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Grazing Bites per Day of Goats on Some Tropical Grass Pastures and the Influence of Sward Characteristics

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The number of grazing bites per day of Japanese Saanen goats was measured on 3 species of tropical grass pastures, fingergrass (*Digitaria adscendens* H.B.K. Henry), Rhodesgrass (*Chloris gayana* Kunth) and green panic (*Panicum* ***maximum*** Jacq. var. *trichoglume* Eyles). In addition, green panic pasture at different stages of growth (vegetative, booting, heading and mature) was used Lo examine the relations of the grazing bites to structural measures (plant height, herbage yield per unit area and cell wall components) and nutritive measures (crude protein, *in vitro* dry matter digestibility and digestible energy) of the pasture. The number of grazing bites varied among species or growth stages of the pasture, ranging from 46,200 to 95,100. The grazing bites in the mature stage of the pastures tended to be higher than those in other growth stages. The grazing bites were positively correlated with the structural measures of green panic and negatively correlated with the nutritive measures. Especially herbage mass had a close association with the grazing bites, being expressed by quadratic regression (R^2=0.905). The results obtained indicate that sward structural and nutritive characteristics affect the daily grazing bites.

INTRODUCTION

In the tropics and subtropics, goats are one of the most important farm animals (Devendra and Coop, 1982). Coop (1986) stressed the need for research on the utilization of tropical pastures by goats in order to elevate their performance.

Herbage intake is affected by pasture availability which in turn affects animal performance. Ingestive behaviour studies can help to explain variations in intake among pasture swards (Hodgson, 1982), and measurements of the number of grazing bites and bite size enable researchers to estimate herbage intake and to clarify major animal and plant factors affecting intake (Minson, 1983).

Nakanishi *et* al. (1985; 1987; 1989; 1993) previously examined the effects of pasture species and maturity on the bite size of goats grazing some tropical pastures. However, there is little information on the number of grazing bites per day for goats on tropical pastures and the relationships between grazing bites and sward characteristics. The purpose of this study was to measure the number of grazing bites taken daily by goats on some tropical grass pastures and to examine the effects of structural and nutritive characteristics of pastures on the grazing bites.

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MATERIALS AND METHODS

Experiment 1. Grazing bites of goats

Eight grazing trials were conducted on 3 species of tropical grass pastures, fingergrass (*Digitaria adscendens* **H.B.K.** Henry), Rhodesgrass (*Chloris gayana* Kunth) and green panic (*Panicum maximum* Jacq. var. *trichoglume* Eyles), using 6 Japanese Saanen goats (2 goats for each pasture). The profile of the animals was shown only for animals 5 and 6 (8 years of age, body weight: 82.4 kg and 67.0 kg, respectively) grazing green panic. After the first cutting the regrowth was grazed by goats at different stages. Each stage of maturity of the pastures was determined from morphological characteristics, i.e. fingergrass at internode elongation stage; Rhodesgrass at heading and mature stages; green panic at vegetative, booting, heading and mature stages. The goats grazed each growth stage of the pasture only once for 24 h. The observation started at 10:00 a.m., and the number of grazing bites was recorded by watching the goats for 24 h and pressing a counter whenever a bite occurred. The number of grazing bites was compared between goats and among growth stages of the pasture using t-test (Steel and Torrie, 1960).

Experiment 2. Relationship between grazing bites and sward characteristics of green panic

The green panic pastures in Exp.1. were used for the Exp.2. Prior to grazing experiments, sward height was measured using 3 quadrats (100×60 cm each) and a sample was obtained from each quadrat at 5 cm above ground level to determine dry matter yield. The samples were ground in a mill fitted with a 1 mm aperture screen, after drying at 70 ℃ for 24 h, and analysed for crude protein (Kjeldahl method), cell wall components (Goering and Van Soest, 1970), *in vitro* dry matter digestibility (Minson and McLeod, 1972) and gross energy using an adiabatic bomb calorimeter (Shimadzu CA-4 type). Energy digestibility was predicted according to the regression equation proposed by Moir (1961), and digestible energy content was calculated by multiplying the gross energy by the energy digestibility. Correlation and regression analyses (Steel and Torrie, 1960) were conducted to examine the relationships between the number of grazing bites and structural and nutritive characteristics of green panic.

