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Effects of Feeding Graded Levels of *Prosopis africana* Pulp (*Kirya*) on Growth and Economic Performance of Finishing Broiler Chickens in Tropical Environment

Yusuf SZ[1*], Iguebuike JU[2], Dunya AM[2] and Husa H[3]

[1]Dept of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Nigeria.
[2]Dept of Animal Science, University of Maiduguri, Maiduguri, Nigeria.
[3]Dept of Animal Production Technology, Ramat Polytechnic Maiduguri, Nigeria

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The study was conducted to determine the effects of substituting maize with Prosopis africana pulp (PAP) on growth and economic performance of finishing broilers. One hundred and fifty day-old chicks were used for the study. The chicks were brooded for four weeks during which they were fed commercial starter diet. At four weeks of age, the chicks were randomly allotted to five dietary treatments in three replicate (ie thirty per treatment and ten per replicate). The PAP was included at 0%, 5%, 10%, and 20% levels in diet 1 (control 2, 3, 4 and 5 respectively, replacing maize as an energy source. The parameter considered in the study were feed intake, rate of gain, feed conversion ratio, protein efficiency ratio and cost benefit analysis. Highest feed intake (130.08g/bird/day) and weight gain (56.30 g/bird/day) were recorded in 0% level of replacement. Feed conversion ratio was similar (P>0.05) among treatment 1, 2 and 4 which were significantly better (P<0.05) than 20% level of replacement (4.05). Protein efficiency ratio was similar across the treatment groups. The feed cost per kg decreased with increase in level of PAP in the diets (ranging from N 62.17 in diet 1 to N 54.39 in diet 5). However, feed per kg weight gain was lower in 5% level of replacement than the other treatments. Results from this study showed that feed consumption and body weight gain was adversely affected by increasing levels of PAP across the treatment groups. Therefore, inclusion of PAP should not exceed 5% of the diets of broiler chickens.

Key words: Prosopis pulp, Broiler, Performance, Cost benefit.

INTRODUCTION

Competition between man and livestock for conventional feed materials make the cost of procurement exorbitant. As a result of this alternative means of feeding most be established to reduce the cost of production. This can be achieved by exploiting the potentials of non-conventional feed materials. One of such unconventional materials is *Prosopis africana* pulp (PAP) which is currently underutilized. *Prosopis africana* (in Hausa kirya) is a tropical tree which is native to Africa and is widely distributed in the savannah region of Nigeria (Keay *et al.,* 1964). It is estimated that a tree produces over 300kg pods in one season and this make it relatively abundant (Apata, 1998). These pods if collected could have potential use in feeding poultry and other monogastrics. Adamu *et al.,* (2013) successfully used *Prosopis africana* pulp as a component of rabbit diet. The present study was aimed at determining the effects of replacing maize with the *Prosopis africana* pulp on the growth and economic performance of broiler chicken in semi-arid environment.

*Corresponding Author: dbanuzubair@gmail.com

Table 1: Ingredient composition of the broiler finisher diets

Level of replacement of maize by *Prosopis africana* pulp					
Ingredients (%)	**0%**	**5%**	**10%**	**15%**	**20%**
Maize	56.00	51.00	46.00	41.00	36.00
Prosopis africana pulp	0.00	5.00	10.00	15.00	20.00
Soya beans (full fat)	12.00	12.00	12.00	12.00	12.00
Groundnut cake	11.00	11.00	11.00	11.00	11.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	6.00	6.00	6.00	6.00	6.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Mineral/vitamin Premix*	0.50	0.50	0.50	0.50	0.50
Salt (NaCl)					
Total	0.20	0.20	0.20	0.20	0.20
	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude Protein (%)	22.32	22.20	22.14	22.08	
Crude Fibre (%)	3.06	4.11	5.17	6.22	22.02
					7.28
Calcium (Ca)	1.00	1.01	1.03	1,05	1.06
					0.85
Phosphorus (P)	0.89	0.88	0.87	0.86	
ME(Kcal/kg)	3030.11	2983.31	2936.54	2889.70	2842.90

ME= Metabolizable energy

* = Premix supplying the following per Kg of feed:

Vitamin A = 12,000.00 IU, Vitamin E = 15,000mg, Folic acid = 1000mg, Pantothenic = 1500mg, acid Vitamin B_{12} = 15,000mg, Vitamin B_6 = 2,500mg, Vitamin K = 2,000mg, Choline = 50,000mg Manganese = 10,000mg, Vitamin D_3 = 25,000 IU, Nicotinic acid = 40,000mg, Vitamin B_1 = 2000mg, Vitamin B_2 = 6000mg, Biotin = 6000mg, Vitamin C = 3000mg, Copper = 15000mg, Cobalt = 250mg and selenium = 1000mg.

