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Effect of different grazing pressure by lambs grazing *Lolium perenne* and *Dactylis glomerata* pastures during spring on: 1. Diet quality

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Abstract

This study was undertaken to determine the influence of three grazing pressures [high (HGP), medium (MGP) and low (LGP), corresponding to 30, 50 and 75 g available DM/kg BW/day, respectively] on the quality of herbage consumed by lambs grazing *Lolium perenne* and *Dactylis glomerata* pastures in spring. Feed samples collected via oesophageal fistulae at the start and end of a six-week grazing period were analyzed for nitrogen (N), ash, neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) concentrations, and *in vitro* digestibility of organic matter (IVDOM). In general, the quality of diets selected by lambs grazing both *L. perenne* and *D. glomerata* pastures was lower at the end than at the start of the grazing period. For both pastures the N concentration of herbage consumed by lambs in the HGP treatment was lower than for that in the LGP treatment. For *L. perenne* HGP resulted in the selection of a diet with higher fibre (NDF and ADF) concentrations and consequently lower IVDOM than in the LGP treatment. In the *D. glomerata* pasture, higher ADF and lower IVDOM were recorded in the MGP treatment compared to the other treatments. On the *D. glomerata* pasture the ADL concentration of the selected forage was lower in the HGP than in the MGP or LGP treatments. Forage selected on the *L. perenne* pasture had generally lower N, ash, ADF and ADL concentrations than those selected from the *D. glomerata* pasture. However, the IVDOM of the selected *L. perenne* was higher than that of selected *D. glomerata*.

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Introduction

Lolium perenne and *Dactylis glomerata* are irrigated perennial pasture species suitable for grazing during winter and spring in South Africa. The nutritive value of the pasture is influenced by the concentration of nutrients in the edible forage biomass and the amount an animal consumes. These along with quality, sward structure, availability and the type, size and productivity of the animal (Allison, 1985; Pearson & Ison, 1997) alter the quantities and relative proportions of nutrients absorbed (Pearson & Ison, 1997), and determine grazing animal productivity and efficiency of production. Grazing management affects intake and animal performance through its direct and indirect effect on leaf area development, photosynthetic capacity, sward structure, forage availability and quality of forage on offer. According to Relling *et al.* (2001) high stocking rates on a *Panicum maximum* pasture depressed lamb performance because the animals did not have the opportunity to select. This, however, increases animal production per unit area and the pasture will be utilized uniformly. Conversely, lower stocking rate increases individual animal performance due to selective grazing of nutritious plant parts and unlimited availability of tillers (Hodgson & Illius, 1996), which enables the animal to avoid consumption of senescent material (Hamilton *et al.*, 1973). This choice can markedly affect the herbivore's nutrient intake (Dove *et al.*, 1999). Animal production per unit area will decline at low stocking rate, because it is normally accompanied by a waste of feed due to low forage utilization and a waste of energy due to longer distances of walking. Therefore, it is essential to determine the carrying capacity of the pasture and then utilize it with the correct number of animals for the appropriate period of time. This is important for pasture maintenance and improving animal performance. This study was aimed to determine the influence of grazing pressure on the quality of the diet selected by lambs grazing *L. perenne* or *D. glomerata* irrigated pasture in spring during a six-week grazing period.

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Materials and Methods

The study was conducted at the Hatfield Experimental Farm of the University of Pretoria. The site situated at 28.11ºE, 25.44ºS, is 1372 m above sea level. The site has an average annual rainfall of 674 mm with a dry autumn and winter. The soil at the experimental site is classified as a sandy-loam, with a pH of 4.2, P concentration of 29 mg/kg, K of 73 mg/kg, Ca of 158 mg/kg, Mg of 38 mg/kg and Na of 11 mg/kg.

The two irrigated perennial pasture species, *L. perenne* cv Nui and *D. glomerata* cv Hera, were planted at the end of April the previous year for subsequent grazing during spring (the next year). Each pasture species was divided further into 0.3 – 0.7 ha (average ±0.5 ha) paddocks that could be subjected to different grazing pressures as per treatment allocation. The exact paddock size was, however, based on the estimated level of feed availability and the predetermined level of grazing pressure. Before planting the seedbeds were fertilized with 200 kg potassium chloride plus 200 kg superphosphate per ha. A total of 1050 kg limestone ammonium nitrate (28% N) per ha was applied in two dressings of 750 kg/ha at the end of August (two weeks prior to grazing) and 300 kg/ha at the middle of January (during the dormant season after the grazing experiment). The pastures received a minimum of 25 mm water per week (irrigation and/or rainfall).

