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SODIUM REQUIREMENTS FOR MAINTENANCE AND GROWTH OF WEST AFRICAN DWARF GOATS

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Target Audience: Animal nutritionists, commercial goat producers, general agriculturists.

ABSTRACT

Sodium (Na) requirements for maintenance and growth of goats were determined in a 70-day feeding trial involving 4 treatment levels (0,5,10 and 15g) of common salt (NaCl), sun-cured cassava peels (SCCP) using Gmelina leaves as basal diet. Results showed that increasing dietary NaCl levels in the SCCP increased total dry matter intake, average daily weight gain and water consumption. However, animals offered 5g salt per day recorded the highest ($P<0.05$)growth rate (58.6g/d), optimum dry matter intake (2.90% body weight) and highest serum Na concentration (200 mmol/L). Goats on higher dietary NaCl depicted a decline in growth rate. Treatment effects at dietary 5 or 10g NaCl were not significant. The data suggested that West African dwarf goats would require 5g common salt in the diet for maximum growth rate and 0.52 ppm/kg BW/day for body maintenance.

Key words: Sodium requirements, maintenance, growth goats.

DESCRIPTION OF PROBLEM

In a developing country like Nigeria, goats are seldom given NaCl in their diets. The most likely reason is that range management system is the norm where the animals have access to different sources of salt from browsing. However, with the increase in demographic growth and the consequent introduction of intensive paddock management system, animals may no longer have access to such benefit. Animals obtain Na in the form of NaCl. Cattle or sheep deprived of NaCl for short periods consume lethal quantities when confronted with large amounts (1). Deficiency of Na has been reported to precipitate retardation of growth, impaired digestion, lack of appetite and reduced efficiency of feed utilization in growing animals(2). It has been recommended(3) that the concentrate diet of goats should contain 1% salt. There is however paucity of information on Na requirements for maintenance and growth of West African dwarf goats. The objective of this trial is to

determine the Na requirements for maintenance and growth in West African dwarf goats fed different dietary contents of salt and SCCP.

MATERIALS AND METHODS

Animals and their management

This study was carried out in the Teaching and Research Farm of the University of Agriculture, Abeokuta, 75°N313°E Nigeria, between April and August, 1998. Twelve West African dwarf goats, weighing 7 to 8kg, were randomly selected in the goat herd and routinely given ivomec injection (1ml/50kg body weight] against endo-and ecto-parasites.

Dietary treatments

The treatments consisted of SCCP and levels (0,5,10,15g) of NaCI arranged in a completely randomized design(4). Salt offered (0,5,10,15g) was dissolved for each treatment in 25ml of water and then sprinkled on 1kg SCCP for each treatment and then manually mixed to enhance intake. Fresh Gmelina leaves whose intake had been determined was in addition supplied at the rate of 1.5kg per treatment in a separate wooden feeder while water supply was at the rate of 2 liters per treatment based on earlier determined consumption rate.

Table 1: Composition of daily experimental ration.

	I	II	III	IV
Common salt (g)	0	5.0	10.0	15.0
Sun-cured cassava peels	1.0	1.0	1.0	1.0
(SCCP)(kg)	1.5	1.5	1.5	1.5
Fresh Gmelina leaves (kg)	2.0	2.0	2.0	2.0
Water Supplied(L)				

The 12 goats were divided into 4 groups of 3 animals per group, balanced for body weight. Each of the 4 groups was assigned to an experimental ration once daily for 10 weeks (70 days).

Data Collection

Before the commencement of the experimental treatment, feed was withdrawn for 14 to 16 h from the goats and then weighed to check error due to "gut-fill" Thereafter, body weights were taken every fortnight, while daily water consumption, residues of SCCP, and Gmelina leaves were weighed every morning between 0080 and 0090h before offering the day's feed and water. After pre-experimental weighing, the goats were transferred into individual metabolism cages for collection of urine, faeces and serum to estimate Na status of the goat. Urine samples were collected from each animal through the use of urine board attached to the base of the entire cage. The board had a tapered conical end which was inserted into the urine sample bottles for urine collection. The floor of the cage on which each animal stood was of wire netting. The faecal samples were collected daily from each animal for 7 days. About 25% of weighed total daily faecal output was dried at 80°C for analysis.

Blood samples were collected through jugular vein puncture and serum harvested(5).

Collection of serum, urine and faeces was repeated at the end of the experiment as described above.

Chemical Analysis

The faecal samples, Gmelina leaves and SCCP were oven-dried at 80°C to constant weight and then milled. Five grams of milled faeces, SCCP and Gmelina leaves were digested(6) and Na estimated. The Na contents of serum and urine were determined on Perkin Elmer Atomic Absorption Spectrophotometer model 290(7).

Statistical Analysis

Data collected were subjected to analysis of variance(4). Differences among treatment means were compared(4). Sodium balance (Na intake minus urinary and faecal Na) and maintenance requirement for Na (the Na intake that will give zero balance) were computed. The maintenance requirement was determined from the regression of Na balance on Na intake using the formula:

$$Y = bx + C$$

where Y = Na balance
X = Na intake (ppm)
C = intercept on Y-axis
b = regression coefficient
When Y = 0, the value of x is an index of Na requirement for maintenance.

