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Nutrient Intake, Digestibility and Nitrogen Balance in Red Sokoto Bucks Fed Different Ratios of Guinea Grass (*Panicum maximum*): Cowpea (*Vigna unguiculata* (L.) Walp) Shells Diets

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Abstract

The feeding value of mixtures of *Panicum maximum* and cowpea shell were investigated with Red Sokoto goats, by feeding with *Panicum maximum* hay at different ratios of 80:20, 70:30, 60:40 and 50:50, in 4 x 4 Latin square designs. The study lasted for 105 days, during which feed intake, weight gain, digestibility and nitrogen utilization were monitored in 20 goats using completely randomized design. Significant (P<0.05) difference in basal diet intake was observed, with animals fed 50:50 diet (166.88g/day) higher than 60:40 (151.25g/day) which was statistically higher than 70:30 and 80:20. Similar trend was also observed in total intake and dry matter intake. The crude protein (CP) digestibility for 60:40 (61.75gday) was significantly (P<0.05) higher than 50:50 (58.06g/day) and 70:30 (56.14g/day) which were statistically similar and higher than 80:20 (54.92g/day), which recorded least value. The crude fibre (CF) digestibility statistically (p<0.05) decreased across treatments from 50:50 (66.82g/) to 80:20 (59.18 and 58.77g/day). Nitrogen intake was significantly (P<0.05) affected by dietary treatment, with 50:50 having higher N intake (6.91g/day), which decrease with decrease panicum in the basal diet. N balance were statistically (P<0.05) higher and similar for 50:50 and 40:60 (3.56 and 3.72g/day, respectively), which were followed by 70:30 (3.04g/day) and least was in 80:20 (2.59g/day). Both nitrogen observed and nitrogen retained as percent of intake for 60:40 were significantly (P<0.05) higher as compared to all other treatments with 80:20 recording the least value. It can be concluded that feeding 60:40 ration of P. maximum to cowpea shell gave the best result in terms of nutrient intake, digestibility and nitrogen balance in Red Sokoto bucks.In conclusion Panicum cowpea shell mixture at 60:40 can be fed to red Sokoto Bucks without adverse effect on intake, digestibility and nitrogen balance.It can be recommended that small scale farmers should include 60:40 of *Panicum maximum*: cowpea shell in feeding their animals because of its availability, affordability and nutritive value.

Keywords: *Panicum maximum*, Cowpea shell and Sokoto red goats.

INTRODUCTION

Nigeria has 53.8 million goat populations (FAOSTAT, 2009) which constitute an important source of milk and meat for local consumption and hide for export market. Ruminants play an important role in socio-economic well-being of rural farmers. The major reason for the low productivity of ruminants is the poor nutritional status in terms of quality (Otchere *et al*., 1987). The major feed resources for ruminant livestock are cereal crop residues and pasture from the rangelands. Livestock graze on about 26 per cent of world's land area. Grazing systems in developing regions mainly rely on native

grassland and are only partially mixed with crops. Tchinda *et al*. (1993) reported that native pastures are the most widely available low cost feeds for ruminants in the tropics. These feed resources are characterized by low nutritive value.
Fodder, the major input in livestock rearing, is cultivated on an estimated four percent of the total cultivable land in Nigeria and this figure has remained more or less static for the last three or more decades (Delgado et al., 1999).

Increased livestock productivity will have to come from improving the productivity per unit area or expansion of marginal lands that have traditionally supplied grazing resource to livestock (Delgado *et al*., 1999).

P. maximum also called guinea grass, colonial grass and Tanganyika grass (FAO, 1989) is a highly productive, palatable, persistent and acceptable grass. It can be fed to livestock solely or with concentrates or legumes. Guinea grass (*P. maximum*) is one of the most common grasses in the dried savannah region of Nigeria. Under good conditions, its nutritional value is high, having up to 12.5% crude protein, total digestible nutrients (TDN) of 10.2% and calcium, phosphorus and magnesium (Agishi, 1985).The present investigation have been carried out with an objective of evaluating the effect guinea grass: cowpea shell mixtures on nutrient intake, nutrient digestibility and nitrogen balance of goat.

