Grazing behaviour of alpaca and sheep

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ABSTRACT

Groups of between 12 and 39 mixed age alpaca females with young at foot, and similar numbers of non-lactating Wiltshire Horn sheep, were grazed in three sets of paired plots of mixed perennial ryegrass/white clover/Yorkshire fog/cocksfoot pastures. Each pair of plots was grazed twice over a period of four months (January-June) in order to compare patterns of grazing behaviour and diet selection. All pastures contained substantial proportions of dead material. Grazing behaviour was recorded manually over 24 hours in each period, and diet selection assessed from marked grass tillers and clover nodes set out on long transects in each plot.

Alpacas and sheep spent similar time grazing (8.7 vs 8.5 ± 0.1 hrs) and ruminating (2.2 vs 2.6 ± 0.2 hrs); alpacas had faster rumination rates than sheep (108 ± 0.16 vs 95 ± 0.30 chews/min, $P < 0.001$), but biting rates during grazing were similar (41 ± 0.89 vs 41 ± 0.80 bites/min). The distribution of these activities was very different. Alpacas spent much more time grazing during the day than sheep (63 vs 48 ± 1.7% of time between 0700 and 1300 hrs, $P < 0.001$; 64 vs 24 ± 1.9% of time between 1300 and 1900 hrs, $P < 0.001$), and substantially less in the evening (12 vs 24 ± 2.3% of time between 1900 and 0100 hrs, $P < 0.001$). Conversely, alpacas spent much more time ruminating during the night (27 vs 17 ± 0.95% of time between 0100 and 0700 hrs, $P < 0.001$). It is suggested that these may be inherited patterns reflecting traditional night corralling procedures for alpacas in their native area; they may limit the ability of alpacas to adjust to prolonged periods of daytime penning.

Sheep selected for ryegrass in mixed pastures, whereas alpaca selected against this species ($x^2 = 9.3$; $P < 0.01$); responses to other plant species did not differ significantly between alpaca and sheep. Alpacas showed more patchy grazing than sheep. These behavioural traits indicate the need for mixed or alternate grazing management to maintain pasture quality.

Keywords: alpaca; sheep; grazing; rumination; diet selection.

INTRODUCTION

Alpaca (*Lama pacos*) are members of the camelidae family (new world camels) which graze the high altitude (over 4,000 m) grasslands of the Andean altiplano. They have been introduced into New Zealand from Chile for their high quality fibre production and as companion animals. The main objective of this study was to investigate comparative aspects of grazing behaviour and diet selection in alpaca and sheep, two herbivore species which differ substantially in dentition and digestive tract structure (Hellier *et al.*, 1986) and, so far as New Zealand animals are concerned, in management history.

METHODS

Site and Management

The experiment was carried out at Flock House Research Station, Bulls, between 6 January and 19 June 1992 on three paddocks of mixed grass/legume pasture sited in the alpaca farmlet. The paddocks were selected on evenness of pasture cover. They were grazed by dairy cows and mechanically topped to a height of 10-15 cm 4 weeks prior to experimental grazing.

The animals used in the experiment were varying numbers (12-39, depending on availability) of mixed aged alpaca breeding females (72 ± 5 kg LW) from the Flock House flock with 3 to 4 month old young at foot. They were compared with similar numbers of non-lactating mixed age Wiltshire Horn sheep (55 ± 5 kg LW).

Paired plots of approximately 0.1 ha each in area were constructed using portable fencing within each of three paddocks. The alpaca and sheep were grazed in paired plots as separate flocks. The three pairs of plots were grazed first at two-week intervals and grazings were then repeated at four-week intervals.

Grazing periods varied according to sward conditions, being 6, 4, 2, 3, 2, 2 days for periods 1-6 respectively. The length of each grazing period was calculated by allowing at least 24 hours for the animals to settle before behavioural observations were made, and removing them when residual pasture height approached 5 cm by visual assessment.

