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EFFECT OF COTTONSEED CAKE REPLACEMENT WITH BROILER LITTER ON PERFORMANCE OF YANKASA RAMS FED MAIZE HUSK BASAL DIETS

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ABSTRACT

Twenty five Yankasa rams with average weight of 16.76±0.24kg were used to study the effect of replacing Cotton Seed Cake (CSC) with broiler litter on ruminant performance. Five rams each were randomly assigned to five treatments in a Completely Randomized Design. The concentrate diets contained broiler litter (BL) at 0, 10, 20, 30 and 40% in replacement for CSC. The diet was offered at 1.8% of body weight while Maize Husk (MH) was fed *ad libitum*. Growth study, metabolism trial, rumen studies and economic analysis were conducted. The proximate analysis indicated that BL had 926.60, 273.00, 110.00, 24.30, 160.20 and 387.00gkg^{-1} of DM, CP, CF, EE, Ash and NFE respectively while maize husk had 922.10DM, 25.70CP, 320.20CF, 9.60EE, 38.80Ash and 601.57gkg^{-1}NFE. The broiler litter and maize husk metebolizable energy were 10.58 and 10.67 MJ/kgDM respectively. Rams on the broiler litter diets showed better weight gain, final weight and feed cost per kg gain with 30 % inclusion level having the best performance. Rumen pH varied slightly across treatments but remained within normal range. It is recommended that BL can be included in the diets of ruminants up to 30% without adverse effect on performance. This will reduce cost of production and increase farmer's income.

Keywords: Yankasa rams, broiler litter, cottonseed cake, maize husk

INTRODUCTION

The problems of livestock production have received considerable attention in Nigeria and other tropical countries. Crop residues and forages could be important ruminant feed resources in Nigeria and other sub-humid zones. The main sources of crop residues in Nigeria include the Stover of maize, sorghum, millets and haulms of leguminous crops such as groundnuts, cowpea and soybean. Maize produces the largest proportion of the total crop residues hence it serves as an indispensable source of ruminant feed in Africa and Nigeria in particular (Tang, 2006).

Among the botanical fractions of maize stover, husk is the most poorly utilized. In many occasions, maize husk (MH) is immediately burnt in situ where maize is processed with Sheller. Similarly, maize husk is sometimes left on farm where it is grazed directly by cattle and small ruminants. In such cases, MH is subjected to trampling, soiling and termite damage. Munthali *et al.* (2000) stated that less than 50% of total MH is actually consumed by livestock.

Intake and digestibility of maize husk can be improved by physical, chemical and biological treatment/ processing. Aregheore and Perera (2004) suggested that feeding MH with poultry litter may allow for higher dry matter intake (DMI) and digestibility of organic matter (OM) than urea treated cereal crop residue. Maize husk Intake and digestibility has also been upgraded successfully by supplementation with concentrates such as maize bran, rice bran, blood meal, groundnut and cottonseed cakes. Though, the results of such researchers were appreciable, the cost and ready availability of the feedstuff were not always taken into cognizance. The high cost of protein concentrate posed by man and poultry industry makes the use of such concentrates expensive for feeding ruminants (Maigandi and Abubakar, 2004).

The cost of ruminant feed formulated with CSC can further be reduced by replacement of the CSC with broiler litter (Elemam *et al.*, 2009). The use of MH with BL may also ensure effective recycling of farm wastes, farm crop residues, as well as ensure safety against toxicity of urea supplementation when handled by unskilled smallholder farmers. It will also reduce the cost of production thereby increasing profit margin.

The objective of the study is to determine the effect of replacing Cottonseed cake with broiler litter on performance, rumen metabolites and feed cost of Yankasa rams fed Maize Husk basal diets.

MATERIALS AND METHOD

Experimental Site

The study was conducted at the Experimental Unit of Small Ruminant Research Programme (SRRP) farm of the National Animal Production Research Institute (NAPRI), Shika-Zaria. Chemical analyses were carried out at the Central Laboratory Service Unit NAPRI, Chemical Pathology Laboratory (ABUTH), Biochemical Laboratory of the Department of Animal Science (ABU), Centre for Energy Research (ABU) and National Institute for Chemical Technology (NARICT) Laboratory.

