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Feed intake, growth performance and nutrient digestibility in growing Red Sokoto bucks fed supplements containing graded levels of *Piliostigma reticulatum* pods in semi-arid Nigeria

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Abstract

Twenty growing Red Sokoto bucks with average weight of 15.25±0.35kg were used to evaluate the effect of supplementing Piliostigma reticulatum pods (PRP) based diets on feed intake, growth performance and nutrients digestibility. The study was conducted at Teaching and Research Farm, Federal University Dutse. The bucks were randomly assigned to five dietary treatments in a completely randomized design (CRD) and were replicated four times each. The five diets were formulated with 0%, 7.5%, 15%, 22.5% and 30% inclusion levels of PRP for T1, T2, T3, T4 and T5 respectively. The diets were supplemented to the experiment bucks at 2% of their body weight for 84 days; crushed sorghum stalk was used as basal diet. The basal diet and water were provided ad libitum. Data were generated on feed intake, liveweight changes; feed conversion ratio and nutrients digestibility. The results obtained revealed significant differences (P<0.05) in treatments evaluated. Treatment with 0%, 7.5% and 15% PRP inclusion were statistically the same in terms of total feed intake, weight gain and feed conversion ratio compare to others. Daily intake of supplements increases with inclusion level up to T3 (7.5% PRP) and decline thereafter. Treatment with 7.5% PRP (T3) was superior (P<0.05) in digestibility of Ash (47.00%); OM (55.81%) and CP (70.49%) while treatment with 30% PRP inclusion leads in CF (45.33%), EE (34.37%) and NDF (40.53%). This study therefore recommends the inclusion of up to 7.5% of Piliostigma reticulatum pods as feedstuff in ration formulation to serve as supplements to avert dry season feed scarcity.

Keywords: Bucks, Digestibility, weight gain, Piliostigma reticulatum Pods

Description of Problem

The most taxing limitation in small ruminant production in the tropics is the inadequacy and poor quality of the available energy and protein feedstuffs particularly during the dry season (1), (2) and (3). The majority of ruminants in tropical Africa are raised on natural pastures, which decline rapidly in quantity and quality during the dry season and such changes in nutritional status result in very irregular growth and marked fluctuations in seasonal live weights (4). Moreover, during this critical period, obtainable forages do usually contain low energy and protein content and this affects voluntary intake and digestibility leading to loss of weight amongst the animals (3). Unfortunately, small scale farmers do not make investment to establish improved pastures and feed concentrate supplements to alleviate dry season decline in body weight, as such are increasingly relying on browse and

crop residues during the dry season.

Fodder trees and shrubs are vital component in livestock productivity in the arid and semi-arid zones (5). About 52% of the cattle, 57% of the sheep, 65% of the goats and 100% of the camels are in tropical Africa and they depend heavily on browse species to meet their dietary requirements (6). They supply goats and camels with the bulk of their nutritive requirements and complement the diet of cattle and sheep with protein, vitamins and minerals in which bush straw is deficient during the dry season (7; 8).

Livestock production contributes considerably to the agricultural GDP in Sub-Saharan Africa (SSA), up to 35% (9). National Agricultural Sample Survey of 2011 estimatedlivestock population in Nigeriaat 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs and 28,000 camels (10). Seventy percent of small ruminants' species in Nigeria are found in the northern part of the country (Semi-arid zone of Nigeria).

Browse plants are the only available feed resource during stress periods of livestock production in the semi-arid zone. *Piliostigma reticulatum* is native to Africa and grows in open woodland, wooded grasslands and sub-humid savannas and in the Sahelo-Sudanian region and is one of the most abundant and available browsespecie in the semi-arid zone of Nigeria (11, 12). *Piliostigma reticulatum* pods harvested from semi-arid zone of Nigeria contain a mean 93.13± 0.30 % DM, 17.95± 0.27 % CP, 3.21± 0.10 % EE, 5.39± 0.12 % Ash, 16.16± 0.14 % CF and 57.29± 0.35 % NFE, tannins 0.99 to 1.21 mg/g, saponins 0.53 to 0.63 mg/g, phytate 0.43 to 0.59 mg/g, oxalate 1.71 to 3.10 mg/g and hydrogen cyanide 0.21 to 0.36 mg/g (13). On the other hand, (14) reported that *Piliostigma reticulatum* seeds contain 30.3± 3.1% CP. Research report on nutritive values of *Piliostigma reticulatum* foliage revealed 78.50± 0.96% DM, 10.57± 1.2% CP 28.23± 0.22% CF, 4.63± 0.22% EE, 6.53± 0.16% Ash and 56.90± 1.19% NFE (3). This study attempts to explore the possibility of using *Piliostigma reticulatum* pods in feeding red Sokoto bucks.

