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# Effect of Traditional Processing Methods on The Amino Acid Profile of *Artocarpus heterophyllus* (Jack Fruit) Fruit.

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**ABSTRACT**

Some plant species have hidden nutrient potentials which are underutilised and unexploited. This research evaluated the effect of processing on the amino acid profile of *Artocarpus heterophyllus* (jack fruit). The seeds and bulb were extracted from the fruit, the seeds were processed using three methods; boiling, roasting and fermentation. The amino acid profile was determined using technicon sequential multi-sample amino acid analyzer (TSM). The results showed that all the essential amino acids were detected in the seeds and pulp but the pulp was limiting in tryptophan. Among the essential amino acids detected, leucine was the most abundant with 8.22 ± 0.02 g/100g and 5.29 ± 0.01 g/100g for the unprocessed seeds (UAH) and pulp respectively, while methionine had the least values. The non-essential amino acids were higher in unprocessed *A. heterophyllus* (UAH) seeds except serine which was higher in the fermented *A. heterophyllus* (FAH) seed although it was not statistically different from other groups. Among the bulb and processed seeds, roasted *A. heterophyllus* (RAH) seed had higher values of both essential and non essential amino acid. *A. heterophyllus* fruit (seeds and bulb) is a good source of essential amino acid.

## INTRODUCTION

Dietary proteins are the source of nitrogen and indispensable amino acids for the body. The quality or nutritional status of protein is defined by its amino acid composition (Ojiako et al., 2010). Among the nine indispensable amino acids, lysine and threonine are strictly indispensable since they are not transaminated and their deamination is irreversible (IoM, 2005). *Artocarpus heterophyllus Lam* tree belongs to the family Moraceae. The plant has both nutritional and medicinal importance, it is used widely in traditional medicine, some of which have been validated in scientific/pharmacological studies. These include: antibacterial, antioxidant, hypoglycaemic, anti-cariogenic and anti-carcinogenic effects (Jagtap and Bapat, 2010; Jagtap *et al*., 2010; Baliga *et al*., 2011). In some developing countries where there is high level of poverty, conventional protein plant sources are very expensive and inaccessible to the poor. Fortunately, in many of these countries there are unconventional plant material that are neglected and unexplored which might be a good source of nutrient especially protein. In Nigeria, *A. heterophyllus* cultivation has not been encouraged, though it is found in the south-coastal parts of the country where it grows wild or semi-conserved (Odoemelam, 2005; Ajayi and Adewale, 2013). About 90 % of the seeds are wasted annually in Nigeria, only a few populations consume the pulp and boiled seeds. The aim of this work is to evaluate the amino acid profile of *A. heterophyllus* fruit and the effect of processing on the amino acid composition.

## MATERIAL AND METHODS

Processing of raw, boiled, roasted and fermented *A. heterophyllus* seeds,

*A. heterophyllus* seeds were obtained from Eke Umuoji local market in Anambra State Nigeria. The fruits were sliced open, the bulb and seeds were extracted manually and sorted. The bulb was washed in clean water, sliced, dried to constant weight in an oven at 50°C and milled. The seeds were divided into five portions. One of the portions was washed in clean water, the seed coats were removed, the seeds were sliced, dried to a constant weight in an oven at 50°C and milled as unprocessed *A. heterophyllus* (UAH) sample. The second portion was boiled for 60 minutes, the seed coats were removed, the seeds were sliced, dried in an oven at 50°C and milled as boiled *A. heterophyllus* (BAH) sample. The third portion was roasted for 60 minutes, the seed coats were removed and milled as roasted *A. heterophyllus* (RAH) sample. The fourth portion,

the seed coats were removed and soaked for 48 h (the water was changed at 24 h intervals), they were boiled for 60 minutes and the seeds were sliced, dried in an oven at 50°C, and milled as soaked *A. heterophyllus* (SAH) sample. The fifth portion was boiled for 60 minutes, the seed coats were removed and the seeds were tied in black nylon and kept in a cupboard for 48 h. They were dried in an oven at 50 °C and milled as fermented *A. heterophyllus* (FAH) sample.

**Determination of amino acid profile**

The amino acid profile in the sample was determined using methods described by Benitez (1989). The sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and loaded into the Technicon sequential Multi-Sample Amino Acid Analyzer (TSM).

