Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
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Journal of Applied Sciences 8 (7): 1337-1339, 2008
ISSN 1812-5654

Characteristics and Composition of African Oil Bean Seed (*Pentaclethra macrophylla* Benth)

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Abstract: The African oil bean (*Pentaclethra macrophylla*) seed was analyzed for its proximate composition. The seed oil was also analyzed for mineral content and physicochemical characteristics. Proximate analysis revealed that the percentage crude protein, crude fibre, moisture and carbohydrate were 9.31, 21.66, 39.05 and 38.95%, respectively. The percentage oil content was 47.90% while the ash content was 3.27%. Results of minerals analysis showed that calcium had the highest concentration of all the elements analyzed and were found to be of the order: Ca > Mg > Pb > Fe > Mn > P > Cu. The low iodine value of the seed oil showed that it can be classified as non-drying oil and thus not suitable for paint and polish production. However, the low acid and free fatty acid values suggest its utilization as edible oil.

Key words: *Penthracletra macrophylla*, seed oil, composition, characteristics

INTRODUCTION

The demand for vegetable oils has ever been widening in Nigeria as industrialists rely mostly on the popular vegetable oils like palm oil, palm kernel oil, groundnut oil and coconut oil for the preparation of their various products (Akintayo, 2004). The increasing demand for vegetable oils and fats in Nigeria, for both domestic and industrial purposes, in recent times, is partly due to the nutritional needs of the teaming population and the increasing number of industries that require oils and fats as their primary raw material. Nigeria however, being a tropical country, has wide variations in climatic conditions and therefore has a wide variety of domestic plants that produce oil. Lack of information on the composition and utilization of the many and varied oil seeds, indigenous to Nigeria is more of a problem than the shortage of these oils. This study is therefore aimed at revealing the potentials of less-known seed oil, *Pentaclethra macrophylla* oil, which could very well replace the popular vegetable oil.

The African oil bean (*Pentaclethra macrophylla*) is a native of tropical Africa and belongs to the family Leguminosea. It is popular in Nigeria where it is known by several names such as *Apara* in Yoruba for the seed as well as the fermented product and the most prominent being *Ugba* (Igbo), as it is a popular condiment and meat analogue among consuming populations (Enujiugha and Akanbi, 2005).

The tree thrives in the Eastern and Southern parts of Nigeria. It grows to a height of about 21 m up to 6 m in girth and it is well branched, forming crown-like canopy. It flowers between March and April after which the pods (brown and woody when matured) open by explosive mechanism, dispersing the seeds and curls up. The seeds are dorso-ventrally flattered, hard, brown in colour and about 6 cm long and 3 cm wide (Achinewhu *et al*., 1998).

The mesocarp of *P. macrophylla* seed serve as food, eaten as snack or dessert (evening meal) or used as condiment. It is prepared by first boiling for about 12 h, dehulled, sliced, wrapped in plantain leaves and allowed to ferment for a period of between 2-4 days at ambient temperatures. It may then be mixed with palm oil, spiced and eaten with cooked cassava chips (African salad) or with roasted yam. *P. macrophylla* has been reported to be rich in protein (48%), amino acids and fatty acids (Ikediobi, 1981).

In this study, we report the characteristics of African oil bean (*Pentaclethra macrophylla* benth) seed with a view to ascertaining its industrial potential.

MATERIALS AND METHODS

The seed of *P. macrophylla* were obtained from Uselu market in Benin City, Edo State, Nigeria. The seeds were dehalled and powdered by grinding in a Labmill laboratory machine. Oil was extracted using n-hexane in a soxhlet apparatus, in batch-wise operation. Solvent was

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removed in a rotavapour. The extracted seed meals were thoroughly air-dried to remove traces of solvent. The extracted seed oils were immediately analyzed for some physicochemical properties (iodine value, saponification value, peroxide value, free fatty acids, refractive index) using standard methods (AOAC, 1990).

