Comparative Grazing Behaviour Of West African Dwarf (Wad) And Red Sokoto (Maradi) Goats In Nigeria

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Abstract: One of the promising ways of combating poor ruminant nutrition and under-utilization of available pasture forages is studying the behaviours of grazing animals, especially goats. This is due to the fact that lack of sustainable ruminant feeding strategies contributed to the slow growth and high mortality of ruminants in Nigeria. The comparative grazing behaviour of Thirty eight goats; comprising Thirty three West African Dwarf does and Five Maradi bucks with Average Weight of 9.50kg and 15.45kg respectively, were observed in the study for a period of 6 weeks. Standard procedures were used to underscore the grazing behaviour of WAD and Maradi goats and proximate composition of the forages. The parameters measured under grazing behaviour are: grazing, ruminating, walking, drinking and resting while crude protein, crude fibre, ether extract and ash were assessed in proximate composition. Data collected were subjected to analysis of variance at P=0.05. For WAD, grazing was significantly highest 53.20 and drinking (1.40) was the least (P<0.05). While for Maradi the values ranged between 72.15 and 2.54 in grazing and ruminating respectively. Seven species of forages consistently eaten through close observation by the goats were identified and divided into forbs, grasses and legumes. The percentage selectivity of forbs, grasses and legumes for WAD ranged from 25-50%. While for Maradi, it ranged between 33.33 and 33.34%. The forages proximate analysis range for crude protein was from 6.17-23.47%, crude fibre 11.97–33.00%, ether extracts 8.50–10.50%, ash 5.50-17.33%. The study showed that breeds of goats exhibit different grazing behaviours when raised on pastures composed of different forages with varying nutrient composition.
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1. Introduction

Grazing goats are the backbone of most of the world's marginal land enterprises. They are capable of utilising effectively a vast variety of plant species and vegetation types. Their level of production may be comparable to that of other ungulates in the improved pastures. However, their output in degraded and low productivity areas is far beyond the production of any other domestic ungulates. The majority of domesticated ruminants are raised solely or partially in semi-extensive or extensive production systems in which most nutrients are derived from grazed forage. Grazing is associated with daily activities considerably different than for confined animals, such as time spent eating and distances travelled (Osuji, 1974; Lachica and Aguilera, 2003). These activities result in greater energy expenditure than in confinement, which can limit energy available for maintenance and production.

In Nigeria, goats represent a veritable resource for economic development and livelihood security in addition to major cultural importance. The population of goats in the country is estimated at 34.5 million of which traditionally reared stock contributes 99.97%, while 0.03% of the stock is commercially managed (Shuaib *et al*., 1997). Red Sokoto (also known as Maradi) and West African Dwarf (WAD) goats are the two most important goat breeds found in the country. They are kept as a source of food and investment. Their ability to tolerate harsh climates, remarkable recovery capacity from drought, suitability to traditional systems due to small size, short generation interval and ability to thrive on poor quality diets resulting from scarce grazing on marginal land (Hoste *et al*., 1988) make goats strategic in increasing livestock productivity in rural agricultural systems (Fitzugh *et al*., 1992). While Red Sokoto goats are more adaptable to the climatic conditions of northern Nigeria, WAD are trypanotolerant (Hoste *et al*., 1988) and able to inhabit the trypano-endemic humid zones of southern Nigeria. Both breeds are meat breeds, although the skin of Red Sokoto goats is reputed to be of high quality and used in the leather industry locally and internationally (Akpa *et al*., 1998).

The study of goat behaviour, like so many aspects of the recorded knowledge of the genus Capra, is sketchy at best. Many inferences to the behavioural patterns of goats have been drawn from the more abundant and detailed information available on the closely related genera of sheep, deer and antelopes. While many behavioural characteristics of these genera are indeed similar, it is important to realize that several basic behavioural differences occur. Common definitions of behaviour are "anything that an organism does involving action and response to stimulation," "the response of an individual, group, or species to its environment," and "the way in which something functions or operates" (Merriam-Webster's Collegiate Dictionary, 1996). Although these definitions are broad, it is well known that animal behaviour varies greatly among domesticated livestock species. However, a commonality is influence of nutrition. For goats, consideration of the effects of nutrition on behaviour can be categorized into goats in grazing settings and goats in confinement settings. Direct observation methods have been, and are still, useful in both scenarios. Although considerable labour is required with grazing goats, measures are restricted to daylight, and the presence of an observer can modify animal behaviour (Barroso *et al*., 2000; Papachristou *et al*., 2005; El Aich *et al*., 2007). Equipment is now available to characterize the behaviour of goats and other ruminant species throughout 24hrs periods, both in confinement and while moving freely.

