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Analysis of Proximate and Amino Acid Profiles of Sterculia Setigera (Karaya Gum Tree) Seed

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Abstract- ***In order to solve global food security and provide sustainable nutritional supplies, it is imperative that underused plant species be explored. In order to assess the nutritional potential of Sterculia setigera seeds, the study examine the proximate and amino acid composition. The seeds have 8.13% moisture, 26.45% crude protein, 10.87% crude fat, 3.26% crude fiber, 3.72% ash, and 25.46% carbohydrates, according to proximate analysis. Amino acid profiling revealed the presence of all essential amino acids, with cysteine, phenylalanine and threonine being main contributors. The abundance of non-essential amino acids, such as aspartic and glutamic acid, improved the nutritional value and functionality of the seed proteins. According to the findings, Sterculia setigera seeds are a promising source high-quality protein and energy source that can be used in food and feed applications.***

Keywords: Amino Acid Profiles, Nutritional Potential, Proximate Analysis, Sterculia Setigera Seed.

I. INTRODUCTION

Numerous native seeds are being investigated as a result of the growing need for underutilized and alternative plant-based protein sources. The ongoing quest for new food supplies is crucial in emerging nations to reduce hunger, which is brought on by population expansion, a lack of a mechanized farming system, and a shortage of arable land. The severity of this issue is highlighted by projections of future requirements based on present rates of population increase and food production. For rural communities' food security, health, and social and economic well-being, non-timber forest products (NTFP) are crucial [1]. While conventional agriculture is taking steps to increase food production, there is currently a lot of interest in the potential for utilizing the numerous unfamiliar plant edible resources found in the wild [2, 3. 4].

Sterculia setigera is a member of the genus *Sterculia*, order *Malvales*, family *Malvaceae*, subfamily *Sterculiaceae*, and kingdom *Plantae.*

The karaya gum tree is its English name.
Various indigenous cultural groupings in Nigeria have distinct names for *Sterculia setigera Del*. Yoruba: "Ose-awere," "eso funfun"; Fulani: "Bo'boli"; Kanuri: "Sugubo"; Hausa: "Kukuki"; Nupe: "Kokongiga";Idoma: "Ompla," "Upula"; Igede: "Upuru"; Igala: "Ufia"; Tiv: "Kume-ndul," "Kumenduur"; Etulo: "Idafu" [5, 6, 7, 8, 9, 10, 11, 12]. It is a savannah tree that grows widely in tropical Africa's savannah regions. This tree is commonly found in savanna areas of Nigeria, especially in the northern states of Sokoto, Kano, Kebbi, Katsina, Zamfara, Bauchi, and Yobe, as well as in the central states of Niger, Nasarawa, Kogi, Taraba, and Plateau. The tree grows in broad savannah forests, which are frequently distinguished by stony hills, and its seeds have yellow aril [5, 11, 12].

With a buttressed base and an open spread crown, *Sterculia setigera* can grow up to 18 meters in height. A slice shows a fibrous, brownish-to-red inner bark with a white exudate, while its grey, purple bark peels off in thin, uneven scales, leaving pale spots [13]. Simple, alternating leaves with palmately organized nerves are present. The upper surface of the leaf blade is often stellate and tomentose, with an outline that ranges from ovate to orbicular. As the dry season draws to a close, the blossoming season starts [14]. Fruit is a sessile follicle that is 6–10 cm long, rectangular, grey-green or brown in color, and has many seeds. The follicle can remain on the tree even after the seeds fall off.

