ISSN 1819-1878

Asian Journal of Animal Sciences

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OPEN ACCESS Asian Journal of Animal Sciences

ISSN 1819-1878
DOI: 10.3923/ajas.2016.154.158

Research Article

Effect of Gmelina (*Gmelina arborea*) Leaf Meal Based Diets on Growth Performance of West African Dwarf Bucks

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Abstract

Six West African Dwarf bucks of 5-8 months of age averaging 6.78 kg were used to study the effect of *Gmelina arborea* leaf meal based diets on their feed intake, weight gain, feed conversion ratio and feed conversion efficiency. The bucks were randomly assigned to three treatments with two bucks per treatment in a Completely Randomized Design (CRD). The bucks were fed 0, 10 and 20% *Gmelina arborea* leaf meals in the concentrate diets, respectively. Data were collected for eight weeks on feed intake and weight gain. Proximate analysis showed lower crude protein in Treatment A (TA) (16.09%) than in Treatment B (TB) (18.68%) and Treatment C (TC) (18.92%). The values observed for TA for ash and fat content were lower than those observed for treatment B and treatment C. Metabolizable energy was significantly ($p<0.05$) different. Significant differences ($p<0.05$) existed for values recorded by the goats fed the different experimental diets. Goats fed treatment B and C had similar ($p>0.05$) feed intake (280.35 and 273.58 g day^{-1}, respectively) but higher ($p<0.05$) than goats fed treatment A.A similar ($p>0.05$) weight gain was recorded in treatment B (2.82+0.23 kg) and C (2.80+0.21 kg) which was significantly higher than that recorded in treatment A (1.80+0.21 kg). Feed conversion ratio was best ($p<0.05$) in treatment C (5.47) followed by the one in treatment B (5.58) and treatment A (8.28). The study therefore suggests 20% inclusion of *Gmelina arborea* leaves in the diet of West African Dwarf bucks as the optimum level for better performance.

Key words: Feed intake, weight gain, feed conversion ratio, *Gmelina arborea*, feed conversion efficiency

Received: September 21, 2015 **Accepted:** November 23, 2015 **Published:** February 15, 2016

Citation: A.I. Ukanwoko and O.V. Okehielem, 2016. Effect of gmelina (*Gmelina arborea*) leaf meal based diets on growth performance of West African dwarf bucks. Asian J. Anim. Sci., 10: 154-158.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The Tigris-Euphrates Valley in South Western Asia was the first to domesticate goats about a decade ago (Ukanwoko *et al*., 2013). In Nigeria, of all the different types of livestock, goats are the most populous with an estimation of 53.8 million (FAO., 2009) and they play an important role in livestock production systems (Hossain *et al*., 2004). They are multi-functional animals and play a significant role in the economy and nutrition of the rural and urban dwellers (Oluwatomi, 2010). In the southern Nigeria, goats provides income for the family, it is used to establish friendship and can be used to settle disputes in a community (Idiong and Udom, 2011) and in the rural areas where most of the resource-poor farmers in Africa live, goats play an important socio-economic role (Anaeto *et al*., 2009) and form an integral part of the cultural life system of Nigerians peasantry (Ajala, 2004).

In Nigeria, the management system employed in goat production is mainly extensive which is characterized by inadequate feeding. Goats are known to utilize poor quality forages and browses better than sheep (Chukwuka *et al*., 2010). In the tropic, there is seasonal shortage of natural forage (Ukanwoko *et al*., 2012). This has led to the search for non conventional feedstuffs that are cheap and are not in high demand by humans (Amaefule, 2002). *Gmelina arborea* leaf is a non conventional feedstuffs and it is available all year round. The leaves remain green to larger part of dry season and have been fed to ruminants with appreciable results (Lamidi *et al*., 2009). It is rich in protein and the protein content fall within the range of 10.01-38.4% as reported by Osakwe and Udeogu (2007). Studies have shown that *Gmelina arborea* leaf can be used as cheap protein supplements which can improve voluntary intake, digestibility and the general performance of animals fed low quality feeds (Kakengi *et al*., 2001).

This study is therefore aimed at determining the effect of *Gmelina arborea* leaf meal on the growth performance of West African Dwarf (WAD) bucks in South-South Nigeria.

