Effects of Processing on the Proximate Components and Amino Acid Profile of Bauhinia Monandra (Kurz) Seed

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Abstract

Three (3) methods of processing were adopted to investigate the effects of processing on the nutritional value of Bauhinia monandra (Kurz) seeds. These processing methods were boiling (in water), toasting and soaking. The raw Bauhinia monandra seed sample were boiled with tap water in seed to water ratio of 1:10 w/v at the rate of 5kg:10 litres in a 15litres metal cooking pot for 10, 20, 30 and 40 minutes respectively and sundried to constant weight and milled before being taken to the laboratory for analysis. Toasting was done for 10, 20, 30 and 40 minutes respectively using a hot open pan and heated with fire from a stove burning with blue flame. The seeds were stirred constantly to prevent charring. The seeds were cooled and milled. The last processing method involved the soaking of the raw Bauhinia seed in a bowl containing seed to water ratio of 1:10 (w/v) at the rate of 5kg to 10litres which completely submerged the seeds in tap water at room temperature ($30 \pm 2^{o}C$) and for 24, 48, 72 and 96 hours respectively and sun-dried to constant weight. The seed samples were then milled. The proximate composition and amino acid contents of the milled representative samples of the raw seed and three processed seed sample (boiled, roasted and soaked) were determined in the laboratory according to AOAC (1980) procedure (moisture content, ash, lipids, crude fibre (CF) and nitrogen few extract (NFE) while the nitrogen/crude protein was determined by the method of Pearsons' (1976). the total amino acid composition was determined by the method described by Spackman et al (1958). Results obtained indicated that processing methods had significant influence on the proximate composition of Bauhinia monandra (Kurz) seeds. Bauhinia seeds processed by soaking in tap water retained more of its nutrient than seeds processed by other means.

1. Introduction

The high competition between man, his livestock and industries for traditional protein and energy sources has imposed scarcity with consequent astronomic costs of these sources (Yashim *et al*., 2009). In fish production feed constitutes the greatest determinant of profitability accounting for 40-70% of total production cost (Ferouz *et al*., 2012). Thus the high production cost has invariably led to increase in cost of fish thereby making it unavailable in the diets of the average Nigerian (Adesulu, 2001 and Omitoyin, 2007). Animal protein content in the diet of low income earners that constitute the majority of Nigerian populace is very low. Average consumption of animal protein in Nigeria is estimated at 4.5g/head/day, against a minimum of 35g/head/day recommended by FAO (Udedibie, 2000 and Atsu, 2002).This situation has compelled animal nutritionists to explore alternative protein and energy feed ingredients that are locally available, relatively cheaper that can meet the nutrient requirements of animals fish inclusive (Somsueb and Booyaratpalin, 2001, Olaniyi 2009a&b, Yashim *et al*., 2009, Tamburawa, 2010 and Ferouz *et al*., 2012).

There are many legumes whose seeds could be explored as aqua-feeds. One of such legumes is the orchid plant (*Bauhinia monandra* Kurz.). The plant is wide spread in Nigeria (Anhwange *et al*., 2004, 2005 and Agbugui, 2011) Bauhinia monandra has potential to serve as protein source in aqua-feeds considering its proximate composition (CP 33.09) and high mineral contents [calcium (77.9mg/g $\pm$ 2.98), phosphorus (1.59mg/g $\pm$ 0.09)]

However like other tropical legumes its usefulness as animal feed ingredient may be limited due to presence of some anti-nutritional factors (Francis *et al.*, 2001a, Anhwange *et al.*, 2005, Yashim *et al.*, 2009, Tamburawa, 2010 and Agbugui, 2011) and probably due to nutrient imbalance; (Lim and Dominy, 1989). It has been established that boiling (hydrothermal treatment), toasting, soaking in water, autoclaving, extrusion, fermentation, alcohol extraction, acid extraction, and other processing methods of leguminous seeds exert beneficial effect by detoxifying the antinutritional factors (ANFS) inherent in them (Francis *et al.*, 2001a, Vijyakumari *et al.*, 2007). Potentials of many processed leguminous seeds and plant by-products have been explored to determine their optimal inclusion levels (within tolerable limits) in aqua-feed formulations considering the inherent levels of anti-nutrients present in the seeds as well as the maximum nutrient levels particularly protein for efficient growth performance and feed utilization. Therefore, this study was conducted to investigate the effect of different processing methods on the proximate composition and essential amino acid index of *Bauhinia monandra* seeds.

2. Materials and Methods

2.1 Sample Collection/Identification

Bauhinia monandra seeds from dehiscenced mature pods of the plants within the main campus of Ahmadu Bello University, Zaria, Nigeria, were collected and used for this research. The plant pod and seed samples were identified at the Herbarium of the Department of Biological Sciences, Ahmadu Bello University, Zaria.

