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Performance of Starter Broilers Fed Raw Pigeon Pea [*Cajanus cajan* (L.) Millsp.] Seed Meal Diets Supplemented with Lysine and or Methionine

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Abstract: Performance of starter broilers fed raw Pigeon Pea [*Cajanus cajan* (L.) Millsp.] Seed Meal (PSM) diets supplemented with lysine and or methionine was determined with 270 unsexed broilers. The experimental design was 2 x 4 factorial in a Completely Randomized Design (CRD), with each dietary treatment replicated three times and 10 broilers per replicate. The factors were inclusion level of raw PSM (30 and 40%) and amino acid supplementation (no supplementation, lysine, methionine and lysine + methionine). There was a conventional maize-soybean diet as positive control while raw PSM without supplementation was the negative control. Lysine and methionine supplementation were 0.10 and 0.25%, respectively. Performance criteria measured were weight gain, feed intake, Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and live weight at 4th week. Results showed that broilers fed methionine or lysine + methionine supplemented diets had significantly ($p<0.05$) higher live weight, live weight gain, feed intake and significantly ($p<0.05$) lower protein intake than broilers fed diet supplemented with lysine. Amino acid supplementation significantly ($p<0.05$) affected only live weight and daily weight gain of broilers. The diet of 40% raw PSM significantly ($p<0.05$) increased cost per kg feed and daily feed cost more than 30% PSM diet. It was concluded that starter broilers could be fed up to 40% raw Pigeon Pea Seed Meal (PSM) diet without adverse effect on performance of starter birds. However, the diet of 30% PSM should be supplemented with methionine and that of 40% with lysine + methionine.

Key words: Lysine, methionine, performance, raw pigeon pea seed meal, starter broilers

INTRODUCTION

One of the major problems of poultry producers is the high cost of feed, which arises mainly from the competition between man and poultry for conventional feedstuffs like maize, groundnut cake, soybean meal and fish meal (Amaefule and Obioha, 2005).

Raw pigeon pea seeds like other legume seeds contain Anti-Nutritional Factors (ANFs) such as protease (trypsin and chymotrypsin) inhibitors and haemagglutinins (Igene, 1999; Udedibie and Carlini, 2002) that increase methionine deficiency and inhibit the enzymatic action of trypsin. These ANFs inhibit the activities of digestive enzymes thereby causing digestive losses (Igene and Ekundayo, 2010) and exact a negative impact on the nutritional quality of the protein that could decrease the performance of poultry fed these ingredients (Olomu, 1995).

Presently, emphasis is being placed on processing methods of raw pigeon pea seeds either by boiling (Amaefule and Obioha, 1998; Amaefule and Onwudike, 2000; Akintunde *et al*., 2010; Yisa *et al*., 2010), boiling and dehulling (Amaefule and Obioha, 2001), toasting (Amaefule and Onwudike, 2000; Amaefule *et al*., 2003; Amaefule and Nwagbara 2004), roasting (Akanji *et al*., 2010), soaking (Amaefule and Onwudike, 2000; Amaefule *et al*., 2003; Akintunde *et al*., 2010) or supplementation with enzyme (Akintunde *et al*., 2010) as a means of eliminating these ANFs.

But these processing methods have been identified to be cumbersome and expensive, consequently limiting their use by farmers and feed millers. This calls for nutritional strategies that could compensate or ameliorate the adverse effects of ANFs and at the same time encourage poultry farmers and feed millers to adopt pigeon pea seed meal as energy and protein source. The objective of this study, therefore, was to determine the performance of starter broilers fed raw pigeon pea [*Cajanus cajan* (L.) Millsp.] seed meal diets supplemented with lysine and or methionine.

MATERIALS AND METHODS

The study was conducted at the Teaching and Research Poultry Unit, Michael Okpara University of Agriculture Umudike Farm. Umudike is located at 05° 29´ North and 07° 33´ East. It has maximum and minimum daily temperature of 27-36°C and 20-26°C, respectively and relative humidity of about 57-91%.

