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Oil content and fatty acid composition of some underutilized legumes from Nigeria

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Abstract

Three underutilized legumes from Nigeria, *Brachystegia eurycoma*, *Tamarindus indica* and *Mucuna flagellipes*, have been subjected to standard analytical techniques in order to evaluate proximate composition, physicochemical properties and contents of nutritional valuable elements and fatty acids of the seeds and oils. The proximate analysis indicated that the oil content was 5.87 ± 0.30, 7.20 ± 0.45 and 3.77 ± 0.21 g/100 g for *B. eurycoma*, *T. indica* and *M. flagellipes*, respectively. The seeds are rich in protein and carbohydrate, the protein content ranging from 11.82 ± 0.25 g/100 g–24.94 ± 0.18 g/100 g dry matter. These compare favourably with high protein animal sources like oyster, beef, pork and marine fishes. The iodine value of two of the oils place them in the non-drying group of oils, while the composition of all the oils compare well with those of rape seed, sesame, sunflower and groundnut seed oils. This suggests their use as edible oils.

Analyses of the oils for fatty acids indicate that the oils contain linoleic acid which is one of the three essential fatty acids. The dominant fatty acids however are linoleic, palmitic, oleic and stearic acids with oleic acid having the highest percentage 24.13–31.50%. Eight nutritional valuable minerals were determined in the seed flours. The seeds are rich in potassium 52.1 mg/100 g–131 mg/100 g. They also contain significant concentration of iron 4.55 mg/100 g–8.20 mg/100 g.

Keywords: Oil content; Fatty acid; Mineral elements; Legumes

1. Introduction

The problems of industrial waste are becoming harder to solve, and much effort will be needed to develop the nutritional and industrial potential of by-products, waste and under-utilized agricultural products. Only a small portion of plant material is utilized directly for human consumption. To be economically viable, both oil and meal from fruit seeds must be utilized (Kamel & Kakuda, 1992). The remainder of plant material may be converted into nutrients for either food or feed, or into fertilizer, thus an important contribution to food resources or industrial products could be made (Kamel, Deman, & Blackman, 1982).

Brachystegia eurycoma and *Tamarindus indica* belong to the same family of Caesalpiniodeae while *Mucuna flagellipes* belong to the Papilionoideae family. They are all legumes from the Leguninosae family. *B. eurycoma* is a fine tree that occurs in the forest from south of Nigeria to Cameroon. It can be recognized by its large size, irregular bole, huge twisted spreading branches and by the rough fibrous bark which peels off in untidy patches and often exudes a brownish buttery gum (Keay, 1989). It is used by the Igbos in Nigeria as an antihelmintic (Iwu, 1986). The bark yields a yellowish or reddish greasy gum which hardens to a guatta – like mass

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(Aubreville, 1970). The root has been examined for a possible lethal action on the fresh water snail, *Bulius glotutus*, one of the vectors in schitosomas and found to be without effect (Adewunmi & Sofowora, 1980).

Tamarindus inidica, commonly known as Tsamiya in Nigeria, is a large leguminous tree that grows wild in the tropics, it thrives well in the North of Nigeria where the fruit is popular. *T. indica* is a rich source of sugars and an excellent source of vitamin B (Burkill, 1995). The pulp is used widely for food and beverages and the seeds are sometimes used as soup thickener.

Mucuna flagellipes, a Papilionoideae, is a glabrous lofty climber with creamy, white or yellowish flowers which turn black on drying. The leaves of *M. flagellipes* are used to blacken cloth and pottery (Burkill, 1995). Phyto-chemical examination of the plant has shown the presence of an emulsifying and suspending agent of pharmaceutical application in preparing suspensions of sulphadimine and zinc oxide (Iwu, 1984).

Information on the chemical composition of *B. eurycoma* seeds and oil content is very scanty while previous workers (Ishola & Agbaji, 1990) in the Northern part of the country have given incomplete data on the chemical composition of the seed and oil content of *T. indica*. There is no reported data on the oil content and fatty acid composition of *M. flagellipes*. This paper therefore reports on the oil content and fatty acid composition of the seeds of *B. eurycoma*, *T. indica* and *M. flagellipes* obtained from the Southern part of Nigeria in order to assess what they can render in terms of industrial development.

2. Materials and methods

2.1. Materials

Seeds of *Brachystegia eurycoma* (BE), *Tamarindus indica* (TI) and *Mucuna flagellipes* (MF) were purchased from Ojoo and Sabo markets in Ibadan, Oyo State. They were then taken to the Herbarium Unit (HIU), Botany Department of University of Ibadan where they were identified.

2.2. Physical characterization

The physical characterization of *B. eurycoma*, *T. indica* and *M. flagellipes* seeds were carried out following the method of Femenia, Rosells, Mullet, and Canellas (1995). The weight of 50 seeds was taken after which the length and width of each seed was noted.

2.3. Sample preparation

The seeds were shelled by cracking with a small iron rod and manually peeled to remove the kernels. The kernels were then ground in a Hammer mill and the final products were wrapped in polyethylene bag and stored in an air-tight sample bottle in a refrigerator (4 °C).

2.4. Proximate analysis

The recommended methods of the Association of Official Analytical Chemists (AOAC, 1990) were adopted to determine the levels of moisture, ash, crude protein and crude fat. Moisture content was determined by heating 2.0 g of each sample to a constant weight in a crucible placed in an oven maintained at 105 °C for 3.5 h. Ash was determined by the incineration of 1.0 g of each sample placed in muffle furnace maintained at 550 °C for 5 h. Crude protein (% total nitrogen $\times$ 6.25) was determined by the Kjeldahl method using 1.0 g samples. Crude fat was obtained by exhaustively extracting 100.0 g of each sample in a Soxhlet apparatus using petroleum ether (boiling point range 40–60 °C) as the extractant (Oderinde & Ajayi, 1998). Total carbohydrate was obtained by difference [100 − (protein + crude fat + ash + crude fibre moisture)] (Ajayi & Oderinde, 2002; AI-Khalifa, 1996).

2.5. Physicochemical analysis

Seed oils were extracted using the continuous Soxhlet extraction technique with petroleum ether (40–60 °C) for 8 h. The oils were then subjected to physical and chemical characterization. Colour and state of the oils at room temperature were noted by visual inspection. The refractive index of the oils was determined using the Abbe refractometer as outlined by Pearson (1976), while the specific gravity which was measured at room temperature was estimated by the use of a specific gravity bottle. The saponification, acid and peroxide values were determined by the method described by the Association of Official Analytical Chemists (1984) while the iodine value was determined by using Wijs' solution (iodine monochloride in glacial acetic acid solution) as outlined by Oderinde and Ajayi (2000).

2.6. Mineral content

Samples were digested by using conc. nitric acid and perchoric acid (1:1, v/v). Sodium, potassium, calcium, magnesium, copper, iron, zinc and manganese were determined by atomic absorption spectrophotometry (Perkin–Elmer) as described by Ajayi, Dawodu, Adebowale, and Oderinde (2002).

2.7. Fatty acid analysis

Fatty acid analysis of the oils was done by the use of gas–liquid chromatography at the Institute of Tuebin-