MATERIALS AND METHODS

The experiment was carried out at the Ruminant Unit of the Teaching and Research Farm. Ahmadu Bello University, Zaria. The site is located within the northern guinea Savannah ecological zones, within latitude 11^0 12'N and longitude $7^0$37'E at an altitude of about 610m above the sea level. (Ovimaps, 2014). The climate is relatively dry with a mean annual rainfall of 700-1400mm per annum, occurring between the months of April and September. The dry season begins around the middle October with the cold weather that ends in February. This is followed by a relatively hot weather from March to April when the rain begins. The mean temperature fluctuates from 31^0C maximum in the dry season to about 18^0C minimum and in the wet season.
Cowpea shells were obtained from the Seed Processing Unit of Institute for Agricultural Research after the grain harvest. *P. maximum* (guinea grass) was harvested from the pasture paddock on the National Animal Production Research Institute (NAPRI) Shika farm. The freshly cut leaves were air-dried
Four adult male Red Sokoto goats (12≠3.0kg of BW) were used in a 4 x 4 Latin square design experiment. Ingredient composition of concentrate (g/kg of fresh matter) was as follows: Four Panicum cowpea mixtures were formulated (50:50,60:40, 70:30 and 80:20), to as basals diets. The basal diets were fed to the animals and in addition the animals received a supplementary concentrate diet at 1.5% of their body weight.

Apparent Nutrient Digestibility and N Utilization

Animals were kept in individual metabolism crates where faeces and urine were separately collected using a collector as described by (Osuji et, al., 1993). Animals had free access to water throughout the experiment.
The animals were fed twice daily, at 0800 and 1400 h. A 5-L plastic bucket containing 50 ml of 10% H2SO4 to keep the final pH below 3 was placed under each crate for urine collection. Each of the 4 experimental periods consisted of 15 days: 10 days for diet adaptation, 5 days for digestibility determination. At the beginning of each trial, the animals were weighed to determine their food requirements, and feed samples were collected milled and kept until required for analysis.

Laboratory analysis

Total daily faecal output for each ram were measured, bulked, sun dried and stored in plastic bags and then oven – dried at 65^0C for proximate analysis and at 105^0 C for DM analysis, both for 24hours. Experimental diets and faecal samples were analyzed for proximate composition using the methods of AOAC (2005) and the data were used to compute the apparent nutrient digestibility of the diets and nitrogen balance.

Statistical analysis

Data collected on nutrient intake, digestibility and nitrogen balance were subjected to analysis of variance (SAS, 2002) and means where separated by Duncan's Multiple Range Test using the same statistical package, The model used for the statistical analysis is presented below.

$Y_{ijk} = M + A_i + B_j + C_k + e_{ijkl}$

Where:
Y_{ijk}= Independent variable (Intake, apparent digestibility, etc.)
M = Overall mean
A_1 = Effect of period
B_j= Effect of goats
C_k =Effect of treatment (Panium: cowpea ratios)
e_{ijkl}= Effect of random error

RESULT AND DISCUSSION

Experimental feeds

Table 1. Proximate composition of concentrate diet Panicum maximum hay and cow pea shells

Parameters	PMH	CPS	Conc. Diet
Dry matters	94.56	93.33	94.15
Organic matter	87.17	82.11	86.02
Crude protein	7.31	12.60	15.82
Crude fiber	23.18	23.40	9.17

Table 2. Proximate composition of treatment basal diets of various Panicum cowpea shell ratios

	Panicum: cowpea shell ratios			
Parameters	**50:50**	**60:40**	**70:30**	**80:20**
Dry matter	95.12	94.8	96.39	96.89
Organic matter	88.73	89.13	89.28	90.59
Crude protein	12.72	12.51	36.08	8.23
Crude fiber	31.88	32.81	36.08	36.18

The results of the proximate composition of the feed materials used are presented in Tables 1 and 2. The crude protein content of the cowpea shells used in this study (12.60%) is however lower than the 14.24% reported by (Ososanya *et al*., 2013). The results also confirm the findings of (Tarawali *et al*., 1997) who reported different values for two varieties of cowpea. The variation in the nutritive value may be attributed to the variety of cowpea used ant trashing efficiency.
The CP content of 7.67% for *P*.maximum hay used in this study is however, similar to the 7.67% CP for *P*.maximum reported by (Tona, 2011), but higher than 7.02% reported by (Bankrole *et al*., 2003), but lower than 8.1% reported by (Adegun and Aye, 2013).The lower CPcontent of *P*.maximum hay was expected because it contained more fiber because it contained more fiber because of its stage of harvest for hay making.
The crude protein of the *P.maximum* hay cowpea ration decrease with increasein the *P*. in the diet. This increase is as a result of the high crude protein content of the cow pea over the p. maximum, as presented in Table 1.