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Birds and their management: Two hundred and seventy day-old Marshal Broilers procured from Obasanjo Farms Ota, Nigeria were used for the experiment. The birds were brooded and reared in deep litter (wood shavings) pens. Experimental feed and clean water were supplied *ad libitum*. Heat was supplied using kerosene stoves placed under galvanized metal hovers while electric bulbs were used to provide artificial light at night. The broilers had 17 h of light during the first 7 days of life and 12 h during the remaining 21 days. Birds were vaccinated against New castle disease at day old (intra ocular) and 4th week (*Lasota*) and *Gumboro* disease vaccine at 9th and 21st days of life.

Experimental diets: Raw pigeon pea seeds (Brown coat coloured) were milled to pass through a 2 mm sieve and used for experimental diet formulation. Synthetic lysine (L-Lysine Monohydrochloride, L-Lysine 78.80%, moisture 1.5%; ADM Specialty Ingredient Europe [BV] Netherlands) and methionine (Rhodimet^{TM} NP 99, max. 0.3% moisture, DLM 99%; ADISSEO) were used to supplement the Pigeon Pea Seed Meal (PSM) diets.

There were nine experimental starter broiler (isoenergetic and isonitrogenous) diets with eight containing raw Pigeon Pea Seed Meal (PSM) included at 30 and 40% of the whole diet. The positive control diet had no raw PSM while the negative control diet had no synthetic lysine and or methionine supplementation as shown in Table 1.

Table 1: Percentage composition of starter broiler diets supplemented with lysine and or methionine

Feedstuffs	Positive control	30% PSM^{a,b,c,d}	40% PSM^{a,b,c,d}
Raw PSM	0.00	30.00	40.00
White maize	45.85	27.00	20.70
Fish meal	4.00	4.00	4.00
Soybean meal	28.65	15.50	11.80
Maize gluten meal	18.00	20.00	20.00
Bone meal	3.00	3.00	3.00
Vitamin premix*	0.25	0.25	0.25
NaCl	0.25	0.25	0.25
Total (%)	100.00	100.00	100.00
Calculated composition			
CP (%)	21.92	21.92	21.92
ME (MJkg^{-1})	14.29	14.10	14.03
ME: CP ratio	134.70	132.87	132.25

^{a,b,c,d}No supplementation, lysine, methionine, lysine + methionine supplementation, respectively. *Composition per 2.5 kg: Vitamin A 10,000,000 IU, Vit D 2,000,000 IU, Vit. E 20,000 IU, Vit. K 2250 mg, Thiamin 1750 mg, Riboflavin 5,000 mg, Pyridoxine 2750 mg, Niacin 27500 mg, Vit. B_{12} 15 mg, Pantothenic acid 7500 mg, Folic acid 7500 mg, Biotin 50 mg, Choline chloride 400 g, Antioxidant 125 g, Manganese 80 g, Zinc 50 g, Iron 20 g, Copper 5 g, Iodine 1.2 g, Selenium 200 mg, Cobalt 200 mg. PSM = Pigeon Pea Seed Meal

Experimental design and data collection: The experimental design was a 2 x 4 factorial in completely randomized design with the model:

$$\gamma_{ijk} = \mu + L_i + A_j + (LA)_{ij} + e_{ijk}$$

Where:

γ_{ijk} = The kth observation on the i$_{th}$ treatment
μ = Overall mean
L_i = Effect of inclusion level of raw pigeon pea in the diets
A_j = Effect of amino acid supplementation
$(AL)_{ij}$ = The effect of interaction between inclusion level of raw PSM and amino acid supplementation
e_{ijk} = Random error

Each dietary treatment had three replicates and 10 broilers per replicate.

Performance: The initial live weight of birds was taken at the beginning of the experiment and subsequent weighing was done weekly on individual basis and in the morning hours (7-8 am). Weight gain was obtained by subtracting initial live weight from the live weight at 4th week. Data on feed intake were also determined by difference between the quantity offered and quantity left over each day. Feed conversion ratio was determined by dividing feed intake by weight gain. Record of mortality was also kept.

Chemical and data analyses: The proximate composition of some of the ingredients and diets were determined according to the methods of AOAC (1990). Statistical data analyses were done using Analysis of Variance (ANOVA) according to Steel and Torrie (1980) while Duncan's Multiple Range Test (Duncan, 1955) was used to separate treatment means that were significantly different from each other.

