Nigerian J. Anim. Sci. 2017 (2):199 - 208

Effects of Locust Bean Pulp with Melon Husk Supplementation on Nitrogen Utilization and Blood Chemistry of West African Dwarf Goats.

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Target Audience: Ruminant Nutritionist, Goat farmers, forage scientist

Abstract

The effect of locust bean pulp with melon husk supplementation on nitrogen utilization and blood chemistry of West African Dwarf goats were assessed in a 3 months feeding trial. Eighteen West African Dwarf goats with an average weight of 6.00 ± 0.15kg were randomly allotted to three dietary treatments with two replicates of three goats per treatment in a completely randomized design. The treatment diets were; diet 1 (100% guinea grass that services as control group), diet 2 (70% guinea grass and 15% locust bean pulp with 10% melon husk) and diet 3 (50% guinea grass and 30% locust bean pulp with 20% melon husk). A metabolism trial was conducted at the end of the feeding trial to assess diets on nitrogen utilization after the blood collection. Results obtained showed that faecal nitrogen output (2.71g/day), urinary nitrogen output (1.00g/day), total nitrogen loss (3.71g/day) and serum urea (11.07mg/dl) were significantly (P < 0.05) higher in diet 1 than diets 2 and 3. Serum globulin (3.58g/dl) and glucose (64.82mg/dl) were significantly (P < 0.05) better in goats on diet 2. Goats on diet 3 were significantly (P < 0.05) higher in nitrogen intake (17.52g/day), nitrogen balance (15.02g/day), nitrogen retention (85.73%), packed cell volume (29.78%), haemoglobin (9.87g/dl), red blood cell (10.46 x 10^6/ML), white blood cell (11.86 x 10^3/ML), total protein (7.45g/dl) albumin (3.93g/dl) and cholesterol (40.31mg/dl) compared to animals on diets 1 and 2. No significant (P > 0.05) effect in treatment diets with regards to mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and creatinine. It can be concluded that goats fed 50% guinea grass and 30% locust bean pulp with 20% melon husk had the potential to enhance nitrogen utilization and blood chemistry in goats.

Keywords: Locust bean pulp, melon husk, nitrogen retention, blood chemistry, goats

Description of Problem

One of the major constraints affecting ruminant animal production in Nigeria is the unavailability of all year round quality native pasture needed to sustain their productivity most especially during the dry season. The use of conventional feedstuffs in the preparation of ruminant feeds did not also yield much benefit to the farmers,

due to the escalating high cost of the available feedstuffs that put the industry into direct competition with human. The overall consequent of this scenario is marked on weight loss of the animals with concomitant increase in the cost of their products (1). However, one of the possible ways of alleviating this challenge and maintain goat production in Nigeria, is to utilize locally available feed resources such as agro-industrial by-products which cannot be consumed by man but can be converted by goats into desirable human food. This will reduce the cost of livestock production without a decrease in productivity. To optimize production therefore, goats fed on grasses needed to be supplemented with cheaper and less-known unconventional feeds (2). Notwithstanding, to meet the high demand for goat products and fulfill the future hope of feeding the ever-growing population and enhanced food security, improvement in the utilization of these by-product feed resources is imperative. Some researchers (3; 4) have reported in recent times that more efforts have been directed towards harnessing and utilizing by-products and wastes which are not directly utilizable by man and take advantage of convertible mechanism of animal organ to convert what is seen as a waste into wholesome animal products for human consumption.

Locust bean pulp and melon husk are such by-products that have been recognized as an important feed resources in goat nutrition. They are by-products of locust bean and melon seeds that can be potentially valuable as supplement for goats on grass based diet when properly harness (5). The potential use of these by-products with grass in goats feeding will go a long way in reducing the shortage of feedstuffs and subsequently strenghten goat production by increasing their products. However, the information about the combination of grasses and locust bean pulp with melon husk is scanty in goat nutrition. Hence, the objective of the study is to determine the effect of locust bean pulp with melon husk supplementation on nitrogen utilization and blood chemistry of West African Dwarf goats.