Feed Intake

Table 3 shows the result of feed intake by goats fed Panicum: Cowpea basal diet. There was significant ($P<0.05$) difference in basal diet intake, with 50:50 (166.88g/day) significantly higher than 60:40 (151.25g/day) which was statistically higher than 70:30 and 80:20 as well as between 70:30 and 80:20. Similar trend was also observed in total intake and dry matter intake with 50:50 having statistically higher ($P<0.05$) intake as compared to all other treatments. Organic matter (OM) intake for 50:50 (267.42g/day) was significantly higher ($P<0.05$) than 60:40(254.16g/day), 70:30 (247.69g/day) and 80:20 (254.95g/day). The OM intake for 60:40 and 80:20 was statistically similar and higher than

Table 3. Feed intake in Goats fed Panicum: Cowpea basal diet

	Treatments				
Parameters	**50:50**	**60:40**	**70:30**	**80:20**	**SEM**
Conc. intake	138.8	1389.8	138.8	138.8	0
Basal diet intake	166.88^{a}	151.25^{b}	149.69^{bc}	143.75^{c}	6.07
Total intake	305.63^{a}	290.00^{b}	288.44^{bc}	282.50^{c}	6.07
Dry matter intake	289.36^{a}	274.02^{b}	275.67^{b}	269.19^{c}	5.84
OM	267.42^{a}	254.16^{b}	254.95^{b}	247.69^{c}	5.45
CP	6.91^{a}	6.54^{b}	5.87^{c}	5.48^{d}	0.09
CF	73.09^{a}	67.29^{b}	60.44^{c}	59.89^{c}	2.03

^{a,b,c}: Means in the same row with different superscript are different. SEM standard error of means

70:30 which recorded the least value. The crude protein(CP) intake decreased significantly across the treatment as more cowpea replaced panicum in the basal diet with 50:50 (6.91g/day) recording the highest value and 80:20 (5.48g/day) the least. The crude fiber (CF) intake also increased statistically ($P<0.05$) across treatments from 50:50 (73.09g/day) to 70:30 (59.89g/day); though, CF intake for 70:30 had the least value but statistically similar to 80:20 (60.444g/day).

The result of DM intake in this study increase with increasing levels of cowpea shells in the diets. The values of DMI increased consistently with the increase levels of cowpea shells inclusion. DM intake is important factor in the utilization of feeds by ruminants and is a critical determinant of energy and performance in small ruminants (Devant *et al.*, 2000). It would appear the combination of cowpea shell panicum was probably more palatable and more acceptable to goats at the 50:50 ratios. Uwechue (2000) observed that the changes could be as a result of improvement In the protein status of the feed which enhances rumen micro-organism proliferation and so encourages a more rapid and through digestion of ingesta leading to stimulation.

Nutrient Digestibility

Table 4. Nutrient digestibility of Goats fed Panicum: Cowpea basal diet

	Treatments				
Parameters	**50:50**	**60:40**	**30:70**	**20:80**	**SEM**
DMD	81.55^{a}	80.92^{a}	78.99^{b}	78.74^{b}	0.7
OMD	99.27^{a}	97.49^{b}	93.18^{c}	84.84^{d}	0.58
CPD	61.75^{a}	58.06^{b}	56.14^{b}	54.29^{c}	1.71

$^{a, b,c}$: Means in the same row with different superscript are significantly different. SEM standard error of means

The results of the nutrient digestibility are presented in Table 4. Dry matter digestibility of panicum: cowpea basal diets for 50:50, 60:40.70:30 and 80:20 were 81.55, 80.92, 78.99 and 78.74g/day respectively. There was no significant increase ($P<0.05$) in dry matter digestibility between 50:50 and 60:40; though, they were both significantly higher than 70:30 and 80:20 which statistically similar and lower. The digestibility of organic matter increase statistically ($P<0.05$) across treatment with increase in the percent and panicum level, with 80:20 (99.27g/day) recording the lowest while 50:50 (84.84g/day) had the highest digestibility, suggesting that as more cowpea was used to replaced panicum organic matter digestibility increased.

