International Journal of Agriculture, Environment and Bioresearch

Vol. 2, No. 06; 2017

ISSN: 2456-8643

WEIGHT GAIN, NUTRIENT DIGESTIBILITY AND REPRODUCTIVE PERFORMANCE OF WEST AFRICAN DWARF GOATS FED LOCUST BEAN PULP WITH MELON HUSK SUPPLEMENTED DIETS

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ABSTRACT

This experiment was conducted to determine the growth and reproductive performance with nutrient digestibility of goats fed locust bean pulp with melon husk supplemented diets. A total of eighteen West African dwarf goats with mean weight of 6.00 ± 0.15kg were allotted to three dietary treatments. Each of the treatment was replicated twice with three goats per replicate in a completely randomized design. The dietary treatments comprised; Diet A(100% guinea grass that served as the control group), diet B(70% guinea grass and 15% locust bean pulp with 10% melon husk) and diet C(50% guinea grass and 30% locust bean pulp with 20% melon husk). The results showed that goats on diet A had higher significant ($P < 0.05$) on average daily feed intake (246.92g/day), feed conversion ratio (7.95) and ash digestibility (70.09%), while ether extract digestibility (65.30%) was significantly higher ($P < 0.05$) in goats on diet B. Final weight (9.50kg), total weight gain (3.40kg), average daily weight gain (40.48g/day), dry matter digestibility (81.96%), crude fibre digestibility (74.33%) and scrotal length (10.05mm) were significantly ($P < 0.05$) better in diet C compared with diets A and B. Initial weight, semen volume, spermatozoa motility, live sperm cells and scrotal circumference were not significantly ($P > 0.05$) different. It was concluded that 50% guinea grass and 30% locust bean pulp with 20% melon husk has the potential to promote weight gain, nutrient digestibility and reproductive performance of goats.

Keywords: Agro-industrial by-products, performance, digestibility, goats.

Introduction

Ruminant livestock production is hampered by inadequate forage availability in the tropics. Forage production in Nigeria is limited in terms of nutrient supply to ruminants and stall-fed animals during the dry season, hence their nutritive value fluctuate with season. The scarcity and fluctuating quantity and quality of these forages are further complicated by stiff competition

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ISSN: 2456-8643

between man and livestock for conventional feeds resulting to high cost of feeds. The nutritional imbalance of these forages with irregular supply of feeds that cannot cover the nutrient requirement of these animals is imposing a constraint to the development and production of small ruminant industry in Nigeria. Thus, this inadequate feed provision is a contributory factor to low nutrient digestibility and weight loss leading to low reproductive performance in the small ruminants. However, this scenario often brings about unsustainable of their products to the ruminant farmers. Hence, the situation warrants exploring the possibilities of using alternative feed sources to supplement forage in order to bring down the increasing deficiency in nutrient requirement of goats (Ajayi et al., 2010).

Locust Bean Pulp (LBP) and Melon Husk (MH) are such alternative feedstuff that can be harness as feeds supplement into goats feeding in Nigeria. These LBP and MH are by-products of processing locust bean and melon seeds that are usually discarded, burnt and caused pollution to the environment. Gernah et al. (2005); Ogbe and George, (2012) have identified LBP and MH as potentially valuable supplement for ruminants on grass based diet therefore, the sustainable way of improving the feeding value of poor quality forage is through supplementation with valuable by-products that can be good strategy to improve livestock performance (Isah et al., 2014; Bemji and Osinowo, 2010). The potential use of these LBP and MH with forage in goat ration will participate in reducing the shortage feedstuff and subsequently increasing goat products. However, information about the inclusion levels of LBP with MH, their nutrient utilization and reproductive performance from such complementary feeding by goats is scanty in existing small ruminant feeds. This objective of the study therefore is the effects of LBP and MH supplementation on growth and reproductive performance with nutrient digestibility of goats.

Materials and Methods

Study area

This study was carried out at the Sheep and Goat Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma – Nigeria (latitude 6.42^0N and longitude 6.09^0E). The area has a humid climate with mean annual temperature and rainfall of about 31^0C and 1556mm respectively during the experimental period. Ekpoma is within the south – south geographical zone of Nigeria that has unimodal rainfall pattern that starts from April and end in October.

