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Full Length Research Paper

A comparative study of proximate composition, anti-nutrient composition and functional properties of *Pachira glabra* and *Afzelia africana* seed flours

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The flours of *Pachira glabra* and *Afzelia africana* seeds were produced and investigated for proximate, anti-nutrient composition and functional properties. The result of the proximate analysis revealed that the flour of *A. africana* was richer than that of *P. glabra* only in moisture content, crude protein and crude fat. The anti-nutrient component showed that *P. glabra* contained 3.5% tannin, 7.41 mg/g phytate, 3.87 mg/g oxalate and 2.11% alkaloid while *A. africana* contained 2.67% tannin, 10.71 mg/g phytate, 0.86 mg/g oxalate and 1.25% alkaloid. This shows that *P. glabra* contained higher anti-nutrients (except pytate) than *A. africana*. The water and oil absorption capacities of *P. glabra* (215 ± 5.0 and 144.15 ± 4.3 respectively) were higher than the respective values for *A. africana* (157.5 ± 2.5% and 106.95 ± 4.65) while *A. africana* had relatively higher foaming capacity and stability, emulsion capacity and stability than *P. glabra*. The two samples recorded minimum gelation concentration of 4.0% (w/v). Protein solubility was found to be pH dependent for the two samples with both recording minimum and maximum protein solubility at the same pH (pH 3 and pH 8, respectively). The proximate and functional properties observed suggested that the flours may be useful as human foods.

Key words: Underutilized seeds, functional properties, proximate composition, anti-nutrients.

INTRODUCTION

The quest of developing countries to make progress in meeting Millennium Development Goals (MDGs), especially in eradicating extreme poverty and hunger in particular, has called for an aggressive research into some underutilized indigenous tree plants. Examples of such plants are *Pachira glabra* (Bombacaceae) and *Afzelia africana* (Caesalpiniaceae). *P. glabra* also known as Guinea peanut, French peanut or Lucky tree grows throughout the tropics and subtropics. It is adaptable to different soil types and grows naturally along rivers and other bodies of water. It is grown as house plant in temperate regions. It begins to fruit at about the age of 4 to 5 years. The fruit is a smooth, green capsule, 10 to 20cm in length that splits open naturally when ripe. The seeds, which are rounded but irregular and about 4 to 5cm long, are very delicious when raw, boiled, fried or roasted.

A. africana, popularly called African oak or African mahogany, with trade names Àpá (Yoruba), Kawo (Hausa) and Akpalata (Ibo) is one of the most widely distributed species in Africa. It is found from Senegal in West Africa to Sudan, Uganda and Tanzania in the east. It produces high quality wood for constructing canoes, cooking utensils; furniture and African drum ('djembe'). The plant is used in local medicine for general pain relief and digestive problems. Little or no information is available on the nutritional quality of the seeds of these tree plants used as ornamental/house plants, furniture, lumber and for medicinal purposes. Therefore, this study investigates the proximate composition, anti-nutrients content and functional properties of the seed flours of these plants.

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Table 1. Proximate composition (%) of *P. glabra* and *A. africana* seed flours.

	P. glabra	*A. africana*
Moisture content	9.13 ± 0.02	9.49 ± 0.01
Crude protein	10.38 ± 0.08	16.52 ± 0.79
Crude fibre	8.55 ± 0.01	7.70 ± 0.02
Crude fat	15.29 ± 0.01	16.35 ± 0.02
Ash	4.34 ± 0.01	4.03 ± 0.03
Carbohydrate	52.32 ± 0.8	45.92 ± 0.72

Table 2. Anti-nutrient composition of *P. glabra* and *A. africana* seed flours.

	P. glabra	*A. africana*
Tannin (%)	3.53±0.01	2.67±0.01
Phytate (mg/g)	7.41±0.02	10.71±0.1
Oxalate (mg/g)	3.87±0.02	0.86±0.03
Alkaloid (%)	2.11±0.1	1.25±0.03

MATERIALS AND METHODS

Seeds of *P. glabra* and *A. africana* were collected from abandoned farmlands within the outskirts of Ado- Ekiti, Nigeria. The seeds were identified at the Department of Plant Science Laboratory, University of Ado-Ekiti, Nigeria. They were dried at 100 to 105°C to a constant weight, de-hulled and dry-milled. The seed flours were analyzed for proximate composition, anti-nutrients (tannins, phytate, oxalate and alkaloids) and functional properties using standard analytical procedures (AOAC, 1998; Oshodi and Ekperigin, 1989).