Perhaps because of the difficulties entail, there is a poor understanding of factors influencing the grazing activity by ruminants. One of the conditions impacting aforementioned factors used to predict the grazing behaviour is nutrient demand of the animal, and thus, forage intake (Fierro and Bryant, 1990). Forage availability can influence both grazing time and the nutritive value of ingested forage (Seman *et al*., 1991; Krysl and Hess, 1993; Herselman *et al*., 1999). As forage availability decreases, bite size declines, which results in at least partially compensatory changes in grazing time and rate of biting (Davies and Southey, 2001). Decreased forage quality also increases time spent in ingestive mastication (Sahlu *et al*., 1989; Lachica and Aguilera, 2003). Also because of differences among ruminant species, such as sheep and goats, in preferences and selectivity for different plants and plant parts, with heterogeneous grass/forb mixtures it is possible that their grazing behaviour may be dissimilar.

The biological relationship between ruminants and forages is a very important one going by the essential role the latter is playing in the nutrition of the former. Goats, like all animals, express a degree of nutritional wisdom since they select plants or parts of them higher in nutrients than the average in pasture (Arnold and Dudzinski, 1978; Provenza and Ralph, 1990; Papachristou and Nastis, 1993) and avoid consuming harmful plants (Raupp and Tallamy, 1991)

An understanding of this grazing behaviour of goat is sure to present a twofold benefit to the farmer. First, it will enable him to provide a more thorough and efficient management system, thereby deriving an economic benefit. Secondly, and perhaps more importantly, a greater knowledge of goat behaviour will help cultivate an enhanced appreciation and enjoyment for the species (Haenlein *et al*., 1992). Study of the behaviour of freely moving goats on pastures and rangelands is useful for purposes such as determining the most appropriate stocking rate and physiological states and seasons of land use, the need for and types of supplemental feedstuffs, and the desirability of monospecies grazing with goats versus cograzing with cattle, sheep, or both (Lachica and Aguilera, 2003; Animut and Goetsch, 2008).

In the past years, the studies on goats especially WAD and Red Sokoto goats have been on feeds nutrition and acceptability. This study therefore seeks to update baseline data on grazing behaviour parameters of goats in Nigeria while the objectives were to compare grazing behaviours and to determine true chemical composition of selected forages by WAD and Red Sokoto goats (Maradi).

2. Materials And Methods

2.1 Study Area

The study was carried out at the Goat and Sheep Unit of the Teaching and Research Farm of University of Ibadan. Ibadan is located in the rainforest-savannah transition zone of south-western Nigeria on latitude 7^0 20'N, longitude 3^0 50'E and altitude 200m above sea level (Bamikole and Babayemi, 2004). In this study area, the unit's pasture was partitioned with wire nettings into 4 paddocks.

2.2. Experimental Animals

Thirty eight (38) goats; comprising Thirty-three (33) WAD does and five (5) Red Sokoto bucks with average weight of 9.50kg and 15.45kg respectively, were randomly studied for the period of 6 weeks i.e. 3 weeks (21 days) for each breeds of goats. The animals are shown in plate 1 and 2 below.

2.3 Management Operations

The animals were acclimatized to the study site for about 2 weeks by giving them prophylactic treatments against stress, worm infestation (helminthiasis), ectoparasitic infections (mange from mites; lameness from ticks), PPR (peste des petites ruminants) (characterised by enteritis, nasal discharge and stomatitis) and foot-rot. They were occasionally given prophylactic treatments such as; doses of antibiotics (subcutaneous injections of Ivomectin 20 %

LA; Procaine penicillins; Penstreps), dewormers (Bolus dewormers), anti-stress (multivitamins; glucose), anti-diarrhoea (Dextrose; Metrosal; Tetracycline; Flagin and Tallazo tablets), eye infections (chlorophenicol "eyes drop"), disinfectants/cleansers (Methylated spirit; Izal; Gentian violet) and ectoparasites infections ("Pour-on").