Measurements

Pasture mass before grazing was estimated for the first three periods by cutting herbage to ground level within six random 0.2 m^2 quadrats per plot. To estimate botanical composition, six random samples of herbage to ground level per plot were bulked and mixed, then a 10-15 g sub-sample was separated into plant species and dead matter. These components were then dried and weighed and composition expressed in percentage terms on a dry weight basis.

Grazing behaviour observations were made over 24 hours in each period. Observations were made at 10 minute intervals of animals in each plot which were standing (including walking) or lying; and grazing, ruminating, or idling. Night time observations were made with the aid of an infra-red night scope and spot light. During main activity periods observations were made of the time taken for individual animals to complete 20 chews during rumination or 20 grazing bites (Freer 1981).

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Within the first three periods, assessment of grazing selectivity was made by identifying numbers of individual plants of different species and noting their fate under grazing. At intervals of 20 cm on a long transect within each plot plants were tagged with small plastic rings. The number of tagged plants in each transect was limited to 150 so that tagging and measuring could be completed for a pair of plots in one day, with the numbers of plants of each selected species tagged being similar. The plant species selected by visual assessment of their relative abundance, and the number tagged for each period were: perennial ryegrass (*Lolium perenne*) 51, 40, 40; white clover (*Trifolium repens*) 51, 40, 40; cocksfoot (*Dactylis glomerata*) 0, 40, 0; Yorkshire fog (*Holcus lanatus*) 50, 30, 30; and dandelion (*Taraxacum officinale*) 0, 0, 40. The tagged plants were measured from the rooting point to the end of the longest leaf before and after grazing.

RESULTS

Pastures

All swards contained high levels of dead material (Table 1). Ryegrass was the main species in periods one and three, with cocksfoot being the major species in period two (Table 1). White clover and Yorkshire fog were important minor components in all three swards, with dandelion also a substantial component in period 3. No data are available for the repeat grazing of paddocks in periods 4-6.

TABLE 1: Herbage mass (kg DM/ha), sward height (cm) and botanical composition (% DM) of experimental pastures.

	Pasture			
	1	2	3	SEM
Herbage mass (kg DM/ha)	5100	4450	3640	296
Sward height (cm)	9.0	7.1	6.3	0.15
Dead matter (%)	64	47	59	3.4
Proportions (%) of live components				
Ryegrass	69	17	71	7.9
White clover	16	15	6	2.1
Yorkshire fog	15	11	11	1.3
Cocksfoot		57		6.2
Dandelion			12	1.2

Diurnal behaviour

The total time spent on each major activity did not differ significantly between animal species (Table 2). The diurnal distribution of activity, on the other hand, differed substantially. Table 3 shows the proportionate distribution of standing, grazing, and ruminating activity respectively for four six-hourly periods, based on mean times of sunrise and sunset. Alpaca showed significantly more grazing activity than sheep during the daylight (0700-1850) hours and less activity at night, but significantly more ruminating activity during the night.

TABLE 2: Time spend (hr) by alpaca and sheep in main activities (means ± SE of six 24-hour studies).

	Alpaca	Sheep	SEM
Standing	10.9	10.3	0.3
Lying	13.1	13.7	0.3
Grazing	8.7	8.5	0.1
Ruminating	2.2	2.6	0.2
Idling	13.1	12.9	0.1

TABLE 3: Proportionate distribution of main activities by alpaca and sheep in six-hour periods within diurnal cycles (means ± SE of six studies). Figures in Table are % of 6 hr periods.

Time		Stand	Graze	Ruminate
0100-0650	Alpaca	12	6	27
	Sheep	16	10	17
	SEM	2.6	2.0	9.1
	P	ns	ns	***
0700-1250	Alpaca	73	63	5
	Sheep	53	48	12
	SEM	1.6	1.7	0.8
	P	***	***	***
1300-1850	Alpaca	78	64	1
	Sheep	68	24	5
	SEM	1.7	1.9	0.3
	P	***	***	***
1900-2450	Alpaca	19	12	6
	Sheep	34	24	9
	SEM	2.9	2.3	0.7
	P	***	***	***

TABLE 4: Bite rate during grazing and chewing rate during rumination (bites/chews per min) for alpaca and sheep (means ± SE of six studies).

