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Characterisation of Fatty Acid Contents of *Sesanum indicum* grown in Nasarawa State, Nigeria using Gas Chromatography

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ABSTRACT

The importance of oil seeds cannot be overemphasised, being a large store of energy in the form of fatty acids deposited in their tissues. This work was aimed at determining the physic-chemical properties and the lipid composition of *Sesanum indicum*. The sesame seeds analysed have acid and saponification values of 0.53 and 185.9 mg KOH / g of oil respectively and an iodine value of 105.12 g of I_2 / 100g of oil. Percentage free fatty acids of 2.52, and kinetic viscosity at 40ºC of 4.8 cSt were also obtained. In addition, trace amounts of trace amounts of butyric, caprioc, caprylic, capric, lauric and myristic acids which are short chain fatty acids were detected. Little amounts of myristic, palmitolic, linolenic, arachidolic and behenic acids of 0.13, 0.18, 1.01, 0.26 and 0.48% respectively were also detected. High amounts of palmitic and stearic acids of 11.49 and 8.124% respectively were obtained with significantly high amount of oleic and linoleic acids of 40.20 and 38.0% respectively. In contrast, trace amounts of longer chain fatty acids including erucic and lignoceric acids were detected. The result obtained also revealed high amount of saturated fatty acids of 32.06%, however the degree of unsaturation of the oil was greater. Monounsaturated and polyunsaturated oils constituted 25.82 and 42.14% of the total fats respectively. The ratio of oleic to linolenic and omega 6 to 3 were 0.67 and 37.7 respectively. The above results imply that the *Sesanum indicum* is a valuable source of essential fatty acids.

Introduction

Oil crops are important components of diets for centuries and also represent a good source of bioenergy in the form of biodiesel (Tapanes et al., 2008; Baud and Lepiniec, 2009; Quettier and Eastmond, 2009). *Sesanum indicum* is one of the most popular oil crops in the world with high nutritive value. It is a member of the Tubiflorae order and Pedaliaceae family. The plantis a very important oil seed found in various places around the world. The major producing countries of Sesame are India, Sudan, Burma and China (Ali et al., 2007; Elleuch et al., 2007). Ali et al. (2007) and Uzun et al. (2008) have described genetic diversity in the *Sesanum* species. The plant is of high interests due to its diverse uses, particularly use in the foodindustry (Makni et al., 2010). Sesame has been reported to contain high amounts of fatty acids as well as other nutrients (Adam et al., 2012). Sesame oil has been described to have a mild odour and a pleasant taste hence it is very popular as cooking oil in many countries of the world. Fats and lipids are important constituents of our daily diets (Doker et al., 2010). Fatty acids may have beneficial and unhealthy roles when consumed, therefore the need to ascertain the actual composition of oil seeds. The attractive attributes of sesame oil makes it valuable as food. In addition, the medical activities of *Sesame indicum* include effects on serum lipid levels, as well as anti-oxidant,anti-inflammatory and antimutagenic activities due to the presence of sesamin, sesamolin and lignans (Fukuda et al., 1986; Zhou et al., 2010). Furthermore, oils from plants have wide range of industrial applications in the manufacture food and non-food products.Several methods are used to extract oils from plants, from sesame seeds oil is extracted by pressing; mechanically or otherwise. Conventionally, severe heat treatment is used during the oil extraction(Latif and Anwar, 2011). Similarly, the use of gas chromatography to characterise oil is not new as has been reported (Lee et al., 1998).

Methodology

Physicochemical parameters that included saponification value, free fatty acid, acid and iodine values, and viscosity were determined as described by AOCS methods, (1997).Gas chromatographic analysis of the fatty acids content of sesame was carried out as their fatty acid methyl esters (FAMEs), and was performed as described by Latif and Anwar (2011).

Results and Discussions

Physicochemical analysis of Sesame seeds

In order to characterise sesame oil, a physicochemical analysis of the oil was initially performed and the result is presented in Table 1 below. The acid value is used as a parameter to determine the edibility or otherwise of the oil. The very low acid value obtained implies that the oil of sesame seed is adjudged to be safe for consumption. As shown in Table 1, the oil exhibited good saponification and iodine values. The iodine value indicates the level of unsaturation of the oil; therefore the high value obtained showed that the sesame oil is highly unsaturated. The iodine value obtained is higher than that reported for some oil seeds. The high iodine value may imply that the oil can be processed into semi-dry oil for either use in margarine and butter or use in the paints and vanish production. The iodine and saponification values obtained correlate with that reported by Fariku et al. (2007); and Mohammed and Hamza (2008) respectively. Similarly, the acid value of sesame obtained in this study is in close agreement with the report of Mohammed and Hamza (2008).

