Research note: Manure production by goats grazing native pasture in Nigeria

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Abstract

In a study carried out to determine the quantity and quality of overnight manure voided by Red Sokoto goats grazing native pasture and fed a concentrate supplement at NAPRI, Shika-Zaria, bucks and does produced 0.38 and 0.37 kg of manure per head per night, respectively, during the wet season. Corresponding values were 0.35 and 0.34 kg during the dry season.

Nutrient concentrations in the dry manure were: N – 2.8%; P – 0.42%; and K – 0.93%. An adult goat is capable of producing 138 kg dry manure per year which would contain 3.4 kg N, 0.5 kg P and 1.1 kg K. There is significant potential to reduce fertiliser costs for crop production by substituting goat manure for expensive inorganic fertiliser currently used. Field studies are warranted to demonstrate to farmers the financial benefits to be obtained.

Introduction

The Red Sokoto goat (RSG) accounts for about 70% of Nigeria's goat population which has been estimated at 34.45 million (Ademosun 1993). The breed is predominantly reddish brown in colour, and is found in the savanna zone of Nigeria (8°N–11°N) where it constitutes more than 90% of the goat population in that area. The breed weighs about 1.5–2.0 kg at birth and reaches about 12.0 kg when weaned at 3 months under good management. Weights of adult does and bucks are 20–35 kg and 25–40 kg, respectively.

Fertilisers are used routinely by farmers in crop production systems in Nigeria. Traditionally, animal manure was the source of fertiliser but this practice was superseded by inorganic fertilisers which have been highly subsidised by the Nigerian government within the last 10–15 years. However, following the recent withdrawal of subsidies, the high cost of inorganic fertilisers has rekindled interest in the use of animal manure which was discarded as waste material during the fertiliser-subsidy era.

The primary purpose of keeping goats is for meat, skins and milk, but the goat also represents a potential source of fertiliser. The relatively high population of goats suggests that a substantial amount of manure could be obtained from these animals. Unfortunately, animal faeces in general and goat manure in particular are often overlooked or deliberately ignored in animal productivity measurements. As goats are penned at night, collection of manure would be relatively simple. We conducted this study to determine the quantity and quality of overnight manure produced by RSG.

Materials and methods

The experiment was conducted at the Goat Breeding Project site of the National Animal Production Research Institute (NAPRI), Shika (11°12′ N, 7° 33′ E; elevation 610 m; 1150 mm mean annual rainfall).

Five bucks and 5 non-pregnant dry does were selected from a group of RSGs grazed on native pasture (comprised mainly of *Hyperrhenia rufa, Andropogon gayanus, Cynodon dactylon* in the wet season and *Pennisetum pedicellatum, Setaria anceps* and *Sida acuta* in the dry season) and supplemented with a 75:25 maize: cottonseed cake mixture which was fed at 300 g/hd/d. The goats were grazed and watered for 8 h daily from 08.00–12.00 h and from 14.00–18.00 h. For the

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remainder of each 24 h period they were confined separately in specific pens designated for each gender. The pens had concrete floors.

Each morning after removal of the goats from the pens, the manure voided was collected and weighed and samples (about 10%) were taken, weighed and oven-dried at 65°C for 18 h. The dried samples were subjected to proximate analysis using the AOAC (1990) procedures. Determination of the P and K concentrations in the faeces was by the use of an Atomic Absorption (Flame) Spectrophotometer. The faecal collection period was for 30 days in the wet season (August) and 30 days in the dry season (January).

Availability of pasture species present within the study area was estimated by visual identification and hand sorting of the species from known weights of forage cut at about 5 cm above ground level from randomly marked out 1 m × 1 m quadrats.

The goats grazed as one group. They were allowed free access to mineral salt blocks and water in the pens and while grazing.

Results and discussion

Mean daily manure production was 0.38 and 0.35 kg/hd/d in the wet and dry seasons, respectively, with no significant ($P > 0.05$) difference between genders (Table 1). This represented 0.36 and 0.33 kg DM/hd/d. This trend was also observed with local (Menz) and crossbred (Menz × Merino) sheep in Ethiopia (Sebsile 1993). Kallah and Adamu (1988) estimated the daily faeces excreted by unsupplemented RSGs to be 240 g/hd DM under the agropastoral system where animals were kraaled at night with no bedding material. The higher faecal output observed in our study could be attributed to the fact that our goats were supplemented. Winks *et al.* (1976) found that supplementation of cattle grazing native pasture with a molasses-urea supplement increased faecal output by 33%. In addition, the concrete floor allowed for more accurate collection of faeces. Trampling resulting in compaction and sticking of faeces to animals' bodies represent sources of error in collection of voided faeces when animals are kraaled.

Despite major differences in DM concentrations in available forage in the wet and dry seasons, DM concentrations in faeces of animals were similar in both seasons ($P > 0.05$).

