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Chemical and Amino Acid Composition of Cooked Walnut (*Juglans regia*) Flour

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Abstract. The proximate analysis of cooked walnut (*Juglans regia*) flour revealed the composition as protein (14.18%), moisture (11.01%), ash (3.14%), crude fibre (3.03%), crude fat (10.22%), carbohydrate (58.42%), phytate (20.18 mg/g), oxalate (1.13 g/g) and tannin (2.33%). Glutamic and aspartic acids were the most predominant amino acids in the sample with values of 151.6 mg/g and 89.5 mg/g, respectively.

Keywords: *Juglans regia*, nutritional composition, amino acids; antinutritional factors

Introduction

Walnut (*Juglans regia*), a deciduous tree, produces fine quality nuts from which considerable quantities of edible oil can be extracted. Walnuts are important food of people of the tropical countries, some parts of France and southern Nigeria. People belonging to the developing countries depend heavily on starchy foods and cereals. These people suffer from shortage of protein rich foods. Edible protein rich seeds, grown abundantly in tropical countries of the world are underutilized due to the lack of attention on the part of food scientists.

The present paper deals with the determination of nutritional and antinutritional factors and the amino acids of cooked walnut (*Juglans regia*) flour and its suitability for human consumption.

Materials and Methods

English walnuts (*Juglans regia*) were obtained from Idoka village near Ilesa, Osun State, Nigeria. The nuts were screened for quality, cooked and cooled. After removing the shells kernels were dried and milled into fine powder. The flour was kept in a rubber container and stored in freezer until use.

Moisture, ash, crude fat, crude fibre and nitrogen contents of the sample were determined according to the method of the Association of Official Analytical Chemists (1990). Crude protein was calculated by multiplying the total nitrogen content by a factor of 6.25. Carbohydrates were determined by the method of difference.

Oxalates and tannins were determined using the methods of Day and Underwood (1986). 1.0 g of sample was taken in 100 ml conical flask, 75 ml of 1.5 N H_2SO_4 was added and the mixture was stirred for 1 h and filtered. The filtrate (25 ml) was titrated against 0.1 N $KMnO_4$ until faint pink colour persisted for 30 sec.

Phytate was determined on Spectronic 20 colorimeter (Gallenkamp, UK) using the method described by Harland and Oberleas (1986). The amount of phytate in the sample was calculated as hexaphosphate equivalent using the formula:

Phytate (mg/g) sample = $K \times A \times 20/0.282 \times 1000$ where A is absorbance, mean K = standard P. Phytate = 28.2 % P

For determination of tannins, 10 ml of 70% acetone was added to 200 mg of the sample. The mixture was put in an ice bath and shaken for two h at 30 °C. The mixture was later centrifuged at 3,600 rpm; the filtrate was pipetted out into test tube to which 0.8 ml of distilled water was added. Standard tannic acid solution was prepared from 0.5 mg/ml stock and the solution was made up to 1 ml with distilled water. Folin reagent, (0.5 ml), was added to the sample and the standard solutions both, followed by addition of 2.5 ml of 20% Na_2CO_3. The solutions were vortexed, allowed to incubate for 40 min at room temperature and the absorbance was measured at 725 nm.

The amino acid profile of the sample was determined using the method described by Spackman *et al.* (1958). The defatted sample was dried to constant weight, hydrolysed, evaporated under vacuum and then loaded into the Technicon Sequential Multisample Amino Acid Analyser (TSM, Taryton, NY).

Results and Discussion

Proximate composition of cooked walnut flour is given in Table 1. Protein content is 14.18%. This value is low as compared to that of soybean, 40.8%, reported by Oyenuga (1968) and 32.5% reported for soybean by Paul and Southgate

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(1985). The value is also lower than those of crude protein content of cowpea varieties (20.6 g/100 g DM in TVX, 24.2 g/100 g DM in Ife brown) (Aletor and Aladetimi, 1989), of *Sphenostylis stenocarpa* (20.63% DM) reported by Abulude (2005) and of lima bean varieties (21.8-26.2%), of *Bombax buonopozence* (13.37% DM) (Oshodi and Adeladun, 1993) but higher than that of *Irvingia gabonensis* (12.78% DM) reported by Abulude (2005).

Moisture and fat contents were 11.01% and 10.22%, respectively. The fat content is lower than that of oil seeds, reported by Olaofe *et al*. (1994). The fat content of cooked walnut is higher than that of Kersting's groundnut (4.9-5.9%) and scarlet runner beans (5.3-6.9%) reported by Aremu *et al*. (2005). Fibre, carbohydrate and ash values were 3.03%, 58.42% and 3.14%, respectively. The fibre content is low when compared with the values reported by Ogungbenle (2006) for benniseed but higher than those of gourd seed (2.80%), white melon (2.00%) and yellow melon (2.60%) reported by Ogungbenle (2006). However, the value compares favourably with that of pigeon pea flour (3.82%) reported by Oshodi and Ekperigin (1989).