Plate 1: WAD (In black) and Maradi (Red colour) goats.

Plate 2: The animals while grazing in the paddock

At the beginning of the study, the animals were tagged for proper identification. They were dewormed and treated against ectoparasites 2 weeks before the commencement of the study on their grazing behaviour in the paddocks. The animals were released into each paddock every morning to graze and browse on the forages present in the paddocks. Water was provided in bowls placed at strategic areas in each of the paddocks. Also a shed was constructed to provide shade for the animals while resting. The release was done randomly to enable the animals have access to all the forages available in all the 4 paddocks throughout the period of study.

The grazing behaviours of the animals studied include time spent grazing/ browsing on the selected forages, time spent: walking, ruminating, drinking and resting under the shed or tree. Forages identified as been consistently grazed at one time or the other by the animals in the paddocks during the period of study include:

i. *Pueraira phaseoloides*, *Alternanthera brasiliana, Tithonia diversifolia*, *Eleusine indica*

ii. *Lantana camara, Chromolaena odorata, Centrosema molle, Panicum maximum.*

2.4. Data Collection

The above behaviours were observed for 2 hours every day after about 30minutes of releasing the goats into a paddock for the day. An individual goat was observed for 5minutes at a time to note all the 5 parameters studied as its grazing activities. The hours of studies was spread between morning, afternoon and evening of each day i.e. 09:00-10:00hr, 12:00-12:30hr and 17:00-17:30hr for effective study of the animals' behaviours at the different periods of the day.

Each animal was tagged for proper identification among the flock. An observer was allocated to a goat to note time taken on each activity. The observer had a record sheet and a stop-watch for scoring and monitoring every animal randomly studied at each period of the day. Also, the forages grazed on by the animals were noted, uprooted and taken for identification and proximate composition determination in the laboratory.

2.5. Statistical Analysis

Data obtained were subjected to the analysis of variance (ANOVA) employing the procedures of statistical analysis system using SPSS Packages to determine the Mean, Standard deviation, Standard errors. Means were separated using Duncan multiple range tests.

Also, the selected forage samples were oven dried at 650ºC in 48hrs for Dry Matter (DM) determination and analysed for Crude protein (CP), Crude fibre (CF), Ether extract (EE) and Ash using AOAC (2000) procedure.

3.0 Results And Discussion

3.1. Grazing behaviour

3.1.1 Grazing activities by West African Dwarf (WAD) goats

Presented in Table 1 and Figure 2, are the grazing activities of West African Dwarf goats. The value ranged between 1.40±1.52 and 53.20±4.38 in drinking and grazing respectively. There were significant differences in all the parameters measured ($P<0.05$).

It was reported by Lachica and Aguilera (2003) that goats love grazing along fence lines before grazing the centre of a pasture and; that they graze the

top of pasture canopy fairly uniformly before grazing close to the soil level. This was observed in this study as the goats grazed more of forages like the forbs and the legumes which are found along the fence and having relatively high canopy than grasses which were more at the centre of the paddocks and closer to the soil level. The WAD goats exhibited this particular behaviour more than the Maradi goats as shown by the selection percentage in Table 3. Also, Iyasere *et al.* (2010) reported that more of grazing activities was observed in the first 30 minutes of morning and afternoon observation period. The diurnal pattern of grazing can be attributed to the facts that ruminants eat to optimize the efficiency of nutrient capture (nutrient balance), maintain rumen function, to dilute the secondary compounds many of which are toxic to animals, and, ruminant tends to fill its rumen with grass in the afternoon as it is a bulky feed with slower passage rate. This was also observed in this study as the activities presented in Table 1 and 2 were observed between 9am and 5 pm of each day of studying the goats. i.e. falling between morning afternoon and evening of studying the goats grazing behaviours.

