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Proximate Analysis, Mineral Contents, Amino Acid Composition, Anti-Nutrients and Phytochemical Screening of *Brachystegia Eurycoma* Harms and *Pipper Guineense* Schum and Thonn

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Abstract The proximate, mineral and amino acid compositions of two different seeds belonging to different families; *Brachystegia eurycoma harms* and *Pipper guineense schum and thonn* were investigated. The proximate analysis revealed the values of carbohydrate, fat, crude protein, crude fibre, ash and moisture contents present to be 53.57%, 4.49%, 8.75%, 17.20%, 5% and 10.60%; 46.57%, 17.30%, 9.33%, 4.20%, 9.90% and 12.70% respectively. Minerals present are Ca (0.64), Na (0.09), K (0.25), Fe (0.111), Mg (0.05) and Mn (0.066) for *Brachystegia eurycoma harms* and Ca (0.42), K (0.81), Na (0.32), Ph (0.25), Zn (0.081), Mg (0.04) and Mn(0.098) in ppm. The anti-nutrient constituents of both seeds revealed the presence of tannins, phytate and cyanide at relatively low concentrations. Phytochemical screening also analysed for the seeds were all positive except glycosides and anthraquinones which are negative in *Brachystegia eurycoma harms* and *Pipper guineense schum and thonn* respectively. This shows that both seeds have therapeutic roles in living organisms. The amino acid (AA) analysis revealed that AA was more concentrated in *B. eurycoma harms* with the total value of 42.28g/100g than 38.78g/100g of *P. guineense schum* and *thonn*. The former also exceeded the later in total EAA by difference of 4.67g/100g. The P-PER and pI both seeds were 2.59; 2.54 and 2.61; 2.18, while the limiting AA was Met + Cys (0.40) and Ile (0.28) for *B. eurycoma harms* and *P. Guineense schum and thonn* respectively.

Keywords: *Brachystegia eurycoma harms, Pipper guineense schum and thonn, proximate, minerals, anti-nutrients, phytochemicals and amino acids*

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1. Introduction

The plant kingdom (especially the legumes) has proven to be the most useful in the treatment of diseases and they provide an important source of all the world's pharmaceuticals. The most important of these bioactive constituents of plants are steroids, terpenoids, carotenoids, flavonoids, alkaloids, tannins and glycosides. Plants in all facet of life have served a valuable starting material for drug development [1]. Antibiotics or antimicrobial substances like saponins, glycosides, flavonoids and alkaloids etc are found to be distributed in plants, yet these compounds were not well established due to the lack of knowledge and techniques [2]. The phytoconstituents which are phenols, anthraquinones, alkaloids, glycosides, flavonoids and saponins are antibiotic principles of plants.

Brachystegia eurycoma also called 'achi' in Igbo speaking states of Nigeria is an underutilized legume, while *Pipper guineense Schum and Thonn* although also an underutilized legume called "Black pepper" is a climbing perennial plant of the family, Piperaceae. It is a highly spicy plant, which provides oil, used as aromatic in the drink industry and medicinally. It is widely used in insect pest control. This study therefore aimed at evaluating the chemical and nutritional composition of both *Brachystegia eurycoma harms* and *Pipper guineense schum and thonn*, and the objective was to highlight their potential as feed supplements and medicinal benefits to humans.

2. Materials and Methods

2.1. Collection of Plant Materials

The two plant seeds; *Brachystegia eurycoma harms* and *Pipper guineense schum* and *thonn* were all obtained from Ikare-Akoko and Akungba-Akoko markets respectively and were identified in the Plant Science Department, Faculty of Science, Adekunle Ajasin University, Akungba-Akoko, Ondo State. The seeds were then separated from their shells, dried appropriately, milled with blender and stored in air-tight containers until required for analysis.

2.2. Proximate Analysis

The proximate composition of both seeds was determined according to the methods described by AOAC [3]. Energy value was calculated using the Atwater conversion factors [4].

