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Nutritional and Pharmacological Potentials of *Solanum melongena* and *Solanum aethiopicum* Fruits

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ABSTRACT

African eggplants, *Solanum melongena* fruit (SMF) and *Solanum aethiopicum* fruit (SAF) are widely cultivated in Nigeria and across the Africa. This study is designed to evaluate and compare the proximate and phytochemical components of SMF and SAF. Proximate composition of both fruit samples shows that SMF has higher moisture content than SAF. Protein, fats and ash contents were non-significantly ($p < 0.05$) higher in SAF compared with SMF. The fibre content was 3.11 ± 0.03 and 2.98 ± 0.08 % for SMF and SAF, respectively. The carbohydrate content of SAF (4.14± 0.11%) was significantly ($p < 0.05$) higher than that of SMF (2.42 ± 0.12%). The results obtained for the phytochemical composition show that cardiac glycosides, anthocyanins and anthraquinone are low for both fruit samples. The phenolic content of SMF was 5.80 ± 0.4 g and that of SAF was 4.17 ± 0.03 g. In this study, we reported a flavonoid content of 2.80 ± 0.08 and 1.46 ± 0.01 g, as well as saponin content of 1.34 ± 0.31 and 0.81 ± 0.23 g for SMF and SAF, respectively. SAF has a tannin content of 0.82 ± 0.14 g, and 1.28 ± 0.05 g for SMF. Eighteen amino acids were identified (Essential and non-essential amino acids) with glutamine having the highest percentage (94.69%) and the lowest in percentage was Threonine (0.014%). In conclusion, the results of this study show that SMF and SAF have adequate nutritional value could be valuable raw material for health and pharmaceutical industries.

Keywords: *Solanum melongena* fruit, *Solanum aethiopicum* fruit, Phytochemical, Proximate, Amino acid.

INTRODUCTION

Solanum species belong to the family of *Solanaceae* which has 'eggplants' as one of its member [1]. It has well-over 1000 species worldwide with at least 100 indigenous species in Africa and adjacent islands, including edible and poisonous ones [2, 3]. In Nigeria, about 25 species are domesticated with their leaves, fruits or both eaten as vegetables or used as traditional medicine [3]. Among them are *S. melongena* (Aubergine) and *S. aethiopicum L.* (Ethiopian eggplant), which are widely cultivated in Nigeria and across the African continent [4]. Amongst the three (3) major tribes in Nigeria, African eggplants are called garden egg (Hausa: Dauta; Yoruba: igbagba and Igbo: afufa or añara). They are highly valued constituents of the Nigerian foods and indigenous medicines; commonly consumed almost on a daily basis by both rural and urban families. They can be eaten as snacks (raw), boiled or fried as ingredient of stews, soups and vegetable sauces. Their use in indigenous medicine range from weight reduction to treatment of several ailments including asthma, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease, swollen joint pains, gastro-esophageal reflux disease, constipation and dyspepsia [5–7]. Notably, these pharmacological properties have been attributed to the presence of certain chemical substances in these plants, such as fiber, ascorbic acid, phenols, anthocyanin, glycoalkaloids, among others [8]. The proximate, phytochemicals, minerals and amino acids constituents of both eggplant cultivars (*Solanum melongena* and *Solanum aethiopicum*) were evaluated in this study.

MATERIALS AND METHODS

Sample Preparation

Fruits of *Solanum* spp. were harvested from a farm community in Esa Anua, Uyo, Akwa Ibom State. The plants were identified and authenticated at Bioresources Development and Conservation Programme (BDCP) Research Centre, Nsukka, Enugu State. The fruits were plucked and sorted out by removing extraneous materials. The samples were washed with water and divided into two portions; the first portion was used immediately for proximate analysis while the second portion was sliced into pieces, air-dried for six weeks, and the dried samples were pulverized and packaged in air-tight-polyethene bags for phytochemical, minerals and amino acid analysis.

Proximate Analysis

Proximate analysis of both fresh eggplants was done in triplicates according to the Association of Official Analytical Chemists (AOAC) standard procedures as reported [9–11].

Mineral Composition Screening

The mineral contents of the two fruits were determined using the standard procedure [10]. Atomic absorption spectrometry (Model Accusy 211 Bulk Scientific USA) was used to determine Ca, Fe, Mg, P and Zn, while flame photometry and spectrophotometry (Model FP6410 Harris Medical Essex, England) were used to determine Na and K.

