The effect of feeding graded levels of raw pigeon pea seed (*Cajanus cajan*) meal on the performance, nutrient retention and carcass characteristics of weaner rabbits

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Abstract

An 8-week study was conducted to determine the effect of feeding graded levels of raw pigeon pea seed (*Cajanus cajan*) meal (PSM) on the performance, nutrient retention and carcass characteristics of weaner rabbits 24 rabbits of initial average liveweight of 600-700g in a completely randomized design (CRD). Four experimental diets were formulated such that diet 1 (control) was maize-soybean meal based with 0% PSM. Treatments 2, 3 and 4 had 10, 20 and 30% PSM, respectively replacing part of maize and soybean in the diets. Results showed that there were no significant differences ($P>0.05$) between the rabbits fed the raw and control diets in all the performance measurements considered. The diet of 30% PSM significantly reduced ($P<0.05$) feed cost of weight gain and significantly improved ($P<0.05$) dry matter (DM) and crude protein (CP) digestibility more than other diets. It was concluded that raw PSM could be included up to 30%, replacing 28.57 and 71.43% of maize and soybean meal, respectively in the rabbits diets without any adverse effect on performance.

Key words: Rabbit, performance, nutrient, pigeonpea seeds, digestibility.

Introduction

The need to improve rabbit production in Nigeria for increased animal protein supply is no longer in doubt especially given the high cost of chicken, pork and beef. Rabbits have been identified to be able to thrive on non-conventional feedstuffs (Omole, 1988) and forages (Aduku and Ohukosi, 1990). Their utilization of large forage diets has been shown to be limited due to the fact that fibre digestion is post-gastric in the caecum (Davidson and Spreadbury, 1975). Although the rabbits' requirement for crude fibre is very high, about 14 – 25% (Adegbola *et al.*, 1985) when compared

with other monogastric animals, it has been reported that the feeding of concentrate feed especially pelleted diet increases feed consumption and crude fibre digestion (Butcher *et al.*, 1981).

Pigeonpea seeds are produced in large quantities in Nigeria, have very low human food preference and no industrial use as at now (Amaefule and Obioha, 2001). The seeds contain some antinutritional substances (ANFs) especially protease inhibitors (D'Mello, 1995). Pigeonpea seed meal (PSM) has proved to be a satisfactory protein ingredient in poultry diets constituting up

to 30% of the whole ration (Tangtaweewipat and Elliott, 1989; Amaefule and Obioha, 1998; Amaefule and Onwudike, 2000; Amaefule and Obioha, 2001). But scientific information on the nutritional implication of feeding PSM to rabbits is scarce. Such information and data are necessary to increase the utilization of the seeds particularly when it has been observed that humans in most parts of Nigeria do not consume the seeds. There is also the likelihood of increasing the number of available protein ingredients for rabbit feeding. The objective of this study was therefore to determine the effect of feeding graded levels of raw pigeonpea seed meal on the performance, nutrient digestibility carcass and organ characteristics of weaner rabbits.

Materials and Methods

The study was conducted with twenty-four 7-week old hybrid weaner rabbits (New Zealand white x Chinchella) that had initial liveweight ranging from 641.66 to 725.00g (average 679.16g). They were of both sexes and randomly assigned to 4 treatment diets. Each treatment was replicated 3 times with each replicate having 2 rabbits. The experimental design was completely randomized design (CRD).

The rabbits were housed in a 3-tier rabbit cage, which had a total of 15 hutches at 5 hutches per tier. The cage was located inside a rabbit building equipped with vents and windows for proper ventilation. Each hutch, which accommodated 2 rabbits, was partitioned with wooden plank and wire-mesh, a wooden tray for collection of faecal droppings and fitted with Aluminum drinkers and feeders (15cm x 10cm x 10cm).

Diets

Raw pigeonpea seeds were cleaned of dust, milled and used in compounding the experimental diets as presented in Table 1. Treatment 1 (control) was maize-soybean based with 0% PSM while diets 2, 3 and 4 contained 10, 20 and 30% raw PSM respectively which partially replaced maize and soybean meal in the diets. The rabbits were also daily fed equal

quantities of fresh *Centrocema pubescens* as forage supplement to the diets.

Data Collection

The study lasted for 8 weeks (56 days) during which the rabbits were fed twice daily in the morning (7.30 – 8.00am) and in the afternoon (2.00 – 3.00pm). The quantity of feed that was offered to the rabbits daily and leftover, when available was weighed with a 20kg capacity Top-loading scale to determine daily feed intake. The rabbits were weighed at the beginning of the experimental feeding and subsequently on a weekly basis. Parameters measured were weight gain, feed intake and final mature weight. Feed conversion ratio (FCR) was calculated as feed: gain ratio, protein intake from feed intake values and protein efficiency ratio (PER) as weight gain divided by protein intake. Feed cost per kg weight gain was calculated as feed cost per kg X FCR.