The physical composition of the forage in the grazing area (Table 3) changed with the season. This was expected with *Hyperrhenia rufa, Andropogon gayanus, Cynodon dactylon* and *Stylosanthes hamata* in abundance in the wet season, whereas *Pennisetum pedicellatum, Sida acuta* and *Setaria anceps* increased in relative abundance during the dry season. The increase in relative abundance during the dry season could be due to persistence and/or reduced preference for those species by the goats. However, although well accepted by the goats, *Hyperrhenia rufa* was abundant during both seasons.

Table 1. Seasonal overnight production and chemical composition of manure from Red Sokoto goats.

Gender	LWT[1]	Seasonal manure production		DM	N	P	K
		Wet season	Dry season				
	(kg)	(kg DM/hd/d)		(%)			
M	22.5	0.36(0.38)[2]	0.33(0.35)[2]	94.6	2.81	0.42	0.93
F	20.5	0.35(0.37)[2]	0.32(0.35)[2]	94.6	2.78	0.43	0.93

[1] Average liveweight.
[2] Figures in parenthesis are for fresh samples.

The concentrate offered to the goats contained in excess of 15% crude protein and 2.5 kcal ME/g (Table 2). Along with the mineral salt blocks provided, this should have ensured that feed intake was maximised since available forage was adequate. Therefore, the quantity of manure produced should represent the maximum quantity produced by grazing goats. Unsupplemented goats would be expected to produce less.

In Nigeria, N,P and K are the major elements in commercial inorganic fertilisers presently in use. In addition to these macro-nutrients, goat faeces provides micro-elements such as Mn, Zn and Cu which are required by plants (Kallah and Adamu 1988).

The relative fertiliser value of goat manure can be calculated from data in Table 1. These calculations reveal that 5.7 kg unadulterated goat manure (devoid of bedding material) would supply the same amount of N as 1 kg of a 15:15:15 N:P:K commercial grade fertiliser. Similarly, 37.8 kg and 17 kg of RSG manure would supply the same amounts of P and K, respectively, as the same 1 kg of inorganic fertiliser (Kang 1995). However, the goat manure would also supply organic matter to the system to improve soil structure.

An adult RSG is capable of voiding as much as 130 kg dry manure per year. This would contain 3.6 kg N, 0.55 kg P and 1.2 kg K. With a population of 34 million goats and assuming 50% are adults, production of 2 million tonnes of dry manure is possible. As a supplier of N, this could replace more than 300 000 tonnes of inorganic fertiliser each year. Given these facts, there is sufficient goat manure for complete replacement of inorganic fertilisers. However, where this is not possible, partial substitution could be an option. These issues need to be investigated.

Table 2. Chemical composition of the concentrate offered to the goats.

Proximate component	Seasonal values	
	Wet season	Dry season
DM (%)	91.80	92.30
Ash (%)	5.22	4.97
EE (%)	4.13	4.01
CF (%)	12.91	13.20
N (%)	2.48	2.51
CP (%)	15.50	15.72
Gross Energy (kcal/g)	2.48	2.61

Table 3. Seasonal botanical composition of the pasture in the grazing area.

Forage spp.	Wet season		Dry season	
	RAR[1]	FVR[2]	RAR	FVR
Pennisetum pedicellatum	++	2	+++	2
Andropogon gayanus	+++	2	++	1
Stylosanthes hamata	+++	3	+	3
Tephrasia liniaris	++	2	+	1
Dolichos biflorus	+	1	+	1
Cassia rotundifolia	++	0	+++	0
Setaria anceps	+	1	+++	2
Boreiria radata	+	0	++	0
Urena lobata	+	0	+	1
Tridax procumbens	++	1	+	1
Crotolaria macrocalyx	+++	0	++	0
Hyperrhenia rufa	++++	2	+++	2
Cynodon dactylon	+++	2	++	2
Aspilia africana	+	1	+	1
Eleusine indica	++	1	+	1
Sida acuta	++	1	+++	2

[1]RAR = Relative Abundance Rating
++++ = Most abundant
+++ = Abundant
++ = Common
+ = Present
[2]FVR = Forage Value Rating
0 = Not accepted by stock
1 = Good, accepted by stock
2 = Very good, well accepted by stock
3 = Very very good, very well accepted by stock.

Goat manure is much cheaper than commercial grade inorganic fertiliser. In October 2001, it costs about five hundred naira (₦500) per tonne whereas a 50 kg bag of 15:15:15 N:P:K inorganic fertiliser sells for more than one thousand naira (₦1000) (US$1 = ₦140 in October 2001). Some farmers continued to use animal manure even when inorganic fertiliser was relatively inexpensive during the fertiliser-subsidy era. This tenacious adherence to tradition appears justified considering that the world is currently preaching organic farming on the basis that it is less hazardous to health and better for the environment than inorganic farming. Bulkiness notwithstanding, the use of goat manure can help to reduce the cost of fertiliser for crop production. Goat manure will again have a commercial value instead of being discarded. Research into methods of reducing the bulkiness is warranted as well as field studies to demonstrate to farmers the economic benefit of using goat manure.

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