Determination of Vitamins

The compositions of vitamins in the fruits samples were determined using standard procedure as reported [10].

Anti-nutrients Analysis

Determination of anti-nutrients such as phytate, oxalate, cyanides and haemagglutinin were investigated using the methods described [12].

Phytochemical Screening

Quantitative determination of saponins, phenols, alkaloids, flavonoids, phytate, oxalates and cyanides were investigated using the methods as described [13, 14]. The phytochemical analyses of the fruit samples were carried out using the methods to identify their active constituents. Basic phytochemical screening was done using simple chemical tests to detect the presence of secondary plant constituents such as alkaloids, tannins, saponins, flavonoids, sterols, phenols, glycosides, reducing sugars in both samples.

Amino Acid Composition

The amino acid contents of *Solanum melongena* and *Solanum aethiopicum* fruits were determined using HPLC [15].

Statistical analysis

The raw data obtained from the study were analyzed using IBM Statistical Product and Service Solutions (SPSS) version 20.0 (Chicago, IL, U.S.A). Student's *t*-test was used to compare means. The results were expressed as mean ± standard deviation of replicate measurements. Mean values with $p < 0.05$ were considered statistically significant.

RESULTS

Proximate Composition

The proximate analysis result obtained from both eggplants (Table 1) reveals very high moisture content within the range of 89.27 ± 0.12% to 92.50 ± 0.14 %. Carbohydrate content was seen to be slightly higher in SAF (4.14 ± 0.11%) than SMF (2.42 ± 0.12%). Also, the fibre content (SMF - 5.11 ± 0.03% and SAF- 3.96 ± 0.08%) and ash (SMF- 0.47 ± 0.12% and SAF- 0.87 ± 0.03%) were found in very low amounts in both fruit samples studied.

Table 1: Proximate Composition of *S. melongena* and *S. aethiopicum* Fruits

Macronutrient (%)	*S. melongena*	*S. aethiopicum*
Moisture	92.50 ± 0.14	89.27 ± 0.12
Crude protein	1.33 ± 0.03	2.24 ± 0.03
Fat	0.17 ± 0.01	0.52 ± 0.04
Fibre	3.11 ± 0.03	2.96 ± 0.08
Ash	0.47 ± 0.12	0. 87 ± 0.03
Carbohydrate	2.42 ± 0.12	4.14 ± 0.11

Results are presented as means ± standard deviations of triplicate determinations (n=3)

Trace Minerals, Macro-minerals and Vitamins

Result from Table 2 shows the amount of trace minerals found in *Solanum melongena* and *Solanum aethiopicum* fruits (Pd, Zn, Cu, Cd, Fe and Se). This result revealed that the highest amount of Fe was found in SMF 2.49 ± 0.17mg/100g while Cu recorded the lowest amount for both *Solanum melongena* and *Solanum aethiopicum* fruit samples (0.01 ± 0.00 - 0.03 ± 0.02 mg/100g). The macro-minerals (Ca, Fe, Mg, P, K, and Na) composition for both *S. melongena* and *S. aethiopicum* fruits presented in table 3 shows that both fruits samples contained very high amounts of potassium (200.50 ± 0.79 - 238.10 ± 0.45mg/100g) and sodium (147. 32 ± 1.07 - 160.12 ± 2.18mg/100g) while Ca, Mg and P recorded very low amounts in both fruit samples. The vitamin content (table 4) shows that *S. melongena* and *S. aethiopicum* contained vitamins A, B1, B2, B3, B6, B9, B12, C and E. Vitamin C (4.17 ± 0.03 - 5.80 ± 0.4 mg/100) was found to be in the highest amount in SAF followed by Vitamin A (2.05 ± 0.11 - 3.60 ± 0.08 mg/100g). The contents of Vitamins B1 and B2 were higher in SAF than SMF. Vitamins B3, B6, B12 and Vitamin E were found in very low amounts in both fruit samples.