Table 1: Grazing Activities By West African Dwarf (Wad) Goats

Parameters	Mean ± SD
Walking	2.80 ± 0.84^{d}
Grazing	53.20 ± 4.38^{a}
Drinking	1.40 ± 1.52^{d}
Resting	10.00 ± 1.87^{c}
Ruminating	32.60 ± 4.22^{b}

[a, b, c, d] Means with different superscripts across the column are significantly different from each other. While, Means with same superscripts across the column are not significantly different from each other at (P<0.05)

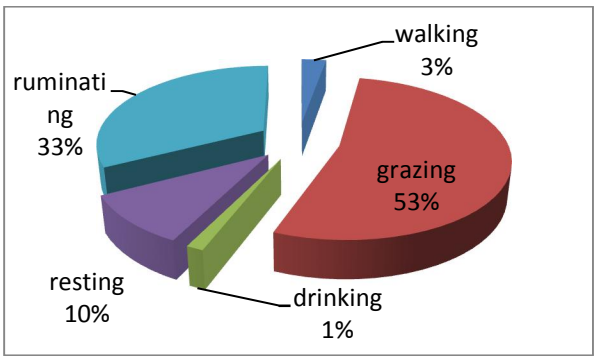

Figure 3: Overall mean of grazing activities of West African Dwarf goats

3.1.2 Grazing activities by Maradi goats

Presented in Table 2 and Figure 2, are the grazing activities of Red Sokoto (Maradi) goats. The values ranged between 2.54±2.44 and 72.15±8.63 in ruminating and grazing respectively. There were significant difference in all the parameters measured (P<0.05).

The 5min observation period can be used successfully to record grazing time (Adams *et al.,* 1986). This was confirmed in this study, as the five (5) parameters observed were randomly monitored and recorded for a goat per observation in the paddocks.

Goats spent 75% of their grazing time browsing, while reverse was true for sheep (Ngwa *et al.,* 2000). It was also reported by Burn *et al.,* (2001) that sheep also spent less time grazing (55%) compared to goats (65%). This was confirmed in the Tables 1 and 2 of this study. But it was also observed, in Figure 2 and 3 that Maradi goats spent longer time (overall mean of 75%) grazing compared to WAD goats (overall mean of 55%).

Table 2: Grazing Activities For Red Sokoto (Maradi) Goats

Parameters	Mean ± SD
Walking	7.63 ± 1.94^{bc}
Grazing	72.15 ± 8.63^{a}
Drinking	3.05 ± 1.53^{c}
Resting	11.18 ± 2.85^{b}
Ruminating	2.54 ± 2.44^{c}

[a, b, c,] Means with different superscripts across the column are significantly different from each other. While, Means with same superscripts across the column are not significantly different from each other at (P<0.05)

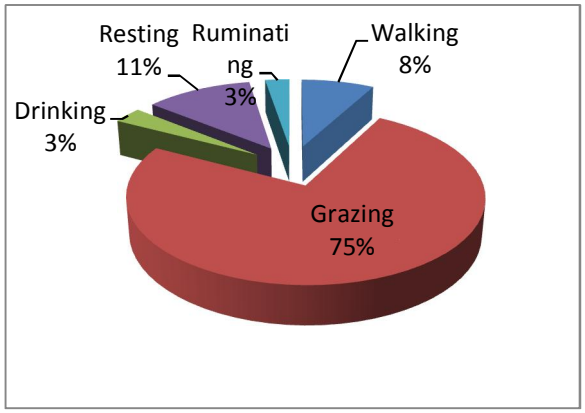

Figure 2: Overall mean of grazing activities of Maradi goat

3.1.3 Forages grazed by West African Dwarf goats

Shown in Table 3 were different forages grazed by WAD goats. Seven forage species were identified. They include forbs, grasses and legumes. The forbs were *Alternanthera brasiliana, Tithonia diversifolia*, *Chromolaena odorata,* and *Lantana camara.* The

grasses were *Panicum maximum* and *Eleusine indica, while the legumes were Centrosema molle* and *Pueraira phaseoloides*. The values of their percentage selectivity ranged between 25 and 50% in grasses and legumes to forbs respectively.

