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RESEARCH ARTICLE

Amino and Fatty Acid Profiles of Mechanically Dehulled Toasted African Breadfruit (*Treculia africana*) Seed Flour as Affected by Pre-toasting Treatments

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Abstract

African breadfruit seeds are rich in essential and non-essential amino acids, have unique fatty acid profile, with a predominance of unsaturated fatty acids. This study was conducted to determine the amino and fatty acid profiles of pretreated, toasted African breadfruit seeds. African breadfruit seeds were soaked with and without Alum at different durations, toasted, mechanically dehulled, milled into flour and 10 samples were generated; five (5) of which were Alum-soaked and five (5) of which were soaked without Alum – SSA2, SSA4, SSA6, SSA8, SSA10 and SWA2, SWA4, SWA6, SWA8, SWA10, respectively. Additionally, a portion of the African breadfruit seeds was toasted without prior soaking, dehulled, milled into flour and coded as SWS. The amino and fatty acid components of the flour samples were determined with standard methods. The results showed that total amino acid composition was highest in sample SWA8 (95.20g/100g protein) and lowest in the untreated sample (SWS) 76.67g/100g, total essential amino acid was highest in sample SSA8 (41.37g/100g) and lowest in sample SWS (29.71g/100g protein), total non-essential amino acid was highest in sample SWA8 (56.48g/100g protein) and lowest in sample SSA6 (46.35g/100g). The total unsaturated fatty acid composition was highest in the untreated sample (SWS) 85.10g/100g and lowest in sample SWA8 (71.40g/100g). The study revealed that pretreated, toasted African breadfruit seeds exhibit substantial amino and fatty acid profiles, contributing invaluable perspectives for their potential applications in food and nutrition.

Keywords: African Breadfruit Seeds, Amino Acids, Fatty Acids, Soaking, Toasting.

1. Introduction

African breadfruit (*Treculia africana*) is a food crop with extensive potential for both domestic and industrial applications (Umezuruike, 2019). The seeds are rarely consumed in their raw state; instead, they can be baked, boiled, roasted, or fried before ingestion. Alternatively, they can be milled into flour, serving as a soup thickener (Okoye and Obi, 2017) or serving as a viable substitute for wheat flour in bakery goods (Agu *et al*., 2007). Notably, breadfruit flour carries substantial potential for pastry production (Obi and Akubuo, 2018). Furthermore, the seeds can be pressed to yield edible oil, commonly utilized in cooking and frying. In this manner, the flour emerges

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as a rich source of protein and fat, thereby providing a protein supplement (Okoye and Obi, 2017).

Soaking and roasting among other traditional processing methods, have been employed to enhance the nutritional content of cereals and pulses (Chauhan *et al*., 2022). Specifically, soaking is commonly used as a preliminary treatment for legumes prior to processing (Yahaya *et al.*, 2022). Toasting/ roasting, a prevalent dry heat processing technique, serves various purposes, inducing notable alterations in moisture content, appearance, texture, etc. According to Bhattacharya (2014), roasting is instrumental in achieving uniform cooking, improving digestibility, enhancing palatability, and modifying sensory characteristics in the foods. This process of roasting, as outlined by Sruthi *et al*. (2021), employs heat to uniformly cook foods, resulting in improved digestibility, palatability, and sensory characteristics. This method transforms nutrients for better digestibility, enhancing aroma, flavor, and color in various foods through a high-temperature, short-time process. Simultaneously, roasting reduces water activity, extends shelf-life, and modifies antioxidant and functional properties, contributing to increased consumer acceptance (Sruthi *et al*., 2021).

