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Protein and Amino Acid Compositions of *Sphenostylis stenocarpa*, *Sesamum indicum*, *Monodora myristica* and *Afzelia africana* Seeds from Nigeria

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Abstract: Flours produced from raw, blanched and boiled seeds of *Sphenostylis stenocarpa* (African yam bean), *Sesamum indicum* (Sesame seed), *Monodora myristica* (Calabash nutmeg) and *Afzelia africana (*African oak) were evaluated for total protein and amino acid compositions. The results show that the seeds of *S. indicum* had the highest total protein content (24.74±0.56%) relative to those of *S. stenocarpa* (18.90±0.35%), *M. myristica* (12.83±0.40%) and *A. africana* (9.56±0.12%). The amino acid contents followed the pattern 0.030±0.010 mol/l for *S. stenocarpa* >0.025±0.005 mol/l for *A. africana* >0.014±0.003 mol/l for *M. myristica* >0.010±0.002 mol/l for *S. indicum*. The seeds were found to be rich in amino acids especially the essential amino acids which relative to the non-essential amino acids had high percentages of 81, 80, 77 and 70% for *S. stenocarpa, M. myristica, S. indicum* and *A. Africana* respectively. Boiling significantly ($p<0.05$) reduced the protein and amino acid contents of all the seeds, while blanching only significantly ($p<0.05$) reduced the amino acid contents of *S. stenocarpa, S. indicum* and *A. Africana* seeds. The results suggest that the seeds are potentially important plant sources of proteins and amino acids especially the essential amino acids necessary for human and livestock nutrition.

Key words: African yam bean, sesame seed, calabash nutmeg, African oak, amino acid analyses

INTRODUCTION

Seeds have nutritive and calorific values which make them necessary in diets. Leguminous seeds are special good sources of plant proteins. For normal functioning the human body requires a sufficient amount of protein. The true value of a protein however depends upon its different amino acid composition especially its essential amino acid content. Furthermore, proteins apart from supplying these essential amino acids, also provide the nitrogen necessary for the synthesis of other macromolecules of life such as nucleic acids, while also being required for repair and maintenance of cells and tissues. Unfortunately, protein foods are in short supply, and thus not within the reach of low-income households who unfortunately form the bulk of the population in developing countries (Oshodi, 1992). In order to bridge this protein supply gap, scientists have focused their attention on lesser known protein-rich sources. This study is one of such attempts and is aimed at determining the protein and amino acid compositions of four lesser known but common legumes found in Nigeria.

Sphenostylis stenocarpa Hochst or African yam bean is locally called *Odudu, Ukpodudu* or *Okpodudu* in southern Nigeria. It is a leguminous crop of family *Leguminosae* grown in tropical regions of Africa, particularly in Cameroun, Cote d'Ivoire, Volta region of Ghana, Nigeria and Togo. This herbaceous climbing vine produces ellipsoid, rounded or truncated seeds, which show considerable variation in size and colour, varying from creamy-white or brownish-yellow to dark brown. Both the seeds and leaves of the plant are edible. The plant also produces tubers, which can be cooked and eaten. They are important sources of starch and protein (Edem *et al*., 1990; Asuzu, 1986).

Sesamum indicum (sesame seed or benni seed) of the family *Pedaliaceae* is locally called *Benisid*, *Kiero* and *Ewa ibejil* by the Igbos, Hausas and Yorubas of Nigeria respectively. It is an ancient oil seed, first recorded as a crop in Babylo and Assyria about 4000 years ago. However, it is presently grown in many parts of the world because of its nutritional, medicinal and traditional values. It is a flowering plant that bears small flat seeds that come in a variety of colours, from cream-white to charcoal black. Sesame seeds are unusually high in edible oil and are either consumed directly as a highly nutritious foodstuff or processed into various confectionery and bakery products. It is also used as medicine. The high methioine content of its oil may help to relieve symptoms of liver disease and aid in nitrogen balance maintenance in the body (Mba, 1980; Norman *et al*., 1995).

Monodora myristica, also known as calabash nutmeg and of the family *Annonaceae*, is a tropical evergreen tree native to Jamaica. It is locally called *Ehuru* or *Ehiri* in Southern Nigeria. It produces soft-ball sized edible seeds that have nutmeg-like flavour, with high protein composition and also having rich medicinal properties.

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The seeds and seed coats are used as a spice for seasoning food and as topical medication for wounds and headaches. The seed oils are used as condiments and carminative and to scent soaps and perfumes (Mayhem and Penny, 1988; Mba, 1980).