Materials and Methods

Experimental Site

The experiment was carried out at the Sheep and Goat Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Nigeria. Ekpoma is located on longitude 6.09^0E and latitude 6.42^0N with a unimodal rainfall pattern, which starts from April and ends in October. The mean annual temperature and rainfall of the area is about 31^0C and 1556m respectively. The vegetation of this zone represents an interface between the tropical rainfall and derived savanna.

Experimental diets

Guinea grass was obtained from the pasture land within the Teaching and Research Farm. They were chopped manually to a length of about 5 – 6cm after allowing them to wilt overnight. Locust bean pulps were collected from locust bean processing points located within Auchi, Edo State. Melon husk were also collected from the rural women who processed melon seeds for commercial purposes in Ekpoma. The

locust bean pulp and melon husk were sieved to remove impurities after sundried for two days before they were crushed separately into meal. However, three experimental diets that consist of the following were prepared; Diet 1(100% guinea grass that served as the control group), Diet 2 (70% guinea grass and 15% locust bean pulp with 10% melon husk) and Diet 3 (50% guinea grass and 30% locust bean pulp with 20% melon husk).

Experimental animals, feeding and management

Eighteen West African dwarf goats (male) that were sourced from livestock market within Ekpoma were used for the study. The goats were about 6 – 7months old with a mean body weight of 6.00 ± 0.15kg. The goats were randomly distributed to the three experimental diets. Each treatment was replicated twice with three goats per replicate in a completely randomized design. The goat house and individual pens were cleaned and disinfected prior to the arrival of the animals. They were vaccinated against diseases before the commencement of the experiment. At the commencement, goats were housed in individual dwarf wall pen with feeders and drinker on the concrete floor. Treatment diets were given to the experimental goats twice daily at about 8:00am in the morning and 4:00pm in the evening at 5% of the body weight. The treatment diets were in form of complete mixing and ensuring voluntary consumption. They also had unrestricted access to clean fresh water in their various pens. The study lasted for 84days after 7days of adjustment period.

Nitrogen Utilization

Nitrogen balance study was carried out immediately after the feeding trial and blood collection. Four goats were randomly selected per treatment and transferred to individual metabolic cage designed for separate collection of urine and faeces for 7days. They were allowed 7 days adjustment to the cages before the commencement of the data collection for 7days. The goats were kept in individual metabolic cage, feed offered, feeds rejected, faeces and urine excreted were recorded daily. Daily collection of faeces and urine were separately bulked and about 10% sub-samples of each total faecal and urinary output were pooled over the 7-day collection as representative samples for chemical analyses. Nitrogen loss from the urine by volatilization was prevented by introducing 10ml of 10% H_2SO_4 into the urine sample to trap the ammonia (6). Faecal samples were oven dried at 70% for 48hours and stored in airtight container while urine samples were store in a deep freezer until required for analyses.

Nitrogen balance by goats was estimated as the difference between nitrogen intake and nitrogen excreted from faeces and urine. The nitrogen retention percent was computed from the nitrogen balance expressed as a percentage of nitrogen intake (7).

Blood Collection and Evaluation

At the end of ten weeks of the feeding trial, two goats were selected per replicate in the morning prior to feeding for blood sampling. However, 5ml of blood sample was collected through the jugular vein puncture of each goat using hypodermic needle and sterile disposable syringes and allowing free flow of blood into labeled sterile universal bottle containing anti-coagulant to determine the

hematological component. Thereafter, the samples were analysed in the laboratory for haematological components which include packed cell volume (PCV) that was determined by using microhaematocrit method, haemoglobin (Hb) concentration by using cyanmethaemoglobin method. Red blood cells (RBC) and white blood cells (WBC) were counted using haemocytometer while mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were estimated from PCV, Hb and RBC as outlined by (8). Another 5ml of blood sample was collected into labelled sterile sample bottles without anti-coagulant for serum biochemistry investigation. The blood was allowed to clot and the serum was separated immediately by centrifugation at 3500 rpm for 10minutes. The serum biochemical parameters assessed include total protein, albumin, glucose, creatinine, cholesterol and urea that were estimated by the method of spectrophotometric technique following the kit (RONDAX) manufacturer's procedure as reported by (9). The globulin content was calculated as the difference between serum total protein and albumin.