The study area lies within latitude 11^0 12``N and longitude $7^0$ 33``E. The altitude of the area is 640m above sea level as reported by Osuhor *et al.* (2004). Shika is located in the Northern Guinea Savannah zone of Nigeria. The area is characterized by sub-humid tropical climate.

Growth Trial

Experimental animals and research design

Twenty five (25) Yankasa rams with an average weight of 16.76±0.24kg were used for the experiment. The animals were randomly divided into five treatments, with five animals per treatment in a Completely Randomized Design (CRD). The animals were individually penned through out the duration of the experiment.

Experimental diets and treatments

Broiler litter was used to replace cottonseed cake (CSC) at 0, 10, 20, 30 and 40 percents in such away that every level of CSC replacement served as a treatment. Other ingredients in the concentrate were maize offal, bone meal, and salt. Each experimental diet was offered at 8:00am at the rate of 1.8% body weight (BW), while MH and water were offered *ad libitum*. The growth trial lasted for 120 days.

Experimental procedure

Prior to the commencement of the growth trial, the selected animals were allowed 14 days to adjust to the environment and the experimental diets. The animals were treated against both ectoparasites and endoparasites using dianzintol solution and albendazole which was administered at a dose of 100ml/kg body weight. The experimental animals were also treated with prophylactic dose of long acting (LA), broad spectrum oxytetracyclin at 20 mg/kg BW.

Data collection

The parameters measured during the trial were feed and water intakes. . Fortnight weight changes were measured using a hanging scale (Salter suspended scale, model 235). The forthnight weight changes were used to adjust feed allowance in such away to maintain feed offered at 1.8% BW. Weight gain was determined as final weight less the initial.

Metabolism Trial

Digestibility study

Digestibility and N-balance study were carried out using fifteen animals, three animals from each treatment. The animals were transferred to respective individual metabolic crates for easy collection of faeces and urine. The animals were allowed 10 days adjustment period before seven days total faecal and urine collection. Each animal was fed with the feed offered during growth trial.

Metabolism data collection

Total faecal output was collected daily from each animal. Twenty percent formaldehyde was added to each day faecal sample and stored in deep freezer till end of the seven days collection period. After seven days of collection, the faecal outputs from each treatment were bulked and a sub-sample was collected for laboratory analysis.

In order to trap ammonia gas, urine output was collected over 100 ml 1N H_2SO_4. About 10% daily urine output was taken from each ram and stored in a deep freezer for the length of the collection period. Total seven days urine collection was bulked and about 10 ml was sub-sampled for nitrogen analysis.

Rumen metabolite study

Three animals from each treatment were used for rumen fluid sampling. Rumen fluid was sampled at 0, 3, 6, 9, and 12 hours post feeding using a manually operated stomach suction pump. Rumen fluid was strained through a two layer surgical gauge immediately after collection, and rumen pH was taken instantly by using a digital pH meter (model pHs-25). Rumen fluid was then preserved over 1N H_2SO_4, and stored in freezer pending analysis.

Chemical and mineral analysis

Feed ingredients and diets were analyzed for proximate constituents using the procedure described by AOAC (2000), Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) were determined using method described by Van soest and Goering (1990), and urinary-N was analysed by Kjeldahl (AOAC,1990) procedure. Metabolizable energy values were determined by equation: ME (MJ/kgDM) = 11.78 + 0.0064 + (0.000665EE) 2 – CF (0.00414EE) – 0.0118A (Alderman, 1992). Mineral contents of ingredients and diets were analyzed using flame spectrometer as described by Kennedy (1984).

Statistical analysis

Data obtained during the trial were subjected to analysis of variance (ANOVA) using general linear model (GLM) of statistical analysis software (SAS, 1999). Treatment means were compared and separated using Duncan Multiple Range Test (Duncan, 1985).