Table 2: Trace Mineral Contents of *S. melongena* and *S. aethiopicum* Fruits

Parameters (mg/100g)	*S. melongena*	*S. aethiopicum*
Cd	0. 020 ± 0.005	0.015 ± 0.002
Se	0. 020 ± 0.005	0.015 ± 0.002
Fe	2.49 ± 0.17	0.32 ± 0.10
Pd	0. 33 ± 0.03	0.25 ± 0.05
Cu	0. 01 ± 0.00	0.03 ± 0.02
Zn	0. 24 ± 0.03	0.16 ± 0.01

Results are means ± standard deviations of triplicate determinations (n=3)

Table 3: Macro- Mineral Contents of *S. melongena* and *S. aethiopicum* Fruits

Minerals (mg/100g)	*S. melongena*	*S. aethiopicum*
Calcium (Ca)	1.64 ± 0.01	9.03 ± 0.03
Potassium (K)	238.10 ± 0.45	200.50 ± 0.79
Magnesium (Mg)	2.49 ± 0.23	0.14 ± 0.06
Phosphorus (P)	2.80 ± 0.16	4.51 ± 0.07
Sodium (Na)	160.12 ± 2.18	147. 32 ± 1.07

Results are means ± standard deviations of triplicate determinations (n=3)

Table 4: Vitamin Contents of *S. melongena* and *S. aethiopicum* Fruits

Parameter (mg/100g)	*S. melongena*	*S. aethiopicum*
Retinol (vitamin A)	3.60 ± 0.08	2.05 ± 0.11
Thiamine (vitamin B_1)	2.80 ± 0.08	1.46 ± 0.01
Riboflavin (vitamin B_2)	1.34 ± 0.31	0.81 ± 0.23
Nicotinamide (vitamin B_3)	0.06 ± 0.03	0.80 ± 0.05
Pyridoxine (vitamin B_6)	0.49 ± 0.08	0.11 ± 0.03
Folate (vitamin B_9)	0.82 ± 0.14	1.28 ± 0.05
Cobalamin (vitamin B_{12})	0.27 ± 0.02	0.17 ± 0.07
Ascorbic acid (vitamin C)	5.80 ± 0.4	4.17 ± 0.03
Tocopherol (vitamin E)	0.301 ± 0.10	0.0063 ± 3.1

Results are presented as means ± standard deviations of triplicate determinations (n=3)

Anti-nutrients and Phytochemicals

Table 5 reveals, haemmaglutinin were relatively present in very large amounts in both fruit samples. Oxalate was found to be next highest in concentration but very much lower than haemagglutinin. Phytate was present in higher amounts than resins but less than the amounts of oxalate. Table 6 shows the presence of bioactive constituents of both fruit samples; alkaloids, saponins, flavonoids, tannins, phenols, anthraquinones, were present in both eggplants. However, *Solanum melongena* had a higher content of phenols, alkaloids, flavonoids, and saponins when compared with *Solanum aethiopicum*, while tannin was observed to be higher in *Solanum aethiopicum.* Table 7 shows that the concentration of saponins ranged from 0.81 ± 0.05mg/100g to 1.34 ± 0.31mg/100g, alkaloids (2.05 ± 0.11mg/100g to 3.60 ± 0.08mg/100g), flavonoids (1.46 ± 0.01mg/100g to 2.80 ± 0.08mg/100g) and tannins (0.82±0.14 mg/100g to 1.28 ± 0.05mg/100g). *Solanum melongena* had the highest concentration of phenols (5.80 ± 0.4mg/100g) compared to *Solanum aethiopicum* (4.17 ± 0.03mg/100g). Anthraquinone and cardiac glycosides had low concentrations in both fruit samples.

Table 5: Anti-nutrients Composition of *S. melongena* and *S. aethiopicum* Fruits

Anti-nutrients (mg/100g)	*S. melongena*	*S. aethiopicum*
Oxalate	3.60 ± 0.08	2.05 ± 0.11
Phytate	2.80 ± 0.08	1.46 ± 0.01
Resin	1.34 ± 0.31	0.81 ± 0.23
HCn	0.06 ± 0.03	0.80 ± 0.05
Haemagglutinin (HU/mg)	0.49 ± 0.08	0.11 ± 0.03

Results are presented as means ± standard deviations of triplicate determinations (n=3)

Table 6: Qualitative Phytochemical Composition of *S. melongena* and *S. aethiopicum* Fruits

Phytochemical (mg/100g)	*S. melongena*	*S. aethiopicum*
Alkaloids	++	++
Flavonoids	++	+
Saponins	+	+
Cardiac glycosides	+	+
Anthocyanin	+	+
Tannins	+	+
Anthraquinone	+	+
Phenol	++++	+++

