TIMBOU-AFRICA PUBLICATION INTERNATIONAL JOURNAL NOVEMBER, 2024 EDITIONS.

INTERNATIONAL JOURNAL OF SCIENCE RESEARCH AND TECHNOLOGY
VOL. 6 NO. 9 E-ISSN 3026-8796 P-ISSN 3026-8095

COMPARATIVE EVALUATION OF PROTEIN AND NON-PROTEIN NITROGEN ON THE PERFORMANCE AND CARCASS CHARACTERISTICS OF RED SOKOTO BUCKS IN MUBI ADAMAWA STATE, NIGERIA

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DOI: https://doi.org/10.70382/tijsrat.v06i9.012

ABSTRACT

An experiment was conducted to evaluate the utilization of protein and non-protein nitrogen on the performance and carcass characteristics of Red Sokoto bucks (RSB) in Northern Nigeria. Twenty four (24) RSB approximately 5-6 months were used in a completely randomized design of four treatments replicated six times. Four different diets were formulated

INTRODUCTION

Small ruminants comprising of sheep and goats rank one of the most important grazing livestock (Aruwayo *et al*., 2023). Nigeria was endowed with an estimated population of 53,061,143 sheep, 99,879,799 goats and 22,378,374 cattle (FMARD 2022; Nayawo *et al*., 2023). Goat production contributes immensely to animal protein supply in Nigeria, and constitutes a very important part of rural economy with majority of the rural households keeping goats (Aruwayo & Muhammad, 2018) .Meat from goat contributes about 24% of the total meat supply in Nigeria (Oni, 2002).Goats rank next to cattle in income generation and their meat is quite popular and well relished (Ladele *et al*., 1996). One of the major factors responsible for low performance of livestock in Nigeria is nutrition. Seasonal scarcity and quality fluctuation in feed impairs growth and reproduction of animals as well as increase in morbidity and mortality rate particularly during the dry season (Uppsala, 2012). Proper nutrition of growing goats is essential to ensure their future productivity (Owens *et al*.,

using two protein nitrogen (Cotton seed cake – CSC and ground nuts cake - GNC) and two non-protein nitrogen (Urea and Poultry litter - PL), mixed each with wheat offal (WO). The diets were designated as I (Urea/WO), II (PL/WO), III (CSC/WO) and IV (GNC/WO). Data were taken on growth performance and carcass characteristics. Data obtained were subjected to analysis of variance using SPSS 23.0 (2017) for windows. The results of growth performance showed that, daily supplement intake and total supplement intake were highly significantly ($P<0.001$), final live weight and total weight gain were significant ($P<0.05$) and daily weight gain was significantly ($P<0.01$) different among the treatments. However initial weight gains of the bucks and feed conversion ratio were not different among the dietary treatments. Result of carcass characteristics showed that, all the parameters measured were significantly ($P<0.01$ or $P<0.001$), except spleen which was not affected by the dietary treatments. It could be concluded that diet IV (CSC/WO) being the best diet in improving the growth of the bucks and with no concomitant effects on the carcass characteristics of the bucks be recommended for feeding goats at 189.61 g/day.

Keywords: Protein, Nitrogen, Performance, Carcass, Red Sokoto Bucks.

1993). On the other hand, diets for growing goats fed in confinement should be cheap and easy to handle (Martinez Marin, 2007).

Tropical grasses are usually associated with high biomass production. However, as the plants mature, the biomass accumulation is associated with thickening and high lignin content in their cell walls. These place constraints for microbial digestion and fermentation and consequently decrease the forage quality (Olafadehan *et al*., 2009). Ruminant animals in Nigeria are underfed due to high costs of feed ingredients especially plant proteins sources like soybean meal, groundnut meal and Cottonseed cake. The use of poultry manure and urea as substitute to reduce the costs of production and improved animal performance has, however, been demonstrated (Belewu, 1997; Lamidi, 2005; Jokthan *et al.,* 2013). The study was therefore designed to compare protein and non-protein nitrogen sources on the performance and carcass characteristic of Red Sokoto bucks in North Eastern Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted at the Federal Polytechnic Mubi Teaching and Research Farm Mubi, Adamawa State. Adamawa State is located in the North Eastern part of Nigeria, lying between latitudes 7° and 11°N of the equator and between longitudes 11° and 14°E of the Greenwich Meridian. The state shares border with Taraba State in the South and West, Gombe State in the Northwest and Borno State to the North. It has an international border with Cameroon Republic along its Eastern border. Adamawa State covers a land mass of 38,741 km^2 with a population of 3,166,101 inhabitants based on the 2006 census (Ajawara, 2007).