MATERIALS AND METHOD

The study was conducted at the Teaching and Research Farm, Department of Animal University of Maiduguri, Nigeria. Maiduguri, the Borno State capital, is situated on latitude 11o5 N, Longitude 13o.09 E (Encarta, 2007) and at an altitude of 354 m above sea level (Alaku 1983). The area falls within the Sahelian region of West Africa, which is noted for its great climate and seasonal variations. The period of rainfall is very short (3 – 4 months) in the area, with annual rainfall of about 645.9 mm, followed by a long dry season of about 8 – 9 months. The ambient temperature ranges from 20oC during the dry, cold season to 44oC during dry hot season. Relative humidity is about 30-45% in August which usually comes down to about 5% in December and January. Day length varies from 11 – 12 hours (Alaku 1983).A total of One hundred and fifty (150) day-old Hubbard breed of broiler chicks obtained from Gujba hatchery were used for the study. The chicks were brooded for four weeks during which they were fed commercial starter diets and later experimental finisher diet from 4 – 9 weeks of age. There were five different diets for the experiment. The ingredients for formulating the diets include ground maize, *Prosopis africana* pulp, wheat offal, groundnut cake, soybean meal, fish meal, common salt, bone meal, limestone and mineral-vitamin premix. *Prosopis africana* pulp replaced maize at 0, 5, 10, 15 and 20% levels in the diets on weight for weight basis. All ingredients were purchased from the local market, but *Prosopis africana* pods were obtained from Prosopis trees in Fune and Potiskum Local Government Areas of Yobe State about 200km west of Maiduguri. The pods were crushed to obtain the pulp by separating the seeds. Each feed was formulated to meet the protein requirement of 20% for broiler finisher diets. The parameters measured were feed intake, rate of gain, feed conversion ratio, protein efficiency ratio and cost benefit analysis. All data collected were subjected to analysis of variance (ANOVA) using the Complete Randomized Block Design (Steel and Torrie, 1980). Significant differences between treatment means were separated and compared using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The proximate composition of the experimental diets and *Prosopis africana* Pulp (PAP) are presented in Table 1. The crude protein (CP) decreased with an increase in the levels of *Prosopis africana* pulp (PAP) in the diets. This means that maize is higher in crude protein (10.60%) than PAP (10.00%). However, all the values fell within the accepted range of 20% – 22% for broiler finishers as

Table 2: Chemical composition of the experimental finisher diets and PAP

Level of replacement of maize by *Prosopis africana* pulp (%)						
Nutrients%	**0**	**5**	**10**	**15**	**20**	**PAP**
Dry matter	98.50	98.00	98.40	98.40	98.40	84.50
Crude protein (CP)	21.44	21.31	21.28	21.25	21.22	10.00
Crude Fibre (CF)	2.75	3.69	4.74	5.80	6.84	21.00
Ether extract (EE)	6.84	6.77	6.69	6.62	6.54	4.60
Ash	3.63	3.72	3.80	3.89	3.97	3.00
NFE	68.09	68.20	68.23	68.24	68.27	58.5
Metabolizable energy (Kcal/kg)**	2874.52	2840.81	2809.40	2777.89	2746.25	2819.35
Tannin (%)	-	-	-	-	-	2.45

NFE = Nitrogen-free extract
** Calculated according to the formula of Pauzenga (1985) (ME (Kcal/kg) = 37 x %CP + 81 x % EE + 35.5 x %NFE)
PAP = *Prosopis africana* pulp

Table 3: Performance of broiler chickens fed graded levels of *Prosopis africana* pulp (PAP)