Table 7: Quantitative Phytochemical Composition of *S. melongena* and *S. aethiopicum* Fruits

Phytochemical (mg/100g)	*S. melongena*	*S. aethiopicum*
Alkaloids	3.60 ± 0.08	2.05 ± 0.11
Flavonoids	2.80 ± 0.08	1.46 ± 0.01
Saponins	1.34 ± 0.31	0.81 ± 0.23
Cardiac glycosides	0.06 ± 0.03	0.80 ± 0.05
Anthocyanin	0.49 ± 0.08	0.11 ± 0.03
Tannins	0.82 ± 0.14	1.28 ± 0.05
Anthraquinone (mg/100g)	0.27 ± 0.02	0.17 ± 0.07
Phenol	5.80 ± 0.4	4.17 ± 0.03

Results are means ± standard deviations of triplicate determinations (n=3)

Amino Acids

Fig.1 and Fig. 2 shows the HPLC chromatogram of amino acids found in both fruit samples studied and this result is summarized as shown in Tables 8 and 9. Eighteen amino acids were detected in both fruits samples (nine in each sample) but only glutamine (94.694%), Histidine (38.666%) oh-Lysine 1 (23.801%), Cysteine (18.478%) and Leucine (9.067%) are present in high concentrations as shown in Tables 8 and 9. The peaks were identified on the basis of comparison between the retention time of the standards, area in percentage and formula.

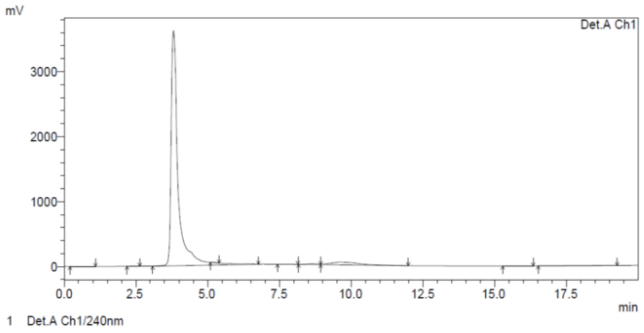

Figure 1: HPLC Chromatogram of Amino Acids Present in *Solanum aethiopicum* Fruits

Table 8: Amino acid Profile Extracted *Solanum aethiopicum* Fruits

Peaks	Name	Formulae	Ret. Time	MW (g/mol)	Area %
1	Threonine	C4H9NO3	0. 351	119.1192	0.014
2	Valine	C5H11NO2	2.406	117.151	0.038
3	Glutamine	C5H10N2O3	3.805	147.13	94.694
4	Alanine	C3H7NO2	5.142	89.09	0.042
5	Proline	C5H9NO2	7.688	115.13	0.049
6	Ornithine	C5H12N2O2	8.649	132.16	0.462
7	GABA	C4H9NO2	9.600	103.12	4.557
8	Phenylalanine	C9H11NO2	16.283	165.19	0.019
9	Lysine	C6H14N2O2	18.982	146.19	0.125
Total	9	-	82.906	1134.2802g/mol	100.000

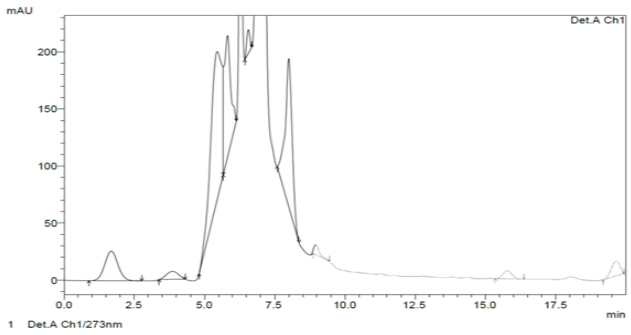

Figure 2: HPLC Chromatogram of Amino Acids Present in *Solanum melongena* Fruit

Table 9: Amino acid Profile of Extracted *Solanum melongena* Fruits

Peaks	Name	Formulae	Ret. Time	MW (g/mol)	Area %
1	Leucine	C6H13NO2	1.675	131.17	9.067
2	Serine	C3H7NO3	3.859	105.09	2.251
3	Histidine	C6H9N3O2	5.449	155.1546	38.666
4	Cysteine	C3H7NO2S	5.817	121.16	18.478
5	Threonine	C4H9NO3	6.557	119.1192	1.772
6	Oh-Lysine-1	C6H15CIN2O2	7.994	146.19	23.801
7	Methionine	C5H11NO2S	8.946	149.21	1.136
8	Aspartate	C4H7NO4	15.803	133.11	1.776
9	Phosphoserine	C3H8NO6	19.697	185.07	3.054
Total	9		75.797	1245.2738	100.000

