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DIETARY PREFERENCES IN GOATS WITH OR WITHOUT GRAZING EXPERIENCE

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SUMMARY

In the present study it was considered whether dietary habits may be affected by grazing experience. Six range-experienced goats and six inexperienced goats were tested with three grasses (ryegrass, barley and brome) and two legumes (alfalfa and clover). The experimental design was a series of seven feeding sessions consisting of two forced trials and one free-choice trial. All the animals showed a higher intake rate for grasses. Both range-experienced and inexperienced goats preferred grasses rather than legumes. Contrary to previous works, it seems from this study that grazing experience may not play an important role in the development of diet selection.
Keywords: goat, diet selection, grazing experience, grass, legume.

INTRODUCTION

It has been reported that goats actively select grasses and reject legumes. Fedele *et al.* (1993) observed that Maltese and Rossa mediterranea goats showed a preference for grasses, having little interest in forbs and even less in legumes. Clark *et al.* (1982) in pastures grazed with different ratios of goats and sheep found that grasses were the principal feed of goats in all associations and that sheep ate white clover in proportion to its presence in the sward, whereas it was rejected by goats. Similar results were obtained by Radcliffe (1985), Wood (1987) and Townsend and Radcliffe (1990).

The intake rate of any component of a sward appears to depend upon a) the potential rate at which it can be eaten, b) its accessibility, and c) its relative acceptability. The potential rate at which a plant component can be eaten is determined largely by the physical characteristics of a plant, such as its ease of fracture, size of particles and water content. The accessibility of any pasture component depends upon its height, density and position in the sward relative to other components. Acceptability is known to be a function of the taste, odour and surface characteristics of the component and can be modified by experience (Ortega-Reyes and Provenza 1993; Launchbaugh and Provenza 1994; De Rosa *et al.* 1995).

The problem with this approach is that, since plant species are rarely homogeneously distributed, it is not certain that an animal moving through the sward will encounter species in proportion to their relative abundance (Newman *et al.* 1992). Therefore, it is useful to investigate whether field observations on goat feeding preferences also apply under the limited conditions of the cafeteria trials, where the factor "herbage accessibility" is absent.

MATERIALS AND METHODS

Twelve female Rossa Mediterranea goats were used in this experiment. Six were aged six months and had no grazing experience (group juvenile); six others were aged three years and were range-experienced (group adult).

Three grasses and two legumes to be tested were chosen. The grasses included *Lolium perenne* (ryegrass), *Bromus mollis* (brome) and *Hordeum secalinum* (barley); the legumes were *Medicago polimorfa* (alfalfa) and *Trifolium repens* (clover). Each grass was separately tested with both clover and alfalfa. A comparison between alfalfa and clover was also performed.

All the species were harvested the afternoon before their utilization, stored during the night in plastic bags and finally chopped into 12-15 cm pieces just before the test started.

Each group was allocated in two straw-bedded pens and offered ad libitum a mixture containing a high percentage of the herbaceous plants to be tested and a commercial pellet for goats. Juvenile goats had no contact with adult animals either before or during the experiment. Animals were exposed to a two-week preliminary phase, during which they were moved once a day to individual test boxes (0.9 x 1.8 m) for one hour, where they received the herbaceous mixture in plastic baskets (40 x 30 x 20 cm).

The experimental design was a series of seven feeding sessions for each animal, one conducted every 48 h. The animals were feed deprived for 10 h before each feeding session. Five minutes before the beginning of each feeding session, the animals were moved to the test boxes. Each feeding session consisted of two

forced trials and a free choice trial. In the first forced trial the animals received either a grass or a legume and were allowed to eat for 20 min or take a maximum of 50 bites. In this latter case the basket was removed. In the second forced trial the goats received the alternative plant species. In the free choice trial the animals were offered both baskets containing the two plant species simultaneously, and were allowed either to eat for 20 min or to take up to 50 bites.

Herbage was weighed before and after each trial in order to determine the total intake per trial. During each forced trial number of bites and ingestion time (prehension time plus mastication time) were computed. These data were used to calculate bite rate (number of bites/ingestion time), bite mass (dry matter ingested/number of bites) and intake rate (dry matter ingested/ingestion time).

In the free-choice trials the preferences of the animals were determined in two different ways: as a proportion of the first 50 bites or as a proportion of total intake taken from the legume, when a grass and a legume were tested, or taken from clover, when the 2 legumes were compared.