Mubi lies on latitude 10° 16′ 8″ N and and longitude 13° 16′ 14″ E of Greenwich meridian (Anonymous, 2015). Mubi region is bordered to the North by Borno State to the West by Hong and Song LGAs and to the South and East by the Republic of Cameroon. It has a land area of 4,728,77 km^2 and human population of 151,000 going by 2006 census figure (Adebayo, 2004; Ajawara, 2007).

Experimental Design

The experiment was conducted in a completely randomized design (CRD) with four treatments replicated six times (Steel and Torrie, 1980).

Procurement and processing/treatment of experimental ingredients

Rice Straw (RS)

The rice straw was collected from the rice farms of Agricultural Technology Programme, Federal Polytechnic Mubi. The rice straw was comprised of the leaf and straw portions. It was chopped manually using small axe to a length of approximately 3-5 cm. It was bagged and stored before use.

Groundnut haulms (GNH)

Groundnuts haulm was purchased from Vimtim town in Mubi North Local Government Area of Adamawa State. The haulms were crushed, bagged and stored before use.

Poultry litter (PL)

Litter materials managed on deep litter system housed for 13 weeks from was obtained from the poultry unit of Federal Polytechnic Mubi. The litter was thoroughly raked to remove any foreign and/or caked materials and sun dried for about five days. The litter (sun-dried poultry litter, SDPL) was then ground, sieved and stored in bags for use to

prepare the experimental supplement diets as reported by Abubakar (2008) and Ngele *et al.* (2010)

Urea

Granular urea 46 % N Notere brand of Notere Industrial Park Onne Rivers State was purchased in Mubi main market. The urea was ground and used for the formulation of the experimental supplements.

Cotton seed cake (CSC): Cotton seed cake was purchased at Mubi cattle market. The cake was ground before use.

Groundnuts cake (GNC): Locally made groundnut cake was purchased at Mubi main market. The cake was pounded in a mortar before feed formulation.

Animals and their Management

Twenty five (24) Red Sokoto bucks approximately 5-8 months old were used. The weights of the animals ranged between 11.20 kg and 13.00 kg with an average weight of 11.94 kg. The animals were purchased from Mubi cattle market and Uba sheep/goats market. About three weeks to the arrival of the animals, the pens were washed with clean warm water followed by applications of disinfectants (Septol). This was done to kill diseases causing organisms and their eggs. Broken pen doors were repaired and cracked floors were mended. The animals were quarantined for one (1) week during which they were dewormed with Albendazole (oral suspension 1.00 mls to 2.00 mls) and dipped against ecto-parasites using an acaricide (Diazintol) solution. Animals were also injected with oxytetracycline L. A. broad spectrum antibiotic. Rectal temperatures were also taken before administering the treatment (average 38.47°C). During the quarantine period, the animals were fed chopped rice straw/groundnut haulms *ad libitum*. They were also provided with good clean drinking water *ad libitum* together with salt licks. At the end of the quarantine, animals were identified with green plastic ear tag carrying three digit numbers. Animals were randomly divided into five groups of five animals each and kept in individual pen. The pens (measuring 4 x 6 feet or 1.22 x 1.83 m) were made of concrete floors and well ventilated. Each pen was cleaned daily (Abubakar, 2008; Shua *et al.,* 2011). The experiment lasted for a period of 88 days, October to December, 2012 (early dry season).