DISCUSSION

The search for plants with nutritional as well as medicinal value remains an active area of health and pharmaceutical research. In the present study, the proximate, phytochemical, minerals and amino acids constituents of the fruits of two eggplant cultivars (*Solanum melongena* and *Solanum aethiopicum*) were evaluated to identify the nature of the compounds present in the plants. As shown in Table 1, both plants have a high moisture content, with that of *S. melongena* higher than *S. aethiopicum*. The high moisture content of these fruits makes them susceptible to infection by micro-organisms; however the fibrous nature of their skin also makes it reasonably difficult for microorganism to penetrate [16]. The crude protein content of both fruits show a higher concentration in SMF (2.24 ± 0.03 %) compared to SAF (1.33 ± 0.03 %). Proteins are known to function in tissue repair and body developments, and our result suggests that both fruits (if consumed in sufficient quantities) may help in maintenance of fluid balance, contribute to immune function, and supports enzyme and hormone synthesis [17]. However, the crude protein values obtained in our study is lower than the value obtained by Agorero and colleagues [18]. The fat content of SMF (0.17 ± 0.01 %) was lower than that of SAF (0.52 ± 0.04 %), and this result falls within the range of other results reported for African egg plants by other researchers [19–21]. Dietary fats are essential part of the make-up of the biological systems, most especially the integrity of cells membrane, and also increases the tastiness of food by absorbing and retaining flavours. The results of this study shows a high fibre content for *Solanum melongena* fruit (5.11 ± 0.03 %) and *Solanum aethiopicum* fruit (3.96 ± 0.08 %). Dietary fibre is the indigestible portion of plants that helps in digestion and elimination of waste and high amount of dietary fibre have been reported in eggplants and several other fruits and vegetables, which have hypercholesterolemic effects. Fibres are known to function in the reduction of cholesterol level, reduce the risk of breast and colon cancer, hypertension and other coronary heart diseases. The calcium content of *S. melongena* and *S. aethiopicum* fruits ranged from 1.64 ± 0.01 mg/100g to 9.03 ± 0.03 mg/100g. Calcium ions are body ions that maintain strong bones, helps in muscle contraction and relaxation, aids in blood coagulation, osmotic pressure and maintains fluid balancing. This result implies that both fruits could therefore be a good source of calcium ion and may be used as supplements in diets low in calcium ion.

The vitamins analysed in this study are, Vitamins A, B1, B2, B3, B6, B9, B12, C and E (Table 4). Vitamin B complexes aid in carbohydrate metabolism and other biological functions and results from this study shows that Vitamin B1 (thiamine) is found in a higher concentration in SAF (6.73 ± 0.94 mg/100g) compared to SMF (0.555 ± 0.01 mg/100g). Thiamine is essential for nervous system, cardiovascular and muscular function. Vitamin B2 (riboflavin) is essential for energy production and also in its co-enzyme forms (FMN and FAD) serves as hydrogen transport systems. It also helps in the production of red blood cells and antibodies as well as building blocks for healthy hair growth, skin and nails. The content of vitamin B2 in SMF (1.34 ± 0.31) was higher than that of SAF (0.81 ± 0.2), and suggests that SMF and SAF can be used in the management of anaemic conditions if consumed in sufficient quantity. The content of vitamin B3 reported in this study for SMF and SAF are 0.649 ± 0.21 mg/100 g and 0.865 ± 12.50 mg/100g, respectively. Vitamin B3 (nicotinamide) plays a key role in DNA regeneration, helps in the breakdown of blood sugar and maintenance of energy levels, dilatation of blood vessels and increase in blood flow [22–24]. The level of vitamin B3 obtained in this study indicates that both fruits are good sources of vitamin B3 for both animal and human consumption. Vitamin C (ascorbate) modulates adipocyte lipolysis, inhibits glucose metabolism and leptin secretion on isolated adipocytes, leading to the improvement in hyperglycemia and decrease glycosylation [25]. The concentration of vitamin C (ascorbate) was higher in SAF compared to SMF, indicating that SAF is a better source of vitamin C than SMF. Vitamin E (Tocopherol) is an important anti-oxidant used for the preparation of various kinds of cosmetic products ranging from soaps, creams, etc. however, both species contain very low amount of this vitamin, and vast differences have also been observed among different cultivars of eggplant in terms of vitamins [26].

