PERFORMANCE OF WEST AFRICAN DWARF BUCKS FED DIETS CONTAINING VARYING LEVELS OF SODIUM BICARBONATE

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ABSTRACT
Diets rich in concentrates lower rumen pH, diminishing the buffering capacity of the rumen and heightening the likelihood of ruminal acidosis which leads to inefficient nutrient absorption, decreased feed consumption, and ultimately reduced weight gain and animal performance. Hence, 63-day study was conducted to assess the performance of West African Dwarf (WAD) bucks fed diets containing varying levels of sodium bicarbonate. A basal diet was formulated and divided into five portions, and each contained 0.0kg, 0.5kg, 1.00g/kg, 1.50kg, and 2.00kg of $NaHCO_3$ to 100kg basal diet, thus, designated as Diet 1, 2, 3, 4, and 5 respectively. Twenty five (25) West African Dwarf (WAD) goats, were randomly assigned to the five dietary treatments in a Completely Randomized design (CRD). Data obtained were initial weight, daily weight gain, final weight, total weight gain, dry mater intake, feed conversion ratio were subjected to one-way analysis of variance. All performance parameters measured were significant ($P< 0.05$) except initial weight and dry matter intake ($P> 0.05$). The values for initial weight, daily weight gain, final weight, total weight, dry matter intake and FCR ranged from 13.05 to 13.17kg, 63.43 to 106.88g/day, 17.00 to 18.50kg, 3.93 to 5.37kg, 550.40 to 604.51g/day and 5.66 to 8.68, respectively. It was concluded that the addition of $NaHCO_3$ helped improve daily weight gain and enhance the feed conversion ratio of bucks. Goats on diet 5 gave the highest daily weight gain of 5.37 kg and lower feed conversion ratio (5.66) and thereby recommended.
Keywords: Performance, WAD buck, Sodium bicarbonate, Small ruminant.

INTRODUCTION

Small ruminants (especially goats and sheep) form an integral and important component of the pattern of animal production in most rural communities (Ajayi *et al*., 2015) and it remains popular among the rural populace and resource-poor people. In Nigeria, goats are significant in socio economic life of the people as they contribute about 35% of the animal meat supply (Babayemi, 2019).According to (Santa *et al*., (2003), high concentrate diets decrease rumen pH and fiber digestibility thereby reducing the buffering capacity of the rumen contents and increasing the risk of ruminal acidosis. Also, high-energy, low-fiber rations increased acid levels in the rumen, which could be detrimental to the rumen papillae. Ruminal papillae damage usually results in poor absorption of feed nutrients in the rumen which may reduce feed intake there by reducing weight gain and performance of the animal (Kawas *et al*., 2007)).

To avoid this incidence of rumen acidosis, several nutritional therapies have been tried, including the use of dietary buffers. Sodium bicarbonate ($NaHCO_3$) is a natural buffer (Erdman, 1988), and one of the dietary buffers commonly used to prevent ruminal pH reduction and enhance ruminal fermentation of low roughage diets. It helps to maintain the blood pH of the animal which is important for proper metabolic function. Although, there are several studies on the effects of $NaHCO_3$ supplementation in large ruminants, particularly in dairy cattle and fattening ewes fed a high concentrate diet, there are limited study on the effect of sodium bicarbonate on small ruminant particularly goat with respect to nutrient utilization and performance of the animal. Therefore, the aim of the present study was to determine the effect of different levels of dietary sodium bicarbonate on the performance of West African Dwarf goats for better and efficient productivity.

MATERIALS AND METHODS

Experimental Site

This experiment was carried out at the Small Ruminant unit of the Teaching and Research Farm, Federal University of Technology, Akure, Ondo State. The university is located in the humid rain forest zone of Western Nigeria with the tropical climate of broadly two seasons, which are rainy season (April – October) and dry season (November – March). Temperature throughout the year ranges between 22 ^{0} C and 29 ^{0} C with relatively high humidity. The mean annual rainfall is about 1,500mm and annual daily temperature ranging between 21^{0}Cand 38^{0}C (Daniel 2015)

Experimental materials (collection and processing of feed ingredients)

The cassava peels were obtained at cassava processing industries in Akure (Igbatoro), Ondo State. The peels were sun dried for 2-4days depending on the intensity of the sun to reduce both cyanide and moisture content, thereafter they were milled at FUTA feed mill to 2mm particle size. Other convectional feed ingredients (wheat

offal, palm kernel cake salt, premix, urea and di-calcium phosphate) were bought at a reputable feed mill industry in Akure. Sodium bicarbonate was bought at Scientific Laboratory store in Akure.

Experimental animals and Management

Twenty five (25) West African Dwarf bucks between the ages of 12 to 13 months were selected from the already existing flock on the farm and were weighed and randomly allocated into five (5) treatments such that each treatment had 5 goats per replicate. The goats were tagged for proper identification and standard prophylactic treatments were administered to ensure good health. The experimental diet was given to the animals at 5 % of their body weight and were fed once per day

Experimental Diets

A basal diet was formulated to meet the nutrient requirement of growing goat using cassava peel, wheat offal, palm kernel cake, premix, Di-calcium phosphate, salt, and urea as shown in Table 1.

