few farmers for economic purpose of which has not been fully utilized for large production. They are commonly refer to as elegede or agbeje in Yoruba, and have been found to grow freely in forest area especially in the rain forest zone in Nigeria and few in the northern region, Oko *et al*. (2014) [24].

Research have being conducted on the seed of some of these cucurbitaceae family such as ash gourd, bottle gourd, ornanmental gourd, cucumber, cloth gourd etc. especially on the nutritional properties which present in them and as a good source of edible fats. Fat a diverse role in human nutrition, they are important as a source of energy both for immediate utilization by the body and in storage (adipose tissue) for later utilization when food intake is reduced dietary fats act as a vechcle or drive for the injection and absorption of fat soluble vitamins. Two fatty acid linoleic and linolenic can not be synthesized in mammalian tissue and are essential in the diets. Lack of essential fatty acids in animals lead to typical scalling of the skin, growth retardation and impaired reproduction. Solomon (2005).

In Nigeria oils are produced in many different forms, some are imported in different brands, packed in different ways, some of this oils are, olive oil, energy oil and other imported vegetable oils. All these oils have their basic sources from vegetable and seeds, are majorly for cooking. Oils has antioxidant properties, and has been recognized for its health benefits as reported by Steveson *et al*. (1974) Many of such vegetable are still in the tropics, and are not utilized for production of oils, one of such is gourd that belong to (cucurbitaceae family), which has about 120 general and and 825 species. Gourds are grown majorly as food and for ornament while some are grown or cultivated for their rich oils, such as ash gourd, bottle gourd and ornamental gourds. The ash gourd is an annual hispid climbing herbercious plant with several meters in length. The leaves are broad, with five to seven lobes. The mature fruits is spherical to oblong in shape measuring 30cm - 40cm in length and 15m - 23cm width and weight as much as 45g - 55g when mature. The bottle gourd called lagenararia siceria has a white flower, the origin is from tropical low land of south Africa. It is a monoecious annual vine used for food in various ways while the ornamental gourd are gaily coloured, oddy shape, squash like, hard skimmed fruits of a plant belonging to several general and useful with species of

the family. Most of the fancy gourd have long climbing or creeping stem. The fruits are generally useful and attractive as ornament when well decorated, and when the pulp dries it becomes hard.

Justification

Several reports on gourd family has shown their medicinal as well as the nutritional properties, such as the proximate, mineral composition, functional properties and the anti – nutritional composition, There is dearth of information on their oil profile Therefore this study investigate the fatty acid profiles of three different gourds namely: ash, bottle and ornamental. And compared with catapilar seed oil fatty acid profile. This will serve as basis for their utilization in food and industrial applications.

Experimental

Materials and Methods

Sample preparation

Mature samples of gourd fruits was purchased from Oja Oba market located in Akure Ondo State Nigeria. The identification and autentification was carried out at the Department of crop and pest management. The Federal University of Technology Akure, Ondo State Nigeria. All the chemical used were analytical grade and water used was glass distilled. The samples purchased were cleaned, dried and cut into two in other to bring out the seeds. The seeds were separated from each of the samples (ash, bottle and ornamental). The seeds were dried, de-husked, blended with kenwood blender (M201), and kept in a clean dried PVC plastic each and placed inside the refrigerator prior analysis.

Methods: 60g of dried de-husked, blended seed was weigh on a mettle balance (M160) and packed inside the thimble and latter placed inside soxhlet apparatus for the oil extraction, using n-hexane (analar grade). The extraction was carried out for 3-4 hours, each of the sample was treated the same. The extracted oil was kept in a cleaned dried universal bottle after separation of the oil from the remaining solvents using rotary evaporator. (Pision M301) and fatty acid profile was done using GC-MS. Together with the catapilar seed oils. (Agent Technology model after methylation process for (FAME).