Protein is an essential macronutrient made up of amino acids, which are building blocks necessary for growth, repair, protection and maintenance of body tissues (Shang *et al*., 2018). Usually, the protein necessary is influenced by the gender, age, activity level, body health, or physiological states (Oana and Istrati, 2018). Different foods exhibit varying protein content, with sources like lean meats, poultry, fish, dairy products, legumes, and nuts being prominent examples (Oana and Istrati, 2018). A food is to be considered as a protein source when the protein content of the food material is up to the 12% protein as recommended (Runsewe-Abiodun *et al.*, 2018). African breadfruit seeds have been identified as a potential protein source for human consumption. They are known to contain essential and non-essential amino acids. These amino acids are relevant for muscle development, immune function, and neurotransmitter synthesis. A comprehensive analysis by Nwozo *et al*. (2019) revealed that African breadfruit seeds were particularly rich in lysine, an essential amino acid often lacking in other plant-based foods. A study by Onochie *et al*. (2010) reported that breadfruit seeds are a good source of essential amino acids, including leucine, isoleucine, valine, lysine, and phenylalanine, which are relevant for protein synthesis and various metabolic processes in the body. Furthermore, the seeds also contain non-essential amino acids like glutamic acid and aspartic acid (Onochie *et al*., 2010).

Fatty acids are essential components of dietary lipids, playing a vital role in energy storage, cellular membrane structure, and various metabolic processes. African breadfruit seeds have unique fatty acid profile, with a predominance of unsaturated fatty acids. Previous researchers highlighted that African breadfruit seeds are rich in unsaturated fatty acids, particularly linoleic acid (omega-6) and oleic acid (omega-9). These fatty acids have been associated with cardiovascular health and anti-inflammatory properties. Another study identified linoleic and oleic acids as the major fatty acids in African breadfruit seeds. Therefore, the objective of the study was to determine the amino and fatty acid profiles of toasted African breadfruit flour as affected by pre-toasting treatments. The findings from this study are expected to expand the potential uses of this nourishing local crop.

2. Materials and Methods

2.1 Material Procurement

African breadfruit (*Treculia africana*) seeds were purchased from Relief market in Owerri Municipal L.G.A, Imo State, Nigeria.

2.2 Material Preparation

2.2.1 Sample Cleaning and Pretreatment Process

African breadfruit (*Treculia africana*) seeds were cleaned to remove bad seeds and foreign particles. Afterward, they were washed, divided into three equal portions with each portion weighing 10kg. The first portion was the control sample, the second was sample soaked with Alum, and the third was sample soaked without Alum, coded as SWS, SSA, and SWA, respectively. Sample SWS was toasted without prior soaking. Subsequently, sample SSA was subdivided into five parts, each soaked in distilled water at a ratio of 1:10 (w/v) with 1.0% Alum (Olapade and Umeonuorah, 2014) for different durations—2h, 4h, 6h, 8h, 10h, resulting in samples SSA2, SSA4, SSA6, SSA8, and SSA10. Similarly, sample SWA was divided into five portions and subjected to same process as SSA, yielding samples SWA2, SWA4, SWA6, SWA8, and SWA10. The steeping method of (Nwosu, 2010) with modifications was employed for the process. After steeping, water was drained from the breadfruit samples and they were toasted.

2.2.2 Dehulled Toasted African Bread Fruit Seed Flour Processing

Toasting was done according to the method described by Ozigbo *et al*. (2015) with modifications. African breadfruit seeds were toasted for 30 minutes at 130^oC, cooled for 1h, dehulled mechanically, winnowed, processed into flour using hammer mill (Model: De-Demark Super) and sieved through a sieve of 4.25µm. The flour was packaged in airtight container for further analysis.

2.3 Method of Analyses

2.3.1 Determination of Amino Acid Profile of Toasted African Breadfruit Seed Flour Samples

The amino acid profile of the flour samples was determined using Automatic Amino Acid Analyzer as described by Olugbuyi *et al*. (2021). Initially, the flour sample was dried to a constant weight, defatted, hydrolyzed and evaporated using a rotary evaporator. Subsequently, it was loaded into Applied Biosystems PTH Amino Acid Analyzer. The resulting hydrolyzate was dispensed and analyzed for free acidic, neutral and basic amino acids, which lasted for 76 hours. The concentrations of each amino acid obtained were recorded and printed as chromatogram peaks using a chart recorder (an integrator attached to the Analyzer) for both the standard and the test samples.