RESULTS

For each group and each comparison the data collected during the forced trial were analysed by analysis of variance for repeated measures (nested structures for goat and plant species) with one factor (order of presentation). None of the variables were influenced by the order of presentation, as plant species played a predominant role in affecting them. Both adult and juvenile goats constantly showed a higher intake rate for grasses than for legumes (Table 1). However, differences were significant for 3 out of 6 comparisons in juvenile goats (ryegrass-clover, $P<0.001$; ryegrass-alfalfa, $P<0.01$; brome-clover, $P<0.05$), whereas only 1 out of 6 was significant for adults (brome-clover, $P<0.05$). Bite mass was higher on brome with respect to clover both in adult (mean±SE: 0.97±0.06 vs. 0.52±0.13, respectively; $P<0.05$) and juvenile goats (0.35±0.04 vs. 0.13±0.03, respectively; $P<0.001$), whereas in the ryegrass-clover comparison it was significantly higher on ryegrass, but for juvenile animals only (0.53±0.04 vs. 0.09±0.03, respectively; $P<0.001$). In the clover-alfalfa comparison both adult (6.10±0.97 vs. 3.81±0.88, respectively; $P<0.01$) and juvenile goats (5.40±0.28 vs. 1.61±0.74, respectively; $P<0.01$) displayed a higher bite rate on clover than on alfalfa, and a higher intake rate on clover, although in this latter case the difference was significant only for the juvenile group (0.78±0.08 vs. 0.39±0.18, respectively; $P<0.05$).

In addition, a 3-way analysis of variance was performed on the variables recorded during the forced trial with order of presentation, type of legume and type of grass as factors. There was no effect of order of presentation and type of legume and none of the interactions were significant. In adult goats bite mass, bite rate and intake rate calculated on grasses depended upon the grass species tested ($P<0.001$; Table 2). A similar pattern was observed in juvenile animals ($P<0.05$, $P<0.05$ and $P<0.001$, respectively; Table 2). In adult animals bite mass was higher on ryegrass with respect to brome and barley ($P<0.01$ and $P<0.001$). Significant differences were also found between brome and barley, where bite mass on brome was higher ($P<0.001$). Bite rate was higher on barley than on ryegrass ($P<0.01$). Intake rate on ryegrass and brome were higher with respect to barley ($P<0.001$ and $P<0.01$, respectively). In juvenile goats bite mass was higher on ryegrass than on barley ($P<0.01$); bite rate was higher on barley than on brome and ryegrass ($P<0.01$ and $P<0.05$) and intake rate was higher on ryegrass than on brome and barley ($P<0.05$ and $P<0.001$). Significant differences were also found between brome and barley ($P<0.05$).

In the free-choice trials the proportion of total intake and bites on grasses was higher than on legumes, both in juvenile and adult goats, whereas in the clover-alfalfa comparison both groups showed a higher preference for clover (Table 3).

DISCUSSION

It has been reported that the diet of adult goats contained a significantly lower proportion of legumes than did the swards on which they grazed. Clark *et al.* (1982) reported that the percentage of legumes in the diet was less than 2%. Townsend and Radcliffe (1990) showed that on dryland *Lolium perenne-Trifolium repens* pastures the availability of *T. repens* increased as goat to sheep ratio augmented. Fedele *et al.* (1993) found that grazing goats preferred grasses above all, having little interest in forbs and even less in legumes

Our results revealed that indoor selectivity against legumes did not differ from that recorded in the field, although we changed the physical characteristics of herbage and removed the factor "accessibility". In the free-choice trials both adult and juvenile goats showed a strong and consistent preference for grasses over legumes. Such a behaviour was recorded even in the forced trials, where they could sample a plant species at a time. When offered feeds were clover and alfalfa, all the animals preferred clover and rejected alfalfa, both in the forced and in the free-choice trials.

As observed by Kenney and Black (1984) in sheep, both chemical and physical characteristics of forage play an important role in determining the rate at which it can be consumed and its palatability. It seems that

goats tend to select more highly digestible material. Nevertheless, it appears unlikely that their selection is based on digestibility, since in the present study we used short-term trials. Probably, they preferred feeds which were easier to chew and swallow, hence more digestible. Moreover, taste, odour and feel contributed to determine preferences.

