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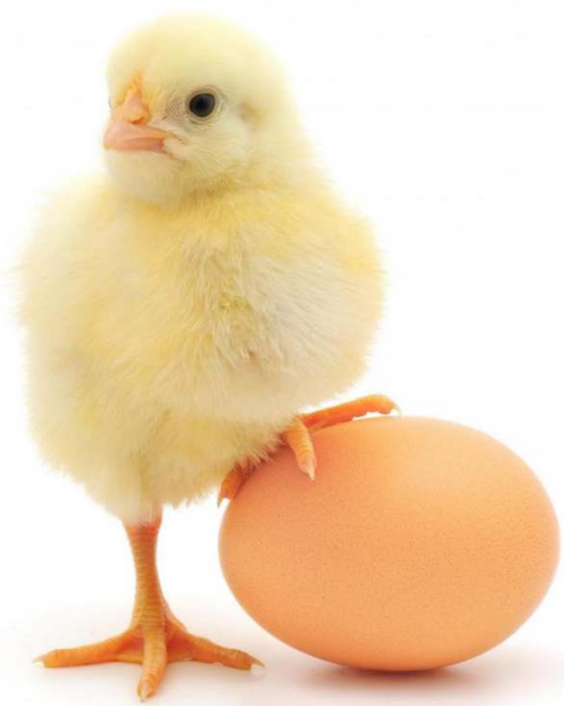

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The Effect of Processing on Nutrient Utilization of Pigeonpea (*Cajanus cajan*) Seed Meal and Pigeonpea Seed Meal Based Diets by Pullets

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Abstract: Two experiments were conducted with fifty-four 9-week old Bovan Nera pullets (24 in experiment 1 and 30 in experiment 2) to determine the effect of processing on the nutrient utilization of pigeonpea seed meal (PSM) and PSM-based diets by pullets. The seeds were processed either as boiled, toasted, soaked or raw (unprocessed). In experiment 2, raw or processed PSM were each included as 10% of a maize-soybean diet. Parameters considered were DM, CP, CF and ether extract utilization of the PSM and that of PSM-based diets. Results showed that in experiment 1, processing significantly increased ($P<0.05$) CP retention of the pullets while boiled and raw PSM had significantly higher ($P<0.05$) CF utilization than toasted and soaked. In experiment 2, boiled PSM diet significantly improved ($P<0.05$) CP retention of the pullets, while soaked PSM diet significantly reduced both CP retention and CF utilization of the pullets. It was concluded that processing of pigeonpea seeds for use in pullet diets would improve CP retention and other nutrient utilization especially boiling and toasting.

Key words: Pigeonpea, pullets, nutrient utilization, processing

Introduction

Pigeonpea seeds have very low human food preference unlike soybean and groundnut (Amaefule and Obioha, 1998) and no industrial use as at now. Like most tropical legume seeds, pigeonpea seeds contain antinutritional substances which affect their utilization in poultry feeding, especially the raw seeds (Grimaud, 1988; Ologhobo, 1992; D'Mello, 1995a). There has been various studies conducted to determine the potential value (proximate composition) and the feeding value of pigeonpea seeds to poultry, especially broilers (Grimaud, 1988; Tangtaweewipat *et al*., 1989; Udedibie and Igwe, 1989; Amaefule and Obioha, 1998; Amaefule and Onwudike, 2000). But the actual value of the seeds to poultry can be determined and established when their nutrient utilization and availability is known. This study was therefore aimed at determining the effect of processing on the nutrient utilization of pigeonpea seed meal (PSM) and PSM-based diets by pullets.

Materials and Methods

The study was carried out in the experimental unit of the poultry farm of Michael Okpara University of Agriculture, Umudike. Pigeonpea seeds, feedstuffs and other materials were purchased from Aba and Umuahia towns, all in Abia State. Processing of seeds were boiling of raw seeds in water for 30 minutes at 100°C, soaking in water (30kg seed in 100litre of water) for 24 hours, toasting of raw seeds for 30 minutes using a frying pan normally used in frying local *garri* and unprocessed seeds. Boiled and soaked seeds were first sun-dried and all were milled with a 2.0hp Lister powered local mill for use in the experiments.

Birds: Fifty-four, 9-week old Bovan Nera pullets were involved in the two experiments (24 in experiment 1 and 30 in experiment 2). They were of the same age, size and live weight (35g/chick). Chicks were brooded in a deep litter pen of the experimental poultry house. The house was a tropical-type, open-sided one whose sides and demarcations between individual pens were covered with wire-gauze. The litter material used was wood-shavings. Heat was provided with kerosene stoves under galvanized metal hovers. Feed and water were provided to the birds *ad libitum*, while additional light was supplied at night using kerosene lanterns. The open sides of the poultry house were covered with black tarpaulin cloth during the brooding (1-4 weeks) period to conserve heat and prevent draft. The birds were vaccinated against Newcastle disease at day-old (I/o) and 4th week (Lasota). Gumboro disease vaccine was given at the 9th and 21st day, while broad spectrum antibiotics and coccidiostat were administered to the pullets between the age of 2 - 3 weeks and 5 - 6 weeks. They were transferred to a deep litter (woodshavings) house with open sides covered with wire-gauze.

