Food Chemistry **17** (1985) 59–64

Chemical Composition and Amino Acid Content of African Breadfruit (*Treculia africana* Decne)

T. E. Ekpenyong

Department of Animal Science, Division of Nutritional Biochemistry, University of Ibadan, Ibadan, Nigeria

(Received: 16 November, 1984)

ABSTRACT

Chemical analysis of the seeds of African breadfruit (Treculia africana) *shows that they have high protein and oil contents (23% and 11%, respectively). The oil can be used for industrial purposes and for human consumption due to its high food energy value. Phosphorus and potassium contents are high but the low calcium content could lead to a low Ca/P ratio.*

Glutamic acid, aspartic acid and glycine are the most abundant amino acids, followed by lysine, leucine, threonine and valine. As in most legumes, the content of sulphur-containing amino acids in African breadfruit is low. Its high content of essential amino acids commends it as a suitable replacement for soybean in areas where the latter is scarce, or too expensive.

INTRODUCTION

Among the large number of trees growing naturally in the high rain forest and savanna areas of Nigeria is the African breadfruit tree (*Treculia africana*, Decne). It is native to many parts of Africa and has edible fruits and leaves. The African breadfruit (*Treculia africana*) is different from the 'breadnut' or 'white man's groundnut' (*Artocarpus communis* J. R. & G. Forst), commonly found in Puerto Rico. The chemical composition of breadnut has been reported by a number of authors (Kennard & Winters, 1960; Reeve, 1973; Graham & De Bravo, 1981.

Food Chemistry 0308-8146/85/$03·30

The African breadfruit, although known and used locally for quite some time, has not attracted the same attention as the cashew nut, the African locust bean or the groundnut. Okafor & Okolo (1974) have reported on the contents of some fruit trees of Nigeria. These authors state that the breadfruit tree contains 17·23% and 10·27% protein and fat, respectively. Their data confirm an earlier report by Roche (1974) that forests and woodlands, among other natural resources in West Africa, provide a very cheap and abundant supply of protein and carbohydrates.

The African breadfruit can be used in a variety of ways. The seeds are small, brownish in colour and, when roasted, have a groundnut aroma. They could be used to thicken soup or be processed into a refreshing drink. Other uses include breadfuit cookies, breadfruit flour, cakes and soup mixes. Like many others, the African breadfruit tree plays a large part in the traditional diet of the West African peoples. If properly processed and preserved, its products could be easily used to meet various culinary needs and the by-products used as livestock concentrate.

Very little information is available in the literature on the chemical and amino acid composition of the African breadfruit. This paper contributes to our knowledge of the useful plants of Tropical West Africa by reporting on the proximate chemical analysis and amino acid composition of African breadfruit.

MATERIAL AND METHODS

The mature fruits were collected early in 1982 from trees growing in various localities in the Imo State of Nigeria. The fruits were covered with banana leaves and left to ferment for a few days. They were then removed from the pulpy substance and washed until thoroughly free of any material. The seeds were then sun dried for 12 h, subsequently dried in an oven at 80 °C for 24 h and then ground in a Waring mill into fine flour. The flour was stored in airtight bottles from which samples were taken for all the various analyses.

Chemical determinations

Crude protein, moisture, crude fibre and ether extract were determined using standard procedures (AOAC, 1975). Phosphorus was determined colorimetrically as the phosphomolybdo-vanadate complex using the AOAC (1975) procedure. All other minerals were determined by the

atomic absorption method, as outlined in the Perkin–Elmer Manual (1971).

The amino acid contents of the samples were determined, using an automatic amino acid analyser, at the Poultry Research Centre, Roslin, Scotland. Tryptophan was determined by enzymolysis using a modified version of the method of Holz (1972), as described by McNab & Scougall (1982). The sulphur-containing amino acids were determined by oxidation with performic acid using the procedure of Moore (1963).

RESULTS AND DISCUSSION

From the proximate composition of *Treculia africana* (Table 1), it is observed that the seeds contain high amounts of protein and fat. The values of 23% and 11% for protein and fat, respectively, are about the same as those reported by Okafor & Okolo (1974), although the protein content we obtained in this study was higher than reported values. Of the four tropical trees compared in the Table, African breadfruit is second best after *Pentaclethra macrophylla*. It is interesting to note, too, the very high oil contents of the other trees, African breadfuit having the lowest. Okafor & Okolo (1974) have reported iodine values of 66·37, 70·58, 4·50 and 56·90 for *Treculia africana*, *Pentaclethra macrophylla*, *Irvingia gabonensis* and *Dacroyodes edulis*, respectively. The iodine value of *Irvingia gabonensis* is low, which they suggest is indicative of a low degree of unsaturation. Compared with other trees, the seeds of *Treculia africana* have a medium fat content and this can be exploited for both industrial and nutritional purposes.

The mineral content of the seeds shows that phosphorus and potassium are in abundance (364 and 601 mg/100 g edible portion, respectively) so that 100–200 g of the seeds might provide sufficient of these two minerals to meet daily requirements. However, the seeds are poor sources of calcium, iron and sodium. The low calcium content would lead to a low Ca/P ratio.

