PERFORMANCE AND NUTRIENT UTILIZATION OF BROILER STARTERS FED DIETS CONTAINING RAW, BOILED OR DEHULLED PIGEONPEA SEEDS (*Cajanus cajan*)

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ABSTRACT

Two hundred and sixteen 7-day old broilers were used to compare three types of pigeon pea seed meal, namely raw, boiled and dehulled at two levels, 20 and 30% of the diet in a 3x2 factorially designed experiment lasting four weeks. Measurements recorded included weight gain, feed intake, feed conversion ratio (FCR), protein efficiency ratio (PER), nutrient retention and live weight of the broilers at the end of the fourth week. Better results were obtained when pigeon pea seed meal (PPSM) was included at 30% level than at 20% in all performance criteria. The interaction between processing method and level of inclusion was significant (P<0.001) with dehulled PPSM included at 30% (D30) producing best results; while at 20%, dehulled PPSM was not superior to boiled PPSM. In all measurements, broilers fed boiled and dehulled PPSM performed significantly better (P<0.01) than those fed raw seed meal. Results of this experiment indicated that broilers fed dehulled pigeon pea seed meal at 30% inclusion level produced best results.

Key words: Pigeonpea, dehulled, performance nutrient utilization, broiler starter

INTRODUCTION

The search for alternative plant protein sources in rations is a continuous one especially in the present condition of scarcity and high cost of soybean meal, groundnut cake and fishmeal in Nigeria. The conventional or primary protein feedstuffs continue to be scarce and expensive because they suffer from severe competition with humans and other industrial users from whom they command higher priority and higher prices than from the compound feed industry. Pigeon pea seeds have very low human food preference and equally no industrial use as at now. Available literature on the feeding of pigeonpea seeds to poultry suggests that its meal is a satisfactory protein ingredient at up to 30% of the whole ration (Springhall *et al.*, 1974; Grimaud, 1988; Tangtaweewipat and Elliott, 1989; Amaefule and Obioha, 1998). Ologhobo (1992) indicated that 25% pigeonpea seed meal adversely affected feed conversion efficiency of broilers and the seeds may have been the raw seeds. As with other grain legumes, the seeds contain antinutritional factors like trypsin and protease inhibitors which tend to limit their use in poultry feeding (Grimaud, 1988; Ologhobo, 1992; D'Mello, 1992). Although pigeonpea seeds contain much less trypsin and chymotrypsin inhibitors than soybean (ICRISAT, 1991), some of the wild relatives to which Nigerian variety may belong, may contain higher concentrations of protease inhibitors that influence protein digestibility. It has also been reported that pigeonpea seeds contain raffinose and starchyose which are flatulence-causing sugars (ICRISAT, 1991). It is known that cooking and other processing methods of grain legumes exert a beneficial effect on the starches and is equally though to be desirable with feedstuffs with considerable proportion of fibre. In this study, boiling was done for 30 minutes at 100°C beyond which

period the nutritive value of the seeds is decreased according to Elias *et al.* (1973). Dehulling is the removal of the seedcoat of pigeonpea seeds which, according to Salunkhe *et al.* (1985), improved the digestibility of the proteins, lowered the tannin content and reduced the crude fibre and calcium content of the seeds. Dehulling of cooked pigeonpea seeds also increases the biological value, percent true protein and net protein utilization of the seeds but leads to considerable loss of protein, iron and other dietary nutrients (ICRISAT, 1987; 1991). The nutritional implication of dehulling pigeonpea seeds is also apparent since the high crude fibre content of the seedcoat may affect nutrient utilization considering that about 98% of the fibre content of the seed is in the seedcoat (Salunkhe *et al.*, 1985).

This study therefore aimed at determining the performance and nutrient utilization of broiler starters fed diets containing raw, boiled or dehulled pigeonpea seed meal when included in broiler starter diets at two levels.