Afzelia africana (African mahogany or African oak) is a semi-deciduous plant in the *Fabaceae* family. It is locally called *Akparata* (Igbo), *Kawo* (Hausa) and *Apa* (Yoruba) in Nigeria. It is a large tree with very beautiful seeds having two coloursL: black with yellow/orange at the bottom. The seeds are edible and have high medicinal values. All parts of the plant are of immense traditional importance; its wood is used for carpentry, the sawdust for making and designing art work, its foliage for cattle forage, the pods containing rich ashes are used for making soap, while the leaves are used to enrich soil because of their rich nitrogen content (Acland, 1980).

MATERIALS AND METHODS

Collection and preparation of samples: Apparently healthy seeds of *S.* Stenocarpa, *S. indicum*, *M. myristica* and *A. Africana* were purchased from Umuahia Central Market, Abia State, Nigeria. They were authenticated at the Central Laboratory of National Root Crops Research Institute, Umudike, Nigeria.

The different seeds were divided into 3 portions each. One portion of each seed type was washed with distilled water, drained in a sieve and dried in an oven (Gallenkemp IH-100 model, UK) at 60°C to a constant weight. The dried seeds were mechanically ground into a powder and the powdered seed sample packed in a clean container and labeled 'Raw seed sample'.

The second portion of each seed type was washed with distilled water and blanched for 5 min. Then the water was drained off with a sieve and the blanched seeds dried to a constant weight in the oven at 60°C. They were later ground into powder and labeled 'Blanched seed sample'.

The remaining portion of each seed type was washed, boiled until the seeds became soft and the water was drained off. The boiled seeds were dried to a constant weight in an oven at 60°C, ground into powder and labeled 'Boiled seed sample'. These labeled samples were then stored in the refrigerator (about 4°C) until required for analyses (Ojiako and Igwe, 2007).

Determination of protein and amino acid composition: The protein content of the ground seed samples was determined by the standard Kjeldahl method (Pearson, 1976; James, 1995). The amino acid content of the samples was determined by alkaline titrimetric method of Ojiako and Akubugwo (1997).

The amino acid composition of the seed samples were determined by the use of an automatic amino acid analyzer (Technicon Sequential Multisample Analysa DNA0209, Ireland).

Statistical analysis: One-way ANOVA and Duncan's New Multiple Range Test were used to statistically analyze data generated in the study. Values for which $p<0.05$ were considered statistically significant (Sanders, 1990).

RESULTS

Percentage total protein content: The raw seeds of *S. indicum* had the highest total protein content (24.73±0.56%) compared to those of *S. stenocarpa* (18.90±0.35%), *M. myristica* (12.83±0.40%) and *A. africana* (9.56±0.12%) (Fig. 1). For all the seed samples, boiling significantly ($p<0.05$) reduced the protein content, while blanching did not.

Percentage amino acid content: Figure 2 shows the percentage amino acid content of the seeds. It shows that the amino acid content of the raw seeds varied thus: *S. stenocarpa* (0.031±0.010 mol/l) > *A. africana* (0.025±0.005 mol/l) > *M. myristica* (0.014±0.003 mol/l) > *S. indicum* (0.010±0.002 mol/l) (Fig. 2). Boiling significantly ($p<0.05$) reduced the amino acid contents of all the seeds giving percentage reductions of 68% for *A. africana*, 60% for *S. stenocarpa*, 38% for *S. indicum* and 14% for *M. myristica*, while blanching did not significantly ($p>0.05$) reduce the amino acid content in *M. myristica*.

Amino acid composition: The amino acid compositions of the raw, blanched and boiled seed samples of *S. stenocarpa* are shown in Fig. 3. Similarly, those of *S. indicum, A. africana* and *M. myristica* are shown in Fig. 4, 5 and 6 respectively. The figures show that arginine, glutamic acid, lysine, isoleucine and leucine were commonly present in all the seed types. Apart from these, Figure 3 also shows the presence of glycine, valine, methioine, threonine and phenylalanine in *S. stenocarpa* seed samples. Similarly, glycine, cysteine, methionine, tryptophan and phenylalanine were also found in *S. indicum* (Fig. 4). Figure 5 shows the presence of cysteine, alanine, valine, tryptophan and threonine in seeds of *A. Africana*, while alanine, valine, methionine, threonine and phenylalanine were found present in *M. myristica* seed samples (Fig. 6).