Fatty Acid Profile

The methylation of the extracted oils was carried out using AOAC 1995 standard methods. Each of the extracted oil samples were homogenized by heat, for the formation of methyl esters and the fatty acid profile was also carried out by method modified by (Joslyn 1970). 100mg of sample of extracted oil was added with 1ml of 0.5N KOH in methanol and 1ml of boron fluoride in methanol, inside a test tube, the tube was then shaken with vortex mixer and transferred to a reactor for one hour at 100°C. The tube was then allowed to cool and 2ml of salt 10% Nacl (v/v) with 2ml of hexane added, it was shaken vigorously and left to settle for the separation of phases. An aliquot of 1ml was taken from the supernatant and was deposited in a hermetically sealed amber bottle with 9ml of hexane and frozen at -26°C until injection into the gas chromatography/mass spectrometer, each samples was treated the same. The composition of fatty acid was analysed using Gc-Ms (Model 7693) equipped with flame ionization detector (FID) with HPS as capillary collum (30m long by 0.25m), internal diameter and 0.25µm solid phase thickness was used. The temperature of the injection and detector are 26°C - 27°C respectively. The flow rate of the carrier gas (N_2) was 2ml/min. The oven temperature programming was as follow 100°C (initial) to 180°C at (5°C/min) and finally increasing to 220°C. at (0.8°C) Injection volume was 0.5µl of each samples fatty acid methyl ester (FAME). The peaks were identified by concentration per second of retention time to the standard mixture GLC 10, GLC 20, GLC 40, and GLC 80 separation, (St. lou M O USA). The peaks area were computed and the percentage of FAME were obtain as the area percentage by direct normalization data and are expressed as normalized peaks area percentage of all identify FAME.

Statistical Analysis: Observed data was subjected to analysis of variance (ANOVA) to ascertain the source of variance. Least significant difference (LSD) test was to determine, if there was significant different between mean. The significant was at $p < 0.05$.

Results and Discussion

Table 1: Fatty Acid Profile Resukts for Bottle Gourd

Fatty Acid	% Composition
SATURATED	
C : (14.0) Palmitic acid [hexadecaonoic acid]	35.57±0.02
C : (18.0) Stearic acid [Octadecanoic acid]	10.86±0.01
C : (20.0) Arachidic acid [Eucosanoic acid]	0.54±0.02
Total saturated	47.20±0.05
UNSATURATED	
C : (18. 2n- 6) Linoleic [9,12, octadecadienoic acid]	21.33±0.12
C : (18. n – 9) Oleic acid [9, octadecenoic acid] mono unsaturated	18.57±0.02
C : (18. 3n – 3) Linolenic [9,12, 15, octadecatrienoic acid	11.19±0.02
Total ratio %	0.89±0.01
Others	
Alkane	1.24±0.12
Aromatics	3.49±0.04
Aldehyde	0.52±0.02
Amine	0.51±0.01

± = Standard deviation. Mean of triplicate determination

Table 1 shows the results of fatty acid profile for bottle gourd seed oil and it revealed the presence of saturated and unsaturated fatty acids and other compounds. The saturated fats include palmitic: 35.58‡0.02%, stearic acid: 10.87±0,04 and arachidic acid: 0.54±0.02 with the absence of myristic acid. Moreover arachidonic is an essential fatty acid unsaturated with twenty (20) carbon fatty acids that human use for synthesize, regularory molecules such as prostaglandin. Arachidic acid is produced when cells activities in the membrane enzyme called phospholipase which breaks down membrane component to arachidonic and further metabolized by one or two enzymes pathways into various prostaglandin or leucotriene that are highly pro-inflammatory, therefore excess amount of linoleic and arachidonic acid are unhealthy because they promote inflammation when in excess, therefore dietary measure are needed. The value of palmitic acid observe was lower than the value reported for Diospyros maspilliferous seed oil (30.06%) but the stearic acid value was higher than that reported (7.74%) by chiwandi *et al*. (2009) for corn seed oil. The observed unsaturated fatty acid include: linoleic: 21.33±0.12, oleic acids: 18.57±0.02%, and linolenic acid: 1.19±0.02%. The value observed for linoleic acid was lower than that reported for cantelope (64.77%), Mazanah *et al*. (2010). Other compound present include alkane: (1.34±0.12%), aromatics: (3.50±0.04%), aldehyde: (0.52±0.02%) and amine: (0.51±0.01). Moreover the total saturated fatty acid (TSA) present was 47.09±0.02% and the total unsaturated fatty acid TUA was 42.29±0.02%, both