South African Mutton Merino wether lambs (initial mass 30 ± 0.2 kg) were used to graze the pastures. Three levels of pasture availability, 30, 50 and 75 g available dry matter (DM)/kg BW/day that corresponds to grazing pressures of 50 (HGP), 30 (MGP) and 20 (LGP) kg BW/kg DM/day, respectively, were evaluated. Pasture availability was determined using a pasture disc meter. A total of 50 test lambs were used per treatment group. An additional 4 oesophageal fistulated lambs were used per treatment to collect samples of ingested vegetation at the start (initial) and end (terminal) of the six-week grazing period. The oesophageal samples were analyzed for nitrogen (N), ash, neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) concentrations and the *in vitro* digestibility of organic matter (IVDOM). Dry matter, ash, N, NDF, ADF and ADL concentrations were determined following AOAC (2000) techniques and IVDOM according to Tilley & Terry (1963).

All parameters measured in the experiments were analyzed using the Proc GLM of SAS (2001). Where the F ratio indicated significance, differences between the means were tested using the Bonferroni's test (Samuels, 1989).

Results and Discussion

Compared to the oesophageal samples collected at the start (initial) of the grazing period, the final (terminal) diet selected by lambs grazing on both *L. perenne* and *D. glomerata* pasture contained lower ($P < 0.05$) concentrations of N, ash and IVDOM, but a higher concentration of ADF (Table 1). During paddock occupation, re-growth of newly grown shoot material is likely, but the proportion in the diet varies according to the frequency and intensity of defoliation of individual plants or tillers (Hodgson & Illius, 1996). Hence, depletion of the available forage due to utilization as well as ageing of the ungrazed sward contributed to the decrease in quality of material selected by the lambs. The N, NDF and IVDOM concentrations in the terminal diets recorded for *L. perenne* and *D. glomerata* were within the ranges reported by Bredon *et al.* (1987) for oesophageal samples from lambs grazing *L. perenne* (34.1 g N/kg DM, 472 g NDF/kg DM and 712 g IVDOM/kg DM) and *D. glomerata* (30.7 g N/kg DM, 522 g NDF/kg DM and 674 g IVDOM/kg DM) pastures. The concentration of N in both sampling periods for both pastures were higher than the optimum level (30 g/kg DM) required to support a high level of animal production (Meissner *et al*., 1993). This is because nitrogen at an early stage of maturity (re-growth) is highly soluble and highly degradable in the rumen (Meissner *et al.*, 1993), and animals will lose N as ammonia from the rumen when the N concentration of a forage exceeds 3% (Meissner *et al.*, 1993). The NDF concentration for both sampling periods and both pastures were below the threshold level of 550 g/kg DM that limits intake and subsequently high levels of animal production (Meissner *et al*., 1991), while the digestibility of the diets at the terminal period for *D. glomerata* was slightly lower than the optimum range suggested for high quality roughage diets (Meissner *et al*., 1989).

The composition of the diet selected at the terminal period from *L. perenne* pasture was lower ($P < 0.05$) in N, ash, ADF and ADL concentrations than that selected from the *D. glomerata* pasture (Table 1). The IVDOM concentration of the *L. perenne* selected by the lambs was higher than that selected from the *D. glomerata* pasture. Interspecies variation in leaf appearance rate largely determines sward structure: High leaf appearance rate corresponds to a high density of small tillers (e.g. *L. perenne*) and a low leaf appearance

Table 1 Mean chemical composition of oesophageal samples collected by sheep at the start (initial) and end (terminal) of each grazing period for *Lolium perenne* and *Dactylis glomerata* pasture

