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Technical Note

Fatty Acid and Amino Acid Composition of African Oil Beans *(Pentaclethra Macrophylla)*

ABSTRACT

Fatty acid analysis of petroleum ether (b.p. 40–60°C) extracts of African oil beans by GLC has shown relatively high proportions of linoleic (45%) and oleic (29·5%) acids. The concentrations of other fatty acids, e.g. palmitic acid (3·76%) and stearic acid (2·80%), were comparatively lower.

Amino acid analysis of the beans by reversed phase HPLC (PICO-TAG system) has shown that the proteins in the beans are rich sources of (in order of increasing value) proline, phenylalanine, tyrosine, valine and threonine. All the essential amino acids assayed were present at substantial levels. Lysine, with a chemical score of 31·3, was the first limiting amino acid while leucine (chemical score 40) and methionine (chemical score 62) were the second and third limiting amino acids, respectively. These results indicate the high nutritional potential of African oil beans.

INTRODUCTION

African oil bean (*Pentaclethra macrophylla*) occurs in rain forests of the humid tropics. In Nigeria it is commonly found in the southern regions either cultivated or growing wild. The beans are located in long pods and are usually dispersed by an explosive mechanism. The oval-shaped bean has a hard brownish testa which encloses the cotyledon (the edible portion). It usually takes long hours of cooking (often followed by fermentation in the traditional method) to prepare the beans for consumption. The prepared beans are either eaten alone as a delicacy, or in combination with other

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vegetable foods. In Nigeria, the consumption of the beans cuts across age and socio-economic groups. Thus, African oil bean could contribute significantly toward the nutrient requirements of a cross section of the population.

Literature is scarce and, where available, scanty on the nutrient composition of African oil bean (Achinewhu & Ryley, 1986). This note reports its fatty acid and amino acid compositions.

MATERIALS AND METHODS

The African oil beans were bought from a local market in Calabar, Cross River State, Nigeria. They were washed clean with tap water before the testa were cut open to extract the edible cotyledons, which were sliced and dried to constant weight at 75°C in air-draught oven (Astell-Hearson, London, UK). The dried samples were pulverised, mixed thoroughly and stored in polythene bags in a refrigerator.

The dried sample powder was extracted exhaustively with petroleum ether (b.p. 40–60°C) using a Soxhlet apparatus (AOAC, 1980). The methylesters of the fatty acids in the ether extract were prepared and analysed by GLC (Hewlitt–Packard, Downers Grove, IL, USA), as described by Beeler (1987).

The residue after ether extraction was analysed for its amino acid composition by reversed phase chromatography using the PICO-TAG system (Waters Associates, Milford, MA, USA) after precolumn hydrolysis and derivatisation as described by Bidlingmeyer *et al.* (1984).

The amino acid (or chemical) score of the protein in African oil bean was calculated as follows (WHO, 1973):

$$\text{Amino acid score} = \frac{\text{mg of amino acid in 1 g of bean}}{\text{mg of amino acid in 1 g reference pattern (egg)}}$$

All analyses were carried out in triplicate.

RESULTS AND DISCUSSION

The results of fatty acid analysis of the lipid extract from African oil bean are presented in Table 1. The bean oil is apparently rich in the unsaturated fatty acids linoleate (45·3%) and oleate (29·5%). The content of the saturated fatty acids palmitate (3·76%) and stearate (2·80%) are comparatively lower. It is worth noting that the GLC showed some peaks which could not be identified for technical reasons. The linoleate content in African oil bean is

TABLE 1
Fatty Acid Composition of African Oil Beans (*Pentaclethra macrophylla*)

Fatty acid	*Total lipid extracted with petroleum ether, b.p. 40–60°C (%)*[a]
Palmitic acid	3·77 ± 0·03
Stearic acid	2·80 ± 0·30
Oleic acid	29·7 ± 0·15
Linoleic acid	45·0 ± 0·27

[a] Means of 3 determinations ± SD.