**RESULTS**

**Table No. 1: Essential amino acid profile of *A. heterophyllus* seeds and bulb**

| Amino acid (g/100g crude protein) | UAH | BAH | RAH | SAH | FAH | Bulb |
|---|---|---|---|---|---|---|
| Lysine | 3.21 ± 0.02 | 2.62 ± 0.01 | 3.00 ± 0.02 | 3.33 ± 0.01 | 2.88 ± 0.01 | 2.01 ± 0.01 |
| Leucine | 8.22 ± 0.02$^{bf}$ | 6.35 ± 0.02$^{a}$ | 7.71 ± 0.02$^{af}$ | 7.02 ± 0.02$^{af}$ | 6.68 ± 0.02$^{af}$ | 5.29 ± 0.01$^{acde}$ |
| Isoleucine | 3.03 ± 0.02 | 2.41 ± 0.01 | 2.69 ± 0.01 | 2.62 ± 0.01 | 2.52 ± 0.01 | 2.08 ± 0.01 |
| Threonine | 2.62 ± 0.01$^{bf}$ | 2.00 ± 0.01$^{acde}$ | 2.73 ± 0.01$^{bf}$ | 2.42 ± 0.01$^{bf}$ | 2.51 ± 0.01$^{bf}$ | 2.00 ± 0.01$^{acde}$ |
| Methionine | 0.68 ± 0.01 | 0.51 ± 0.01 | 0.59 ± 0.01 | 0.62 ± 0.01 | 0.54 ± 0.01 | 0.51 ± 0.01 |
| Phenylalanine | 3.73 ± 0.01 | 3.42 ± 0.02 | 3.62 ± 0.01 | 3.45 ± 0.02 | 3.37 ± 0.01 | 3.02 ± 0.02 |
| Tryptophan | 0.72 ± 0.02$^{bcde}$ | 0.50 ± 0.02$^{acd}$ | 0.61 ± 0.01$^{abde}$ | 0.40 ± 0.01$^{abde}$ | 0.56 ± 0.01$^{acd}$ | - |
| Valine | 3.55 ± 0.01 | 3.15 ± 0.02 | 3.73 ± 0.01 | 3.49 ± 0.01 | 3.50 ± 0.01 | 3.51 ± 0.03 |

Values are mean of triplicate assays ± standard deviation (SD).

Significant differences among groups ($p < 0.05$) were represented with different superscript. UAH ($^{a}$), BAH ($^{b}$), RAH ($^{c}$), SAH ($^{d}$), FAH ($^{e}$) and bulb ($^{f}$).

Leucine was the most abundant essential amino acid in *A. heterophyllus* seeds and bulb. It was higher in the seeds than the bulb, UAH had 8.22% while the bulb had 5.29%. Among the processed samples, RAH had the highest value while BAH had the least value. There was a significant difference ($p < 0.05$) between the bulb and the seeds.

Tryptophan was not detected in bulb but was present in the seeds. UAH had the highest value 0.72% while SAH had the least value 0.4%. There was a significant difference ($p < 0.05$) between UAH and all the processed samples.

All the essential amino acids were higher in the seed than the bulb. Isoleucine, methionine, leucine, tryptophan and phenylalanine were abundant in UAH while threonine and valine were abundant in RAH, lysine was abundant in SAH. Leucine and Isoleucine concentration follow the pattern of Raw > Roasted> Soaked> Fermented> Boiled> Bulb.

