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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Pigeon Pea (*Cajanus cajan*) Seed Meal as Protein Source for Pullets: 1. Performance of Grower Pullets Fed Raw or Processed Pigeon Pea Seed Meal Diets

K.U. Amaefule, M.C. Ironkwe and G.S. Ojewola
College of Animal Science and Animal Health, Michael Okpara University of Agriculture, Umudike, PMB 7267 Umuahia, Abia State, Nigeria

Abstract: The experiment was conducted with 150 nine week-old black Bovan Nera pullets to evaluate the performance of grower pullets fed raw or processed pigeon pea seed meal (PSM) diets from the grower (9^{th} week) stage of life. The experiment, which was in a completely randomized design (CRD), comprised pullets fed 20% PSM diets that were isoenergetic and isonitrogenous. The seeds were used as raw, boiled for 30 minutes, toasted for 30 minutes or soaked in water for 24 hours. Each treatment (raw, boiled, toasted, soaked or control diets) was replicated three times. Parameters measured were feed intake, weight gain, feed conversion ratio, live weight at point of lay and feed cost. Pullets fed 20% boiled PSM diet had significantly higher ($P<0.05$) daily protein intake and live weight at point of lay. It was concluded that PSM could be a good protein source for grower pullets, which could be incorporated into the diets at 20% of the whole diet without any adverse effect on growth performance.

Key words: Diets, grower pullets, pigeon pea seeds, processed seeds

Introduction

Low animal protein intake has remained a major human nutritional problem in Nigeria, especially for the low income and non-wage earners. Amaefule and Obioha (2005) had identified exorbitant prices of commercial poultry feeds, arising mainly from high cost of conventional feedstuffs (maize, soybean meal, groundnut cake and fish meal) as the major constraint towards increased animal protein supply.

Pigeon pea seeds are one of the non-conventional feedstuffs that is being developed as an alternative to maize, soybean meal and/ or groundnut cake in broiler (Preston, 1987; Amaefule and Obioha, 1998; Amaefule and Onwudike, 2000; Amaefule and Obioha, 2001), pullet chicks (Amaefule and Obioha, 2005) and layer (Udedibie and Igwe, 1989; Agwunobi, 2000) diets. Raw pigeon pea seeds contain 26.25% CP (Amaefule and Nwagbara, 2004; Amaefule and Obioha, 2005), 11.10 MJ kg^{-1} ME (Nwokolo, 1987), 7-10% CF (Borget, 1992). Boiling and soaking of raw pigeon pea seeds in water have been reported to improve its CP content (Amaefule and Nwagbara, 2004) and reduce the antinutritional contents (D'Mello, 1995) while toasting the seeds reduced the CP and crude extract contents due to volatization during dry heat application (Amaefule and Nwagbara, 2004).

Reports of our earlier studies have shown that processing of raw pigeon pea seeds significantly improved nutrient utilization and CP retention of pullet chicks fed PSM or PSM based diets, especially boiling and toasting (Amaefule and Nwagbara, 2004). Amaefule and Obioha (2005) have also reported that pullet chicks could be fed 10% raw, toasted, boiled or soaked PSM in the diet, without adverse effect on the performance of the pullets. With the knowledge that the laying performance of poultry is affected by their feeding and management during the starter and grower periods, the objective of this study was to evaluate the performance of grower pullets fed raw or processed pigeon pea seed meal diets.

Materials and Methods

Processing of seeds: Three processing methods for the pigeon pea seeds were employed, namely boiling in water, toasting and soaking in water. Raw seeds were put into boiling water, boiled for 30 minutes and sun dried. Toasting the raw seeds was for 30 minutes using a frying pan normally used in frying local *garri*. After toasting, the seeds were poured out on a clean cemented floor and allowed to cool. Soaking of raw seeds in water was for 24 hours in a 200 litre capacity plastic container. The seed: water ratio was 30 kg per 100 litre water. After 24 hours, the seeds were removed from the container with a basket and sun dried. The raw (unprocessed) or processed pigeon pea seeds were milled with a local milling machine powered by a 2.0 hp diesel Lister engine to pass through a 2 mm sieve.

