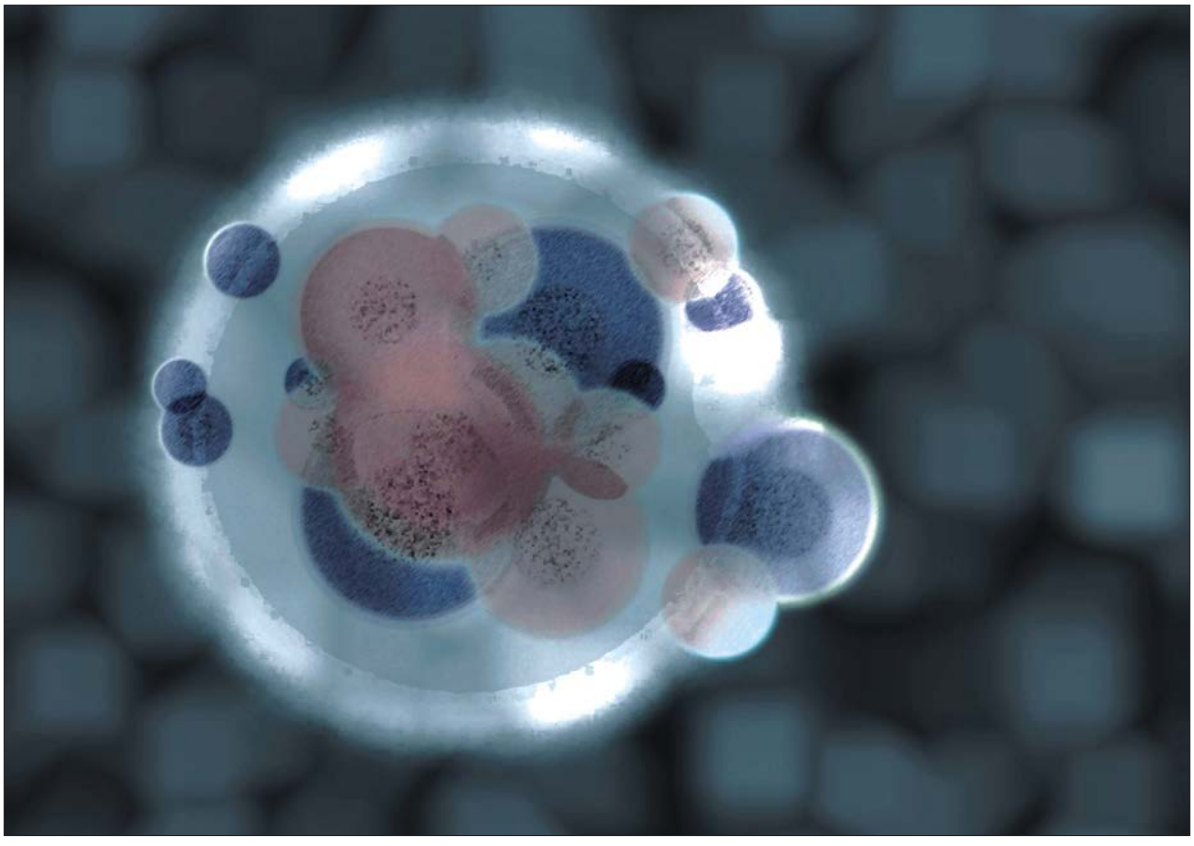

Journal of Biological Sciences

ISSN 1727-3048

science alert

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Journal of Biological Sciences 8 (4): 814-817, 2008
ISSN 1727-3048
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Physicochemical Properties and Fatty Acid Composition of *Citrullus lanatus* (Egusi Melon) Seed Oil

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Abstract: In this study, the physicochemical properties and fatty acid composition of *Citrullus lanatus* (egusi melon) were investigated. Oil from the seeds of *Citrullus lanatus* (egusi melon) was extracted with petroleum ether as solvent. The ether extract was evaluated for its specific gravity, refractive index, acid, iodine, peroxide and saponification values. The fatty acid profile analysis of the oil was also carried out by Gas Liquid Chromatography. The oil has a specific gravity of 0.93 and refractive index of 1.45 indicating that the oil is less thick compared to most drying oils with refractive indices between 1.48 and 1.49. Its acid, iodine, peroxide and saponification values were 3.5±0.3, 110±8.2, 8.3±4.6 and 192±43.7, respectively. These values are within recommended range for edible oils. The oil has four main fatty acids: palmitic, stearic, oleic and linoleic acids, linoleic acid being the most abundant. The fatty acid content of the oil showed that 71.9% is unsaturated. These results indicate that egusi melon oil could be a good source of table oil. Its high content of linoleic acid is of particular interest especially in the fight against atherosclerosis.

