Effect of dietary salt levels on the performance of West African Dwarf (WAD) goats

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Abstract

A 70-day feeding trial was conducted to estimate the effect of levels (0, 5, 10, and 15g/kg cassava peels, respectively) of common salt and cassava peels (dry and fresh using *Gmelina arborea* leaves as a basal diet on the average daily gain, dry matter intake, feed conversion efficiency and water consumption in West African Dwarf goats. Total dry matter intake and the average *Gmelina arborea* leaf intake increased with applied common salt, irrespective of cassava peel form. Increasing common salt level also increased average daily gain and feed conversion efficiency in both dry and fresh cassava peels, but this was not accompanied by a remarkable gain beyond 5g common salt. Moreover, the average cassava peel intake increased but not significantly ($P > 0.05$) with salt level up to 10g beyond which there was a sharp decline and an insignificant gain with dry and fresh cassava peels, respectively. Goats fed dry cassava peels significantly ($P < 0.05$) consumed more water as the salt level increased in the diet. It was concluded that application of 5g common salt per kg dry cassava peels promoted highest daily gain, optimum dry matter intake and feed conversion efficiency in West African Dwarf goat production. However, the response with fresh cassava peels revealed no statistically significant difference in average daily gain, total dry matter intake and feed conversion efficiency.

Keywords: Salt, cassava peels, WAD goats performance.

Introduction

In the developing country like Nigeria, goats are seldom given common salt in their diets. This may be because they practice range management system where the animals have access to different sources of salt. However, with the increase in the demographic growth and the consequent introduction of intensive paddock management system, animal may not have access to different sources of salt (Aina, 1999). Loose salt is a common and cheap household item while salt lick which is about 90% common salt (NaCl) is very expensive and not easy to come by, hence the use of salt lick in the developing countries is highly limited. Dietary salt shortages reduced feed intake and

induced dirt chewing, poor hair coat, and heat stress all of which indirectly affected their reproductive efficiency (Church and Pond, 1988). Cattle or sheep deprived of NaCl for short period of time have been found to consume lethal quantities when confronted with large amounts (West *et al.*, 1966). These animals are known to travel a great distance to find 'salt lick' if they are otherwise deprived of such (Boumgardt, 1969). Van Horn and Haenlein (1983) recommended that goats in general should have 1% salt in their concentrate supplement while Steele (1996) observed that goats require salt in large amounts.

Dietary salt requirements in West African Dwarf (WAD) goats for optimum performance have not been sufficiently studied in Nigeria, yet WAD goats occupy an important place in the socio-economic life of the people. The general convention is to impose recommendations determined for temperate breeds of the cattle and sheep on goats in general and the WAD goats in particular (Kearl, 1982). There is an urgent need for a meaningful and realistic recommendation on salt requirements in WAD goat production in the humid tropics, particularly in Nigeria. The objective of this study was to estimate the quantity of salt that would promote optimum dry matter intake (DMI), average daily gain (ADG), feed conversion efficiency (FCE) and serum Na and Cl concentrations in WAD goats.

Materials and methods

Feed description and preparation

Two forms of cassava peels (dry and fresh) as factor A and four levels (0,5,10,15g/kg cassava peels) of sodium chloride as Factor B arranged in 2 x 4 factorial experiment were the applied treatments (Table 1). Salt rates were dissolved in 50ml of water and sprinkled on the dry cassava peels in each treatment and then thoroughly mixed manually to enhance intake, Fresh cassava peels were mixed with the salt rates without dissolving in water.

Fresh cassava peels procurement

Fresh cassava peels were collected from the neighboring Gari processing factory every other day throughout the experimental period. However, small samples from the collected quantities (about 20g) were oven-dried, milled and preserved. At the end of the experiment, the milled samples were thoroughly mixed together before the determination of proximate composition (Table 2).