Chemical and Statistical Analyses:

Locust bean pulp, melon husk, experimental diets and faecal samples were analysed for proximate composition using the procedure of (10). Nitrogen concentration in the urine was analysed also using the same methods as reported by (10).

Data obtained from nitrogen utilization and blood chemistry were subjected to analyses of variance (ANOVA) and significant difference between means was separated using Duncan multiple range test (11).

Results and Discussion

The analyzed proximate composition of the test ingredients and experimental diets are presented in Table 1. The dry matter content of the test ingredients (locust bean pulp 94.99% and melon husk 97.62%) were higher than the dry matter of the experimental diets that ranged between 86.47% for diet 1 and 92.02% for diet 3. The crude protein content of diet 3 (13.11%) was higher than that of diets 2 (11.06%) and 1 (9.01%). However, the values of crude protein recorded in the diets were above the 8% values required to satisfy the maintenance requirements for ruminants (12). The crude fiber content ranged from 28.46% to 37.32% with the least value recorded in diet 3 and highest in diet 1. The disparity might be attributed to the growth stage, maturity and inclusion levels of guinea grass. Ether extract of diet 1 (0.98%) was higher than the values of 1.74% and 2.50% recorded for diets 2 and 3. Ash content was ranged between 8.31% and 9.65% while nitrogen free extract values were better in diets 3 (44.64%) and 2 (42.31%) that diet 1 (39.51%). However, the proximate composition of locust bean pulp and melon husk obtained in this study were comparable with the values reported by (4) and (5) respectively.

Table 1. Proximate composition (%DM) of the test ingredients and experimental diets

Nutrients	locust bean pulp	melon husk	Experimental diets		
			1	2	3
Dry matter	94.99	97.62	86.47	89.98	92.02
Crude protein	11.23	13.68	9.01	11.06	13.11
Crude fibre	12.78	29.81	37.32	32.89	28.46
Ether extract	3.47	4.82	0.98	1.74	2.50
Ash	6.86	7.13	9.65	8.98	8.31
Nitrogen free extract	60.65	42.18	39.51	42.31	44.64

Nitrogen utilization of West African Dwarf goats fed mixture of locust bean pulp and melon husk supplement is shown in Table 2. Nitrogen intake values of 13.82, 15.98 and 17.52g/day were recorded among goats placed on diets 1, 2 and 3, respectively. The significant variation ($P < 0.05$) observed in nitrogen intake among diets could be associated with the amount of protein content provided by the test ingredients and their inclusion levels in the treatment diets. It is an established fact that the quantity and quality of nitrogen intake in diets are influenced by the amount of protein content provided by the feed ingredients (7). Faecal nitrogen output that ranged between 1.99 and 2.7g/day was significantly ($P < 0.05$) higher in goats on diets 1 and 2 compared with diet 3. This disparity in values could probably be due to the high fiber content of guinea grass and the degree of protein utilization in the diets. It was noted in literature that poor utilization of protein in a diet changes the pattern of nitrogen excretion towards increasing nitrogen loss (13). Urinary nitrogen output for goats on diet 1 (1.00g/day) were having higher values and differed significantly ($P < 0.05$) from diets 2 (0.62g/day) and 3 (0.51g/day). This observation could be a reflective of unused ammonia that was absorbed through the rumen wall and transported to the liver which later converted to urea and excreted as urine. Total nitrogen loss that ranged from diet 3 (2.50g/day) to diet 1(3.71g/day) followed the same trend as in urinary nitrogen output. Some researchers (7; 14) reported that excess of ammonia production in the rumen increases nitrogenous excretion rather than contribute directly to the animal nutrient requirements.

Nitrogen balance and retention for goats placed on diet 3 (15.02g/day and 85.73%) were significantly ($P < 0.05$) higher, followed by diet 2 (13.35g/day and 83.54%) before diet 1 (10.11g/day and 80.34%). This observed difference could be attributed to the degree of the anti-microbial effect on the diets which delay ruminal protein degradation in the rumen. Hence, the higher nitrogen balance and retention obtained in the test diets could be connected with the protein in the diets that was denatured due to suppression of bacterial population in the rumen (15).