2.3. Mineral Analysis

Sodium, potassium, calcium, magnesium, zinc and iron were determined with an automatic Atomic Absorption Spectrophotometer (Unicam Model 929, Unicam Cambridge, England). Total phosphorus was determined spectrophotometrically after incubation with Molybdo-vanadate solution [3].

2.4. Amino Acid Analysis

Amino acid composition was determined with Technicon Amino Acid Analyzer (TSM–1 Technicon Instrument Basingstoke, UK) using Norleucine as internal standard. Tryptophan was not detected.

2.5. Phytochemical Analysis and Anti-Nutrients

Phytochemical screening of the seeds for saponins, tannins, cardiac glycosides, alkaloids, anthraquinones and flavonoids was carried out according to standard methods [5,6]. The anti-nutrients were also determined using the same method.

3. Results

The proximate composition indicates that the two seeds contained slightly high moisture contents with *P. guineense* schum and thonn seeds having the higher moisture content (Table 1). The crude fiber content of *B. eurycoma* harms seeds was evidently higher than that of *P. guineense* schum and thonn seeds while the ash content of *P. guineense* seeds was higher than that of *B. eurycoma* seeds (Table 1). There was a difference in the protein content in the two seeds, with *P. guineense* schum and thonn seeds having the higher value. The result also indicates that the two seeds contained appreciable amount of carbohydrates suggesting that they can be ranked as carbohydrate rich seeds (Table 1). Carbohydrate content was higher in *B. eurycoma* seeds.

The mineral analysis of the two seeds indicated their richness in sodium, potassium, manganese, zinc, magnesium, calcium and iron (Table 2). The level of sodium, potassium and manganese were markedly higher in *P. guineense* schum and thonn seeds than *B. eurycoma* seeds, while the values of magnesium, calcium and iron were markedly higher in *B. eurycoma* seeds than *P. guineense* schum and thonn seeds. However,there was no difference in Zn content among the two seeds, while Cu was not detectable.

The phytochemical analysis indicated that the seeds are rich in phytonutrients (Table 3). Saponins, phlobatannins and steroidal glycosides were detected in both seeds (Table 3), but general glycosides were detected only in *P. guineense* schum and thonn, while anthraquinones were detected only in *B. eurycoma* harms.

The anti-nutrient contents (cyanide, phytate and tannin) were observed to be significantly low in both seeds as shown in Table 4 but the cyanide, phytate and tannin contents in *B eurycoma* harms seeds exceeded that of *P. guineense* schum and thonn seeds.

The amino acid (AA) results of the samples are shown under various headings in terms of various designations. In the results of AA analysis from Table 5.1, leucine (Leu) and arginine (Arg) were most concentrated in *B. eurycoma* harms seeds while glutamate (Glu) and leucine (Leu) were most concentrated in *P. guineense* schum and thonn seeds. A look at Table 5.1 shows that AA of both seeds was almost equally concentrated (on pair wise comparison) with 8 parameters each, and both having exactly the same amount of threonine (Thr). However, of the nine essential AA determined, five of them or 62.5% were more concentrated in *B. eurycoma* harms seeds than *P. guineense* schum and thonn seeds on pair wise comparisons. Leucine was the most concentrated essential AA (EAA) in both samples.

The essential AA score (EAAS) of the two seeds based on the provisional AA scoring pattern (FAO/WHO, 1973) were presented in Table 5.4. The limiting AA (LAA) in the samples are Met + Cys and Ile. Try was not determined. The result in Table 5.5 gives a brief summary of the AA profile in the samples. Column under Factor B shows that the values were very close.