The crude protein(CP) digestibility for 60:40 (61.75g/day) was significantly higher than 50:50 (58.06g/day)and 70:30 (56.14g/day) which were statistically similar to each other while 80:20 (54.92g/day) recorded significantly least value, suggesting that the CP digestibility increased with increase in percent cowpea up to 60:40 but further decreased statistically as more cowpea replaced panicum. The crude fibre (CF) digestibility decreased statistically across treatments from 50:50 (66.82g/day) to 70:30 (58.77g/day) as more cowpea replaced panicum while CF digestibility for 70:30 and 80:20(59.18 and 58.77 g/day) were similar and lower.

The result of dry matter and crude protein digestibility (Table 4) generally reported in this study are higher than 56.88 and 58.51, respectively reported by (tona, 2011) for sheep fed P. maximum. The observation in this study is consistent with Girl *et al*.(2000)and Aregheore (2000) who affirmed that digestibility of nutrients varies with nutrients composition of diet. The higher crude fibre digestibility observed in the 50:50 treatment diets might be related to changes in the rate of passing of ingesta from the rumen (Badamana,1992). The result obtained in this study is consistent with Ososanya *et al*.(2013) who fed corncobs and cowpea shells to West African dwarf sheep.

Nitrogen Balance

Table 5. Nitrogen Balance in Goats fed Panicum: Cowpea basal diet

	Treatments				
Parameters	**50:50**	**60:40**	**70:30**	**80:20**	**SEM**
Nitrogen intake	6.91[a]	6.54[b]	5.87[c]	5.48[d]	0.10
Urinary Nitrogen	0.42[a]	0.34[b]	0.27[c]	0.39[c]	0.04
Faecal Nitrogen	2.93[a]	2.48[b]	2.55[b]	2.50[b]	0.12
Total N outgo	3.34[a]	2.82[b]	2.84[b]	2.89[b]	0.15
N balance	3.56[a]	3.72[a]	3.04[b]	2.59[c]	0.14[*]
N observed	3.32[b]	4.06[a]	3.32[b]	2.98[c]	0.12[*]
N retained as % of intake	52.06[b]	56.48[a]	51.46[bc]	47.42[c]	2.12

[a, b,c] : Means in the same row with different superscript are significantly different. SEM standard error of means

Table 5 shows the result of nitrogen balance in goats panicum: cowpea shells mixture as basal diets to a concentrate diets. Nitrogen intake was significantly (P<0.05) affected with the dietary treatment. 50:50 diet having higher N intake (6.91g/day), which decreases with decrease in panicum in the basal diet. The increase is as a result of increase in the cowpea shell, having a higher CP value (Table 2). The N intake of experimental animals fed 50:50 and 60:40 were similar and statistically (P<0.05) higher than 70:30. N balance and also statistically decreased further with decrease in cowpea added (80:20).

Total N outgo increased significantly (P<0.05)across treatments as more cowpea replaced Panicum, with animals fed 50:50 diet having higher N outgo, followed by the rest of the treatments which were similar.

N balance were statistically (P<0.05) higher and similar for 50:50 and 40:60 (3.56 and 3.72g/day, respectively), which were followed by 70:30 (3.04g/day) and the least was in 80:20 (2.59g/day). Both nitrogen observed and nitrogen retained as percent of intake for 60:40 were significantly (P<0.05) higher as compared to all other treatments with 80:20 recording the least value.

Table 6. Economic analysis of Feed combination ratio

Feed combination	**Unit Cost/kg (₦)**		**Total amount (₦)**
	Panicum	**Cowpea shell**	
50:50	10	40	2,500.00
40:60	10	40	2,800.00
30:70	10	40	3,100.00
20:80	10	40	3,400.00

Source: National Animal Production Research Institute, Shika, Nigeria

Table 6 shows the economic analysis of the feed combinations. Feed combination 20:80 cost higher, followed by 30:70 and 40:60 while least cost was 50:50. Though 50:50 feed combination had the cost it is however does not translate to high productivity. 40:60 feed combination is relatively higher the 50:50 but has higher productivity of the buck in terms of feed intake, nutrient digestibility and nitrogen balance.

Conclusion and Recommendations

Based on the present study it can be concluded that Panicum: cowpea shell mixture at 60:40 can be fed to red Sokoto bucks without adverse effect on intake, digestibility and nitrogen balance. It is therefore recommend that small scale farmers should include 60:40 of panicum maximum: cowpea shell in feeding their animals because of its availability, affordability and nutritive value.

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