2.2 Sample Preparation

The collected seed samples were sorted, screened and distributed into four batches. The first batch was the untreated seeds, the second, third and fourth batches were toasted, boiled and soaked respectively.

2.3 Processing of Untreated (Raw) Seeds

Two hundred grams (200g) of raw, sorted *Bauhinia* seeds were used for proximate analysis, amino acid assay and anti-nutrient determination.

2.4 Boiling

Raw *Bauhinia* seed samples were boiled with tap water in seed to water ratio of 1:10(w/v) at the rate of 5kg:10litres (Vadivel and Pugalenthi, 2007) in a 15litre metal cooking pot for a duration of 10 minutes, 20 minutes, 30 minutes and 40 minutes. The water was brought to boil at a temperature of 100^0C before the seeds were poured into it. A portion (1kg) of the original seed samples were removed from the boiling water with a sieve at 10, 20, 30 and 40 minutes intervals respectively using a stopwatch while the boiling continued. Dense ox-brown exudates were noticed and this became more pronounced as duration of boiling increased. The boiled samples at the stipulated intervals were allowed to cool and sun-dried to a constant weight. The seed samples were then packed in tightly sealed polythene bags.

2.5 Toasting

5kg of raw *Bauhinia* seeds were placed in a hot open pan which was pre-heated on fire for

5minutes to ensure that sufficient and uniform heat was obtained for toasting. The heating processing continued and toasting was accomplished by constant stirring of seeds to ensure uniform application of heat and to prevent charring (Eyo, 2001). Toasted *Bauhinia* seeds were removed at 10, 20, 30 and 40 minutes intervals then spread and allowed to cool on clean trays placed on concrete slabs. The samples were then stored separately in tightly sealed labelled polythene bags.

2.6 Soaking in Water

Raw *Bauhinia* seed samples were soaked in a bowl containing tap water at room temperature (30 ± 2^0C) in seed to water ratio of 1:10(w/v) at the rate of 5kg to 10litres which completely submerged the seeds (Vadivel and Pugalenthi, 2007). Dense ox-brown exudate was observed and was more pronounced as duration of soaking increased. The soaked seed samples were removed from the soaking water at the rate of 1kg with a sieve at 24, 48, 72 and 96 hours respectively and then spread separately on clean trays to sun-dry to a constant weight. The seed samples were then placed in appropriately labeled and tightly sealed polythene bags and stored in a cool dry place.

2.7 Biochemical Analyses

2.7.1 Determination of Proximate Components

The proximate composition of the raw seed and three processed seed samples (roasted, boiled and soaked) were determined at the Biochemistry laboratory of Department of Zoology, University of Jos, Plateau State.

The method of AOAC (1980) was used in the determination of moisture content, ash, lipids, crude fibre (CF), and nitrogen free extract (NFE), while the nitrogen/crude protein was determined by the method of Pearsons' (1976). while the total amino acid composition was determined on an automatic model TSM – Technicon Sequential multi-sample analyzer by adopting the method described by Spackman *et al.* (1958).

2.7.2 Essential Amino Acid Index

The Technicon Sequential Multi-sample Amino acid analyzer (TSM) – Model DNA 0209 was used to determine the profile of the amino acids as well as the quantity and quality of the amino acids.

$$EAAI = \sqrt[n]{\frac{a \times b \times c \times \ldots \times j}{a_e \times b_e \times c_e \times \ldots \times j_e}}$$

(Mc Donald *et al.*, 1987)

Where a, b, c, ... j = concentrations (g/kg) of the indispensable amino acids in the food protein, ae, be, ce ... je = concentrations of the same amino acids in egg protein, and n = the number of amino acids entering into the calculation.

2.7.3 Statistical Analysis

Data obtained were pooled and subjected to one way analysis of variance (ANOVA) at 5% level of probability. Least Significant Difference (LSD) was used to separate means.

3. Results

3.1 Proximate Composition of Boiled Bauhinia Seed at Different Time Interval

The results show that the value of CP, CF, EE, Ash, NFE and EAAI reduces with increase in toasting time. There was significant difference at P ≤ 0.05 of the raw seed with the toasted seed. However, among the boiled seeds, there was no significant difference in the values of CF eventhough there was significant difference in the values of Moisture, CP, EE, Ash, NFE and EAAI at P ≤ 0.05 (Table 1)

Table 1: Percentage proximate composition of boiled *Bauhinia* seed at different time intervals