Sources and preparation of experimental diets

Locust bean pulps were sourced from locust bean processing points located around Auchi, Edo state, Nigeria. Melon husk were collected from the rural women who processed melon seeds for commercial purposes in Ekpoma. The pulps and husk were sieved to remove impurities after sundried for two days, before they were crushed separately into meals. Guinea grass was

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obtained within the Teaching and Research Farm. They were allowed to wilt overnight to remove microbes, before being chopped with cutlass to a length of about 5 – 6cm. Three experimental diets that comprise the following were prepared. Diet A(100% guinea grass that served as the control group), diet B(70% guinea grass and 15% locust bean pulp with 10% melon husk) and diet C(50% guinea grass and 30% locust bean pulp with 20% melon husk).

Animals and their management

Eighteen West African dwarf male goats procured from livestock market within Ekpoma were used for the experiment. The goats were about 6 – 7months old with a mean body weight of 6.00 ± 0.15kg. The goats were acclimatized for 7days during which they were treated against ecto and endo parasites. They were also injected with oxytetracycline (L.A) antibiotics to enhance their resistance to infections and subsequently vaccinated against *Pestes des Petit Ruminants* (PPR). During this adaptation period, the goats were maintained solely on guinea grass. Water was provided *ad libitum*. The goats were randomly divided into three treatment groups. Each treatment groups was replicated twice with three goats per replicate in a completely randomized design. The goats were transferred to the experimental pens previously swept, cleansed, washed with morigad® and Diazinto solutions to disinfect. Goats under each group were housed individually in individual pens. Treatment diets were given to the experimental goats twice daily at about 8:00am in the morning and 4:00pm in the evening. The treatment diets were manually mixed together inform of complete mixing and ensuring voluntary intake. They also had free access to water in their various pens. Feeding of the goats was done at 5% of their body weight for 84days aside from the initial 7 days of acclimatization.

Growth study

Weight of individual goat was measured at onset of the experiment and subsequently on weekly basis with measuretech® hanging scale prior to feeding to determine change in body weight. Total body weight gain was calculated as the difference between the final and initial body weight of each goat. The quantity of the feeds offered to goats and the residual feeds were weighed daily in the morning prior to feeding to estimate daily feed intake.

Data derived from the daily feed intake and daily weight gains were computed and feed intake and daily weight gains were computed and feed conversion ratio was calculated as the ratio between feed intake and body weight gain.

Digestibility trial

Metabolic trial was conducted at the end of the 10^{th} week of the body weight gain measurement to determine the apparent nutrient digestibility of the diets. Two goats per replicate making a total of twelve goats were randomly selected and house separately in metabolic cage designed for

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separate collection of faeces and urine. The goats were acclimatized for 7days prior to the commencement of 7days metabolic trial. A known weight of diet was fed to the goats housed in individual metabolic cages. Feeds rejected, faeces and urine were collected, weighed and recorded per goat per day in the morning before feeding and offering water on the last 7days of the metabolic study.

The daily collection of faeces was separately bulked for each goat and about 10% of sub-samples from each goat was pooled and dried in forced draft oven at 105^0C for 48hours for dry matter determination. The dried faecal samples were stored in airtight container which later used for proximate analysis.

Thereafter, apparent nutrient digestibility of the diet was calculated as the difference between nutrient intakes and excreted in faeces expressed as a percentage of nutrient intakes. Note that,

nutrient intake (g) = feed intake X nutrient in feed

Nutrient output (g) = faecal output X nutrient in faeces.

Semen collection

Semen was collected from goats weekly using artificial vagina. The semen samples were collected into a clean and sterile graduated ependorf tube and analyzed immediately at room temperature. Semen volume, spermatozoa motility and live sperm cells were assessed as described by Ewuola and Egbunike, (2010). Scrotal circumference and length were also measured as reported by Adeniji and Osasanya, (2015).

Chemical and statistical analyses

Locust bean pulp, melon husk, experimental diets and faecal samples were analysed for proximate composition using the procedure of AOAC (1990).

Data generated from growth and reproductive performance with nutrient digestibility were subjected to analysis of variance (ANOVA) and significant difference between means was separated using Duncan multiple range test (SAS, 2000).