The blood constituents of West African dwarf goats fed diets supplemented with varying proportions of locust bean pulp and melon husk is presented in Table 3. Blood for their constituents are used to monitor and evaluate health and nutritional status of animals. Packed cell volume (PCV) for goats on diet 2 (28.93%) and 3 (29.78%) were significantly ($P < 0.05$) higher than those

Table 2. Nitrogen utilization of West African Dwarf goats fed mixture of locust bean pulp and melon husk supplement.

Parameters	Treatment diets			SEM±
	1	2	3	
Nitrogen intake (g/day)	13.82[c]	15.98[b]	17.52[a]	0.29
Faecal nitrogen output (g/day)	2.71[a]	2.01[a]	1.99[b]	0.06
Urinary nitrogen output (g/day)	1.00[a]	0.62[b]	0.51[b]	0.34
Total nitrogen loss (g/day)	3.71[a]	2.63[b]	2.50[b]	0.10
Nitrogen balance (g/day)	10.11[c]	13.35[b]	15.02[a]	0.28
Nitrogen retention (%)	80.39[c]	83.54[b]	85.73[a]	0.47

[a,b,c] means on the same row with different super script differ significantly ($P < 0.05$)

goats on diet 1 (25.96%). This significant variation observed among treatment diets could probably be used to explain the realistic evaluation of the nutritional and diagnosis of health condition of these goats. However, the PCV values of goats obtained in this study were not adversely affecting the functions of their cells and nutritional qualities in the blood. Hence, they had low susceptibility to infections and stress. The numerical values obtained for haemoglobin (Hb) in goats were significantly ($P < 0.05$) higher in test diets 3 (9.87g/dl) and 2 (9.04g/dl) compared with those animals on the control diet 1 (7.07g/dl). However, the Hb values recorded in this study were within the reference values (7.01 – 10.86g/dl) documented for healthy goats by (16). This indicates that at the levels of locust bean pulp and melon husk inclusion in the diets, oxygen carrying capacity of goats circulatory system in the blood were perfectly supported. Red blood cell (RBC) values of 8.01, 8.83 and 10.42 x 10^6/ML were recorded among goats on diets 1, 2, and 3, respectively. Goats placed on diets 1 and 2 were similar but significantly ($P < 0.05$) lower than those on diet 3. The RBC values obtained were within the recorded reference values (7 – 11.87 x 10^6/ML) as reported by (17). This could be an indication that goats maintained on these diets had absence of anemia related diseases that could have resulted from iron deficiency. The mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) values that ranged from 30.47 to 32.76fl, 9.01 to 10.24Pg and 29.99 to 32.14g/dl were not significantly ($P < 0.05$) influenced by the test diets. This further explained the better nutritional adequacy and safety of the test ingredients. Some authors (8; 9) reported that haematological indices can be used to evaluate the immune status, efficiency of nutrient absorption and utilization in animals.

White blood cell (WBC) is usually associated with immune response capability to infection. Higher values (11.86 x 10^3/ML) of WBC observed in animals fed diet 3 compared to those on another diet, could be attributed to the challenges from microbes infection or the presence of foreign bodies in the circulatory system of the goats. Animals with low WBC were reported to be exposed to high risk of disease infection, while those with high counts are capable

of generating anti bodies in the process of phagocytosis and have high degree of resistance to diseases (8).

