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Research Article

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Gmelina arborea Seed Oil Characterization, Proximate and Heavy Metal Analyses

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Abstract Oil quality of *Gmelina arborea* seed was investigated. The oil was obtained by solvent extraction using petroleum ether. Percentage oil yield was 10.82%. Proximate analyses showed that the seed contained 4.6% ash, 3.86% crude fiber, 2.98%crude protein, 5.71%mosture, and specific gravity of 0.89. Characterization of the oil showed that the oil had acidity of 3.50mgKOH/g, iodine value of 31.11mg/l, saponification value 33.00mg/g, peroxide value 5.70mg/g, and 1.75%free fatty acid. The low acid and free fatty acid values of the oil indicated that it was not prone to oxidative rancidity, thus good edible oil. The iodine and saponification values showed the oil has low degree of unsaturation, thus non-drying oil and has fatty acid of high molecular weight which makes the oil good for making edible fat, margarine and others. Heavy metals were also determined by Atomic Absorption Spectroscopic method. Lead, cadmium, copper, and mercury were not detected while the value of selenium was 0.002ppm which is below the WHO permissible limit.

Keywords *Gmelina arborea*, oil, proximate analyses, iodine value, heavy metals

Introduction

Gmelina arborea is a tree native to Pakistan, Bhutan, India, Myanmar, Thailand, Indonesia, China, and South China. It is found in tropical forest to 1,100 meters above sea level. It is a tree that can grow to 30m high, with smooth whitish to greenish-brown bark and a straight trunk. Its leaves are 8 to 20cm long, 4.5 to 15cm wide, and covered with star shaped hairs. The flowers are reddish-yellow, hairy, and five-lobed. The hairless fruits are 10 to 15mm in diameter and glossy yellow when mature. Record had it that it has a bitter test [1]. The fruit is a drupe, 1.8-2.5cm long, obovoid, seated on the enlarged calyx, gloss and yellow when ripe; exocarp succulent and aromatic; endocarp bony and usually 2-celled. Seeds -3, lenticular, exalbuminous. Mature fruits are produced 1 week after flowering peak and fruiting may be spread over a 2 month period [2]. The fruit of *G. arborea* is edible, leaves are regarded as good fodder and cattle eat the fruit. Flowers produce abundant nectar, which produces high quality honey [3]. *G. arborea* is planted mostly for fire wood which has a calorific value of 4800kcal/kg. The wood is used for fiber because the wood produces good quality pulp. It is a source of timber. The natural durability of the wood is about 15years. Both wood ash and fruit yield a very persistent yellow dye [3]. As ornamental, *G. arborea* is sometimes planted as an avenue tree.

It is pertinent in our country today, to device means of harnessing and reinforcing the growth and usefulness of *G. arborea* tree in the light of the aforementioned usefulness, and new economic diversification cannot be relegated to the background. *G. arborea* is readily available in Nigeria, except for the wood being harnessed for timber and firewood while other parts usually form a waste and litter the environment. It is on this note that this research work

is being carried out to characterize the oil and determine the proximate principles and heavy metal content in order to make a deduction on the uses of *G. arborea* seed.

Material and Methods

Sample collection and Preparation

The *G. arborea* seed that was used for this study was collected from the environment of Chukwuemeka Odumegwu Ojukwu University, Uli campus around March and April. The seed was identified as *Gmelina arborea* by Prof. Okafor J.C. of Fame consultant Enugu

Methods

The seed coats were removed and the seeds wash and dried for two days and kept for two weeks under room temperature to complete the drying process. It was milled into powder using manual grinder. The ground sample was stored in an air tight plastic container ready for analysis. Extraction of the oil from the seed was done by soxhlet extraction method using petroleum ether (b.p.60-80) as solvent according to recommendation by American oil Chemists Society (AOCS)[4].

The oil was analyzed by the method outlined by the AOCS [4] and the proximate principles were determined using the method of Association of Official Analytical Chemists (AOAC) 1980[5]. Heavy metal compositions were determined applying the Atomic Absorption Spectroscopic method.

Results and Discussion

Results

The results of the oil extraction, characterization, proximate analyses and heavy metal determination of *G.arborea* seed oil are shown on tables 1-3 below.