Experimental Diets and Animal Feeding

Two non- protein nitrogen (Urea and Poultry Litter) and two protein nitrogen (Ground nuts cake and Cotton Seed Cake) were each mixed with Wheat offal to formulate the

supplements making a total of four experimental diets designated as supplement; I = urea/wheat offal (urea/WO), II = poultry litter/wheat offal (PL/WO), III = cotton seed cake/wheat offal (CSC/WO), IV = groundnut cake/wheat offal, while groundnut haulms/ rice straw (GNH/RS) as the basal feed. The supplements were formulated to contain 15 % crude protein. Each animal was offered 200 g (1.7 % body weight) of its respective supplement every morning at about 8:00 am. They were allowed to consume the supplement for about one and half hours (8:00 am to 9:30 am). Supplemental feed refusals were collected and weighed, in order to determine their intake. The basal diets (GNH/SDRS) were offered *ad-libitum,* although this was offered two times per day to avoid wastage (10:00 am and 4:00 pm). Clean drinking water was given *ad libitum*. Treatments were administered where necessary throughout the duration of the experiment as described by Abubakar, 2008; Shua *et al.,* 2011. Ingredients and chemical composition of the experimental diets are presented in Tables 1 and 2.

Measurement of Growth Performance

Feed intake of bucks was measured by weighing the left over feed using a manual measuring scale, while daily weight gain was determined by weighing the animals using 200kg hanging scale every week and the value divided by seven to obtain daily weight gain. Total feed intake and daily weight was obtained by multiply daily feed intake or daily weight gain by the duration of the experiment.

Carcass Evaluation

At the end of the feeding trial (87^{th} day), two animals per treatment were randomly selected and slaughtered for carcass evaluation (total of 8 bucks). The carcass was evaluated according to the methods of Ahmaefule and Udo (2010). Fasted live weights of the animals were taken before slaughter. After slaughter, bled weights were also taken. The animals were flayed (skinned with knife). The external and internal organs carefully removed. Empty weights and warm carcass weights were taken, dressing percentages were calculated. The weights of the head, legs, skin and gut (reproductive organs, gut, heart, liver, spleen, kidney and lungs) were taken after carefully removed and weighed individually. The four legs were weighed together as one.

Chemical Analysis

The dry matter of the feed sample was determined based on weight loss after 24 hours in an oven at a temperature of $100^{o}C$. Nitrogen content was determined by the micro Kjedahl method (AOAC, 2010) and crude protein (CP) calculated as nitrogen content multiply by

6.25 (N x 6.25). Ash content was determined by combustion in a furnace at 500°C following the procedure of (AOAC, 2010). Organic matter was assumed to be the result of subtracting the percentage of ash from 100. Neutral detergent fibre and acid detergent fibre of the samples were determined as described by Van Soest (1991).

Statistical Analysis

Data collected were subjected to standard ANOVA procedures using the software package SPSS 25.0 (2017) for Windows. Significant means were separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1955)

Table 1: Ingredients Composition of Non- Protein and Protein Nitrogen Supplements and Basal Diet Fed to Red Sokoto Bucks

	Supplements				
	NPN		PN		
Ingredients (%)	I Urea/WO	II PL/WO	III GNC/WO	IV CSC/WO	Basal Diet
Urea	0.78	0.00	0.00	0.00	0.00
Poultry litter	0.00	33.74	0.00	0.00	0.00
Groundnut cake	0.00	0.00	12.66	0.00	0.00
Cotton seed cake	0.00	0.00	0.00	8.73	0.00
Wheat offal	97.22	64.26	85.34	89.27	0.00
Groundnut haulms	0.00	0.00	0.00	0.00	40.58
Sun dried rice straw	0.00	0.00	0.00	0.00	58.42
Salt lick	0.50	0.50	0.50	0.50	0.50
Bone meal	1.50	1.50	1.50	1.50	1.50
Total	100.00	100.00	100.00	100.00	100.00

CSC= Cotton seed cake, GNC= Groundnut cake, WO= Wheat offal, PL= Poultry litter, NPN= Non protein nitrogen, PN = protein nitrogen

Sources: Shua (2022)

Table 2: Chemical Composition of Non- Protein and Protein Nitrogen Supplements and Basal Diet Fed to Red Sokoto Bucks