The wood is very soft and white to be used for charcoal and fuel wood. As a result, it is applied to non-timber forest products (NTFP). In carpentry, it is utilized for hidden objects and insulation. The tree yields karaya, a gum that dissolves in water. Technically, the gum is used as an adhesive and for coating ceramics; in

medicine, it is used as a laxative, diuretic, and tranquilizer; and in culinary, it can be tapped and utilized as an emulsifier, stabilizer, and viscosifier. The sap from the bark can be turned into a cool beverage, while the bark itself is used to make rope. The bark is also used in traditional medicine to cure rickets, leprosy, syphilis, coughs, bronchitis, snake bites, and insanity. The leaves are used as cattle feed, while the seeds are edible and contain an edible oil [15]. The stem bark has long been used to heal wounds, bilharzia, asthma, bronchitis, jaundice, and dysentery. Leaves are used to cure malaria and to relieve discomfort. Edible oil is present in the edible seeds. Dermatosis is treated with seeds and stem bark [16]. As part of a herbal regimen, a decoction of stem bark extract is used to treat toothaches, fever, diarrhea, and skin conditions and infections [17]. The stem bark's methanol extract is used to treat wounds, diarrhea, jaundice, and dysentery. The exudate (gum) is used to cure rickets, leprosy, syphilis, snake bites, coughs, bronchitis, and insanity [18].

The nutritional and industrial potential of edible fruit seeds, some of which had previously been thrown away has been documented in literature [19, 20, 21]. The majority of findings on several conventional and lesser-known crops suggest that they may be good suppliers of nutrients, and many of them have the potential to expand the human species' currently limited dietary base [22]. According to [23], *sterculia setigera* are abundant in minerals, digestible proteins, and a wide variety of amino acids. Most legumes have crude protein contents between 20 and 50 grams per 100 grams of dry weight. According to reports, legumeous seeds are a great source of energy for both humans and animals [24]. This is why a lot of research has been done to maximize the seed's potential in diets for both humans and animals.

[26] Also reported that a significant amount of carbohydrates (73.7%) are present in *sterculia monosperma seeds. The moisture content was 62.8%, which is necessary for their preservation and delivery* to new markets from the perspective of human consumption. The crude fat content was 12.04%, protein 7.77%, fiber 5.46%, and ash 1.03%. However, during storage and transportation, the high moisture content poses a mold concern.

Despite being widely available and having cultural value in many cultures, the important plant species *Sterculia setigera*, sometimes known as the Karaya gum tree, is still underutilized since little is known about its nutritional and biochemical qualities. There is limited scientific data on the seeds' proximate composition and amino acid profile, despite the fact that they have historically been utilized medicinally and for other purposes.

Their effective use and promotion as a viable alternative source of nutrients is limited by this information gap, especially in areas where conventional protein sources are less accessible and food insecurity is a problem. To assess *Sterculia setigera* seeds' nutritional worth, possible health advantages, and role in human diets, it is crucial to evaluate their proximate composition and amino acid profile. By examining the proximate and amino acid profiles of *Sterculia setigera* seeds, this study aims to close the information gap on alternate plant-based food sources and assist their potential incorporation into food industries and nutrition programs.

II. MATERIALS AND METHODS

Materials:

Sterculia setigera samples were collected from the plant in Nigeria's Nasarawa state. After being cleaned of impurities, the seeds were allowed to dry in the sun for seven days before being ground in an electric mill (National Food Grinder, Model MK308, Japan). After passing through a 40 mesh sieve, it was kept at room temperature in a plastic container until it was needed.
Proximate analysis

Determination of moisture content
The oven drying method was used to determine the moisture content. After weighing two grams of the ground sample in a dry, clean crucible, it was oven-dried at 105 degrees Celsius until its weight remained constant. After that, the crucible was left to cool before being weighed again. A percentage of the initial weight was used to represent the moisture content [27].

$$\% \text{ Moisture} = \frac{W_1 - W_2}{\text{Weight of sample}} \times 100$$

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Where:
W_1 = Initial weight of the crucible and the sample before loss of moisture
W_2 = Final weight of crucible and the sample after loss of moisture

Determination crude protein:
Kjeldahl nitrogen analysis was used to measure the total nitrogen content [28], and the total nitrogen was multiplied by a factor of 6.25 to estimate the proportion of crude protein.