RESULTS AND DISCUSSION

The chemical composition of feed ingredients

The chemical composition of feed ingredients is presented in Table 1. The DM and CP recorded for BL are within the range of 85 to 93% DM and 15 to 35% CP reported for broiler litter by many authors (Park *et al.,* 1995). The 92.66% DM reported for BL in this work was higher than 90.16% DM reported by Shahid *et al.* (2008). The 27.30% CP content of BL was similar to 26.51% CP obtained by Asrat *et al.* (2008). The high CP content of BL is promoted by high uric acid content which is also known to be affected by degree of fermentation during stacking (Ruffin and McCaskey, 1990). The proximate values 97.21% DM, 2.57% CP and 3.88% ash reported for MH in the present study were different from 87% DM, 4% CP and 3.94% ash reported by Phiri *et al.* (2002). The differences observed could be associated with soil nitrogen condition, level of maturity and varietal differences (Huiling *et al*., 2009).

Animal performance

The feed intake and weight gain of Yankasa rams fed with experimental diets is presented in Table 2. The total feed intake (TFI) and Dry matter intake of T5 was significantly higher than (P>0.05) than T1, T2, T3 and T4. The increased MH intake agrees with Asrat *et al.* (2008) who recorded increase in dry matter intake (DMI) at 14 and 28% BL inclusion in goat's diet. The Maize husk intake (MHI) of 463.19 g/d recorded in the current study was higher than 249.5 to 331.6 g/day reported by Phiri *et al.* (2002) for goats fed MH supplemented with urea, *Leucaena* , *Calliandria* or their combinations, but within the range of 440 to 481.2 g/day reported by Asrat *et al.* (2008). The differences observed on MHI from different authors could be associated with concentrate allowance and quality of the basal feed. The daily weight gain (DWG) of the present work was similar to 28.5 g/d reported by Phiri *et al.* (2002) who fed complete diet of MH plus *Leucaena* to goats, but lower than 53 g/d recorded for Yankasa rams fed CSC plus sun dried broiler litter (Abubakar *et al.*, 2010). The differences observed on DWG could be explained in terms of high fibre content of MH which could limit DMI and CPI. The absence of significant difference on DWG observed across the treatments agreed with Akande and Adeleye (2002) who reported no significant difference in average weekly gain of sheep fed 0, 5, 10 and 15% level of poultry droppings as a replacement for groundnut cake.

Nutrient digestibility

The nutrient digestibility of Yankasa rams fed with graded levels of BL with MH as basal feed is presented in Table 3. The percentage digestibility of DM, OM, CP, NFE, ADF, NDF and ME were statistically similar (P>0.05) across the treatments, while EE, CF and ash were significantly different (P<0.05). The decreasing trend of Ether Extract Digestibility (EED) in the present work agrees with the report of Elemam *et al.* (2009) who also observed decreasing trend of EED from 89.05 to 78.67% at 30% and 45% BL inclusion respectively. The 45.66% crude fibre digestibility (CFD) of the present study was lower than 64.18 to 80.69% CFD obtained by Elemam *et al.* (2009), but higher than 17% reported by Asrat *et al.* (2008). The CFD at higher level of BL inclusion could be ascribed to higher intake of uric acid from the litter which yielded higher concentration of rumen ammonia-N. Normal concentration of RAN was reported to improve cellulosis by cellulytic bacteria (Abebe *et al.*, 2004).

Table 1: PROXIMATE COMPOSITION OF FEED INGREDIENTS (gkg^{-1})

		Ingredients				
Nutrient	**MO**	**CSC**	**BL**	**MH**	**SEM**	**LOS**
Dry matter	901.10^{b}	930.60^{b}	926.60^{b}	972.10^{a}	20.40	*
Crude protein	110.20^{b}	230.01^{a}	273.00^{a}	25.70^{c}	25.70	*
Crude fibre	110.00^{c}	172.80^{b}	110.90^{c}	320.20^{a}	20.10	*
Ether extract	90.00^{b}	209.10^{a}	24.30^{c}	9.60^{d}	6.20	*
Ash	9.00^{c}	46.60^{b}	160.20^{a}	38.80^{b}	13.02	*
Nitrogen free extract	680.80^{a}	551.49^{b}	431.60^{b}	640.62^{a}	74.72	*
ME(MJ/Kg DM)	14.17^{a}	14.88^{a}	10.58^{b}	10.67^{b}	1.60	*

a, b, c, d = Means in the same row with different superscripts differ significantly at $p < 0.05$