Material and Methods

Study Area

The study was conducted at the Department of Animal Science, Teaching and Research Farm, Federal University Dutse, Jigawa State located between longitudes $11^{o}42'$ to 12^{o} 27' and latitudes 07^{o} 29' to 11^{o} 04' at an attitude of 434m above sea level in semi-arid zone of Nigeria. The area receives an annual average rainfall of 743 mm/ annum with a mean annual temperature of 26.5^{o}C (15).

Preparation of Experimental Feeds

Field grown matured pods of *Piliostigma reticulatum* used for this study were harvested within longitudes $11^{o}52'0''$N and latitudes $09^{o}58'0''$E, at an altitudes of 420m above sea level in Itas-Gadau Local Government Area of Bauchi State. The pods were packed in 50kg jute bags and transported to Department of Animal Science Teaching and Research Farm, Federal University, Dutse where they were further dried under shade and later crushed with machine to pass through 3 mm sieve. The processed pods were used in the formulation of the experimental diets as indicated in Table 1.

Table 1: Compositions of experimental diets used for the feeding trial

	Treatments: Graded levels of *Piliostigma reticulatum* Pods (%)				
Ingredients	T1	T2	T3	T4	T5
Piliostigma reticulatum pods	0.0	7.5	15.0	22.5	30.0
Soya bean meal	8.0	5.0	3.0	0.0	0.0
Maize Grain	8.0	9.0	12.0	12.0	7.0
Cowpea husk	20.0	19.0	21.0	21.0	5.0
Wheat offal	18.0	15.0	6.0	2.0	2.0
Rice mill waste	45.5	44.0	42.5	42.0	55.5
Salt	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100
Calculated Analysis					
Energy (Kcal/kg)	2029	2021	2052	2027	2025
Crude Protein (%)	12.4	12.3	12.4	12.4	12.3
Crude Fibre (%)	21.4	22.3	23.8	25.6	28.6
Ether Extract (%)	4.3	4.3	4.3	4.3	4.3
Cost/Kg (₦)	26.62	24.83	23.09	21.25	20.25

Experimental Animals and their Management

Twenty growing red Sokoto bucks (RSB) of average aged 12 months, and initial body weights (BW) of 15.25± 0.35kg were procured from a local market in Taura LGA of Jigawa State. The animals were quarantined for 3 weeks and ear tagged for identification. Prior to commencement of the experiment, the animals were given prophylactic treatments. They were dewormed with anthelmintics (Albendazole®) to control endo-parasite at 3ml/10kg body weight; and repeated after 2 weeks. Ivermectin (Ivomec®) was administered by subcutaneous route at the rate of 1ml/50kg BW against ecto-parasites. Oxytetracycline LA (Tridox®) and multivitamins were administered by intramuscular route, at the rate of 1mL per 10Kg BW against bacterial infections and to enhance apetite, respectively, one week before the commencement of the experiment; the dosages were repeated after 3 days. The goats were housed in individual pens 1.25m^2 each, well-lighted and adequately ventilated building with slightly sloppy concrete floor. The pens were disinfected with Izal solutions before the animal arrived and thereafter cleaned fortnightly till the end of the experiment.

Experimental Design and Treatments

The animals were assigned to treatments 1 to 5; four animals per treatment as replicates in a Completely Randomized Design (CRD). The treatments evaluated were diets containing *Piliostigma reticulatum* pods at 0% (T1), 7.5% (T2), 15% (T3), 22.5% (T4), and 30% (T5) inclusion levels and fed as supplement for a period of 84 days (12weeks). Crushed Sorghum stalk was provided *ad-libitum* after feeding of the experimental diet to goats at 2% BW in morning from 09:00h to 12:00h daily for the duration of the trial. Clean drinking water was provided *ad-libitum*; the daily feed intake was determined by difference in weight of quantity of feed offered and the residue of the feed leftovers at 12:00h. Weighing of the goats was carried out weekly before the morning feed is offered to determined

liveweight gainusing a hanging scale (Salter suspended weigher, model 235).

Nutrients Digestibility

Fifteen red Sokoto bucks comprising of three animals randomly selected from each treatment at the terminationof the growth study were used for digestibility study. They were put in individual metabolic crate and fed the experimental diet *adlibitum*. Faecal sample was collected for seven days following the adjustment period of 14 days, under a wire mesh (netting) suspended under the digestibility crates. Feed intake was determined by the difference between the quantity of feeds offered and the amount of feed leftover the following morning. The daily faecal output was weighed for each animal during the seven dayscollectionperiodfor laboratory analysis. Measured samples of faeces from each animal werecollected in white polythene bags and stored at -40C in the freezer. Faecal samples of the animals used for this study were separately bulked, mixed thoroughly and sub-sampled for proximate and fibre analysis.

