Evaluation of different combinations of palm kernel cake - and cotton seed cake - based diets on the performance of West African Dwarf goats

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Abstract

An experiment was carried out using 15 West African Dwarf goats (8 - 10kg body weight) to investigate the comparative performance of the animals when different combinations of palm kernel cake and cotton seed cake were contained in their diets. Results indicated that 40% palm kernel cake (zero cotton seed cake) in the diets significantly induced better feed utilization for gain (100g/d) and feed conversion ratio (3.70), least total dry matter intake (4.8% body weight) and least water consumption (40ml/ $W^{0.75}$ kg; $P>0.05$) than other combinations. The least crude protein (15.5%) and the highest metabolizable energy (8.37MJ/kg) diet (40% PKC) provoked the fastest growth rate (100g/d) in the animals. Concentrate intake was higher in all the treatments than grass intake. The blood glucose, total blood protein, blood urea nitrogen and cost per kg body weight (18.3, 13.3, 31.0mg/dl and ₦33.8 (0.4 US dollar), respectively) were significantly lower in goats fed sole palm kernel cake based diets than those fed combinations of palm kernel cake and cottonseed cake. It is concluded that palm kernel cake alone (without any combination with cottonseed cake) is adequate as protein source in compounding protein supplements for West African Dwarf goats for profitable performance.

Keywords: *Palm kernel cake, cotton seed cake, goats, performance*

Introduction

Protein supplements are expensive feed ingredients in livestock feed formulation. Improvement in weight response of ruminant being fed crop residue can be achieved through protein supplementation of oil seed cake or legume forage (Lufadeju and Lamidi, 1993). Cottonseed cake (CSC) has been recognized as an excellent and economic source of protein for starter and grower rations of dairy calves (Risco et al, 1992) while palm kernel cake (PKC) has the reputation of increasing the butterfat content of milk (Oyenuga, 1968; McDonald et al, 1989). Nigeria produced 548,000 metric tones of palm kernels (the

largest production level in the continent of Africa) and 280,000 metric tones of cotton seed (the 4th in Africa) in 1966 (FAO,1996). These data were indicative of respective potential quantity and availability of PKC and CSC in Nigeria for livestock feeds in general and ruminant animals in particular.

However, the comparative effects of these feedstuffs on the performance of West African Dwarf (WAD) goats have not been sufficiently documented. The trial reported here assessed the growth performance and some blood metabolites of WAD goats as well as the cost effectiveness when PKC and CSC were induced in different combinations in the concentrate supplements of goats.

Materials and methods

Pre-experimental management of the goats

Fifteen female WAD goats, weighing between 8 and 10g were used. They were routinely dewormed with Baminth II^R Wormer (12.5g/kg body weight) and bathed in Asuntol^R Powder solution (3g/litre of water) to eliminate ectoparasites. They were intensively managed in previously disinfected and well-ventilated pens. They were allowed 3 weeks acclimatization period during which they were fed *Panicum maximum* (Guinea grass) and wheat offal as concentrate supplement. Water was provided *ad libitum*.

Experimental diet preparation

Five experimental concentrate supplements comprising (% of diet) CSC and PKC in combinations of 40 and 0; 30 and 10; 20 and 20; 10 and 30; and 0 and 40, respectively, were compounded while the proportions of other ingredients were constant (Table 1). The table also contained calculated proximate components of the supplement.

Dietary treatments

The fifteen goats were divided into 5 groups of 3 goats each, balanced for body weight. Each group was assigned to one of the experimental diets and fed at 300g/head/d in the morning between 0800 and 0900h for 8 weeks. Water was offered *ad libitum*.

Data Collection

The goats were weighed prior to the commencement of the experiment and every fortnight on the same day of the week between 0800 and 0900h after withdrawing feed only for 14 to 16h to avoid error due to gut-fill. Each animal was transferred to individual metabolism cage for separate collection of faeces before the commencement of the experiment and in the last 7 days of the experiment. The collection was after overnight fasting and before the days feed was supplied. About 25% of daily faecal collection was oven-

dried at 80°C, bulked for each animal and stored for subsequent analysis. Blood sample from each animal was collected via jugular venipuncture (Frandsen, 1986) into heparinized bottle and was taken to the laboratory for immediate analysis.