Table 1 *Composition of experimental diets*

Ingredients	I	II	III	IV	V	VI	VII	VIII
Common salt (g)	0	5	10	15	0	5	10	15
Fresh cassava peels (kg)	-	-	-	-	1.0	1.0	1.0	1.0
Dry cassava peels (kg)	1.0	1.0	1.0	1.0	-	-	-	-
Fresh Gmelia leaves (kg)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Water (Litre)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Adapted and modified from Aina (1999)

Table 2 *Proximate composition of cassava peels and gmelia leaves (g/kg)*

Measurements	Cassava peels	Gmelina leaves
Moisture	721	604
Dry matter	279	396
Ash	59	75
Crude protein	47	248
Crude fibre	209	384
Ether extract	12	48
Nitrogen free extract	673	245
Sodium	0.35	0.41
Chloride	5.0	3.0
Calcium	2.0	10.1
Phosphorus	0.3	4.3

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Dry cassava peels preparation

Dry cassava peels were directly purchased from the Gari processing factory in Alabata throughout the experimental period. The peels had been earlier sun-cured and stored during the proceeding dry season. The peels were purchased as the need arose during the experimental period.

Fresh Gmelina leaves

Fresh Gmelina leaves and branchlets, which had just been established in the last 12 months were cut daily, fed to the animals at the rate of 500g/animal twice daily (8-9 a.m. and 3-4p.m.). Fresh samples of the leaves and branchlets were taken once a week oven dried, milled and stored in an air-tight condition. At the end of the experiment the samples were mixed together and proximate components determined (Table 2).

Experimental animals

The experiment was carried out at the Teaching and Research Farm, University of Agriculture, Abeokuta, using 24 female WAD goats, weighing between 6 and 8kg. On arrival, the goats were routinely bathed in asuntol solution^R (3g/litre of water) against ectoparasites and given Ivomec^R injection (1ml/50kg body weight) against internal parasites. After a week, Terramycin injection was administered on the animals to enhance their resistance to infection and improve their feed intake and efficiency (Owens and Geary, 1992). Clout^R was applied at 4 weeks intervals along the spine of the animals to check against possible mange infection.

The 24 goats were divided into 3 animals per group balanced for body weight. Four of the 8 groups were assigned to dry cassava peels treatment and the other 4 groups to fresh cassava peels treatment, respectively. The animals were exposed to the experimental diets for 7 days prior to the commencement of the experiment. This was to determine their feed intake and water consumption as well as flushing out from the digestive system of the

animals previous feed residues. The animals were then introduced to their respective dietary treatments for 10 weeks. Two litres of water was offered per animal once daily.

Before the commencement of the experimental treatment, feed only was withdrawn for 14-16 hours followed by taking their body weights. This was to avoid gut-filled weights. The goats were then transferred into their individual metabolism cage for the collection of urine, faeces and serum samples to estimate NaCl status in the goats before experimental treatment. Blood samples were collected through jugular venipuncture and serum harvested using the method of Frandson (1986), and then stored at -10°C until required for analysis. The urine sample bottles were rinsed with dilute sulphuric acid for preservation of urine samples and then stored at -10°C until required for analysis. Collection of serum, faeces and urine was repeated during the last week of the experiment. Body weights were also taken every fortnight while residues of cassava peels (dry or fresh), Gmelina and left over water were also estimated every morning between 08.00 and 09.00 before fresh feed and water were supplied.

Analytical procedure

The faecal samples, Gmelina leaves and cassava peels were oven-dried at 105°C to constant weight and milled. Five grams each of milled samples of faeces, cassava peels and Gmelina leaves were weighed out and the chemical analysis was done according to AOAC (1990). The Na content of faecal and urine samples and those of serum were determined by flame photometry method while titration method was used to estimate cl concentration in urine and serum.

Analysis of variance (ANOVA) was carried out on all the data collected based on the design (Little and Hills, 1978). Fisher ratio was used to test for significant means at 5% probability.

Results and discussion

Effect of common salt intake on goat performance

The mean dry cassava peel intake (0.67% body weight) and water consumption ($0.10\text{L/W}^{0.75}\text{ Kg}$) was higher than the mean fresh cassava peels intake (0.59% body weight) and WC ($0.04\text{L/W}^{0.75}\text{ Kg}$) by the goats though not significantly different ($P>0.05$). Five gram common salt with dry cassava peels promoted better performance in the goats in terms of ADG (58.1g/d), optimum DMI (1.90% body weight), lowest WC ($0.07\text{L/W}^{0.75}\text{ Kg}$), FCE (0.397) and highest serum Na concentration (20mmol/dl). With fresh cassava peels 5g common salt induced the highest ADG (53.3g/d), optimum DMI (2.32% body weight) lowest WC ($0.03\text{L/W}^{0.75}\text{ Kg}$), FCE (0.305) and serum Na concentration (7mmol/dl).

