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Dietary selection of heifers in natural grasslands: effect of time of day and phenological stage

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Abstract

This study was conducted on a natural mosaic grassland of tall tussocks comprised mainly of *Eragrostis plana* Nees, and shorter inter-tussock areas comprised of prostrate grasses. The experimental paddocks were grazed by beef heifers and contained equal proportions of tussock and inter-tussock areas. Measurements were made at two times of day (during the first and the last grazing meals) replicated four times: twice spatially on paddocks and twice in time. The complete set of replicate measurements was conducted during two different tussock phenological stages: green reproductive (GR) and senescent reproductive (SR). Time of day had no effect on the proportions of grazing activity spent on the inter-tussock areas and tussocks. However, during GR stage the heifers spent more time grazing the reproductive tissues than the inter-tussock areas (66% vs. 34% of grazing activity, respectively). During SR stage virtually all grazing activity was concentrated on the inter-tussock areas (2% vs. 98% of grazing activity, respectively) and the heifers were able to increase mean bite mass and short-term intake rate.

Keywords: foraging behaviour, mixed diets, short-term intake rate, tussocks

Introduction

Grazing ruminants exhibit dietary selection, availability (biomass or sward height) being the main constraint when they graze on short swards, whereas on taller swards the quality (nutrient content) is the major constraint, i.e. when forage is mature (Agreil *et al.*, 2006). Offering animals selection choices on pastures allows each animal to meet its needs for nutrients and to regulate its intake by selecting mixed diets (Provenza *et al.*, 2009). Within this context, studies have shown that grazing ruminants may increase consumption of grasses with higher fibre content in the afternoon to maintain rumen fill overnight (Rutter, *et al.*, 2000). The present experiment was designed to examine the effect of time of day at two phenological stages of tussocks on dietary selection by beef heifers in mosaic natural grassland in southern Brazil.

Materials and methods

The measurements were made at two times of day (during the first and the last grazing meals) and the investigation comprised four replicates: two spatial replicates (paddocks) and two replicates in time (measurement dates). The complete set of replicate measurements was conducted during two different tussock phenological stages: green reproductive (GR) and senescent reproductive (SR).

The grazing paddocks contained equal proportions of shorter inter-tussock and taller tussock areas. The inter-tussocks areas were predominantly comprised of *Axonopus affinis, Paspalum micorae, Paspalum notatum, Desmodium incanum, Andropogon lateralis*. Tussock vegetation was predominantly (>95%) *Eragrostis plana* Nees.

Paddocks were 368 m^2 and they were grazed between 08:00 and 09:30 hours in the morning and between 16:30 and 18:00 hours in the afternoon, by four crossbred beef heifers (Angus x Brahman). Measurements when tussocks were at the GR stage began in January 2009 with heifers aged 15 months and a mean weight of 198 ± 2.2 kg. At the SR stage of tussocks, the evaluation began in April 2009 with the same animals (226.5 ± 3.5 kg).

At 1-minute intervals during grazing activity, records were taken of whether the heifers were grazing on tussock or inter-tussock areas. The short-term intake rate was measured by weighing the heifers pre- and post-grazing, corrected for insensible weight losses. Grazing time and jaw movements were recorded using behaviour recorders (Rutter *et al.*, 1997).

The sward height was estimated by 150 pre- and post-grazing measurements using a sward stick. To determine the herbage mass six quadrats (0.5 m x 0.5 m; three in tussock and three in inter-tussock areas) by paddock were cut at ground level.

In all analyses the paddock group of four heifers was used as the experimental unit. A repeated-measures ANOVA with measurement dates as repeated effect was used to test for significant interactions between time of day and tussock phenological stage.

Table 1. Effect of time of day (TD, am vs. pm) and phenological stages of tussocks (PS, green reproductive vs. senescent reproductive) on sward structure and grazing behaviour in tussock and inter-tussock (IT) areas.

Phenological stage	Green reproductive				Senescent reproductive				*P* of PS effect
	am	pm	*P* of TD effect	Daily mean	am	pm	*P* of TD effect	Daily mean	
Sward characteristics									
Sward height of IT areas (cm)	11.7	11.0	0.129	11.4	11.0	10.7	0.146	10.8	0.388
Sward height of tussocks (cm)	39.8	40.1	0.392	40.1	42.2	41.9	0.923	42.0	0.264
HM of IT areas (Mg ha^{-1})	2.50	2.30	0.328	2.40	2.32	2.36	0.894	2.34	0.691
HM of tussocks (Mg ha^{-1})	14.1	14.7	0.639	14.41	15.7	14.9	0.707	15.29	0.497
Animal characteristics									
STIR (g min^{-1} kg^{-1})	0.08	0.09	0.681	0.084	0.12	0.12	0.937	0.122	0.013
Bite mass (mg kg^{-1})	2.01	2.38	0.342	2.19	4.98	4.08	0.530	4.57	0.017
Bite rate (min^{-1})	41.2	40.5	0.879	40.9	40.8	37.4	0.617	38.4	0.025
Grazing IT areas (% of total)	27.8	40.0	0.484	33.5	97.9	98.4	0.840	98.1	0.003
Grazing tussocks (% of total)	72.2	60.0	0.484	66.5	2.1	1.6	0.840	1.9	0.003

HM = Herbage dry matter mass
STIR = Short-term dry matter intake rate per life weight

Results and discussion

There were neither significant interactions (P>0.10) between time of day and tussock phenological stage, nor an effect (P>0.10) of time of day (morning vs. afternoon). At both phenological stages heifers showed similar diet selection strategies irrespective of the time of the day (Table 1).

During the GR stage, heifers spent more time grazing the reproductive tissues compared with the inter-tussock areas (67% vs. 34% of grazing activity, respectively). In contrast, during the SR stage, virtually all grazing activity was concentrated on the inter-tussock areas (2% vs. 98% of grazing activity, respectively). The sward height and herbage mass in the inter-tussock areas and tussocks were similar (P>0.10) between the phenological stages. Therefore, probably the change in diet selection was due to changes in chemical composition of the plant species (higher energy and a better carbon : nitrogen (C : N) ratio, in the earlier than in the later phenological stage). Rutter (2006) reported that ruminants adopt diet selection strategies to optimize their intake of nutrients, especially C and N.

During the SR stage, the greater concentration of grazing activity on the inter-tussock areas allowed heifers to increase their bite mass by 108% and, despite a reduction in bite rate, to increase short-term intake rate by 45%. During the GR stage, heifers selected a 'mixed' diet, (from inter-tussock areas and tussocks) compared with the SR stage, when they appear to abandon virtually all interest in the tussocks. Furthermore, bite rate was not adapted to compensate for a low bite mass and, as a result, short-term intake rate was lower than in the SR stage. Probably these smaller bites were due to the selection of green reproductive tissues from the tussocks, characterized by a smaller density and major spatially dispersion. In a mosaic vegetation, ruminants have to choose either small plant parts, which means small bite mass and highly nutritive bites, or large plant parts, which means bigger bite mass but poorer quality (Shipley *et al.*, 1999).

Conclusion

The fact that heifers selected a mixed diet in GR stage may represent a good strategy of control of *Eragrostis plana* Nees in natural grasslands of southern Brazil. However, since bite mass and short-term intake were lower in GR than in SG stage, the use of animals with lower nutritional requirements should be considered.

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