2.3.2 Determination of Fatty Acid Profile of Toasted African Breadfruit Seed Flour Samples

The fatty acid profile of the flour samples was determined as described by Salimon *et al*. (2017). Before derivatization, the Fatty Acid constituents of the samples were processed by accurately weighing 150 mg aliquots of the homogenised samples into extraction tubes. Lipid extracts were prepared by homogenising the samples in 20 ml of hexane containing (50 ppm) teributylated hydroxy toluene (BHT) to avoid oxidation of cis and trans PUFAs. The homogenates were dried with anhydrous sodium sulphate Na_2SO_4 and filtered with sintered glass funnels. After washing the funnels with 5 ml of hexane, the solvent was removed under vacuum in a rotary evaporator. Finally, the extracted lipids of the samples were dried under nitrogen, weighed carefully and stored frozen until analysis.

Preparation of fatty acid methyl esters (FAMEs): After the extraction process, FAMEs were prepared before the Gas Chromatographic (GC) analysis. For this, each of extracted lipids of the samples was transferred to a screw-cap test tube (10 mL) and 1 mL of a solution containing 10 mg 5 mL-1 heptadecanoic acid (internal standard) in methanol was added and followed by 1 mL of 2 M $NaOCH_3$. The content was placed in a water bath at 60^oC for 5 min. Drops of concentrated glacial acetic acid were added to each tube to neutralize NaOH. The samples were reduced to dryness under N_2 and then redissolved in 1 mL of methanol: toluene (2:1 vol.). After that, TMS-DM was added in molar excess of 2 M in n-hexane (100 µl) at 50^oC for 10 min without capping the tubes. Drops of glacial acetic acid were added until the yellow colour disappeared to remove unreacted TMSDM and the reaction mixture was diluted with 1 ml of 0.5% NaCl solution. To extract the FAME, 1 mL of n-hexane containing 50 ppm BHT was added and the tubes were vortexed for about 30 s. After the solution settled, the organic layers, containing the methyl esters, were transferred to a vial for GC.

Gas chromatographic analysis: One microlitre volume of each sample was injected into GC (Shimadzu, GC-17A, Kyoto, Japan) equipped with FID for separation and quantification of the FAMEs. The analysis was carried out using a BPX70 fused silica capillary column (30 M, 0.25 mm i.d., 0.2 lm film thickness, Melbourne, Australia). The run was under an optimised temperature programme as follows: initial column temperature 100^oC, programmed to increase at a rate of 10^oC min-1 up to 160^oC and then at 3^oC min-1 up to 220^oC. This temperature was maintained for 5 min, then at 10^oC min-1 up to final temperature of 260^oC and held for 5 min. Injector and detector temperatures were at 260 and 280^oC, respectively. Helium was used as the carrier gas at a flow rate of 1 mL min-1 with a split ratio of 30:1. FAMEs were identified by comparing their relative and absolute retention times to those of authentic standards. The fatty acid composition was reported as a relative percentage of the total peak area.

3. Results and Discussion

3.1 Effect of Pre-Toasting Treatment on the Amino Acid Profile of Toasted African Breadfruit Seed Flour Samples

Table 1 shows the result of the amino acid profile of toasted African breadfruit seeds flour samples. The glutamic acid content of the flour samples were found to be between 11.96g/100g of protein and 15.71g/100g of protein. Sample SWA6 had the highest glutamic acid composition while sample SSA6 had the least. The aspartic acid content of the flour samples ranged from 7.07g/100g of protein to 12.93g/100g of protein. Sample SWA6 had the highest aspartic acid composition while sample SWA4 had the least. The leucine content of the flour samples were found to be between 6.21g/100g of protein and 9.04g/100g of protein. Sample SSA8 had the highest value (9.04g/100g of protein) while sample SWA4 had the least (6.21g/100g of protein).

The lysine content of the flour samples ranged between 4.29g/100g of protein and 8.12g/100g of protein. Sample SWA8 had the highest value while sample SWS had the least value. The tryptophan content of the flour samples were found to be between 0.31g/100g of protein and 3.01g/100g of protein. Sample SWA6 had the highest value while sample SSA2 had the least value. The cysteine content of the flour samples were found to be between 0.48g/100g of protein and 6.65g/100g of protein. Sample SWA6 had the highest composition while sample SSA2 had the least value. The methionine content of the flour samples ranged from 0.93g/100g of protein to 5.38g/100g of protein. Sample SSA8 had the highest value while sample SWS had the least value.