Minutes Trts	10	20	30	40	Raw seed	SED ±	LSD(P<0.05)
DM	96.19 ^{c}	96.14 ^{b}	96.02 ^{a}	96.25 ^{d}	96.39 ^{e}	0.012	0.034
ASH	4.67 ^{c}	4.65 ^{c}	4.63 ^{c}	4.57 ^{b}	3.81 ^{a}	0.014	0.039
CP	30.48 ^{b}	30.47 ^{ab}	30.32 ^{a}	30.23 ^{a}	30.52 ^{b}	0.086	0.239
CF	7.37 ^{b}	7.36 ^{b}	7.35 ^{b}	7.33 ^{b}	6.41 ^{a}	0.014	0.038
EE	27.43 ^{b}	27.41 ^{b}	27.37 ^{a}	27.35 ^{a}	27.87 ^{c}	0.012	0.034
NFE	26.92 ^{d}	26.25 ^{a}	26.36 ^{b}	26.79 ^{c}	27.45 ^{e}	0.029	0.081
EAAI	0.61 ^{b}	0.57 ^{a}	0.55 ^{a}	0.55 ^{a}	0.64 ^{b}	0.013	0.036

Values with the same superscripts in the same row are not significantly different (P > 0.05) LSD.

3.2 Proximate Composition of Toasted Bauhinia Seed at Different Time Intervals

The results show that the value of CP, CF, EE, Ash, NFE and EAAI reduces with increase in toasting time. There was significant difference at P ≤ 0.05 of the raw seed with the toasted seed. There was significant difference in the values of Moisture, CP, EE, Ash, NFE and EAAI at P ≤ 0.05 among the toasted seeds (Table 2).

Table 2: Percentage proximate analysis of toasted *Bauhinia* seed at different time intervals

Minutes Trts	10	20	30	40	Raw seed	SED ±	LSD(P<0.05)
DM	96.29 ^{b}	96.34 ^{c}	96.19 ^{a}	96.33 ^{bc}	96.39 ^{d}	0.015	0.042
ASH	3.89 ^{d}	3.54 ^{a}	3.54 ^{a}	3.61 ^{b}	3.81 ^{c}	0.028	0.057
CP	26.77 ^{d}	26.41 ^{c}	26.39 ^{b}	25.01 ^{a}	30.65 ^{e}	0.013	0.037
CF	9.07 ^{d}	9.05 ^{cd}	9.01 ^{c}	8.83 ^{b}	6.41 ^{a}	0.014	0.039
EE	27.21 ^{b}	27.06 ^{a}	27.04 ^{a}	27.01 ^{a}	27.87 ^{c}	0.017	0.048
NFE	29.36 ^{b}	30.29 ^{c}	30.22 ^{c}	31.87 ^{d}	27.45 ^{a}	0.047	0.131
EAAI	0.51 ^{c}	0.47 ^{b}	0.46 ^{ab}	0.43 ^{a}	0.64 ^{d}	0.010	0.028

Values with the same superscripts in the same row are not significantly different (P > 0.05) LSD.

3.3 Proximate Composition of Soaked Bauhinia Seed Meal

The results clearly indicated that the values of CF, Ash and NFE reduces with increase in soaking time while the values of Moisture, CP, EE and EAAI increases with increase in soaking time. There was significant difference at P ≤ 0.05 of the raw seed with the soaked seed, however the EAAI did not show any significant difference with the raw seed at P ≤ 0.05. Among the soaked seeds, there was no significant difference in the values of EE and EAAI eventhough there was significant difference in the values of Moisture, CP, CF, Ash and NFE at P ≤ 0.05 (Table 3)

Table 3: Percentage proximate composition of soaked *Bauhinia* seed meal

Hours Trts	24	48	72	96	Raw seed	SED ±	LSD(P<0.05)
DM	95.39 [c]	95.37 [c]	94.39 [b]	94.06 [a]	96.39 [d]	0.049	0.137
ASH	3.17 [b]	3.17 [b]	3.09 [a]	3.06 [a]	3.81 [c]	0.017	0.047
CP	30.81 [b]	30.85 [b]	32.38 [c]	32.45 [c]	30.65 [a]	0.028	0.079
CF	6.17 [b]	6.17 [b]	6.07 [a]	6.04 [a]	6.41 [c]	0.014	0.039
EE	27.37 [a]	27.38 [a]	27.39 [a]	27.41 [a]	27.87 [b]	0.130	0.036
NFE	27.87 [c]	27.80 [c]	25.47 [b]	25.11 [a]	27.45 [b]	0.057	0.160
EAAI	0.63	0.62	0.66	0.66	0.64	0.020	0.056NS

Values with the same superscripts in the same row are not significantly different (P > 0.05) LSD.

4. Discussion

Among the processed seeds, the soaked seeds gave the highest mean value of crude protein at 96hours duration of soaking while boiling for 40 minutes gave the least value of crude protein. This trend may be due to the effect of hydrolysis during the soaking which increased the content of the Crude Protein (CP), a process often associated with microbial activities. Yashim *et al.* (2009) and Tamburawa (2010) reported that crude protein increased progressively with increasing duration of soaking *Crotalaria retusa* L. and Parkia seed respectively. The lower Crude Protein value in the heat treatments may be related to denaturation of protein on exposure to high temperature. For instance lower protein values were obtained when Mucuna and Parkia seeds were roasted (Vadivel and Pungalenthi, 2007 and Tamburawa, 2010). Unintended adverse effect may take place as a result of denaturing of proteins during heat processing which alters the chemical nature and decreases the nutritional quality of proteins (Liener, 1980; Van der Poel, 1989; Norton, 1991).

