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Chemical Evaluation of the Nutritive Quality of Pigeon Pea [*Cajanus cajan* (L.) Millsp.]

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Abstract: This study was carried out to evaluate the proximate and amino acid compositions of samples of raw and roasted pigeon pea seeds. The following range of values were obtained for dry matter (95.89-96.34%), crude protein (21.03-21.07%), crude fat (4.43-5.96%), crude fibre (7.16-7.52%) and ash (3.76-4.02%) respectively for the raw and roasted seeds of pigeon pea. While values for nitrogen free extract ranged from 57.77-59.51% for the roasted and raw pigeon pea seeds respectively. Results from the amino acid analysis revealed that some amino acids like arginine, aspartic acid, threonine, serine, glutamic acid, glycine, alanine, leucine and tyrosine had their concentration in the seeds increased with heat processing, while other amino acids were not. On the whole, the concentration of glutamic acid was found to be the highest in the pigeon pea, with a value of 14.21 g/16 gN for the roasted seeds. Lysine showed the highest concentration among the indispensable amino acids (7.79 g/16 gN for the raw seeds and 7.55 g/16 gN for the roasted seeds). Pigeon pea seed was found to be deficient in the sulphur-containing amino acids (cystine and methionine).

Key words: Evaluation, pigeon pea, proximate, amino acid, composition

INTRODUCTION

Pigeon pea [*Cajanus cajan* (L.) Millsp.] probably evolved in South Asia and appeared about 2000 B.C. in West Africa, which is considered a second major centre of origin (Van Den Beldt, 1988). The slave trade took it to the West Indies, where its use as bird-feed led to the name "pigeon pea" in 1692 (Van der Maesen, 1986). Pigeon pea [*Cajanus cajan* (L.) Millsp.] is a leguminous plant, it is an annual, Pigeon pea is hardy, widely adaptable and more tolerant of drought and high temperatures than most other crops. Pigeon pea has a deep and quick growing taproot.

A wide variability exists in the chemical composition of pigeon pea seeds due to genotype, growth conditions and duration/condition of storage (Salunkhe *et al*., 1985; Amaefule and Onwudike, 2000). Pigeon pea is a rich source of protein, carbohydrate and certain minerals. The protein content of commonly grown pigeon pea cultivars ranges between 17.9 and 24.3 g/100 g for whole grain samples (Salunkhe *et al*., 1986). Wild species of pigeon pea have been found to be very promising sources of high protein and several high-protein genotype have been developed with a protein content as high as 32.5% (Singh *et al*., 1990). These high-protein genotypes contain protein content on average by nearly 20% higher than the normal genotypes (Reddy *et al*., 1979; Saxena *et al*., 1987). The high-protein genotypes also contain significantly higher (about 25%) sulphur-containing amino acids, namely methionine and cystine (Singh *et al*., 1990). Pigeon pea seeds contain about 57.3-58.7% carbohydrate, 1.2-8.1 crude fibre and 0.6-3.8% lipids (Sinha, 1977). Pigeon pea is a good source of dietary minerals such as calcium, phosphorus, magnesium, iron, sulphur and potassium. It is also a good source of water soluble vitamins, especially thiamine, riboflavin, niacin and choline (Sinha, 1977).

The pigeon pea plant as a whole has been found to be useful. Pigeon pea is used for food, feed and fuel. It is most widely eaten in the form of split seeds; it contains protein with an amino acid profile similar to that of soybean (Singh *et al*., 1990).

It is widely grown in about 14 countries in over 4 million ha. The major producer of pigeon pea in the world includes: India, followed by Uganda, Tanzania, Kenya, Malawi, Ethiopia and Mozambique in Africa; the Dominican Republic, Puerto Rico and the West Indies in the Caribbean region and Latin America; Burma and Thailand; Indonesia and the Philippines in Asia and Australia (Sinha, 1977).

MATERIALS AND METHODS

Processing of pigeon pea seeds: The pigeon pea used in this study was obtained from Bauchi main market, Bauchi state, Nigeria. The pigeon pea seeds were sand-roasted. This involved the use of clean fine alluvial sand in a wide aluminum frying pan and heating the sand to the temperature of about 80°C. Sufficient quantity of each

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batch of the raw seeds to cover about two-third of the area of sand was placed on the sand. The seeds and sand were mixed together by constant stirring to prevent the burning of the seed coat and enhance even distribution of heat. The sand roasting of pigeon pea took 3-5 min. The sand was then sieved from the seeds and allowed to cool and then milled in hammer mill.

Chemical analysis

Proximate analysis: Proximate analysis of pigeon pea (both raw and processed seeds) were carried out using the methods outlined by the Association of Official Analytical Chemists (AOAC, 1990). The proximate compositions of the pigeon pea seeds are presented in Table 1.