MATERIALS AND METHODS

The experiment was carried out in the experimental block of the poultry section, Department of Animal Science Farm, University of Nigeria, Nsukka. Feedstuffs, ingredients and day-old broilers were obtained from suppliers at Nsukka Town, while pigeonpea seeds were bought from Oba market.

Diets

The treatment diets were isoenergetic and isonitrogenous, with the inclusion of processed and raw pigeonpea seeds meal (PPSM) at 20 and 30% of the whole ration. Thus six experimental diet were made up of three pigeonpea seed meal namely, raw, boiled and dehulled. each included at two levels of 20 and 30%. The boiling of the seeds was for 30 minutes at 100°C which involved putting the raw seeds in a boiling water and maintaining the temperature for 30 minutes; while dehulled seed meal was obtained by drying the already boiled seeds, cracking and separating the seedcoat from the rest of the cotyledon with a blower. The percentage composition of the experimental diets is as shown in Table 1. The experimental diets were R20, (20% raw PPSM, 30% maize and 23% BDG), R30 (30% raw PPSM, 29% maize and 17% BDG), B20 (20% Boiled PPSM, 30% maize and 25% BDG), B30 (30% boiled PPSM, 29% maize and 17% BDG), D20 (20% dehulled PPSM, 30% maize and 23% BDG) and D30 (30% dehulled PPSM, 29% maize and 17% BDG).
Two hundred and sixteen 7-day old Anak broilers were randomly assigned to 6 dietary treatment with 36 birds per treatment and each treatment replicated 3 times. The chicks were brooded in a deep litter (woodshavings) pen measuring 2.6m x 3m in the same experimental block with kerosine stove under a metal hover. They were vaccinated against New castle disease at day-old (intra ocular) and 4th week (Lasota) and Gumboro disease at 9th day of life. Feed and water were supplied *ad libitum*.

Data Collection

Data on daily feed consumption and weekly body weight gain were kept throughout the experimental period. These were used to calculate the feed efficiency ratios for the birds. Weighing of the broilers was on individual basis and in the morning hours when their crops were virtually empty. Nutrient utilization study involved three birds from each replicate transferred to a metabolism cage (75cm x 35cm) housed in a deep litter house and fed the test diet and water *ad libitum* for 3 days to enable the broilers get used to the cage and to establish feed intake. The test diets were the same as those used in the feeding trial. They were then fed 90% of their *ad libitum* intake daily during the study period to encourage total feed consumption. Droppings were collected daily for four days in an Aluminum tray, sundried and weighed.

TABLE 1: PERCENTAGE COMPOSITION OF THE BROILER STARTER EXPERIMENTAL DIETS

Feedstuffs	R20	R30	B20	B30	D20	D30
Yellow Maize	30.00	29.00	30.00	29.00	30.00	29.00
Fishmeal[+]	10.00	10.00	10.00	10.00	10.00	10.00
Brewers Grain	23.00	17.00	25.00	17.00	23.00	17.00
Raw Pigeonpea	20.00	30.00	-	-	-	-
Boiled pigeonpea	-	-	20.00	30.00	-	-
Dehulled Pigeonpea	-	-	-	-	20.00	30.00
Maize Offal	13.00	10.00	11.00	10.00	13.00	10.00
Bonemeal	3.00	3.00	3.00	3.00	3.00	3.00
Vitamin premix*	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Total (%)	100.00	100.00	100.00	100.00	100.00	100.00
Calculated composition						
CP (%)	21.57	22.34	21.60	22.12	21.57	22.34
CF (%)	5.34	5.20	5.30	5.49	4.15	3.21
ME (MJ/kg)	11.64	11.96	11.64	11.86	11.50	11.75
L-lysine (%)	1.64	1.90	1.64	1.90	1.56	1.78
DL-Methionine (%)	0.56	0.53	0.57	0.53	0.56	0.53
Calcium (%)	1.68	1.74	1.68	1.76	1.57	1.60
Phosphorus (%)	1.22	1.24	1.19	1.21	1.20	1.21