Key words: Physicochemical properties, fatty acid, egusi melon, oil

INTRODUCTION

Egusi melon (*Citrullus lanatus*) belongs to the family of Cucurbitaceae which has a tremendous genetic diversity, extending to vegetative and reproductive characteristics (Ng, 1993). They thrive in tropical, subtropical, arid deserts and temperate locations. Egusi melon is an annual, herbaceous, monoecious plant with a non-climbing creeping habit. After planting, they completely cover the soil surface within 3 weeks and flowering starts. Pollination is by insects. Often the fruits are ready to harvest 90-120 days (3-4 months) after sowing (Ng, 1993). The fruits are indehiscent smooth berries, very large and seedy and when sound can be removed, washed and dried.

In West Africa, a region where soups are integral to life, egusi melon (*Citrullus lanatus*) seeds are a major soup ingredient and a common component of daily meals. Coarsely ground up, they thicken stews and contribute to widely enjoyed steam dumplings. Some are soaked, fermented, boiled and wrapped in leaves to form a favourite food seasoning. Egusi melon-seed meal is compacted into patties that served as a meat substitute. Despite being a significant foodstuff even by global standard, egusi melon is hardly known to nutritionists outside a few West African nations. Little nutritional detail on egusi melon oil is readily available to an international readership. Research studies have shown that these seeds contained about 50% oil (Olaofe *et al*., 1994), 42-57% oil (Fokou *et al*., 2004), 44-53% oil (Achu *et al*., 2005) for seeds cultivated in different bioclimatic regions of Cameroon. These studies showed that egusi melon seeds contained good amounts of oil that can be exploited. The aim of the present study therefore is to determine some physical and chemical properties as well as the fatty acid composition (which could be used in determining the quality of the oil) of egusi melon oil obtained locally from a South Western region of Nigeria.

MATERIALS AND METHODS

Chemicals: All chemicals used were of analytical grade and were products of BDH Chemicals Ltd., Poole, England unless otherwise stated.

Collection and preparation of seeds sample: This study was carried out between October to November, 2007.

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Egusi melon seeds used for this study were obtained from a local market in Iwaro-Oka Akoko, Ondo State, Nigeria and were identified as *Citrullus lanatus* by a taxonomist in the Department of Crop Science, Faculty of Agriculture, University of Benin, Nigeria. The seeds were screened to remove bad ones, shelled manually and further screened. The seeds were then dried to constant weight in an oven at 70°C, ground using mechanical grinder, put in air-tight containers and stored in desiccators for further analysis, some of the seeds was subsequently deposited at the herbarium of the faculty.

Oil extraction: Oil from the seeds of egusi melon was extracted by continuous extraction in Soxhlet apparatus (Cehmglass) for 8 h using petroleum ether (60-80°C boiling range) as solvent according to the method described (AOAC, 1980). At the end of the extraction the extraction solvent was evaporated in a rotary evaporator (Cehmglass). The extracted oil was used for feed formulation and the remaining stored in light proof, airtight and moisture proof container at -4°C for further analysis.

Physicochemical properties analysis: The physicochemical indices (acid, iodine, peroxide and saponification values and specific gravity and refractive index) were carried out according to the methods described (AOAC, 1980).

Fatty acid composition analysis: The fatty acid profile of egusi melon oil was determined by gas liquid chromatography (Hewlett Packard, model 5750).

RESULTS AND DISCUSSION

Table 1 shows the yellowish colour oil had specific gravity of 0.93 indicating that it is less dense than water. The result of the refractive index, 1.45 is in close agreement with the value of 1.46 obtained for *B. sapida* (Akintayo *et al*., 2002) oil. This shows that the oil is less thick compared with most drying oils whose refractive indices were between 1.48 and 1.49 (Duel, 1951). The acid value of 3.5±0.3 mg KOH g^{-1} is relatively low compared to that reported for tropical almond (7.6 mg KOH g^{-1}) and similar to that of fluted pumpkin (3.5 mg KOH g^{-1}) (Christian, 2006). The low acid value of the oil indicates that it is good as edible oil. The iodine value of egusi melon seed oil, 110.0±8.2 mg iodine g^{-1} is similar to those of unsaturated fatty acid-rich oils such as peanut (86.0-107.0), cottonseed (100.0-123.0), sesame (104.0-120.0), sunflower (118.0-141.0) but lower than that of soybean oil (124.0-139.0) (Aremu *et al*., 2006). Egusi melon seed oil however has iodine value higher than those of saturated fatty acid-rich oils such as *Theobroma cacao*, cocoa butter (32.0-42.0) (Ige *et al*., 1984), coconut (6.0-10.0), palm oil (50.0-55.0), palm kernel (14.0-1.0) (Aremu *et al*., 2006).

