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## Chemical Evaluation of the Nutritive Value of *Pentaclethra macrophylla benth* (African Oil Bean) Seeds

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**Abstract:** *Pentaclethra macrophylla benth* (African oil bean) seeds were analyzed for their nutritive values. The result showed that *Pentaclethra macrophylla* seeds have moisture content 11.87%, ash content 2.95%, crude fat content 46.95%, crude protein content 20.95%, crude fibre content 2.50%, carbohydrate content 14.79%, available energy 2344.56 kJ. The mineral content of the analyzed samples showed that *Pentaclethra macrophylla* seeds were rich in iron of value 140.97 mg/100 g. The analysis indicates that potassium is the most abundant mineral. The high Ca/P ratio indicates that *Pentaclethra macrophylla* is a very good food source.

**Key words:** *Pentaclethra macrophylla*, nutritive values, mineral compositions

### INTRODUCTION

*Pentaclethra macrophylla benth* (African oil bean) is a tropical tree crop found mostly in the Southern rain forest zone of West Africa. It belongs to the leguminosae family and sub-family mimosoideae (Keay, 1989). African oil bean tree grows to about 21 m in height and to about 6 m in girth. The leaves have stout angular petiole. The compound leaves are usually about 20 cm large and covered with rusty hairs. The flowers are creamy, yellowish or pinkish-white and sweet smelling. The main flowering season is between March-April with smaller flushes in June and November. African oil bean fruits are available at most periods of the year because of the large woody pods, which are persistent. The pods are 40-50 cm long and 5-10 cm wide. The pods contain between 6-10 flat glossy brown seeds. The flat glossy brown seeds contained in brown flattened pod explodes at maturity and the seeds are dispersed (Enujiugha, 2003). The mature dispersed seeds are harvested by gathering them manually around the tree. The seed is an edible product and a source of oil, hence the name, "the oil bean tree".

The Igbos of Eastern Nigeria call it Ukpaka, while the Cameroonians call it Duala-Kombola. The plant is cultivated by farmers in Southern and Middle belt regions of Nigeria for its soil improvement properties and as a component of an agro-forestry system (Okafor and Fernandez, 1987). The seeds of African oil bean are edible when boil and fermented especially among the Eastern part of Nigeria. The seeds are eaten alone or with other ingredients like stockfish, garden egg, sliced tapioca or they can be mixed with vegetable popularly known as "Africa Salad" among the Eastern part of Nigeria. The seed is a source of edible oil used for candle making and soaps. The seed shells are

decorative and often used as craft beads which are worn as necklaces and sometimes as local dancing apparels. It has been reported that the seeds, when crushed and eaten with red ants could induce abortion (Isawunmi, 1993; Abbiw, 1990). The aim of present study is to investigate the proximate and mineral composition of seeds of *Pentaclethra macrophylla* and its usefulness in human nutrition and health.

### MATERIALS AND METHODS

**Sample collection and preparation:** Fresh seed samples of *Pentaclethra macrophylla* were obtained from Ekeonunwa market in Owerri, Imo state, Nigeria. The samples were thoroughly washed and the shell removed with sharp knife. The embryo were sliced into smaller pieces and dried in an oven at 105°C. The dried samples were ground into powder and sieved through 250 µm mesh and stored in a plastic container until use.

**Proximate analysis:** The moisture, ash and crude fibre contents of samples of *Pentaclethra macrophylla* were determined using Standard Chemical Methods as described by Association of Official Analytical Chemists (AOAC, 1990) by drying 2 g of the sample at 105°C for 24 h for moisture content determination. The ash content was determined by incineration of 2g of the sample in a muffle furnace at 575±25°C for 2 h. Soxhlet extraction technique using petroleum ether (40-50°C) was used to evaluate the fat content of the sample (Pearson *et al.*, 1981). Kjeldahl method was used to determine the crude protein content of the sample as described by (AOAC, 1990). The carbohydrate content of the sample was estimated by difference (% carbohydrate = 100% - sum of percentage of moisture, ash, fat, crude fibre and crude protein contents).