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Furthermore, previous reports have suggested that oils with high saponification values contained larger amount of short chain fatty acids when compared to those with lower saponification values. Therefore, the relatively low saponification value of Sesame oil may indicate that it has a high proportion of long chain fatty acid of C16 and above. The saponification and iodine values are lower than that of *C. sinensis*, *P. gratesiria*, *L. cylindrical* among others.

Table 1: Physicochemical properties of Sesame seed oil

Parameters	Values
Saponification value (mg KOH/g of oil)	185.9
Free fatty acid (%)	2.52
Acid value (mg KOH/g of oil)	0.53
Iodine value (g of I_2 /100g of oil)	105.12
Kinetic viscosity at 40ºC (cSt)	4.8

GC characterisation of Sesame oil revealed oleic and linoleic acids as the major fatty acids

In order to fully characterise the fatty acid content of sesame seed, a gas chromatographic (GC) analysis was performed. The result of the characterisation in presented in Table 2 and 3 below, trace amounts of shorter chain fatty acids of such as butyric, caprioc, caprylic, capric, lauric and myristic acids were obtained. In contrast significant amounts of fatty acids with 16-carbon chain such as palmitic stearic, oleic, and linoleic acids were detected (Table 2). The amount of saturated fatty acids; palmitic and stearic acids of 11 and 8% respectively agrees with that reported by Uzun and colleagues (Uzun et al., 2008) with very little amount of arachidic and behenic acids. In addition, oleic and linoleic acids of 40 and 38% respectively (Table 2) constituting approximately 80% of the total fatty acids content of the seeds. Sesame seeds have been reported to show variation in fatty acid composition (Uzun et al., 2008). However, the amount of palmitic, oleic, linoleic and linolenic acids obtained in this study is comparable to previously reported data (Uzun et al., 2007; Hahm et al., 2009; Nzikou et al., 2010).

Table 2: The fatty acid composition of Sesame seeds

Fatty acids	Concentrations (%)
Butyric (C5:0)	Trace
Caproic (C6:0)	Trace
Caprylic (C8:0)	Trace
Capric (C10:0)	Trace
Lauric (C12:0)	Trace
Myristic (C14:0)	0.13
Palmitic (C16:0)	11.49
Palmitoleic (C16:1)	0.18
Stearic (C18:0)	8.124
Oleic (C18:1)	40.20
Linoleic (C18:2) ω-6	38.08
Linolenic (C18:3) ω-3	1.01
Arachidic (C20:0)	0.26
Behenic (C22:0)	0.48
Erucic (C22:1)	Trace
Lignoceric (C24:0)	Trace

Furthermore, the high amount of unsaturated oils (see Table 3) obtained further confirmed the result in Tables 1 of the implication of high iodine values. The percentage of mono- and polyunsaturated acids contents of sesame obtained in this work is in agreement with that reported previously (Elleuch et al., 2007). In addition, the high lipid content of the Sesame seeds is in agreement with previous reports (Yusuf et al., 2008; Kanu, 2011; Adam et al., 2012). High amount of saturated fatty acids have been shown to have effects on elevation of serum cholesterol, in contrast polyunsaturated fatty acids exhibit an opposite effects. Moreover, linoleic and linolenic acids have been reported to play significant roles on growth and otherphysiologic activities of the body. The omega 3 and 6 oils are essential fatty acids that have important roles in maintaining membrane structure and integrity. They also serve as precursors of eicosanoid biosynthesis.

Table 3: Classification based on saturation of fatty acids

Component	Percentage (%)
Saturated fatty acid	32.06
Monounsaturated fatty acid	25.82
Polyunsaturated fatty acid	42.14
Oleic / linolenic fatty acids ratio	0.65
ω6 / ω3	37.7

Conclusion

The oil extracted from sesame seeds has good qualities both as food and additives such as paints based on its physicochemical attributes. Sesame oil may also be beneficial to health due to its high amounts of unsaturated fats in addition to the significant ratio of the omega 6 to 3 oil. The desirable of oil derived from Sesame makes it not only an invaluable resource for food, feed but also as a raw material for the biodiesel industry.

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