The crude fibre values from all the processed seeds were higher than in the soaked, but lower than in the raw. Crude fibre decreased progressively in soaked locust bean seed meal (Tamburawa, 2010). The crude fibre for the boiling and soaking were low because the fibre is broken or softened. The digestibility of nutrients and dry matter are significantly affected by high dietary fibre (Safari *et al*., 2005), therefore fiber renders such nutrients unavailable or reduces their utilization (Omoregie and Ogbemudia, 1993). Furthermore dietary fibre has a reductive effect on enzyme activity (Patridge *et al*., 1982), and interferes with nutrient digestion by decreasing the mean retention time of food in the digestive tract (Cherbut *et al.,* 1998). High fibre has also been associated with poor pellet durability (Tacon *et al.,* 1984).

The concentration of lipid reduced progressively from raw to boiled and toasted, but increased with soaking. Similarly Tamburawa (2010) reported a decline in lipids with increasing duration of toasting Parkia seed and a general increase with increased duration of soaking

The lowest value of fat obtained in the toasted seed meal could be attributed to denaturing effect of heat and loss of volatile essential fatty acids. Feedstuffs with high fat content are prone to oxidative rancidity due to the effect of long time storage (UNDP, 1983; Sena and Anderson, 1995; Effiong and Eyo, 1997). Rancid fats reduce palatability and therefore reduce availability of nutrients to fish (Rumsey, 1980) and can contain toxic compounds which inhibit growth. Carbohydrate present in feed could also ferment. Chemicals produced in the degenerating feeds may reduce amino acids and vitamins available, vitamin C being particularly susceptible (Cockerell *et al*, 1971).

The least Ash value was obtained in soaking ($SBSM_{96}$) while the highest value was in boiled. The substantial reduction of the Ash content in the soaked seed meal sample when compared to the raw seed sample and other processed seed samples might be due to leaching of both micro and macro element into the soaking medium through the enhanced permeability of the seed coats during the soaking treatment. Wee and Wang (1987) reported the loss of certain nutrients in water during soaking of *Leucaena leucocephala* leaf. Vadivel and Pungalenthi (2007) made similar observations with *Mucuna pruriens* var.utilis. The least Ash value of the soaked seeds makes it a better energy source among other processing methods since Ash does not contribute to the TDN (Akinmutimi, 2004).

The NFE of seed meals had the highest values in the raw (27.45%) and roasted (31.87%) and the least value was in the soaked meal. However the high NFE value in roasted seeds indicated that it will be a better seed meal because it will enhance a high value of total digestible nutrients, TDN (Akinmutimi, 2004). However based on its low CP value the roasted seed meal may not be a right choice for feed formulation.

The moisture content was not uniform, however the variations could still be due to experimental error and processing techniques with higher moisture content in the soaked seeds (5.94%), followed by boiled (3.75%), while the roasted and raw seeds had the least (3.67%) and (3.60%) respectively. The moisture contents of the processed *Bauhinia* seed meals were generally low and the values fall below 15% moisture content required as safe storage limit for plant food materials (Sena *et al.*, 1998).

Eventhough the results of this study indicated that there were significant differences in essential amino acid index (EAAI) among the roasted *Bauhinia* seed meal and the boiled *Bauhinia* seed meal with the roasted seed for 10minutes and the raw seeds being the best (the boiled seed also followed the same pattern) while the soaked seed did not show any significant difference ($P>0.05$) implying that any of the treatment levels can be used. However, based on the mean values the soaked *Bauhinia* seed meal ($SBSM_{96}$) had the highest EAAI value.

Based on the results of this study the soaked *Bauhinia* seed meal gave the best results in terms of maximum retention of proximate components (with particular reference to protein) compared to boiling and roasting. The high crude protein value recorded in the soaked seed $SBSM_{96}$ in this study suggest that the seeds could serve as a potential source and better supplement for fish feed formulation.

5. Conclusion

This experiment was conducted to investigate the effect of processing methods on the proximate composition and amino acid index of *Bauhinia monandra* (Kurz) seeds. Results obtained indicate that to retain most of the nutrient in the seeds, soaking in water is the most probable method of processing. However more investigations need to be done to determine the effect of these processing methods on the anti-nutritional factors of the seed. It is after such a complete work that inference can be drawn as to the best processing method that fish farmers can adopt to process *Bauhinia* seeds for incorporation into fish diets.

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