Nigerian J. Anim. Sci. 2020 Vol 22 (2):147-154 (ISSN:1119-4308)

Forage species availability, food preference and grazing behavior of goats in southeastern Nigeria

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***Target Audience:** Ruminant production farmers, Nutritionists and Agronomists*

Abstract

A study on the grazing behavior of three goat ecotypes, Red Sokoto (RS), West African Dwarf (WAD) and their crossbreeds (CB), reared in the same environment was conducted. These parameters were monitored for a period of 18 weeks at Abakaliki, Nigeria. A general inventory of forage species available and the key forage species preferred by the goat were also determined. Twenty-six forage species comprising of 13 grasses, 5 legumes, 2 trees and 6 shrubs were identified. Grasses, legumes and trees were the most preferred species, and these formed the bulk of their diet. The most preferred species were not necessarily the most aboundant on the ground, indicating that ease of accessibility and palatability may be important determinants for choice of a forage species. The least preferred forage was Leucana leucocephala. Behaviours such as ingestion, walking, resting, rumination, playing, bullying and courtship behaviours were all observed during the grazing period. Time spent on these behaviours varied slightly between the three different breeds with the RS playing for a longer period ($P < 0.05$) and walking longer ($P < 0.05$) distances than others. There were also significant differences ($P < 0.05$) in time spent for ingestion and resting among the three breeds with the WAD spending greater time ($P < 0.05$) in ingestion as well as resting than others. All the animals rested after 1-2h of intensive grazing with the WAD returning to their pens first. Their choice of food differ slightly too; RS showed more preference for short trees, dry leaves and standing hays; WAD prefer fresh forage while CB seem to show equal interest for both. The result of the study will therefore be useful in planning a grazing strategy for the three goat breeds used for the study.

***Keywords:** Forage availability; Grazing hebaviour; Indigenous goats*

Description of problem

According to (1) who reported that the feeding behavior of animals varies according to species. The simple stomached animals eat their food slowly and chew it finely before swallowing it. Conversely, animals with complex stomach swallow forage quickly after chewing it into coarse pieces, than in the course of rumination, they regurgitate the food back into the mouth where it is finely ground. It is possible that, this feeding behavior pattern also varies according to breed within species of animals.

Information on food habits of pastoral animals is generally scarce. When compared to cattle and sheep, goats utilize a much wider variation of plant types (2) and select from amongst them the materials with the highest nutrient concentration. They select leaves more than the stems and the thin stems more than thick ones (3; 4). Choice varies widely and seems to depend on availability. Goats relish variation in their feed and may not thrive with one type of plant material. They prefer to select from many different types of feed such a combination of grasses and shrub plants or tree

leaves. Feeding behavior and feed preference can vary according to local conditions (ecology/season). Observations showed that they can graze at interval in various locations at 50% tree and 50% bush vegetation (5) respectively.

Continued grazing pressure may increase the number of less preferred plant species at the expense of the preferred. As a result of wide temporal and spatial variation in forage preference and nutrient composition of diets, they grazing pattern, quantity selected by different types of animals tend to differ. Research findings from a given area and kind or class of animals have limited inferences and should not be applied to too wide an area. It is therefore important to ascertain the locally available food types, the preferred diets and grazing habits for the various species and/or breeds of livestock reared in a particular region. This study therefore had undertaken to determine the forage species availability, food preference and grazing behavior of three Nigerian goat ecotypes reared in the equatorial tropics of southeastern Nigeria.

Materials and methods

Experimental site

The experiment was conducted at the Teaching and Research Farm of the Department of Animal Science, Ebonyi State University, Abakaliki which lies between latitude $06^0 2^{'}$N and longitude $08^0 5^{'}$E. The site has annual rainfall which ranges from 1500 to 1800 mm, and a mean temperature of 30^0C during the very hot weather (February-April) and 21^0C during the coldest period of the year (December-January) (6).

Experimental animals and design

The study was conducted with a flock of 15 goats aged between 12 to 18 months. They comprised 5 animals each of Red Sokoto (RS), West African dwarf (WAD) and their crossbreeds (CB). There were 3 treatments with 5 replications in a completely roundomized Design (CRD). All animals were reared under semi-intensive technique of management. They were vaccinated and dewormed with tissue culture rinderpest vaccine and levamisole hydrochloride respectively. An acaricidal bath with coumaphos (Asuntol) was also given before the commencement of the study. All animals were weighed individually.

Experimental procedures

All animals were monitored for grazing activities during the day. Grazing observation covered the entire period of grazing. This involved following and monitoring the animals by three enumerators from distances of 3-5m. The observations included plant species chosen by the goats and their grazing behavior.