	Alpaca	Sheep	P
Bite rate	41 ± 0.9	41 ± 0.8	NS
Chewing Mte	108 ± 0.2	95 ± 0.3	***

Chewing rate during rumination was significantly ($P < 0.001$) greater for alpaca than for sheep (Table 4). Bite rates during grazing for the two animal species, however, were not significantly different.

Selective grazing

Chi-squared analysis of the relative numbers of defoliated and undefoliated units within marked plant populations was used as a measure of selective grazing. The results (Table 5) showed that sheep exerted a greater degree of preferential grazing than alpaca for ryegrass, but there were no significant animal differences within other plant species.

Relationships between change in plant height during grazing and initial plant height were defined using independent fits for sheep and alpaca within the pooled results for each plant species. Regression equations were different for ryegrass, white clover and Yorkshire fog (Table 6), with the regression constant in each case being significantly lower (implying more limited response) in alpaca than sheep.

DISCUSSION

Both animal species utilised similar proportions of their day for the activities of grazing, ruminating and standing, but periods of grazing and ruminating activity were more concentrated for alpaca than sheep (Tables 2 and 3). The alpaca generally commenced grazing later in the morning than sheep, and completed grazing earlier in the evening. How-

TABLE 5: Selective grazing: relative numbers of tagged plants grazed or ungrazed by alpaca and sheep respectively, summed across trials (ryegrass, white clover, and Yorkshire fog - three trials. Cocksfoot and dandelion - one trial).

Plant Species	Animal	Grazed number	Ungrazed number	X^2
Ryegrass	Alpaca	58	76	9.3 **
	Sheep	80	49	
White clover	Alpaca	55	68	2.0^{ns}
	Sheep	64	55	
Yorkshire fog	Alpaca	68	25	0.5^{ns}
	Sheep	75	22	
Cocksfoot	Alpaca	39	2	1.6^{ns}
	Sheep	34	4	
Dandelion	Alpaca	21	7	2.2^{ns}
	Sheep	17	13	

TABLE 6: Regression of change in plant height during grazing (Y) on pre-grazed plant height (X) (mm).

Plant Species	Animal	Regression Equation†	R^2	n	Regression contrast
Ryegrass	Alpaca	-9.38 - 0.26 X	0.44	138	***
	Sheep	19.36 - 0.65 X			
White clover	Alpaca	-2.27 - 0.15 X	0.41	119	***
	Sheep	18.96 - 0.55 X			
Yorkshire fog	Alpaca	-22.23 - 0.20 X	0.31	143	**
	Sheep	8.59 - 0.51 X			
Cocksfoot	Alpaca	5.72 - 0.63 X	0.56	73	NS
	Sheep	7.03 - 0.60 X			
Dandelion	Alpaca	-6.70 - 0.56 X	0.52	38	NS
	Sheep	-6.02 - 0.54 X			

† Negative regression constant implies greater reduction in height for taller plants.

ever, when alpaca were grazing, a high proportion of the flock would be active. In relation to sheep, alpaca grazing was more continuous with fewer periods of rest or rumination through the day. This implies fewer discrete meals in alpaca than sheep. The ruminating activity of alpaca was much more concentrated than that of sheep in the hours of darkness (Table 3). The relatively low retention time of digesta particles and fluid in the fore-stomachs of alpaca noted by Hellier *et al.*, (1986) would be necessary to accommodate such a pattern of grazing activity. The high chewing rates during rumination observed for alpaca (Table 4) would be expected to result in a relatively high rate of comminution of food particles. Alpaca chewed on alternate sides of their mouth using a figure-of-eight motion of the jaw, compared to the circular jaw movement of sheep which chewed on only one side of the mouth at a time (Arnold & Dudzinski, 1978).