High concentrations of anti-nutrients [27] in foods have been reported to cause great effects on mineral bioavailability in foods and other nutrients by forming complexes with them, which in most cases results in reducing the absorption of minerals and utilization by the body systems. As shown in table 5, the amount of phytate in SMF and SAF samples are 28.19 ±0.15 and SAF 34.33 ± 0.33 mg/100 g, respectively. The low amount of phytic acid in both fruits could be attributed to the presence of an enzyme called phytase which aids in degradation of phytic acid in plant [28, 29]. Excessive ingestion of cyanogenic glycosides can be lethal as it intercalates with cytochrome oxidase for aerobic function [30–32]. The values obtained in this study for cyanide content were low, and within the range of 13.33± 0.39 mg/100g - 20.67 ± 0.46 mg/100g compared to the values from other reports [26]. It therefore shows that both fruit samples are safe for human consumption. Generally, the values obtained for the analysed anti-nutrients in both fruits studied are lower than the lethal dose, hence, may not elicit toxic effect when consumed.

Qualitative phytochemical screening studies of the fruits used in this study showed the presence of many phytochemicals namely; alkaloids,

flavonoids, saponins, tannins, glycosides, anthraquinone, and anthocyanin as represented in table 6. Likewise, the quantitative phytochemical analysis as represented in table 7 showed high concentrations of alkaloids, flavonoids and phenols in both fruit samples studied. These bioactive components have been used as raw materials in most pharmaceutical agents [33–35]. Alkaloids and saponins are known to elicit antimicrobial abilities and defend plants against microbial and pathogenic attacks [36–38], and the presence of these phytochemical constituents showed that the *S. melongena* and *S. aethiopicum* have medicinal properties. The roles of these phytochemicals as analgesic, anti-inflammatory, anti-hypertensive and anti-microbial. Phenolic acids (flavonoids, tannins, anthocyanins, hydroxycinnamate esters, and lignin) are often referred to as secondary metabolites. Flavonoids and phenols are potential antioxidants, free radical-scavengers, antimutagenic, antitumor activities and are also able to elicit hypolipidemic effects. In this study, the content of flavonoids for both plant samples are 1.46 ± 0.01 (SAF) and 2.80 ± 0.08 mg/100g (SMF), and phenols for both fruits are 4.17 ± 0.03 (SAF) and 5.80 ± 0.4 mg/100g (SMF), hence consuming these fruits can help in prevention of atherosclerosis, reduction of blood cholesterol and lipid levels. Tannins possess anti-microbial, anti-inflammatory, anti-oxidants and diuretic properties [39]. Result from this study showed that the level of tannins in *Solanum melongena* (0.82 ± 0.14 mg/100g) was lower than that of *Solanum aethiopicum* fruits (1.28 ± 0.05 mg/100g) respectively, and this indicates that *S. aethiopicum* fruits may have protective effects on the kidney if consumed in large quantity as low intake of tannins is known to protect the kidney and also neutralizing the effects of viruses [40]. Anthraquinones have the laxative effect by directly stimulating colonic smooth muscles, and also known to serve as anti-inflammatory, antimicrobial as well as colouring agents [41, 42]. However, the concentration of anthraquinone obtained in this study were relatively low in both *Solanum melongena* and *Solanum aethiopicum* fruits (0.27 ± 0.00 and 0.17 ± 0.77 mg/100g, respectively), and this is consistent with previous study of [43]. This implies that these fruits are poor in this anti-nutrient content. Anthocyanins possess free radicals-inhibitory properties and also possess other functions such as anti-aggregative, vasodilating and antioxidant properties which could decrease the LDL oxidized concentration and protects the cell wall from damage [44, 45]. The concentration of anthocyanin in plants we studied, though in minute quantity, may contribute to the lipid lowering potentials of the plants. Plants that are rich in cardiac glycosides are used traditionally in most cases to restore heart rhythm problems and congestive heart failure, and cardiac glycosides have been reported to be useful as flavouring agents in pharmaceutical preparations and also act on cardiac muscles [46, 47]. The presence of glycosides in *Solanum melongena* fruit (0.06 ± 0.03 mg/100g) was relatively low when compared with *Solanum aethiopicum* fruit (0.80 ± 0.05mg/100g) which indicates that *Solanum aethiopicum* fruit may have more anti-arrhythmic, antihypertensive properties as well flavouring properties than *Solanum melongena* fruits.