Experimental diets: Five isoenergetic and isonitrogenous diets were formulated with raw, boiled, toasted, soaked pigeon pea seed meal (PSM) and control (0% PSM). Each of the raw or processed PSM was included at 20% of the whole diet (Table 1). The diets had 15.5% CP, 4.27% CF, 1.03% Ca, 0.51% P and

Table 1: Percentage Composition of raw or processed pigeon pea seed meal diets fed to grower pullets

Feed stuffs %	Control	Raw	Boiled	Toasted	Soaked
Maize	37.00	36.00	36.00	36.00	36.00
Local Fish meal	1.00	1.00	1.00	1.00	1.00
Spent grain	12.00	5.00	5.00	5.00	5.00
Maize gluten feed	22.50	14.50	14.50	14.50	14.50
Wheat offal	15.00	15.00	15.00	15.00	15.00
Soybean meal	9.00	5.00	5.00	5.00	5.00
PSM	0.00	20.00	20.00	20.00	20.00
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:					
CP (%)	15.24	15.39	15.55	15.75	15.75
ME (MJ/kg)	12.65	12.65	12.65	12.65	12.52
CF (%)	4.27	4.27	4.27	4.27	3.74
Lysine (%)	0.69	0.81	0.81	0.81	0.81
Methionine (%)	0.26	0.26	0.26	0.26	0.26
Ca (%)	1.03	1.03	1.03	1.03	1.05
Avail. P (%)	0.51	0.51	0.51	0.51	0.51

*Composition per 2.5kg: Vitamin A 10000000IU, Vit.D 2000000IU, Vit E 20000IU, Vit K 2250mg, Thiamine 1750mg, Riboflavin 5000mg, Pyridoxine 2750 mg, Niacin 27500mg, Vit B12 15mg, Pantothenic acid 7500mg, Folic acid 7500mg, Biotin 50mg, Choline chloride 400gm, Antioxidant 125g, Manganese 80g, Zinc 50g, Iron 20g, Copper 5g, Iodine 1.2g Selenium 200mg, Cobalt 200mg.

12.7 MJ/kg ME. Lysine and methionine contents were 0.69 and 0.26%, respectively.

Experimental birds and their management: Nine week-old grower pullets were used. The pullets in each replicate were brooded and reared in a deep litter (wood shavings) pen of a tropical-type, open-sided poultry house whose sides and demarcations between pens were covered with wire-gauze (Amaefule and Obioha, 2005). The pullets were fed a chick diet (maize 45%, soybean meal 25%, maize gluten feed 8%, local fish meal 2%, spent grain 10%, wheat offal 6.50%, bone meal 3% vitamin premix 0.25% and salt 0.25%) that contained 20.57% CP, 3.70% CF, 1.32% Ca, 0.67% P and 12.97 MJ/kg ME at the pullet chick (0-56 days) stage. The lysine and methionine contents of the diets were 1.07% and 0.30%, respectively.

The birds were vaccinated against Newcastle disease at day-old (I/O) and at the 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 ages of 2–3 weeks and 5 – 6 weeks. Additional medications given to the pullets were Piperazine^{R} dewormer, fowl pox vaccine and Newcastle disease vaccine (Komorov) at 9th, 12th and 18th weeks of age, respectively.

Experimental design and data collection: The experimental design was completely randomized design (CRD). There were 30 grower pullets per treatment and 10 pullets per replicate. Parameters measured were feed intake, weight gain and feed conversion ratio and live weight at point of lay. Feed and water was given to the birds *ad libitum*. Feed intake was determined by subtracting the quantity of feed leftover (unconsumed) from the total quantity offered on a weekly basis. The birds were weighed as replicate groups and the group weight divided by the number of birds to obtain the average live weight per bird.