RESULTS AND DISCUSSION

Experiment 1. Grazing bites of goats

The number of grazing bites per day of goats on some tropical grass pastures at different growth stages is shown in Table 1. The grazing bites varied between animals and among species or growth stages of the pasture, ranging from 46,200 to 95,100. As for green panic, the heavier goat (animal 5) had a higher number of grazing bites in all the growth stages ($P<0.02$). Ortega-Reyes and Provenza (1993) observed total bites by goats during short-term tests with blackbrush and suggested that the differences in foraging behaviour were the result of age and amount of experience. In this study, however, there seems to be little effect of age and experience on feed ingestion by goats because they

Table 1. The number of grazing bites per day of goats on some tropical grass pastures at different stages of regrowth.

Grass species	Stage	Grazing bites(no./day)		
Fingergrass		Animal 1	Animal 2	Mean
	Internode elongation	57,422	51,576	54,499
Rhodesgrass		Animal 3	Animal 4	
	Heading	65,588	46,943	56,266
	Mature	89,568	91,601	90,585
Green panic		Animal 5	Animal 6	
	Vegetative	71,677	61,439	66,558
	Booting	69,489	46,177	57,833
	Heading	73,242	61,674	67,458
	Mature	95.093	78.405	86,749

were of almost the same age (8-year) and had been reared together under almost the same feeding condition. Therefore, the difference in the number of grazing bites per day between animals 5 and 6 is probably due to the difference in their feed requirements associated with body size.

Goats tended to take higher number of grazing bites with increasing maturity of Rhodesgrass and green panic, and the bites showed higher value in the mature stage than in the others ($P<0.20$ and $P<0.10$, respectively).

Experiment 2. Relationship between grazing bites and sward characteristics of green panic

As both goats had a similar pattern of grazing (Table 1), the numbers of grazing bites of two goats were pooled to examine the relationship between the bites and sward characteristics.

Structural and chemical characteristics of green panic and the mean number of grazing bites per day of goats on the pasture are shown in Table 2. Plant height and herbage mass increased as the pasture matured. Crude protein, *in vitro* dry matter digestibility and digestible energy of the pasture tended to decrease with advancing maturity, whereas NDF, ADF and ADL tended to increase. Thus, plant height and herbage mass increased and concurrently the nutritive value of the pasture decreased. The number of grazing bites per day of goats was lowest at booting stage and highest at mature stage, showing intermediate values for vegetative and heading stages. The grazing bites had positive correlation with plant height ($P<0.10$) but not significant (Table 3). The grazing bites had significantly positive correlation ($P<0.05$) with NDF and ADL, but had significantly negative correlation ($P<0.05$) with in *vitro* dry matter digestibility. The effect of herbage mass on the number of grazing bites was well expressed by quadratic regression (Fig. 1),

$$Y=0.005X^2-17.574X+77219.358 \quad (R^2=0.905)$$

where X=herbage mass (kg DM/ha) and Y=the number of grazing bites (no./day). The higher number of grazing bites in the vegetative stage compared with the booting stage was probably caused by the smaller bite size when grazing the immature pasture that had

Table 2. Effect of sward characteristics on the mean number of grazing bites per day of goats on green panic pasture.

	Sward characteristics								
	Structural		Chemical						
Stage	Plant height (cm)	Herbage mass (kg DM/ha)	Crude protein	NDF[1]	ADF[2]	ADL[3]	IVDMD[4] (% DM)	DE[5] (kcal/g)	Grazing bites[6] (no. /day)
Vegetative	42	800	19.0	72.3	36.4	3.5	66.9	2.84	66,558
Booting	55	2,120	15.3	72.1	39.7	3.0	67.8	2.78	57,833
Heading	81	2,220	16.8	73.0	42.6	4.1	65.6	2.75	67,458
Mature	137	3,990	6.7	77.9	47.5	5.8	51.9	2.17	86,749

[1] Neutral detergent fiber.
[2] Acid detergent fiber.
[3] Acid detergent lignin.
[4] *In vitro* dry matter digestibility
[5] Digestible energy
[6] Mean of values obtained from 2 goats(animals 5 and 6) in Table 1.