**Mineral analysis:** Mineral composition of the samples were determined according to methods recommended by Association of Official Analytical Chemists (AOAC, 1990). 1 g each of the sample of *Pentaclethra macrophylla* was digested using 12 cm<sup>3</sup> of mixture of HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> and HClO<sub>4</sub> (9:2:1 v/v) (Sahrawat *et al.*, 2002). Copper, iron, zinc, sodium, potassium, calcium and magnesium were analyzed by Atomic Absorption Spectrophotometer (Pye-Unicam 969, Cambridge, UK). Phosphorus content of the sample was determined using Flame Photometer.

## RESULTS AND DISCUSSION

The results of the proximate composition of flour samples of *Pentaclethra macrophylla* were shown in Table 1. The result indicates that *Pentaclethra macrophylla* has moisture content 11.87%. The value was higher than those reported for gourd seeds by (Olaofe *et al.*, 1994) and (Ogungbenle, 2006) of moisture content 4.8% and 3.46% respectively. It has been reported (Olaofe *et al.*, 2006) that *Bombcopsis glabra* seed has moisture content 3.46%. The high moisture content of seed of *Pentaclethra macrophylla* indicates that the sample could not be stored favourably for a long period of time because of deterioration. The result of the analysis shows that flour sample of African oil bean seed has ash content 2.95%. Reports (Hassan *et al.*, 2008) have shown that ash content of *Monodora myristica* seed was 6.50%. Fluted pumpkin seeds have been reported (Fagbemi and Oshodi, 1991) to have ash content 4.80%. Ash is a measure of total mineral content in the samples. This suggest that *Pentaclethra macrophylla* seeds could provide essential, valuable and useful minerals needed for body development.

Table 1: Proximate composition of *Pentaclethra macrophylla* berth (% dry weight)<sup>a</sup>

Parameters	<i>Pentaclethra macrophylla</i> (African oil bean)
Moisture content	11.87±0.01
Ash content	2.95±0.02
Crude fat content	46.95±0.01
Crude protein content	20.94±0.02
Crude fibre content	2.50±0.03
Available carbohydrate	14.79±0.02
Available energy (KJ) <sup>b</sup>	2344.56±0.06

<sup>a</sup>Values are mean±standard deviation of triplicate determinations.

<sup>b</sup>Calculated metabolisable energy (KJ/100 g sample): (Protein x 17 + Fat x 37 + Carbohydrate x 17)

This study shows that *Pentaclethra macrophylla* has high fat content 46.95% when compared to fat content 34.8% reported for *Bombcopsis glabra* seed (Olaofe *et al.*, 2006) and fat content 23.5% for soyabean seed (Paul and Southgate, 1985). The result indicates that African oil bean seed is a better source of oil than soyabean seed hence it could be grouped under oil rich plant foods. Its seed could also be used as a source of

vegetable oil for domestic and industrial purposes. That fat supplies most of the energy required by man (Osborne and Voogt, 1978) suggests that *Pentaclethra macrophylla* is a better source of calories. Fat serve as energy store in the body. It can be broken down in the body to release glycerol and free fatty acids. The glycerol can be converted to glucose by the liver and used as a source of energy. It has been reported that 1g of fat provide 37 kcal of energy (Gaman and Sherrington, 1990). The crude protein content of African oil bean seed was 20.94% lower than the value 43.1% obtained for seed of *Luffa cylindrica* (Olaofe *et al.*, 2008). The result is comparable to crude protein content 23.7% for gourd seed reported by (Olaofe *et al.*, 1994). Therefore *Pentaclethra macrophylla* seed could be used as an alternative source of protein in diet/protein supplement especially in under developed countries such as Nigeria where majority of the populace live on starchy food and cereals.