values were higher than that observed for ash gourd and ornamental gourd seed oil except for the total unsaturated fatty acid. The total saturated fatty acid observed was higher than that reported for irvingina gabonesis 30.41% and citrilus lunantus 23.57% as reported by Oko *et al*. (2014) [24], it was also higher than that of cashew nut (anarcadium occidentalis): 28.30% as reported by Aremu *et al*, (2007). Linoleic acid (LA) is an omega 6 fatty acids that once consumed, it is converted to gamma linoleic acid (GLA) in the body and further broken down to arachidonic acid, rapid metabolism of arachidonic acid increases the activities of phospholipase (PLAZ) and elevate the level of cyclo-oxygenase and lipo-oxygenase in colonic acid cells, this event occurs in various stages of maligency suggesting linkage between dietary lipids and incidence of colorectal cancer but base on this findings and reasons on diet, a low omega 6 fatty acid should be maintained. In addition gamma linoleic acid (GLA) can convert to arachidonic acid, but more of the gamma linoleic acid taken as supplement may actually reduce inflammation by converting to that substance called dichromo gamma – linoleic (DGLA), the DGLA compete with arachidonic acid and prevent the negative inflammatory effect that arachidonic acid would otherwise caused in the body/ In addition, having adequate amount of certain nutrients in the body like magnesium, zinc, and vitamin C, B3, and B6 used to help to promote the conversion of gamma linoleic acid to dichromo gamma linoleic acid rather than arachidic acids. Therefore animaks feeding on diet that are deficient in linoleic acid grow poorly and suffer a number of disorder, These disorder can be reversed by feeding them with vegetable oil that is rich in linoleic acid and other polyunsaturated fatty acid. However the total unsaturated value observed observed: 47.09±0.02% was lower than that reported for irivingina gabonesis: 69.60% and citrullus lunantus: 76.44% as reported by Oko *et al*. (2014) [24].

Table 2: Fatty Acid Profile for Ash Gourd Seed Oil

Fatty acid	%Composition
SATURATED	
C; (16.0) Palmitic acids [hexadecanoic acid]	15.94±0.03
C: (20.0) Arachidic acid [Eucosanoic acid]	0.11±0.02
C: (18.9) Stearic acids [octadecanoic acid]	10.56±0.01
C: (16.0) Myristic acid [Tetradecanoate]	0.11±0.02
Total saturated	26.72±0.02
UNSATURATED	
C: (18: n-9) Oleic acid [9, octadecenoic acid]	7.11±0.04
C: (18. 2n – 6) Linoleic acid [9,12, octadecanoic acid]	60.99±0.02
C: (18. 3n-3) Linolenic acid [9,12,15,octadecatrienoic acid]	0.96±0.02
Total Unsaturated	69.06±0.02
Ratio of O/L (%)	0.12±0.01
Other Compound	
Guanine	0.65±0.03
Carboxylic aldehyde	3.07±0.02
Ketone	0.49±0.03