Weighing of the birds was at the beginning of the experiment and subsequently on a weekly basis usually in the morning (8.00 - 9.00 am) hours. Weight gain was calculated as final live weight minus initial weight, feed conversion ratio (FCR) as feed intake divided by weight gain, and protein efficiency ratio (PER) as protein intake divided by weight gain. Mortality records and other observations were kept throughout the period of study. Feed cost per kg weight gain was calculated as FCR x cost/ kg feed.

Chemical and data analyses: Feed and PSM samples were analyzed for proximate composition according to methods of A.O.A.C (1990). The gross energy of PSM and experimental diets were determined using adiabatic oxygen Bomb Calorimeter (1241 Adiabatic Calorimeter, PARR Instrument Co., Illinois, USA) technique.

Data collected were subjected to analysis of variance (ANOVA) and differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955). All statistical procedures were according to Steel and Torrie (1980).

Table 2: Proximate composition of raw or processed pigeon pea seed meal (% DM)

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
N Free Extract (%)	49.65	47.98	47.63	48.44
Gross Energy (MJ/kg)	16.02	16.18	16.52	16.30

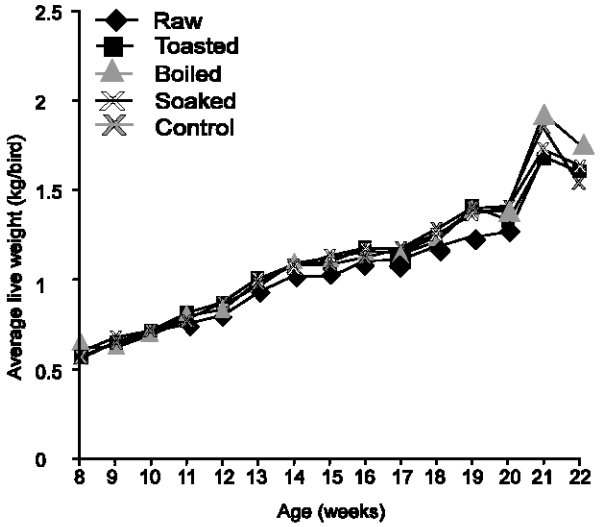

Fig. 1: Average weekly weights (kg/b) of grower pullets fed raw or processed PSM diets from the grower (9th week) stage of life

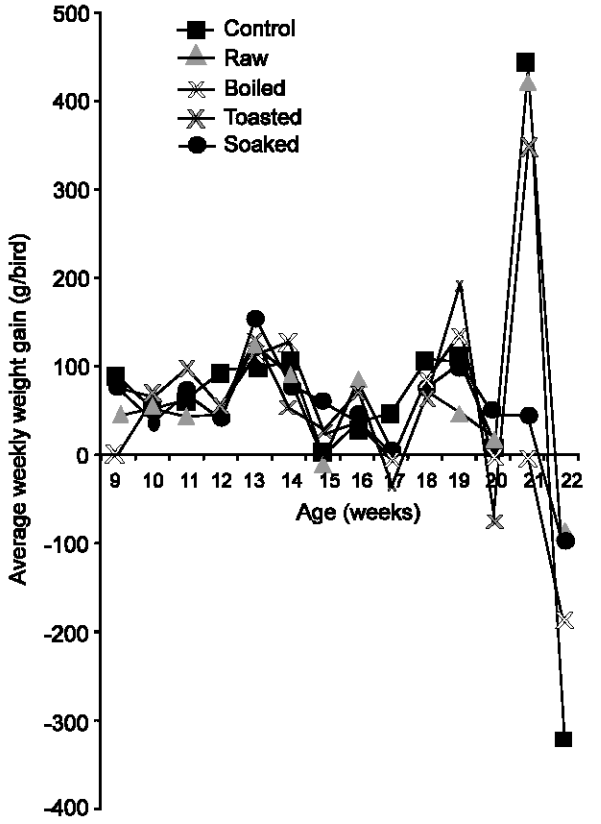

Fig. 2: Average weekly weight gain (kg/b) of grower pullets fed raw or processed PSM diets from the grower (9th week) stage of life.