DISCUSSION

Plant sources, especially legumes are increasingly being used by thickly populated regions of the world to alleviate the problem of protein energy malnutrition. Yet the extent of interest in these plants, especially among the lesser known ones, is still very poor probably because their nutritional advantages have been inadequately highlighted. The results of this study show that the protein content of the seeds of *S. stenocarpa, S. indicum, M. myristica* and *A. africana* are comparable to those of *Cleome rutidosperma* (11.73%), *Lagenaria siceraria* (8.93%) and *Cucurbita maxima* (16.80%) (Ojiako and Igwe, 2007). However, their protein contents are slightly lower than those reported for common edible

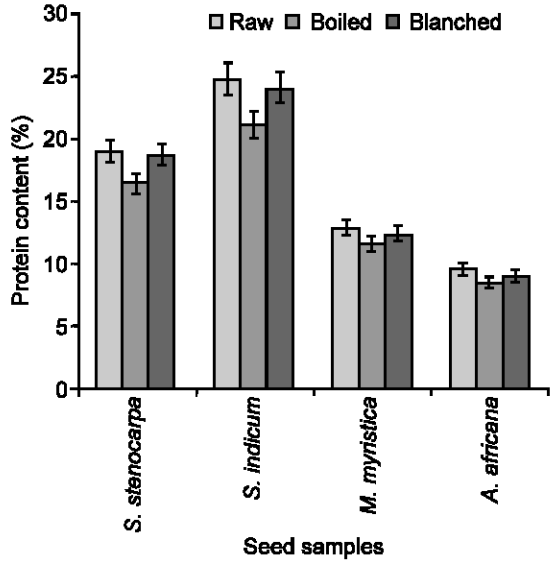

Fig. 1: Protein content of the raw, boiled and blanched seed samples

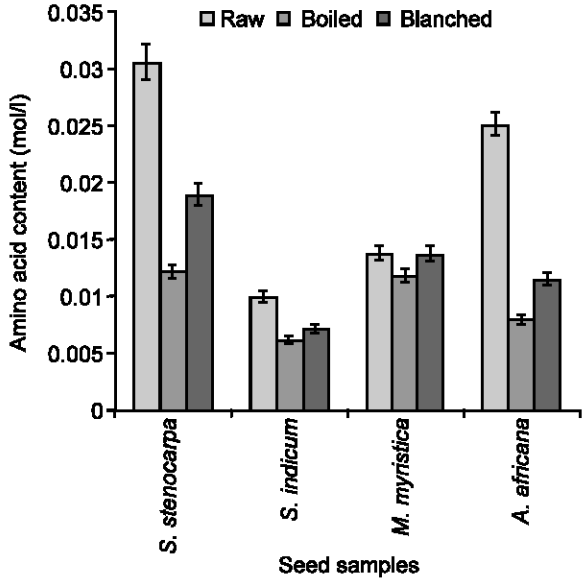

Fig. 2: Amino acid content of the raw, boiled and blanched seed samples

seeds such as 28.7% for fluted pumpkin (Fagbemi and Oshodi, 1991) and 36.2% for African oil bean (Odoemelam, 2005) seeds, but higher than that reported for snake tomato fruits (1.85%) (Ojiako and Igwe, 2008). An adult male of about 70 kg body weight requires 35 g of protein daily, therefore only about 166, 214, 303 and 411 g of *S. indicum, S. stenocarpa, M. myristica* or *A. Africana* seed respectively would be required to provide the minimum daily protein need. Each of these may be an equivalent of a plate of food typically consumed at a sitting by an average Nigerian adult. However, larger

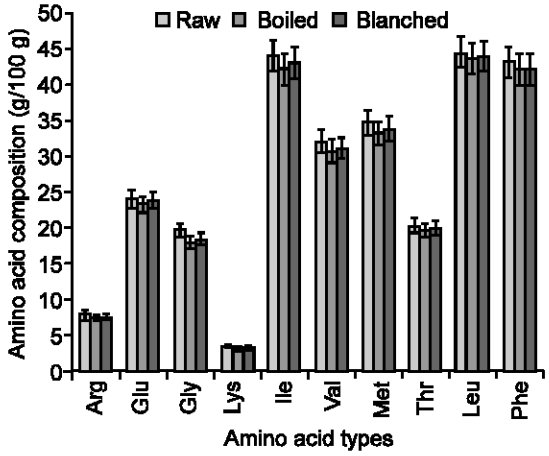

Fig. 3: Amino acid composition of raw, boiled and blanched seeds of *S. stenocarpa*