In terms of absolute figure, the goats appeared to respond better to salt-treated dry cassava peels than salt-treated fresh cassava peels though the responses were not significantly different. The average Gmelina leaf intake (GLI) was higher with fresh cassava peels (1.89% body weight) than in dry (1.33% body weight). Gmelina leaf intake was, however, consistently higher, though not significantly different, in fresh than in dry cassava peels while 15g salt encourage the highest intake (2.6% body weight) in fresh cassava peels. The responses of the goats to 10g salt followed those of 5g salts in terms of absolute values (Table 3) though the differences in the two responses to the two salt rates, either dry or fresh cassava peels were not significant ($P>0.05$). The performance of the goats on the zero salt rate in both dry and fresh cassava peels were similar, though they were numerically lower than those of salt treated goats (Table 3). No adverse effect of salt was however observed on the behaviour of the animals. This agrees with the reports of Haelein (1980) who observed no adverse effect of salt on feed utilization and performance of dietary concentration of 5% or higher. ARC (1980) has

reported an increasing dietary Na requirements as weight gain is increasing.

The dry cassava peel intake (CPI) and water consumption were consistently higher, though not significantly different ($P>0.05$), than the intake of fresh cassava peels (FCP) and consumption of water in fresh cassava peels. As salt rate increased, cassava peels (dry and fresh) intake also increased accordingly while the mean intake in dry (0.67% body weight) was higher than in fresh (0.59% body weight). However, the differences were not significant. On the other hand, Gmelina leaf intake in fresh cassava peels treatment was consistently higher than in the dry cassava peels.

The lower CPI in the fresh form than in the dry form could be attributed to likely cyanide content in the fresh than in the dry cassava peels (Devendra, 1977; Adegbola and Asaolu, 1986). Thus the goats tended to consume more Gmelina leaves to compensate for the lower fresh CPI to meet their DMI requirement, whereas higher dry CPI coupled with higher WC could be attributed to the goat's higher preference for dry cassava peels than fresh cassava peels. The higher WC could have been used to soften the dry peels and facilitate easier chewing, fine mastication and quench an induced thirst. The moisture contained in the fresh Gmelina leaves could have neutralized the cyanide content of the fresh cassava peels. However, higher mean ADG was induced in fresh cassava peels (47.4g/d) than in dry cassava peels (43.8g/d; Table 3).

The mean faecal (0.588 ppm) and urinary (7.5mmol/dl) Na excretions in the dry cassava peels were in positive balances (Table 4) while negative balances were obtained with fresh cassava peels (-0.343ppm and -5.2mmol/dl) respectively. The observation with respect to fresh cassava peels could be an indication of significant retention of Na and Cl or it could be that the ions had formed some complexes with cyanide content of the fresh cassava peels

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Table 3 *Performance of West African Dwarf goats fed the experimental diets*

	Dry cassava peels						Fresh cassava peels					
	Common salt levels (g)						Common salt levels (g)					
	0	5	10	15	Mean	±se	0	5	10	15	Mean	±se
Average initial body weight (kg)	6.1	6.2	6.3	6.0	6.15	0.129	6.8	6.9	7.1	7.0	7.95	0.129
Average final body weight (kg)	8.4	10.3	9.7	8.6	9.25	0.904	9.6	10.6	10.7	10.1	10.25	0.507
Body weight change (kg)	2.3	4.1	3.4	2.6	3.10	0.812	2.8	3.7	3.6	3.1	3.30	0.424
Average daily gain (g/d)	32.2 ^b	58.1 ^a	48.0 ^a	37.0 ^b	43.83	11.589	40.7 ^a	53.3 ^a	51.7 ^a	43.8 ^a	47.38	6.087
Average cassava peel intake												
(% body weight: DM)	0.51	0.57	0.70	0.89	0.67	0.168	0.55	0.61	0.67	0.54	0.59	0.060
Average <i>Gmelina</i> leaf intake												
(% body weight: DM)	0.98	1.33	1.42	1.59	1.33	0.278	1.45	1.71	1.78	2.60	1.89	0.497
Total dry matter intake												
(% body weight)	1.49	1.90	2.12	2.48	2.00	0.414	2.00	2.32	2.45	3.14	2.48	0.480
Average water consumption												
(L/W ^{0.75} kg)	0.08 ^b	0.07 ^b	0.11 ^a	0.15 ^a	0.10	0.036	0.03	0.03	0.04	0.05	0.04	0.010
Feed conversion efficiency												
(Gain/Feed)	0.232	0.397	0.333	0.274	0.309	0.072	0.302	0.305	0.288	0.235	0.283	0.033