4. Discussion

The moisture content obtained for both seeds 10.60 ± 0.77 and 12.70 ± 0.47 for *B. eurycoma* harms and *P. guineense* schum and thonn respectively (Table 1) varied significantly with those obtained for Guinea peanut, *Pterygota macrocarpa* (10.38 ± 0.08%), *Hexalobus crispiflorus* (7.11 ± 0.02%) and *Clitandra togolana* (10.81 ± 0.25%) seeds as reported by Ogunlade *et al.* [7], Amoo and Agunbiade [8] and Akoja and Amoo [9] respectively. However, the results of both seeds are higher than the (3.21 ± 0.10%) value of *Moringa oleifera* leaves reported by Ogbe and John [10] but extremely lower than the 70.30-75.54 range value of some Nigerian pumpkins (*Cucurbita spp*) reported by Blessing *et al*. [11]. High amount of moisture in crops makes them vulnerable to microbial attack, hence, spoilage [12]. The moisture content of any food is an index of its water activity [13] and is used as a measure of stability and susceptibility to microbial contamination [14]. These slightly high moisture contents also mean that dehydration would increase the relative concentration of other food nutrient and therefore improve the shelf-life or preservation of the seeds. There is also need to store the seeds in cool condition if they would be kept for a long period without spoilage especially in the tropics where wastage of crops is estimated to be around 50% due to high moisture content [15]. The crude fiber content of *B. eurycoma* harms (17.20 ± 0.87) was evidently higher than that of *P. guineense* schum and thonn (4.20 ± 0.14) which varied with 6.4% value obtained by Akindahunsi and Salawu [16] who worked on the same *P. guineense* seeds. Agostoni *et al.* [17] reported that non-starchy crops are the richest sources of dietary fiber. Crude fiber is the part of food that is not digested by human but the normal functioning of the intestinal tract depends upon the presence of adequate fiber. It increases stool bulk and decreases the time that waste materials spend in the gastrointestinal tract. Fiber helps in the maintenance of human health and has been known to reduce cholesterol level of the body [18]. A low fiber diet has been associated with heart disease, cancer of the colon and rectum, varicose veins, phlebitis, obesity, appendicitis, diabetes and even constipation [19,20]. Hence, *B. eurycoma* harms could be recommended as a veritable crude fiber source in the diet as a result of its relatively high fiber content even when compared with 8.43 ± 0.028 of *Lophira lanceolata* seeds[21], 8.20 ± 0.08 and 10.03 ± 0.16 of fermented and non-fermented *Jatropha curcas* seeds [22], 7.09 ± 0.11 of *Moringa oleifera* leaves [10], 7.00% of *Corchorus olitorius* and 6.5% of bitter leaves [16] and 3.60% of cowpea [23].

Table 1. Proximate Composition of *Bracystegia eurycoma* harms and *Pipper guineense* schum and thonn

Proximate analysis	*B.eurycoma*	*P.guineense*
Ash	5.00 ± 0.07	9.90 ± 0.98
Moisture content	10.60 ± 0.77	12.70 ± 0.47
Crude protein	8.75 ± 1.16	9.33 ± 0.54
Crude fibre	17.20 ± 0.87	4.20 ± 0.14
Fat	4.49 ± 0.05	17.30 ± 0.85
Carbohydrates	53.57 ± 0.30	46.57 ± 1.42

Values are triplicate determination.

The ash content of *P. guineense* seeds was higher than that of *B. eurycoma* seeds and some other seeds; *C. pepo* seeds (5.1- 6.3%) [24,25], *Annona muricata* (9.7 ± 0.12) [26], fermented and non-fermented *Jatropha curcas* L. seeds (4.75 ± 0.06 and 4.43 ± 0.16 respectively) [22] and *Lophira lanceolata* (1.45 ± 0.018) [21]. The proportion of ash content is a reflection of the mineral contents present in the food materials [27,28]. The results could suggest a high deposit of mineral elements in the *P. guineense* schum and thonn. Ash content of 1.5- 2.50% for nut has been recommended for suitability as animal feeds [29]. The observed crude protein (CP) contents for both seeds were 8.75 ± 1.16 and 9.33 ± 0.54 for *B.eurycoma* harms and *P. guineense* schum and thonn respectively. These values compare favourably with the CP values reported for Zanthxylum zanthoxyloides (8.74%) [28] and yam (7.31- 9.067%) [30]. Ene-Obong [31] reported that diet is nutritionally satisfactory if it contains high calorie value and a sufficient amount of protein. Ali [32] and Effiong *et al*. [33] also stated that any plant food that provide about 12% of their caloric value from protein are considered good sources of protein. Thus, none of the two seeds meet this requirement.