Amino acid is a class of biologically active compounds present in food and beverages and are important for human nutrition and affect the quality of foods including taste, aroma, and colour. In summary, amino acids are precursors for the synthesis of secondary metabolites and they play important biological roles which includes formation of hormones (thyroxine and adrenaline); promotion of prostrate health; production of histamine and glutamate; prevention of muscle breakdown during exercise, aids the liver in fat procession and aids in growth and nitrogen maintenance. Table 8 and 9 summarizes the amino acids commonly found in proteins of the fruits of both eggplant and the amount of amino acids composition varied among both fruit samples. Such rich contents for these amino acids make it irreplaceable as a raw material for the production of pharmaceuticals and diet supplements. The HPLC chromatogram of the study revealed eighteen peaks that corresponds to nine amino acids and other organic substances present in *Solanum melongena* and *Solanum aethiopicum* fruits (Fig. 1 and Fig 2). These amino acid compounds were confirmed by their retention time, formulae and molecular weight. The major amino acids detected are Glutamine (94.698%), Histidine (38.666%), oh-Lysine-1 (23.801%), Cysteine (18.478%), Leucine (9.067%), GABA (4.557%), Phosphoserine (3.054%), Serine (2.251%), Aspartate (1.776%), Threonine (1.772%), Methionine (1.136%), Ornithine (0.462%), Lysine (0.125%), Proline (0.049%), Alanine (0.042%), Valine (0.038%), Phenylalanine (0.019%) and Threonine (0.014%). As stated earlier, figure 1 showed nine peaks representing different amino acids, with concentration of glutamine being the highest as in depicted by peak 3 in SAF, followed by Histidine, Lysine and Cysteine. Glutamine, threonine and lysine are known to function in the maintenance of intestinal integrity and health in general [48–50]. Aside its medicinal benefits, glutamine is also used as food flavouring agents (monosodium glutamate (MSG) [51]. Aspartic acid was seen in the fruits of SMF but in small amounts (1.776%), however, Aspartic acid is essential for purine, pyrimidine, asparagine and inositol synthesis [52]. Interestingly, very low amounts phenylalanine was obtained for SMF in this study (0.019%), and this shows that the fruits is safe for consumption as concern for the safety of phenylalanine have been implicated with the abnormal brain development known to occur in humans with phenylketonuria [53]. Valine is known to function in maintenance and balancing the chain of amino acids whereas alanine is involved in autophagy, gluconeogenesis and transamination [54, 55]. This amino acid was however found in small amounts in both fruit samples studied. Although no single plant would provide humans with adequate levels of all essential amino acids, *Solanum melongena* fruits and *Solanum aethiopicum* fruits can be consumed with other foods and contribute useful amounts of the amino acids to the diet.

CONCLUSION

This study reports the phytochemical, anti-nutrients, vitamins, minerals, and amino acid constituents of two different species of eggplant fruits. The variations that occur in the eggplants cultivars do not end at the morphological level only but also in the composition of the various nutrients and bioactive substances present in both fruit samples studied. These compounds are bioactive and could be the basis of their nutritional and medicinal potentials. In other words, this study has provided some scientific rationale for *Solanum melongena* and *Solanum aethiopicum* fruits in the management of diseases, as obtained in folklore.

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Conflict of Interest

Authors declare that there is no conflict of interest

Author contributions

EA: Conceptualized and co-designed the work, carried out literature search, conducted laboratory experiments, analysed results, interpreted the data and wrote the initial draft of the manuscript. UN: supervised and guided through all the experimental stages of the research. OK:

provided all technical support for the experiments. OAS: Co-designed and Co-supervised the work, provided insight into the laboratory investigations, data interpretation and improved on the final draft of the manuscript. All authors read and approved the final manuscript.

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