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Chemical Characterization of *Monodora tenuifolia* Seeds from Nigeria

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ABSTRACT

Monodora tenuifolia seeds, obtained from University of Ibadan premises in Ibadan, Nigeria, have been subjected to standard analytical technique in order to evaluate their proximate composition, physicochemical properties and contents of nutritional valuable elements. The average values of the proximate analysis on dry matter basis were 32.09 ± 1.58 g/100 g dry matter (DM) crude oil, 8.40 ± 0.25 g/100 g DM crude protein, 16.20 ± 1.85 g/100 g DM moisture, 2.85 ± 0.40 g/100 g DM ash, 33.91 ± 1.42 g/100 g DM crude fibre and 6.55 ± 1.58 g/100 g DM carbohydrate. The physical properties of the oil extracts showed the state to be liquid at room temperature (25 ± 1°C) and the colour of the oil brown. The specific gravity of the oil was 0.8806 ± 0.0253. The iodine value of the oil placed it in the non-drying group. The mineral analyses showed that the most prevalent mineral element in *M. tenuifolia* seeds is potassium (42.05 ± 0.50 mg/l DM). Other mineral elements in the seeds are magnesium 18.40 ± 5.73 mg/l; sodium 3.15 ± 1.73 mg/l DM and calcium 1.60 ± 0.03 mg/l all on dry matter basis. Iron, which is a trace element, is quite high in the seed (2.26 ± 0.05 mg/l). The seed oil could serve industrial purposes such as soap making, lubrication and cosmetics.

Keywords: mineral element, physico-chemical, proximate, seeds

INTRODUCTION

The search for lesser known and underutilized crops, many of which are potentially valuable as human and animal foods has been intensified to maintain a balance between population growth and agricultural productivity, particularly in the tropical and sub-tropical areas of the world Oladele and Aina (2007). Currently, large amount of fruit seeds are discarded yearly at processing plants. This not only wastes a potentially valuable resource but also aggravates an already serious disposal problem. To be economically viable, however, both oil and meal from these fruit seeds must be utilized (Kamel and Kakuda 1992). Recently more attention has been focused on the utilization of food processing by-products. Obviously such utilization would contribute to maximizing available resources and result in the production of various new foods. Simultaneously, a major contribution to avoiding waste disposal could be made. *Monodora tenuifolia*, belonging to the family Annonaceae, is commonly referred to as *abo-lakoshin*, *ehuru ofia* and *uyenghen* by the Yoruba, Igbo and Edo tribes in Nigeria. It is a tree up to 17 m in height of the evergreen and fringing forest of West and Central Africa with seeds of slightly brown colour. Morphological parts of *M. tenuifolia* plants are used in traditional medicine for the treatment of disease such as dermatitis (root), headache (stem bark), toothache roots by Yorubas, dysentery (bark and root). The fruits which are edible appear around April- June. They are speckled green and white at first but turn black eventually (Keay 1989). The seeds may be roasted, ground and rubbed on the skin for skin diseases. They are also considered anti-hemorrhage in Gabon Burkill (1985). There exit in literature some reports on different aspects of *M. tenuifolia* (Adeoye *et al.* 1986; Oguntimehin *et al.* 1989; Adesomoju *et al.* 1990) but there is not much information about the chemical composition of *M. tenuifolia* seeds and seed oil. This paper reports on the chemical characterization of *M. tenuifolia* seeds and seed oil.

MATERIALS AND METHODS

Plant materials and sample collection

The seeds were collected from the Botanical Garden and the premises of University of Ibadan campus, Ibadan, Nigeria. They were identified according to the flora of West Africa in the Herbarium Unit of University of Ibadan where vouchers of each specimen were already deposited. The collection extended from April to June 2006. About 300 pieces of the seed sample was collected. The seeds were mostly collected out of curiosity.

Physical measurements

The method of Femenia *et al.* (1995) and Arogba (1997) were followed in determining the physical dimensions of the seeds by taking the average measure of 25 seeds. The dimensions (length and breadth at mid-length of the seeds) were measured using a Vernier caliper. Weights were recorded using a Mettler digital top-loading balance.

Sample preparation and extraction

The seeds of *M. tenuifolia* were cracked to remove the brown coloured kernels. They were ground to powder with the use of Hammer mill and were then stored in polythene bag and kept in refrigerator until needed for analysis. The oils were extracted from the seeds with a Soxhlet extractor using petroleum ether (40-60°C). The oils obtained, after distilling off the hexane, was stored in a labeled flask. The chemicals used were supplied by British Drug House (BDH).

Proximate analysis

All analyses were carried out in Chemistry Department, University of Ibadan and International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria. The moisture content of the seed was determined by drying a representative 2 g sample in an oven with

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air circulation at 100-105°C. Nitrogen content was estimated by the Kjedhal method while crude protein was calculated by multiplying the evaluated nitrogen by 6.25 (Ajayi 2009). Oil was exhaustively extracted from the seeds using petroleum ether (40-60°C) in a Soxhlet apparatus. Ash was determined by the procedure given by Otitologbon *et al.* (1997). Carbohydrate contents were determined by difference [100 - (protein + ash + crude fat + moisture content)] following the method of Guner *et al.* (1998).

