FATTY ACIDS COMPOSITION OF BAMBARA GROUNDNUT (*VIGNA SUBTERRANEAN* (L) VERD C) GROWN IN MADOBI, KANO STATE-NIGERIA

A. J. Alhassanm
M. S. Sule
H. Abubakar
Department of Biochemistry, Faculty of Biomedical Sciences
Bayero University, Kano, Nigeria
T. M. Abdulmumin
M. A. Dangambo
Department of Animal Health and Husbandry,
Audu Bako College of Agriculture Danbatta

Abstract

Introduction: The important of research to evaluate the fatty acids content of a neglected crop with nutritional potential cannot be over emphasis. **Aim:**this research work aimed at evaluating the fatty acid(s) profile of Bambara ground nut grown in Rimingado LGA. **Methodology:**The fatty acid content of a representative sample of the composite sample collected from Rimingado LGA of Kano- Nigeria was evaluated using GC – MS.**Result:**The oil was found to contain both saturated and unsaturated fatty acids that differ in chain length, number and positions of double bond (s).Thirty three (33) different fatty acids were detected including arachidic acid (eicosanoic acid).Detection vitamin C fatty acid conjugate (1-(+)-ascorbic acid 2, 6 dihexadecanoate)indicates the presence of vitamin C in the plant. The presence of arachidic acid (eicosanoic acid) implies that Bambara groundnut oil may be rich in essential fatty acid. The presence of unsaturated fatty acid indicates that Bambara groundnut oil could play a significant role in cardiovascular fitness; while that of saturated fatty acids implies that the oil could be a source of energy from non-carbohydrate. **Conclusion:**It is concluded that Bambara groundnut oil could play an important role in food and pharmaceutical industries.

Keywords: Fatty Acids, GC – MS, Bambara Groundnut

Introduction

Fats are esters of fatty acids used locally and industrially in food processing and medicaments. Dietary fat or lipids is rich in fatty acids of chain length ranges from one to more than 30 carbons. It characterized by carboxylicand methyl terminals (Michael *et al.,* 2009).The saturated fatty acidsusually has 12–18 while, the unsaturated has 16–22 carbon (Tom and Peter 2003). On the basis of synthetic ability and the nutritional requirement, of the fatty acids are categorized into essential and non essential(Evangelos*et al*., 2012).

Bambara groundnut (*Vignasubterranea (L.)Verdc*), an indigenous African legume, plays an important socio-economic role in the semi-arid regions of Africa.It originated in the Sahelian region of present day West Africa, which its name originating from the Bambara tribe who now live mainly in Mali (Nwanna*et al.,* 2005). Among the quality of the plant is its tolerance to drought and poor soils. It is also relatively pest and disease resistant,tolerating extreme weevil attack and allows the seed to be stored for long periods without loss (Collision *et al.,* 2000). Despite these numerous advantages, it is unfortunately, one of the neglected and under-utilized crops in sub Saharan Africa. Bambara groundnut is the third most important food legume of Africa (Chomchalow, 1993).The plant is known by different names among African tribes (Ihekoronye and Ngoddy, 1985; Alhassan *et al.,* 2013b).The young fresh seedsmay be boiled and eaten as a snack in a manner similar to boiled peanuts and could be made into pudding locally called MoiMoi or Okpa (bean porridge) in some parts of Nigeria. It reported that in Zambia, Bambara groundnut is used for bread making (Brough*et al.,* 1993) while Poulter and Caygill (2006) also reported that it could be used for milk making. A seed protein functionality test indicates that Bambara nut can compete with or replace other conventional flours in a range of processed products (Brough*et al.,* 1993). Bambara groundnut seed makes a complete food, as it contains sufficient quantities of proteins, carbohydrates and lipid (Brough and Azam-Ali, 1992; Brough*et al.,* 1993). It is regarded as a balanced food because when compared to most food legumes, it is rich in iron and the protein contains high lysine and methionine (AduDapaah and Sangwan, 2004). Bambara groundnut is also rich in fiber, protein, lipid and carbohydrate (Alhassan*et al.,* 2013). Alhassan *et al* (2013b) reported high levels of sulphur containing and aromatic amino acid in Bambara groundnut than the minimum reference value in food set by WHO/FAO/UNICEF. Plants oils are usually rich in unsaturated fatty acids that are negative risk factors to cardiovascular diseases. The limited information on its (Bambara Groundnut) fatty acid composition limits it nutritional and industrial application. This work is therefore to determine the fatty acid composition of

Bambara Groundnut oil using GC-MS analysis. With the view to abreast the available information on the neglected poorly utilized crop.