Table 3. Correlation coefficient between grazing bites and sward characteristics.

Variable	Correlation coefficient(n=4)
Plant height	0.900
Herbage mass	0.748
Crude protein	-0.821
NDF[1]	0.962 *
ADF[2]	0.797
ADL[3]	0.984 *
IVDMD[4]	-0.964 *
DE[5]	-0.923

[1] Neutral detergent fiber.
[2] Acid detergent fiber.
[3] Acid detergent lignin.
[4] *In vitro* dry matter digestibility.
[5] Digestible energy.
P<0.10, *P<0.05

lower biomass yield and density (Allden and Whittaker, 1970; Stobbs, 1973; Nakanishi et *al.*, 1985). When the amount of pasture accessible is extremely low, goats are likely to compensate for the smaller bite size by increasing the number of bites. This result is in agreement with that of Stobbs and Cowper (1972) who showed that dairy cattle grazing tropical grass with low herbage availability took a higher number of bites.

Goats took the most bites when the vegetation was in the mature stage. Nakanishi *et al.* (1985) found a smaller bite size in goats grazing more mature Rhodesgrass pasture

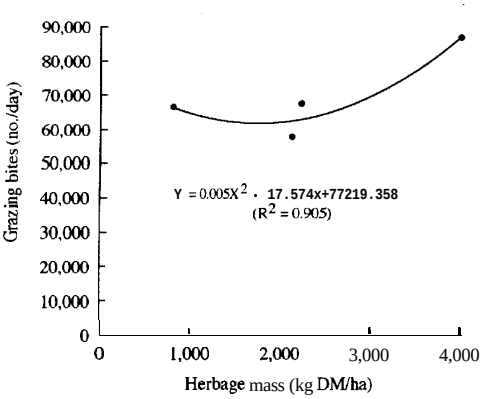

Fig. 1. Relationship between herbage mass of green panic and grazing bites per day of goats.

with low quality despite large herbage mass, and ascribed the smaller bite size to the increased mastication bites required for chewing and swallowing the highly lignified leaf and stem. When pasture quality becomes poor, despite high yield in the more mature stage, goats take smaller bites and increase the number of bites to satisfy their nutrient requirements. Those factors, therefore, may largely have caused higher grazing bites of goats in the mature stage than in the others.

Hodgson (1982) described that cattle and sheep on temperate swards had daily grazing bites ranging from 8,000 to 36,000 and from 17,000 to 34,000, respectively. Phillips (1993) also stated that cattle can take a normal maximum of 50,000 grazing bites per day, depending on sward conditions. The maximum number of grazing bites obtained by a goat in this study was 95,093. This value is much larger than the maximum values in cattle and sheep. Goats differ from cattle and sheep in several morphological features, including a mobile split upper lip and their ability to assume a bipedal stance and to climb small trees in feeding (Devendra and Coop, 1982; Van Soest, 1982; Malechek and Provenza, 1983), whereby they are able to select discriminately favored parts of plants (Huston, 1978). In addition, there is some evidence that goats have a greater voluntary feed intake than sheep (Huston, 1978). Under free-grazing conditions such as pasture, browse, range and mountains, goats and sheep have markedly different feeding habits, and the former are more active and travel greater distances than the latter (NRC, 1981). Therefore, it is possible that maintenance requirements of goats are to some extent higher than those of sheep. Thus, the difference in grazing bites among goats, sheep, and cattle may be partly associated with the difference in the mechanics of grazing, selectivity and/or nutrient requirements. Another possible reason for the differences between our results and those of Hodgson (1982) is the difference in pasture species. Generally the nutritive value of tropical pastures is low and tropical pasture swards have low bulk densities compared with temperate swards, so that there is the large potential for diet selection when animals graze tropical pasture swards and the animals have difficulty in satisfying intake requirements due to small bite size (Stobbs, 1975). Thus, the grazing bites may be affected by the difference in pasture quality and herbage allowance deriving

from different pasture species.

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