Nutrient Digestibility

At the end of the feeding trial, one rabbit per replicate was put in a metabolism cage and fed *ad libitum* for 3 days during which period the rabbits got used to the cage environment. They were fasted for 24 hours and thereafter fed 90% of their *ad libitum* intake for 3 days. Faeces arising from the 3 day feeding plus that from another 24-hour fasting period were collected. This was to ensure total collection of faecal droppings associated with the feed consumed. Faecal droppings collected each day were oven-dried at 60°C, put in a plastic bag and stored in a refrigerator. At the end, all droppings collected from each replicate were pooled together and samples taken for determination of proximate composition.

Carcass and Organ Evaluation

One rabbit from each replicate was selected, weighed, starved overnight to clear the gut and stunned. The rabbit was sacrificed by cutting the jugular vein with a sharp knife. The tail close to the base was first removed, and then the head, feet and pelt. During evisceration, the internal organs and other gut contents were carefully

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removed and weighed. Then the dressed carcass was weighed and expressed as percentage of the liveweight.

Chemical and Data Analysis

Experimental feed and faecal droppings were analyzed for proximate composition using the methods of A. O. A. C. (1990). All data collected were subjected to analysis of variance (ANOVA) for a CRD. Differences between the treatment means were separated using Duncan's New Multiple Range Test. All statistical procedures were according to methods of Steel and Torrie (1980) and Duncan (1955) as packaged in SAS (1997).

Results and Discussion

The inclusion of 10, 20 and 30% raw PSM in the rabbit diets replaced 10, 20 and 28.57% maize respectively and corresponding 21.43, 42.86 and

71.43% soybean meal respectively in the rabbit diets. This in line with earlier reports on poultry (Udedibia and Igwe, 1989; Amaefule and Onwudike, 2000; Amaefule and Obioha, 2001) that pigeonpea seed meal replaced part of maize and soybean meal in the diets. There were no significant differences ($P>0.05$) between the rabbits fed the control and raw PSM diets in mature live weight, weight gain, feed intake, FCR, protein intake and PER as shown in Table 2. The results of daily weight gain and mature liveweight obtained in this study are higher than that obtained with pelleted diets (Biobaku and Oguntona, 1997), sunflower seed meal (Okonkwo *et al.*, 1995) and fortified cassava peels (Agunbiade *et al.*, 2001). Also the feed intake of rabbits in this study (23.78 – 24.04g/d) fell below that (58.22 – 68.21g/d) reported by Agunbiade *et al.* (2001).

Table 1: Percentage Composition of the Experimental Diets

Ingredients	1	2	3	4	
Raw Pigeon pea seed meal	0.00	10.00	20.00	30.00	
White maize	70.00	63.00	56.00	50.00	
Soybean meal	14.00	11.00	8.00	4.00	
Palm kernel meal	42.00	12.00	12.00	12.00	
Local fish meal	1.00	1.00	1.00	1.00	
Bone meal	2.50	2.50	2.50	2.50	
Vitamin premix*	0.25	0.25	0.25	0.25	
Salt	0.25	0.25	0.25	0.25	
Total %	100	100	100	100	
Calculated composition					
Crude Protein %	15.96	16.41	16.86	16.96	
Crude Fibre %	3.76	4.28	4.69	4.98	
ME (MJ/kg)	14.85	14.86	14.67	14.52	
Avail. Ca %	1.00	1.00	1.00	1.00	
Avail. P %	0.40	0.40	0.40	0.40	
Analyzed Composition (% DM)					
DM %	89.15	86.70	87.85	89.00	PSM
CP %	16.26	16.10	16.21	17.30	88.50
CF %	3.85	3.85	4.25	3.60	26.25
Ash %	24.90	16.00	27.00	27.70	2.10
EE %	5.20	5.80	6.10	6.65	5.00
NFE %	38.94	44.95	34.29	33.75	5.50
					49.65

* Contains per kg: Vit. A, 10,000 iu; Vit. B, 2,000 iu; Vit. E, 13,000 iu; Vit. K, 1,500mg; Vit. B12, 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, 25,000mg.

Table 2: Performance of Weaner Rabbits fed Graded Levels of Raw PSM Diets

Measurements	1	2	3	4	SEM
Initial liveweight (g)	641.66	641.66	708.33	725.00	63.74
Final liveweight (g)	1292.00	1358.00	1250.00	1525.00	90.09
Total feed intake (g)	1331.68	1299.76	1290.24	1302.00	12.88
Feed intake (g/day)	23.78	23.21	23.04	23.25	0.23
Total liveweight gain (g)	650.34	716.34	514.67	800.00	102.48
Weight gain (g/ly)	11.61	12.79	9.67	14.29	1.83
Feed: Gain Ratio (FCR)	2.05	1.81	2.38	1.63	0.26
Protein Intake (g/day)	3.87	3.74	3.73	4.02	0.06
PER	3.00	3.42	2.59	3.55	0.04

SEM = Standard error of mean. PER = Protein efficiency ratio.

