http://dx.doi.org/10.22161/ijeab/4.1.2 ISSN: 2456-1878

Chemical Composition and Functional properties of *Caesalpina bonduc* and *Monodara myristica* seed flours

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Abstract— *The chemical composition, nature minerals, anti-nutrients, functional and physicochemical properties of Caesalpina bonduc and Monodara myristica seed flours were determined. The results for proximate compositions in the samples were for Caesalpinia bonduc flour were moisture (7.89%), Ash (2.96%), Crude protein (18.26%), Crude fibre (12.54%), fat content (23.59%) and Carbohydrate (34.76%) while for Monodora myristica flour were: moisture (5.05%), Ash content (2.81%), crude fibre (4.69%), crude protein (24.62%), fat content (7.01%) and carbohydrate (55.82%). The mineral contents in (mg/l) for Caesalpinia bonduc and Monodara myristica seed flours were: K(36.68), (101.87), Ca(40.98), (59.43), Na (475.65), (463.57), Mg (13.20), (14.80), Zn (61.80), (66.20), P (18.5), (23.86), Ni (14.70), (13.40), Fe (12.80), (28.3), Cu (0.06) and (0.08) respectively. These results showed that the seeds samples contained some valuable minerals that are useful in bone formation as well as physiological and metabolic activities. The results of the functional properties for Caesalpina bonduc and Monodora myrictca seeds flours were: gelation capacities (51.40%), (53.80%), water absorption capacities (113.00), (121.50), emulsion capacities(56.25%), (56.00%), swelling capacities(7.10), (6.80) and oil Absorption capacities (137.50%), (115.50) and foaming capacities were (5.05) and (5.00) respectively. The anti-nutritents contents for Caesapina bonduc and Monodora myristica reported in this study were: Phytate (0.406%), (0.37%) Saponin (0.184%), (0.172%), Oxalates (0.068%), (0.056%), Tannins (0.083%) and (0.074%) respectively.This result suggested that the seed flours have low anti-nutritional content and may be useful in food formulations like doughes and baked products. It also confirmed that the seed samples may be good substitutes for wheat flour and Soy flour as extender in binder formulation.*

Keywords— ***chemical composition, functional properties, Caesalpina bonduc, Monodara myristica and seed flours.***

I. INTRODUCTION

Plants are primary sources of medicines, fibre, food, shelter and other items of everyday use by humans. The root, stems, leaves, flowers, fruits and seeds provide food for animals and human (Hemingway, 2004). Plants serve as indispensable constituents of diet supplying the body with mineral salts, vitamins and certain hormone precursors in addition to protein and energy (Oyenuga and Fetuga, 1975). Seeds possess nutritive and calorific values which make them necessary in diets (Odoemelarin, 2003). Among these plants are: *Monodora myristica* and *Caesalpinia bonduc* popularly known as African nutmeg and fever nut respectively.

Morphologically, African family is a berry that grows mild in the evergreen forest of West Africa (Burn *et al*, 2009). The seeds are economically and medicinally important (Okafor, 1987; Okigbo, 1977)

The kernel obtained from the seed is a popular condiment used as a spicing agent in both African and continential food in Nigeria

They are romantic and mostly used as condiment in food as flavouring agent. When in powdered form, may be taken as stimulant or stomadic to relieve constipation.

Caesalpinia bonduc is widely grown in India, in the plain waste lands and coastal areas. It is popularly referred to as "Ayo" in the southwest parts of Nigeria. The plant has a very large straggling thorny shrub, branches armed with hooks and straight hard yellow prickles. Fruits inflated pods cover with wiry prickles with seed grew with a smooth shinny surface. The seed is bitter but has no toxic effect on human body with consumption. The root of the plant is used in curing fevers, cough, and asthma while the leaves are

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useful in curing elephantiasis, intestinal worms and fever. However, there is limited information of the nutritional evaluation of these seeds. Thus, the main objective of this study is to investigate the nutritional evaluations for domestic and industrial applications.