Supplements	NPN			PN	Basal feeds	
	I	II	III	IV		
Parameters	Urea/WO	PL/WO	GNC/WO	CSC/WO	GNH	SDRS
Dry matter	93.67	93.81	92.14	93.03	91.02	91.84
Organic matter	91.94	91.49	91.11	89.80	90.97	91.64
	14.57	14.88	14.30	15.01	6.15	3.79

Crude protein Ash	8.06	8.51	8.89	10.20	9.03	8.36
Neutral detergent fibre	41.52	40.77	44.29	43.08	40.97	62.08
Acid detergent fibre	30.44	29.52	31.69	31.28	22.58	50.22
Hemicellulose	10.08	11.25	12.60	11.80	18.39	11.86
Ether extract	3.13	4.40	6.34	5.81	2.11	0.89

CSC= Cotton seed cake, GNC= Groundnut cake, WO= Wheat offal, PL= Poultry litter, GNH= Groundnut haulms, SDRS= Sun dried rice straw, NPN= Non protein nitrogen, PN = protein nitrogen

Sources: Shua (2022)

RESULTS AND DISCUSSION

Growth Performance of RSB Fed Non- Protein and Protein Nitrogen and Basal Groundnut Haulms / Rice Straws

The result of daily supplement intake (DSI) indicated that, there was highly significant (P<0.001) difference among the different protein sources. The DSI was higher for protein nitrogen with a mean value of (187.61 g/day) and (174.99g/day), for CSC/WO and GNC/WO, respectively. This is not in agreement with the report of Adegbola *et al.* (1985) that types of protein had no effect on the feed intake of sheep. The result obtained in this study did not fall within the values report by Ndlovu and Manyame (1987) where types (sources) of protein had no effect on the feed intake of steers. The result however agreed with the findings of Jokthan *et al*. (2013) who reported a significant difference in different types of protein on daily concentrate intake of sheep fed graded levels of broiler litter in replacement of cotton seed cake. The high DSI obtained with bucks fed CSC/WO and GNC/WO may be due to palatability of these diets over the other diets.

Total supplement intake (TSI) was also significantly (P<0.001) affected across the dietary treatments. The trend is similar to DSI. The means value of TSI ranged from 13.00 to 16.69 kg, this is not comparable with 36.68 to 98.33 kg reported by Jokthan *et al.* (2013) for Yankasa rams. This difference may be attributed to the differences in the species of animals and experimental diets used in the two experiments. The initial and final live weight of the animals did not vary significantly which indicates that the weights of the animals were similar at the commencement of the experiment. This report is similar to the finding of Finangwai *et al*. (2012) who also observed in significant difference in initial weight and final weight of growing WAD bucks fed Acha straw supplemented with ensiled poultry litter in concentrate mixture.

The daily weight gain was significantly (P<0.01) affected across the treatments. The values ranged from 22.73 to 31.25 g/day. This value is not similar with 32.68 to 50 50.19 g/day

obtained by Ibrahim *et al.* (2014) for Red Sokoto goats fed Sabara leaf meal. This difference may probable be explained due to differences in environment, protein and energy contents of forages in the two experiments. Ash and Norton (1987) reported that weight gain by goats is highly dependents on protein and energy contents of the forage. Bucks fed rumen un degradable protein CSC/WO gained more weight (31.25 g/day) than rumen degradable protein (urea and poultry litter) with mean values of 25.23 and 22.73 g/day respectively. The lower DWG obtained by urea and poultry litter could be due to supply of low level of rumen un-degradable protein in these diets. In connection to this, McDonald *et al.* (2002) revealed that rumen un-degradable protein was more useful in promoting daily live weight gain.

The total weight gain (TWG) which ranged from 2.00 to 2.75 kg was significantly (P<0.05) different among treatments. The value reported in the present study is slightly lower than 3.02 to 3.12 kg reported by Jokthan *et al.* (2013) for Yankasa ram. Differences might be due to difference in nutrient and nutrient utilization of the animals in the two experiments.