Parameters	**Level of replacement of maize by PAP**					
	0%	**5%**	**10%**	**15%**	**20%**	**SEM**
Number of Birds	30	30	30	30	30	
Initial Live weight (g)	630.00^{a}	610.00^{a}	610.00^{a}	600.00^{a}	630.00^{a}	0.24^{NS}
Final Live weight (g)	2641.70^{a}	2200.00^{b}	1377.00^{C}	1216.70^{cd}	1025.00^{d}	9.745*
Daily weight gain (g/bird)	56.30^{a}	45.50^{b}	26.66^{c}	23.81^{c}	11.44^{d}	3.39*
Daily feed intake (g/bird)	130.08^{a}	103.84^{b}	68.64^{c}	65.72^{c}	58.77^{c}	4.02*
Feed conversion ratio	2.36^{b}	2.44^{b}	2.88^{b}	2.84^{b}	4.05^{a}	
Protein efficiency ratio	2.11^{a}	2.11^{a}	1.53^{a}	1.26^{a}	1.00^{a}	0.34^{NS}
Mortality (number)	0	1	1	3	1	

abc = means on the same row with different superscripts differ significantly (P<0.05)
SEM = standard error of mean
NS = Not significant (P>0.05)
* = Significant (P<0.05)

reported by Olomu (1995). Crude fibre increased with an increase in the levels of PAP; 0% level, 5% level and 10% level fell within accepted levels of 5% Crude fibre (CF), 15% level and 20% level of replacement were higher than the maximum recommended level of 5% fibre in broiler finisher diet(NIS 1989). The values obtained for Fats (EE), ash and nitrogen-free extract (NFE) are almost similar for all the treatment diets. Therefore PAP can be said to be similar to maize in this respect. The metabolizable energy values of the experimental diets also are presented in Table 2. The values in 0% level of replacement, 5% level of replacement and 10% level of replacement fell within the recommended value of 2800 kcal/kg by Jagdish (2008), while values in 15% level of replacement and 20% level of replacement were lower than the recommended value.

The proximate analysis of PAP reveals that it contains 84% dry matter (DM), 10% CP, 21% CF, 4.6% EE, 3% ash, 58.5% NFE, 2819.35 Kcal/Kg ME and 2.45% tannins. This makes it relatively comparable to maize in composition. The mean daily feed consumption (g/bird) is presented in Table 3. The control group, 0% level of replacement, consumed significantly (P<0.05) more feed than those on PAP-based diets. However, there were no significant (P>0.05) differences in feed consumption among 10% level of replacement, 15% level of replacement, and 20% level of replacement, but their feed intake was inferior to that of 5% level of replacement. The low feed intake in groups with 10, 15 and20% level of replacement respectively, may be due to the higher fibre content of the feed.

Some workers (Lee *et al.,* 1978; Okorie *et al.,* 1988; Macdonald *et al.,* 1995) previously observed that dietary fibre reduced feed intake in chicks. Similarly, Ranjhan

Table 4: Cost Benefit Analysis of Substituting Maize with Prosopis africana pulp (PAP)

Parameters	Level of replacement of maize with PAP				
	0%	5%	10%	15%	20%
Initial body weight (g/bird)	630:00	610.00	610.00	600.00	630.00
Final body weight (g/bird)	2641.70	2200.00	1377.00	1216.70	1025.70
Live weight gain (g/bird/day)	56.30	45.50	26.66	23.81	11.44
Total weight gain (g/bird)	2011.70	1590.00	767.00	616.70	395.00
Feed intake (g/bird/day)	130.08	103.84	68.64	65.72	58.77
Total feed intake (g/ bird)	4552.80	3634.40	2402.40	2300.20	2056.95
Cost of feed (₦ /kg)	62.19	60.24	58.29	56.24	54.39
Total feed cost (₦)	283.14	218.94	140.04	129.36	111.88
Cost of gain (₦ /kg wt gain)	136.40	132.43	179.07	192.41	280.24

NB: Based on the price prevailing in Maiduguri when the experiment was conducted (February/March, 2009).

(2001) and Oluyemi and Roberts (2000) reported that increase in fibre content of diets reduces feed intake. This also concurred with the work of Adamu and Bulus (2004) who reported that feed intake was significantly reduced when fibre levels exceeded 3.62% of the diet. Therefore the result showed that fibre level has a somewhat inverse relationship with feed intake. This is contrary to the work of Butcher et al. (1981) and Deblas *et al.,* (1981) who reported a linear increase in voluntary feed intake with increasing level of fibre. The tannin content of PAP might also have contributed to low feed intake in these treatments. Tannins are known to depress feed intake in poultry and rabbits (Jansman, 1993).