Diets: In experiment 1, each of raw, boiled, toasted and soaked PSM was a treatment diet fed to a group of 6 pullets. In experiment 2, raw and processed PSM were each included at 10% level of a maize-soybean diet as shown in Table 1. The experimental diets were isoenergetic and isonitrogenous.

Data collection: The experimental design was a completely randomized design (CRD), with each treatment having 3 replications. There were 6 pullets per

Table 1: Percentage composition of PSM based diets

Ingredients	Raw	Boiled	Soaked	Toasted	Control
Maize	36.00	36.00	36.00	36.00	45.00
Maize grit	10.00	10.00	10.00	10.00	8.00
Brewer dry grain	7.00	7.00	7.00	7.00	10.00
Wheat offal	8.50	8.50	8.50	8.50	6.50
Soybean meal	23.00	23.00	23.00	23.00	23.00
Pigeonpea meal (PSM)	10.00	10.00	10.00	10.00	----
Local Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Vitamin Premix*	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total %	100	100	100	100	100
Calculated composition					
CP %	20.82	20.72	20.64	20.56	20.58
CF %	3.71	3.71	3.71	3.71	2.80
ME (MJ/kg)	12.87	12.87	12.87	12.97	13.37
Avail. Ca %	1.32	1.32	1.32	1.32	1.31
Avail. P %	0.67	0.67	0.67	0.67	0.70

*Contains per kg: Vit. A, 10,000 iu; Vit. B, 2,000 iu; Vit. E, 13,000 iu; Vit. K, 1,500mg; Vit. B_{12}, 10mg; Riboflavin, 5,000mg; Pyridoxine, 1,300mg; Thiamine, 1,300mg; Panthothenic Acid; 8,000mg; Nicotinic Acid, 28,000mg; Folic Acid, 500mg; Biotin, 40mg; Copper, 7,000mg; Manganese, 48,000mg, Iron, 58,000mg; Zinc, 58,000mg; Selenium, 120mg; Iodine, 60mg; Cobalt, 300mg; Choline, 275,000mg.

Table 2: Proximate Composition of Raw and Processed Pigeonpea Seed Meal (PSM) (%DM Basis)

Composition	Raw	Toasted	Boiled	Soaked
Dry Matter (%)	88.50	87.00	88.50	89.00
Crude Protein (%)	26.25	25.37	27.34	27.12
Ether Extract (%)	2.10	1.05	2.03	1.94
Crude Fibre (%)	5.00	6.50	7.50	7.50
Ash (%)	5.50	6.10	4.00	4.00
NFE (%)	49.65	47.98	47.63	48.44
Gross Energy (MJ/kg)	16.02	16.18	16.52	16.60

treatment and 2 per replicate. After brooding, birds in experiment 1 were fed conventional ration until 9 weeks of age, while those in experiment 2 were randomly allotted to the five treatment diets when they were 6 weeks and fed the diets for 3 weeks. This was to enable them get used to the diets. At 9 weeks of age, two pullets per replicate (experiments 1 and 2) were transferred to a metabolism cage unit (75cm x 35cm x 40cm), fed PSM meals and experimental diets for 3 days to enable them get used to the cage environment and establish feed consumption. They were starved for 24 hours and then fed 90% of their *ad libitum* feed intake each day for 3 consecutive days. Faecal droppings were collected each day with an Aluminum tray properly fitted under each cage unit, oven-dried at 60°C and weighed. The droppings were kept in a polyethylene bag and properly labeled.

Chemical and data analyses: Pigeonpea seed meals, experimental diets and faecal droppings were analyzed for proximate composition according to methods of A.O. A.C (1990). Data on feed intake and nutrient utilization coefficients were subjected to analysis of variance (ANOVA), while means with significant differences were separated using Duncan's New Multiple Range Test. All statistical procedures were according to Steel and Torrie (1980).

Results

The result of proximate composition analysis of raw and processed pigeonpea seed meal (PSM) is presented in Table 2 and that of the PSM based diets in Table 3. There was no major differences (unanalyzed) in the proximate composition of the raw or processed PSM although boiled PSM had higher numerical values for crude protein, crude fibre and gross energy than raw and toasted PSM. Also differences were not expected in the proximate composition of the experimental diets since they were formulated to be isoenergetic and isonitrogenous.