± = Standard deviation. Mean of triplicate determination

Table 2 shows the fatty acid profile results for ash gourd and it revealed the presence of satirated and unsaturated acid. The saturated acid include: palmitic acid, stearic acids, arachidic acid and myristic acids with the absence of lauric acid, lignoceric acid. The value observed for palmitic acid was (15.94±0.03%) and stearic acid: 10.56±0.01%. These values were lower than that of palmitic acids reported for Cassia tora seed oil (23.49%) but higher in stearic acid value 1.5% present in Tora seed oil and also higher than occidentalis (4.40%) as reported by Ayodele *et al*. (2004) [2]. The unsaturated fatty acid showed the presence linoleic acid: 60.99±0.02, Oleic acid: 7.11±0.44% and linolenic acid: 0.96±0.02%. The value for linoleic acid was higher than the value reported for Cassia occidentals (11.95%) by Ayodele *et al*. (2004) [2]. But far higher than the value reported for Cyclocarpon seed oil (0.2%) by (Folarin and ilusanmi 2008) [14] and lower than that reported for Catelope seed oil: 64.77& by Maznah *et al*, (2010) [21]. The essential and non essential fatty acids are integra component of cell membrane phospholipids and play important role in structural and functional role in the cell. Other substances present include guanine: (0.65±0.03%) which is important to the structure of DNA and RNA and also plays a role in determining how the gene will be expressed, carboxylic aldehyde: 3.07±0.02% and ketone: 0.49±0.02%. The ketone present was lower than that observe for ornamental gourd seed oil:2.48±0.01% but the carboxylic aldehyde: 3.07±0.02% in ash gourd was higher than the value observed for ornamental gourd: 0.74±0.02%. The total saturated fatty acid and unsaturated fatty acids observed value were26.72±0.02% and 69.06±0.02% respectively. The total saturated value was lower than that of cashew nut seed oil 28.30% as reported by Aremu *et al*, (2007) but higher than that of harn seed oil: 17.06% as reported by Ogoko *et al*. (2009). The myristic acid present had 0.11±0.02% and was lower to that of irvinginal gabonesis seed oil: 2.40% as reported by Oko *et al*. (2004). The observed value for the total unsaturated fatty acid: 69.06±0.02% was higher than value observed for bottle gourd seed oil: 41.09±0.02%and ornamental seed oil, 62.01±0.02%. Aldehyde and ketones are mainly use for industrial purposes such as food, textile, plastic, leather and health care industry.

Table 3: Fatty Acid Profile Results for Ornamental Gourd

FATTY ACIDS	% COMPOSITION
SATURATED	
C: (14,0) myristic acid [tetradecaoate]	0.11±0.01
C: (16.0) Palmitic acid [hexadecanoic acid]	20.94±0.02
C: (18.0) stearic acid [octadecanoic acid]	11.28±0.02
C: (20.0) arachidic acid [eicosanoic acid]	0.31±0.03
Total saturated	32.64±0.02
UNSATURATED	
C: (18. n- 9) Oleic acid [9, octadecenoic acid]	18.95±0.02
C : (18. 2n- 6) Linoleic acid [9,12, octadecadienoic acid]	42.10±0.02
C : (18.3n - 3) linolenic acid [9,12,15, octadecatrienoic acid]	0.96±0.02
Total unsaturated	62.01±0.02
Ratio O/L	0.45±0.01
Other compounds	
Alkane	0.48±0.02
Ketone	2.48±0.01
Aldehyde	0.74±0.02
Alcohol	0.28±0.02
Aromatic acid	1.75±0.01

± = Standard deviation. Mean of triplicate determination.

Table 3 shows the fatty acid profile result for ornamental gourd and it reveals the presence of saturated acid which include stearic acid:11.28±0.02%. Arachidic acid: 0.31±0.03%, palmitic acid: 20.94±0.02% and myristic acid: 0.11±0.01%. The myristic acid and stearic acid in ornamental gourd seed oil were higher than the value reported for cantelope seed oil 0.9 % and 5.24% respectively by Maznah *et al* (2010) [21]. In addition, the unsaturated fatty acid observed include: oleic acid: 18.95±0.02%, linolenic acid: 0.96±0.03%, Linoleic: 42.10±0.02%. The observe value for oleic was higher than that reported for cantelope: 16.13% by Maznah *et al*. (2010) [21]. The linolenic: 0.96±0.02% value observe was higher than that of ash and bottle gourd seed oils but the linoleic acid observe 42.10±0.02% was next to that of ash gourd: 60.99±0.02%

observed value, while that of oleic acid: 18.95±0.02% was higher than that of the bottle gourd: 18.57±0.02% and ash gourd: 7.11±0.02% seed oils. Moreover the linolenic acid present 0.96±0.02% was lower than the observed value for bottle gourd seed oil 1.19±0.02%. Other compound present were alkane, ketone, alcohol; and aromatic acid, but the alcohol was only present in the ornamental gourd seed oil.