**Table No. 2: Non-essential amino acid profile of *A. heterophyllus* seeds and bulb**

| Amino acid (%) | UAH | BAH | RAH | SAH | FAH | bulb |
|---|---|---|---|---|---|---|
| Histidine | $2.28 \pm 0.01^{bcdef}$ | $1.62 \pm 0.01^{ae}$ | $2.13 \pm 0.01^{ae}$ | $2.19 \pm 0.01^{ae}$ | $1.76 \pm 0.01^{ae}$ | $1.42 \pm 0.01^{abcdef}$ |
| Arginine | $4.52 \pm 0.02$ | $3.46 \pm 0.02$ | $4.16 \pm 0.01$ | $4.12 \pm 0.02$ | $3.71 \pm 0.01$ | $3.83 \pm 0.01$ |
| Aspartic acid | $8.52 \pm 0.02^{bf}$ | $6.66 \pm 0.02^{acdef}$ | $7.81 \pm 0.03^{b}$ | $8.03 \pm 0.03^{b}$ | $7.19 \pm 0.03^{b}$ | $5.29 \pm 0.03^{ab}$ |
| Serine | $2.40 \pm 0.01^{ef}$ | $2.30 \pm 0.01^{e}$ | $2.34 \pm 0.01^{e}$ | $2.41 \pm 0.01^{e}$ | $2.62 \pm 0.01^{abcdf}$ | $1.64 \pm 0.01^{ae}$ |
| Glutamic acid | $8.19 \pm 0.02^{f}$ | $7.28 \pm 0.03^{f}$ | $8.07 \pm 0.02^{f}$ | $7.84 \pm 0.02^{f}$ | $7.62 \pm 0.03^{f}$ | $5.98 \pm 0.02^{abcde}$ |
| Proline | $3.06 \pm 0.02^{bcdef}$ | $2.27 \pm 0.01^{a}$ | $2.63 \pm 0.01^{a}$ | $2.57 \pm 0.01^{a}$ | $2.42 \pm 0.01^{a}$ | $2.23 \pm 0.01^{a}$ |
| Glycine | $4.83 \pm 0.01$ | $3.34 \pm 0.01$ | $4.05 \pm 0.02$ | $2.95 \pm 0.01$ | $3.54 \pm 0.01$ | $3.01 \pm 0.01$ |
| Alanine | $3.82 \pm 0.02^{f}$ | $3.02 \pm 0.01^{f}$ | $3.63 \pm 0.01^{f}$ | $3.39 \pm 0.01^{f}$ | $3.25 \pm 0.01^{f}$ | $2.42 \pm 0.01^{abcde}$ |
| Cystine | $0.66 \pm 0.01^{f}$ | $0.52 \pm 0.01^{f}$ | $0.64 \pm 0.01^{f}$ | $0.58 \pm 0.01^{f}$ | $0.59 \pm 0.01^{f}$ | $0.41 \pm 0.01^{abcde}$ |
| Tyrosine | $2.40 \pm 0.01^{f}$ | $1.76 \pm 0.01^{f}$ | $2.22 \pm 0.01^{f}$ | $1.91 \pm 0.01^{f}$ | $2.24 \pm 0.01^{f}$ | $1.57 \pm 0.01^{abcde}$ |

Values are mean of triplicate assays ± standard deviation (SD).

Significant differences among groups ($p < 0.05$) were represented with different superscript. UAH ($^{a}$), BAH ($^{b}$), RAH ($^{c}$), SAH ($^{d}$), FAH ($^{e}$) and bulb ($^{f}$).

Non-essential amino acids were abundant in the seeds than the bulb. UAH had the highest yield of all the non-essential amino acid except serine that was abundant in FAH (2.62 ± 0.01) and there was a significant difference ($p < 0.05$) between FAH and other samples. Glutamic and aspartic acids were the most abundant non-essential amino acid. UAH had 8.19 ± 0.02 and 8.52 ± 0.02 while the bulb had 5.98 ± 0.02 and 5.29 ± 0.03 respectively. There was a significant difference ($p < 0.05$) between UAH and the bulb. Processing reduced the glutamic and aspartic acid levels. BAH had the least glutamic and aspartic acid yield (7.28 ± 0.03) and (6.66 ± 0.02) and these differed significantly ($p < 0.05$) from other groups. Histidine, arginine, glutamine, proline, cystine and alanine concentration follow the pattern of concentrations: Raw > Roasted > Soaked > Fermented > Boiled.