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of the seed flours of *P. glabra* and *A. africana*. The moisture content for *P. glabra* (9.13 ± 0.02%) and *A. africana* (9.49 ± 0.01%) were higher than 4.85 as reported for gourd seed (9.13 ± 0.02%) (Ogungbenle, 2006), pumpkin seed (5.02%) (Aisegbu, 1987), pumpkin seed (5.5%) (Fagbemi and Oshodi, 1991) and shelled lima bean (4.42%) (Oyenuga, 1968). The seed flours of *P. glabra* and *A. africana* recorded ash content of 4.34 ± 0.01% and 4.03 ± 0.03% respectively. These values were higher than (3.00 to 3.87%) reported for some cowpea varieties (Aletor and Aladetimi, 1989) and (3.1 ± 3.6%) for different lima bean flours (Oshodi and Adeladun, 1993), but compared favourably with 4.8% reported for fluted pumpkin (Fagbemi and Oshodi, 1991). This suggests that the flours of the seeds of these plants could be a good source of minerals needed for body development. The values for *P. glabra* (15.29 ± 0.01%) and *A. africana* (16.35 ± 0.02) for the crude fat content were low when compared with 43.2% for calabash kernel (Olaofe et al., 2009) and 23.5% for soya bean seed (Paul and Southgate, 1985). However these values were higher than 1.93 ± 10.74% for different cultivars of African yam beans (Adeyeye, 1998). The crude fibre values 8.55 ± 0.01% for *P. glabra* and 7.70 ± 0.02% for *A. africana* were high when compared with 2.8% and 4.28% for gourd seeds (Ogungbenle, 2006) and soya bean (Temple et al., 1991) respectively.

The protein content values for both flours were low (10.38 ± 0.08%, 16.52 ± 0.79%) when compared with other edible leguminous seed flours such as pigeon peas, cowpeas and soya beans (Olaofe et a., 1994), some lima bean varieties (Oshodi and Adeladun, 1993), some cowpea varieties (Aletor and Aladetimi, 1989) and similar underutilized legumes (*Caesalpinia pulcherima*) (Olaofe et al., 2004). A critical look at Table 1 shows that *A. Africana* recorded a higher value of crude protein, crude fat and moisture content than *P. glabra*. Anti-nutrients such as tannin, oxalate and alkaloid were significantly low in both flours (Table 2). Their respective values were 3.53 ± 0.01%, 3.87 ± 0.02 mg/g, 2.11 ± 0.1% in P. *glabra* and 2.67 ± 0.01%, 0.86 ± 0.03 mg/g, 1.25 ± 0.03% in *A. africana*. However, the phytate level of *A. africana* (10.7 ± 0.1 mg/g) and *P. glabra* (7.41 ± 0.02 mg/g) were high. Oxalate is of great concerned to food analysts because of its negative influence on mineral availability. High oxalate level in food had been implicated as a cause of kidney stones because high level of oxalate correlates with increase in calcium absorption in the kidneys (Chai and Liebman, 2004). Oxalate levels in the seed flours of these plants were significantly lower than 0.23 to 1.10 g/100 g (Bello et al., 2008) and 0.4% (Amoo and Agunbiade, 2010) obtained for some Nigerian fruits and whole seed flour of *Pterygota macrocarpa* respectively.

Tannins are known for their ability to form insoluble complexes with proteins thereby reducing digestibility of food proteins. The values of tannin for *P. glabra* (3.53 ± 0.01%) and *A. africana* (2.67 ± 0.01%) were lower than 13.3% cashew nut, 19.1% fluted pumpkin (Fagbemi et al., 2005) and 7.0% hulled seed of *P. macrocarpa* (Amoo and Agunbiade, 2010). It is apparent from this study that *P. glabra* recorded higher levels of phytochemicals (except phytate) than *A. africana.* The results of the functional properties (Table 3) revealed that the values

Table 3. Functional properties of *P. glabra* and *A. africana* seed flours.