Generally, the saturated fatty acids present in the three samples were stearic acid, arachidic acid, myritic acid and palmitic acid with the absent of lauric acid, erucic acid, behenic acid, lignoceric acid and magaric acid. While the unsaturated fatty acid present were oleic acid, linoleic acid, linolenic acid with the absence of palmitoleic acid, arachidonic acid and nervonic acid. The mono unsaturated acid present in the three gourds had values: 18.95±0.02%, 7.11±0,02% and 18,57±0.02% for ornamental, ash and bottle gourd seeds oil respectively. Monounsaturated fatty acid are responsible for antioxidant properties of oils and a good source of alpha tocopherol which is a free radical scavenger that protect cellular membrane and enhance long term health. This acids is one of the acid that aid the transeterification in biodiesel production. There was a compeling evidence that too much of saturated fat in diet is a factor in the development of hearth diseases and cancer. Solomon (1996) [25] Considering the values observed, therefore the consumption of the oils must be moderate and monitored. The observed values of monounsaturated for ornamental and bottle gourd were higher than the value: 11.84% reported for luffa cylindrical by Aremu *et al*. (2008) [10] and 13.28% reported for water melon seed oil but lower than that reported for wild mango seed oil by Oko *et al*. (2014) [24]. The polyunsaturated fatty acid was observed in all the samples. The linoleic and linolenic acids were observed with values: 42.10±0.02% and 0.96±0.02% respectively for ornamental gourd. while 60.99±0.02% and 0,96±0.02% for ash gourd respectively and 21.33±0.12% and 1.19±0.02% respectively for bottle gourd. The observed value:60.99±0.02% for linoleic in ash gourd was the highest value observed, for polyunsaturated fatty acid present in the samples, this value was higher than the value 54.32%reported for luffa cylindrical by Aremu *et al*. (2008) [10] and corn oil with value 55.7% as reported by ihekoroye and Ngoddy 1985 and 60.07% value for water melon seed oilby Oko *et al*. (2014) [24]. The omega (w6) and omega (w3) are refers to the essential fatty acid, they are the constituent of essential fatty acid that play critical role in membrane structure as reported by Lynch and Thonpson (1984), and Kinsela (1990). It must be noted that excess amount of linoleic and arachidic acid are unhealthy because they promote inflammation therefore, dietry measures are necessary and highly needed. The ratio of oleic/linoleic express as percentage was use for oil stability and potentiality of oil for deep frying fat as reported by Branch *et al*. (2007b), He also reported that 1.48% for peanut oil but the values calculated for the samples were: 0.12% for ash, 0,87% for bottle gourd and 0,45% for ornamental gourd seed oil, all this values were lower than that reported for peanut oil and anarcandium 12.28% by Aremu *et al*. (2007b) [4] There is a clear or significant different in the values observed for the saturated and unsaturated fatty acid present such that, saturated fatty acid present in the samples were in the order of bottle gourd > ornamental gourd > ash gourd seed oil, while the unsaturated fatty acid were in the order ash gourd > ornamental gourd > bottle gourd seed oil.

Conclusion

In conclusion from the above discussion, it was revealed that all the oil samples has both saturated and unsaturated fatty acid and that the presence of monounsaturated fatty acid were ascertained for all the oil seed samples. The presence of essential fatty acid makes them to be recommended for loss of fertility, kidney and skin problems. It is also good as a special diet whenever there is challenge because of the presence of dietary essential oil and antioxidant properties of the oil and that, it is recommended for regular consumption and the cultivation must be encourage by famers. In addition, the oil is good for industrial use, such as polymer industry, soap making, biodiesel production and paint making.

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