It has been hypothesized that selective grazing is influenced by learning and genetics (Provenza and Balph 1987), although very little is known about the genetic basis for the innate preferences of ruminants. It seems from our study that grazing experience may not play an important role in the development of diet selection. As both adult and juvenile animals preferred grasses over legumes when offered together, we can postulate that such a preference could depend on the sensorial, nutritional and physiological characteristics of forages, whereas grazing experience influenced only the total intake rate as previously shown by Flores *et al.* 1989a, 1989b, 1989c.

As far as grasses are concerned, the forced trials revealed that feeding behaviour depended on the species tested. The higher intake rate and bite mass on ryegrass, compared to that of barley and brome, was probably a consequence of its higher acceptability. In fact, Kenney and Black (1984) reported that sheep spent a longer time eating feeds which could be eaten faster. The lower bite rate on ryegrass with respect to barley could have been caused by the increased time needed to chew a larger amount of herbage per bite.

Flores *et al.* (1989b) found that the phenological stage of a plant species influences bite rate, bite size and intake rate in lambs. In goats the palatability of some plant species changes considerably with the season (Becker and Lohrmann 1992). These findings suggest that it would be useful to repeat our experiment in other periods of the year, to evaluate whether seasonal changes in goat preferences can be observed.

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Table 1. Mean (±SE) intake rate of grasses and legumes (g DM/min ingestion time) in the forced trials

Plant species	Adult goats	Juvenile goats
barley	3.09±0.80[C]	1.20±0.11
alfalfa	4.19±0.71[D]	1.60±0.46
ryegrass	5.45±0.50	1.96±0.25[C]
alfalfa	4.20±0.94	0.76±0.19[D]
barley	2.63±0.52	0.95±0.11
clover	2.13±0.49	0.65±0.18
ryegrass	5.70±0.40	2.41±0.22[E]
clover	4.33±0.97	0.65±0.12[F]
brome	4.82±0.38	1.57±0.26
alfalfa	4.50±0.87	1.27±0.26
brome	4.93±0.43[A]	1.65±0.33
clover	3.20±0.59[B]	0.93±0.17
clover	3.57±1.18	0.78±0.07
alfalfa	2.94±0.63	0.57±0.11

[A,B C,D E,F] Indicate significant differences ($P<0.05$. $P<0.01$ and $P<0.001$. respectively) within columns

Table 2. Mean (±SE) bite mass (g DM/bite). intake rate (g DM/min) and bite rate (bites/min) of grasses in the forced trials

	Adult goats			Juvenile goats		
	ryegrass	brome	barley	ryegrass	brome	barley
Bite mass	1.34±0.07[CE]	0.96±0.05[DE]	0.51±0.10[F]	0.47±0.03[EC]	0.35±0.03[ED]	0.20±0.02[F]
Intake rate	5.57±0.31[E]	4.87±0.27[E]	2.86±0.46[F]	2.19±0.17[EB]	1.61±0.20[A]	1.07±0.08[FB]
Bite rate	4.24±0.26[AC]	5.21±0.40[B]	5.76±0.30[D]	4.66±0.15[A]	4.45±0.23[C]	5.28±0.23[DB]

[A,B C,D E,F] Indicate significant differences ($P<0.05$. $P<0.01$ and $P<0.001$. respectively) within rows

Table 3. Mean (±SE) proportion of bites and total intake in the free-choice trials

Plant species	Proportion of bites[A]		Proportion of total intake[A]	
	Adult	Juvenile	Adult	Juvenile
Brome-clover	0.011±0.011	0.007±0.007	0.020±0.020	0.012±0.012
Brome-alfalfa	0.171±0.144	0.127±0.123	0.189±0.138	0.125±0.118
Ryegrass-clover	0.000±0.000	0.000±0.000	0.000±0.000	0.000±0.000
Ryegrass-alfalfa	0.130±0.079	0.000±0.000	0.129±0.081	0.000±0.000
Barley-clover	0.128±0.076	0.000±0.000	0.142±0.095	0.000±0.000
Barley-alfalfa	0.214±0.106	0.153±0.153	0.348±0.160	0.135±0.135
Clover-alfalfa	0.828±0.064	0.923±0.044	0.737±0.091	0.855±0.077

[A] Proportion from legume for grass-legume comparisons. Proportion from clover for the clover-alfalfa comparison