Chemical analysis

Chemical analysis of faecal samples to estimate faecal nitrogen was carried out according to AOAC (1990). The blood urea nitrogen was estimated by the method of Bauer *et al.* (1974), blood glucose by the procedure of Trinidad (1969) and blood total protein by the method of Hyduke (1975).

Statistical analysis

Values of dry matter intake, weight gain, average daily gain (ADG), blood glucose, blood total protein, faecal protein and blood urea nitrogen were subjected to analysis of variance using completely randomized design (Wahua, 1981). Duncan Multiple Range Test (Duncan, 1955) was used to separate significant treatment means.

Results and discussion

In Table 1, the crude protein (CP) content tended to decrease gradually with decreasing levels of cottonseed cake in the diet while metabolizable energy (ME) appeared to increase slightly with increasing level of PKC in the diets. Thus differences in growth performance would appear to be reasonably attributable to variations in CP and ME contents of the diets since other components were constant. However, the highest CP (24.5%) and least ME (8.20 MJ/kg) in Diet A could not provoke the highest average daily gain (Table 2) while the least CP (15.5%) and highest ME (8.37MJ/Kg) in Diet E promote the fastest growth rate (100g/d) in the animals (Table 2). It appears there is an optimal CP: ME ratio that enhances best performance in the goats.

Palm-kernel and cotton seed cake-based diet for goat

Table 1 Energy, proximate and mineral composition (g kg^{-1}) of cotton seed cake (CSC) and palm kernel cake (PKC) used in the study

	CSC	PKC
Crude protein	468	180
Ether extract	86	60
Crude fibre	102	120
Ash	63	48
Ca	2.0	2.1
P	12.0	4.8
M E (MJ/kg)	9.27	9.21

Source : Tewe O. O. (1984).

In Table 2, the goats in all treatment groups depicted improvement in growth responses. This is similar to the observation of Lufadeju and Lamidi (1993). However, Diet E (40% PKC) significantly improved ADG (100g/d) and feed conversion ratio (3.7). Though not significant, the total dry matter intake (4.8% body weight) and water consumption ($40\text{ml/W}^{0.75}\text{ Kg}$) were lowest for animals on Diet E. Incidentally, this is the diet with least CP content (15.5%). Apparently this level of

CP in the diet and 8.37MJ/Kg ME are the optimal ratio for best performance in the goats. The PKC appeared to favour increase in weight gain than CSC. This could be attributed, probably, to the likely presence of residual gossypol - an anti-nutritional component- in the CSC (Oyenuga, 1968, McDonald *et al.*, 1989). The residual gossypol in the CSC could have remarkably limited its utilization for weight gain in the animals while the utilization of PKC is enhanced.

Table 2 Composition of experimental diets and calculated proximate components (%)

Ingredients	Diets				
	A	B	C	D	E
Cotton seed cake	40.0	30.0	20.0	10.0	-
Palm kernel cake	-	10.0	20.0	30.0	40.00
Wheat offal	59.2	59.2	59.2	59.2	59.20
Bone meal	0.3	0.3	0.3	0.3	0.30
Common salt	0.5	0.5	0.5	0.5	0.50
Total	100.0	100.0	100.0	100.0	100.00
Calculated Proximate Analysis:					
Dry matter(%)	89.1	88.9	88.5	88.2	88.00
Crude protein(%)	24.5	22.2	20.0	17.2	15.5
Crude fibre(%)	11.8	11.5	11.3	11.0	10.8
Ether extract(%)	4.7	4.9	5.0	5.2	5.3
Metabolizable					
Energy (MJ/kg)	8.20	8.24	7.45	8.33	8.37

Dry matter intake and water consumption were not affected by the concentrate diets. However, average concentrate consumption was higher in all the treatments than grass consumption. This could be attributed to better palatability of the concentrate supplements which was probably preferred by goats to succulent fresh grass. Matthewman (1977) had established that animals feed intake was greatly affected by the palatability and digestibility of the feed and the animals level of productivity.