The crude fibre content of flour of African oil bean seed was 2.50% similar to the value of 2.50% obtained for *Luffa cylindrica* (Olaofe *et al.*, 2008) and comparable to values of 2.80% and 2.40% for gourd seeds and cowpea seeds as reported by (Ogungbenle, 2006) and (Aremu *et al.*, 2006) respectively. Fibre has useful role in providing roughage that aids digestion. (Eva, 1983). Dietary fibre reduces the risks of cardiovascular diseases. Report have shown that increase in fibre consumption might have contributed to the reduction in the incidence of certain diseases such as diabetes, coronary heart disease, colon cancer and various digestive disorder (Augustin *et al.*, 1978). Fibre consumption also soften stools and lowers plasma cholesterol level in the body (Norman and Joseph, 1995). The carbohydrate content 14.79% analyzed for African oil bean seed was high when compared to values 9.89% and 6.93% for gourd seeds and pumpkin seeds as reported by (Ogungbenle, 2006) and (Olaofe *et al.*, 1994) respectively. However, the result of the analysis was lower than the value of 33.0% for *Bombcopsis glabra* (Olaofe *et al.*, 2006). Carbohydrate supplies energy to cells such as brain, muscles and blood. It contribute to fat metabolism and spare proteins as an energy source and act as mild natural laxative for human beings and generally add to the bulk of the diet (Gordon, 2000; Gaman and Sherrington, 1996). The calculated metabolizable energy 2344.56 KJ/100 g was high when compared to values 1595.34 KJ/100 g and 1300 KJ/100 g for legumes and cereals as reported by (Aremu *et al.*, 2006) and (Paul and Southgate, 1985) respectively. The high energy value of *Pentaclethra macrophylla* seed may be attributed to high fat content. Table 2 presents the mineral composition of *Pentaclethra macrophylla*. Minerals are important component of diet because of their physiological and metabolic function in the body. The result presented in Table 2 shows that *Pentaclethra macrophylla* has

Table 2: Mineral composition of *Pentaclethra macrophylla* benth samples (mg/100 g)<sup>a</sup>

Minerals	<i>Pentaclethra macrophylla</i> (Africa oil bean)
Sodium	906.60±0.02
Potassium	1178.93±0.03
Calcium	329.59±0.02
Magnesium	292.90±0.04
Iron	140.97±0.03
Copper	706.73±0.02
Zinc	1134.36±0.02
Phosphorus	4.39±0.03
Na/K	0.77
Ca/P	75.08
Ca/Mg	1.13

<sup>a</sup>Values are mean±standard deviation of triplicate determination

sodium content 906.60 mg/100 g. Sodium is an important mineral that assist in the regulation of body fluid and in the maintenance of electric potential in the body tissue. The World Health Organization's (WHO) recommended intake of sodium per day is 500 mg for adult and 400 mg for children (WHO, 1973). The result indicates that sodium content of *Pentaclethra macrophylla* sample was above WHO recommended standard, therefore *Pentaclethra macrophylla* is a good source of sodium. This study shows that potassium content of *Pentaclethra macrophylla* was 1178.93 mg/100 g. This study shows that potassium is the most abundant mineral. This observation is in agreement with the report of (Olaofe and Sanni, 1988). (Olaofe *et al.*, 1994), (Aletor and Aladetimi, 1989), (Olaofe *et al.*, 1993) and (Badifu and Ogunsina, 1991) who have reported that potassium is the most abundant in agricultural products. Potassium is important in the regulation of heart beat, neurotransmission and water balance of the body. The WHO recommended intake of potassium per day is 2000 mg for adult and 1600 mg for children. This study revealed that potassium content of *Pentaclethra macrophylla* sample was below WHO standard. Calcium is an important mineral required for bone formation and neurological function of the body. *Pentaclethra macrophylla* sample has calcium content 329.59 mg/100 g. The recommended daily intake of calcium by WHO is 800 mg for both adult and children. This study shows that calcium content of African oil bean was below WHO standard. Magnesium plays essential role in calcium metabolism in bones and also involve in prevention of circulatory diseases. It helps in regulating blood pressure and insulin releases. This study indicates that *Pentaclethra macrophylla* sample has magnesium content 292.0 mg/100 g. The Recommended Dietary Allowance (RDA) for magnesium in adult is 350 mg/100 g, while children is 170 mg/100 g. The result shows that magnesium content of the sample was below WHO standard for adult and above WHO standard for children. Therefore *Pentaclethra macrophylla* could serve as a rich source of magnesium for children.