MATERIALS AND METHODS

Experimental location: The experiment was carried out in the University of Port Harcourt Research and Demonstration Farm, Choba, Obio/Akpor Local Government Area of Rivers State in the South-South zone of Nigeria. It is situated on latitude 4°47′21″ North and longitude 6°59′55″ East of the equator, it falls within the humid rain forest zone of West Africa with a long duration of rainfall (March-November) and a very short dry season precipitation occurs during September with an average of 367 mm of rain in 182 rain days with a temperature range of 25-28°C and a very high relative humidity (above 80%).

Experimental animals and management: Six West African Dwarf bucks of 5-8 months of age and weighing between 6.55-7.05 kg were purchased from local farmers and used for the experiment. The bucks were housed individually in separate pens measuring 2×2 m each. The bucks were fed in the morning and evening (09:00-16:00 h), respectively and water was offered *ad-libitum*. The goats were generally observed during the feeding trial and the quantity of feed provided daily for each animal was recorded while the remnants of the previous day feed were individually weighed to determine the daily feed intake of each animal. The animals were weighed at the commencement of the experiment and subsequently weighing was done once in a week in the morning before they are offered the day's feed. The bucks were kept under hygiene conditions and were confined throughout the experimental period. The experiment will last for 56 days.

Experimental design: Six West African Dwarf bucks were randomly assigned to one of the three experimental diets (A, B and C) at two bucks per experimental diet. A period of 7 days was allowed for the bucks to adjust to the diets and then, they were weighed for a period of 8 weeks.

Experimental diet: The *Gmelina arborea* leaves used for this study were harvested from mature trees in the University of Port Harcourt premises and were air-dried on a concrete floor at a temperature of 26-27°C until they become crispy to touch. The air-dried leaves were crushed and bagged in sacs for feed formulation. Wheat bran, palm kernel cake, brewers' dried gain, soya bean meal, bone meal and common salt were purchased and used for feed formulation as shown in Table 1.

Table 1: Experimental diets

	Treatments		
Ingredients	TA (%)	TB (%)	TC (%)
Wheat bran	62	57	52
Gmelina leaf meal	0	10	20
Palm kernel cake	19	16	12
Brewers dried grain	10	8	7
Soya bean meal	5	5	5
Bone meal	3	3	3
Common salt	1	1	1
Total	100	100	100

TA: Treatment A, TB: Treatment B, TC: Treatment C

Data collection and analysis: Data was collected on feed intake; feed intake was calculated as the difference between the amounts of feed served daily and the left over as the trial last. The goats were weighed individually once in a week, to determine the live weight change. This was calculated as the difference between the previous week body weight and the current week body weight. The total body weight gain was determined at the end of the experiment by subtracting the initial body weight in the first week from the final body weight in the last week of the experiment. Feed conversion ratio was determined by dividing the total feed intake by the total body weight gained per treatment, average daily and weekly feed intake and average weekly body weight gain were calculated. Proximate composition of the experimental diets were analyzed for crude protein, crude fibre, ash, fat, energy and dry matter contents immediately the feed was formulated.

Statistical analysis: The data obtained in this study were subjected to one way analysis of variance (ANOVA). Differences between means were determined using Duncan's Multiple Range (DMR) test (Duncan, 1955).

RESULTS

The result of the proximate composition of the experimental diets is shown in Table 2 below. The crude protein content of Treatment B (18.68%) and Treatment C (18.92%) recorded higher values compared to Treatment A (16.09%). The values observed for crude fiber was lower for Treatment B (11.02%) and Treatment C (11.37%) than values for treatment A (11.82%). The values recorded for Treatment A for ash (5.33%) and fat (0.41%) were lower than those observed in Treatment B (6.20 and 0.81%) and Treatment C (6.50 and 1.21%). The metabolizable energy content of Treatment A (2805 kcal kg^{-1}) was higher than that of Treatment B (2799 kcal kg^{-1}) and treatment C (2793 kcal kg^{-1}).

The results of growth performance of West African Dwarf bucks fed varying levels of *Gmelina arborea leaves* is shown in Table 3 below. The result revealed that the final body weight was significantly different ($p<0.05$) with TC and TB being similar (9.60±0.32 and 9.57±0.25 kg for TC and TB, respectively) and different from TA (8.85±0.00 kg). Total feed intake of the animals differs significantly ($p<0.05$) between diets. This ranged from 14.90±0.01 kg (TA) to 15.70±0.03 kg (TB). TB had the highest body weight gain of 2.82±0.23 kg compared to other treatment groups with TC having 2.80±0.21 kg and TA having the lowest (1.80±0.21 kg). Feed conversion ratio was best in TC (5.47) with TB and TA having 5.58 and 8.28, respectively.