*To provide the following per kg: Vit. A 1500 IU; Vit. D3 1600 IU; Riboflavin, 9.0mg; Biotin, 0.25; pantothenic acid, 11.0mg; Vit. K3.0mg; Vit B2, 2.5mg; Vit B6, 0.3mg; Vit B12, 8.0mg; Nicotinic acid, 8.0mg; Fe, 5.0mg; Mn, 10.0mg; Zn, 4.5mg; Co, 0.02mg; Se, 0.01mg. [+]Local Fishmeal.

Data Analysis

The proximate composition of the feedstuffs, experimental diets and droppings were determined according to methods of A.O.A.C. (1990). These are shown in Table 2. Data on daily feed intake, weight gain, final liveweight, feed conversion ratio, protein intake and protein efficiency ratio were analyzed statistically using analysis of variance (ANOVA). Differences between the treatment means were separated using Duncan's New Multiple Range Test. All stastistical procedures were according to Steel and Torrie (1980).

RESULTS

The processing of the pigeonpea seeds resulted in a significant improvement over the raw seeds in most of the measurements recorded as shown in Tables 3, 4 and 5. Birds fed dehulled PPSM diet gained significantly ($P<0.001$) higher weight than those fed boiled PPSM diet. The latter's weight gain was in turn significantly ($P<0.001$) higher than those fed raw seed meal diet. The consumption of birds fed the raw PPSM diet was significantly higher than the dehulled, PPSM which in turn was significantly higher ($P<0.001$) than birds fed the boiled PPSM diet. The average daily feed consumption figures were 48.33, 43.33, and 42.67g per bird for raw, dehulled and boiled PPSM respectively. Protein intake of

TABLE 2: PROXIMATE COMPOSITION OF EXPERIMENTAL (BROILER STARTER) DIETS AND SOME FEEDSTUFFS (% DM BASIS)

	Drymatter	Crude Protein	Esther Extract	Crude Fibre	Ash	N-Free Extract
Maize (Yellow)	91.73	10.10	4.50	1.62	2.69	80.82
Local Fishmeal	93.00	50.00	10.98	1.50	22.52	15.00
Raw PPSM	87.50	24.01	1.84	7.25	5.50	61.40
Boiled PPSM	87.00	23.15	1.65	7.03	3.35	64.82
Dehulled PPSM	87.50	24.53	2.20	0.38	5.80	67.09
Starter Diets						
R20	89.00	21.70	3.87	5.00	12.60	56.83
R30	87.50	22.04	3.39	4.98	12.00	57.59
B20	88.00	21.81	3.83	5.03	12.35	56.98
B30	88.00	21.88	3.37	5.37	13.50	55.88
D20	87.00	21.88	3.81	3.84	12.60	58.00
D30	88.00	21.93	3.34	3.65	13.70	57.38

PPSM = Pigeonpea seed meal.

broilers fed raw seed meal diet was siginficantly higher ($P<0.001$) dehulled diet which was similar to that of the boiled PPSM. There were also significant differences ($P<0.001$) in the treatment means for FCR and PER of broilers fed the different diets. ($P<0.05$).

TABLE 3: PERFORMANCE OF BROILER STARTERS FED RAW, BOILED OR DEHULLED PIGEONPEA SEED MEAL

Measurements	Raw®	Boiled (B)	Dehulled (D)	Sign. Level
Initial Liveweight (g/bird)	105.00	102.78	104.72	
Final Liveweight (g/bird)	288.89^{a}	359.44^{b}	386.12^{c}	***
	(2.20)	(5.90)	(17.50)	
Daily weight gain (g/day)	8.77^{a}	12.22^{b}	13.40^{c}	***
	(0.13)	(0.03)	(0.87)	
Daily Feed Intake (g/bird/day)	48.33^{c}	42.67^{a}	43.33^{b}	***
	(0.90)	(1.13)	1.400	
Feed Conversion Ratio	5.58^{c}	3.49^{b}	3.23^{a}	***
	(0.28)	(0.46)	(0.11)	
Daily Protein Intake	10.33^{b}	9.00^{a}	9.00^{a}	***
(g/bird/day)	(0.17)	(0.20)	(0.27)	
Protein Efficiency Ratio	0.85^{a}	1.36^{b}	1.49^{c}	***
	(0.02)	(0.14)	(0.05)	

