

PERFORMANCE AND NUTRIENT UTILIZATION OF DIETS CONTAINING RAW, BOILED OR DEHULLED PIGEONPEA SEED MEALS (*Cajanus cajan*) FED TO BROILER FINISHERS

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ABSTRACT

One hundred and eighty, 4-week old broilers were used to study the performance of broiler finishers fed diets containing raw, boiled or dehulled pigeonpea seed meals included at levels of 30 and 40% of the diets in a 3 x 2 factorially designed experiment. Performance criteria were daily weight gain, feed intake, feed conversion ratio (FCR), protein efficiency ratio (PER), nutrient utilization and final liveweight of the broilers at the end of 8th week. Results showed that dehulled seed meal diet produced broilers with the highest daily weight gain, final liveweight and protein efficiency ratio, lowest feed intake, FCR and daily protein intake. Broilers fed boiled seed meal diet performed significantly better than those fed raw seed meal diet in all measurements. Broilers fed on 30% inclusion level of PPSM gave better results than those on 40% which significantly depressed growth rate, feed conversion efficiency, protein efficiency and increased protein intake. The interaction between processing methods and inclusion levels were not significant. There was a higher nutrient utilization of dehulled and boiled PPSM diets by broilers than the raw seed meal. Increase in the level of inclusion generally decreased protein retention except for the dehulled PPSM diet. It is concluded that a better option is to dehull boiled pigeonpea seeds and include the meal at not more than 30% of the whole ration for broiler finishers.

Keywords: Pigeonpea seeds meal, dehulling, broiler finisher, nutrient utilization.

INTRODUCTION

The development of alternative plant protein feedstuffs in broiler diets will continue to be a necessity in Nigeria as long as the conventional or primary protein feedstuffs like soybean meal, groundnut cake and fishmeal continue to be scarce and expensive. These primary feedstuffs are costly because they are competed for by humans and other industrial users who are ready to pay higher prices than the compound feed industry. Pigeonpea seeds which have low human food values and no known industrial use as of now could therefore be developed into a protein feedstuff for broilers especially for small scale and rural poultry producers.

The chemical composition of pigeonpea seeds varies widely with the crude protein content ranging from 17.90 to 30% (Geervani, 1981; Salunkhe *et al.*, 1985; Obioha, 1992; Amaefule and Obioha, 1998). The protein is mainly deficient in sulfur amino acids and tryptophan but rich in lysine (Church and Pond, 1974). The seeds contain antinutritional factors like trypsin inhibitors which tend to limit their use in poultry feeding (Grimand, 1988; Ologhobo, 1992; D'Mello, 1992). Although, Ologhobo (1992) reported that 25% pigeonpea seed meal adversely affected feed conversion efficiency of broilers, it has been observed that pigeonpea seed meal is a satisfactory protein ingredient in poultry diets up to 30% of the whole ration (Grimand, 1988; Tangtaweeinpat and Elliott, 1989; D'Mello, 1992; Udedibie and Mba, 1994; Amaefule and Obioha, 1998). It has been established that cooking and other processing methods of grain legumes exert a beneficial effect on the

starches, especially with those containing considerable proportion of fibre like pigeonpea seeds (Siegel and Fawcett, 1976). It has also been reported that dehulling of cooked pigeonpea seeds fed to rats increased 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, 1988; 1991). This study was designed therefore to determine the performance and nutrient utilization of broiler finishers fed diets containing raw, boiled or dehulled pigeonpea seed meals.

MATERIALS AND METHODS

The study took place at the experimental block of Animal Science Poultry Farm, University of Nigeria, Nsukka. The feedstuffs, ingredients and day-old broilers were procured from the local dealers and market. The pigeonpea seeds were used in formulating the experimental diets either as raw, boiled or dehulled seed meal. Each type was included at two levels, 30 and 40% in a 3 x 2 factorial design. Each of the experimental diets was then assigned to 30 Anak broiler finishers per treatment, while each treatment was sub-divided into 3 replicate groups of 10.

The broilers were housed in deep litter floor pens each measuring 2.6m x 3m. The deep litter house was a tropical open-sided type with the floors adequately covered with wood shavings. The broilers were vaccinated against Newcastle and Gumboro diseases and supplied with feed and water *ad libitum*.