Table 2 shows the level of antinutrients in the sample. The antinutrients studied were: phytate, tannin and oxalates. The level of phytate in walnut seems to be much higher than that of moth bean cultivars (8.52-8.99 mg/kg) reported by Khokhar and Chauhan (1986) but is still higher than that of whole grain maize (539 mg/100 g) reported by Oke (1969) and phytate level of 530 mg/100 g for cassava, yellow yam (452 mg/100 g) and white yam (694 mg/100 g) reported by Adeyeye *et al*. (2000). This further implies that the phytate level is relatively high when compared with other grains. The value of tannin, 2.33%, is very close to 2.6% reported for faba beans (Marguardt, 1989), rapeseed (Yapar and Clandinin, 1972) and sorghum (Price *et al*. 1979). The value of oxalate is 1.13% which falls in the range of 1.7-6.5% reported for some oil seeds by Enujiugha and Ayodele (2003). Dietary phytic and oxalic acids have shown to disturb efficient utilization of certain minerals such as calcium, zinc and magnesium and led to development of rickets when certain legumes and cereals are consumed (Aletor, 1987; Liener, 1976). Therefore, consumption of oxalate may require dietary supplementation of the divalent minerals. The amino acid composition of cooked walnut flour is shown in Tables 3, 4 and 5. Glutamic and aspartic acids had the highest values of 151.6 mg/g protein and 89.5 mg/g protein, respectively. This observation was in close agreement with that of Olaofe *et al*. (1994). Total amino acid (TAA) content was 757.1 mg/g protein shared by the total non-essential amino acids (TNEAA), 312.5 mg and the total essential amino acid (TEAA), 444.6; TEAA was 58.7% with histidine and 55.5% (without histidine) (Table 3). These TAA values of walnut are within the range of 705-918 mg/g for African yam bean reported by Adeyeye (1997). Total essential amino acid (TEAA) with histidine was 444.6 mg/g and without histidine, was 420.1 mg/g; these values compare favourably with those reported for soybean by Altschul (1958) as 444 mg/g and for dehulled and hulled African yam beans (376-518 mg/g) reported by Adeyeye (1997). TEAA percentage is also comparable

Table 1. Proximate composition of the sample

Component	Composition (%)
Moisture	11.01
Ash	3.14
Crude protein	14.18
Crude fat	10.22
Crude fibre	3.03
Carbohydrate (by difference)	58.42

Table 2. Anti-nutritional factors of the sample

Component	Content
Phytate (mg/g)	20.18
Tannin (%)	2.33
Oxalate (%)	1.13

Table 3. Amino acid profile

Amino acid	(mg/g crude protein)
Lysine*	42.1
Histidine*	24.5
Arginine*	46.1
Aspartic acid	89.5
Threonine*	29.6
Serine*	30.0
Glutamic acid	151.6
Proline	30.0
Glycine	26.6
Alanine	37.1
Cystine	14.0
Valine*	39.2
Methionine*	15.9
Isoleucine*	30.6
Leucine*	87.5
Tyrosine	23.2
Phyenylalanine*	39.6

*Essential amino acids

with that of cow milk being 490 mg/g protein with histidine but without tyrosine, 463 mg/g protein without histidine or tyrosine and egg, 495 mg/g with histidine but without tyrosine and 473 mg/g, without histidine and tyrosine (FAO/WHO/UNU, 1985). Percentage composition of TNEAA was 41.3 and that of TEAA was 58.7 with histidine and 55.5, without histidine. This indicates that the sample had less TNEAA thus making walnut a good source of plant protein for children and adults (Table 4).

Table 4. Essential and non-essential amino acids of the sample

Amino acid	(mg/g protein)
Total amino acids (TAA)	757.1
Total non-essential amino acids (TNEAA)	312.5
Total essential amino acids (TEAA)	
– With histidine	444.6
– Without histidine	420.1
TNEAA %	41.3
TEAA %	
– With histidine	58.7
– Without histidine	55.5

Comparison between the amino acid profile of walnut and the amino acid reference values quoted by FAO/WHO/UNU (1985) demonstrates that most of the amino acids in cooked walnut meet the range of amino acid requirements recommended for infants, pre-school children and school going children as well as for adults (FAO, 1970). Both histidine and arginine are particularly essential for children (FAO/WHO/UNU, 1985; Harper, 1984; Muller and Tobin, 1980). The present results show that walnut is a good source of essential amino acids (Table 3). The quality of dietary protein can be estimated in various ways but basically the ratio of amino acids available in the food to the needs gives a good comparison (Bender, 1992; Orr and Watt, 1957) (Table 5).

Table 5. Amino acid score of the sample

Amino acid	Score
Isoleucine	0.8
Leucine	1.3
Lysine	0.8
Methionine + cystine	0.9
Phenylalanine + tyrosine	1.0
Threonine	0.8
Valine	0.8

Conclusion

It can be concluded from the study of cooked walnut flour that walnut has good nutritive value which is favourably comparable with that of other conventional sources of proteins. The anti-nutrient values were within the recommended range and walnut contained essential amino acids required by pre-school children, school going children and adults.

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