Forage species availability

The relative abundance of all forage species was determined. This was by use of a quadrant method where the pasture land was measured 60m x 60m, further divided into four equal parts with tape to give 30m x 30m. All plant species intercepted by the tape were identified. Random throwing of a batten of 5m was made from any standing point and to any direction. Ten throwing were made at different sides of the quadrant and the different plant species occurring in each throw identified, enumerated and recorded. Trees and shrubs occurring within the quadrant were identified, counted and recorded. The total plant species was calculated.

The population density for each plant population density of species A

$$= \frac{\text{No.of times species A occurred}}{\text{Area}}$$

Number of bites and time spent on individual species

The method used to observe forage preference involved close observation of randomly selected focal animals (one at a time)

as they grazed with the others. Each focal goat was closely followed and observed by three enumerators who recorded the number of bites per plant and time spent on each plant species as the goat grazed or browsed. A bite was taken as the act of breaking of or picking up a piece of forage. The time spend by the animal feeding on one individual plant without walking one full step was estimated and recorded according to (7). The flock was grazed in different positions and a different goat breed was randomly selected for observation.

Statistical analysis

Data collected were subjected to analysis of variance in a Completely Roundomizsed Design according to the procedure described by (8). The treatment means were separated using Duncan's multiple rang test (9).

Results and Discussion

The inventory of forage species available in the experimental areas as well as their relative density expressed as number of plants/3600 m2 is shown in Table 1 of which the names of three were not identified. There were 13 grasses, five legumes, two trees and six shrubs. The most dominant forage species were *Calo-pogonium mucunoides, Cynedon polystachus and Centrosema pubescens,* in a decreasing order of availability. The least forage species was *Gliricidia sepium(Table 1).* This therefore implied that *Calopogonium mucunoides,* a legume species, formed the most abundant whereas *Gliricidia sepium,* also a legume species formed the least prevalent forage species in the study area.

Generally, the most highly preferred forage species was *Andropogon gayanus.* This was followed by *Andropogon tectorum, Pureria phasloides,* The indication was that the relative abundance did not necessary determine the choice or preference of plant species. There was no significant difference in forage preference among the three goat breeds for most of the forages preferred. However, the RS showed greater preference (P> 0.05) for *Danilia olivery*, *Sida acuta* and dry *Gmelina* leaves than the other breeds. Table3: shows the grazing activities of the goats. All animals grazed intensively on pasture in the first 1 to 2hrs, then tended to stand and ruminate, play with each other, lick and brush the body, or sometimes lie down.

All the three breeds exhibited similar activities at grazing time except that the WAD goat rarely stood without attempting to ruminate. Sometime they attempted to climb trees (browsing) and sometimes jumping from a height. The time spent by the different breeds of goat in carrying out the activities observed during grazing is shown in Table 4.

Average distance walked per day were 1860 ± 211.04, 1420 ± 165.32 and 1398 ±169.54 m for RS, CB and WAD, respectively. the mean daily distance walked by RS was significantly higher ($p<0.05$) than that observed for the other breeds. Observation also showed that preference for food varied from time to time and/or day to day. There were significant differences ($P < 0.05$) in time spent by different breeds of goat carrying out most of the observed activities. The WAD spent more time ingesting and resting (in standing or lying position) with or without rumination. This was followed in each case by CB. On the other hand, RS spent more time walking and bullying or playing around. The WAD spent least time doing this. There was no significant differences ($P > 0.05$ in time spent in display of sexual or courtship behavior. Average distance walked per day were 1860 ± 211.04, 1420 ±165.32 and 1398± 169.54m for RS, CB and WAD, respectively. The mean daily distance walked by RS was significantly higher ($P < 0.05$) than that observed for the other breeds.Observation also showed that preference for food varied from time to time and /or day to day.

Table1: Average plant population density (Plants/3600m^2) of forage species"

Forage species	Total frequency	Plants/3600m^2
× *Calopogonium muconodies*	41166 ± 082	11.44
° *Cynodon polystachus*	11080 ± 069.	3.07
× *Centrosema obensis*	9034 ± 0.7	12.5
° *Tridas procubens*	4043 ± 0.50	1.12
° *Setera barbeta*	2106 ± 0.52	0.6
≠*Sida acuta*	1948 ± 0.26	0.54
≠*Mimosa pudica*	1137 ± 0.40	0.32
° *Axonopus compressus*	809 ± 0.18	0.2
° *Panicum maximum*	311 ± 0.22	0.09
° *Andropogun gayanus*	84 ± 0.19	0.02
° *Hyperrhenia rufa*	79 ± 027	0.02
° *Panisetum purpureum*	73 ± 011	0.02
° *Ageratum conizides*	73 ± 0.09	0.02
≠ *Unidentified I*	69 ± 0.12	0.02
× *Peria phasioloides*	62 ± 0.07	0.02
t *Danelia olivery*	62 ± 0.10	0.02
° *Ellusine indica*	*59 ± 0.01*	*0.02*
° *Sporobolus pyramidalis*	55 ± 0.18	0.02
° *Andropogum tectorum*	27 ± 0.12	0.02
× *Lecuana leucocephala*	27 ± 0.10	0.008
≠ *Eupatorum odorantum*	15 ± 0.04	0.004
° *Imperata cylindrical*	12 ± 0.01	0.003
t *Gmelina arboris*	9 ± 0.02	0.003
≠ *unidentified II*	9 ± 0.02	0.003
≠ *unidentified III*	8 ± 0.04	0.002
× *Gliricidia sepium*	2 ± 0.01	0.0006

