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THE CHEMICAL COMPOSITION OF *STERCULIA SETIGERA*

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Target Audience: Animal nutritionists, livestock producers

ABSTRACT

Samples of *Sterculia setigera* seeds were analysed for proximate composition, elemental and amino acid composition. The nutritive value of the seed was extrapolated by comparing its oil, protein crude fibre, ash and nitrogen free extract (NFE) contents with other known edible seeds. Comparison of the results with the recommended nutrient requirements showed that the seed is adequate in its protein content. Quantitative chromatographic analysis of the seed hydrolysates revealed 18 amino acids. Comparing the amino acids of kukkuki with hen's egg, showed a higher superiority in alanine, arginine, aspartic, cystine and histidine but a deficiency in isoleucine and leucine.

DESCRIPTION OF PROBLEMS

Most foods consumed by the peasant Nigerians are indigenous but little is known about their chemical composition and nutritional values (1,2). A typical example is the *Sterculia setigera* seeds eaten as relics by the nomadic Fulanis and their animals. *Sterculia setigera* belongs to the family Sterculiaceae and the genus Sterculia (3). It is a tropical and subtropical family of 60 genera and 700 species. In West Africa, it is composed of 17 genera and 83 species (4). It is called *Kukkuki* by the Hausa populace in Nigeria (5). It is conspicuous in the dry season because of its large persistent fruits. The tree grows to about 10 m and the trunk is concorted with reddish bark, which later flakes off in thick dark brown scale exuding a gummy sap. The stem when cut yields a clear liquid and the fibres may be woven into mats or used as cordage. The gummy bark is used in treating catarrh and the powder when mixed with *Ficus carpenses* and *Danellia oliveri* can be used to treat leprosy (6). When used in conjunction with other herbs, it is effective in the treatment of some venereal diseases. The seeds when fed to cows make them prolific (7).

Although relevant literature on the chemical composition of these seeds is sparse, preliminary studies have shown that the seed may be rich in oil, crude protein and mineral salts . Prompted by the paucity of information and the search for cheap source of

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oil and protein food effective for the prevention and treatment of protein /caloric malnutrition (pcm) which mostly affects infants and children of

low income group who cannot afford to buy expensive animal protein and blends of vegetable proteins, this paper reports the chemical composition of *Sterculia setigera* with a view to appraising its nutritive value.

MATERIALS AND METHODS

In the preparation of reagents, chemicals of analytical grade, clean and glass distilled water were used. All samples were authenticated by comparison with Herbarium sample of Bayero University Botanical Garden in Kano. Samples of matured seeds were collected from wild trees in Bauchi and Gombe States, Nigeria.

Treatment of Sample

The seeds were shelled and crushed to fine powder in a steel- bladed electric mill (National Food Grinder, Model Mu 308, Japan) and was sieved through a 30 unit mesh sieve (8). Each sample was oven dried at 102^0C to constant weight. The samples were then packed in a doublestacked water proof polythene bag and stored in screw capped bottles before analysis.

Chemical Analysis

The flour was analysed for its moisture, ether extract, crude protein, crude fibre, ash and NFE by the official AOAC methods (9). Ash content was determined by dry ashing method and was further analysed for the mineral content by atomic absorption spectroscopy.

The amino acid profiles were quantitatively carried out (10) using automatic amino acid analyzer (Technicon TSM Sequential Multisample Analyzer). Samples were hydrolysed for determination of all amino acids except for tryptophan in constant boiling 6 M hydrochloric acid for 24 hr under nitrogen flush.

Data Analysis

All the statistical computations were done on a PC 686 66MHz microcomputer using either the integrated statistical package for Windows from Umstat Ltd (London) or dedicated macro instruction for the Excel Spreadsheet from Microsoft. This approach enabled the advantages of the various computational and graphic facilities of both types of software to be used with the ability to read different formats (11.12).

RESULTS AND DISCUSSION

Results of the proximate composition of the experimental material and other parameters are as shown in Tables 1 - 6. Table 1 shows the proximate composition. Table 2 shows the elemental composition while Table 3 shows the amino acid composition. Table 4 compares the amino acid in kukkuki with those of soybean, groundnut, cotton, etc. Table 5 compares the kukkuki amino acid with the hen's egg while Table 6 shows its essential amino acid with those recommended by FAO/WHO.