RESULTS AND DISCUSSION

The proximate composition of the raw Pigeon Pea Seed Meal (PSM), soybean, fishmeal and maize used in diets is presented in Table 2. The crude protein content of raw pigeon pea seed was 22.48%, while that of maize was 10.64%. The CF content of raw PSM (5.72%) compared favourably with that of soybean (4.18%).

Table 2: Proximate composition of raw pigeon pea seed meal, soybean meal, fish meal and maize used in diets (% DM basis)

Composition (%)	Raw PSM	Fishmeal	Soybean	Maize
Dry matter	90.65	90.10	90.42	89.76
Crude protein	22.48	60.20	34.02	10.64
Ether extract	2.22	2.36	14.23	3.42
Crude fiber	5.72	1.59	4.18	2.06
Crude ash	4.44	8.02	5.39	3.86
Nitrogen free extract	55.79	17.93	32.60	69.78

PSM = Pigeon Pea Seed Meal

Table 3: Proximate composition of starter broiler diets supplemented with lysine and or methionine (% DM basis)

PSM Incl. level	Amino acid suppl.	Dry matter (%)	Crude protein (%)	Ether extract (%)	Crude fibre (%)	Crude ash (%)	NFE (%)
	Positive control	90.26	18.61	1.95	9.73	10.74	49.22
	No amino acid	89.26	21.74	1.52	9.07	9.14	47.79
30%	Lysine	90.26	23.11	2.87	8.27	11.42	44.60
	Methionine	88.72	21.12	2.64	8.20	9.53	47.23
	Lys + Met	89.30	21.91	1.57	8.20	10.06	47.51
	No amino acid	88.14	20.04	2.10	9.91	8.27	47.82
40%	Lysine	89.26	19.42	1.93	10.00	10.05	47.86
	Methionine	89.74	19.01	2.91	8.00	9.85	49.97
	Lys + Met	88.30	19.96	2.42	9.04	10.31	46.57

Incl. = Inclusion; PSM = Pigeon Pea Seed Meal; Lys = Lysine; Met = Methionine; NFE = Nitrogen Free Extract

Table 4: The effect of inclusion level of raw pigeon pea seed meal on the performance of starter broilers

Parameters	+ve Control	30%	40%	SEM
Initial live weight (g/b)	74.33	74.25	76.42	0.60
Final live weight (g/b)	747.33^{a}	655.17^{b}	679.42^{b}	12.23
Daily weight gain (g/b)	24.04^{a}	20.75^{b}	21.54^{b}	0.44
Daily feed intake (g/b)	59.65	59.10	59.86	0.42
Feed Conversion Ratio (FCR)	2.49^{b}	2.86^{a}	2.79^{a}	0.06
Daily protein intake (g/b)	13.07	12.96	13.11	0.09
Protein Efficiency Ratio (PER)	1.84^{a}	1.60^{b}	1.64^{b}	0.42
Mortality (%)	0.00	2.50	0.00	1.28

^{a,b}Means within the same row with different superscripts are significantly ($p<0.05$) different. SEM = Standard Error of Mean

The proximate composition of starter broiler diets (Table 3) showed that the diets of raw PSM had higher CP content than the control diet (0% PSM). Results also showed that the diets that contained 40% raw PSM had lower CP content than those of 30% raw PSM. The CP contents of diets supplemented with lysine were higher than those supplemented with methionine, while the diets supplemented with lysine + methionine had higher CP content than those with only methionine.

Performance: There were no significant ($p>0.05$) differences among starter broilers fed 30 or 40% raw PSM diets in all performance parameters measured (Table 4). Broilers fed the control diet that had 0% raw PSM had significantly ($p<0.05$) higher final live weight, daily weight gain, Protein Efficiency Ratio (PER) and significantly ($p<0.05$) lower feed conversion ratio than those fed 30 or 40% PSM diets.

There were no significant ($p>0.05$) differences among broilers fed PSM diets supplemented with methionine or lysine + methionine in all the parameters measured. Rather broilers fed these two diets had significantly ($p<0.05$) higher live weight and average daily weight gain, daily feed intake and significantly ($p<0.05$) lower protein intake than broilers fed diets supplemented with lysine. Live weight, daily weight gain, Feed Conversion Ratio (FCR) and protein efficiency ratio also showed no significant ($p>0.05$) differences among broilers fed diet supplemented with lysine and the un-supplemented. Broilers fed the control diet (0% PSM diet) had significantly ($p<0.05$) higher performance indices than those fed PSM diets except feed and protein intakes as shown in Table 5.