Results

Growth performance: The performance of grower pullets (9-week old) fed 20% raw or processed PSM diets is presented in Table 2. There were no significant differences (P>0.05) among grower pullets fed the control, raw or processed PSM diets in daily weight gain, feed conversion ratio (FCR) and PER. Pullets fed boiled or soaked PSM diets had significantly higher (P<0.05) live weight at point of lay (POL) than those fed control diet. Pullets fed raw, toasted, boiled or soaked PSM diets had live weights that were not significantly different (P>0.05) from one another. As shown in Fig. 1, pullets fed boiled PSM diet attained the highest live weight and those fed control diet the lowest weight at the end of 22nd week. Among the pullets fed the treatment diets, live weight continued to increase until 21st week when there was a drop in body live weight.

The average weekly weight gain of pullets fed raw or processed PSM diets from the grower stage (Fig. 2) showed that the pullets had no uniform growth pattern. Pullets fed toasted PSM diet had a more pronounced negative growth rate than the rest. Live weight gain peaked at week 21 and dropped sharply by week 22. The intake of toasted and boiled PSM diets was not significantly different (P>0.05) from each other, but was significantly higher (P<0.05) than the intake of the raw PSM diet. Intake of toasted, boiled, soaked PSM and control diets was not significantly different (P>0.05) from each other. The pattern of intake of the different diets (Fig. 3) was similar except for differences presented by pullets fed toasted and soaked PSM diets. The control diet had the highest intake of about 120 g/b/d at week 19, while soaked PSM diet had the lowest intake at that age. Average daily protein intake followed the same trend as feed intake, except that the protein intake of pullets fed toasted PSM diet, although numerically higher, was not significantly different (P>0.05) from that of raw PSM diet.

Feed cost: The feeding of raw or processed PSM diets to pullets from the grower stage resulted in significant differences (P<0.05) in average daily feed cost per bird as presented in Table 4. Cost per kg weight gain and feed cost to point of lay (POL) were not significantly different (P>0.05) among grower pullets fed the PSM and control diets.

Discussion

Growth performance: The feeding of raw or processed

Table 3: Performance of grower pullets fed raw or processed pigeon pea seed meal diets from grower stage of life

Parameters	Control	Raw	Boiled	Toasted	Soaked	SEM
Initial live weight (kg/b)	0.56	0.61	0.62	0.57	0.60	0.02
Final live weight (kg/b)	1.53^{b}	1.60^{ab}	1.75^{a}	1.60^{ab}	1.63^{a}	0.05
Daily weight gain (g/b)	9.90	10.1	11.5	10.5	10.5	0.52
Daily feed intake (g/b)	76.5^{ab}	70.1^{b}	80.8^{a}	80.1^{a}	73.0^{ab}	2.25
FCR	7.73	6.94	7.03	7.62	6.95	0.50
Daily protein intake (g/b)	12.1^{ab}	11.1^{b}	12.6^{a}	12.2^{ab}	11.9^{ab}	0.35
PER	0.82	0.93	0.92	0.87	0.89	0.06
Mortality (%)	0.0	0.0	0.0	0.0	0.0	0.0

a,b: Means in the same row followed by different superscripts are significantly different (P<0.05). SEM = Standard error of Mean

Table 4: The feed cost of feeding raw or processed PSM diets to Pullets from theGrower (9th Week) Stage of life

Cost	Raw	Toasted	Boiled	Soaked	Control	SEM
Feed Cost / kg (N)	18.13	18.33	18.33	18.13	19.34	-
Daily Feed Intake/ b (g)	70.13	80.09	80.77	77.46	76.50	2.25
Daily Weight gain/ b (g)	10.15	10.56	11.55	10.54	19.89	0.25
Daily feed Cost/ b (N)	1.27^{b}	1.47^{a}	1.48^{a}	1.40^{a}	1.48^{a}	0.04
Cost / kg weight gain (N)	126.15	139.85	128.64	134.91	149.88	9.09
Feed Cost to POL (N)	194.70	213.95	215.18	207.72	215.07	6.87

a, b Means in the same row with the same letters are not significantly different (P>0.05). SEM = Standard Error of mean. POL = Point of lay.