Diets

The diets were isoenergetic and isonitrogenous, with the inclusion of processed and raw pigeonpea seed meals at 30 and 40% of the whole ration. The 6 experimental diets as shown in Table 1 were raw seed meal included at 30 and 40% (R30 and R40), boiled seed meal at 30 and 40% (B30 and B40) and dehulled seed meal at 30 and 40% (D30 and D40). The boiling of the seeds was for 30 minutes at 100°C as recommended by Elias *et*

al. (1973). Raw seeds were put into boiling water, boiled for 30 minutes, sun dried and milled. Dehulling involved boiling of the seeds for 30 minutes, drying, cracking and seedcoat removal using a blower. The percentage composition of the diets is presented in Table 1.

Data Collection

The experimental design was a 3 x 2 factorial in a completely randomized design with model: $Y_{ijk} = U + T_i + L_j + (TL)_{ij} + e_{ijk}$ where Y_{ijk} = the k th observation on the i th treatment (processing method) effect and j th level of inclusion; U = overall mean, T_i = Treatment (Processing method) effect; L_j = level of inclusion effect; $(TL)_{ij}$ = Interaction effect between processing method and level of inclusion; e_{ijk} = Experimental error.

Feeding Trial

Data on feed intake were obtained by difference between the quantity offered and quantity leftover each day, while weighing of the broilers was on an individual basis, weekly and in the morning hours (7 a.m. – 8 a.m.) when their crops were virtually empty. The study lasted for 4 weeks.

Metabolism Trial

Two, 7-week old Anak broilers per replicate that had been fed the experimental diets were transferred from the deep litter floor to a metabolism cage (75cm x 35cm) housed in a deep litter house. The broilers continued to receive their diet for 3 days to enable them adapt to the cage environment and also to establish feed intake. They were starved for 24 hours, fed the test diets at 90% of their *ad libitum* intake to encourage total feed consumption for 4 consecutive days. Faecal droppings from each replicate were collected each day in an Aluminium tray, sun-dried, weighed and kept in a polythene bag. The 4-day collection was pooled together and subsampled for proximate analysis.

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TABLE 1: COMPOSITION OF THE BROILER FINISHER EXPERIMENTAL DIETS (%)

Feedstuffs	R30	R40	B30	B40	D30	D40
Yellow Maize	38.00	37.00	38.00	37.00	38.00	37.00
Local Fishmeal	10.00	9.00	10.00	9.00	10.00	9.00
Brewer's Dried Grain	10.00	6.00	12.00	7.00	9.00	3.00
Raw Pigeonpea	30.00	40.00	-	-	-	-
Boiled pigeonpea	-	-	30.00	40.00	-	-
Dehulled Pigeonpea	-	-	-	-	30.00	40.00
Maize Offal	7.50	3.50	5.50	2.50	8.50	6.50
Bone Meal	3.50	3.50	3.50	3.50	3.50	3.50
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						
Crude Protein (%)	19.67	20.00	19.77	20.03	19.94	20.26
Crude Fibre (%)	4.77	4.59	4.78	4.55	2.67	1.73
M.E. (MJ/Kg)	12.26	12.55	12.22	12.50	12.02	12.22
L-Lysine (%)	1.70	1.93	1.65	1.85	1.58	1.75
DL-Methionine (%)	0.50	0.51	0.49	0.49	0.47	0.46
Calcium (%)	0.76	0.79	0.75	0.77	0.61	0.58
Phosphorus (%)	0.74	0.72	0.69	0.68	0.70	0.69

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

Data Analysis

The proximate analysis of feedstuffs, diets and faecal droppings was according to the methods of A.O.A.C. (1990), while the Adiabatic oxygen bomb calorimeter was used to determine the gross energy of the diets, feedstuffs and droppings. The results were as presented in Table 2. Nutrient retention figures

were the difference between the amount consumed in the diet and that recovered from the faecal droppings. All statistical analysis on the data collected was by the analysis of variance (ANOVA) according to Steel and Torrie (1980). Duncan's New Multiple Range Test was used to identify the significantly different treatment means.

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

Ingredients	Drymatter	Crude protein	Ether extract	Crude fibre	Ash	N-Free extract
Maize (Yellow)	91.73	10.10	4.50	1.62	2.69	81.09
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
Finisher Diets						
R30	90.65	20.04	4.17	4.08	13.00	58.71
R40	90.85	20.09	3.72	4.44	14.90	56.85
B30	89.75	20.05	4.20	3.95	15.35	56.45
B40	90.90	20.15	3.68	4.33	17.55	54.29
D30	91.60	20.03	4.17	2.06	15.10	58.64
D40	90.90	20.22	3.78	1.75	15.55	58.70

PPSM = Pigeonpea seed meal.