The interaction of inclusion level of raw Pigeon Pea Seed Meal (PSM) and amino acid supplementation on the performance of starter broilers produced significant ($p<0.05$) differences only in live weight and daily weight gain (Table 6). The diet of 40% PSM supplemented with lysine + methionine produced starter broilers of similar daily weight gain and live weight with those fed 30 or 40% PSM diet supplemented with methionine. The un-supplemented 40% PSM diet gave the lowest ($p<0.05$) starter broiler weight gain and consequently lowest live weight compared to other 30 or 40% PSM diets.

Feed cost: The effect of inclusion level of raw PSM in the diets on the feed cost of starter broilers is shown in Table 7. It was observed that 40% raw PSM diet significantly ($p<0.05$) increased the cost per kg feed and daily feed cost more than 30% PSM diet, leaving feed cost per kg weight gain unaffected. The feed costs of starter broilers fed positive control (0% PSM) diet were significantly ($p<0.05$) higher than that of broilers fed raw PSM at 30% and 40% PSM diets, except feed cost per kg weight gain.

Lysine supplementation significantly ($p<0.05$) reduced the cost per kg of feed more than methionine, lysine + methionine or no amino acid supplementation, while the positive control diet gave the highest cost per kg of feed. The daily and total feed cost of broilers fed methionine, lysine + methionine supplemented and negative (un-supplemented raw PSM) diets were similar, significantly ($p<0.05$) higher than those of broilers fed lysine supplemented diet but lower than those of starter broilers fed positive control diet. The PSM diet with no amino acid supplementation resulted in a significantly ($p<0.05$) higher feed cost per kg weight gain than only the control diet.

Table 5: The effect of amino acid supplementation on the performance of starter broilers fed raw pigeon pea seed meal diets

Parameters	No amino acid	Lysine	Met	Lys + Met	SEM
Initial live weight (g)	75.17	74.67	75.17	76.33	1.03
Final live weight (g)	653.33^{ab}	629.67^{b}	692.00^{a}	694.17^{a}	14.35
Daily weight gain (g)	20.65^{ab}	19.82^{b}	22.03^{a}	22.07^{a}	0.50
Daily feed intake (g)	60.03^{a}	56.59^{b}	60.69^{a}	60.61^{a}	0.47
Feed conversion ratio	2.92	2.87	2.76	2.76	0.06
Daily protein intake (g)	13.16^{a}	12.41^{b}	13.30^{a}	13.26^{a}	0.11
Protein efficiency ratio	1.57	1.60	1.66	1.66	0.42
Mortality (%)	1.67	1.67	0.00	1.67	1.36

^{a,b,c}Means on the same row followed by different superscripts are significantly ($p<0.05$) different. SEM = Standard Error of Mean. Lys and Met = Lysine and Methionine, respectively; AA = Amino Acid

Table 6: The effect of inclusion levels of raw pigeon pea seed meal and amino acid supplementation on the performance of starter broilers