^{a, b} Means along the same row with any identical superscripts are not significant ($P > 0.05$).

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Table 4 Summary of dietary salts effects on serum concentration, faecal and urinary output of Na and Cl

	Dry cassava peels										Fresh cassava peels				
	Common salt levels (g)					Mean	tse	0	5	10	15	Mean	tse		
	0	5	10	15											
Na concentration in <i>Gmelina</i> leaf consumed (ppm)	0.388	0.399	0.426	0.477		0.423	0.084	0.345	0.513	0.534	0.780	0.566	0.149		
Cl concentration in <i>Gmelina</i> leaf consumed (ppm)	0.060	0.055	0.058	0.065		0.065	0.011	0.059	0.070	0.073	0.107	0.077	0.021		
Na concentration in cassava peels consumed (ppm)	0.265	0.285	0.350	0.445		0.336	0.081	0.275	0.305	0.335	0.270	0.296	0.030		
Cl concentration in cassava peels consumed (ppm)	0.010	0.020	0.025	0.031		0.022	0.008	0.019	0.021	0.023	0.019	0.021	0.002		
NaCl concentration in cassava peels + salt mixture (ppm)	0.000	0.003	0.007	0.013		0.006	0.006	0.000	0.003	0.007	0.008	0.005	0.004		
Total Na consumed (ppm)	0.866	0.762	0.866	1.031		0.881	0.111	0.710	0.821	0.876	1.058	0.866	0.145		
Total Cl consumed (ppm)	0.070	0.075	0.083	0.096		0.081	0.011	0.078	0.091	0.06	0.126	0.098	0.020		
Average serum Na concentration (mmol/dl)	16 ^a	20 ^a	13 ^b	17 ^a		16.5	2.887	3 ^b	7 ^a	7 ^a	7 ^a	6	2		
Average serum Cl concentration (mmol/dl)	13	14	10	12		12.3	1.708	2 ^b	5 ^a	4 ^a	6 ^a	4.3	1.708		
Average faecal Na output (ppm)	0.480 ^a	1.17 ^a	1.10 ^a	-0.400 ^b		0.588	0.404	0.030 ^b	-2.230 ^c	-0.100 ^c	0.930 ^a	-0.343	1.024		
Average faecal Cl output (ppm)	0.031	0.022	0.036	0.010		0.025	0.011	0.001 ^b	0.024 ^a	-0.007 ^c	0.024 ^a	0.011	0.012		
Average urinary Na excretion (mmol/dl)	2 ^b	5 ^b	12 ^a	11 ^a		7.5	4.795	-5 ^b	0.30 ^a	-15 ^b	-1 ^b	-5.20	6.774		
Average urinary Cl excretion (mmol/dl)	5 ^b	13 ^a	24 ^a	17 ^a		14.8	7.932	-10 ^b	-1 ^b	-29 ^b	7 ^a	-8.3	12.093		

^{a, b, c} Means along the same row with any identical superscripts are not significant ($P > 0.05$).

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or some other salts not toxic to the goats. Average serum Na and Cl concentrations were higher by 175.0 and 186.0%, respectively in dry cassava peels than in fresh cassava peels.

It appears that the goats reacted differently to salt rates in dry and fresh cassava peels. With salt-treated fresh cassava peels, the goats exhibited significantly ($P < 0.05$) lower serum Na and Cl concentrations and urinary Na and Cl excretion than with dry cassava peels. However, the two forms (fresh and dry) depicted similar trend in DMI and ADG. It could be concluded that 5g common salt per kg of dry or fresh cassava peels is the optimum rate that will promote the best performance in West African Dwarf goats.

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