The results of the amino acid determination (Table 2) of African breadruit are compared with those of two other common oil seeds—soybean and groundnut. The levels of two essential amino acids, threonine and lysine, found in African breadfruit, compare favourably with values found in groundnut, which is used both for human food and as a livestock feed. Most of the other essential amino acids make up a third, or half, of

TABLE 1
Chemical Composition of the Seeds of African Breadfruit Compared With Some Other Tree Crops

Tree crop	*Crude protein* %	*Ether extract* %	*Crude fibre* %	*Ash* %	*Nitrogen-free extracts* %	*Food energy (calories)*	*Iodine value*[b]	*Minerals (mg/100 g edible portion)*				
								Ca	*P*	*Fe*	*K*	*Na*
African breadfruit (*Treculia africana*)	23·2	11·4	1·34	1·98	62·2	418	66·4	18·2	364	1·49	601	4·90
Pentaclethra macrophylla[a]	28·4	23·0	—	—	—	—	70·6					
Irvingia gobanensis[a]	8·65	72·0	—	—	—	—	4·50					
Dacryodes edulis[a]	4·47	44·0	—	—	—	—	56·9					

[a,b] Source: Okafor & Okolo (1974).
—, Not available.

TABLE 2
Amino Acid Composition of African Breadfuit Compared with Soybean and Groundnut (Grams per kilogram of sample)

Amino acid	*African breadfruit*	*Soybean*	*Groundnut*[a]
Aspartic acid	12·5	49·0	32·7
Threonine	7·1	18·0	7·7
Serine	8·5	22·5	15·5
Glutamic acid	15·7	73·6	57·4
Proline	5·2	19·1	13·5
Glycine	9·2	18·3	17·2
Alanine	5·8	19·4	11·2
Valine	8·5	20·1	12·1
Isoleucine	7·0	18·2	10·0
Leucine	8·7	29·2	18·9
Tyrosine	6·2	13·7	11·5
Phenylalanine	7·2	17·5	15·8
Histidine	3·9	10·1	6·3
Lysine	7·9	24·4	9·5
Arginine	6·0	26·5	32·4
Cystine	1·2[b]	6·1[b]	3·7
Methionine	1·6	5·4	3·2
Tryptophan	1·9	3·2	2·9

[a] Source: Jansen *et al.* (1979).
[b] Half cystine.

what is found in groundnut or soybean. These results differ from those reported by Edet *et al.* (1982) who failed to detect a number of essential amino acids in African breadfruit, notably methionine, tryptophan, isoleucine and leucine. Two of the dispensable amino acids—aspartic and glutamic acids—are abundant in African breadfruit. This is of significance because most of the dispensable amino acids derive their α-amino groups from glutamic acid which, in turn, is synthesized from α-ketoglutaric acid and ammonia. Aspartic acid is a precursor of such essential amino acids as methionine, threonine and lysine (Stryer, 1981) and its high level, as shown by this result, is therefore to be expected.

The sulphur amino acids are of low concentration and seem to be the limiting amino acid. However, considering its relatively high levels of some essential amino acids, especially lysine, breadfruit could be used as an alternative source of vegetable protein, suitable as a supplement to livestock feed.

ACKNOWLEDGEMENT

The author acknowledges with thanks the technical assistance provided by Mr R. K. Scougall and the staff of the Poultry Research Centre, Roslin, Edinburgh, Scotland, in determining the amino acid content.

REFERENCES

AOAC (1975). *Official methods of analysis* (12th edn). Association of Official Analytical Chemists, Washington, DC.

Edet, E. E., Eka, O. U. & Ifon, E. T. (1982). Chemical evaluation of the nutritive value of seeds of African breadfruit (*Treculia africana*). Abstract, Science Association of Nigeria, No. 026.

Ekpenyong, T. E., Fetuga, B. L. & Oyenuga, V. A. (1977). Fortification of maize flour-based diets with blends of Cashewnut meal, African Locust Bean Meal and Sesame Oil Meal. *J. Sci. Fd Agric.*, **28**, 710.

Graham, H. D. & De Bravo, E. N. (1981). Composition of the breadfruit. *J. Food Sci.*, **46**, 535.

Holz, F. (1972). Automatische Bestimmung von Tryptophan in Proteinen and proteinhaltigen Pflanzenproduckten mit Dimethiaminozimtaldehyde. *Landwirtsch. Forsch.*, **27**, 96.

Jansen, W. M. M., Tarpstra, K., Beeking, F. F. E. & Bisalsky, A. J. N. (1979). *Feeding values for poultry* (2nd edn). Spelderholt Institute for Poultry Research, Beekbergen, The Netherlands.

Kennard, W. & Winters, H. (1960). *Some fruit and nuts for the Tropics.* Miscellaneous Publication 801, USDA, Washington, DC.

McNab, J. M. & Scougall, R. M. (1982). The tryptophan content of some feedingstuffs for poultry. *J. Sci. Fd Agric.*, **33**, 715.

Moore, S. (1963). On the determination of cystine as cysteic acid. *J. Biol. Chem.*, **238**, 235.

Okafor, J. C. & Okolo, H. C. (1974). Potentialities of some indigenous fruit trees of Nigeria. Paper presented at the 5th Annual Conference of the Forestry Associations of Nigeria, Jos. 1–6 December.

Perkin–Elmer (1971). *Analytical methods for atomic absorption spectrophotometry.* Perkin–Elmer, Norwalk, Connecticut. USA.

Reeve, R. M. (1973). Histological structure and commercial dehydration of the breadruit. *Econ. Botany*, **28**, 82.

Roche, L. (1974). Major trends and issues in forestry education in Africa: A view from Ibadan. Paper prepared for World Consultation of Forestry School Executives. Helsinki, Finland, August 18–24, 1977.

Stryer, L. (1981). *Biochemistry* (2nd edn). W. H. Freeman and Co., San Francisco.