The basal diet was divided into five (5) equal portions and each supplemented with graded levels of $NaHCO_3$ (sodium bicarbonate) in diets as shown below

Table 1: Gross Composition of basal Diet (%)

Ingredient	Quantity (%)
Cassava peel meal	49.70
Wheat offal	34.00
Palm Kernel Cake	13.00
Premix	0.60
Di-calcium Phosphate	1.00
Salt	0.70
Urea	1.00
Total	**100.00**

A = Basal diet B = Basal diet + 0.5kg $NaHCO_3$ /100kg feed C = Basal diet + 1kg $NaHCO_3$ /100kg feed
D = Basal diet + 1.5kg $NaHCO_3$/100kg feed E = Basal diet + 2kg $NaHCO_3$/100kg feed

Data Collection

The goats were weighed at the commencement of experiment and were repeatedly weighed weekly in the morning before feeding, to observe any weight change using spring balance (hanging scale). The following growth performance parameters were determined; **Initial weight** - This is the weight of the WAD goat taken before feeding trial commenced. **Weight change** – This was determined by deduction of initial weight before feeding trial using the following formula: Weight change (kg) = final weight (kg) – initial weight (kg). **Feed Intake** –The difference in total feed offered and feed left over were taken as feed intake. **Feed Conversion Ratio =** Total feed consumed (g/day) / weight gain (g/day)

DATA Analysis

All data collected were subjected to one-way analysis of variance (ANOVA) using SPSS software. Where significant difference existed, Duncan Multiple Range Test was used to compare the mean at 5% level of significance.

RESULTS AND DISCUSSION

Table 2: Performance characteristics of West African Dwarf goats fed diets containing graded levels of sodium bicarbonate

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	P-Value
Initial weight (kg)	13.07	13.05	13.17	13.17	13.13	0.49	0.923
Daily weight gain (g/day)	63.43^{b}	79.89^{ab}	98.41^{a}	101.06^{a}	106.88^{a}	5.97	0.006
Final weight (kg)	17.00^{b}	17.20^{b}	18.00^{a}	18.27^{a}	18.50^{a}	0.59	0.012
Total weight (kg)	3.93^{c}	4.15^{bc}	4.83^{b}	5.10^{a}	5.37^{a}	0.38	0.007
Dry matter intake (g/day)	550.40	578.31	598.43	601.85	604.51	15.01	0.912
Feed conversion ratio	8.68^{c}	7.24^{b}	6.08^{a}	5.96^{a}	5.66^{a}	0.73	0.024

^{abcde}: Mean with different superscript along the same row are significantly ($P<0.05$) different

All parameters were significantly ($P<0.05$) different across the treatments except the initial weight and dry matter intake. The highest daily and total weight gain (106.88 g/day and 5.37 kg) were recorded from goats fed diet 5 while the least values (63.43 g/day and 3.93 kg) from goats fed diet 1. The feed conversion ratio was found to be least (5.66) from goats fed diet 5 and the highest (8.68) from goats placed on diet 1.

The initial and final weight were in the range of 13.05 to 13.17kg and 17.00 to 18.50 kg. The highest (604.51g/day) dry matter intake was obtained from goats fed diet 5 while the least (550.40 g/day) intake from goats fed diet 1.

Evaluation of growth performance is of economic importance to farmers especially when goats are raised for meat production. Omotoso *et al*., (2023) reported that weight gain in goat is dependent on dry matter intake, protein intake and the digestibility of the nutrients. The highest weight gain was obtained from goats fed diet 5. This could be attributed to the aforementioned factors. Similarly, the crude protein value of the diet, improved nitrogen intake and retention from goats fed diet 5 which might be due to the microbial population in the rumen, and microbial protein available in the goat.

Also, (Aguilera-Soto *et al*., 2008) reported that the supplementation of $NaHCO_3$ to lamb diets increased dry matter intake and feed efficiency as observed in this study. On the other hand, the voluntary feed intake of the animals was not affected by supplementation of sodium bicarbonate (Fellner *et al*., 2000). Similarly, the addition of $NaHCO_3$ to the concentrate diets helped to control acidity and increases the palatability of the diets through neutralization of acidity which is responsible for improving feed intake, as observed by Jacques *et al*., (1986).

The least feed conversion ratio was obtained from goats fed diet 5 and the highest from goats fed diet 1. Omotoso *et al*., (2022) reported that the lower the feed conversion ratio the better the feed efficiency of the animal. It was observed that the buck fed diet 5 converted their diet to flesh better than others. The observed feed conversion ratio in buck fed diet 5 might be attributed to the crude protein quality and intake that might enhance the growth performance and rumen microbial protein required by the bucks to convert their diet to flesh (Lu *et al*., 2008) Thus, goats fed diet 5 would consume 5.66kg of the feed to convert into a unit kilogram of live weight as against other groups.

CONCLUSION

This study examined the effect of inclusion of varying levels of sodium bicarbonate ($NaHCO_3$) to concentrate diet locally formulated with conventional feedstuffs on the performance of WAD buck. The results showed that the addition of $NaHCO_3$ helped improve daily weight gain with the highest (5.37 kg) values obtained gain from goats fed diet 5.

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