Material and Methods

Sample Collection and Preparation

Bambara groundnuts used for this research were collected from farm in Madobi town of Madobi local government area of Kano State, Nigeria. The representative sample, drawn from the composite sample was dried, de-hulled and grounded in to powder. The fat was extracted using petroleum ether by sohxlet method as described by Harold *et al* (1981).Derivertization and GC-MS analysis (using GC-MS-QP2010 SHIMADZU, JAPAN) followed alkaline hydrolysis of 0.2g of the extracted oil as described by Rexanka*et al* (1990), methyl ester of the corresponding fatty acids were prepared according to Kitson*et al* (1996) by using 0.3mg sodium sulphate, $2cm^3$of n-hexane/dimethyl carbonate mixture (1:1) and $1cm^3$ of sodium methylate and shaken for one minute. To the whole preparation $3cm^3$ water was added with shaking and finally centrifuged at 2500rpm for 3 minutes, and the filtrate was used for GC-MS analysis by aspirating to the column via an inlet where the heat chamber acts to volatize the sample. Carrier gas acts to transport the sample in to capillary column and the molecules in the analytes were separated as they moved along the length of the column due to differences in their chemical properties. The molecules elute separately from the gas chromatograph owing to the differences in their retention time. The eluted molecule is captured, ionized, accelerated, deflected and detected by the mass spectrometer, by breaking each molecule into ionized fragments and the fragments were detected using their mass to charge ratio by the detector.

Result and discussion

Results

The oil of Bambara ground collected from Maddobi characterized by GC – MS analysis, show the presence of both saturated and unsaturated fatty acids; the fatty acids that differ in chain length, number and position of double bond(s) (table 1). Some of the fatty acids are in *trans* configuration while others are in the *cis* configuration. 1-(+)-Ascorbic acid 2, 6-dihexadecanoate which is vitamin C fatty acid conjugate were also detected in the sample, indicating the presence of vitamin C.

Table 1: Fatty acid composition of Bambara Groungnut (*Vigna subterranean* (L) verd C) grown in Madobi, Kano State-Nigeria.