Results and discussion

The proximate composition of the ingredients and experimental diets are shown in Table 1. The dry matter content of the test ingredients (94.99 to 97.62%) and experimental diets (86.47 to 92.02%) were quite high. However, their higher values suggest the ability of them to accumulate more nutrients with less feed spoilage. Crude protein values of the experimental diets that ranged from 9.01 to 13.11% were a reflection of the relative proportions of locust bean pulp and melon husk inclusion levels in the diets. This is an indication that locust bean pulp and melon husk were good sources of dietary protein but low in fiber when compared with guinea grass. It is also

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uniquely low in fat and serves as nutrient diluents when preparing a diet for ruminants. The recorded values of crude protein in the diets were above the least value (8%) required for maintenance requirement for ruminants (Gatemby, 2002). Crude fibre content that ranged between 28.46% and 37.32% increased as the quantity of guinea grass increased in the diets. Ether extract and nitrogen free extract values were lower in diet A(0.98 and 39.51%) and higher in diet C(2.50 and 44.64%). Ash content of diet A(9.65%) was higher than the values of 8.98 and 8.31 recorded for diets B and C respectively. However, the proximate composition of locust bean pulp and melon husk obtained in this study were compared favourable with the values reported by Gernah et al, (2005) and Ogbe and George, (2012).

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

Nutrient	locust bean pulp	melon husk	Diets		
			A	B	C
Dry matter	94.99	97.62	86.47	89.78	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	8.89	8.31
Nitrogen free extract	60.65	42.18	39.51	42.31	44.64

Table 2 shows the growth performance of West African dwarf goats fed experimental diets. Final weight of goats was significantly ($P < 0.05$) affected by treatment diets. Diets B(9.21kg) and C(9.50kg) were higher than those on diet A(8.76kg). The higher final weight values that were observed in goats on diets B and C might be attributed to the higher energy and protein quality of test diets which tend to improve their weight. Total weight gain by goats in the treatments that ranged between 2.61 and 3.49kg followed a trend closely similar to that of final weight. This further suggests the better utilization of the test diets that could played important role in the enhancement of their total weight gain. Sowande et al. (2008b) reported that the rate of fat

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deposition relate more to the amount of energy available in excess of requirements for maintenance and lean growth. Average daily weight gain was also significantly ($P < 0.05$) influenced by treatment diets with goats on diet C(40.48g/day) recorded the highest, followed by diets B(35.83g/day) and A(31.07g/day). This variation in average daily weight gain of goats observed could be attributed to the direct relationship between the final weight and total weight gain with the difference in nutrient supply from the diets. However, average daily weight gain for goats in this study is in line with previously reported values of 40 to 55g/day of sheep fed agro-industrial wastes and *Panicum maximum* (Oladotun et al., 2003).

Average daily feed intake (229.23 to 246.92g/day) decreased significantly ($P < 0.05$) as the proportion of locust bean pulp with melon husk in the diets increased. This could be due to lowering of acceptability of the diets or meeting the nutrient requirement of the goats by the increasing proportion of the test ingredients. Sowande et al. (2008a) reported that productivity of ruminants is influenced primarily by feed intake, which in turn, is determined by feed digestibility and the capacity of the diet to supply the correct balance of nutrients required by the animals. Feed intake in this study is within the intake level recommended for sheep and goats as reported by Gatemby (2002). Sowande et al. (2008b) observed difference in daily feed intake of sheep fed diets containing elephant grass, layers droppings and cassava peel. Feed conversion ratio that ranged between 5.66 and 7.95 was significantly ($P < 0.05$) difference among the treatment diets. It revealed the ability of goats on diet C(5.66) to consume less feed but utilized and converted the feed to more weight than goats on diets A(7.95) and B(6.67). Though feed intake was lower in goats fed diet C, higher ($P < 0.05$) utilization of the diet was reflected in weight gain and feed conversion ratio on the goats. According to FAO (1995), the energy value of a diet and the efficiency of its utilization are largely determined by the relative balance of glucogenic, energy and long chain fatty acid and essential amino acid absorbed by the animals. It could then mean that this diet contained a balance of nutrients which efficiently interacted to give the highest average daily weight gain.

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Table 2. Growth performance of West African Dwarf goats fed experimental diets

Parameter	Diets			SEM±
	A	B	C	
Initial weight (kg)	6.15	6.20	6.10	0.16
Final weight (kg)	8.76[b]	9.21[a]	9.50[a]	0.72
Total weight gain (kg)	2.61[b]	3.01[a]	3.40[a]	0.05
Average daily weight gain (g/day)	31.07[c]	35.83[b]	40.48[a]	0.83
Average daily feed intake (g/day)	246.92[a]	238.79[b]	299.23[c]	1.07
Feed conversion ratio	7.95[a]	6.67[b]	5.66[c]	0.12

[abc] Means along the same row with similar superscripts are not significant (P > 0.05).
SEM = standard error of means