TABLE 2
Amino Acid Composition of African Oil Beans (*Pentaclethra macrophylla*)

Amino acid	*Content*[a] *(g/kg dry matter)*
Aspartic acid	37·8 ± 3·5
Glutamic acid	27·5 ± 2·1
Serine	32·5 ± 0·7
Glycine	36·2 ± 0·6
Histidine	25·2 ± 2·2
Arginine	37·8 ± 3·5
Threonine	54·1 ± 1·9
Alanine	19·3 ± 0·8
Proline	582 ± 7·9
Tyrosine	103 ± 3·9
Valine	60·2 ± 2·0
Methionine	13·2 ± 0·1
Cystine	23·7 ± 3·5
Isoleucine	35·7 ± 2·2
Leucine	27·6 ± 1·1
Phenylalanine	115 ± 4·8
Lysine	27·3 ± 0·5
Tryptophan	ND

[a] Mean of 3 determinations ± SD.
ND, Not determined.

comparable to the value of 42% reported in cotton seed (*Gossypium* spp.) as well as African locust bean (*Parkia filicoidea*) oils (Busson, 1965; Oyenuga, 1968). It is, however, poorer than the value of 62% reported for watermelon (*Citrullus vulgaris*) oil while being richer than the linoleate contents in African bush mango (*Irvingia gabonensis*) and groundnuts (*Arachis hypogea*), which range between 2% and 19·7% (Oyenuga, 1968; Eka, 1980). The oleate contents in African oil bean compare well with the value (25%) reported for cotton seed oil (Oyenuga, 1968). African bush mango is lower (1·88%) in oleate whereas groundnut is higher (61·8%) (Oyenuga, 1968) when compared to African oil beans. These observations underline the fact that, although plants are usually recommended as sources of unsaturated fats, the contents vary widely in types and amounts among different sources. Thus, it is necessary to investigate the lipid composition of individual plant sources.

Table 2 shows the individual amino acids contents in the bean while Table 3 shows their chemical (or amino acid) scores. The results show that proline, phenylanine, tyrosine, valine and threonine are predominant with values increasing in that order. All the essential amino acids (except tryptophan which was not determined) are present in substantial amounts. This suggests that African oil bean protein is a rich source of essential amino acids.

However, it is observed that, when compared to a reference pattern of

TABLE 3

Essential Amino Acid Composition and Chemical Score of African Oil Bean (*Pentaclethra macrophylla*) Compared with Other Plant Sources and Whole Hen's Egg Pattern

Essential amino acid (g/kgDM)	*African oil bean*	*African[a] locust bean*	*Soya bean[b]*	*Whole hen's egg[c]*
Threonine	54·1	38·0	36·8	40·0
Tyrosine	103	44·0	41·5	26·6
Valine	60·2	56·0	49·3	53·4
Methionine	13·2	4·0	11·4	21·3
Isoleucine	35·7	48·0	58·6	40·8
Leucine	27·6	85·0	76·3	69·0
Phenylalanine	115	58·0	57·6	37·8
Lysine	27·3	73·0	62·4	86·1
Tryptophan	ND	ND	13·7	16·3
Chemical score	31·3	18·8	53·5	100

[a] Oke and Umoh (1978).
[b] Fetuga *et al.* (1974).
[c] Mba (1980).
ND, Not determined.

whole hen's egg (Mba, 1980), lysine (chemical score 31·3) is the first limiting amino acid, while leucine (chemical score 40) is the second. This differs from African locust bean and soya bean in which methionine and lysine are the first and second limiting amino acids (Fetuga *et al.*, 1974; Oke & Umoh, 1978). The score of the first limiting amino acid approximates to the probable efficiency of utilisation of the test protein (WHO, 1973). Thus, these results of amino acid composition imply that African oil bean should be consumed with mixtures of dietary protein from different plant sources in order to complement one source lacking in essential amino acid(s) with others rich in such amino acid(s).

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