RESULTS AND DISCUSSION

The proximate compositions of cassava peels and Gmelina leaves as fed to goats are shown in Table 2 and summary of the performance of the goats on experimental diets is presented in Table 3.

Table 2: Proximate compositions of cassava peels and Gmelina leaves (% Dry matter)

	Cassava peel	Gmelina leaf
Dry matter	27.9	39.6
Ash	5.9	7.5
CP	4.7	24.8
CF	20.9	38.4
EE	1.2	4.8
NFE	67.3	24.5
Na	0.035	0.041
CI	0.50	0.30

Increasing common salt levels in the SCCP based diets increased dry matter intake (DMI), average daily gain (ADG) and water consumption ($P<0.05$). Results further showed that dietary inclusion of 5g salt per day provoked the highest growth rate ($P<0.05$) which then witnessed a decline (37.1g/d) as the dietary salt reached maximum rate (15g addition). However, the differences observed between the growth rate of goats fed 5g and 10g salt daily (58.6 and 48.6g/d, respectively) were not significant ($P>0.05$). In like manner, ADG observed for goats on the control diet and those fed 15g salt per day were not significant (32.9 and 37.1g/d, respectively). It appears that there was a limit to which salt addition to the goat diets could induce performance beyond which further dietary increase would reduce performance. Five gram salt rate promoted optimum DMI (2.90% body weight), feed conversion ratio (2.52) and highest serum Na concentration (200 mmol/L) which could be responsible for the performance of goats on this treatment.

Table 3: Performance of West African Darf Gats Fed Varying Levels of Sun-cured Common Salt-based Dets

	Common salt levels (g)					
Parameters	0	5	10	15	Mean	±SE
Average initial body weight (kg)	7.3	7.5	7.8	8.0	7.65	0.311
Average final body weight (kg)	9.6	11.6	11.2	10.61	0.75	0.870
Average daily gain (g/d)	32.9[b]	58.6[a]	48.6[a]	37.1[b]	44.30	11.61
Average cassava peels intake (DM) (% body weight)	0.55	0.57	0.70	0.89	0.67	0.168
Average Gmelina leaf intake (DM) (% body weight)	1.98	2.33	2.42	2.59	2.33	0.278
Total dry matter intake (% body weight)	2.53	2.90	3.12	3.48	3.10	0.414
Feed conversion ratio Total feed intake (kg)/ Total weight gain (kg)	4.31	2.52	3.00	3.65	3.37	0.779
Average water consumption (L/kg body weight)	0.07	0.08	0.11	0.15	0.10	0.036
Na concentration in Gmelina leaf consumed (ppm)	0.388	0.399	0.426	0.477	0.423	0.084
Na concentration in cassava peels consumed (ppm)	0.265	0.285	0.350	0.445	0.336	0.081
Na concentration in cassava peels plus salt mixture consumed (ppm)	0	0.003	0.007	0.013	0.006	0.006
Total Na concentration consumed (ppm)	0.653	0.687	0.783	0.935	0.765	0.126
Average serum Na concentration (mmol/L)	160.0	200.0	130.0	170.0	165.0	28.87
Average faecal Na output (ppm)	0.480	1.170	1.100	-0.400	0.585	0.404
Average urinary Na excretion (mmol/L)	20.0	50.0	120.0	110.0	75.0	47.958
Na balance (ppm)	-19.827	-50.483	120.317	-180.665	-74.823	-47.721

a,b, means along the same row with any identical superscript are not significant ($P>0.05$)

Average Gmeina leaf intake was higher than the average SCCP intake which could be due to the succulent nature of fresh Gmelina leaves than SCCP. There was a significant positive correlation between water consumption and SCCP intake ($r = 0.99$; $P<0.05$). The increasing water consumption could be attributed to the dry nature of the peels coupled with increasing salt rates (r salt/water intake = 0.98; $P<0.05$). It seems that the increasing dietary salt also induced increasing water consumption by the goats. The result of the regression of Na balance upon intake showed that goats would require 0.52 ppm per kg body weight per day for body maintenance. This is an indication that goats require very low dietary Na for body maintenance. This could also be the reason for copious excretion of Na from urine and an attempt to regulate osmotic pressure and maintain acid-base balance of the body(8). Dietary inclusion of NaCl at 5g/day seems to be the level required for optimum growth of goats.

The responses of the goats on the control (zero salt addition) were the lowest in terms of mean values of daily gain (32.9gld), total DMI (2.53% body weight), water consumption (0.07L/kg body weight) and feed conversion ratio (4.31). Responses also suggested that addition of NaCI to goat rations improved performance and feed utilization. The goats excreted more Na in the urine than faeces(8). All goats depicted negative Na-balance which suggested that endogenous production of Na exceeded intake. The most likely source of endogenous production is through the wears and tears of the linings of the intestinal tract or excretion from the kidney(8). The serum Na concentration was higher than the faecal and urinary output put together probably indicating that serum reserves substantial Na for all the physiological activities involving Na.

CONCLUSION AND APPLICATIONS

1. The West African dwarf goats require 0.52 ppm Na per kg body weight/day for body maintenance and 0.5% of concentrate ration for optimum growth rate.
2. The application of this result as it affects farmers is that about one spoonful of NaCl can be mixed with a *mudule* of dry cassava peels for a remarkable performance of the goats.

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