The diets did not significantly differ ($P>0.05$) from each other in total and daily feed cost while the 20% PSM diet gave significantly higher ($P<0.05$) feed cost per kg weight gain than 10 and 30% PSM diets as shown in Table 3. The significant reduction in cost per kg weight gain resulting from feeding the 30% PSM diet was due to the better performance of the rabbits in terms of daily weight gain and protein efficiency

ratio (PER). The highest daily feed cost as a result of feeding the control diet to the rabbits is the consequence of the high level of maize and soybean meal all of which are costly as against the PSM that are very cheap. It could be observed (Table 3) that increases in the level of PSM in the diets resulted in a decrease in the daily feed cost.

Table 3: Cost of Feeding Raw PSM Diets to Weaner Rabbits.

Measurements	1	2	3	4	SEM
Cost per Kg Feed (N)	33.97	32.49	31.01	29.37	-
Total Feed Cost per Ani. (N)	45.24	42.23	40.01	38.24	0.30
Daily Feed Cost per Ani. (N)	0.81	0.75	0.71	0.68	0.10
Feed Cost per Kg weight gain (N)	69.64 ^{ab}	58.81 ^b	73.80 ^a	47.87 ^c	2.54*

* Significant ($P < 0.05$). Means on the same row with different superscripts a, b, c, are significantly different ($P < 0.05$).

SEM = Standard error of mean.

Nutrient Digestibility

Nutrient digestibility results are shown in Table 4. There was a significant increase ($P<0.05$) in DM and CP digestibility coefficients with increase in the level of PSM in the diets. These results were against our expectation that the control diet will have a higher DM and CP retention since the ANFs in the raw PSM diet were expected to reduce nutrient digestion and utilization. This suggests that the antinutritional substances in the raw seeds had no adverse effect

on the DM and CP digestibility of the rabbits. It was also possible that the micro-organisms inhabiting the caecum of the rabbits played a significant role in de-toxifying the antinutritional substances. Crude fibre (CF) and ether extract (EE) digestibility coefficients significantly decreased ($P<0.05$) with increase in the level of inclusion of PSM and were all significantly higher ($P<0.05$) than that of the control diet. This may have been due to the increase in dietary CF (Table 1) with increase in the level of PSM

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which consequently reduced CF digestibility coefficients. The decrease in EE digestibility indicated that PSM ether extract was inferior to that of soybean meal. There was no significant difference ($P>0.05$) in NFE digestibility coefficient between 10 and 20% PSM diets, two

of which were significantly lower ($P<0.05$) than that of 30% PSM diet. The NFE digestibility coefficient of PSM diets were significantly ($P<0.05$) lower than that of the control diet which may be related to the low NFE % of the diets (Tables 1 and 4).

Table 4: Digestibility Coefficients of Raw PSM Diets fed to Weaner Rabbits

Measurements	1	2	3	4	SEM
Dry matter (%)	63.35 ^c	29.86 ^d	65.17 ^b	66.20 ^a	0.26 [*]
Crude protein (%)	27.04 ^d	29.21 ^c	55.76 ^b	64.77 ^a	0.29 [*]
Crude Fibre (%)	76.55 ^d	88.95 ^a	85.68 ^b	82.56 ^b	0.43 [*]
Ether Extract (%)	88.84 ^b	97.90 ^a	88.59 ^b	84.81 ^c	0.33 [*]
Nitrogen Free Extract (%)	59.15 ^a	43.07 ^c	43.08 ^c	49.83 ^b	0.38 [*]

* Significant ($P < 0.05$). Means on the same row with different superscripts a, b, c, are significantly different ($P < 0.05$).

SEM = Standard error of mean.

Carcass Quality

There were no significant differences ($P>0.05$) in warm dressed carcass percentage and organ weights between rabbits fed PSM and the control diets as presented in Table 5. Rabbits fed 30% PSM diet had a numerically higher dressed carcass percentage than the rest indicating that the rabbits deposited more protein as muscle

tissue than others did. This is in relation to the higher CP retention (Table 4) recorded by the rabbits fed 30% PSM diet. Gross examination of the rabbits' liver did not show any enlargement or pathological lesions suggesting that the antinutritional substances in the raw seeds were well tolerated by the rabbits or detoxified by microbes in the caecum as earlier stated.