Daily water consumption (WC) was fairly uniform in all the treatments. It could be inferred that the experimental goats were in the same physiological status and under the same environmental conditions of the experiment. Therefore, water consumption might be expected to be largely the same while the experimental diet had no influence on WC of the goats.

The blood glucose, total blood protein, blood urea nitrogen and faecal protein levels before and after the experiment did not follow any regular pattern (Table 3), but 40% PKC (Diet E) induced significant ($P < 0.05$) reduction in blood glucose (18.32mg/dl), total blood protein (13.33mg/dl) and blood urea nitrogen

(31.00mg/dl) at the end of the experiment. The significantly lower blood glucose and total blood protein levels (Table 3) exhibited in the goats on Diet E appeared to indicate higher utilization of glucose and protein for growth rather than for excretion since the goats on this diet (E) the highest growth rate (100g/d). This report is at variance with the report of Nikoryis *et al.* (1991) who observed, with CSC-based diet, no significant differences in most of the blood constituents examined including plasma concentration, urea, total protein and globulin. As a further indication of better PKC protein utilization for gain, the goats on 40% PKC also had the least blood urea nitrogen (31.00mg/dl). Besides, the average level of blood glucose (36.30mg/dl), total blood protein (26.50mg/dl) and blood urea nitrogen (42.50mg/dl) were higher before treatment than after experimental treatment (30.30, 21.60 and 34.50mg/dl, respectively). Also the average pre-experimental faecal protein (12.50%) was lower than the average post-experimental level (15.00%, Table 3). Faecal protein is derived from nitrogenous substances that escaped digestive activities along the gastro-intestinal tract. The more such substance escape digestive activities the higher the faecal

Table 3 Summary of the performance of goats fed cotton seed cake and palm kernel cake diets

Measurements	Diets					±SE
	A	B	C	D	E	
Initial body weight (kg)	9.5	9.6	9.3	9.0	9.0	0.3
Final body weight (kg)	12.3	12.7	11.4	11.8	14.6	1.1
Average daily gain (g/d)	50.0 ^b	55.4 ^b	55.7 ^b	50.0 ^b	100.00 ^a	13.9
Dry matter intake (conc.)(%BW)	3.1	3.0	3.1	3.0	2.5	0.1
Dry matter intake (grass) (%BW)	2.6	2.4	2.6	2.6	2.2	0.1
Total dry matter intake (%BW)	5.7	5.4	5.7	5.6	4.8	0.1
Feed conversion ratio	7.6 ^a	6.7 ^a	9.3 ^a	7.0 ^a	3.7 ^a	1.2
Water consumption (ml/kg BW)	42.0	42.0	50.0	50.0	40.0	4.0
Cost of feed (₦/kg)	95.40	79.66	100.76	69.63	33.76	-
* (Dollar/kg)	0.95	0.80	1.01	0.70	0.44	-

*(1 US dollar = #100.00)

^{a,b,c} Means along the same row with any bearing identical superscript are not significantly different ($P > 0.05$)

Palm-kernel and cotton seed cake-based diet for goat

Table 4 *Laboratory analysis of blood glucose, total blood protein, blood urea nitrogen and faecal protein*

Measurement	Before experiment						After experiment					
	A	B	C	D	E	Mean	A	B	C	D	E	Mean
Blood glucose (mg/dl)	36.7	28.9	30.0	48.3	38.3	36.3	36.7 ^a	36.7 ^b	35.0 ^a	25.0 ^b	18.3 ^b	30.0
Total blood protein (mg/dl)	26.3 ^b	21.3 ^b	24.3 ^b	33.3 ^a	27.0 ^b	26.5	25.7 ^a	26.3 ^a	24.7 ^a	18.0 ^b	13.4 ^b	21.6
Blood urea nitrogen (mg/dl)	43.0	38.3	40.3	47.0	43.7	42.5	36.7	40.7	35.7	33.0	31.0	35.4
Faecal protein (%)	13.6	13.4	12.0	10.2	13.3	12.5	16.0	12.7	15.9	15.7	14.4	15.0