R.t. (min)	Compounds Identified and their formulae	Corresponding acid
13.575	Methyl tetradecanoate (myristic acid) $C_{15}H_{30}O_2$	Tetradecanoate C14:0
13.575	Methyl tridecanoate $C_{14}H_{28}O_2$	Tridecanoate C13:0
13.575	Hexadecanoic acid methyl ester (Palmitic acid) $C_{17}H_{34}O_2$	Hexadecanoate C16:0
13.575	Methyl 14-methyl pentadecanoate $C_{17}H_{34}O_2$	Pentadecanoate C15:0
16.333	n-hexadecanoic acid (Palmitic acid) $C_{16}H_{32}O_2$	n-Hexadecanoate C16:0
16.333	1-(+)-Ascorbic acid 2,6-dihexadecanoate $C_{38}H_{68}O_8$	Dihexadecanoate C38:0
16.333	Pentadecanoic acid $C_{15}H_{30}O_2$	Pentadecanoate C15:0
16.333	Eicosanoic acid (Arachidic acid) $C_{20}H_{40}O_2$.	Eicosanoate C20:0
17.400	Methyl cis, cis-9, 12-octadecadienoic acid (linoleic acid) $C_{19}H_{34}O_2$	9, 12 Octadecadienoate C18:2 ω6
17.400	Methyl trans, trans 9, 11-octadecadienoic acid $C_{19}H_{34}O_2$	9, 11-octadecadienoate C18:2
17.400	1, E-8, Z-10-Tridecatriene $C_{13}H_{22}$	Tridecatriene C13:3
17.400	1, 5-Cyclododecadiene, (z,z) $C_{12}H_2O$	Cyclododecadiene C12:2
17.442	Methyl trans-9-Octadecenoate (Elaidic acid) $C_{19}H_{36}O_2$	trans-9-Octadecenoate C18:1
17.442	Methyl trans-8-octadecenoate (methyl (8E)-8-octadecenoate) $C_{19}H_{36}O_2$	trans-8-octadecenoate C18:1
17.600	Methyl 16-methyl heptadecanoate $C_{19}H_{38}O_2$	Heptadecanoate C17:0
17.600	Cis-9-hexadecenal $C_{16}H_{30}O$	Hexadecenal C16:1
18.00	Cis-9-Octadecen-1-ol (Oleyl alcohol) $C_{18}H_{36}O$	Cis-9-Octadecenol C18:1
18.00	9-Tetradecenel (Z) $C_{14}H_{26}O$	9-Tetradecenel C14:1
18.00	Oxacycloheptadec-8-en-2-one $C_{16}H_{28}O_2$	Oxacycloheptadecenone C16:1
18.00	Oxacycloheptadec-8-en-2-one $C_{16}H_{28}O_2$	Oxacycloheptadecenone C16:1
R.t. (min)	**Compounds Identified and their formulae**	**Corresponding acid**
19.133	Methyl (11E)-11-icosenoate $C_{21}H_{40}O_2$	11-icosenoate C20:1

19.133	Methyl 8- (2-hexylcyclopropyl) octanoate $C_{18}H_{34}O_2$	Cyclopropyloctanoate C17:0
19.133	Methyl cis-9- Octadecenoate (oleic acid) $C_{19}H_{36}O_2$	cis-9- Octadecenoate C18:1
19.133	9- Hexadecenoic acid methyl ester (Z) (palmitoleate) $C_{17}H_{32}O_2$	Hexadecenoate C16:1
19.317	n-heptadecanoic acid methyl ester (Margaric acid) $C_{18}H_{36}O_2$	n-heptadecanoate C17:0
19.317	Methyl 15-methylhexadecanoic acid $C_{18}H_{36}O_2$	Hexadecanoate C16:0
20.917	Nonadecanoic acid methyl ester $C_{20}H_{40}O_2$	Nonadecanoate C19:0
20.917	Docosanoic acid methyl ester (Behenic acid) $C_{23}H_{46}O_2$	Docosanoate C22:0
22.583	Heneicosanoic acid methyl ester $C_{22}H_{44}O_2$	Heneicosanoate C21:0
22.583	Tetracosanoic acid methyl ester (Lignoceric acid) $C_{25}H_{50}O_2$	Tetracosanoate C24:0
17.600	Octadecanoic acid methyl ester (stearic acid) $C_{19}H_{38}O_2$	Octadecanoate C18:0
17.442	Methyl trans-8-octadecenoate (methyl (8E)-8-octadecenoate) $C_{19}H_{36}O_2$	trans-8-octadecenoate C18:1
17.442	Methyl (7E)-7-Octadecenoate $C_{19}H_{36}O_2$	7-Octadecenoate C18:1

Discussion

The GC-MS analysis of Bambara groundnut oil indicates the presence of both the saturated and unsaturated fatty acids that varies in chain length number, position of double bond (s) and configurations. The presence of odd number carbon fatty acids, opposes the impression that fatty acids of plant and animal origin have even numbered chains of 16-22 carbon atoms, with zero to six double bonds of the *cis* configuration; methylene interrupted double bond system predominate.These however agrees withBadami and Patil (1981); Alhassan and Sule (2013) that many exception exist in nature, odd and even numbered fatty acids with up to nearly 100 carbon atoms exist and double bonds can be of the *trans* configuration, acetylenic and allenic bonds occur, and there can be innumerable other structural features including branch point, rings, oxygenated functions and many more.