MO= Maize offal, CSC= Cottonseed cake, BL= Broiler litter, MH= Maize husk, SEM=standard error mean, LOS=Level of significance

TABLE 2: FEED CONSUMPTION AND WEIGHT GAIN OF YANKASA RAMS FED GRADED LEVELS OF BROILER LITTER IN REPLACEMENT OF COTTONSEED CAKE

	Treatment						
Parameter	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**LOS**
Maize husk (g/d)	398.07^{b}	389.50^{b}	392.14^{b}	394.21^{b}	463.19^{a}	47.64	*
Concentrate (g/d)	316.52^{b}	311.54^{b}	318.98^{ab}	334.73^{ab}	342.94^{a}	10.80	*
TFI (kg)	87.12^{b}	85.46^{b}	86.68^{b}	88.83^{b}	98.33^{a}	4.60	*
DFI (g)	726.00^{b}	712.17^{b}	722.33^{b}	740.25^{b}	819.42^{a}	42.98	*
Total DMI (g)	694.03^{b}	670.63^{b}	685.50^{b}	691.58^{b}	767.40^{a}	32.66	*
Initial WT (kg)	17.00	16.76	16.80	16.98	17.10	1.55	NS
Final WT (kg)	20.04	19.02	19.92	20.10	20.30	1.74	NS
TWG gain (kg)	3.04	3.02	3.12	3.12	3.10	0.57	NS
DWG (g)	25.33	25.17	26.00	26.00	25.83	4.78	NS
Av.H_2OI (L)	1.47	1.46	1.47	1.54	1.60	0.17	NS
Feed to gain ratio	28.66	27.99	28.04	28.47	31.72	9.57	NS
Intake %BW	3.07	3.13	3.17	3.30	3.06	0.11	NS

a, b = Means in the same row with different superscripts differ significantly at $p < 0.05$
T1=0% BL, T2=10% BL, T3=20% BL, T4=30% BL, T5=40% BL, SEM=standard error mean, LOS=Level of significance

TABLE 3: NUTRIENT DIGESTIBILITY (%) OF YANKASA RAMS FED GRADED LEVELS OF BROILER LITTER IN REPLACEMENT OF COTTONSEED CAKE

	Treatments						
Parameter	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM**	**LOS**
DM	51.33	43.93	48.77	47.33	44.31	7.12	NS
OM	51.90	45.67	49.65	46.73	42.83	6.96	NS
CP	59.78	56.32	63.51	62.09	60.46	5.49	NS
EE	73.35^{a}	65.2^{ab}	69.12^{ab}	69.44^{ab}	58.62^{b}	6.45	*
CF	33.34^{b}	34.83^{b}	36.07^{ab}	38.54^{ab}	45.66^{a}	5.01	*
Ash	44.12^{b}	47.16^{ab}	49.11^{ab}	52.83^{ab}	59.90^{a}	7.45	*
NFE	51.40	48.01	47.74	44.88	42.22	6.89	NS
ADF	18.69	18.01	16.52	16.27	16.04	3.55	NS
NDF	18.23	18.31	18.34	18.52	18.96	6.17	NS
ME (MJ/Kg)	59.69	56.82	57.15	54.24	52.65	8.23	NS

a, b = Means in the same row with different superscripts differ significantly at $p < 0.05$
DM=dry matter, CP=crude protein, CF=crude fibre, NFE=nitrogen free extract, NDF=neutral detergent fibre, ADF=acid detergent fibre, ME=metabolizable energy
T1=0% BL, T2=10% BL, T3=20% BL, T4=30% BL, T5=40% BL, SEM=standard error mean, LOS=Level of significance