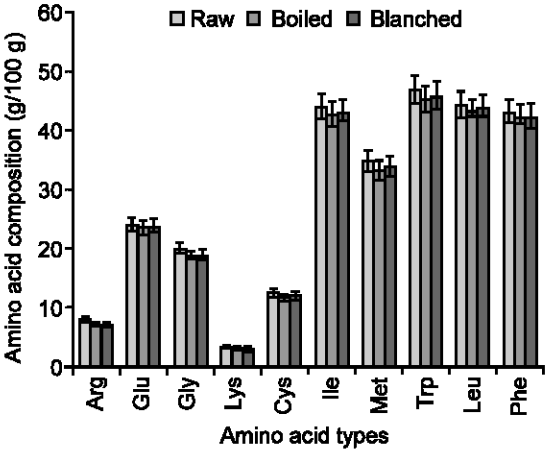

Fig. 4: Amino acid composition of raw, boiled and blanched seeds of *S. indicum*

amounts may be need to be consumed per day to meet the requirement, if allowance of 25% is made for indigestibility and the limiting sulphur amino acid content (Fagbemi and Oshodi, 1991).

The seeds studied, like other forms of seeds are known to contain antinutrients, which are reduced or eliminated by cooking (Egbe and Akinyele, 1990). Boiling and blanching, like other methods for processing of food reduce to minimal levels these antinutrients (Onwuliri *et al*., 2002). The results of the present study show that boiling significantly ($p<0.05$) reduced protein content of the seeds, while blanching did not. Similarly, boiling and blanching did significantly ($p<0.05$) reduce the amino acid contents of almost all the seeds except in *M. myristica* where blanching did affect the amino acid content. This shows that blanching may relatively be a better method of food processing in the preservation of protein and amino acid contents of edible seeds. This may be because of the longer heating involved in boiling

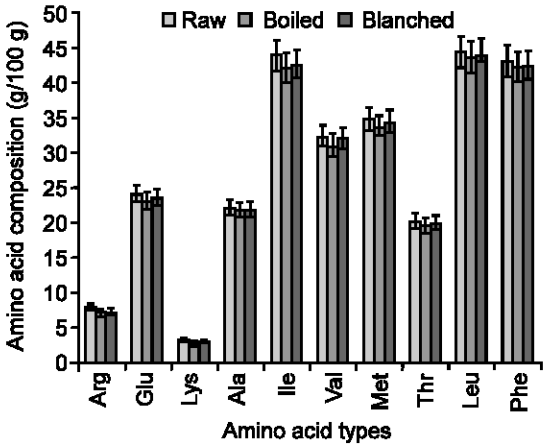

Fig. 5: Amino acid composition of raw, boiled and blanched seeds of *M. myristica*

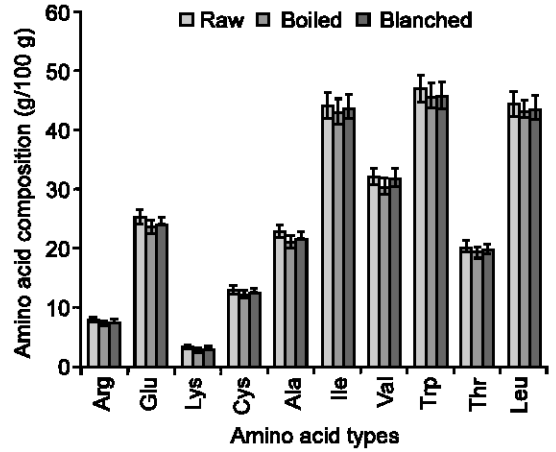

Fig. 6: Amino acid composition of raw, boiled and blanched seeds of *A. africana*

than blanching. However, there may be need to study the extent of reduction of antinutrients and availability of the proteins in the seeds after the processes of boiling and blanching.

A study of the amino acid distribution of the seeds show that they are rich sources of both essential and non-essential amino acids, with the essential amino acids being interestingly high at 81, 77, 70 and 80% for *S. stenocarpa*, *S. indicum*, *A. africana* and *M. myristica* respectively relative to the non-essential amino acid levels. The only sulphur-containing amino acid which could limit the seeds' protein availability to animals is methioine (Mba, 1980) and is present in all the seeds with the exception of *A. africana*.

Conclusion: The study has shown that the seeds of *S. stenocarpa*, *S. indicum*, *A. africana* and *M. myristica* are potentially important plant sources of proteins and amino acids, especially the essential amino acids needed by humans and livestock. The processes of boiling and blanching required for preparation of seeds to make them edible affected their protein and amino acid contents levels but did not eliminate them. Since processing eliminates or reduces anti-nutrient levels, it may be necessary to recommend that these seeds be incorporated into human and animal diets considering the observed nutritional composition, relative abundance of essential amino acids in them and the dire need to bridge the protein supply gap especially for the low-income and resource-constrained households in developing countries.

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