Parameters	IL	No AA	Lys	Met	Lys + Met	Mean
Initial live weight (g)	30%	74.33	74.66	71.50	75.33	74.25
	40%	76.00	74.67	77.67	77.33	76.42
	Mean	75.17	74.67	75.17	76.33	
	SEM	IL = 0.60;	AA Suppl. = 1.03;	IL x AA Suppl. = 1.36		
Final live weight (g)	30%	677.33^{bc}	678.33^{bc}	700.00^{ab}	681.67^{bc}	655.17
	40%	629.00^{d}	681.00^{bc}	700.67^{ab}	706.67^{a}	679.42
	Mean	653.33^{ab}	629.67^{b}	692.00^{a}	694.17^{a}	
	SEM	IL = 12.23;	AA Suppl. = 14.35;	IL x AA Suppl. = 8.35		
Daily weight gain (g)	30%	21.54^{bc}	17.99^{bc}	21.81^{ab}	21.66^{bc}	20.75
	40%	19.76^{d}	21.65^{bc}	22.25^{ab}	22.48^{a}	21.54
	Mean	20.65^{ab}	19.82^{b}	22.03^{a}	22.07^{a}	
	SEM	IL = 0.44;	AA Suppl. = 0.50;	IL x AA Suppl. = 0.66		
Daily feed intake (g)	30%	60.04	53.88	60.97	61.52	59.10
	40%	60.02	59.30	60.41	59.70	59.86
	Mean	60.03^{a}	56.59^{b}	60.69^{a}	60.61^{a}	
	SEM	IL = 0.42;	AA Suppl. = 0.47;	IL x AA Suppl. = 0.62		
Feed conversion ratio	30%	2.79	3.00	2.80	2.85	2.86
	40%	3.04	2.74	2.71	2.67	2.79
	Mean	2.92	2.87	2.76	2.76	
	SEM	IL = 0.06;	AA Suppl. = 0.09;	IL x AA Suppl. = 0.09		
Daily protein intake (g)	30%	13.16	11.81	13.36	13.48	12.96
	40%	13.16	13.00	13.24	13.03	13.11
	Mean	13.16^{a}	12.41^{b}	13.30^{a}	13.26^{a}	
	SEM	IL = 0.09;	AA Suppl. = 0.11;	IL x AA Suppl. = 0.14		
Protein efficiency ratio	30%	1.64	1.53	1.63	1.60	1.60
	40%	1.50	1.67	1.68	1.72	1.64
	Mean	1.57	1.60	1.66	1.66	
	SEM	IL = 0.42;	AA Suppl. = 0.42;	IL x AA Suppl. = 0.06		
Mortality (%)	30%	3.33	3.33	0.00	3.33	2.50
	40%	0.00	0.00	0.00	0.00	0.00
	Mean	1.67	1.67	0.00	1.67	
	SEM	IL = 1.28;	AA Suppl. = 1.36;	IL x AA Suppl. = 1.93		

^{a,b,c}Means on the same row followed by different superscripts are significantly ($p<0.05$) different. SEM = Standard Error of Mean. Lys and Met = Lysine and methionine, respectively; AA = Amino acid. IL = Level of PSM, AA Suppl. = Amino acid Supplementation, IL x AA Suppl. = Level and Amino Acid Supplementation Interaction

Table 7: The effect of inclusion levels of raw pigeon pea seed meal in the diets on feed cost of starter broilers

Parameters	+ve Control	30%	40%	SEM
Feed cost/kg (Naira)	75.71^{a}	67.02^{c}	73.19^{b}	0.00
Total feed intake (kg)	1.68	1.66	1.68	0.01
Total feed cost (Naira)	127.19^{a}	110.95^{c}	122.71^{b}	0.89
Daily feed cost (Naira)	4.54^{a}	3.96^{c}	4.38^{b}	0.03
Total weight gain (kg)	0.67^{a}	0.58^{b}	0.60^{b}	0.01
Feed cost/kg weight gain (Naira)	185.23^{b}	191.58^{ab}	204.37^{a}	4.21

^{a,b,c}Means on the same row followed by different superscripts are significantly ($p<0.05$) different. SEM = Standard Error of Mean

Table 8: The effect of amino acid supplementation on feed cost of starter broilers fed raw pigeon pea seed meal

Parameters	NAA	Lys	Met	Lys + Met	SEM
Feed cost/kg (Naira)	70.93[a]	69.28[d]	70.13[b]	70.08[c]	0.00
Total feed intake (kg)	1.68[a]	1.59[b]	1.70[a]	1.70[a]	0.01
Total feed cost (Naira)	119.15[a]	110.04[b]	119.08[a]	119.05[a]	1.02
Daily feed cost (Naira)	4.25[a]	3.93[b]	4.26[a]	4.25[a]	0.04
Total weight gain (kg)	0.58[ab]	0.56[b]	0.62[a]	0.62[a]	0.01
Cost/kg weight gain (Naira)	207.25	198.44	193.18	193.03	4.83

[a,b,c]Means on the same row followed by different superscripts are significantly ($p<0.05$) different. SEM = Standard Error of Mean. Lys and Met = Lysine and Methionine, respectively. NAA = No Amino Acid