Grazing and browsing of forages by ruminants is a selective event (Philip, 1993) and selection of forage is aimed at obtaining plant component with the highest nutritive value and the presence of anti-nutritional factors or toxins also affect plant selection by ruminants (Provenza,1995). There was a lot of plant species observed in the rangeland comprising of grasses, legumes and forbs however, the selected ones were consistently grazed by these animals. Most of the forages grazed by the ruminants are available in south western of Nigeria (Aregheore, 1995). It has been inferred that goats have a preference for feeding stuffs rich in crude protein (Haas and Horst, 1979). This was observed in Tables 3, 4 and 5 where the selected forages grazed by goats have high crude protein composition. But the WAD goats' preferred forages with more aggregated crude proteins than the Maradi goats. This may be due to physiological needs and body size as reported by Gordon and Illius (1988).

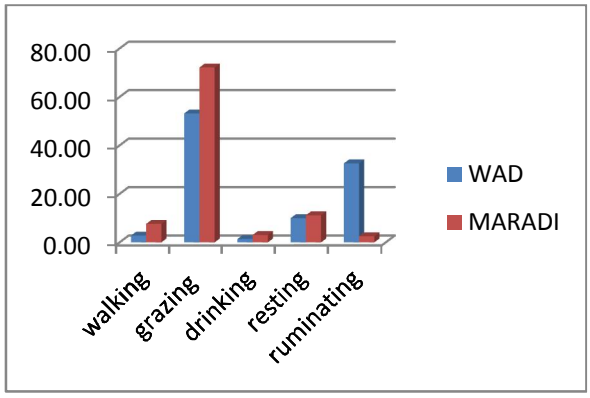

Figure 3: Comparative overall means of grazing activities of WAD and Maradi goats

Table 3: Forage Grazed By West African Dwarf (Wad) Goats

	Sward composition	
Forbs	**Grasses**	**Legumes**
Alternanthera brasiliana, Tithonia diversifolia Lantana camara, Chromolaena odorata	*Eleusine indica Panicum maximum*	*Centrosema molle Pueraira phaseoloides*

Percentage Selectivity:

Forbs: 4 x 100
8 = 50%
Grasses: 2 x 100
8 = 25%
Legumes: 2 x 100
8 = 25%

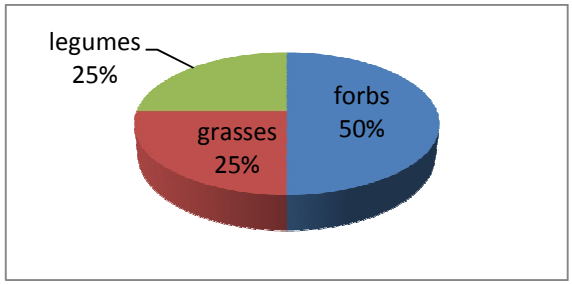

Figure 4: Percentage Selectivity of Forage grazed by West African Dwarf (WAD) goats

3.1.4. Forages grazed by Maradi goats

Shown in Table 4 were different forages grazed by Maradi goats. Six forages species were identified. They include forbs, grasses and legumes. The forbs were *Chromolaena odorata,* and *Tithonia diversifolia.* The grasses were *Panicum maximum* and *Eleusine indica, while the legumes were Centrosema molle* and *Pueraira phaseoloides*. The values for their percentage selectivity ranged between 33.34%, 33.33% and 33.33% respectively. The nutrient composition of the selected forages observed in this study showed that they might be useful energy and protein supplement in ruminant feeding.

Table 4: Forage Grazed By Red Sokoto (Maradi) Goats

	Sward composition	
Forbs	**Grasses**	**Legumes**
Chromolaena odorata	*Eleusine indica*	*Centrosema molle*
Tithonia diversifolia	*Panicum maximum*	*Pueraira phaseoloides*

Percentages Selectivity:

Forbs: 2 x 100
6 = 33.34%
Grasses: 2 x 100

6 = 33.33%
Legumes: 2 x 100
6 = 33.33%

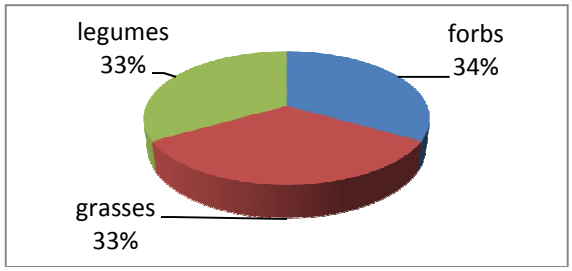

Figure 5: Percentage Selectivity of Forage grazed by Red Sokoto (Maradi) goats

3.2 *Proximate Composition of selected forages grazed by West African Dwarf and Maradi goats*