	P. glabra	*A. africana*
Water absorption capacity	215 ± 5.0	157.5 ± 2.5
Oil absorption capacity	144.15 ± 4.3	106.95 ± 4.65
Foaming capacity	12.0 ± 0.3	17.0 ± 0.1
Foaming stability	2.0 ± 0.0	4.0 ± 0.0
Emulsion capacity	35.5 ± 0.5	41.5 ± 0.5
Emulsion stability	50.0 ± 0.0	51.0 ±0.0
Least gelation (w/v)	4.0 ± 0.3	4.0 ± 0.17

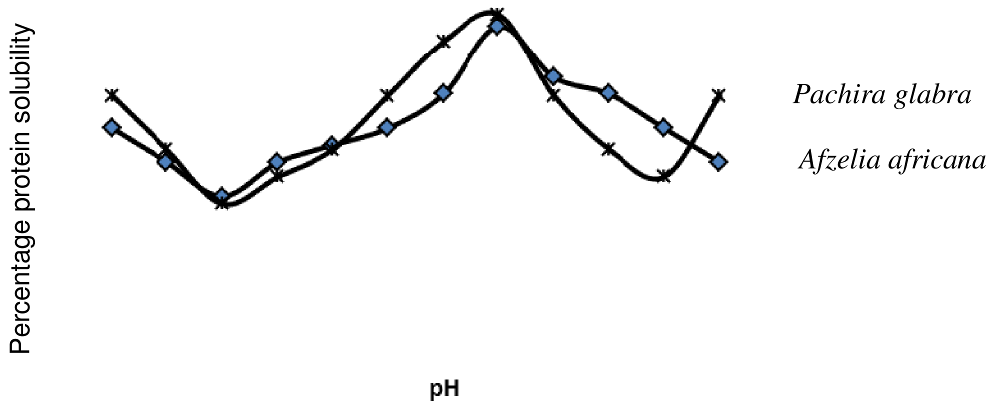

Figure 1. Protein solubility of *P. glabra* and *A. africana* seed flours as a function of pH effects.

of water absorption capacity (WAC) of both flours were high 215 ± 5.0% (*P. glabra*), 157.5 ± 2.5% (*A. africana*) and were comparable with 157% of calabash seed flour (Olaofe et al., 2009) and many of oil seeds defatted flours (100 to 260%) (Ige et al., 1984). These values were higher than 138% (Oshodi and Ekperigin, 1989) and 100% (Olaofe et al., 1994) reported for pigeon pea and gourd seed flours respectively. This indicated that the flours of *P. glabra* and *A. africana* may be useful in the production of soups and gravies. Also oil absorption capacity (OAC) values of 144 ± 4.3% (*P. glabra*) and 106.9 ± 4.65% (*A. africana*) were higher than the fat absorption capacity for pigeon pea (89.74%) (Oshodi and Ekperigin, 1989) and gourd seed flour (96%) (Olaofe et al., 1994), but close to 142.5% for pumpkin seed flour (Fagbemi and Oshodi, 1991).

This is an indication that the flours can act as flavor retainer and be used to improve the mouth feels of food. The low values of foaming capacity of the two seed flours (17 ± 0.1, 12 ± 0.3%) was in close agreement with 13% obtained for calabash kernel flour (Olaofe et al., 2009) suggesting that the flours may not be rich in flexible protein molecules, which rapidly reduce the surface tension to give a good foaming ability (Graham and Philips, 1980). The foaming stability of the seed flours after 2 h shows that the flours had low foaming stability (4 ± 0.0.2 ± 0.0%) which was comparable with that of calabash seed flour (4%) (Olaofe et al., 2009) but lower than that of white melon and beni seed flours (Ogungbenle, 2006) indicating the suitability of the flours as whipping agent in foods (Lin et al., 1974). The Emulsion capacity (35.5 ± 0.5 and 41.5 ± 0.5%) values in both seed flours were observed to be higher than those of soya bean (15.0%), wheat flours (7.00 ± 11.00%) (Lin et al., 1974) and calabash seed flour (23.2%) (Olaofe et al., 2009) suggesting that the seed flours of *P. glabra* and *A. africana* could be utilized as substitutes for soya and wheat flours in complementary/weaning foods. The emulsion stability values (50.0 ± 0.0% and 51.00 ± 0.0%) were higher than 11.5 and 29.5% for gourd seed and yellow melon respectively (Ogungbenle, 2006).

The solubility of protein in the two seed fours as a function of pH is shown in Figure 1. The lowest solubility was recorded at pH 3 (acidic medium) while the maximum solubility is at the basic medium pH 8; showing that the seed proteins were fairly soluble in both acidic and basic regions and can therefore be used in the production of milk beverages as well as thickening agent in food formulation especially in soups, gravies and pastries.

