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Full Length Research Paper

Comprehensive investigation into the nutritional composition of dehulled and defatted African locust bean seed (*Parkia biglobosa*)

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The nutritional and anti-nutritional composition of the African locust bean (ALB) was evaluated, with the aim of providing data that will guide the effective utilization of it under exploited tropical legume in food applications. Seeds of the African locust bean were depulped, dehulled, dehydrated and defatted. Chemical analyses were carried out using standard methods. Anti-nutritional factors, mineral analysis, fatty acid composition and free amino acid composition were also determined. The results obtained showed it to be a good source of potassium and phosphorus. A high unsaturated-saturated fatty acid ratio was observed, with linoleic acid having the highest level. Unlike most other legumes, it has appreciable quantity of sulphur-containing amino acids and thus ideal for the fortification applications with various food formulations.

Key words: African locust bean, antinutritional factor, minerals, fatty acid, amino acid.

INTRODUCTION

Food legumes or pulses are found throughout the world with great varieties growing in the tropics and subtropics (Ihekoronye and Ngoddy, 1985). It is however pertinent to note that, of the thousands of known legume species, only a fraction is being used extensively today (National Academy of Science, 1979). Food legumes offer a singular advantage of providing plant proteins with reduced cost of production, less difficulty of processing and yet, higher prospect of boosting energy efficiency than that supplied via animal protein (Balogun and Fetuga, 1986). Pulses are among the foods recognized and recommended for consumption for the noble purposes of neutralizing acids in the body system (Russel-Seddon, 1985). Hence, all research effort geared towards effective utilization of these inexpensive plant proteins for nutritional and functional properties and applications cannot be over-emphasized. At present however, their utilization in food processing and product development on industrial scale is not being accorded the attention it deserves (Alabi et al., 2005; National Academy of Science, 1979). This has been attributed to the dearth of information available on their varied processing techniques as linked to their nutritional and functional properties for different end usage and applications. One major impediment militating against their direct usage in food applications for human consumption is the hulls or outer coating, which more often than not, composes of over 80% of anti-nutritional components/factors (National Academy of Science, 1979). Additionally, the oil content of many of these legumes hinders their applications in food products that could be stored over time, being predisposed to rancidity effect. *Parkia biglobosa*, the African locust bean, falls into this category of under-exploited tropical legume despite its promising economic value. The world agro-forestry data base (Leaky, 1999) described *Parkia biglobosa* as a perennial deciduous tree with pods ranging from pink brown to dark brown, when matured. The pods are reported to contain up to 30 seeds embedded in a yellow pericarp. The seeds having a mean weight of 0.26 g/seed have a hard testa with large cotyledons forming about

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Table 1. Proximate composition of African locust bean (*P. biglobosa*).

Chemical component	Composition (%)
Protein	27.9
Starch	0.39
Dry matter	88.79
Ash	4.24
Fat	15.48
Carbohydrate	41.10
Moisture	11.21
Total reducing sugar	1.07
Glucose	0.09

Table 2. Fibre composition of African locust bean (*P. biglobosa*).

Fibre component	Composition (%)
Crude fibre	11.23
Natural detergent fibre	28.34
Acid detergent fibre	19.6
Hemicellulose	8.8

70% of their weight. *P. biglobosa* is well known for its high commercial values (Jayeoba, 2002) as food and medicinal agent. Reports made by Alabi et al. (2005) showed that the tree have found its usefulness, not only for human consumption purposes, but also as timber for making pestles, mortar, bows, hoe-handles and seats. The husks and pods are reportedly good for feeding livestock (Obiozoba, 1998). However, the most popular form of consumption is in its traditional fermentation into dawadawa, a food condiment for seasoning traditional soups (Campbell-Platt, 1980). Of recent, Femi-Ola (2008) reported the termicidal properties found in the water used in boiling *P. biglobosa* seeds during its fermentation into dawadawa (commonly called *Iru* or locust bean). This work reports a comprehensive study on the nutritional and anti-nutritional composition of the African locust bean.

MATERIALS AND METHODS

Plant material

African locust been seed were purchased from retailers in a local market in Lagos, Nigeria. The dry bean seeds were stored at room temperature until ready for use.

Processing of African locust bean

The raw bean seeds were prepared by depulping, dehulling, dehydrating, and defatting as described by Ikenebomh and Kok (1984). The seed were soaked in tap water for twelve (12) h to soften the adhering pulpy materials. The pulp was removed by rubbing seeds between the palms and washing them with water. The depulped cleaned seeds were dried at room temperature for twenty-four (24) h and dehulled to free the cotyledon from the dark brown testa by hydrating, boiling, cooling, draining and rubbing of seed between the palms, and washing with water. The dehulled seeds were oven dried at 70°C for twenty-four (24) h (Nordeide et al., 1996) to a constant weight, cooled and grounded to fine powder using a blender. Fat was extracted using the soxhlet method and the resulting defatted locust bean powder was oven dried, cooled and stored in an airtight polythene bags in a dessicator until they were analyzed.

Chemical analysis

Crude protein, fats, ash, lipid profile, elemental analysis and total carbohydrate content of the sample were estimated by standard methods (Pearson, 1970; AOAC, 1990). The soluble sugars and free amino acids in the defatted samples were extracted with 80% ethanol (v/v) following the method of Odibo et al. (1990). The free amino acids content in the samples were determined using the method of Spackman et al. (1958), while reducing sugar was estimated by colorimetric method (Somogy, 1945) using glucose as a standard. Total starch was estimated using the diastase hydrolysis method as modified by Fasidi (1975). The quantity of hydrolysed starch was determined by using the phenol-l sulphuric acid method of Gilles et al. (1956). The dry matter, moisture content and crude fibre contents were determined by Alabi (1990). Trypsin inhibitor activity of sample was determined by the method of Kekede et al. (1974). Phytic acid was determined by an indirect colorimetric method of Wheeler and Ferrel (1971).