Data on average daily body weight gain per bird during the period of the study are presented in Table 3. Birds in 0% level of replacement gained significantly ($P<0.05$) more weight than all the treatment groups. No significant differences were recorded ($P>0.05$) between 10% and 15% level of replacement. 20% level of replacement recorded the least weight gain among all the treatments. Weight gain slightly decreased as the amount of PAP increased in the diets. This behavior may be due to fibre content and anti-nutritional factor (tannins) present in the PAP. The observation agrees with the work of Igwebuike *et al.,* (2001) who showed that higher crude fibre levels of diet depress growth rate in birds. It also agreed with the report of Adamu and Bulus (2004) which indicated that growing chicken on a high fibre diet exhibited a delay in sexual maturity and reduced body weight gain. According to Kondra *et al.,* (1974), feed consumption and body weight gain, especially in meat type birds were decreased when birds were fed a high fibre diet. They also observed a reduction in body weight gain and increased weight and size of the various part of the alimentary tract of the birds.

Data on feed conversion ratio (FCR) presented in Table 3 shows that FCR increased with an increase in levels of PAP. Since FCR is the measure of how efficient the birds converted feed consumed into flesh, therefore the smaller the value the better. Hence birds in 0% level of replacement recorded the best and those in 20% level of replacement recorded the worse. The FCR values for 0%, 5%, 10% and 15% level of replacements were, however, similar ($P>0.05$) and within acceptable range of 1.8 – 3.2 for broilers in the finisher phase as reported by Olomu (1995). Duru *et al.,* (2008) also reported 2.37 – 2.84 for broiler finishers fed three types of rice offal and Igwebuike *et al.,* (2001) reported 2.86 – 3.19 when they replaced maize with spent sorghum grain in the broiler finisher diet.

The protein efficiency ratio values are also presented in Table 3. The values were similar in 0% and 5% level of replacement, but declined from 10% to 20% as the level of *Prosopis africana* pulp (PAP) increased. No statistical difference ($P>0.05$) was noticed across the treatment groups. The decline noticed across the treatments shows that the inclusion of more than 5% level of replacement in the broiler finisher diet may depress protein utilization. Mole (1989) also reported a negative effect of tannins on protein utilization; therefore increase in tannins levels as a result of increase in PAP in the diets may be responsible for the lower PER in 20% level of replacement. This agreed with the work of Adamu *et al.,* (2004) who fed graded levels of PAP to growing rabbits and revealed that the level of PAP higher than 20% in rabbit diet is capable of depressing protein and amino acid utilization. The PER observed in this study is, however, comparable to the values reported by Ani and Okeke (2002) who fed pigeon pea seed meal to broilers. The cost benefit analysis is presented in Table 4. The feed cost (N/Kg feed) decreased with an increase in the level of PAP in the diets. Thus the cost per Kg feed were N62.19 and N54.39 for diets 1 (0%PAP) and 5 (20%PAP) respectively. However, the cost per (N/Kg) weight gain was lower in treatment 2 (N132.43/kg) than the other treatments. Hence, diet 2 (5% PAP) proved to be more cost effective than diet 1 (0%PAP). This implied that inclusion of not more than 5% PAP in place of maize may increase the profit margin of broiler production in Nigeria.

Mortality was recorded between sixth to ninth weeks of

the experiment. No mortality was recorded in the control group (0% PAP); all other treatments recorded one each, except 15% level of replacement which recorded three. No pathological evidence was detected after post-mortem examination, thus suggesting that the deaths may not be due to treatment effects.

CONCUSION

Results from this study showed that performance (feed consumption and body weight gain) was adversely affected by increasing levels of *Prosopis africana* pulp across the treatment groups. The economic analysis showed that diet 2 (5% PAP) was the most economically viable diet. However the use of *Prosopis africana* pulp as an energy source may be more suitable in ruminants than monogastrics based on the outcome of the study. Further studies on the use of PAP should focus on different processing methods to eliminate tannins, which may be the limiting factor in the use of PAP in poultry diets.

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