The result presented in Table 2 revealed that iron content of *Pentaclethra macrophylla* was 140.97 mg/100 g. The RDA for iron in adult and children is 10 g/day, while adult female is 15 mg/day. This study indicates that African oil bean is rich in iron and far above the recommended standard. Iron is required for blood formation and it is important for normal functioning of the central nervous system (Adeyeye and Fagbohon, 2005). It also facilitates the oxidation of carbohydrate, protein and fats. This study revealed that copper content of *Pentaclethra macrophylla* was 706.73 mg/100 g. It has been reported (Hassan *et al.*, 2008) that *Monodora myristica* whole seeds and dehulled seed have copper content 1.21mg/100g and 1.88mg/100g, respectively. The RDA for copper in adult is 3mg/day, while children is 2 mg/day. The result indicates that copper content of the sample was higher than the recommended standard. Therefore *Pentaclethra macrophylla* could serve as a very rich source of copper for adult and children. Copper is required in the body for enzyme production and biological electron transport.

The result of the analysis shows that zinc is second most abundant mineral of value 1134.36 mg/100 g. Report (Hassan *et al.*, 2008) have shown that *monodora myristica* whole seeds and dehulled seeds have zinc content 21.41 mg/100 g and 11.35 mg/100 g respectively. The WHO recommended standard for zinc in adult and children are 15 mg/day and 10 mg/day respectively. The result indicates that *Pentaclethra macrophylla* could serve as a very rich source of zinc for both adult and children. Zinc is an essential micronutrient associated with number of enzymes, especially those associated with synthesis of ribonucleic acid (Guil-Guerrero *et al.*, 1998). Zinc deficiency limits the rate of recovery for protein energy in malnourished children (Hambridge, 1986). The phosphorus content of Africa oil bean was 4.39 mg/100 g. Reports (Olaofe *et al.*, 2008) have shown that *Luffa cylindrica* seeds have phosphorus content 700 mg/100 g higher than that obtained from *Pentaclethra macrophylla*. The RDA for phosphorus in adult and children is 800 mg/day. The value of phosphorus obtained from the analysis of the sample was far below recommended standard.

The Na/K ratio in the body help in controlling high blood pressure. A food source having Na/K ratio of less than value of 1 has impact in lowering blood pressure. The Na/K value of 0.77 obtained from *Pentaclethra macrophylla* indicates that *Pentaclethra macrophylla* will not promote high blood pressure because of low Na/K value. The Ca/P ratio in *Pentaclethra macrophylla* sample was 75.08. If the Ca/P ratio is low (low calcium, high phosphorus intake), more than the normal amount of the calcium may be lost in the urine. Food is considered "good" if Ca/P ratio is above 1 and "Poor" if the ratio is less than 0.5, while Ca/P ratio above 2 help

to increase the absorption of calcium in the small intestine. This study revealed that *Pentaclethra macrophylla* is a very good food source because of its high Ca/P value. The Ca/Mg ratio for *Pentaclethra macrophylla* was 1.13 within the recommended value of 1.00 (NRC, 1989).

**Conclusion:** The result of the analysis shows that *Pentaclethra macrophylla* is rich in protein and it could be used as alternative source of protein in diet/protein supplement especially in under developed countries such as Nigeria. This study also revealed that African oil bean seeds have high available energy and high fat content. This study revealed that *Pentaclethra macrophylla* sample is rich in iron when compared to RDA standard. Iron is required for blood formation in the body and the normal functioning of central nervous system. The presence of calcium, magnesium and phosphorus would make *Pentaclethra macrophylla* suitable for bone formation for children since the deficiencies of these minerals could lead to abnormal bone development. The high Ca/P value indicates that *Pentaclethra macrophylla* is a very good food source.

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