Table 9: The effect of inclusion level of raw pigeon pea seed meal and amino acid supplementation on the feed cost of starter broilers

Parameters		NAA	Lys	Met	Lys + Met	Mean
Feed cost/kg (Naira)	30%	67.84[e]	66.20[h]	67.04[f]	67.00[g]	67.02
	40%	74.01[a]	72.36[d]	73.21[b]	73.16[c]	73.19
	Mean	70.93[a]	69.28[d]	70.13[b]	70.08[c]	
	SEM	IL = 0.00;	AA Suppl. = 0.00;	IL x AA Suppl. = 0.00		
Total feed intake (kg)	30%	1.68[ab]	1.51[c]	1.70[ab]	1.73[a]	1.66
	40%	1.68[ab]	1.66[ab]	1.69[ab]	1.67[ab]	1.68
	Mean	1.68[a]	1.59[b]	1.70[a]	1.70[a]	
	SEM	IL = 0.01;	AA Suppl. = 0.01;	IL x AA Suppl. = 0.01		
Total feed cost (Naira)	30%	113.97[d]	99.96[e]	114.19[d]	115.69[d]	110.95
	40%	124.33[ab]	120.12[c]	123.97[abc]	122.42[bc]	122.71
	Mean	119.15[a]	110.04[b]	119.08[a]	119.05[a]	
	SEM	IL = 0.89;	AA Suppl. = 1.02;	IL x AA Suppl. = 1.32		
Daily feed cost (Naira)	30%	4.07[b]	3.57[c]	4.08[b]	4.13[b]	3.96
	40%	4.44[a]	4.29[ab]	4.43[a]	4.37[ab]	4.38
	Mean	4.25[a]	3.93[b]	4.26[a]	4.25[a]	
	SEM	IL = 0.03;	AA Suppl. = 0.04;	IL x AA Suppl. = 0.05		
Total weight gain (kg)	30%	0.60[bc]	0.50[cd]	0.61[ab]	0.61[ab]	0.58
	40%	0.55[c]	0.61[ab]	0.62[a]	0.63[a]	0.60
	Mean	0.58[ab]	0.56[b]	0.62[a]	0.62[a]	
	SEM	IL = 0.01;	AA Suppl. = 0.01;	IL x AA Suppl. = 0.02		
Cost/kg weight gain (Naira)	30%	189.50[b]	198.38[b]	187.71[b]	190.73[b]	191.58
	40%	224.99[a]	198.51[b]	198.64[b]	195.34[b]	204.37
	Mean	207.25[a]	198.45[ab]	193.18[ab]	193.04[ab]	
	SEM	IL = 4.21;	AA Suppl. = 4.83;	IL x AA Suppl. = 5.88		

[a,b,c]Means on the same row followed by different superscripts are significantly ($p<0.05$) different. SEM = Standard Error of Mean. Lys and Met = Lysine and Methionine, respectively. NAA = No Amino Acid. L= Level of PSM, AA Suppl. = Amino Acid Supplementation, L x AA Suppl. = Level and Amino Acid Supplementation Interaction

With or without amino acid supplementation, 40% PSM significantly increased the feed cost per kg and daily feed cost as shown in Table 9. Amino acid supplementation, starting from lysine + methionine, methionine and lysine decreased the feed cost per kg with 40% PSM while with 30% PSM, lysine, methionine and lysine + methionine supplementation increased feed cost per kg relative to the un-supplemented PSM diet. Also at 30% PSM inclusion level, lysine supplementation significantly ($p<0.05$) reduced total feed cost more than methionine, lysine + methionine or un-supplemented PSM diet. It could be observed that the control (0% PSM) diet had significantly ($p<0.05$) higher cost per kg of diet and total feed cost than 30% PSM diets supplemented or un-supplemented. The diet of 40% PSM not supplemented with any amino acid significantly ($p<0.05$) increased the cost per kg weight gain of the starter broilers more than any other diet.