[a] **Key: x: legume; : ° grass; #: shrub; t: tree.**

This observation differs from that of (7) who reported that shrubs constitutes the most prevalent and grasses the least prevalent forage species respectively in the semi-arid zones of east central kenya. It is therefore possible that the difference in soil structure and composition as well as climate and topography of an area determines the vegetation cover of that particular area. Among the forage species available, grasses were the most preferred. Other forages of choice were legumes, trees, and to a low extent shrubs. This supports some previous reports (10) (2;11; 4) that goats utilize a much wider variation of plant types, and select among them the material with highest nutrient concentration.(12) explained that the goats ability to feed on large forage variety is due mainly to their agility, tendency to assume a bipedal stance and possession of a mobile upper lip and prehensile tongue. These results suggest that food preference is not solely determined by relative abundance of forage species. This agrees with previous reports (13) ; (7) indicating that the grazable plant part were possible more accessible and palatable for some species. Therefore, goats sought them more seriously than others.

Table 2: Breeds and overall preference for forage species

Forage species	Breed mean ± S.E. of no. of bites			Overall mean	Overall mean
	RS	CB	WAD	No.of bites	Time spent
Andropogon gayanus	21 ± 1.14	22±1.58	23±1.30	22.0±0.58	15.0±1.00
Andropogon tectorum	19 ± 1.51	22±1.00	22±1.41	21.0±1.00	13.0±0.58
Panicum maximum	19 ± 1.09	19±1.30	19±0.95	19.0±0.00	13.0±0.23
Pennisetum purpureum	16 ± 1.25	16±1.34	16±1.92	16.0±0.00	11.0±0.17
Danelia olivery	18 ± 0.84[a]	16±1.05[ab]	14±1.23[b]	16.0±1.16	10.3±0.33
Hyperrhenia rufa	15 ± 1.22	15±1.10	16±1.30	15.3±0.33	10.3±0.33
Unidentified shrub1	14 ± 1.64	13±0.95	12±0.71	13.0±0.58	7.0±0.58
Ageratum conizoides	13 ± 1.14	12±1.48	12±0.63	12.3±0.33	6.2±0.39
Calopogonium mucunoides	11 ± 0.97	11±0.71	11±1.34	11.0±0.00	6.2±0.15
Pureria phasioloide	10 ± 0.89	10±0.89	11±0.71	11±0.033	6.2±0.15
Gmelina arborea	10 ± 0.32	8±0.71	8 ± 0.89	8.6±0.66	6.03±0.15
Centrosema pubescens	8 ± 0.95	8±0.63	8±1.30	8.0±0.00	5.1±0.10
Cynedon polystachus	8 ± 0.84	8±1.38	8±1.52	8.0±0.00	4.1±0.24
Unidentified shrub II	9 ± 1.30	8±1.30	7±0.89	8.0±0.58	5.0±0.50
Dry (Gmelina) leaves	12 ± 0.84[a]	5±0.71[b]	4±0.45[b]	7.0±2.52	4.03±1.40
Unidentified shrub III	6 ± 0.95	6±0.55	6±0.32	6.0±0.00	4.0±0.12
Axonopus compressus	5±0.54	5±0.71	6± 1.10	5.3±0.33	3.03±0.09
Tridas procubens	5 ± 0.63	5±0.83	5±0.83	5.0±0.00	3.0±0.00
Gliricidia sepium	5±0.84	5±0.32	5±1.00	5.00.00	2.9±0.10
Ellusin indica	5±0.45	6±0.71	4±0.71	5.0±0.58	3.03±0.07
Sida acuta	6±0.71[a]	3±0.45b	4±0.31[b]	4.3±0.88	3.06±0.07
Sporobolus pyramidalis	4±0.45	4±0.95	4±0.63	4.0±0.00	2.0±0.12
Leucana leucocephala	3±0.45	4±0.55	5±0.55	4.0±0.58	3.03±0.12