II. MATERIALS AND METHODS

The samples used for the work were purchased in neighborhood market, Akure, Ondo State, Nigeria. The seeds were separated from the shells, dried and ground into flour, then packaged and stored in freezer at -4º prior to analysis. The oils from the samples flours were extracted by soxlet apparatus using n-hexane (40-60ºC).

Proximate analysis

The moisture and Ash contents were determined using an oven and dry ashing method. (AOAC, 2005).

Crude protein and fat were determined according to the method described by (AOAC, 2005).

Nitrogen was converted to crude protein by multiplying by a factor of 6.25. The crude fiber was determined by adding 2g (w_1) of the sample into 500ml conical flask; 200ml of boiling 1.25% H_2SO_4 was added and boiled for 30 minutes. The mixture was filtered through muslin cloth and rinsed with hot distilled water. The sample was scrapped back into the flask and 200ml of boiling 1.25% NaOH was added and allowed to boil again for another 30 minutes.

Filtered and then rinsed with 10% HCl twice with industrial methylated spirit and allowed to drain and dry. The residue was scrapped into a crucible, dried in the oven at 105ºC, allowed to cool in a desiccators and weighed (W_2); then placed in a muffle furnace at 300ºC for 30 minutes and finally allowed to cool at room temperature and weighed (w_3) (AOAC, 2005).

$$\% \text{ crude fiber} = \frac{w_2 - w_3 \times 100}{W_1}$$

The carbohydrate content was calculated by difference.

% carbohydrate = (100 – (% moisture + %ash + % crude fiber + % crude fat + % crude protein).

Minerals Analysis

The minerals were analysed by dry ashing the samples at 550ºC to constant weight and dissolving the ash in 100ml standard flask using dionized water with 3ml of 3MHCl. Sodium and potassium were determined using Flame photometer (model 405, Corning, UK). All other minerals were determined by Atomic Absorption Spectrophotometer (Perkin and Elmer model 403, USA), (AOAC, 2005; Pearson, 1976).

Protein functional properties determination

Water absorption capacities and oil absorption capacities of *Caesalpinia bonduc* and *Monodora myristica* seed flour were determined by using the combination of the procedure of Shathe *et al* (1982) and Sisulki (1962)

The bulk densities of seed flours were determined using the standard analytical recommended by Narayana and Marasinga Rao (1984) with little modification. The least gelation and foaming capacities of seed flour were determined by modifying the method of (Offman and Garcia, 1977). The emulsion capacities for *Caesalpinia bonduc* and *Monodora myristical* seed flours were also determined using the procedure of AOAC (1990).

Anti nutrients determination

The anti nutritional contents of the seed sample flours were determined using the standard analytical method recommended by AOAC (2005). These include; phytate, oxalate, tannin, saponins contents of the flour samples.

III. RESULTS AND DISCUSSION

Table 1 showed the proximate compositions of *Caesalpinia bonduc* and *Monodora myristica* seeds flours. The protein content (18.26%) and 24.62%) for *C. bonduc* and *M.myristica* were a significantly lower than (44.5%0 reported for *Afzehia africana* (Ogungbele, 2014), but were in close range with water melon (24.30%) limon bean flour (22.7%). and pigeon pea (22.4%) reported by Oshodi *et al*, (1989). However these values were significantly higher than those of cereal crops (quinoa, 6.3% (Ogungbenle), pear millet (7.6%) (Oshodi *et al*., 1999). Protein serves as the building block of the body. This showed that only M.myristica can contribute significantly to human daily requirement of 23-56g of protein (Witto, 1973). Fat is essential in the diet as it increase the palability of food. The fat content (34.4%) for *M.myristica* seed flour was significantly higher than that of *C.bonduc* seed flour (7.01%). This value was lower than that of periwinkle (74.74%), (Ogungbenle, 2012), gourd seed (50.5%) and yellow melon (51.9%) reported by Ogungbenle, 2003) but significantly higher than (18.9%) *Afzelia africana* seed. (Ogungbenle, 2004). This suggested that *Monodora myristica* seed flour can be grouped as oil-rich crop.The ash content of *C. bonduc* and *M. myristica* seed flours were in close rangeHowever, these values (2.96%) and (2.81%) in this study were lower than (4.93%) reported for *Afzelia africana* (Ogunbenle, 2014). Ash is an indicator of the quality of inorganic compounds (minerals) in the sample. The recommended value for Ash in nuts seed and tubers should fall in the range 1.5- 2.5% (Pomeranz and Clifton, 1981). These values fall within this range, this suggested