Chemical Analysis

Samples of 500g from each treatment of experimental diets were oven dried at 65^{o}C for 48 hours for determination of dry matter and thereafter sub-samples were ground in hammer miller to pass though a 1mm mesh sieve for crude protein, crude fibre, nitrogen free extract, ether extract and ash according to procedures described by (16). Fibre fractions: neutral detergent fibre, acid detergent fibre and hemicellulose according to procedures described by (17). Metabolizable energy (ME) was calculated using the equation described by (18) MEkcal/kg = 37(%CP) + 81.1(%EE) + 35.5(%NDF).

Statistical Analysis

The data obtained from chemical analysis, growth trial and nutrients digestibility were subjected to analysis of variance (ANOVA) using General Linear Model of SAS (19), where differences in means were detected by Fisher's least significant difference (FLSD) at 5% level of probability.

Results and Discussion

Chemical Composition of Experimental Supplements

Table 2 shows chemical composition of supplements with graded levels of *Piliostigma reticulatum* pods fed to red sokoto bucks in the semi-arid Nigeria. The results of chemical analysis revealed that: DM 94.46% to 95.39%; Ash 13.05% to 16.57%; OM 78.54% to 81.41%; CP 11.67% to 12.45%; CF 16.88% to 17.77%; EE 3.88% to 5.18%; NFE 49.68% to 53.06%; NDF 54.10% to 57.36%; ADF 38.42% to 42.78%; HE 11.06% to 18.94% and ME 2584.88 to 2795.95 kcal/kg.

Table 2: Proximate composition of *Piliostigma reticulatum* pods based diets fed as supplement to red sokoto bucks in semi-arid Nigeria

	Treatments: Graded Levels of *Piliostigma reticulatum* Pods					SE±
	0(T1)	7.5% (T2)	15% (T3)	22.5% (T4)	30% (T5)	
DM	94.65	95.39	94.49	94.46	95.11	0.10
Ash	15.79	15.23	13.38	13.05	16.57	0.37
OM	78.86	80.16	81.11	81.41	78.54	0.32
CP	12.04	12.45	12.10	12.01	11.97	0.09
CF	17.48	17.77	16.88	17.32	16.88	0.09
EE	4.34	4.87	5.18	4.47	3.88	0.12
NFE	50.35	49.68	52.66	53.06	51.00	0.68
NDF	50.83	53.84	54.10	56.03	57.36	0.59
ADF	38.47	42.78	41.25	40.30	38.42	0.45
HE	12.36	11.06	13.17	15.41	18.94	0.74
ME (Kcal/kg)	2584.88	2766.93	2788.35	2795.95	2793.84	0.85

DM-Dry matter, OM-Organic matter, CP-Crude protein, CF-Crude fibre, EE-Ether extract NFE-Nitrogen free extract, NDF-Neutral detergent fibre, ADF-Acid detergent fibre, HE-Hemicellulose, ME-Metabolizable energy.

Performance of Red Sokoto Goats Fed Experimental Diet

Table 3 Demonstrated growth performance of red Sokoto bucks fed the experimental supplements. Results indicated significant differences (P<0.05) in all parameters evaluated. However, final body weight varied from 16.30kg in 30% PRP (T5) to 19.35kg in diet with 7.5% PRP inclusion (T2). T1, T2 and T3 were statistically similar in respect to the daily weight gain. Daily intake of experimental diets varied from 200.13g/day in T5 to 303.19g/day in T2. Intake decreased as inclusion levels of PRP increased. Also, daily intake of roughage ranges from 245.00g/day in T3 to 273.25g/day in T5. The roughage intake increased with increased in PRP inclusion levels and it indicated that treatments with 30% level of PRP inclusion had the highest intake. Weight gain of experimental animals varied from 0.95kg in T5 to 4.10kg in T2. However, T1, T2 and T3 were statistically similar in terms of weight gain. In terms of feed conversion ratio, treatments T1, T2 and T3 were better and statistically the same, followed by T4 and T5 is the least.

Table 3: Effect of graded levels of *Piliostigma reticulatum* pods supplements on growth performance of red sokoto bucks in semi-arid Nigeria

Parameters	Treatments: Graded levels of *Piliostigma reticulatum* Pods					SE±	P=0.05
	T1	T2	T3	T4	T5		
Initial body weight (kg)	15.33	15.25	15.18	15.03	15.35	0.05	NS
Final body weight (kg)	19.30^{a}	19.35^{a}	18.83^{b}	17.15^{c}	16.30^{d}	0.29	*
Daily Intake of Expt. Diet (g)	302.25^{ab}	303.19^{a}	294.97^{b}	226.43^{c}	200.13^{d}	10.02	*
Daily Intake of Roughage (g)	249.25^{c}	250.00^{c}	245.00^{c}	263.00^{b}	273.25^{a}	2.72	*
Total Intake (g)	551.50^{a}	553.19^{a}	539.97^{a}	489.43^{b}	473.38^{c}	7.93	*
Weight Gain (kg)	3.96^{a}	4.10^{a}	3.65^{a}	2.13^{b}	0.95^{c}	0.29	*
Daily Weight Gain (g)	47.14^{a}	48.81^{a}	43.45^{a}	25.30^{b}	11.31^{c}	3.44	*
Feed Conversion Ratio	11.65^{a}	11.33^{a}	12.43^{a}	19.34^{b}	41.85^{c}	2.98	*

Means in the same row bearing different superscripts are significantly different (P<0.05) level, * = significant at P<0.05; and NS = not significant at P>0.05.