Determination crude ether extract:
In order to determine the crude ether extract, 2.0g of a dry ground sample was extracted with petroleum ether for 12 hours in a soxhlet. The solvent was then removed using a rotary evaporator, and the sample was dried in a hot air oven set at 1000C for approximately an hour to allow the ether to evaporate [28].

Determination of crude fibre:
The crude fibre was carried out using methods described by [28].
Determination of ash content:
2g of the grounded samples were weighed in dry crucible and heated in a furnace at 550^0C after six hours it was allowed to cooled in a desiccator and weighed ([29] Degnew *et al.,* (2009). The total ash content was determine using the following expression:

$$\frac{W_3 - W_2}{W_1} \times 100$$

Where:
W_3 = Weight of the sample and crucible after heating
W_2 = Weight of empty crucible
W_1 = Weight of the sample before heating.
The total carbohydrate content was determined by subtracting the total percentage of all other components above from 100.

Each sample was analyzed in triplicate.
Determination of Amino Acid Composition
The amino acids profiles of *sterculia setigera* were quantitatively analyzed as described by [30], using automatic amino acid analyzer (Technicon (TSM) Sequential multisample amino acid analyzer). Samples were hydrolysed for determination of amino acids in constant boiling of 6M hydrochloric acid for 24 hours under nitrogen flush [14].

III. RESULT AND DISCUSSION

Table 1: Proximate Composition of *Sterculia setigera* seed

Nutrients	Percentage
Moisture	08.13 ± 0.33
Crude Protein	26.45 ± 0.51
Crude fat	10.87 ± 0.35
Crude Fibre	03.26 ± 0.12
Ash	03.72 ± 0.18
Carbohydrate content	25.46 ± 0.20

Table 2: Amino acid Composition of *Sterculia setigera* seed in mg/g

Amino Acid	Mg/g
Alanine	5.89 ± 0.27
Arginine	7.53 ± 0.47
Aspartic Acid	6.94 ± 0.20
Cystine	8.01 ± 0.01
Glutamic Acid	13.10 ± 0.28
Glycine	3.21 ± 0.44
Histidine	3.43 ± 0.10
Isoleucine	2.09 ± 0.06
Leucine	3.62 ± 0.03
Lysine	4.65 ± 0.21
Metheonine	2.31 ± 0.16
Phenylalanine	6.32 ± 0.30
Proline	3.41 ± 0.58
Serine	4.92 ± 0.59
Threonine	6.12 ± 0.17
Tryptophan	nd
Tyrosine	3.57 ± 0.38
Valine	4.87 ± 0.52

Table 3: Amino acid composition of *Sterculia setigera* seeds compared with Soya bean and groundnut (mg/g). [31]

Amino acid	Sterculia setigera	Soya beans	Groundnut seed

Alanine	5.89	3.90	4.90
Arginine	7.53	8.42	12.4
Aspartic acid	6.94	-	11.6
Cystine	8.01	1.58	1.40
Glutamic acid	13.01	-	19.3
Glycine	3.21	-	-
Histidine	3.43	2.55	2.40
Isoleucine	2.09	5.10	3.60
Leucine	3.62	7.72	6.40
Lysine	4.65	6.86	3.60
Methionine	2.31	1.56	1.40
Phenylalanine	6.32	5.01	4.90
Proline	3.41	4.31	4.50
Serine	4.92	5.00	4.00
Threonine	6.12	4.31	2.60
Tryptophan	nd	1.28	-
Tyrosine	3.57	3.90	3.80
Valine	4.87	5.38	4.60

Table 4: Chemical score of *Sterculia setigera* seeds amino acid relative to hen's egg [32]

Amino acid	Sterculia setigera	Hen's egg	% Chemical score
Alanine	5.89	5.87	100.34
Arginine	7.53	7.06	106.66
Aspartic acid	6.94	5.80	119.66
Cystine	8.01	0.64	1251.56
Glutamic acid	13.01	13.14	99.01
Glycine	3.21	3.36	95.54
Histidine	3.43	2.96	115.88
Isoleucine	2.09	7.32	28.55
Leucine	3.62	9.58	37.79
Lysine	4.65	7.26	64.05
Methionine	2.31	3.52	65.63
Phenylalanine	6.32	6.58	96.05
Proline	3.41	4.43	76.98
Serine	4.92	7.45	66.04
Threonine	6.12	5.49	111.48
Tryptophan	nd	1.92	-
Tyrosine	3.57	4.96	71.98
Valine	4.87	8.04	60.57

Table 5: Essential Amino Acid in *Sterculia setigera* seeds compared with FAO reference.