TABLE 3: PERFORMANCE OF BROILER FINISHERS FED RAW, BOILED OR DEHULLED PIGEONPEA SEED AND MEAL DIETS

Criteria	Raw(R)	Boiled (B)	Dehulled (D)	SEM
Initial Liveweight (g/bird)	343.00	344.50	344.00	ns
Final Liveweight (g/bird)	1292.00 ^a	1447.60 ^b	1582.00 ^c	0.04 ^{***}
Feed Intake (g/bird/day)	140.54 ^b	133.37 ^a	131.61 ^a	0.02 [*]
Weight Gain (g/bird)	33.89 ^a	39.40 ^b	44.21 ^c	0.01 ^{***}
Feed Conversion Ratio (FCR)	4.15 ^c	3.39 ^b	2.98 ^a	0.02 ^{***}
Protein Intake (g/bird/day)	27.50 ^b	26.75 ^a	27.00 ^a	0.01 [*]
Protein Efficiency Ratio (PER)	1.23 ^a	1.47 ^b	1/64 ^c	0.07 ^{***}

*** Very Highly Significant (P<0.001); * Significant (P<0.05); ns = Not significant (P>0.05); SEM = Standard Error of Mean. Means in a row followed by the same superscripts are not significantly different (P>0.05).

RESULTS

Feeding trial

As shown in Table 3, broilers fed dehulled pigeonpea seed meal (PPSM) diet significantly (P<0.001) gained higher weight than those fed

boiled PPSM diets, which in turn had a significantly higher (P<0.001) weight gain than those fed raw seed diet. The final liveweight of the broilers fed raw and processed PPSM diets followed the same trend as described above. The average feed intake of broilers fed dehulled

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TABLE 4: THE EFFECT OF LEVEL OF INCLUSION OF RAW BOILED OR DEHULLED PIGEONPEA SEED MEAL DIETS ON THE PERFORMANCE OF BROILER FINISHERS

Criteria	Level		SEM
	30%	40%	
Initial Liveweight (g/bird)	343.00	344.00	Ns
Final Liveweight (g/bird)	1475.90	1405.30	0.05 ^{ns}
Feed intake (g/bird/day)	127.45 ^a	141.75 ^b	0.01 ^{***}
Weight Gain (g/bird/day)	40.46	37.90	0.01 ^{ns}
Feed Conversion Ratio (FCR)	3.15 ^a	3.74 ^b	0.02 ^{***}
Protein Intake (g/bird/day)	25.75 ^a	29.25 ^b	0.01 ^{***}
Protein Efficiency Ratio (PER)	1.57 ^b	1.30 ^a	0.08 ^{***}

*** Very Highly Significant (P<0.001); * Significant (P<0.05); ns = Not significant (P>0.05). SEM = Standard Error of Mean. Means in a row followed by the same superscripts are not significantly different (P>0.05).

TABLE 5: THE EFFECT OF INTERACTION BETWEEN PROCESSING METHOD AND LEVEL OF INCLUSION OF PROCESSED OR RAW PPSM DIETS ON THE PERFORMANCE OF BROILER FINISHERS

Criteria	Level 30%			Level 40%			SEM
	Raw	Boiled	Dehulled	Raw	Boiled	Dehulled	
Initial liveweight (g/bird)	342.00	344.00	343.00	343.00	344.50	344.00	ns
Final liveweight (g/bird)	1302.00	1475.70	1650.00	1283.00	1418.90	1510.30	0.05 ^{ns}
Feed intake (g/bird/day)	130.99	126.31	134.17	149.08	140.36	135.86	0.01 ^{ns}
Weight gain (g/bird/day)	34.29	40.42	46.68	33.57	38.37	41.65	0.01 ^{ns}
FCR	3.82	3.13	2.66	4.44	3.66	3.26	0.01 ^{ns}
Protein Intake (g/bird/day)	26.75	25.00	25.75	31.00	28.50	28.25	0.01 ^{ns}
PER	1.29	1.57	1.84	1.12	1.36	1.58	0.02 ^{ns}

ns = Not significant (P>0.05); SEM = Standard Error of mean.