The moisture content is within the acceptable range for a good keeping period (13). With a lipid content of 42.67%, the seed is comparable with those of soybean and groundnut that are

commercially exploited and thus can be classified as an oil seed. The crude protein was high though not as with groundnut. *Sterculia setigera* crude fibre of 3.57% is the least among the oil seeds in Table 1. Since the crude fibre is an index of the feeding quality of poultry and stock feeds. kukkuki may then have high nutritional value. Considering the mineral elements content of the seed (Table.2) the sample appeared adequate in calcium. sodium. potassium. magnesium. iron zinc and copper for poultry feed.

TABLE 1: Proximate composition of *Sterculia setigera* seeds compared with seeds of other plants

	S.setigera	Soybean[a]	Groundnut[a]	Locustbean[a]	Cotton[a]
Moisture	7.17± 0.03				
Lipid Content	42.67± 1.55	19.10	50.9	20.30	14.05
Crude Fibre	3.57± 0.035	5.17	9.61	8.82	21.61
Crude Protein	25.83± 0.18	44.08	27.20	30.38	28.47
Ash	3.86± 0.03	5.06	2.79	6.42	4.75
NFE	24.50± 1.48	26.05	9.48	35.12	31.12

a: (24)

TABLE 2: Elemental composition of *Sterculia setigera* seed (mg/g) (mean ± Std Dev)

Sterculia setigera	**Elemental Concentration**
Calcium	3.33±0.01
Iron	4.00±0.06
Sodium	26.03±1.12
Pottasium	82.69±4.22
Phosphorus	3.48±0.15
Zinc	1.19±0.21
Magnesium	0.62±0.15
Copper	1.02±0.01

Quantitative chromatographic analysis of the seed hydrolysates revealed the presence of 18 amino acids. The seed is rich in glutamic. aspartic. cystine. phenylalanine and alanine in that order. Other essential amino acids are moderate. Tryptophan was not determined while isoleucine was the limiting amino acid (Table3).

A comparative study of the seed and the hydrolysates of soybean. groundnut. locustbean and cotton show that its crude protein and amino acid contents compared with those of edible ones. Except for cystine. glycine. isoleucine and leucine. there were no significant differences in the amino acid composition of *Sterculia setigera* with those of soybean and groundnut (Table 4). Comparing the amino acid of the seed with that of hen's egg (Table5) the seed appeared superior to the egg in alanine. arginine. aspartic acid. cystine

TABLE 3: Amino acid composition of *Sterculia setigera* seed (mg/g) dry amino acid value (mg/g Dm)

Alanine	5.99 ± 0.72
Arginine	7.12 ± 2.35
Aspartic acid	7.60 ± 1.66
Cystine	7.50 ± 3.36
Glutamic acid	12.46 ± 1.68
Glycine	3.28 ±0.15
Histidine	3.23 ± 0.92
Isoleucine	2.19 ± 0.19
Leucine	3.97 ± 0.42
Lysine	4.49 ± 1.20
Methionine	2.37 ± 0.41
Phenylalanine	6.28 ± 0.82
Proline	3.25 ± 1.49
Serine	4.51 ± 1.08
Threonine	5.70±0.41
Tryptophan	-
Tyrosine	3.40 ± 0.29
Valine	4.68 ± 0.79

and histidine contents as indicated by the chemical score but deficient in isoleucine and leucine (13, 14).

Comparing *S.setigera* with other oil seeds, which are known for their nutritive values as rations in feeds, the seed is rich in the sulphur hydroxyl imino, aromatic, acidic and basic amino acids, but deficient only in isoleucine and leucine (Table4). The seed may be recommended for human consumption since the sulphur amino acids are important in diets for the children, nursing mothers and pregnant women (15). Comparing the amino acids in *S.setigera* with the FAO/WHO (Table 6) recommended provisional pattern; the seed is superior with respect to arginine, lysine, histidine, methionine, threonine, tyrosine and valine. It is only for isoleucine and leucine that supplementation may be required (16).

Table 4: Amino acid composition of *Sterculia setigera* seeds compared with some plant and animal protein sources (mg/g DM).