Proximate composition: The proximate composition of raw pigeon pea seed meal used in this study is in line with earlier reports of Salunkhe *et al.* (1985) and Amaefule *et al.* (2003). The crude protein content fell within the range (17.9-30%) reported by Salunkhe *et al.* (1985), Obioha (1992), Amaefule *et al.* (2003) and Amaefule and Obioha (2005). These authors had reported that the chemical composition of pigeon pea seeds depends on geographical location, cultivar and growth conditions. The differences in the crude protein content of the starter broiler diets (Table 2) could be due to the supplementation of the diets with lysine and/ or methionine as the diets were formulated to be isoenergetic and isonitrogenous.

Performance of starter broilers: The decrease in daily weight gain, live weight (at 4th week) and protein efficiency ratio of the starter broilers fed raw Pigeon Pea

Seed Meal (PSM) diets compared to those fed positive control diet could be attributed to the presence of Anti-Nutritional Factors (ANFs), especially trypsin inhibitor contained in the raw seeds. Ologhobo (1992), D'Mello (1995) and Pezzato *et al*. (1997) had reported that raw PSM diets depressed broiler performance over soybean meal diets. Also it could be observed that 40% raw PSM diet could support the growth of young broilers without serious adverse effect, supporting an earlier report of Amaefule *et al*. (2003) that raw pigeon pea seeds may not contain as much anti-nutritional substances and in lethal doses as most tropical legume seeds. This starter broiler performance is an improvement on earlier reports (Salunkhe *et al*., 1985; Ologhobo, 1992) that raw pigeon pea seed meal should not exceed 30% of the entire diet.

The impressive performance of starter broilers fed lysine + methionine or methionine supplemented raw PSM diets was an indication that methionine could have denoted sulphur needed for detoxification of ANFs contained in the raw PSM diets. This is considered so because lysine supplementation alone could not elicit the same performance response as methionine did. Although the un-supplemented diet gave a worse starter broiler performance than methionine and lysine + methionine supplemented diets, the broilers compared favourably with those fed lysine supplemented diet but with a higher feed and protein consumption, suggesting that the un-supplemented diet was adequate in lysine that is the critical amino acid required for muscle tissue formation.

The effect of interaction between level of raw PSM inclusion and amino acid supplementation pointed that 30% raw PSM diet should be supplemented with methionine alone while with an increase to 40%, the raw PSM diet should be supplemented with lysine + methionine for better starter broiler performance to be achieved.

Feed cost: The reduction in feed cost per kg by raw PSM diets relative to the control diet could be attributed to cheaper pigeon pea seed (₦56.00/kg) compared to maize (₦47.06/kg) and soybean meal (₦70.00/kg) it replaced; while the higher cost of 40% PSM diet over 30% suggests that the optimum level of PSM inclusion in starter broiler diet should be 30%. However, the reduced cost per kg of diet did not translate to lower cost per kg live weight gain of broilers.

Raw PSM diet supplemented with lysine had the lowest cost per kg due to the cheaper price of lysine (₦850.00/kg) compared to methionine (₦950/kg), which also gave a lower daily feed cost relative to methionine or lysine + methionine supplemented diets. Although the reduction in cost per kg and daily feed cost of raising broilers are desirable economic indices, it could not translate to reduction in cost per kg live weight gain of the broilers. The numerical values indicate that it is cheaper to supplement raw PSM diets with either lysine and or methionine than no supplementation at all or feeding 0% PSM diet. However, the cost per kg live weight gain obtained in this study were lower than those (232.65-259.74 Naira) reported by Akintunde *et al*. (2010) with broiler starter chicks fed soaked + fermented + allzyme, 35 or 50 min boiled pigeon pea seed meal each included as 30% of the diet.

Considering the effect of interaction between raw PSM inclusion level and amino acid supplementation on feed cost of starter broilers, it was cheapest to include raw PSM as 30% of the diet and supplement with lysine in terms of cost per kg feed and daily feed cost but when the cost per kg live weight gain and the general performance of the starter broilers is of interest, the suggestion would be to include 40% PSM in the diet and supplement with lysine + methionine.

Conclusion: Starter broilers could be fed up to 40% raw Pigeon Pea Seed Meal (PSM) diets without adverse effect on performance and feed cost of weight gain of the birds. However, the diet of 30% PSM should be supplemented with methionine and that of 40% with lysine + methionine.

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