Essential Amino Acids	FAO Reference	*Sterculia setigera*
Arginine	2.00	7.53
Histidine	2.40	3.43
Isoleucine	4.20	2.09
Leucine	4.80	3.62
Lysine	4.20	4.65
Metheonine	2.20	2.31
Phenylalanine	2.80	7.13
Threonine	2.80	6.12
Tryptophan	1.40	nd
Valine	4.20	4.87

Table 1 shows the results of the proximate analysis of *sterculia setigera* seeds. The low moisture content prolongs the seeds' shelf life by improving storage stability and lowering the chance of microbial growth and spoiling [33]. The sample's crude protein content was 26.45%, which is similar to the 25.83% found in a study by [14] on the same species. Protein serves as a source of vital amino acids, which are necessary for bodily tissue growth, repair, and maintenance. The sample's crude fiber content was discovered to be 3.26%, which was less than what had previously been reported by [25]. The seeds' high crude lipid content emphasizes its potential as an oil source. The seed's 25.46% carbohydrate content promotes digestive health and aids in the prevention of chronic illnesses. Both essential and non-essential amino acids were found in the sample hydrolysates after quantitative chromatographic analysis of the amino acid content. Glutamic acid, cystine, arginine, and phenylalanine are abundant in the seed. It is deficient in isoleucine, others are moderate while tryptophan was not determined. (Table 2).

According to a comparison of the nutritional hydrolysate of *sterculia setigera* seed samples with those of soybeans and groundnuts, the seed is high in sulfur hydroxyl imino. Amino acids that are acidic, basic, and aromatic but lacking in arginine, leucine, and isoleucine (Table 3). The sulfur amino acid is important for pregnant women and nursing mothers, as well as for developing children [34]. Contrasting the amino acid content of hen eggs and *sterculia setigera* seeds (Table 4). Although the seed is deficient in leucine and isoleucine, it is high in alanine, arginine, aspartic acid, cystine, histidine, and threonine.

When the hydrolysate of a *sterculia setigera* seed sample is compared to that of soybeans and the amino acids in the seed are compared to the FAO reference (Table 5), more arginine, histidine, lysine, methionine, phenylalanine, threonine, and valine are found in the seed.

Both essential and non-essential amino acids were found in *sterculia setigera* seeds, according to the amino acid profile, with an emphasis on those that are crucial for human health. In comparison to other popular protein-rich seeds like soybeans, the seeds were shown to have lower levels of leucine and isoleucine, despite having a considerable amount of necessary acids like tyrosine and valine. Since providing a sufficient quantity of amino acids is the fundamental function of protein in nutrition, *sterculia setigera* seeds hold great potential as a source of protein. This implies that complementary protein sources could help *sterculia setigera* seeds meet all of their amino acid needs. However, their nutritional value is further increased by the inclusion of significant non-essential amino acids like arginine and glutamic acid.

CONCLUSION

The seeds of *sterculia setigera* may be incorporated into different diets and provide promise as an alternative and sustainable source of protein for food security. Although it is not a full source of protein on its own, it can be a valuable addition to plant-based food systems when combined with other foods high in protein in a varied diet. Additionally, by utilizing its high fat content and useful amino acid composition, it may be investigated for its industrial uses, specifically in the synthesis of oils and bioactive chemicals.

RECOMMENDATION

Further studies on anti-nutritional factors, mineral bioavailability, and fatty acid composition are recommended to enhance its practical utilization.

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