Carcass Characteristic of RSB Fed Non- Protein and Protein Nitrogen and Basal Groundnut Haulms / Rice Straws

Fasted live weight and bled weight differs significantly (P<0.001), although bucks fed CSC/WO were heavier than the rest. This may be attributed to higher supplement intake and higher total weight gain recorded by bucks on this diet. The fasted live weight and bled weight (11.84 to 15.92 kg and 11.42 to 15.10 kg, respectively) reported in this study is higher than fasted live weight (6.00 to 9.27 kg) and bled weight (5.63 to 8.92 kg) reported by Ahamefule and Udo (2010). This could be due to differences in species, age and diets used in the two experiments.

Empty live weight and dressed carcass are functions of live weight (Aruwayo & Muhammad, 2018). The empty live weight obtained in the present study of 9.70 to 13.54 kg differ significantly (P<0.001) among treatments. These values are similar to 10.4∓0.7 to 16.8 ± 1.9 kg reported by Okello *et al.* (2009) for Mubende goats fed elephant grass *ad libitum*. The high significant mean value obtained with bucks fed CSC/WO than other diets was in agreement with Okello *et al.* (2009) who also obtained high empty body weight with Mubende goats on CSC than other diets Warm carcass was statistically different (P<0.001). The values in the present study which ranged from 4.32 to 6.90 kg were not comparable with 1.98 to 5.38kg observed by Ahamefule and Udo (2010).

Dressing percentage differed significantly (P<0.05), although goats fed CSC/WO and GNC/WO recorded higher dressing percentage than the rest (43.44 and 43.73 %, respectively). The lower dressing percentage recorded by Urea/WO, PL/WO and control

diets may be attributed to the insufficient amount of energy and protein in these diets. The value of dressing percentage in the present study ranged from 30.55 to 43.73 % reported by Ahamefule and Udo (2010) for West African Dwarf goats. The legs were heavier for bucks on urea diet (640.00 g) than the rest of the diets. This may be due to lower dressing percentage recorded by bucks on this diet.

The head was heavier for bucks fed CSC/WO (1.34 kg), this may be due to higher fasted live weight by bucks on this diets. The value which ranged from 1.12 to 1.34 kg did not tally with 552.66 to 679.00 g obtained by Ahamefule and Udo (2010), this may be attrbitued to the difference in age and breed of animals used in the two experiments. The reproductive organ (full) as well as testes after detachment were significantly ($P<0.001$) different among the treatments. The fact that gossypol may have detrimental effects on male reproductive organ with marked testicular and spermatogenic epithelium damage (Randel *et al*., 1992) was not applicable to the present study. Because animals on CSC/WO based diet recorded the highest weight of reproductive organ (268.00 g) as well as for testis (165.00 g).

Weight of gut, which is the reflection of feed intake was statistically different ($P<0.001$ and $P<0.05$) for full gut and empty gut respectively. The gut was heavier for bucks on CSC/WO (4.55 kg) and least for bucks on GNC/WO (3.22 kg). These maximum and minimum values of gut obtained in the present study is higher than 2.32 kg (maximum) and 1.46 kg (minimum) reported by Ahamefule and Udo (2010).

The heart, lungs, liver, spleen and Kidney of the bucks were normal indicating that, there was no effect of gossypol or Aflatoxin or urea toxicity from the diets. Ahamefule and Udo (2010) also reported a normal heart, lungs liver, spleen and kidney for West African Dwarf goats. The skin was significantly ($P<0.001$) different among treatments and was highest for bucks fed CSC/WO (1.24 kg) suggesting that is one of the component of function of final body weight.

CONCLUSION

Supplementing Red Sokoto bucks with protein nitrogen gave satisfactory result in the bucks than the non- protein counterpart. The bucks' feed CSC especially had balanced nutrients. The non- satisfactory performance of the bucks placed on non-protein nitrogen diets may be due to the fact that, non-protein nitrogen utilization depends on digestible energy or total digestible nutrients contents of the diets and deficiency of any minerals which are essential for rumen micro -organism were probably the factors.

RECOMMENDATIONS/APPLICATION

Based on this study, diet IV (CSC/WO) was the best diet due to significant improvement in the growth of the bucks and with no concomitant effects on the carcass characteristics of the bucks be recommended for feeding goats at 189.61 g/day.