Daily feed intake differ between the bucks used with the highest daily feed intake of 553.19g recorded in T2, this was in agreement with 601.87g to 545.16g reported by (2) on evaluation of *Acacia nilotica* pods in red Sokoto goats. However, this was in shortfall as compared to values reported by (20), they reported an average daily DM intake of 768.40g and 790g for goats fed *A. fleckii*and *A. tortilis* respectively. The intake of experimental diets decreased as the level of *Piliostigma reticulatum* pods inclusion increases from T1 to T5 and it reflected on weight gain, this could be related to the amount of tannins in *Piliostigma reticulatum* pods as the quantity increased. A threshold concentration of tannin of 5% has been reported beyond which there may be rejection of browses by goats and wild browsers (21).This is in agreement with the finding of (22); who reported reduction in intake of dry matter and crude protein when sheep were fed with browse diets containing tannins.

Nutrients digestibility in red sokoto bucks

Table 4 shows nutrients digestibility in red sokoto bucks fed supplement with graded levels of *Piliostigma reticulatum* pods in the semi-arid Nigeria. Results revealed significant difference (P<0.05) in all parameters evaluated on treatments with the exception of DM (52.50% to 54.26%) and ADF (32.20% to 33.73%). T2 supplement had significantly higher digestibility in terms of Ash 47.00%; OM 55.81% and CP 70.49% as compared to others; likewise T5 was superior in terms of CF 45.33%, EE 34.37% and NDF 40.53%.

Table 4: Influence of Piliostigma reticulatum pods based supplements on nutrients digestibility by red Sokoto bucks in semi-arid Nigeria

Nutrients (%)	Treatments: Graded levels of *Piliostigma reticulatum* pods					SE±	P=0.05
	T1	T2	T3	T4	T5		
DM	54.26	53.60	52.50	53.70	53.11	0.27	NS
Ash	45.70^{b}	47.00^{a}	45.16^{b}	45.22^{b}	43.99^{c}	0.28	*
OM	55.38^{ab}	55.81^{a}	54.55^{bc}	54.29^{c}	53.37^{d}	0.25	*
CP	68.19^{b}	70.49^{a}	63.27^{c}	57.83^{d}	52.08^{e}	1.81	*
CF	42.02^{d}	42.34^{cd}	43.65^{bc}	44.05^{ab}	45.33^{a}	0.37	*
EE	33.08^{b}	32.40^{c}	34.17^{a}	33.43^{b}	34.37^{a}	0.21	*
NDF	34.97^{d}	34.93^{d}	36.93^{c}	38.96^{b}	40.53^{a}	0.59	*
ADF	32.86	33.73	33.33	32.20	32.50	0.26	NS

Means in the same row bearing different superscripts are significantly different (P<0.05).DM-Dry matter, OM-Organic matter, CP-Crude protein, CF-Crude fibre, EE-Ether extract NFE-Nitrogen free extract, NDF-Neutral detergent fibre, ADF-Acid detergent fibre.

Nutrients digestibility of experimental diets obtained in the present study were within the range for values of browse foliage and pods reported by several authors worldwide. Values obtained on Dry matter digestibility (52.50% to 54.26%) and organic matter digestibility (53.37% to 55.81%) was in agreement with DMD (36.4% to 62.00%) and OMD (29.84% to 56.79%) reported on browse foliage and pods (23; 24; 25; 2). As reported by (13), dry matter digestibility characteristics may be due to the wall configuration of their polysaccharides and their effect on microbial attachments and colonization of digest particles. Linear increase in digestibility of fibre fraction CF 42.34% to 45.33%; NDF

34.93% to 40.53% were obtained as a result of increasing the inclusion level *Piliostigma reticulatum* pod in the diets from T2 to T5, this implies that digestibility of CF; EE; NDF were directly proportional to increases in PRP in diets, but reverse is the case with CP.

Conclusion and Applications

The study concluded that:

1. Inclusion of 7.5 % *Piliostigma reticulatum* pod in the diets of red Sokoto bucks improve liveweight gain and digestibility of Ash, organic matter, crude protein.
2. *Piliostigma reticulatum* pod can be used as feedstuff in ration formulation to serve as supplements to avert dry season feed scarcity in the semi arid of Nigeria

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