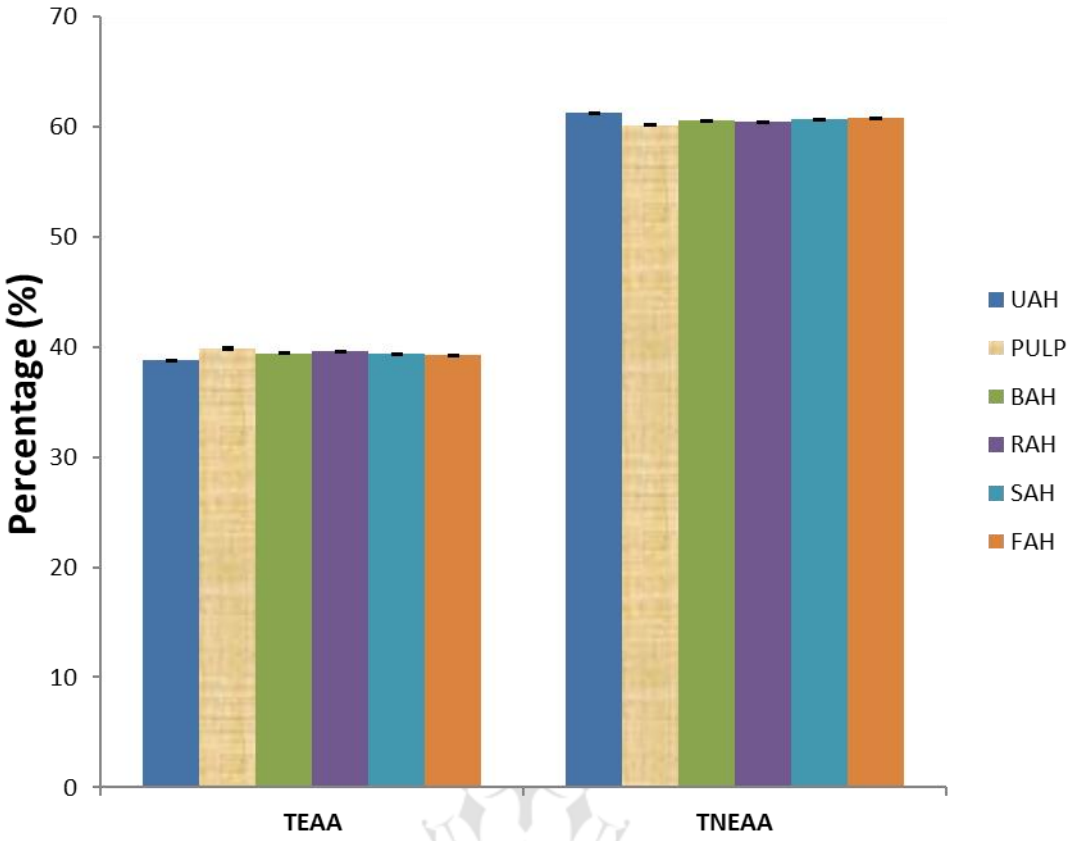


**Figure No. 1: Total essential and total non-essential amino acid profile of *A. heterophyllus* seeds and bulb**

Values are mean of triplicate assays ± standard deviation (SD).

TEAA: Total essential amino acid. TNEAA: Total non-essential amino acid,

The bulb had the highest total essential amino acid (TEAA) (39.85%), followed by RAH 39.58%. UAH had the least value 38.77% and it differed significantly ($p < 0.05$) from the bulb and processed samples. There was no significant difference between the bulb and the processed samples. UAH had the highest total nonessential amino acid (TNEAA) (61.23%) which differed significantly ($p < 0.05$) from other samples. The bulb had the least TNEAA value (60.15%) and it compared favourably with the processed samples.

## DISCUSSION

The nutritive value of a dietary protein is governed by the pattern and amount of essential amino acids (EAA) present. The presence of one or more of the EAA in adequate amounts would increase the nutritive value of the protein. Hence the bulb and seed proteins as sources of amino acids were assessed by comparison with the WHO/FAO/UNU (2007) reference pattern of EAA. The processed and unprocessed *A. heterophyllus* seeds contain all the essential amino acids, while the bulb is limiting in tryptophan. The samples (bulb, UAH, BAH, FAH, RAH and SAH) contain more than adequate levels of leucine and phenylalanine and comparable levels of lysine, isoleucine, tyrosine and valine with reference to FAO/WHO/UNU (2007) amino acid pattern. It is very important to note that leucine and phenylalanine concentrations in *A. heterophyllus* fruit (seeds and bulb) is higher than WHO reference pattern for essential amino acid, it is also higher than the concentration in cow milk and egg (WHO/FAO/UNU 2007). For example,

Lysine for UAH seed was found to be 3.21± 0.02, it was higher than the concentration reported for groundnut which is 2.80 (Aremu et al., 2006a), bambara groundnut 3.01 (Aremu et al., 2006b) and melon seed 1.85 (Akobundu et al 1982). UAH had leucine value of 8.22 ± 0.02 which is higher than leucine in some conventional legumes pigeon pea had 7.15 (Aremu et al., 2017), soybean 7.80 (Iwe et al., 2001), cowpea 7.50 (Aremu et al., 2017), groundnut 6.40 (Salunkhe et al., 1985) , bambara groundnut 7.80 (Salunkhe et al., 1985). Processing affected the amino acid content of *A. heterophyllus* seeds. Leucine was the most abundant amino acid; UAH contained 8.22 ± 0.02 g/100g while the bulb contained 5.29 ± 0.01 g/100g. This was similar to the report of Adeyeye (2010) who reported a high content of Leucine in raw and processed groundnut seeds. All the processing techniques used reduced the leucine level with RAH had the highest value. For leucine and isoleucine the pattern of concentration was raw > roasted > soaked > fermented > boiled > bulb. Tryptophan was detected in *A. heterophyllus* seeds. This fact gives the seeds an edge over groundnut seeds in which tryptophan have earlier been reported absent by Adeyeye (2010). Therefore, the seeds protein could very well complement those protein sources that are low in tryptophan.

## CONCLUSION

*A. heterophyllus* fruit (seeds and bulb) contains appreciable quantity of essential amino acid. The UAH seeds had higher values than the bulb and among the processed samples, RAH seeds had higher values. Therefore, *A. heterophyllus* fruit is a good source of essential amino acid.

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