Amino acid analysis: The amino acid compositions of the samples were determined using the method described by Spackman *et al.* (1958). The samples were dried to constant weight and defatted. A known weight of the defatted sample was hydrolyzed under vacuum with 7ml of 6N HCl in a sealed pyrex tube at 105°C for 22 h. Immediately after cooling, it was filtered through non-absorbent cotton wool. The filtrate was dried at 40°C using rotary evaporator.

The amino acids in the flask were diluted with 5ml of acetate buffer (pH 2.0) and 5-10 microlitre was loaded into the cartridge of Technicon Sequential Multi sample amino acid analyzer (TSM). The steam carrying the amino acid reagent mixture went through a heating bath where development of the coloured reaction product occurred. The absorbance was proportional to the concentration of each amino acid and was measured by colorimeter.

RESULTS AND DISCUSSION

Proximate and amino acid compositions of raw and roasted pigeon pea seeds: The proximate compositions of pigeon pea seeds are presented in Table 1. The following range of values were obtained for dry matter (95.89-96.34%), crude protein (21.03-21.07%), crude fat (4.43-5.96%), crude fibre (7.16-7.52%) and ash (3.76-4.02%) respectively for the raw and roasted seeds of pigeon pea. While values for nitrogen free extract ranged from 57.77-59.51% for the roasted and raw pigeon pea seeds respectively. The crude protein range of 21.03-21.07% obtained in this study is within the range of 17.9-24.3% reported by Salunkhe *et al.* (1986) for commonly grown pigeon pea cultivars. Nitrogen free extract range of 57.77-59.51% reported in this study falls within the range of 57.3-58.7% reported by Sinha (1977).

The amino acid profiles of raw and roasted seeds of pigeon pea are presented in Table 2. Results obtained in this study on the amino acid composition of pigeon pea, revealed that some amino acids (arginine, aspartic acid, threonine, serine, glutamic acid, glycine, alanine, leucine and tyrosine) were generally heat-stable and their concentrations were increased with heat processing (roasting), whereas the concentration of other amino acids (lysine, histidine, proline, cystine, valine, methionine, isoleucine and phenylalanine) were decreased with heat treatment. Glutamic acid was found to have the highest concentration in pigeon pea with the value of 14.21 g/16 gN for the roasted seed, which was closely followed by aspartic acid with the value of 11.56 g/16 gN for the raw seeds and 12.20 g/16 gN for the roasted seeds. Similar report was made by Apata and Ologhobo (1994). Lysine showed the highest concentration among the indispensable amino acids (7.79 g/16 gN for the raw seeds and 7.55 g/16 gN for the roasted seeds). Pigeon pea seed was found to be deficient in the sulphur-containing amino acids (cystine and methionine). Cystine was found to have the lowest concentration and the most limiting amino acid with the value of 1.19 g/16gN and 0.69 g/16 gN followed by methionine with 1.19 g/16 gN and 0.89 g/16 gN for the raw and roasted seeds respectively. The relatively low concentrations of methionine and cystine in legumes has been reported by several authors (Doku *et al.*, 1978; Apata and Ologhobo, 1990; Kessler *et al.*, 1990; Olomu, 1995; Fabiyi, 1999; Aremu *et al.*, 2006).

Conclusion: This study has contributed additional valuable nutritional information on pigeon pea of tropical

Table 1: Proximate composition (%) of raw and roasted pigeon pea seeds

Contents	Raw seed	Roasted seed
Dry matter	95.89	96.34
Crude protein	21.03	21.07
Crude fat	4.43	5.96
Crude fibre	7.16	7.52
Ash	3.76	4.02
Nitrogen free extract	59.51	57.77

Table 2: Amino acid profiles of raw and roasted pigeon pea seeds (g/16 gN)

Amino acids	Raw pigeon pea	Roasted pigeon pea
Lysine	7.79	7.55
Histidine	3.66	2.88
Arginine	5.86	6.18
Aspartic acid	11.56	12.20
Threonine	3.12	3.28
Serine	3.59	3.84
Glutamic acid	9.23	14.21
Proline	3.17	3.16
Glycine	3.07	3.36
Alanine	3.79	4.06
Cystine	1.19	0.69
Valine	5.85	4.27
Methionine	1.19	0.89
Isoleucine	3.47	2.73
Leucine	6.78	7.23
Tyrosine	2.63	2.86
Phenylalanine	6.15	5.54
Tryptophan	ND	ND

ND = Not Determined

origin. The amino acid profile of pigeon pea are comparable with the conventional plant protein sources. Roasted pigeon pea seeds are recommended as valuable feed ingredient at both domestic and industrial levels for monogastric animals. Production of pigeon pea of high-protein genotype should be encouraged.

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