and boiled seed meal diets were similar but were significantly lower (P<0.05) than the intake of broilers fed raw PPSM diets. Daily protein intake showed a similar trend with feed intake. The feed conversion ratio (FCR) of broilers fed raw PPSM diets was significantly higher (P<0.001) than that of the boiled, which

was in turn significantly higher than FCR of broilers fed dehulled PPSM diets. Broilers fed PPSM at 40% inclusion level in the diets had significantly higher (P<0.001) feed intake, FCR, and daily protein intake than those fed PPSM at 30% (Table 4); while those fed at 30% had a significantly higher (P<0.001) protein

efficiency ratio. The two levels of PPSM inclusion produced broilers with non-significant differences in final liveweight and daily weight gain. The interaction between processing method and level of inclusion did not produce significant ($P>0.05$) effects for all the measurements considered as presented in Table 5.

Nutrient utilization

In general, utilization of nutrients of dehulled PPSM diet by broilers was significantly higher ($P<0.05$) than that of raw PPSM diet, but not different from that of broilers fed the boiled PPSM diets. Also boiled PPSM diet was similar to raw diet in terms of nutrient utilization by broilers. Considering the individual nutrients, DM, EE, CF, energy and CP utilization of dehulled PPSM diet by broilers were significantly higher ($P<0.01$) than those of birds fed raw PPSM diet but similar to those of birds

that received boiled PPSM diet (Table 6). The inclusion of the processed and raw PPSM in the diets at 30% resulted in a significantly higher ($P<0.05$) crude protein utilization than at 40%; while the utilization of other nutrients were not affected. The interaction between processing method and level of inclusion produced significant results in all the nutrient utilization measurements taken. The diet containing 30% raw PPSM was similar to those containing 30% boiled and dehulled PPSM in terms of metabolizable DM, EE, CF, energy and protein retention. At 40% inclusion level, raw PPSM diet was significantly lower ($P<0.001$) than boiled diet, which was in turn significantly lower ($P<0.001$) than dehulled PPSM diet in utilizable EE, CF and energy. Dehulled PPSM diet was similar to boiled diet but significantly higher ($P<0.001$) than raw PPSM diet in DM utilization and crude protein retention by broilers.

TABLE 6: ENERGY AND NUTRIENT UTILIZATION OF PIGEONPEA SEED MEAL (PPSM) BASED DIETS BY BROILER FINISHERS

Measurements	Raw(R)	Boiled (B)	Dehulled (D)	SEM
DM	48.35 ^a	53.09 ^{ab}	58.40 ^b	2.84 [*]
CP	28.03 ^a	50.60 ^{ab}	52.49 ^b	4.58 ^{***}
EE	76.13 ^a	78.30 ^{ab}	80.46 ^b	1.49 [*]
CF	51.95 ^a	57.16 ^{ab}	67.27 ^b	2.23 ^{***}
ME	64.54 ^a	67.41 ^{ab}	71.32 ^b	2.21 [*]

*** Very Highly Significant ($P<0.001$); * Significant ($P<0.05$); SEM = Standard Error of Mean. Means in a row followed by the same superscripts are not significantly different ($P>0.05$).

TABLE 7: THE EFFECT OF LEVEL OF INCLUSION OF PPSM IN THE DIETS ON ENERGY AND NUTRIENT UTILIZATION OF BROILER FINISHERS

Measurements	Level		SEM
	30%	40%	
DM	53.08	53.48	2.37 ^{ns}
CP	50.34 ^b	37.07 ^a	4.47 [*]
EE	77.33	79.26	1.18 ^{ns}
CF	58.27	59.31	2.50 ^{ns}
ME	67.35	68.16	1.87 ^{ns}

*Significant ($P<0.05$); ns = Not significant ($P>0.05$); SEM = Standard Error of Mean. Means in a row followed by the same superscripts are not significantly different ($P>0.05$).