^{a, b} Means along the same row with any identical superscripts are not significant ($P > 0.05$)

The blood glucose of the animals on Diet A was the same before and after the experiment. protein. From this study one can deduce that the higher faecal protein after the experiment could be due to some of the protein content of the CSC that escaped digestive activities as a result of possible residual gossypol in the CSC-containing diets. This could be noticed from Table 3. As the PKC was increasing in the diet, the faecal protein was decreasing indicating that CSC was implicated in the increasing faecal protein.

The reason for this could not be fully explained. However, there might be a regulatory mechanism regulating the amount of glucose to be released into the blood of the animals on this treatment. This diet also contained the highest inclusion of CSC.

The cost analysis indicated that it is remarkably ($P < 0.05$) economically cheaper to use PKC alone (N33.2/kg live weight i.e. 0.34 US dollar) in compounding concentrate supplement for goats than any combinations of PKC and CSC.

In conclusion, based on the results of this trial, using 40% PKC only in compounding concentrate supplements for goats is more beneficial in terms of gain and cost of production than PKC in any combination with CSC. Besides, PKC is less expensive, easier to mill with machine, contains less severe anti-nutritional agent and more readily available than CSC.

References

- A.O.A.C.**, 1990. Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. Washington D.C. USA.
- Duncan, D.B.** 1955. Multiple Range and Multiple F-test Biometrics. 11: 1-42.
- F.A.O.** 1997. Food and Agricultural Organization Production Year Book. Vol. 50:112-118.
- Frandsen, R.D.** 1986. Anatomy and Physiology of Farm Animals. Lea and Febiger. 2nd ed. Pp 174 – 209.
- Hyduke, R.R.** 1975. The University of IOWA Medical Technology Programme. Clinical Biochemistry Manual. Iowa city, Iowa.
- Bauer, J.D., Ackermann, P.G. and Toro, G.** 1974. Blood Urea Nitrogen. Clinical Laboratory Methods. 8th ed. Pp. 393 – 394.
- Lufadeju, E.A. and Lamidi, S.O.** 1993. Utilization of browse, grass, crop residues and other locally available agro-by-products as feed for ruminants. Advance Animal Husbandry Practices for subject matter specialists in ADPs Training manual. Published by Federal Agricultural Coordinating Unit (FACU) Sheda – Abuja and National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika, Zaria pp. 75 – 82.
- Matthewmann, R.W.** 1977. A survey of small ruminant production at the village level in the derived savannah and lowland forest zones of South-West Nigeria. AES Research Bulletin No 1.
- Nikokyris, R., Mandylis, K., Deligiannts, K. and Liamadis, D.** 1991. Effect of gossypol content of cotton seed cake on blood constituents in growing-fattening lambs. *J. Dairy Sci.* 74: 4305 – 4313.
- Oyenuga, V.A.** 1968. Nigeria's foods and Feeding Stuffs. The Caxton Press (West Africa) Limited, Ibadan pp 60 – 63; 77.
- Risco, C.A. Holmberg, C.A. and Kutches, A.** 1992. Effect of graded concentration of gossypol on calf performance. Toxicological and pathological consideration. *J. Dairy Sci.* 75: 2787 – 2798.
- Tewe, O. O.** 1984. Energy and protein sources in poultry feeds. In Poultry Seminar on Soyabean. July, 1984 : 52 - 59.
- Trinidad, P.** 1969. Enzymatic glucose analysis. *Ann. Clin. Chem.* 6: 24-27.
- Wahua, T.A.T.** 1981. Similified Experimentation Statistics for Agricultural and Biological Sciences. Ibadan

(Received 30 May 2000; Accepted 15 May 2001)