RESULTS AND DISCUSSION

The proximate composition and fibre composition of the African locust beans is presented in Tables 1 and 2, respectively. The protein, fat and carbohydrate contents corresponded with that of other workers who reported the nutritional adequacy of the African locust bean seeds with a proximate composition of 30.0% protein, 15.0% fat, 4.0% crude fiber, 2.0% ash and 49.0% carbohydrate (Fetuga et al. 1974; Campbell-platt, 1980; Eka, 1980; Odunfa, 1986; Oke and Umoh, 1987). Though the ash (4.2%) and crude fiber (11.2%) contents of the sample was observed to be a little higher compared to results of the above workers, it is however in agreement with the observations of Esenwah and Ikenebomeh (2008) and Omafuvbe et al. (2004) who reported higher values. The starch, reducing sugars and glucose contents obtained in this study was low while the dry matter was higher than those reported. These differences could be attributed to environmental factors, as well as the cultivars of *P. biglobosa* and the experimental procedure used. Reducing sugar levels has been reported to decrease with processing (Omafuvbe, 2004). The result of the effect of processing on the levels of anti-nutritional factors of *P. biglobosa* is shown in Table 3. The result for trypsin inhibitor in this study (19.4 mg/100 mg) was lower than reported in the literature while that for phytic acid (163 mg

Table 3. Anti-nutritional factors in African Locust bean (*P.biglobosa*).

Antinutritional factor	Composition (mg/100g)
Trypsin Inhibitor	19.4
Phytic Acid	163.0

Table 4. Mineral composition of African locust bean (P. biglobosa).

Mineral	Symbol	Composition (mg/100g)
Sodium	Na	29.0
Potassium	K	1101.5
Magnesium	Mg	280.2
Calcium	Ca	222.2
Manganese	Mn	5.3
Zinc	Zn	3.8
Iron	Fe	9.3
Phosphorus	P	170.0

Table 5. Fatty acid composition of African locust bean (*P. biglobosa*).

Fatty acid	Composition (mg/100g)
Palmitic acid (16:00)	ND
Palmiloleic acid (16:1)	19.8
Stearic acid (18:0)	18.6
Oleic acid (18:1)	25.6
Linoleic acid (18:2)	90.4
Arachidic acid (20:0)	7.6

ND; not detected.

/100 g) was comparable with the observations of Esenwah and Ikenebomeh (2008) (150 mg/100 g). The health implications of antinutrients are well known. Reduction of these antinutrients during the processing of African locust beans is therefore of great importance for the safety of the product. The result of the mineral content of the African locust bean is shown in Table 4. Potassium was observed to be present at a very high level (1101.5 mg/100 g). Except for magnesium (280.2 mg/100 g), calcium (222.2 mg/100 g) and phosphorus (170 mg/100 g), the others were present in trace amounts. This is within the value of some legumes such as pigeon peas, *Cajanus cajan* with potassium (1784 mg/100 g), and phosphorus (489 mg/100 g), soybean, *Glycine max* with potassium (1509 mg/100 g), calcium (201 mg/100 g) and phosphorus (313 mg/100 g) (Pirman et al., 2001).

The result of the fatty acid analysis of the African locust bean is presented in Table 5. The observed fatty acids were present in low amount, ranging from 7.7 mg/100g for arachidic acid (20:0) to 90.4 mg/100g for linoleic acid. The result indicated that the ratio of unsaturated fatty acid to saturated fatty acids was high, thus will have beneficial effect to man. Table 6 shows the amino acid composition of the African locust bean. The amino acids were observed to be present in fair amounts. The results obtained from this study were lower than those reported in literature where the composition ranges from 1.46 g/100 for threonine to 14.89 g/100 g for glutamic acid (Hassan and Umar, 2005). The result compared favourably to that of Ega et al. (1988) in terms of distribution except for tryptophan which was not detected in their sample. Sulphur containing amino acids has been reported to be the limiting amino acids in legumes (Baudoin and Maquet, 1999; Laurena et al., 1991). *P. biglobosa* showed fair amounts of methionine and cystine(Table 1).

Conclusion

Results from this study revealed the nutritional adequacy of the African locust bean. It is a good source of potassium and phosphorus. Unlike other legumes, it has

Table 6. Free amino acid composition of African locust bean (*P. biglobosa*).

Amino acid	Composition (mg/100 g)	Amino acid chemical score	Amino acid (g/100 g) (reference protein: egg-white)
Lysine	475.0	10.24	4.64
Histidine	143.7	8.52	1.69
Arginine	312.5	6.87	4.54
Aspartic acid	762.5	12.53	6.09
Threonine	231.3	6.77	3.41
Serine	331.3	5.45	6.07
Glutamic acid	1325.0	12.21	10.89
Proline	925.0	31.68	2.92
Glycine	393.8	13.63	2.89
Alanine	356.3	6.49	5.49
Cystine	100.0	5.32	1.88
Valine	568.8	9.45	6.02
Methionine	62.5	2.09	3.01
Isoleucine	200.0	4.00	5.00
Leucine	506.3	7.44	6.80
Tyrosine	381.3	11.87	3.21
Phenylalanine	431.5	8.75	4.94
Tryptophan	30.0	2.54	1.18

appreciable quantity of sulphur-containing amino acid and thus ideal for fortification applications with various food formulations.

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