Minerals are considered to be essential in human nutrition [34] and generally, minerals from plant sources are less-bioavailable than those from animal sources [35]. Table 2 shows the mineral composition of both *B. eurycoma* harms and *P. guineense* schum and thonn in parts per million (ppm). Although, the minerals were nutritively and quantitatively low in most of the minerals, which include sodium, (0.32 ± 0.00), potassium (0.25 ± 0.01), manganese (0.028 ± 0.04), zinc (0.081 ± 0.01), while magnesium (0.05 ± 0.01), calcium (0.64 ± 0.02) and iron (0.111 ± 0.05) were only higher in *B. eurycoma* harms. The values obtained for the two seeds are extremely lower than those of *Senna alata* and *Cajanus cajan* (medicinal plants), both reported by Lawal [36], *Moringa oleifera* leaves reported by Ogbe and John [10] and *Lophira lanceolata* seeds reported by Lohlum *et al*. [21]. These minerals are vital for the overall mental and physical well being; and are important constituent of bones, teeth, tissues, muscles, blood and nerve cells [37]. They generally help in maintenance of acid-base balance, response of nerves to physiological stimulation and blood clotting [38].

Table 2. Mineral composition of *Brachystegia eurycoma* harms and *Pipper guineense* schum and thonn

Minerals	*B. eurycoma*	*P. guineense* (ppm)
Calcium	0.64 ± 0.02	0.42 ± 0.05
Magnesium	0.05 ± 0.01	0.04 ± 0.02
Sodium	0.09 ± 0.00	0.32 ± 0.003
Potassium	0.25 ± -.018	0.81 ± 0.01
Phosphorus	0.16 ± 0.04	0.25 ± 0.01
Manganese	0.07 ± 0.001	0.098 ± 0.04
Iron	0.11 ± 0.05	0.096 ± 0.01
Zinc	0.08 ± 0.006	0.08 ± 0.01
Copper	ND	ND

Values are triplicate determination.

Calcium and phosphorus are associated with each other for growth and maintenance of bones, teeth and muscles [39,40]. Magnesium is a component of chlorophyll and it is an important content in connection with Ischemic heart disease and calcium metabolism in bones [41]. Zinc is involved in normal functioning of immune system [42] and is associated with protein metabolism. Iron is an essential trace element for haemoglobin formation, normal functioning of central nervous system and in the oxidation of carbohydrate, protein and fats [43]. Deficiency of these nutrients and minerals are known to affect the performance and health of animals. In animals, a Ca/P ratio above 2.0 helps to increase the absorption of calcium in the small intestine. Food is considered “good” if the ratio Ca/P > 1 and “poor” if < 0.05 [44], while recommended Na/K is 0.60. For *B. eurycoma* harms, the Ca/P ratio is 4, while it is 1.68 for *P. guineense* schum and thonn. Therefore, *B. eurycoma* harms is better in calcium absorption because of its favourable Ca/P ratio. Furthermore, the Na/K for *B. eurycoma* harms is 0.36 and for *P. guineense*, it is 0.40, both which are within the recommended level, so they could be recommended for consumption by hypertensive patients.

The presence of phytochemicals in the seeds suggests possible medicinal applications. They are known to exhibit both medicinal activities as well as physiological activities [3]. Saponins, phlobatannins and steroidal glycosides were detected in both seeds (Table 3), but general glycosides were detected only in *P. guineense* schum and thonn, while anthraquinones were detected only in *B. eurycoma* harms. Saponins are glycosides, which include steroid saponins and triterpenoid saponins

[45]. These saponins have also been reported in two medicinal plants; *Senna alata* and *Cajanus cajan* [36] and *Lophira lanceolata* seeds [21]. According to Harborne [46], saponins have anti-hypercholesterol, anti-inflammatory, cardiac depressant property and also appear to kill or inhibit cancer cells without killing the normal cells in the process [47]. Phlobatannins inhibit the growth of many microorganisms like fungi, yeast, bacteria and viruses [48]. These compounds were also detected in *A. hispida* and *A. racemosa* [49] and the leaves of *Senna alata* and *Cajanus cajan* [36]. Steroidal compounds observed in both seeds are of importance and interest in pharmacy due to their relationship with such compounds as sex hormones [47], they also promote immune functions in the skin and also reduce inflammation [50].