This study revealed that various essential and non-essential amino acids are present in toasted African breadfruit seeds and it was observed that the most abundant amino acid in toasted African breadfruit seeds is glutamic acid, followed by aspartic acid, leucine and lysine, while the most limiting amino acid is tryptophan, followed by cysteine and methionine. Schwab and Whitehouse (2022) stated that methionine is generally a limiting amino acid in legumes as well as vegetables; also tryptophan and cysteine (Twari and Singh, 2012). Glutamic acid performs numerous functions in the human body including strengthening the immune system, regulating body weight, improving long and short term memory, regulating the acid-base balance and making the skin firm, etc (Akinjayeju *et al*., 2019); hence, its abundance in this present study is beneficial to human diet.

The total essential amino acids of the flour samples ranged between 29.71g/100g of protein and 41.37g/100g of protein and are lower than the total non-essential amino acids of the flour samples, which ranged between 46.35g/100g of protein and 56.48g/100g of protein. This suggests that toasted African breadfruit seeds are more abundant in non-essential amino acids. This report is in agreement with the findings of Okoronkwo *et al.* (2020). Although most values obtained in this study were high compared to FAO/WHO (1991) daily requirement value, it is still suggested that African breadfruit should be supplemented with especially, essential amino acid rich food source.

The total amino acid composition of the flour samples ranged between 76.67g/100g of protein and 95.20g/100g of protein which shows that generally toasted African breadfruit seeds are rich source of protein. According to Onochie *et al*. (2010), Ukwa (African breadfruit) contains several essential amino acids therefore its consumption could support growth and maintain health.

Treculia africana contains essential amino acids which are in concentrated quantity, and these amino acids are precursors of neurotransmitters (Onochie *et al*., 2010). Onochie *et al*. (2010) further suggested that *Treculia africana* as a good locally available and acceptable food of high nutritive value, effective in the nutritional rehabilitation, should be formulated into different foods such as alcoholic beverages (breadfruit drinks), breadfruit cakes, soup thickeners, snacks and other cookies.

The basic amino acid values ranged from 11.29g/100g of protein to 18.98g/100g of protein. Sample SWA4 (African breadfruit seeds soaked without Alum for 4h before toasting) had the highest value while sample SWS (African breadfruit seeds toasted without pretreatment) had the least value. On the other hand, the acidic amino acid values ranged between 20.92g/100g of

Table 1. *Amino acid profile of toasted African breadfruit seed flour samples (g/100g protein)*

Amino Acid/SAMPLE	SWS	SSA2	SSA4	SSA6	SSA8	SSA10	SWA2	SWA4	SWA6	SWA8	SWA10
Leucine	6.30	8.91	8.66	6.48	9.04	7.03	7.85	6.21	8.81	7.39	7.82
Lysine	4.29	5.42	7.21	4.64	6.28	6.55	7.18	7.04	7.83	**8.12**	6.80
Isoleucine	3.79	2.81	3.60	3.40	3.21	3.53	3.27	4.28	4.50	4.70	4.53
Phenylalanine	4.08	6.56	6.24	5.14	5.93	5.32	5.12	6.11	3.49	6.83	3.50
Tryptophan	0.86	0.31	0.82	0.97	2.61	1.26	0.68	0.70	3.01	0.94	3.00