Presented in Table 3 is the effect of locust bean pulp with melon husk supplementation on nutrient digestibility and reproductive performance of West African dwarf goats. Dry matter digestibility that ranged between 73.02% and 81.96% was significantly (P < 0.05) highest in diet C followed by diets B and A. This dry matter digestibility increased progressively as the levels of supplement inclusion increased in the diets, probably reflects the more effective utilization of the test feeds than guinea grass. Similar trend was observed for crude protein digestibility that ranged from 62.99% in diet A to 70.59% in diet C. The significant (P < 0.05) higher crude protein digestibility recorded in diets B and C might indicates that locust bean pulp with melon husk could serves as potential protein supplements that will enhance the intake and utilization of low quality grass and fibrous crop residues by goats. This submission agrees with the speculation of Okah and Antia (2016) that digestibility of crude protein dependent on the activity of rumen microbes which require energy, nitrogen and mineral with a suitable medium to enable them perform well for protein availability in ruminants. However, the digestibility of ether extract that did not have specific pattern of variation was significantly (P 0.05) higher in diets B(65.30%) compared with diets A(58.89%) and C(60.55%). The most probable explanation for this phenomenon is the fact that goats on diet B could conveniently and efficiently utilized the inclusion level of the test ingredients than diet C, or the digestive system of the goats on diet C could not utilized higher inclusion level of locust bean pulp and melon husk due to manifestation of the imbalance fat and oil in blood as the quantity increased (Tona et al., 2014). Crude fibre

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that was significantly ($P < 0.05$) varied among treatment digestibility was higher in diets C(74.33%) and B(73.09%) compared with diet A(68.83%). This higher crude fibre digestibility in the test diets could be positively influenced by higher content of the digested protein in the diets. This agrees with the report of Okah et al. (2012) that crude fibre digestibility increases with increasing levels of crude protein digested in the diets. Okoruwa et al. (2015) also reported that digestibility of crude fibre may be due to the wall configuration of their polysaccharides and their effect on microbial attachments and colonization of digest particles. Digested ash that ranged between 62.97% and 70.09% decreased with increased inclusion levels of locust bean pulp with melon husk in the diets. The significant ($P < 0.05$) higher digestibility of ash in goats on diet A might be ascribed to the usefulness of assessing the quality grading of guinea grass and also give an idea of the amount of mineral element present in the test diets.

Table 3 also presents semen characteristics of goats fed locust bean pulp with melon husk supplemented diets. Among the quality parameters assessed only scrotal length was significantly ($P < 0.05$) affected by treatment diets, while semen volume, spermatozoa motility, live sperm cells and scrotal circumference were not significantly ($P > 0.05$). The lower effect of the scrotal length of goats on diet A might be as a result of poor nutrient utilization of the diet that reduced the daily weight gain which affects scrotal length (Adeniji abd Ososanya, 2015).

Table 3. Proximate composition (%DM) of the test ingredients and experimental diets

Parameters	**Diets**			**SEM ±**
	A	**B**	**C**	
Dry matter	73.02^{c}	78.41^{b}	81.96^{a}	1.02
Crude protein	62.99^{c}	68.98^{b}	70.59^{a}	0.97
Ether extract	58.89^{c}	65.30^{a}	60.55^{b}	0.83
Ash	70.09^{a}	66.68^{b}	62.97^{c}	0.93
Semen characteristics				
Semen volume (ml)	0.36	0.38	0.37	0.02
Spematozoa mortility (%)	1.92	1.94	1.91	0.01

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Live sperm cells (%)	98.08	98.06	98.09	0.65
Scrotal circumference (mm)	18.01	18.00	18.02	0.34
Scrotal length (mm)	9.99[b]	10.01[a]	10.05[a]	0.19

[abc] Means on the same row with different superscripts differ significantly (P > 0.05).
SEM = standard error of means

Conclusion

This study indicated that locust bean pulp with melon husk can be used as a good source of alternative feeds in supplementing forages for goats, most especially during the dry season, without compromising any negative effect on the performance. This will help in making animal protein available for human consumption and at the same time reducing the competition between man and livestock for feeds.

The results obtained from this study can therefore be concluded that locust bean pulp with melon husk could be served as good source of alternative feeds for goats. However, goats fed on 50% guinea grass and 30% locust bean pulp with 20% melon husk performed better in terms of weight gain, nutrient digestibility and reproductive performance than other treatment diets.

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