Table 3. Phytochemical content of *Brachystegia eurycoma* harms and *Pipper guineense* schum and thonn

Phytochemical	*B. eurycoma*	*P. guineense*
Saponins	+	+
Anthraquinones	+	_
Glycosides	_	+
Glycosides with steroidal ring	+	+
Phlobatannins	+	+

Table 4. Anti-Nutrient values of *Brachystegia eurycoma* harms and *Pipper guineense* schum and thonn

Anti-nutrient	*B. eurycoma*	*P. guineense*
Cyanide	0.84 ± 0.05	0.34 ± 0.014
Phytate	0.296 ± 0.16	0.183 ± 0.30
Tannin	0.039 ± 0.13	0.026 ±0.001

Values are triplicate determination.

Anti-nutrients such as cyanide, phytate and tannin were observed to be significantly low in both seeds as shown in Table 4. *B eurycoma* harms exceeded *P. guineense* schum and thonn in all the three anti-nutrients (0.84 ± 0.05, 0.296 ± 0.16 and 0.039 ± 0.13; 0.34 ± 0.014, 0.183 ± 0.30 and 0.026 ± 0.001 respectively). Tannins are plant polyphenols which have ability to form complexes with metals ions and with macro-molecules such as proteins and polysaccharides [51,45]. Tannins have also been claimed to affect adversely protein digestibility [52]. The tannin contents are considered low when compared with the value (2.56%) reported for Cuban Boa (*Epicrates anquifer*) [53], 21.19 ± 0.25% for *Moringa oleifera* leaves [10] and 4.56% and 3.87% for two medicinal plants *Senna alata* and *Cajanus cajan* [37]. According to Emijiugha and Agebede [54], tannin usually forms insoluble complexes with proteins, thereby interfering with their bioavailability. Poor palatability is generally attributed to high tannin diets [55]. Tannins are capable of leaving available protein by antagonistic competition and can therefore elicit protein deficiency syndrome, 'Kwashiorkor'. The phytate content of the two seeds were low when compared with those reported for some commonly consumed tropical legumes, cowpea, *Vigna ungiculata* (2.0-2.9%), pigeon pea, pea, *Cajanus cajan* (2.0- 2.4%) and African yam beans, *Sphenostylis stenocarpa* (2.4%) [56]. Oboh *et al*. [57] reported that phytate has the ability to chelate divalent minerals and prevent their absorption. Phytic acid has complicated effect in human system including indigestion of food and flatulence [58]. However, the level of cyanide in both seeds is considered to be non-toxic when ingested due to its very small amount. Thus, the results revealed that the anitnutrient composition of both seeds were generally low such that none of the anti-nutrients was above the lethal dosage approved by standard bodies like National Agency for Food and Drugs Administration and Control (NAFDAC) in Nigeria [11]. Also, the amounts of phytate and tannins reported in this study were well below the range of values that would adversely affect their nutritional values or cause any of the toxic effects associated with the anti-nutrients. This could mean that the two seeds will not affect human nutrition if consumed in large quantity and is therefore an advantage to the consumers of the seeds.