The free fatty acid was calculated from the relationship given by Norris (1965). The mean molecular mass was estimated from the relationship (56/Saponification value) × 100 (Ajiwe *et al*., 1995). Proximate analysis of the seeds was carried out as described by the Association of Official Analytical Chemists (AOAC, 1995). Fatty acid composition of the oils was determined as described by Akintayo (1997). The mineral content (Ca, Mg, Fe, Pb, Cu, Mn and P) was obtained through colourimetirc method by using UV-visible technique with a 21D spectrophotometer (430-545 nm).

RESULTS AND DISCUSSION

Proximate analysis: The moisture content of *P. macrophylla* is fairly high and this could imply short self life. The value compared favourably with those of other seed oils e.g., Melon seed and *Desterium microcapum* (Tallow) seed oils (Eromosele, 1993). The crude fibre and ash content values are important in terms of the suitability of the seed cakes for the compounding of animal feeds. As a result of the low crude fibre content, the African oil bean seed may be considered unsuitable for compounding animal feeds. However, on the grounds of high carbohydrate content and low ash content, it may be considered otherwise (Abighor *et al*., 1997). The protein content of the seed was fairly low. The high oil content (47.90%) implied that processing the seeds for oil would be economical (Table 1). The value also compared favourably with that obtained for *Jatropha curcas* (47.25%) (Akintayo, 2004).

Characteristics of the oil: The oil was light brown in colour. The iodine value of the oil shows that it is non-drying oil. This makes it unsuitable for varnishes, polish and alkyd resins. The high saponification value of the oil implies that it consists primarily of high molecular weight fatty acid glycerides. This also indicates its suitability in the production of soaps and shampoos. Generally, this high saponificaiton value and low unsaponifiable matter in the oil suggest that it is a normal triglyceride (Table 2).

The free fatty acid obtained in this analysis compares favourably with those reported for some conventional oil seeds such a soybean, olive and sunflower oils. Free fatty acid can stimulate oxidative deterioration of oils by enzymatic and/or chemical oxidation to form off-flavour component. The free fatty acid and acid value of *P. macrophylla* are low and this suggests its application as a good edible oil. Free fatty acid is also related to smoke point. *P. macrophylla* with low fee fatty acid will have a high smoke point, so it would be suitable for stir-fry cooking. The refractive index obtained compared favourably with that obtained for *Jatropha curcas* and *Parkia biglobbossa* oils (Akintayo and Bayer, 2002).

Table 1: Proximate composition (%) of the African oil bean seed flour

Components	Composition (%)
Moisture	39.05±0.25
Oil content	47.90±1.30
Ash	3.27±0.14
Crude fibre	21.66±0.40
Crude protein	9.31±1.05
Carbohydrate	38.99±0.50

Table 2: Physico-chemical characteristics of Africa oil bean seed

Parameters	Value
Colour	Light brown
Saponification value (mg KOH g^{-1})	171.11±1.20
Iodine value (10 mg iodine g^{-1})	57.60±0.60
Peroxide value (Meq. Peroxide kg^{-1} oil)	5.20±0.10
Acid value (mg KOH g^{-1})	3.25±0.20
Free fatty acid (mg g^{-1})	1.64±0.13
Refractive index (25°C)	1.46

Table 3: Minerals composition of the Africa oil bean seeds

Mineral elements	Concentration (μg g^{-1})
Calcium	8.16±0.20
Magnesium	4.86±0.62
Iron	1.69±0.45
Lead	3.94±0.14
Copper	0.05±0.10
Manganese	0.72±0.30
Phosphorus	0.06±0.11

Elemental analysis: Calcium (Ca) had the highest concentration of 8.16 μg g^{-1}. Magnesium (Mg), iron (Fe), lead (Pb) and manganese (Mn) also showed reasonably high concentrations (Table 3).

The minerals (calcium, magnesium and phosphorus) are micro-elements essential to health. Their presence in the African oil bean seed makes the oil serves as a viable source of these minerals in the body. Also, phosphorus (P) and copper (Cu) levels obtained from the oil analysis were considerably low. Generally, the varying levels of these mineral elements may be due to the different rates at which the elements are taken up from the soil by the plants and subsequent incorporation into the oil.

CONCLUSION

Evaluation of the composition and characteristics of African oil bean seed (*P. macrophylla*) shows that the oil has some domestic and industrial potentials.

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