Pasture species	Sampling point	Composition (g/kg DM)					IVDOM (%)
		N	Ash	NDF	ADF	ADL	
Lolium perenne	Initial	49[a]	133[a]	545[a]	233[b]	29[b]	73.7[a]
	Terminal	32[b]	119[b]	527[b]	239[a]	32[a]	70.9[b]
	s.e.	0.3	2	4	1	0.3	0.4
Dactylis glomerata	Initial	51[a]	141[a]	545	279[b]	41	68.5[a]
	Terminal	37[b]	128[b]	544	292[a]	39	64.7[b]
	s.e.	0.7	2	5	2	0.6	0.4
Contrast between the two pastures							
	Terminal	*	*	NS	*	*	*

[a,b] For each pasture species, column means followed by different superscripts differ at P < 0.05

Table 2 Mean chemical composition of oesophageal samples from sheep at different grazing pressures of *Lolium perenne* and *Dactylis glomerata* pasture

Pasture species	Grazing pressure (g DM/kg BW/d)	Composition (g/kg DM)					IVDOM (%)
		N	Ash	NDF	ADF	ADL	
Lolium perenne	75	35[a]	118	517[b]	236[b]	31	72.6[a]
	50	33[a]	118	515[b]	238[ab]	33	70.3[b]
	30	29[b]	123	550[a]	242[a]	32	69.8[b]
	s.e.	0.6	2	8	2	0.5	0.2
Dactylis glomerata	75	39[a]	121[c]	545	287[b]	39[a]	65.5[a]
	50	37[ab]	135[a]	544	304[a]	40[a]	62.8[b]
	30	36[b]	127[b]	542	286[b]	37[b]	65.9[a]
	s.e.	0.7	2	5	2	0.6	0.3

[a,b] For each pasture species, column means followed by different superscripts differ at P < 0.05

rate to a low density of larger tillers (e.g. *F. arundinacea*) (Hodgson & Illius, 1996). Other factors such asdifferences in growth rate, developmental stage of growth, re-growth potential and DM percentage of thepasture on offer might have modified the influence of stage of maturity in the two species differentially, which would influence the quality of the overall diet of the lambs. Since the N concentration was above the threshold level for a high level of animal production, variations in cell wall concentrations were probably responsible for the differences in diet quality of the two pastures. The higher levels of ADF and ADL recorded in *D. glomerata* than in *L. perenne* pastures confirm this. Therefore, during spring a higher level of intake and consequent animal response could be expected from grazing lambs on *L. perenne* compared to *D. glomerata* pastures.

In both *L. perenne* and *D. glomerata* pastures, N concentration of the selected diet by lambs on the HGP treatment was lower (P < 0.05) than under LGP (Table 2). Although a higher intensity of defoliation under HGP stimulates a higher rate of leaf appearance and tillering (Hodgson & Illius, 1996), the availability of re-growth vegetative material is constrained by the associated high frequency of defoliation of regrowth material at individual plant or tiller level (McKenzie, 1997). As a result the animals will be left without any option than to consume stem material higher in fibre and lignin. The observed reduction in N concentration and increase in NDF, ADF and ADL concentrations were an indication of a lower forage availability and selectivity that eventually might have resulted to a higher proportion of stem fraction in the ingested plant material. Furthermore, the associated lower (P < 0.05) IVDOM concentration under HGP for *L. perenne*

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supports this while in the lambs on *D. glomerata* pasture, a higher ($P < 0.05$) ADF and lower IVDOM were evident in the diets in MGP compared to those in the LGP or HGP treatments (Table 2).

In line with low ADF concentrations and higher IVDOM, the ADL concentrations of grasses were higher at MGP than at HGP. A lower level of ADL under HGP suggests the presence of a higher proportion of young vegetative material or leaf fraction under HGP than MGP treatment conditions. Relatively low pasture availability and hence selectivity could have attributed to the higher ADF concentration and consequently lower digestibility of selected diets under MGP than LGP treatments. This is because leaf to stem ratio decreases with decreasing stocking rate or increasing pasture availability, as a result of senescence of older leaves and lignification of ungrazed swards due to ageing (Relling *et al.*, 2001).

Conclusions

Under the current set of conditions the diet quality available to lambs grazing *L. perenne* and *D. glomerata* decreased with increasing paddock occupation and increasing grazing pressure. Diet quality of lambs under MGP was comparable to those under LGP during the 6-week grazing period. Diet quality of lambs on *L. perenne* was better than when grazing *D. glomerata*, suggesting that the former pasture should result in a higher intake and consequently a higher performance than when grazing *D. glomerata*.

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