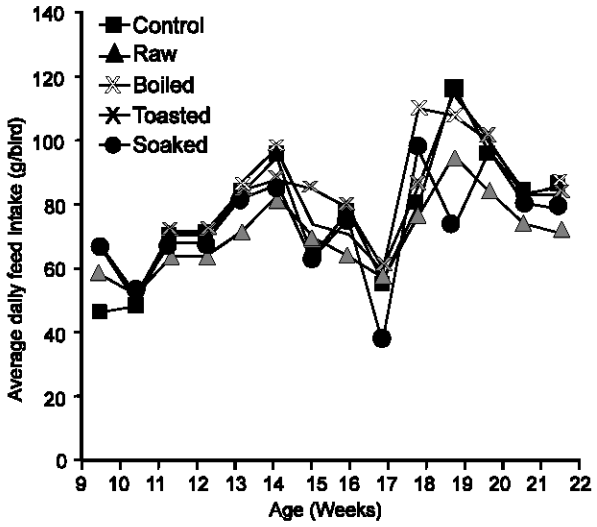

Fig. 3: Average daily feed intake (g/b) of grower pullets fed raw or processed PSM diets from the grower (9th week) stage of life.

PSM diets to pullets from the grower pullets did not affect average daily weight gain, FCR and PER of the pullets. Rather, boiled and soaked PSM diets improved live weight of the pullets at point of lay over the live weight attained by pullets fed control diet. The sharp drop in live weight gain between 21st and 22nd week corresponds to the period of physiological changes preparatory to egg lay (Morris, 2004). The live weight attained by pullets fed processed PSM and control diets at 19th week are comparable to that obtained by Elzubeir and Mohammed (1993) with Hisex Brown pullets. The weekly weight gain also fell within the range (8.4 -12.4 g/b) obtained by Elzubeir and Mohammed (1993). It is not clear whether the growth rate pattern obtained with pullets in this study is peculiar to only pullets fed PSM diets, while the sharp increase in live weight gain between 20 and 21st week had earlier been attributed to preparations for egg lay.

The reduced intake of the raw PSM diet was a surprise and ran contrary to earlier observations with broilers (Amaefule and Onwudike, 2000; Amaefule and Obioha, 2001) that raw PSM diet caused increased feed intake. Rather, boiled and soaked PSM diets caused an increase in feed intake, which could be attributed to increased growth rate (weight gain) and higher live weight of pullets fed soaked and boiled PSM diets. The higher intake of the control diet when compared to the PSM diets may be due to unknown factors; while the whole feed intake pattern of the pullets could be related to the pattern of growth rate, which had been indicated to be in response to the nutrient requirement of the pullets for development (Morris, 2004).

Feed cost: The feeding of grower pullets with raw or processed PSM diets significantly affected only the daily feed cost per pullet which could be attributed to the differences in the daily feed intake of the pullets. The lower daily feed cost of pullets fed raw PSM diet resulted in a lower cost of kg weight gain. Although, this was not significantly different from others, means much financial benefit to a poultry farmer when compared with the cost of kg weight gain of pullets fed toasted PSM and control diets. The lower feed cost to POL of pullets fed raw PSM diet could also be attributed to the lower cost per kg weight gain. Pullets fed boiled PSM diet had a comparable feed cost to POL with those fed control and

toasted PSM diets and this could be due to the added cost of processing and higher feed intake.

Conclusion: The study showed that pigeon pea seed meal (PSM) could be a good protein source for grower pullets, which could be incorporated into the diet at 20% of the whole diet. Any of the processed or raw PSM diets could be fed to the pullets from the 9th week of life without adverse affect on growth performance.

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