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that, they can be recommended for animal feeds. The carbohydrates contents for the samples, *C.bonduc* (34.76%), *M. myristica* (55.82%) and crude fibres contents (12.54%) and (4.69%) were significantly higher than the values (10.06%) and (2.6%) for Huran crepitan seed flour reported by Adeleke *et al*, (2009). The carbohydrate helps to regulate protein and fat metabolism. The high values suggested that both *Caesalpina bonduc* and *Monodara myristica* seed flour will be a source of energy for daily requirement.

The mineral contents (*mg/kg*) of *Caesalpina bonduc* and *Monodora myristica* seed flours were shown in Table 2.The least abundant minerals are Cu, Ni, Cr and Fe. While sodium was found to be the most abundant mineral (475.65), and (1264.19) for *Caesalpina bonduc* and *Monodara myristica* seed flours respectively. Sodium plays crucial role in maintaining osmotic pressure of the body fluid which protects the body from excessive fluid loss. It deficiency leads to muscular weakness and mental convulsion.

Calcium, an important mineral required for bone formation and neurological function was found to be present at significant level especially in Monodora myristica seed flour (121.45%) that of *Caesalpinia bonduc* seed flour with value (40.98).However, this value was lower than melon (130.7 mg/kg) and higher than pumpkin (*72.3 mg/kg*) and gourd seeds (54.9 mg/100g) respectively reported by Olaofe *et al*, 1994). The mean values of potassium in this study were for C. bonduc (36.68) and M.myristica (*353.93mg/mg*). It has been reported that magnesium as an activator of many enzyme systems and maintains the electrical potential in nerves. Phosphorous is always found with calcium in the body both contributing to the food Ca/K ratio is *Monodora* seed and greater than 1. Thus suggest that they would serve as good sources of mineral for bone formation.

Table.1: Proximate compositions of C.bonduc and M.myristica seed flours

Parameters	*Caesalpinia bonduc*	*Monodora myristica*
Moisture	7.89 ± 0.00	4.88 ± 0.13
Crude fat	23.59 ± 0.00	34.44 ± 0.01
Crude Protein	18.26 ± 0.10	10.79 ± 0.10
Ash	2.96 ± 0.04	5.99 ± 0.13
Crude fibre	12.54± 0.01	35.85 ± 0.10
Carbohydrates	34.76 ± 0.00	8.05± 0.01

Table.2: Mineral compositions of Caesalpinia bonduc and Monodora myristica seed flours.

Parameters minerals (mg/g)	Caesalpiniabondue seed flour(mg/g)	Monodoramyristica seed flour (mg/g)
Potassium	36. 68 ±0.02	353.95 ±0.10
Calcium	40 98 ±0.05	121.45 ± 0.021
Sodium	475.65±0.39	1264.19±0.03
Magnesium	13.20 ± 0.01	13.90 ±0.02
Zinc	61.80 ±0.02	21.50 ± 0.03
Phosphorous	18.5 ±0.10	17.2 ±0.20
Nickel	14.70 ± 0.00	16.60±0.61
Ferrous	12.8 ±0.30	13.70 ±0.15
Chromium	12.8 ±0.01	13.7 ± 0.15