Conclusion

The proximate composition of the seed flours of *P. glabra* and *A. africana* were comparable with reported values for edible legumes and oilseeds. The high value of water absorption capacity and oil absorption capacity recorded by the seed flours of these underutilized plants indicated that these flours may be utilized in the production of soups and gravies and as flavor retainer in foods. The high values of the emulsion capacity of the two flours suggested that the seed flours could be a good substitute for wheat flour and soya flour and as an additives/extender in food formulation. The seed proteins of the two flours were fairly soluble in both acidic and basic regions indicating their suitability in the formulation of both acid and basic foods.

REFERENCES

Adeyeye EI (1998). The relative merits of the presence of hull on the nutritional qualities of the African yam bean flour. Nahrung, 8(42): 84-88.

Aisegbu JE (1987). Some biochemical; evaluation of fluted pumpkin seed. J. sc. Food Agric., 40: 151-155.

Aletor VA, Aladetimi OO (1989). Compositional evaluation of some cowpea varieties and some underutilized legumes in Nigeria. Nahrung., 10: 999-1007.

Amoo IA, Agunbiade FO (2010). Some nutrients and antinutrient components of Pterygota macrocarpa seed flour. Electronic J. Environ., Agric. Food Chem., 9 (2): 293-300.

AOAC (1998). Official Methods of Analysis, 16th Edition Vol. 1 and 2. Association of Official Analytical Chemists, Washington D.C.

Bello MO, Falade OS, Adewusi SRA, Olawore NO (2008). Studies on the chemical compositions and anti-nutrientss of some lesser known Nigeria fruits. Afr. J. Biotechnol., 7 (21): 3972-3979.

Chai W, Liebman M (2004). Assessment of oxalate absorption from almonds and black beans with and without the use of an extrinsic label. J. Urol., 172: 953-957.

Fagbemi TN, Oshodi AA (1991). Chemical composition and functional properties of full fat fluted pumpkin seed flour. Niger. Food J., 9: 26-32.

Fagbemi TN, Oshodi AA, Ipinmoroti KO (2005). Processing effects on some anti-nutritional factors and in vitro multienzyme protein digestibility (IVPD) of three tropical Seeds: Breadnut (Artocarpus altilis), Cashewnut (Anarcardium occidentale) and Fluted Pumpkin (Telfairia occidentalis). Pak. J. Nutr., 4(4): 250-256.

Graham C, Philips H (1980). The conformation of protein at the air water interface and their role in stabilizing foam. Ed. R.J. Akers, Academic Press, London, p. 237.

Ige MN, Ogunsua AO, Oke OL (1984). Functional properties of the proteins of some Nigeria oilseeds: Casophor seeds and three varieties of some Nigeria oilseeds. Food Chem., 32: 822-825

Lin M, Humber JY, Solsulki, FW (1974). Certain functional properties of sunflower meal products. J. Food Sci., 39: 368-370.

Ogungbenle HN (2006). Chemical composition, functional properties and amino acid composition of some edible seeds. La Rivista Italiana Delle Sostanze Marzo, LXXXIII, pp. 81-86.

Olaofe O, Adeyemi FO, Adediran GO (1994). Amino acid, chemical composition and functional properties of some oil seeds. J. Agric. Food Chem., 42(4): 879-881.

Olaofe O, Ogunlade I, Jibuah N (2004). Proximate, mineral composition and Functional properties of Pride of Barbados (Caesalpinia pulcherrima) seed flour. Proceedings of the 27th International Conference of the Chemical Society of Nigeria, pp.130-135.

Olaofe O, Ekuagbere AO, Ogunlade I (2009). Chemical, amino acid composition and functional properties of calabash seed's kernel. Bulletin of Pure an Appl. Sci., 28(1-2): 13-24.

Oshodi AA, Adeladun MOA (1993). Proximate composition, nutritionally valuable minerals and functional properties of three varieties of Lima bean (Phaseolus lunatus) flour. Int. J. Food Sci. Nutr., 43: 181-185.

Oshodi AA, Ekperigin MM (1989). Functional properties of pigeon pea (Cajanus cajan) flour. Food Chem., 34: 187-191.

Oyenuga V (1968). Nigeria's food and feeding stuffs, their chemistry and nutritive value. 3rd ed. Ibadan Univesity Press. Ibadan, Nigeria, p. 99.

Paul AA, Southgate DAT (1985). Mccane and Widdowsen's. The composition of foods. HMSO/Royal society of Chemistry, London.

Temple VJ, Odewumi L, Josesph K (1991). Soyabeans and soyabeans based diets. Proceedings of the 3rd regional workshop on rural development, Jos, pp. 45-50.