Table 1: Results of characterization of *G.arborea* seed oils

S/N	Parameter	Value
1	Iodine value (g iodine/100g oil)	31.11
2	Saponification value (100gKOH/g)	33.00
3	Peroxide value (mg/g)	5.70
4	Acid value (mg/g)	3.50
5	Free fatty acid (mg/g	1.75

Table 2: Results of proximate analysis of *G. arborea* seed

S/N	Parameters	Values
1	Oil content (%)	10.82
2	Ash content (%)	4.60
3	Crude fibre (%)	3.86
4	Crude protein (%)	2.98
5	Moisture content (%)	5.71
6	Specific gravity	0.89

Table 3: Results of Heavy metal assay of *G. arborea* seed

S/N	Metals	Concentrations (mg/l)
1	Lead	ND
2	Cadmium	ND
3	Copper	ND
4	Mercury	ND
5	Selenium	0.002

ND = Not detectable.

Discussion

The iodine value of *G. arborea* seed oil was 31.11mg/g. This value falls in the range characteristics of non-drying oil which is below100. The stability of oils to oxidation is determined by iodine value and allows the overall unsaturation of the fat to be determined quantitatively [7]. *G. arborea* seed oil is therefore nondrying oil. Therefore, the oil has oxidative storage stability. The oxidative and chemical changes in oils during storage are characterized by an increase in the free fatty acid contents and a decrease in the total unsaturation of oils [8]. The saponification value obtained for obtained for *G. arborea* seed oil as shown in Table 1 was 33 mgKOH/g. Saponification value is an index of average molecular mass of the fatty acid in the oil sample. The smaller the molar mass of the fat, the higher the saponification value. By implication, *G.a rborea* seed oil has a high molar mass, therefore good for human consumption and could be used for making edible fat, mayonnaise, salad oil and margarine [9]. Peroxide value is used as an indication of the quality and stability of fats and oils [10]. It is used as a measure of of the extent to which rancidity occurs during storage. From Table 1, *G. arborea* had peroxide value of 5.70 mg/g showing that it does not undergo auto-oxidation. Low acid value (3.50mg/g) indicated the oils acceptability for human consumption and could be used to produce edible fat[11]. Low free fatty acid, 1.75mg/g for the oil showed the oil has a long shelf life. The oil yield level (10.82%) reported in this work may be useful in food industries but cannot be considered economical as oil seed when compared to other vegetable oils. Ash content is a measure of the total amount of minerals present within a food. The ash contents includes potassium, sodium, calcium, as well as smaller quantities of aluminum, iron, manganese, or zinc, arsenic, iodine fluorine and other elements present in traces [12]. The levels of ash contents and crude fibre in the oil were low. This was in line with report by Narasinga Rao [12] that dehulled seed contains significantly more oil and less crude fibre, calcium, iron, thiamine, and riboflavin. The seed was low in protein showing that it was not a proteinous seed. G.arborea seed has moisture content of 5.71% after drying. This was good for its storage quality. Seeds with high percentage of moisture contents were prone to microbial activity and such seeds does not have long shelf life [14]. The specific gravity of the oil was 0.89 which was almost the same with fuel oil (0.893 at 60^{o}F). Specific gravity is an important factor in optimizing a mixer. Without factoring this measurement into mixer design results would not reach product specification[15].

From Table 3, except selenium which is trace metal, heavy metals determined were not detected within the sensitivity of the instrument used. The value of selenium was below the WHO permissible limit. Selenium is an essential trace mineral which is vital for the human body as it increase immunity, takes part in antioxidant activities that defends against free radial damage and inflammation [16].

Conclusion

Results from the characterization of the oil indicated the oil to be edible and does not undergo auto-oxidation. The proximate analyses results qualified the oil good and edible and made it useful in making edible fat, margarine, and mayonnaise. *G. arborea* seed can be equally included in the formation of animal feeds. Though the oil yield cannot be considered economical compared to some other vegetable oils, *G. arborea* seed cannot be allowed to be wasted. There is need therefore for more research on the Pharmaceutical composition of the seed. Using spectroscopic methods, determination of the fatty acids composition of the oil has been recommended.

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