Table 5: Dressed carcass and organ percentage of weaner rabbits fed raw PSM diets

Measurements	1	2	3	4	SEM
Dressed carcass (%)	54.31	56.71	54.03	58.82	0.29
Liver (%)	2.40	2.42	2.38	2.50	0.06
Heart (%)	0.22	0.25	0.24	0.25	0.002
Caecum (%)	0.52	0.52	0.50	0.54	0.02
Lung (%)	0.40	0.42	0.40	0.42	0.007
Spleen (%)	0.04	0.04	0.04	0.04	0.008

SEM = Standard error of mean.

Conclusion

It is evident from this study that raw pigeonpea seed meal (PSM) is a satisfactory protein replacement in rabbit diets. PSM could constitute 30% replacing 28.57 and 71.43% of maize

and soybean meal, respectively in the diets. This will guarantee good performance and reduce feed cost of liveweight gain. 30% PSM diet also improved DM and CP digestibility of the rabbit

References

- Adegbola, J. A., Tibi, E. U. and Adogwa, D. C. (1985). Feed intake and digestibility in rabbits on all forage plus concentrate and all concentrate diet. *J. Anim. Prod. Res.* 5 (2): 15-16.
- Aduku, A. O. and Olukosi, J. O. (1990). Rabbit management in the Tropics: Production, processing, utilization and marketing. Living Books Pubs., Abuja. Pp 43-56.
- Agunbiade, J. A., Adeyemi, O. A., Fasina, O. E. and Bagbe, S. A. (2001). Fortification of cassava peel meals in balanced diets for rabbits. *Nig. J. Anim. Prod.* 28 (2), 167-173.
- Amacfulé, K. U. and Obioha, F. C. (1998) The Substitution of Pigeonpea seed (*Cajanus cajan*) for Groundnut cake and maize in broiler finisher rations. *Nig. Journal for Anim. Prod.* 25(1), 9-12.
- Amacfulé, K. U. and Obioha, F. C. (2001) Performance and Nutrient utilization of Boiler starters fed diets containing raw, boiled or dehulled pigeonpea seeds (*Cajanus cajan*). *Nig. Journal of Anim. Prod.* 28(1): 31-39.
- Amacfulé, K. U. and Onwudike, O. C. (2000) Comparative Evaluation of the processing methods of pigeonpea seeds (*Cajanus cajan*) as protein source for broilers. *Journal of sustain. Agric. And Environ.* Vol. 1 (2) 134,136.
- A. O. A. C. (1990) Official Methods of Analysis. Association of Official Analytical Chemists. Washington D. C., USA.
- Biobaku, W. O. and Oguntona, E. B. (1997). The effect of feeding multi-nutrient Mini block and pelleted diets on the growth of rabbits. *Nig. J. Anim. Prod.* 24 (2), 147-149.
- Butcher, C., Bryant, M. J. and Owen, E. (1981). Effect of metabolizable energy concentration on performance and digestibility in growing rabbits. *Tropical Anim. Prod.* 6: 93-100.
- Davidson, J. and Spreadbury, D. (1975). Nutrition of NewZealand White rabbit. *Proceed. of the Nutri. Soc.* 34: 75-83.
- D'Mello, J. P. F. (1995) Antinutritional substances in legume seeds. In: D'Mello, J. P. F. and Devendra, C. (eds) Tropical Legumes in Animal Nutrition, CAB International, Wallingford, UK.
- Duncan, D. E. (1955) Multiple Range and Multiple F-tests. *Biom.* 11: 1-42.
- Okonkwo, A. C., Igwebuike, J. A., Tarfa, H. U., Okon, B. I. and Umoh, B. I. (1995) Effect of various dietary levels of sunflower seed meal in the performance of growing rabbits in Sudano-sahelian zone. *Nig. Journal Anim. Prod.* 22(2):150-154.
- Omole, T. A. (1988). Alternative to feed formulation; Presidential Task Force on Alternative Feed Formulation, Abuja.
- Statistical Analysis Systems Institute (1997). SAS Users Guide Statistics (Cary, NC, SAS Institute).
- Steel, R. G. and Torrie, J. H. (1980) Principles and procedures of statistics, McGraw Hill Book Co. New York, USA.
- Tangtaweewipat, S. and Elliott, R. (1989) Nutritional value of pigeonpea (*Cajanus cajan*) meal in poultry diets. *Ani. Feed Sci. and Techn.* 25:123-135.
- Udedibie, A. B. I. and Igwe, F. O. (1989) Dry matter yield and chemical composition of pigeonpea (*C. cajan*) leaf meal and the nutritive value of pigeonpea leaf meal and grain meal for laying hens. *Ani. Feed Sci. and Techn.* 24:111-119.

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