Table 3: Growth Performance of Red Sokoto Bucks Fed Protein and Non-Protein Nitrogen and Basal Groundnut Haulms/Rice Straws

Parameters	Supplements				±SEM	LOS
	NPN		PN			
	I Urea/WO	II PL/WO	III GNC/WO	IV CSC/WO		
Daily supplement intake (g/day)	147.71^{d}	158.99^{c}	174.99^{b}	189.61^{a}	3.75	***
Total supplement intake (kg)	13.00^{cd}	14.00^{c}	15.50^{b}	16.69^{a}	0.31	***
Initial live weight (kg)	11.3	11.54	11.2	12.7	0.99	NS
Final live weight (kg)	13.50^{b}	13.54^{b}	13.28^{b}	15.45^{a}	0.92	*
Total weight gain (kg)	2.22^{b}	2.00^{c}	2.08^{c}	2.75^{a}	0.15	*
Daily weight gain (g/day)	25.23^{b}	22.73^{c}	23.63^{bc}	31.25^{a}	1.68	**
Feed conversion ratio	5.86	7	7.4	6.12	1.01	NS

^{a,b,c}Means bearing different superscripts are significantly different (*= P<0.05, ** =P< 0.01, *** =P< 0.001), GNC = Groundnut cake, CSC = Cotton seed cake, PL= Poultry litter, WO = Wheat offal, LOS = Level of significance, NS = Not significant, SEM = Standard error of the mean, NPN= Non-Protein Nitrogen, PRN = Protein Nitrogen.

Sources: Shua (2022)

Table 4: Carcass Characteristics of RSB Fed Non- Protein Nitrogen, Protein Nitrogen and Basal Groundnut Haulms and Rice Straws

Parameters	Supplements				**±SEM**	**LOS**
	NPN		PN			
	I	II	III	IV		
	Urea/WO	PL/WO	GNC/WO	CSC/WO		
Fasted live weight (kg)	14.12^{c}	14.80^{b}	11.84^{e}	15.92^{a}	0.25	***
Bled weight (kg)	13.53^{c}	14.08^{b}	11.42^{e}	15.10^{a}	0.24	***
Empty weight (kg)	11.74^{c}	12.57^{b}	9.70^{c}	13.54^{a}	0.22	***
Warm carcass (kg)	4.32^{d}	5.78^{b}	5.18^{c}	6.90^{a}	0.27	***
Dressing percentage (%)	30.55^{d}	38.98^{b}	43.73^{a}	43.44^{a}	1.38	*
Legs (g)	640.00^{a}	436.00^{c}	520.00^{bc}	600.00^{ab}	59.11	**
Head (kg)	1.12^{b}	1.33^{a}	1.12^{b}	1.34^{a}	0.07	***
Reproductive organ full (g)	160.40^{b}	164.00^{b}	116.00^{d}	268.00^{a}	4.53	***
Testis (g)	108.40^{b}	112.00^{b}	65.00^{c}	165.00^{a}	17.26	***
Full gut (kg)	3.52^{b}	4.48^{a}	3.22^{b}	4.55^{a}	0.3	***
Empty gut (kg)	1.02^{b}	1.22^{ab}	1.18^{b}	1.51^{a}	0.15	*

Heart (g)	76.00^{c}	108.00^{a}	98.00^{ab}	94.00^{ab}	7.57	**
Lungs (g)	181.00^{b}	196.00^{a}	174.00^{bc}	180.00^{b}	5.64	**
Liver (g)	295.00^{b}	302.00^{ab}	204.00^{c}	320.00^{a}	8.77	***
Spleen (g)	37	36	37.2	36.62	11.77	NS
Kidney (g)	80.00^{c}	114.00^{a}	78.00^{c}	94.00^{b}	5.47	***
Skin (kg)	0.80^{b}	1.12^{a}	0.85^{b}	1.24^{a}	0.09	***

^{a,b,c}Means bearing different superscripts are significantly(P<0.05) different (* P<=0.05, ** P<=0.01, *** P<=0.001), GNC = Groundnut cake, CSC = Cotton seed cake, WO = Wheat offal, LOS = Level of significance, NS = Not significant, SEM = Standard error of the mean, NPN= Non-Protein Nitrogen, PRN = Protein Nitrogen.

Sources: Shua (2022)

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