The fatty acid methyl tetradecanoic acid detected in this study is similar to myristic acid. It is a ubiquitous component of lipids in most living organisms, it is more abundant in cow's milk fat, some fish oils and in those seed oils enriched in medium-chain fatty acids (e.g. coconut and palm kernel). This fatty acid is specifically found in certain proteolipids, and is

essential to the function of the protein components (Anonymous, 2013). It is also a very important as stabilize to many different body proteins, including immunoglobulins and it fight tumors via myristoylation (Mary, 2009).

The fatty acid hexadecanoic acid methyl ester detected in this study is similar to palmitic acid, it is considered the most abundant saturated fatty acid in nature, found in animals, plants and lower organisms. It functions in cells as specific proteolipids (Anonymous, 2013). Octadecanoic acid methyl ester also detected is similar to stearic acid and is found in the lipids of most living organisms. In lipids of some commercial importance, it occurs in the highest concentrations in ruminant fats (milk fat and tallow) or in vegetable oils such as cocoa butter, and of course in industrially hydrogenated fats. It can comprise 80% of the total fatty acids in gangliosides (Anonymous, 2013). The fatty acid eicosanoic acid (arachidic acid) detected in the current study,exist at low levels in most of animals' lipid, and more common to plants and microorganisms lipids. Eicosanoic acid is derived from the essential fatty acids, linolenic acid and linoleic acid; this indicates that there might be a presence of essential fatty acids in Bambara groundnut oil. This could have been detected if derivitizing agents other than methyl were used. The unsaturated fatty acids detected in Bambara groundnut oil;*Cis*-9-hexadecenal; present in nearly all fats, *Cis*-9-Octadecenol, the most common fatty acid in natural fat and *trans*-9-Octadecenoate, mostly found in hydrogenated and ruminant fats (Mayes and Botham, 2003). Other unsaturated fatty acids detectedbut not commonly found in natural fats (table 1), may play important roles in living organisms.

Bambara groundnut oil could play important role in medicine and nutrition, since monounsaturated fats help to decrease the levels of LDL cholesterol in blood, while increasing levels of HDL cholesterol. This can lower the risk of heart disease and stroke, while providing nutrients, such as vitamin E. Monounsaturated fats can also decrease the risk for breast cancer, help in losing weight and relieve the pain of rheumatoid arthritis. They also help the body absorb nutrients, especially the fat-soluble vitamins A, D, E and K. Fats are needed for normal growth and development in children, and kept brains and central nervous systems healthy. They also produce hormone-like substances that regulate blood pressure, blood clotting and the immune system (Anonymous, 2011a).

A 2010 study of 3,081 women suffering from breast cancer, demonstrated that the consumption of high amounts of long chain polyunsaturated fats from food produced a 25% reduced risk. These women were also shown to have reduced risk of all-cause mortality (Patterson *et al.*, 2010).Bambara groundnut oil could therefore play an important role in cancer

By detection of eicosanoic acid, the presence of essential fatty acid might be inferred. Bambara ground nut mayhave many health benefits, loweringhigh blood cholesterol, high blood pressure, relief; digestive difficulties, attention disorders, some cancers, asthma, arthritis and depressive disorders (Fortin *et al.,* 1995;Augustsson*et al.,* 2003;Mita*et al.,* 2007; and Sica 2007; Vanek and Connor 2007). Incidence of insulin resistance was found to be lowered with diets higher in monounsaturated fats (especially oleic acid) (Storlien*et al.,* 1996) hence bambara may show same effects. Eicosanoids are biologically active, oxygenated metabolites of arachidonic acid, eicosapentanoic acid (EPA), or dihomo-γ-linolenic acid. They act as modulators of numerous physiological processes including reproduction, blood pressure, homeostasis, and inflammation (Jim and Stewart, 2002).

Conclusion

Base on finding of this study it may be drawn that Bambara groundnut oil could play a significant role in food and pharmaceutical industries.

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