TABLE 4: N-BALANCE (g/day) OF YANKASA RAMS FED GRADED LEVEL OF BROILER LITTER IN REPLACEMENT OF COTTONSEED CAKE

			Treatment				
Parameter	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM**	**LOS**
Nitrogen intake	8.25	8.21	8.37	8.57	8.80	0.45	NS
Faecal nitrogen	2.51	2.22	2.09	2.05	2.00	0.24	NS
Urinary nitrogen	1.51	1.32	1.28	1.20	1.12	0.21	NS
Total nitrogen loss	4.02^{a}	3.54^{a}	3.37^{a}	3.25^{ab}	3.12^{ab}	0.36	*
Nitrogen balance	4.23^{b}	4.67^{ab}	5.00^{a}	5.32^{a}	5.68^{a}	0.31	*
% Nitrogen retained	51.27^{b}	56.88^{ab}	59.74^{ab}	62.08^{a}	64.55^{a}	5.20	*

a, b = Means in the same row with different superscripts differ significantly at $p < 0.05$
T1=0% BL, T2=10% BL, T3=20% BL, T4=30% BL, T5=40% BL, SEM=standard error mean, LOS=Level of significance

TABLE 5: RUMEN FLUID pH AND METABOLITES OF YANKASA RAMS FED GRADED LEVELS OF BROILER LITTER IN REPLACEMENT OF COTTONSEED CAKE

			Treatment				
Metabolites	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM**	**LOS**
NH_3-N (mg/dl)	4.84^{c}	6.77^{b}	8.13^{a}	8.56^{a}	7.59^{a}	0.36	*
VFA (mmol/L)	12.60^{c}	13.87^{abc}	15.33^{a}	15.27^{ab}	13.27^{bc}	0.35	*
pH	7.09^{a}	6.69^{b}	6.44^{c}	6.50^{c}	6.69^{b}	0.05	*

a, b = Means in the same row with different superscripts differ significantly at $p < 0.05$
T1=0% BL, T2=10% BL, T3=20% BL, T4=30% BL, T5=40% BL, SEM=standard error mean, LOS=Level of significance
NH_3-N= ammonia nitrogen, VFA= volatile fatty acids, pH= power of hydrogen

TABLE 6: FEED COST OF YANKASA RAMS FED GRADED LEVELS OF BROILER LITTER WITH MAIZE HUSK AS A BASAL DIET

Parameter	Treatment						
	T1	T2	T3	T4	T5	SEM	LOS
Conc. Cost (N/d)	11.24[a]	11.37[a]	11.06[ab]	10.99[ab]	10.63[ab]	0.21	*
MH Cost (N/d)	2.84[b]	2.81[bd]	2.82[bc]	2.84[b]	3.34[a]	0.19	*
FI Cost (N/d)	14.11[a]	14.18[a]	13.88[b]	13.83[b]	13.97[b]	0.13	*
Feed cost/kg gain (N)	556.97	563.44	533.85	531.99	540.77	20.23	NS
Saving (N)	-	6.47	23.12	24.98	16.20	-	-

a, b = Means in the same row with different superscripts differ significantly at $p < 0.05$
T1=0% BL, T2=10% BL, T3=20% BL, T4=30% BL, T5=40% BL, SEM=standard error mean, LOS=Level of significance
Conc. = concentrate, MH= maize husk, FI= feed intake