Valine	4.09	4.23	4.16	4.27	0.84	5.99	4.21	4.65	1.87	4.22	1.90
Methionine	0.93	1.59	2.17	1.23	5.38	1.17	1.33	2.03	4.18	3.04	4.15
Histidine	2.01	4.02	3.48	2.23	2.67	2.87	4.66	5.81	0.65	0.71	4.70
Threonine	3.36	3.80	3.18	3.11	5.41	4.02	3.61	3.18	2.01	2.77	4.00
TEAA	29.71	37.65	39.52	31.47	41.37	37.74	37.91	40.01	36.35	38.72	40.40
Proline	2.23	4.01	4.82	4.97	1.12	3.96	5.94	6.77	5.79	4.91	3.82
Arginine	4.99	5.58	5.16	5.33	4.16	6.71	5.33	6.13	4.01	5.88	2.07
Tyrosine	3.44	3.06	3.27	2.41	5.08	2.06	3.10	2.94	2.06	3.70	2.00
Cysteine	1.09	0.48	0.81	0.91	0.84	1.21	0.85	0.74	6.65	3.91	4.90
Alanine	4.47	2.73	3.65	3.90	3.55	5.88	4.02	6.13	1.04	4.02	1.02
Glutamic acid	12.11	14.24	14.21	11.96	13.18	13.09	15.33	14.81	15.71	15.61	15.70
Glycine	4.08	4.24	4.60	4.51	5.13	5.56	3.99	3.22	4.31	4.94	5.50
Serine	3.70	3.00	3.16	3.40	3.38	3.59	3.81	4.90	3.82	4.80	1.80
Aspartic acid	10.85	10.41	10.12	8.96	10.02	11.35	10.08	7.07	12.93	8.71	10.21
TNEAA	46.96	47.75	49.80	46.35	46.46	53.41	52.45	52.71	56.32	56.48	47.02
TAA	76.67	85.40	89.32	77.82	87.83	91.15	90.36	92.72	92.67	95.20	87.42
Hydrophobic AA	25.89	30.84	33.30	29.39	29.07	32.88	31.74	36.18	29.68	35.11	26.74
Hydrophilic AA	15.67	14.58	15.02	14.34	19.84	16.44	15.36	14.98	12.85	20.12	18.20
Basic AA	11.29	15.02	15.85	12.20	13.11	16.13	17.17	18.98	12.49	14.71	13.57
Acidic AA	22.96	24.65	24.23	20.92	23.20	24.44	25.41	21.88	28.64	24.32	25.91

TEAA = Total essential amino acids, TNEAA = Total non-essential amino acids, TAA = Total amino acids

*TEAA = Total essential Amino acids = phenylalanine + valine + methionine + lysine + leucine + isoleucine + threonine + tryptophan + histidine

*TNAA = Total non essential Amino acids = Arginine + cysteine + glycine + tyrosine + proline + serine + glutamic acid + alanine + aspartic acid

*Hydrophobic amino acids; methionine + alanine + valine + leucine + isoleucine + proline + phenylalanine

*Hydrophilic amino acids; serine + threonine + cysteine + tyrosine + glycine

*Basic amino acids; lysine + histidine + arginine

*Acidic amino acids = glutamic acid + aspartic acid.

Key: SWS = African breadfruit seeds toasted without pretreatment (control), SSA2 = African breadfruit seeds soaked with *Alum* for 2h before toasting, SSA4 = African breadfruit seeds soaked with *Alum* for 4h before toasting, SSA6 = African breadfruit seeds soaked with *Alum* for 6h before toasting, SSA8= African breadfruit seeds soaked with *Alum* for 8h before toasting, SSA10 = African breadfruit seeds soaked with *Alum* for 10h before toasting, SWA2 = African breadfruit seeds soaked without *Alum* for 2h before toasting, SWA4 = African breadfruit seeds soaked without *Alum* for 4h before toasting, SWA6 = African breadfruit seeds soaked without *Alum* for 6h before toasting, SWA8 = African breadfruit seeds soaked without *Alum* for 8h before toasting, SWA10 = African breadfruit seeds soaked without *Alum* for 10h before toasting.

Protein and 28.64g/100g of protein. Sample SWA6 had the highest value while sample SSA6 had the least. This suggests that soaking (with or without Alum) has effect on the amino acid composition of the flour samples. The total amount of polar (acidic and basic) amino acids is greatest in sample SWA2 (42.58g/100g of protein) compared to other flour samples and lowest in sample SSA6 (33.12g/100g of protein) which suggests that there will be higher protein solubility in sample SWA2 (African breadfruit seeds soaked without Alum for 2h before toasting) than in sample SSA6 (African breadfruit seeds soaked with Alum for 6h before toasting) as well as other flour samples. According to Hellebois *et al.* (2021), protein solubility is important during food production because it defines the type of food that can be produced, phases that can be stabilized, processing operations needed and time required to carry out these operations. The hydrophobic amino acids were highest in sample SWA4 (African breadfruit seeds soaked without Alum for 4h before toasting) and lowest in sample SWS (African breadfruit seeds toasted without pretreatment). This may be attributed to the effect of soaking (pretreatment) on the toasted African breadfruit seeds.