[a] Mean within set of breed with different letters are siginificantly differenty (p <0.05)

The goats generally showed highest preference for grasses. This is probably because the study was conducted during early rainy season. At this period of the year grasses are expected to be succulent and less coarse. This finding supports the facts that goats tend to prefer the less coarse grass than the succulent ones. These workers (13,7) are also of the opinion that legumes form the main source of feed for ruminants from the onset of dry season. This could be attributed to the early and fast growth rate of grasses at the early rain, leaving legumes more fresh and less coarse and more succulent at the onset of dry season. Even though goats are popularly known as browsers, this study suggests that they prefer to graze more on grasses than trees. There was a higher prevalence of grasses in the study area than trees. It is probable therefore that goats grazed heavily on grasses when there was a scarcity of trees on which to browse. Thus, preference for feed went with types of vegetation cover. Shoots and dry leaves of trees were browsed but the dry leaves were mostly preferred by RS and CB. The WAD goat preferred grazing succulent forages. The preference of RS for dry leaves may be attributed to their place of orgin (i.e northern Nigeria) where forage and vegetation cover are generally dry almost all year round. So, they are adapted to feeding

mostly on the available dry leaves and standing hays. Variation in food preference from time to time and/or day to day was also observed. It is therefore possible that preference depends on availability and quality of forage species, previous dietary experience and environment-related factors.

Table 3: General activities shown by individual goats during the time on pasture[a]

Breed	AnimaL no.		Sex	Age	Grazing activities					
WAD	WAD_1	F	8	0	1a	1b	2	3	4	
WAD_2	M	8	0	1a	1b	6	10			
WAD_3	F	3	1a	1b	2	3	4			
WAD_4	F	8	0	1b	2	4	6	8		
WAD_5	F	8	0	1a	1b	6	9	10		
RS_1	F	8	0	1a	1b	2	5	6	9	
RS_2	M	8	0	1a	1b	2	3	5	6	8	9
RS	RS_3	F	8	0	1a	1b	2	5	6	9
	RS_4	F	3	0	1b	2	6	9	10	
	RS_5	F	8	0	1a	1b	2	4	8	
	CB_1	F	8	0	1b	2	6	9	10	
	CB_2	M	8	0	1b	5	8	9	10	
CB	CB_3	F	8	1a	1b	2	4	5	9	
	CB_4	F	8	1a	1b	2	3	4	8	
	CB_5	F	8	1a	1b	2	3	4	8	10

[a] key: 0: lying down and ruminating; 1a: bullying; 1b: consuming grass; 2: standing and ruminating;3: lying down wihout ruminating;4: playing; 5: standing and not ruminating; 6: licking and brushing of body; 8: courtship behavour; 9: climbing short trees; 10: digging soil.

Table 4: Mean time (in minutes) ± S.E. spent by the three goat breeds in carrying out the major activities observed [a]

Observed activity	Bread		
	RS	CB	WAD
Ingestion	88.0 ±7.22[a]	105.1 ± 9.73[b]	127.0±8.56[c]
Walking and bullying or playing around	244.1 ±13.89[a]	120.0±10	90.8 ±3.12[c]
Resting in standing or lying position with or without rumination	99.76 ± 3.21 [a]	116.5 ±6.34 [ab]	120.9 ± 5.57 [b]
Courtship behavior	25.1 ± 1.90	24.08 ± 1.49	22.0 ± 1.52
Digging of soil	10.76 ± 0.46	8.58 ± 0.43	9.0 ± 0.37
Total time	466.96[a] (7.78 h)	365.74 b (6.10h)	360.72 [b](6.01 h)

[a] Mean with different letters on same row are significantly different ($P<0.05$)

Grazing observation revealed that WAD started to graze intensively as soon as they were released to pasture. In comparisons with RD and CB, the WAD goat seemed to graze more intensively. However, the RS goats explored further away than the other breeds in selection of their pasture including short trees to browse on shoots and leaves at higher level hence the greater preference for *Sida acuta and Danilia olivery*. This agrees with the report by (15). In addition to grazing, walking, playing, resting and rumination, the goats showed courtship behavior. The courtship behavior manifest during the grazing period could be due to the effect of sunlight on ovarian activity as well as the teasing effects of both sexes on each other. After grazing all animals will naturally return to their pens on their own. This is an indication that they have fed to satisfaction.

Conclusion and Applications

1. The knowledge of feed availability, feed preference and grazing behavior of Nigerian goat ecotypes as determined in this study will be of great value in pasture establishment.
2. With this study, the problems associated with the predominant systems (free range and semi-intensive) of goat production in southeastern Nigeria will be reasonably reduced.

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