*** Very Highly Significant ($P<0.001$)

Means followed by the same superscript are not significantly different ($P>0.05$)

( ) = Standard Error of mean (SEM)

The levels of inclusion of the processed and raw pigeon pea seed meal diets also produced significant treatment differences in all the measurements. Broilers fed diets containing 30% PPSM had significantly better results (P<0.01) than those fed PPSM at 20% level (Table 4). The interaction effects between processing method and inclusion level presented in Table 5 were also significant except for feed consumption and daily protein intake. Apart from these two measurements, dehulled PPSM at 30% (D30) was significantly higher (P<0.001) than boiled at 30% (B30), which in turn was significantly higher (P<0.001) than raw at 30% (R30), in all measurements. Dehulled meal at 20% (D20) was similar to boiled at 20% (B20) in PER, two of which were significantly higher (P<0.001) than raw at 20% (R20). In all measurements, R20 was similar to R30, B20 differed significantly (P<0.001) from B30 only in final body weight, daily weight and PER, while D20 was significantly lower (P<0.001) than D30 in all the measurements.

TABLE 4: EFFECT OF LEVEL OF INCLUSION OF PPSM IN THE DIETS ON BROILER STARTER PERFORMANCE

Measurements	Level						Sign. Level
	20%			30%			
	Raw	Boiled	Dehulled	Raw	Boiled	Dehulled	
Initial Liveweight (g/bird)	104.26			104.07			
Final Liveweight (g/bird)	326.67a			362.96[b]			***
	(10.80)			(19.10)			
Daily weight gain(g/day)	10.59[a]			12.33[b]			***
	(0.50)			(0.93)			
Daily Feed Intake	42.67[a]			47.00[b]			***
(g/bird/day)	(1.17)			(0.83)			
Feed Conversion Ratio	4.03[b]			3.81[a]			***
	(0.06)			(0.05)			
Daily Protein Intake	9.00[a]			10.00[b]			***
(g/bird/day)	(0.27)			(0.20)			
Protein Efficiency Ratio	1.18[a]			1.23[b]			***
	(0.08)			(0.11)			

*** Very highly significant (P<0.001)
Means followed by the same superscript in the same column are not significantly different (P>0.05)
( ) = Standard Error of mean (SEM)

The dry matter (DM) utilization of broilers fed raw, boiled, or dehulled pigeonpea seed meal (PPSM) diets were not significantly different (P>0.05) from each other, although boiled PPSM diet produced numerically higher values Table 6. There were also no significant differences between the two levels of inclusion (20 and 30%) in most of the nutrient retention measurements (Table 7).