3.2 Effect of pre-toasting treatment on the fatty acid profile of toasted African breadfruit seed flour samples.

Table 2 shows the result of fatty acid profile obtained from toasted African breadfruit seeds flour samples. From the results, the oleic acid contents of the flour samples were found to be between 48.7 and 54.1g/100g. Sample SSA10 had the highest oleic acid composition while sample SWS had the least. The linoleic acid content of the flour samples ranged from 16.0 – 34.6g/100g. Sample SWS had the highest linoleic acid composition while sample SSA8 had the least. The palmitic acid content of the flour samples ranged from 9.1 – 13.6g/100g. Sample SWA8 had the highest oleic acid composition while sample SSA2 had the least. The stearic acid content of the flour samples ranged between 2.1 and 3.1g/100g. Sample SWA2 had the highest stearic acid composition while sample SWA8 had the least. In this study, the predominant fatty acids in toasted African breadfruit seeds flour samples were found to be oleic (48.7 – 54.1g/100g) and linoleic (16.0 – 34.6g/100g) acids, followed by palmitic (9.1 – 13.6g/100g) and stearic (2.1 – 3.1g/100g) acids. The total unsaturated fatty acid content ranged from 71.4 – 85.1g/100g, in which monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) were in the range 50.5 – 56.4g/100g and 16.0 – 34.6g/100g respectively. While the total saturated fatty acid content of the flour samples ranged between 16.2 – 19.9g/100g. This suggests that toasted African breadfruit seeds are more abundant in unsaturated fatty acids. The total unsaturated fatty acids were found to be higher in sample SWS (African breadfruit seeds toasted without pretreatment) than other flour samples and lower in sample SWA8 (African breadfruit seeds soaked with Alum for 8h before toasting), while the total saturated fatty acids were found to be higher in sample SWA8 (African breadfruit seeds soaked without Alum for 8h before toasting) than other flour samples and lower in sample SWA10 (African breadfruit seeds soaked without Alum for 10h before toasting).

It is suggested that soaking (with or without Alum) has effect on the fatty acid composition of the flour samples; although the exact effect has not been determined by research.

The order of predominance of the fatty acids in the flour samples is consistent with the reports of Adeyeye and Adesina (2012) and Ifeduba *et al*. (2013). Relatively small amounts of other unsaturated fatty acids in the tune of gadoleic, erucic and nervonic acids were detected but these fatty acids comprised less than 3g/100g of the total unsaturated fatty acids. In the same vein, small amounts of some saturated fatty acids – arachidic, behenic and lignoceric acids were detected but these fatty acids comprised less than 6g/100g of the total saturated fatty acids. This result is in agreement with the report of Ifeduba *et al*. (2013). Also, the result of total fatty acid composition of the toasted African breadfruit seeds flour samples is in agreement with the report of Ifeduba *et al*. (2013) for fatty acid profile of *T. africana* seed oil.

The ratios of unsaturated and saturated fatty acids (UFA/SFA) ranged from 3.99 – 5.15g/100g. This (UFA/SFA) ratio was greater in sample SWA10 (African breadfruit seeds soaked without Alum for 10h before toasting) than other flour samples and least in sample SWA8 (African breadfruit seeds soaked without Alum for 8h before toasting). The current results show that the UFA/SFA ratios were within the optimum values for human diets. Woloszyn *et al*. (2020) had similar results for fatty acid profile and lipid indices of goose. According to Mapiye *et al*. (2011), foods with PUFA/SFA ratios below 0.45 have been considered undesirable for human diet because of their potential to induce cholesterol increase in the blood. Denardi-Souza *et al*. (2017) also stated that unsaturated fatty acids/saturated fatty acids ratios below 0.45 are not really advisable to health since they may cause heart disorders. The UFA/SFA has become one of the most important parameters for evaluating the nutritional value and healthiness of foods (Yang *et al*., 2010; Mapiye *et al.*, 2011; Attia *et al*., 2017; Woloszyn *et al*., 2020).