Table 3 presents the results for protein functional properties of *Caesalpinia bonduc* and *Monodora myristica* seed flours. The result for water absorption capacities were *Caesalpinia bonduc* flour (113.00) and *Monodora myristica* seed flour (121.50). However, these values were lower compared to the value reported for defatted gourd seed (199.00), white melon (221.0) Ogungbenle,(2004).Water absorption capacity is a critical function of protein in various foods like doughes and baked products (bread and cakes). Hence, these seed flours may be useful for these food formulations (Oshodi *et al*., 1999). The foaming capacities for the samples were Caesalpina bonduc (5.05%) and Monodora myristica (8.16%) respectively. These value were significantly lower than those of soya bean flour(70.0%),sun flower (23.0%),reported by Linn *et al*, 1974 and pigeon flour (68.0%)reported by Oshodi and Ekpengin, (1989). These low values reported in this study suggested that the seed flour samples may not be rich in flexible protein in molecules which rapidly reduce the surface tension to give a foaming ability (Gration and Plutips, 1980).

The emulsion capacities values were; *Caesalpina bonduc* (56.25%), *Monodora myristica* flour (55.77%).these value were lower than Africa yam bean flours (90%) and (95.10%)reported for sun flower flour by Linn *et al* ,1974). However ,the values were higher than soy flour (18.00%),wheat flour (7.0-110%)as reported by Linn *et al*, 1974) and (49.40%)reported by Fagbemi and Oshodi (1991) which suggested that they may be good substitutes for wheat flour ,Soy flour and full fat flulted pumpkin as meat additives/extender and binder formulation.

The oil absorption capacities were; *C.bonduc* (137.5%) and *M. myristica* (182.5%) respectively. These values in the present study showed that the seed flours have high oil absorption capacities and would be very useful in food formulation.

Table.3: Protein functional properties (composition) of C.bonduc and M.myristica seed flours.

Parameters	*Caesalpinia bonduc* seed flow	*Monodora myristica* seed flow
Loosed Bulk density	0.4878± 0.01	0.4348 ± 0.02
Packed bulk density (s/me)	0.625± 0.01	0.5714± 0.00
Gelation capacity (%)	51.40± 0.33	56.20± 0.01
Water absorption capacity (%)	113.00±0.05	121.50± 0.01
Oil Absorption capacity (%)	137.50± 0.5	182.50± 0.20
Emulsion capacity (%)	56.25± 0.10	55.77± 0.02
Foaming capacity (%)	5.05±0.04	8.16±0.02
Selling capacity	7.10±0.10	6.60±0.01

Table.4: Antinutrients composition of C. bonduc and M.myristica seed flours.

Parameters (%)	Caesalpinia bonduc seed flour	Monodora myristica seed flour
Phytate	0.406 ± 0.02	0.371± 0.02
Saponin	0.184 ± 0.01	0.172± 0.01
Oxalate	0.068 ± 0.00	0.056 ± 0.00
Tannins	0.083 ± 0.00	0.074 ± 0.00

The results in Table 4 showed that the seed flours have a very low level of tannins (%) *C. bonduc* (0.083%) and *M.myristica* (0.074%) and Oxalates (0.68%) and 0.056%) respectively. Tannic acid (tannins) inhibit minerals especially iron (Fe) in human body. It also forms complex with proteins, starch, cellulose and minerals.

Also, saponins values for seed flours were *C.bonduc* (0.184%), *M.myristica* (0.172%) respectively. These values were however lower when compared with values reported for *S.nignum* seeds (0.66%) by (Akutugwo *et al*, 2007). Saponin has been reported to possess but beneficial and deleterious properties and exhibit structure on biological activities (savage 1993). The phytate levels were; (0.406%) and (0.371%) for *C.bonduc* and *M.myristica* seed flours. A high concentration of phytate could cause adverse effect in the digestability (Akintayo and Bayer, 2002). It also forms complexes with Zn^{2+}, Fe^{2+} and CO^{2+}. However, these values were significantly lower than 1.0% recommended value.

IV. CONCLUSION

This present study suggested that *Ceasalpinia bonduc* and *Monodora myristica* seed flours were rich on important foods nutrients compared to some oil seeds and nuts. The protein functional properties result showed that the seed flour might be a good substance in food formations such as doughes (breads and cakes).

Also, the anti-nutrients analysis showed that seed flours contained low concentrations of anti-nutrients, thus allowing the proper intake of valuable minerals when consumed.

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