In their native country, alpaca have been domesticated for around three thousand years (Fowler, 1989) and are corralled at night to protect them from native carnivores, thus preventing any night grazing. The animals used in the trial were born in New Zealand and kept with their dams while growing, without direct experience of nightly penning, suggesting their grazing periodicity was an inherited behavioural trait. This may limit the ability of alpaca to compensate by night grazing for prolonged daytime penning, such as can occur during shearing or drenching.

The results of observations on incidence of defoliation within populations of marked plant units are sensitive to variation in grazing pressure, but yield reasonable estimates of grazing selectivity in relative terms (Hodgson *et al.*, 1994). Sheep showed greater grazing preference for perennial ryegrass than did alpaca (Table 5), but there were no other significant differences in selectivity between animal species.

Preferential defoliation appeared to be greater for cocksfoot, Yorkshire fog and dandelion than it did for ryegrass or white clover in both alpaca and sheep plots. This observation may be a consequence of the relatively limited sample data for cocksfoot and dandelion in particular. It may also be explained if leaves of ryegrass and white clover lay lower in the sward canopy than those of other species, and were protected from grazing to a greater extent by the substantial quantities of dead material (Table 1). However, the data is not adequate to examine this possibility.

Regression of change in plant height during grazing on initial plant height (Table 6) indicated that for ryegrass, white clover and Yorkshire fog, the three plant species observed in all three paddocks, the grazing strategies adopted by alpaca and sheep differed. In alpaca the rate of increase in leaf length removed with increasing initial tiller size was relatively small, so tending to perpetuate or exacerbate variability in tiller or node size. In sheep, on the other hand, the length of leaf removed increased much more rapidly as initial leaf length increased, thus tending to reduce variability in unit size.

Though these results apply to random populations of plant units, the implication is that alpaca would tend to exacerbate patchy grazing, sheep to reduce it. This effect, taken together with the observation that alpaca tend to use specific sites for defaecation, implies the need for alternate grazing or mixed grazing with species like sheep in order to reduce the risk of patchy sward developing and consequent grazing inefficiency. This observation has recently been confirmed by results of comparative studies on guanaco and sheep in the UK (Moseley, 1994).

REFERENCES

Arnold, G.W. and Dudzinski, M.L. 1978. Ethology of free-ranging domestic animals. Elsevier, Amsterdam, The Netherlands.

Fowler, M.E. 1989. Medicine and surgery of South American Camelids. Iowa State University Press, Ames, Iowa, USA.

Freer, M. 1981. The control of food intake by grazing ruminants. *In* Grazing Animals, Ed. F.W. Morley, Volume B1, 105-124. Elsevier, Amsterdam, The Netherlands.

Hellier, R., Cercasov, V. and Englehardt, W.V. 1986. Retention of fluid particles in the digestive tract of the llama (*Lama guanacoe F. glama*). *Comp. Biochem. Physiol* **83A** 687-691.

Hodgson, J., Clark, D.A. and Mitchell, R.J. 1994. Foraging behaviour in grazing animals and its impact on plant communities. *In* Forage Quality, Evaluation and Utilization, Ed. G.C. Fahey, L.E. Mauer, D.R. Merton and M. Collins. American Society of Agronomy, Crop Science Society of American, Soil Science Society of America, Madison, Wisconsin, pp 796-826.

Hughes, T.P., Sykes, A.R., Poppi, D.P. and Hodgson, J. 1991. The influence of sward structure on peak bite force and bite weight in sheep. *Proceedings of the New Zealand Society of Animal Production* **51:** 153-159.

Moseley, G. 1994. Pasture utilization by South American camelids. *1993 Annual Report, Institute of Grassland and Environmental Research, Aberstwyth*, pp. 102-103.