Presented in Table 5 is the proximate composition (100g/kg DM) of the forages grazed by WAD and Maradi goats. Crude protein ranged between 6.17 and 23.47%; Crude fibre: 11.97 and 33.00%; ether extract: 8.50 and 10.50% and dry matter: 32.07 and 85.48%. There were significant differences all the parameters measured in the proximate composition of all the selected forages ($P<0.05$).

Preference for forages by ruminants depends on nutrient composition, physical structure (Provenza, 1995) and the presence of anti-nutritional factors (Babayemi *et al.*, 2007). Also, Moore (2004) reported that the ability for an animal to consume and perform depends on the forage's fibre, protein, and dry matter.

It was reported by Nguyen Van Hiep and Ngo Van Man (2008) that *Pueraira phaseoloides* and *Centrosema molle* have high levels of protein (CP 12-24%). Similar trend for crude protein was observed in the legumes in that they fell within this range.

Table 5: Proximate Composition (Kg/100g) DM Of Selected Forages Grazed By West African Dwarf And Maradi Goats

	Forages Grazed						
Nutrient constituents	**PP**	**LC**	**CM**	**CO**	**AB**	**EI**	**TD**
Crude protein	23.47^{a}	13.67^{c}	15.83^{b}	15.79^{b}	6.17^{e}	10.25^{d}	13.70^{c}
Ash	5.50^{d}	10.00^{c}	6.00^{d}	10.00^{c}	17.33^{a}	9.50^{c}	14.50^{b}
Crude fibre (%)	33.00^{a}	11.97^{e}	12.17^{e}	31.67^{b}	12.50^{e}	16.50^{d}	29.50^{c}
Ether extract (%	10.50^{a}	9.67^{ab}	7.67^{d}	9.67^{ab}	8.67^{c}	8.50^{c}	9.50^{b}
Dry matter	85.48^{a}	36.58^{e}	82.89^{b}	58.04^{d}	32.07^{f}	75.47^{c}	75.36^{c}
Moisture content	14.52^{f}	63.42^{b}	17.11^{e}	41.96^{c}	68.27^{a}	24.53^{d}	24.64^{d}

a, b, c, d, e, f, Means with different superscripts across the column are significantly different from each other. While, Means with same superscripts across the column are not significantly different from each other at ($P<0.05$)
PP: *Pueraira phaseoloides*
LC: *Lantana camara*
CM: *Centrosema molle*
CO: *Chromolaena odorata*
AB: *Alternanthera brasiliana*
EI: *Eleusine indica*
TD: *Tithonia diversifolia*

4.0 Conclusion

The study established that the comparative grazing behaviour provided an insight into how ruminants especially goats behave at range. The study also established that animals are the best judge of what they eat. However, their natural judgment of feedstuff can be maximized and manipulated by farmers and researchers to optimise their output in terms of weight gain and production. The selected forages by the goats were all naturally selected, i.e. the animals grazed the forages willingly and their nutrient composition was observed to be adequate for small ruminant production. However their availability throughout the seasons of the year is not feasible. Some are available throughout the year especially the forbs. These forages can be harvested when they are available and conserved till the off season period when they can be feed out to avoid production fluctuation by the animals.

From this study, it can be recommended that given the reputation of goats as highly-selective feeders, range management programmes should aim at preserving plant communities that are highly diversified in botanical structure as well as ensuring the survival of plant species that are highly and consistently grazed by goats. Also, the seven species of forage consistently selected by goats observed in this study can be harvested when they are available in abundant and processed as silage or meal. In this form, the fibre content of the forages will be more digestible

by grazing animals. Two, three or four species of the forages can be combined and ensiled depending on their availability. There is need to determine the factors that govern forage rejection. This will help to know if actually the rejected forages should be ignored or not. All these information if simplified through the extension worker, herdsmen and other subsistence goat farmers will benefit immensely and goats' production at their level will be enhanced.

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