Physicochemical characteristics

Procedures for the determination of the iodine value (Wijs' method) were those recommended by the AOAC (1984). The methods of analysis for free fatty acid, saponification, peroxide and acid values are as outlined by Ajayi *et al.* (2004). Colour and state of the oils at room temperature were noted by visual inspection. The refractive indices of the oils were determined using an Abbe refractometer while the specific gravity which was done at room temperature was estimated by the use of a specific gravity bottle following the method of Pearson (1976).

Mineral element composition

The metal composition of the seeds was determined following the method used by Idouraine *et al.* (1996). 1 g of each seed was dried-ashed in a muffle furnace at 550°C for 5 h until a white ash was obtained. The minerals were extracted from ash by adding 3 ml of concentrated HNO_3 (63%). The digest was carefully filtered into 100ml standard bottle and made up to mark with distilled water. Minerals were estimated with the use of an atomic absorption spectrophotometer (Perkin Elmer model 703, USA). The instrument was calibrated with standard solutions containing known amounts of the minerals being determined, using analytical reagents; results are expressed in parts per million of dry matter (DM).

Statistical analysis

All the experiments were conducted in triplicate and the means and standard deviation of three values are reported.

Table 1 Physical characterization[a] of *Monodora tenuifolia* oil.

Parameter	Mean ± SD
Colour of seed	Brown
Seed weight (g/100 seeds)	46.87
Seed length (cm)	1.47 ± 0.14
Seed width (cm)	0.73 ± 0.07

[a] Length and weight are expressed as mean ± standard deviation for 100 seeds

Table 2 Results of proximate analysis of *Monodora tenuifolia* seeds[a] (g/100 g dry matter).

Parameters	Mean ± SD
Oil yield	32.09 ± 1.58
Crude protein	8.40 ± 0.25
Moisture content[b]	16.20 ± 1.85
Ash content	2.85 ± 0.40
Crude fibre	33.91 ± 1.42
Carbohydrate[c]	6.55 ± 1.58

[a] Values are expressed as mean ± SD for triplicate results
[b] Results other than moisture are on a dry weight basis
[c] Calculated by difference

Table 3 Results of Physical analysis of *Monodora tenuifolia* oil.

Parameters	Means ± SD
Specific gravity (25°C)[a]	0.8806 ± 0.0253
Refractive index (25°C)	1.465
State at room temperature	Liquid
Colour	Brown

[a] Values are expressed as mean ± SD for triplicate results

Table 4 Results of chemical analysis of *Monodora tenuifolia* oil.[a]

Parameters	Mean ± SD
Acid value (mgKOH/g oil)	58.91 ± 2.81
Peroxide value (mEq/kg oil)	2.06 ± 0.11
Free fatty acid[b]	24.45 ± 1.40
Iodine value (mg/100 g oil)	87.47 ± 0.04
Saponification value (mgKOH/g oil)	184.29 ± 1.01
Ester value (mgKOH/g oil)	125.39 ± 3.69

[a] Values are expressed as mean ± SD for triplicate results
[b] % as oleic acid

RESULTS AND DISCUSSION

Physical measurement

The physical properties of *M. tenuifolia* seeds regarding weight, length and width are listed in **Table 1**. The seeds which were brownish in colour have their weight to range from 11.44-11.96 g/100 seeds while the length ranged from 11.44 ± 0.14 cm to 1.52 ± 0.14 cm. The seed width which ranged from 0.74 ± 0.07 to 0.74 ± 0.08 cm is significantly lower than the value of 8.0-9.4 cm reported for *T. occidentalis* by Ajayi *et al.* (2004). Values from 22 to 38 g/100 kernels have been reported by Filsoof *et al.* (1976). Tlili *et al.* (2011) also reported 3.45 ± 0.30 mm, 2.86 ± 0.27 mm and 10.14 ± 2.46 g for seeds of *C. spinosa*.

Proximate analysis

Table 2 summarizes the proximate composition of *M. tenufolia.* The seeds are rich in oil. The oil yield 32.09 ± 1.58 g/100 g DM is higher than 18.30 – 21.53 g/100 g DM reported for various soybean cultivars but lower than that of groundnut oil 40.80 g/100 g DM (Onyeike and Acheru 2002). Dagne and Jonnson (1997) reports 41.6 g/100 g DM and 30.7 g/100 g DM for *Guizotta abyssinica* and *Guizotta villosa*, respectively. The moisture content 16.20 ± 0.50 g/100 g DM of *M. tenuifolia* is high. Ash represents the inorganic part of a sample (Garcia *et al.* 1998). The ash content of the seeds of *M. tenuifolia* is 8.40 ± 0.25 g/100 g DM. It is lower than the range of 19.07 ± 0.61 to 34.00 ± 0.11 g/100 g DM reported for some edible seaweeds (Sánchez-Machelo *et al.* 2004). It is however higher than 1.60 g/100 g DM and 1.08 g/100 g DM reported for raw kernel and processed flour of Nigerian mango (*Mangifera indica*) by Arogba (1977). The seeds have low protein content of 8.40 g/100 g DM; this is however higher than the range of 264.40 ± 9.91 g/kg and 299.70 ± 11.50 g/kg reported for peanut cultivars from Bolivia (Grosso *et al.* 1977). The level of carbohydrate which was obtained by the difference method, that is, by subtracting the sum of the protein, ash, fat and crude fibre from the total dry matter was 6.55 ± 1.58 g/100 g DM. This value was much lower than the range of 20.382 ± 0.014% and 70.123 ± 0.020% (Hussain *et al.* 2011). The crude fibre content 33.91 ± 1.42 g/100 g DM of the seeds suggests that the seed residue if found not to have antinutritional factors could serve as roughage for animal feed.