Table 2: Chemical composition of the experimental diets

Parameters (%)	TA	TB	TC
Dry matter	89.49	88.79	88.13
Crude protein	16.09	18.68	18.92
Crude fiber	12.82	11.02	11.31
Ash	5.33	6.20	6.50
Fat	0.41	0.81	1.21
ME (kcal kg^{-1})	2805.00	2799.00	2793.00

TA: Treatment A, TB: Treatment B, TC: Treatment C, ME: Metabolizable energy

Table 3: Feed consumption, body weight change, feed conversion ratio of WAD goats fed *Gmelina arborea*

Parameters	TA	TB	TC
Initial body weight (kg)	7.05±0.15	6.75±0.16	6.55±0.25
Final body weight (kg)	8.85±0.00^{b}	9.57±0.25^{a}	9.60±0.32^{a}
Total feed intake (kg)	14.90±0.01^{b}	15.70±0.03^{a}	15.32±0.02^{a}
Feed intake (g/day)	266.10±0.01^{b}	280.35±0.01^{a}	273.58±0.01^{a}
Body weight gain (kg)	1.80±0.21^{b}	2.82±0.23^{a}	2.80±0.21^{a}
Feed conversion ratio	8.28±0.00^{a}	5.58±0.00^{b}	5.47±0.00^{c}

^{abc}Means in the same column with different superscripts are significantly ($p<0.05$) different, WAD: West African dwarf, TA: Treatment A, TB: Treatment B, TC: Treatment C

DISCUSSION

The values of the proximate composition obtained in this study showed higher crude protein in TC than TB. The crude protein percentage recorded in this study fell within the range of 16.09-18.92% which is well above the values of 10.25 and 13.73% reported by Abdu *et al.* (2012) and Okafor *et al.* (2012), respectively for sheep and goat production but below the value of 23.00% reported by Adamu *et al.* (2015). The ash and fat contents were observed to increase with increasing level of *Gmelina aborea* leaves. The ash content fell within the range of 5.33-6.50%. This is comparable with the ash contents of 5.30 and 5.39% reported by Okafor *et al.* (2012) and Adamu *et al.* (2015), respectively and below the values of 9.15 and 11.30% reported by Okpara *et al.* (2014) and Abdu *et al.* (2012). The fat content reported in this fell within the range of 0.41-1.21%. This is low when compared to the fat content of 1.62 and 12.70% reported by Lamidi and Ogunkunle (2015) and Amata and Lebari (2011).

The result of the growth performance showed that the final body weight was highest in TC and TB (the Gmelina leaf meal diets). This might be a good indication of high crude protein contents of TC and TB. Body weight gain is best in TB followed by TC and TA. This is in line with Adamu *et al.* (2015) who reported a significant weight gain of Yankasa rams fed with *Gmelina arborea* whereas, Okafor *et al.* (2012) reported no significant ($p<0.05$) difference in body weight gain of Red Sokoto bucks fed with varying levels of *G. arborea*. This is in line with the report of Njidda (2008) that an efficient utilization of nutrients supplying adequate energy and protein is required for optimum growth performance in ruminant. Feed

conversion ratio was best in TC which might be an indication of the final body weight recorded in TC, this is the same in TB indicating that diets without *Gmelina arborea* leaves had the best feed conversion efficiency.

Comparing the results obtained from this study with the findings of Oguike and Etim (2010) and Tona *et al.* (2010), it could be observed that bucks tolerates leaf meals at optimum levels between (10-20%), respectively. Thus an inclusion of 20% is ideal for optimum performance. Poor performance of TA (control) in total feed intake and total weight gain may be attributed to the high crude fibre level of the diet which directly lowered digestibility, proper utilization of nutrients and metabolism of various nutrients (Anderson and Chen, 1992; Officer, 2000; Agbabiaka, 2013).

CONCLUSION

From the results of this experiment, it is evident that *Gmelina arborea* leaf at 10 and 20% levels in the diet of West African Dwarf bucks enhanced feed intake, growth rate and feed conversion ratio of the bucks. The result of this study suggests that *Gmelina arborea* leaf can be included up to 20% in the diets of West African Dwarf bucks in confinement without adversely affecting their performance. However, greater performance is attained at the level of 20% Gmelina leaf meal inclusion.

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