Table 5.1. Amino acid composition (g/100g) of *Brachystegia eurycoma* harms and *Pipper guineense* schum and thonn

Amino acid	*B. eurycoma*	*P. guineense*
Lys	2.24	2.60
His	1.73	0.66
Arg	5.09	2.29
Asp	3.94	4.29
Thre	1.66	1.66
Ser	0.91	0.94
Glu	4.60	6.35
Pro	1.83	0.85
Gly	1.44	1.14
Ala	2.43	1.69
Cys	0.66	0.72
Val	2.83	3.24
Met	0.73	0.78
Ile	2.32	1.13
Leu	5.16	5.09
Tyr	2.05	3.05
Phe	2.66	2.30
Total	42.28	38.78

The amino acid (AA) results of the samples are shown under various headings in terms of various designations. In the results of AA analysis from Table 5.1, leucine (Leu) and arginine (Arg) were the most concentrated in *B. eurycoma* harms respective value (g/100g) of; 5.16 (Leu) and 5.09 (Arg), while glutamate (Glu) and leucine (Leu) were the most concentrated in *P. guineense* schum and thonn with 6.35g/100g and 5.09g/100g respectively. A look at Table 5.1 shows that AA of both seeds was almost equally concentrated (on pair wise comparison) with 8 parameters each, and both having exactly the same amount of threonine (Thr) (1.66g/100g); of the nine essential AA determined, while five of them or 62.5% were more concentrated in *B. eurycoma* harms than the *P. guineense* schum and thonn on pair wise comparisons. Leucine was the most concentrated essential AA (EAA) in both samples with 5.16g/100g and 5.09g/100g for *B. eurycoma* harms and *P. guineense* schum and thonn respectively.

Table 5.2. Essential amino acid standards for pre-school children (2-5 yrs) in g/100g protein

Amino acid	Value
Leu	6.6
Phe + Tyr	6.3
Thr	3.4
Try	1.1
Val	3.5
Ile	2.8
Lys	5.8
Met + Cys	2.5
His	1.9
Total (with His	33.9
Total (no His)	32.0

Source: FAO/WHO/UNU [65]

According to the information in Table 5.2, both samples would not provide (individually) enough of the EAA for the pre-school children (2-5 yrs). Although, histidine is a semi-essential AA particularly useful for histamine present in small quantities in cells. Arginine is also good for children and it is considerably high only in the *B. eurycoma* harms with 5.09g/100g. Isoleucine is an EAA both for young and old. Methionine is needed for the synthesis of choline which in turn forms lecithin and other phospholipids in the body. When the diet is low in protein, for instance in alcoholism and kwashiorkor, insufficient choline may be formed; this may cause accumulation of fat in the liver [59]. Phenylalanine is the precursor of some hormones and the pigment melanin in hair, eyes and tanned skin. The entire above mentioned AA were low in both samples but comparatively higher in *B. eurycoma* harms.

The result in Table 5.3 presents parameter on the quality of the protein of the samples. The total AA (TAA) was 42.48 and 38.78g/100g for *B. eurycoma* harms and *P. guineense* schum and thonn respectively. These values are lower to those reported for the seeds of *Mucana puriens var pruriens* (92.43g/100g) [60], *Lophira lanceolata* seeds (355.01g/100g) [20], fermented cocoa nibs (70.8g/100g) and *B. sapida* (48.13g/100g) [61]. The EAA ranged from 24.42-19.75g/100g (*P. guineense*). The values of 1.39-1.5g/100g are very far from the value of 5.8g/100g recommended for infant protein (6.8-11.8g/100g) [62]. The aromatic AA (ArAA) range suggested for infant protein (6.8-11.8g/100g) [62] does not favour the present report of 6.44-6.01g/100g. The percentage ratio of EAA to the total AA (TAA) in the samples ranged between 57.76% and 50.90%. These values are well above the 39% considered adequate for ideal protein food for infants, 26% for children and 11% for adults [62].