Physical properties

The physical properties of *M. tenuifolia* seed oil is presented in **Table 3**. The crude fat which was brownish in colour was smooth and free from granules. It remained consistently liquid at room temperature. Oils from seeds of different plants were also found to be liquid at room temperature (Ajayi 2010). The specific gravity of the oil extract 0.8806 ± 0.053 is comparable to 0.87 and 0.89 reported for palm kernel and coconut seeds, respectively. Refractive index was 1.465. Joseph (1995) reports 1.40 ± 0.01 – 1.45 ± 0.01 as the range for wild mango seeds.

Chemical properties

Some chemical properties of the oil extract of *M. tenuifolia* seeds analyzed are shown in **Table 4**. The total acidity expressed as acid value 58.91 ± 2.81 mg KOH/g is very high. It is higher than the value reported for known edible oils such as soybean and sunflower seed oils (Pearson 1976). It

Table 5 Metal composition of *Monodora tenuifolia* seeds (mg/l of dry matter).[a]

Metal	Mean ± SD
Manganese	0.44 ± 0.05
Calcium	1.60 ± 0.03
Sodium	3.15 ± 1.73
Magnesium	18.40 ± 5.73
Iron	2.26 ± 0.05
Copper	1.20 ± 0.41
Zinc	0.29 ± 0.03
Potassium	42.05 ± 0.50

[a] Values are expressed as mean ± SD for triplicate

will be necessary to subject the oil to alkali refining before it might be suitable for edible purposes. According to Ekpa and Ekpe (1995), unlike free fatty acid content, the free fatty acid concentration, which is a measure of free fatty acid present in a fat or oil, acid value is a measure of total acidity of the lipid, involving contributions from all the constituent fatty acids that make up the glyceride molecule. The free fatty acid concentration of the oil 24.45 1.40, like the acid value, is high; it is higher than the value of 2.54 reported for *A. julibrissin* (Nehdi 2011). The peroxide value of the oil extract which is 2.06 ± 0.11 mg/g oil indicates the freshness of the oil. Fresh oils have been shown to have peroxide values lower than 10 mg/g oil (Pearson 1976). Oil of *M. tenuifolia* could be stored for a long time without deterioration. The oil has high saponification value of 184.29 ± 1.01 mg KOH/g oil that is higher than the recommended value of 100 mg/g by the British Pharmacopocia (Alabi and Alausa 2006). The oil could find usefulness in soap production. The iodine value of the oil 87.47 ± 0.04 mg/100 g oil placed the oil in non-drying group. The oil could be utilized for cooking (after refining) and may find application as raw material for the manufacture of vegetable oil-based ice-cream.

Mineral elements

Potassium was the most prevalent mineral element present in the seeds followed by magnesium and then sodium with values of 42.05 ± 0.50, 18.40 ± 5.73 and 3.15 ± 1.73 mg/l DM, respectively (**Table 5**). This is nutritionally significant considering the fact that potassium plays a principal role in neuro-muscular function (Ajayi *et al.* 2006). The finding is in close agreement with the report given by Chavan *et al.* (1999) that potassium was the most abundant mineral element present in beach pea (*Lathyrus maritimus* L.). Similarly, the findings of Ajayi *et al.* (2006) revealed potassium as the most abundant mineral element present in *Brachystegia eurycoma*, *Tamarindus indica* and *Mucuna flagellipes* which are some underutilized legumes from Nigeria. Vegetables are known to supply the vitamins, iron, calcium, zinc and other minerals that are important for human health and according to Schultink *et al.* (1987), they are affordable source of these minerals and vitamins for African families. The seeds also contain trace elements such as iron (2.26 ± 0.05 mg/l DM), copper (1.20 ± 0.41 mg/l DM), zinc (0.29 ± 0.03 mg/l DM) and manganese (0.44 ± 0.05 mg/l DM). According to Schwart (1975), the role of trace elements in human nutrition and disease cannot be over-emphasized. Even though the mineral elements form a small proportion of the total composition of most plant materials and total body weight and do not contribute to the energy value of food, they are of great physiological importance particularly in body metabolism.

CONCLUSION

Monodora tenuifolia seeds are good sources of oil and dietary fibre. The oil can be stored for a long time without deterioration because of its low peroxide value. The saponification value affords the possibility of using the oil in the manufacture of soaps and lather shaving cream while the iodine value of the oil makes the oil seemed suitable for cooking. However, the oil has to be refined before it could serve edible purposes because of its high acid value.

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