Nitrogen balance

The N-balance of broiler litter in replacement of cottonseed cake is presented in Table 4. The NI increased with level of CSC replacement with BL. This observation confirms the finding of Asrat *et al.* (2008) who observed that NI of goats increased at 14 and 28% then decreased at 45% level of BL inclusion. The two results disagree with the report of Rankins *et al.* (1993) that NI decreases at lower BL inclusion level. The NI (8.21 to 8.57 g/d) reported in the present study falls below 11.2 to 13.9 g/d (Abubakar *et al.*, 2010) and 9.26 to 10.78 g/d (Adu and Lakpini, 1983). The higher NI at higher inclusion level of BL recorded in the present work could be associated to higher concentrate and MH intake. The faecal-N values were within the range of 1.7 to 3.0 g/d recorded for sheep fed different sources of nitrogen (Abubakar *et al.*, 2010). The lower N excreted by animals fed higher level of BL was an indication that animals had higher N absorption and digestibility (Abubakar *et al.*, 2010). The urinary-N values also decreased across the treatments. The highest urinary-N value (2.5 g/d) recorded in the present study fall below 2.7 to 4.0 g/d recorded by Asrat *et al.* (2008) who fed similar diets to Hararghe highland goats. The low excretion of urinary-N by the experimental animals could be associated to rumen N degradability (Mc Donald *et al.*, 2002) and N absorption (Abubakar *et al.*, 2010). The total N excreted decreased across the treatments. The N output values fall within 3.3 to 8.8 g/d (Osuhor *et al.*, 1991), but lower than 5.5 to 7.3g/d (Asrat *et al.*, 2008). The low values of total N output observed in the study could be linked to low NI recorded for each respective treatment. The N-retention (4.23 to 5.3 2g/d) observed in the present work increases with the increase level of BL in the diet. The N-retention (5.32 g/d) recorded in the present work disagree with 0.7 g/d reported by Asral *et al.* (2008) for goats fed higher level of 45% BL. The increasing N-retention observed in the study could be associated to higher sugar availability due to higher uric acid intake which believe to promote cellulose degradation (Pan *et al.*, 2003) and the consequent increase amino acid synthesis by rumen bacteria. A higher amount of these amino acids from the microbial protein could have entered the small intestine thus increase N-retention (kozloski, *et al.*, 2006). The N-retention as % intake also increases across the treatments. The N- retentions (51.27 to 64.55%) reported in this work were higher than 38.6% (Abubakar *et al.*, 2010), 45.62 to 52.32% (Elemam *et al.*, 2009), but within the range of 8.2 to 58.7% (Asrat *et al.*, 2008).

Variation of rumen metabolites

The effect of the experimental diets on rumen metabolites of Yankasa rams is presented in Table 5. The trend of rumen ammonia nitrogen (RAN) and Total Volatile Fatty Acids increased with the level of BL inclusion, while rumen pH decreased linearly in the opposite direction. The RAN, TVFA and rumen pH were significantly different ($p<0.05$) across the treatments. The RAN (4.84 to 8.56 mg\dl) recorded in this work was lower than 11.17mg/dl reported by Abubakar *et al.* (2010). The differences observed could be attributed to several factors affecting NH_3-N concentration in the rumen which included animal breed, nutritional status, age of the animal and level of supplementation.

The highest TVFA (15.33 mmol/dl) recorded in the present work was higher than 13.1mmol/dl recorded for Yankasa rams fed with sun dried broiler litter (SDBL) (Abubakar *et al.*, 2010) and also higher than 6.19 to 11.59mmol/dl reported for Yankasa rams fed similar diets (Ngele, 2008). The concentration of TVFA of the present study was within the range of 14.02 to 15.67 mmol/dl (Elemam *et al.*, 2009). The higher concentration of TVFA observed in the study due to drop of rumen fluid pH was an indication of high level of diet fermentation. But high concentration of VFA also has a reducing effect over rumen pH (Abubakar *et al.*, 2010).

Feed cost implication

The cost of feeding Yankasa rams with the experimental diets is presented in Table 6. The cost of concentrate intake of control treatment and T2 was significantly higher ($p<0.05$) than T3, T4 and T5. In the contrast, cost of MHI of T5 was significantly higher ($p<0.05$) than other treatments. The higher intake of MH at higher level of BL inclusion agrees with the report of

Asrat *et al.* (2008) who observed that goats fed higher levels of BL had higher basal feed intake of poor quality hay. The total feed intake cost/day and feed cost/kg gain decreases linearly at higher BL inclusion level. This observation was supported by Lanyasunya *et al.* (2006) who opined that poultry litter had potential for replacing much expensive grain meal-based protein supplements by decreasing feed cost while maintaining feed quality and weight gain. The higher saving recorded at 20 and 30% CSC replacement with BL was buttressed by the report of Nadeem *et al.* (1993) who observed reduced cost/kg gain on goat kids when the level of poultry litter on the diet was raised from 25 to 30%.

CONCLUSION AND RECOMMENDATION

It is recommended that BL can be included in the diets of ruminants up to 30% without adverse effect on performance. This will reduce cost of production and increase farmer's income.

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