The percentage of total neutral AA (TNAA) ranged from 58.4 down to 58.1 indicating that those formed the bulk of the AA; percentage total acidic AA (TAAA) ranged from 20.2-27.4 which is lower than % TNAA, whilst the percentage range in total basic AA (TBAA) was 21.4 (*B. eurycoma harms*) and 14.3 (*P. guineense schum and thonn*) which made them the third largest group among the parameters. The predicted protein efficiency ratio (P-PER) was 2.59 *(B. eurycoma harms*) and 2.54 (*P. guineense schum and thonn*) meaning that *B. eurycoma harms* may be slightly bioavailable than the *P. guineense* by as much as 1.94%. The essential AA index (EAAI) ranged from 0.66-0.57. EAAI is useful as a rapid tool to evaluate food formulations for protein quality, although it does not act for difference in protein quality due to various processing methods or certain chemical reactions [63]. In the results of the isoelectric point (pI), calculation of pI from the AA would assist in the production of the protein isolate of an organic product, the % Cys in TSAA was low with a range value of 47.5-48.0, while many animal proteins, viz; rat, chick, and pig have been reported to have a proportion of about 50% [64]; it is known that cystine can pair with methionine in improving protein quality and has positive effects on mineral absorption, particularly zinc. FAO/WHO/UNU [62] does not however give any indication of the proportion of total sulphur AA that can be met by cystine. It is known that proteins could prevent the precipitation of zinc in the intestinal lumen through the AA such as cystine and peptides which facilitate zinc uptake by the mucosal cells.

Table 5.3. EAA, non-EAA, acidic, neutral, sulphur, and aromatic acid contents (g/100g) of *Brachystegia eurycoma* harms and *Pipper guineense* schum and thonn

Amino acid	*B. eurycoma*	*P. guineense*
Total amino acid (TAA)	42.28	38.78
Total non-essential amino acid (TNEAA)	17.86	19.03
Total EAA- with His	24.42	19.75
-no His	22.69	19.09
% TNEAA	45.30	49.10
% Total EAA- with His	57.76	50.9
-no His	53.67	49.22
Total neutral amino acid (TNAA)	24.68	22.53
% TNAA	58.40	58.1
Total acidic amino acid (TAAA)	8.54	10.64
% TAAA	20.2	27.4
Total basic amino acid (TBAA)	9.06	5.55
% TBAA	21.40	14.3
Total sulphur amino acid (TSAA)	1.39	1.50
% TSAA	3.20	3.87
% Cys in TSAA	47.5	48
Total aromatic amino acid (TArAA)	6.44	6.01
% TArAA	15.2	15.5
P-PER[a]	2.59	2.54
Leu/Ile ratio	2.22	4.50
Leu- Ile (difference)	2.84	3.96
EAAI[b]	0.664	0.571
Isoelectric point (pI)	2.61	2.18

Table 5.4. Essential amino acid scoring pattern of *Brachystegia eurycoma* harms and *Pipper guineense* schum and thonn

Amino acid	*B. eurycoma*	*P. guineense*
Ile	0.58	0.28
Leu	0.74	0.73
Met + Cys	0.40	0.43
Lys	0.41	0.47
Phe + Tyr	0.79	0.90
Thr	0.42	0.40
Val	0.57	0.65

The results in Table 5.4 shows the essential AA score (EAAS) based on the provisional AA scoring pattern [65].

The limiting AA (LAA) in the samples are Met + Cys (0.40) and Ile (0.28) in *B. eurycoma harms* and *P. guineense schum and thonn* respectively. Normally, the EAA most often acting in a limiting capacity are Lys, Met + Cys, Thr and Try in that order. Try was not determined, Met + Cys and Ile would then be limiting in the corresponding samples. However, to make corrections for the LAA in the samples if it serves as the sole source of protein food, therefore, it would be 100/99 x protein of *B. eurycoma harms* or *P. guineense schum and thonn* or 1.01 x protein of the samples.

Table 5.5. Summary of the amino acid profile information factors A & B

	Samples (Factor A)		
	B. eurycoma	*P. guineense*	Factor B means
AAcomposition (Factor B)			
TEAA	24.42	19.75	22.09
TNEAA	17.86	19.03	18.45
Factor A means	21.14	19.39	20.27

The result in Table 5.5 gives a brief summary of the AA profile in the samples. Column under Factor B shows that the values were very close with a range of 18.45-22.09.

5. Conclusion

This study shows that both seeds are good sources of carbohydrates. Additionally, they have been the sources of most drugs used for combating infections. The two plants used in this study were found to contain the important constituents needed to combat various kinds of infections in beings.

Conflict of Interests

No competing financial interests exist.

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