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TABLE 8: THE EFFECT OF INTERACTION BETWEEN PROCESSING METHOD AND LEVEL OF INCLUSION OF PPSM IN THE DIETS ON ENERGY AND NUTRIENT UTILIZATION OF BROILER FINISHERS

Measurement	Level						SEM
	30%			40%			
	Raw	Boiled	Dehulled	Raw	Boiled	Dehulled	
DM	55.62 ^{bc}	51.93 ^{ab}	51.68 ^{ab}	41.08 ^a	54.24 ^{bc}	65.11 ^c	2.61
CP	48.75 ^b	53.54 ^b	48.74 ^b	07.31 ^a	47.66 ^b	56.23 ^b	3.89 ^{***}
EE	78.92 ^{ab}	77.11 ^{ab}	75.95 ^{ab}	73.33 ^a	79.50 ^b	84.96 ^c	1.18 ^{***}
CF	56.38 ^{ab}	56.83 ^{ab}	61.60 ^b	47.51 ^a	57.49 ^a	72.93 ^c	2.35 [*]
ME	69.56 ^{ab}	66.03 ^{ab}	66.46 ^{ab}	59.52 ^a	68.80 ^{ab}	76.18 ^c	2.13 [*]

*** Very Highly Significant (P<0.001); * Significant (P<0.05); SEM = Standard Error of Mean. Means in a column followed by the same letters are not significantly different (P>0.05).

DISCUSSION

Dehulled pigeonpea seed diets improved the daily weight gain of broiler finishers which resulted in an improvement in the final liveweight of the broilers. This improvement over boiled and raw PPSM diets can be attributed to an increase in protein utilization, net protein efficiency and lowering of crude fibre level resulting from dehulling of boiled pigeonpea seeds as has been reported by Salunkhe *et al.* (1985). The higher feed intake of broilers fed raw PPSM diets did not result in higher weight gain suggesting that the broilers increased feed consumption to meet their nutrient requirement from a diet that contained antinutritional substances. It equally suggests that the raw pigeonpea seedcoat contains the antinutritional substances which make nutrients of raw PPSM diets not as available as those in the boiled or dehulled seed meal diets. The difference in performance between broilers fed boiled and dehulled PPSM diets may have been due to higher intake of fibre from the boiled PPSM diets since about 90% of the curde fibre of pigeonpea seeds is contained in the seedcoat (Salunkhe *et al.*, 1985).

Increased level of inclusion of the raw, boiled or dehulled PPSM from 30 to 40% in the diets depressed growth rate, increased feed intake and resulted in poor feed conversion efficiency of the broilers. Protein efficiency ratio of the

broilers was also adversely affected. This is in agreement with the report of Grimand (1988) and Ologhobo (1992) that the inclusion of pigeonpea seeds above 25% in a poultry diet depressed growth rate and feed efficiency of broilers, but differed from the observations of Amaefule and Obioha (1998) that broilers finishers can perform well when given up to 50% pigeonpea seed meal in their diet. It has been observed from this study that broiler finishers can tolerate raw PPSM up to 30% of the whole ration, but it should be expected that growth rate will be depressed when compared with broilers fed processed PPSM diet. Although the interaction between processing method and inclusion level produced non significant effect in all measurements considered, it was observed that dehulled PPSM at 30% (D30) diet was superior to the rest of the diets having produced broilers with numerically higher liveweight, weight gain, PER and lower feed intake, FCR and protein intake than others.

Processing of pigeonpea seeds improved nutrient utilization of the diets by broilers over the raw PPSM diet. These could be attributed to the elimination of antinutritional substances in the PPSM as a result of processing. These results are in agreement with the reports of Salunkhe *et al.* (1985) and ICRISAT (1988, 1991). The reduction in protein retention with

an increase in percent inclusion level of PPSM in the diet from 30 to 40% could be as a result of loss of protein, iron and other dietary nutrients due to processing (ICRISAT, 1991) and due to higher levels of anti-nutritional substances in the diet containing 40% raw PPSM. Apart from protein retention, level of inclusion of PPSM in the diets did not affect any other measurement of nutrient utilization suggesting that it is not necessary to increase the level of PPSM in broiler finisher diets up to 40%. The poorer performance of broiler finishers fed raw PPSM diets can therefore be ascribed to the presence of anti-nutritional substances in the raw seeds.

CONCLUSION

It has been shown from this study that dehulling of boiled pigeonpea seeds is a better processing method than boiling alone and that the inclusion level of the meal should not exceed 30% of the whole broiler finisher ration. Processing of pigeonpea seeds also enhanced nutrient utilization. If raw pigeonpea seed meal should be used in broiler finisher rations, its inclusion level should not exceed 30% of the whole ration, with the expectation of a likely depression in broiler performance.

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