Table 2. *Fatty acid profile of Toasted African breadfruit seed flour samples (g/100g).*

Fatty Acid/SAMPLE	SWS	SSA2	SSA4	SSA6	SSA8	SSA10	SWA2	SWA4	SWA6	SWA8	SWA10
Palmitic [16:0]	9.3	9.1	9.5	9.4	9.5	9.8	12.5	12.1	13.0	13.6	11.3
Stearic [18:0]	2.4	2.4	2.6	2.5	2.3	2.7	2.1	2.3	2.6	3.1	2.1
Oleic [18:1]	48.7	50.4	51.2	51.8	53.3	54.1	50.7	51.6	49.2	52.7	51.8
Linoleic [18:2]	34.6	31.2	30.8	29.3	16.0	25.1	29.4	28.9	30.0	24.3	30.1
Arachidic [20:0]	0.9	1.0	0.7	1.1	1.0	1.3	1.0	1.0	1.1	1.2	1.0
Gadoleic [20:1]	0.5	0.3	0.2	0.3	0.5	0.4	0.9	0.9	0.8	0.9	0.7
Behenic [22:0]	3.8	2.9	2.7	2.5	2.8	2.9	1.9	1.8	1.3	1.7	1.2
Erucic [22:1]	1.2	0.8	0.9	1.2	1.3	1.3	0.8	0.9	1.0	1.4	0.8
Lignoceric [24:0]	1.1	1.2	0.9	1.3	1.3	1.5	0.5	0.5	0.7	0.3	0.6
Nervonic [24:1]	0.1	0.5	0.4	0.1	0.3	0.6	ND	ND	0.1	0.2	ND
TUFA	85.1	83.2	83.5	82.7	71.4	81.5	81.8	82.3	81.1	79.5	83.4
TSFA	17.5	16.6	16.4	16.8	16.9	18.2	18.0	17.7	18.7	19.9	16.2
U/S	4.86	5.01	5.09	4.92	4.22	4.48	4.54	4.65	4.34	3.99	5.15

ND = not detected, TSFA = total saturated fatty acids, TUFA= total unsaturated fatty acids, U/S = unsaturated fatty acids/ saturated fatty acids ratio.

Key: SWS= African breadfruit seeds toasted without pretreatment (control), SSA2 = African breadfruit seeds soaked with Alum for 2h before toasting, SSA4 = African breadfruit seeds soaked with Alum for 4h before toasting, SSA6 = African breadfruit seeds soaked with Alum for 6h before toasting , SSA8= African breadfruit seeds soaked with Alum for 8h before toasting, SSA10 = African breadfruit seeds soaked with Alum for 10h before toasting, SWA2 = African breadfruit seeds soaked without Alum for 2h before toasting,SWA4 = African breadfruit seeds soaked without Alum for 4h before toasting,SWA6 = African breadfruit seeds soaked without Alum for 6h before toasting, SWA8 = African breadfruit seeds soaked without Alum for 8h before toasting, SWA10 = African breadfruit seeds soaked without Alum for 10h before toasting.

4. Conclusion

This study explored the impact of pre-toasting treatments with and without Alum on the amino and fatty acid profile of toasted African breadfruit seed flour samples. Result revealed that toasted African breadfruit seeds are rich source of protein containing various essential and non-essential amino acids with glutamic acid as the most predominant, it also showed that the predominant fatty acids in toasted African breadfruit seeds flour samples were found to be oleic acid followed by linoleic, palmitic and stearic acids which suggests that toasted African breadfruit seeds are more abundant in unsaturated fatty acids. The UFA/SFA ratios in the toasted African breadfruit seed flour samples were within the optimum values for human diets. In general, soaking (with or without Alum) has effect on the amino and fatty acid compositions of the flour samples. This suggests that toasted African breadfruit seed flour can be beneficial in food and nutrition and should be employed in food formulations.

Author contributions

The work was a joint collaboration among all Authors. Author ALO: writing—original manuscript draft, investigation, methodology, data curation, evaluated the data obtained, and writing review. Authors NTU and OGI: supervision, project administration, conceptualization, investigation, methodology, data curation and review and editing original draft. All authors read and approved the final manuscript.

Ethical Statement

On behalf of all coauthors, I, Mrs. Akajiaku, Linda .O, declare that this article has not been published in part or whole elsewhere. Neither is it under consideration for publication in another journal.

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Conflicts of Interest

The authors declare that no conflicts of interest exist.

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