Experiment 1: Crude protein (CP) retention significantly increased (P<0.05) with processing, and boiled PSM having significantly higher (P<0.05) values than raw and

Table 3: Proximate Composition of Experimental Chick Diets (%DM Basis)

Composition	Raw	Toasted	Boiled	Soaked	Control
Dry Matter (%)	87.91	85.50	89.50	86.50	85.00
Crude Protein (%)	21.16	21.00	21.28	21.37	21.22
Ether Extract (%)	2.00	2.00	1.00	1.00	2.00
Crude Fibre (%)	4.00	5.00	4.00	4.50	6.00
Ash (%)	8.25	9.00	11.00	10.00	10.00
NFE (%)	52.50	47.50	52.22	49.63	35.78
Energy (MJ/kg)	16.98	14.85	17.44	18.40	15.26

Table 4: The Nutrient Utilization coefficients of Raw or Processed PSM fed to pullets

	Raw	Boiled	Toasted	Soaked	SEM
Dry Matter %	52.53^{c}	69.23^{a}	60.33^{b}	64.12^{b}	4.06*
Crude Protein %	59.04^{c}	71.88^{a}	74.05^{a}	67.40^{b}	6.88*
Ether extract %	67.28^{ab}	69.56^{a}	63.14^{b}	70.50^{a}	6.56*
Crude Fibre %	51.42^{a}	51.76^{a}	33.89^{c}	41.99^{b}	4.41*

*Means in the same row followed by the same letters a, b, c, d, are not significantly different (P>0.05). SEM = standard error of mean. Ns = not significant (P>0.05).

Table 5: The Nutrient Utilization coefficients of PSM based diets by pullets

	Raw	Boiled	Toasted	Soaked	Control	SEM
DM %	74.31	75.20	73.49	72.21	72.59	1.47ns
CP %	81.28^{ab}	85.89^{a}	82.60^{ab}	69.16^{c}	78.29^{b}	2.10*
EE %	93.16	94.58	94.33	95.42	93.77	0.57
CF %	66.48^{ab}	$57.48b^{c}$	76.47^{a}	15.89^{d}	46.13^{c}	5.06*

*Means in the same row followed by the same letters a, b, c, d, are not significantly different (P>0.05). SEM = standard error of mean. ns = not significant (P>0.05).

soaked. Toasted PSM had significantly higher (P<0.05) CP retention than soaked and raw PSM. Toasted PSM had significantly lower (P<0.05) ether extract retention than the rest, while boiled and raw PSM had significantly higher (P<0.05) crude fibre utilization than toasted and soaked. Toasted PSM was significantly lower (P<0.05) in metabolizable CF than soaked. These are presented in Table 4.

Experiment 2: The processing of pigeonpea seeds had no significant effect (P>0.05) on DM and EE utilization of PSM based diets by pullets. However, soaking significantly reduced (P<0.05) CP retention and CF utilization of the diets. The CP retention of boiled PSM diet was significantly higher (P<0.05) than that of soaked and control diets while CP retention between raw, boiled and toasted PSM diets were not significantly different (P>0.05) from each other. Also metabolizable CF of toasted PSM diet was significantly higher (P<0.05) than that of boiled, soaked and control diets but was similar to that of raw PSM diet. These are shown Table 5.

Discussion

Experiment 1: Processing of pigeonpea seeds improved its DM and CP retention especially boiling and toasting which are heat processing methods thus confirming the report of D'Mello (1995a) that protease inhibitors and cyanogens, the two antinutritional substances in pigeonpea seeds, are heat labile and could be effectively removed by heat processing. The lower DM and CP utilization of raw and soaked PSM (Table 4) could be attributed to the presence of antinutritional substances in the raw and the ineffectiveness of soaking to remove the substances in soaked PSM. Metabolizable EE of the raw, boiled and soaked PSM were almost the same probably due to unknown factors, while the lower value recorded for toasted PSM could be that the dry heating (toasting) altered the nature of the lipids. It could be observed that PSM had generally low metabolizable CF, with toasted PSM having the poorest value. These may be due to the fact that the fibre fraction of the seed is concentrated in the seed coat, which is mainly cellulose and hemicelluloses (Salunkhe *et al.,* 1985). Overall poorer nutrient utilization of toasted PSM when compared with boiled is in agreement with the report of D'Mello (1995a) that dry heating (toasting) of legume seeds is less effective in the removal of antinutritional substances than wet heating.

Experiment 2: The processing of pigeonpea seeds did not affect DM and EE retention of PSM based diets by pullets (Table 5). Rather, soaking negatively affected CP retention suggesting that it was not as effective as boiling in eliminating antinutritional substances from the seeds. The CP retention of boiled PSM diet, which was better than that of control diet, is contrary to earlier reports of ICRISAT (1988) that pigeon pea seeds protein has a lower protein digestibility than other grain legumes even after boiling. And our result may be attributed to diet composition, which may have modulated the pullets' response to the diets (D'Mello, 1995b). The very low CF utilization of soaked PSM diet (15.89%) may not only be attributed to the ineffectiveness of soaking in removing antinutritional substances but may be due to some other factors unknown to us.

Conclusion: The results of these studies showed that processing of pigeonpea seeds significantly improved nutrient utilization and CP retention of PSM and PSM-based diets by pullets especially boiling and toasting. Soaked PSM diets had inferior CP retention coefficient than the rest.

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