TABLE 5: EFFECT OF INTERACTION BETWEEN PPSM PROCESSING METHOD AND LEVEL OF INCLUSION ON BROILER STARTER PERFORMANCE

Measurements	20%			30%			Sig.
	Raw	Boiled	Dehulled	Raw	Boiled	Dehulled	
Initial Liveweight (g/bird)	104.44	104.45	103.89	105.56	101.11	105.55	***
Final Liveweight (g/bird)	283.89[a] (1.30)	348.89[b] (7.00)	347.23[b] (2.00)	293.89[a] (0.30)	370.00[c] (3.50)	430.00 (1.00)	***
Daily weight gain (g/day)	8.55[a] (0.10)	11.64[b] (0.33)	11.59[b] (0.10)	8.97[a] (8.97)	12.80[c] (0.23)	15.21[d] (0.23)	***
Daily Feed Intake (g/bird/day)	47.00 (0.30)	40.33 (0.87)	40.33 (0.50)	49.67 (1.50)	45.00 (0.57)	46.33 (0.10)	
Feed Conversion Ratio	5.50[c] (0.29)	3.47[b] (0.30)	3.49[b] (0.19)	5.54[c] (0.14)	3.58[b] (0.39)	3.05 (0.30)	***
Daily Protein Intake (g/bird/day)	10.00 (0.10)	8.86 (0.20)	8.67 (0.10)	10.67 (0.30)	9.33 (0.10)	9.67 (0.00)	
Protein Efficiency Ratio	0.86[a] (0.02)	1.34[b] (0.22)	1.34[b] (0.02)	0.84[a] (0.03)	1.37[c] (0.02)	1.57[d] (0.00)	***

***Very highly significant (P<0.001)
Means followed by the same superscript in the same column are not significantly different (P>0.05)
( ) = Standard Error of mean (SEM)

Broilers fed raw PPSM diet had a significantly higher (P<0.05) crude protein (CP) retention than those fed dehulled PPSM diet, but was similar to those fed boiled PPSM (Table 6).
Also crude protein utilization of broilers fed dehulled PPSM diet was not significantly different (P>0.05) from that of broilers fed boiled PPSM diet. The utilization of crude fibre was significantly higher (P<0.05) with boiled PPSM; dehulled and raw PPSM were similar. (Table 6).

At 20% inclusion level, PPSM protein was significantly higher (P<0.05) than at 30%, while the utilization of other nutrient at the two levels of inclusion were similar (Table 7). The interaction between processing method and level of inclusion did not produce any significant effect in nutrient utilization (Table 8).

DISCUSSION

Dehulling of pigeonpea seeds improved the daily weight gain of the birds, which resulted in an improvement in the final liveweight of the birds over the boiled and raw seeds. This may have been due to the fact that dehulling of pigeonpea seeds eliminates the anti-nutritional substances and lowers the crude fibre level of the seeds, increases its protein digestibility but not protein efficiency (Salunkhe *et al.*, 1985). Although the feed intake of the diet containing raw PPSM was higher than those containing dehulled and boiled PPSM, it did not result in

higher weight gain and final body weight. The birds apparently increased feed consumption of the raw seed diet to meet their nutrient requirement from a diet that had anti-nutritional substances. This suggests that nutrients in the raw seeds were not as available as was in the diets containing dehulled and boiled seeds. Between the dehulled and boiled PPSM diets, the difference in performance may have been due to the fact that there was higher intake of fibre from boiled, PPSM which may have reduced the intake of other nutrients since about 90% of the crude fibre of pigeonpea seeds is contained in the seedcoat (Salunkhe *et al.,* 1985). As the results showed, it is unnecessary to increase the percentage inclusion level of the raw PPSM from 20 to 30% in the diet. With the boiled seeds, increase in the level of inclusion produced significant improvement in the daily weight gain and final body weight of the birds, while other measurements were unaffected. Also birds fed on D30 diet performed better than those on D20 in all measurements except feed consumption and protein intake which may have been due to the fact that increasing the level of inclusion further reduced the crude fibre and increased the level of utilization of other nutrients in the diet. At 30% level, dehulled PPSM diet was better than boiled seed diet which may have been due to the effect of seedcoat removal. This confirms the report of ICRISAT (1991) that dehulling of pigeonpea seeds increased the biological value and net protein utilization of the seeds. Dehulled and boiled PPSM diets were better than raw PPSM diet also probably due to elimination of antinutritional substance contained in the seeds. At 20% level, dehulled seed diet did not improve the performance of the birds over boiled which suggests that it is not important to remove the seed coat of the seeds at the level of inclusion. Dehulled and boiled PPSM were all better than raw seed diet. This confirms that processing of pigeonpea seeds improves its nutritive quality as feed for broilers (Salunkhe *et al.,* 1985; ICRISAT, 1991).