Table 1: Physicochemical properties of egusi melon seed oil

Parameters	Value
Acid value (mg KOH g^{-1})*	3.5±0.3
Iodine value (mg iodine g^{-1})*	110.0±8.2
Peroxide value*	8.3±4.6
Saponification value (mg KOH g^{-1})*	192.0±43.7
Colour	Yellow
Specific gravity	0.93
Refractive index	1.45

*Values are mean±standard deviations of triplicate determinations

Egusi melon oil has a peroxide value of 8.3±4.6 mg equiv. of O_2 kg^{-1} of oil. This value is higher than the value recorded for *Bauchinia racemora* (4.9) seed (Amoo and Moza, 1999). Peroxide value depends on a number of factors such as the state of oxidation (quantity of oxygen consumed), the method of extraction used and the type of fatty acids present in the oil. The high peroxide value recorded for egusi melon oil in this study may be due to too much exposure of the seeds to sun during drying, causing lipid oxidation resulting from the absorption of oxygen, which increases the formation of peroxides. Secondly, it may be attributable to heating of the oil during its extraction process. Heat favours oxidation of fatty acids increasing the formation of peroxides (Cheftel and Cheftel, 1992). Thirdly, the oil contains mostly polyunsaturated fatty acids which easily undergo oxidation, raising peroxide value of the oil. The peroxide value obtained in this study is however lower than 15 mg equiv. O_2 kg^{-1} of oil (the maximum level for cold pressed and virgin oils) (Aremu *et al*., 2006), showing that egusi melon oil is good for consumption.

The saponification value of egusi melon oil was 192.0±43.7 mg KOH g^{-1} which agrees with values obtained for some vegetable oils ranging from 188-196 mg KOH g^{-1} (Pearson, 1976). However, there are some vegetable oils with higher saponification values such as coconut oil (253.0 mg KOH g^{-1}), palm kernel oil (247.0 mg KOH g^{-1}) and butter fat (225.0 mg KOH g^{-1}) (Aremu *et al*., 2006). As reported by Pearson (1976) oil with higher saponification values contain high proportion of lower fatty acids. Therefore, the values obtained for egusi melon oil in this study show that it contains high amounts of higher fatty acids.

Table 2 shows the fatty acid profile of egusi melon oil. Table 2 showed that palmitic (13.5%), stearic, (13.7%), oleic (14.5%) and linoleic, (56.9%) are the main fatty acid present in egusi melon. The linoleic acid level in egusi seed oil obtained in this study is similar to that of egusi

Table 2: Fatty acid composition (% of methyl fatty acids) of egusi seed oil

Fatty acid	Composition (%)
Lauric	0.2
Myristic	0.7
Palmitic	13.5
Stearic	13.7
Oleic	14.6
Linoleic	56.9
Linolenic	0.5
Saturated fatty acids	28.1
Monounsaturated fatty acids	14.5
Polyunsaturated fatty acids	57.4
Total unsaturated fatty acids	71.9

seeds from Niger (30.0-74.0%) (Lazos, 1986). These results show that egusi melon oil is better than animal fats in their content of linoleic acid, while animal fats contain mostly oleic acid (29.0-48.0%) (NRC, 1989).

Present results are also similar to that of previous study on *Cucurbita pepo* seed oil which was found to contain mostly palmitic, stearic, oleic and linoleic acids, with linoleic acid as the most abundant (Murkovic *et al*., 1996; Younis *et al*., 2000). Present values are also similar to those of corn, cottonseed, sunflower, soybean and sesame oils. They are different from those of peanut and palm olein oils, (which have oleic acid as the most abundant) and palm and coconut oils (contain mostly saturated fatty acids, palmitic and lauric acids respectively) (Aremu *et al*., 2006).

From our results, egusi oil is observed to be poor in linolenic acid (0.5). Linolenic acid though an omega-3 fatty acid with positive health effects is easily susceptible to peroxidation, hence, it is undesirable in edible oils because of the off-flavours and potentially harmful oxidation products formed. As reported by Warner and Gupta (2003), a decrease from 2 to 0.8% linolenic acid content in oils improved flavour quality and oxidative stability of fried foods. This therefore shows that the lower the linolenic acid content of oil, the more suitable is the oil for frying. Egusi oil contained 57.4% poly unsaturated fatty acid majorly composed of linoleic acid which is an essential fatty acid. This indicates that egusi seed oil is a good source of edible oil such as cooking and frying oil, making it good for the fight against cardiovascular diseases.

CONCLUSION

The present study indicates that egusi seed oil has acid, iodine, peroxide and saponification values within recommended limits. The iodine value is close to those of unsaturated fatty acid-rich oils (corn, cottonseed, sesame, sunflower and peanut oils) showing that the oil is rich in unsaturated fatty acids. Egusi seed oil is very rich in essential fatty acids (linoleic) but poor in linolenic acid. The fatty acid profile follows the same pattern as that of corn, cottonseed, soybean and sesame oils but has a lower linoleic acid level compared to soybean. The acceptable acid and peroxide values, high linoleic acid and low linolenic acid content of egusi seed oil suggest it could be a good source of edible oil (for cooking and frying) and a potential antidote for the fight against cardiovascular disease.

Further research is being carried out on the proximate amino acid and mineral composition of egusi seed as well as its potential atherogenicity *in vivo*.

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