Table 3 also presented serum biochemical indices of West African Dwarf goats fed experimental diets. Serum biochemical assay are commonly employed in monitory the status of vital organs as well as to quantify available dietary protein in ruminants. Serum total protein values for goats fed diets 2 (7.01g/dl) and 3 (7.47g/dl) were similar but significantly ($P < 0.05$) higher than goats on diets 1 (5.96g/dl). The observed variability could however be linked with the different protein sources. Blood traits is a reflection of the effects in dietary treatments on the animals in terms of type, quality and amount of the feed ingested and available for the animals to meet its physiological, biochemical and metabolic necessities (19). Albumin values that ranged from 2.95 to 3.93g/dl followed the same pattern of variation as observed in total protein values. It was reported by (20) that liver is the usual site for albumin synthesis and the levels in serum subject the liver health in animals. Globulin levels are however, a measure of immune strength of animal to infection in those anti-bodies are products of globulin which attack disease gents (19). The variation of globulin levels in goats due to inclusion levels of locust bean pulp with melon husk was significantly ($P < 0.0\%$) higher in diet 2 (3.58g/dl) followed by diet 3 (3.52g/dl) before the control diet 1 (2.97g/dl). This implies that the immune status of goats on test diets did not compromised with infections. Glucose values were significantly ($P < 0.05$) higher among goats placed on diets 2 (64.82mg/dl) and 3 (63.99mg/dl) compared with diet 1 (50.55mg/dl). The elevation in the level of serum glucose in test diets might perhaps be ascribed to the influence of locust bean pulp with melon husk utilization in the diets which could probably increase the energy content and subsequent improved glucose levels in the goats. Serum glucose concentrations in animals have been reported by (18) to directly associate with energy metabolism and expenditure in ruminants. The cholesterol values (30.99 to 40.21mg/dl) declined significantly in the diets. This implies that serum cholesterol synthesis and utilization was directly affected by goats on control diet. Though values obtained in the study were still within the range values (30.10 to 82.08mg/dl) reported by (21). Creatinine that is muscle mass dependent is formed when feed is changed into energy through the process of metabolism. Its increase could be an indication of the damage that might have been done to the kidney, hence it leads to tissue wastage. The creatinine values (1.01 to 1.52 mg/dl) obtained in this study were not significantly ($P > 0.05$) influenced by the treatment diets. The values were within the range (0.81 to 1.62mg/dl) reported by (18) for healthy goats. This suggests that the test diets were of good protein quality and no muscular stress caused by anti-nutritional factors in the goats. Serum urea levels was significantly ($P < 0.05$) higher in diet 1(11.07mg/dl) compared with diets 2 (8.26mg/dl) and 3 (7.99mg/dl). The higher value observed in the control diet might perhaps be

ascribed to the effect of some endogenous anti-quality components which could probably reduced protein utilization owing to increase amino acid catabolism which subsequently degraded into urea (21).

Table 3. Blood constituents of West African d warf goats fed diets supplemented with varying proportions of locust bean pulp and melon husk.

	Treatment diets			
Parameters	1	2	3	SEM±
Packed cell volume (%)	25.96[b]	28.93[a]	29.78[a]	0.21
Haemoglobin (g/dl)	7.09[b]	9.04[a]	9.87[a]	0.06
Red blood cell ($x10^6$/ML)	8.01[b]	8.83[b]	10.46[a]	0.04
MCV (fl)	32.41	32.76	30.47	0.52
MCH (Pg)	9.01	10.24	9.44	0.13
MCHC (g/dl)	29.99	30.52	32.14	0.97
White blood cell ($x10^3$/ML)	8.89[b]	10.96[a]	11.86[a]	0.40
Serum Biochemical Indices				
Total protein (g/dl)	5.96[b]	7.01[a]	7.45[a]	0.09
Albumin (g/dl)	2.95[b]	3.43[a]	3.93[a]	0.03
Globulin (g/dl)	2.97[b]	3.58[a]	3.52[a]	0.06
Glucose (Mg/dl)	50.55[b]	64.82[a]	63.99[a]	0.24
Cholesterol (Mg/dl)	30.99[b]	39.59[a]	40.31[a]	0.73
Creatinine Mg/dl)	1.52	1.10	1.01	0.01
Urea (mg/dl)	11.07[a]	8.26[b]	7.99[b]	0.38

MCV = mean corpuscular volume, MCH = mean corpuscular haemoglobin, MCHC = mean corpuscular haemoglobin concentration

[a,b,c] means on the same row with different superscripts differ significantly ($P < 0.05$)

Conclusion and Applications

It was concluded that:

1. Locust bean pulp and melon husk have great potential to enhance goats' productivity.
2. 50% of guinea grass and 30% of locust bean pulp with 20% melon husk (diet 3) improved nitrogen utilization in West African Dwarf goats.
3. Goats Diet 3 had enhanced haematological and serum bio-chemical indices than those on 70% guinea grass and 15% locust bean pulp with 10% melon husk (diet 2) and those on solely guinea grass (diet1).

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