The result of nutrient utilization of broilers fed raw, broiled or dehulled pigeonpea seed meal (PPSM) showed that the raw seed diet compared favourably with the boiled and dehulled PPSM diets, with boiled PPSM showing improvement over the rest, suggesting that boiling of pigeonpea seeds was effective in removing anti-nutritional substances from the raw seeds. There may also have been a higher rate of passage of the raw PPSM diets through the alimentary system of the broilers fed on it as evidenced from the higher feed intake recorded.

The lower CP retention and DM utilization of the dehulled PPSM diets by broilers could be due to considerable loss of protein, iron and other dietary nutrients as indicated by ICRISAT, (1987; 1991). The better performance recorded by broilers fed 20% PPSM diets over those fed 30% although could not be ascribed to any known factor suggests that broiler starters are less efficient in utilizing pigeonpea nutrients at inclusion level higher than 20%, thus confirming the report of Ologhobo (1992). The superiority of boiled PPSM diet over dehulled in terms of nutrient utilization by broilers is an indication that pigeonpea seed coat removal is not necessary especially when it was observed that crude fibre utilization of boiled PPSM was numerically higher than that of dehulled PPSM diet.

CONCLUSION

It is evident from this study that dehulling is a better processing method for pigeonpea seeds and that the dehulled seed diet is generally better than boiled seed diet for broiler starters. Thirty percent inclusion level of pigeonpea seed meal in the diet of broiler starters proved better than 20%. In all, the diet of dehulled PPSM at 30% inclusion level (D30) proved to be the best.

TABLE 6: NUTRIENT AND ENERGY RETENTION (%) OF PIGEON-PEA SEED BASED DIETS BY BROILER STARTER BIRDS

Measurements	Raw	Boiled	Dehulled	SEM
DM	50.21	54.68	49.34	2.64^{ns}
CP	58.70^{a}	56.00^{ab}	48.64^{b}	2.87^{*}
EE	77.12	78.49	76.72	1.27^{ns}
CF	55.87^{a}	66.79^{b}	58.78^{a}	2.25^{*}
Energy	57.75	62.26	57.36	2.30^{ns}

* Significant (P<0.05)
Means followed by the same superscript in the same column are not significantly different (P<0.05). ns = not significant, SEM = Standard Error of Mean

TABLE 7: EFFECT OF LEVEL OF INCLUSION OF PPSM IN THE DIETS ON NUTRIENT AND ENERGY RETENTION (%)

Measurements	20%	30%	SEM
DM	53.19	49.63	2.15^{ns}
CP	58.04^{a}	50.85^{b}	2.43^{*}
EE	78.46	76.40	0.97^{ns}
CF	59.07^{a}	61.26	2.39^{ns}
Energy	61.49	56.75	1.80^{ns}

*Significant (P<0.05). Means followed by different superscript are significantly different (P<0.05); ns = not significant

TABLE 8: EFFECT OF INTERACTION BETWEEN PROCESSING METHOD AND LEVEL OF INCLUSION OF PPSM IN THE DIETS ON NUTRIENT AND ENERGY RETENTION (%) OF BROILER STARTER

Level	20%			30%			
Nutrient	Raw	Boiled	Dehulled	Raw	Boiled	Dehulled	SEM
DM	51.67	56.62	51.27	48.75	52.73	47.41	3.70^{ns}
CP	59.92	60.29	53.91	57.47	51.71	43.36	3.44^{ns}
EE	77.96	79.16	78.26	76.28	77.74	75.19	1.72^{ns}
CF	55.59	63.80	59.71	56.15	69.77	57.85	3.07^{ns}
Energy	60.27	64.49	59.71	55.22	60.02	55.03	2.97^{ns}

ns = not significant (P>0.05).

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