Amino acid	S.setigera	Soy bean[b]	Ground nut[a]	Locust bean[b]	Cowmilk[c]	Fish[c]
Alanine	5.99±0.72	3.9	4.9	3.6	6.1	
Arginine	7.12±2.35	8.42	12.4	4.5	3.5	6.6
Aspartic acid	7.60±1.66		11.6	23.1	7.5	8.6
Cystine	7.50±3.36	1.58	1.4	0.8	0.9	1.2
Glutamic acid	12.46±1.68		19.3	15.9	21.7	12.0
Glycine	3.28±0.15		-	3.7	2.1	5.4
Histidine	3.23±0.92	2.55	2.4	1.8	2.7	2.9
Isoleucine	2.19±0.19	5.10	3.6	3.1	6.5	5.2
Leucine	3.97±0.42	7.72	6.4	5.4	9.9	7.9
Lysine	4.49±1.20	6.86	3.6	5.2	8.0	10.1
Methionine	2.37±0.41	1.56	1.4	0.8	2.4	2.8
Phenylalanine	6.28±0.82	5.01	4.9	3.5	5.1	3.8
Proline	3.25±1.49	4.31	4.5	4.6	9.2	5.1
Serine	4.51±1.08	5.0	4.0	5.2		3.5
Threonine	5.70±0.41	4.31	2.6	2.7	4.7	4.5
Tryptphan 0.9	-	- 1.28		-	-	1.3
Tyrosine	3.40±0.29	3.9	3.8	2.7	4.9	2.4
Valine	4.68±0.79	5.38	4.6	4.1	6.7	5.5

a (23): b (24): c(14)

The amino acid profiles of *S.setigera* thus suggest that its protein content could be of potential value. The similarity in its profiles with those of soybean, groundnuts, locust bean and cotton suggests its possible uses as food supplements. The lipid content is of commercial quantity while the meal because of its high methionine content could be blended with other meals to produce high quality animal feed.

Whilst widespread malnutrition in developing countries persists inspite of gains in production of basic cereal foods, protein and vitamin deficiencies are widespread (17, 18) as shown by blindness and poor physical and mental development in vulnerable groups in many tropical countries surrounded by edible green leaves and fruits which contain more than sufficient amounts of vitamin A, protein, mineral elements, fats and oil if eaten to prevent diseases (19,20,21,22). However, the disease continues because we choose not to eat leaves or wild fruits. Vegetable crops and some wild fruits offer the most rapid and lowest cost method for providing adequate supplies of vitamins, minerals and plant proteins to these disadvantaged groups.

TABLE: 5 Chemical score of *Sterculia setigera* amino acid relative to hen's egg.

Amino acid	*S setigera*	Hen.s egg(13)	%Chemical score.
Alanine	5.99	5.87	102.04
Arginine	7.12	7.06	100.85
Aspartic acid	7.60	5.80	131.04
Cystine	7.50	0.64	
Glutamic acid	12.46	13.14	94.84
Glycine	3.28	3.36	97.62
Histidine	3.23	2.96	109.12
Isoleucine	2.19	7.32	29.92
Leucine	3.97	9.58	41.44
Lysine	4.49	7.26	61.85
Methionine	2.37	3.52	67.33
Phenylalanine	6.28	6.58	95.44
Proline	3.25	4.43	73.36
Serine	4.51	7.45	60.05
Threonine	5.70	5.49	67.94
Tryptophan	-	1.92	
Tyrosine	3.40	4.96	68.55
Valine	4.68	8.04	58.21

TABLE 6: Comparing recommended FAO/WHO essential amino acids provisional pattern with those in *Sterculia setigera* seeds.

Amino acid	***Sterculia setigera***	**FAO/WHO(16)**
Arginine	7.12	2.00
Histidine	3.23	2.40
Isoleucine	2.19	4.20
Leucine	3.97	4.80
Methionine	2.37	2.20
Phenylalanine	6.28	2.80
Threonine	5.70	2.60
Trypophan	-	1.40
Valine	4.68	4.20

CONCLUSION AND APPLICATION

A whole range of fruits, little known or utilised in the tropical and subtropical world are excellent sources of essential nutrients and merit attention as is the case of *Sterculia setigera*. Its seeds not only offer the potential for nutritional improvement but also economic and medicinal. Improvements to the poor people in both rural and urban environments. Its oil

content is of commercial quantity, while the meal may be used as nutritional supplementation and fortification of stable grains.

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