Rumen fungal degradation of *Digitaria pentzii*

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The intake of *Digitaria pentzii* grown with sulphur fertilizer (0,14%; + S) was almost 50% higher than that of unfertilized forage (0,08%; − S). Results showed no differences in plant anatomy or in rumen bacterial populations in sheep fed + S and − S *Digitaria*. However, the + S *Digitaria* had a greater fungal population and caused a much lower breaking strength of the leaves when incubated with antibiotics compared to the unfertilized forage (− S). It is postulated that fungal activity in sheep fed + S *Digitaria pentzii* permitted a more rapid reduction in the size of feed particles in the rumen and hence greater DM digestion and feed intake.

Die inname van *Digitaria pentzii* wat met swael kunsmis (0,14%; + S) gekweek is, was byna 50% hoër as dié van voer wat nie swaelbemesting ontvang het nie (0,08%; − S). Resultate het getoon dat daar geen verskil in plant anatomie of in die bakteriese populasie van die grootpens van skape was wat + S en − S *Digitaria* gevoer is nie. Die + S *Digitaria* het egter 'n groter fungus populasie gehad en dit het 'n baie laer breeksterkte van die blare tot gevolg gehad wanneer dit met antibiotika geïnkubeer is in vergelyking met die onbemeste voer (− S). Dit is gepostuleer dat fungus aktiwiteit in skape gevoer met + S *Digitaria pentzii* 'n vinniger verlaging van die grootte van voer partikels in die grootpens toelaat en dus meer DM vertering en voedsel inname.

Keywords: Rumen fungi, fibre, *Digitaria*, sulphur

Introduction

The intake by sheep of *Digitaria pentzii* (Stent.) grown with sulphur fertilizer (0,14%; + S) was almost 50% higher than that of unfertilized forage (0,08% S; − S). (Rees *et al.*, 1982). This difference in intake was not greatly reduced when elemental sulphur (1 g/d) was added to the feed. To explain this difference, a study was made of certain characteristics of plant anatomy and rumen microbes.

Materials and Methods

Techniques used included *in vitro* and nylon bag incubation, measurements of liquid and digesta flow from the rumen and abomasum by reference to radioactive chromium and ruthenium markers, and measurement of the proportion of microbial nitrogen in digesta leaving the abomasum by ^{35}S-labelling. The breaking strength of *D. pentzii* leaf blades was determined by using an Instron Universal Testing Instrument. Observations of plant structure and fungal colonization were made by light, scanning and transmission electron microscopy. Bacterial counts were performed as described previously (Akin, 1980; Joblin, 1981).

Results and Discussion

As is usual with tropical species, the leaves of these forages were much more vascular than those of temperate species. The proportion of mesophyll plus epidermis was only about 65% of the total area of the leaf with both forages. On incubation in the rumen in nylon bags, little bacterial association with plant cell wall was observed in the first six hours. By 24 hours a few encapsulated cocci were present but these were replaced after 48 hours by small numbers of an irregularly shaped bacterium often not directly attached to clearly defined zones of erosion of plant cell walls. Total viable bacterial counts were similar on the two diets (Table 1), as were rumen volumes (3,9 and 3,8 l for + S and − S

Table 1 Total viable counts of rumen bacteria for sheep fed + S and − S forage (mean ± SD)

	Colonies × 10^{-8}/ml developing on:		
Inoculum from sheep fed:	10 − x[a]	Xylan	Pectin
+ S	8,91 ± 3,28	5,06 ± 2,10	3,74 ± 1,68
− S	7,88 ± 1,91	5,11 ± 3,46	4,18 ± 1,76

[a]medium contains: glucose, cellobiose, starch and xylan

diets, respectively), water flow from the rumen (10,8 and 9,3 l/d) and the proportion of microbial N (66 and 63%) in digesta leaving the rumen.

Fungal sporangia of diverse shapes (Orpin, 1977; Bauchop, 1979) were observed on the surfaces and cut ends of both +S and −S leaf blades incubated in the rumen of sheep fed +S forage, but were virtually absent with sheep fed −S forage as determined by scanning eletron microscopy. Sporangia were observed within six hours of the introduction of leaves into the rumen selectively colonizing sclerenchyma patches. Fungal penetration through stomata was often seen while colonization of sclerenchyma by sporangia and penetration of cell walls by thalli was also readily observed with transmission electron microscopy (TEM).

D. pentzii leaves incubated *in vitro* with rumen liquor in the presence of antibiotics to inhibit bacteria were overgrown by fungi within 24 hours. TEM studies indicated the virtual absence of bacteria but revealed the degradation by fungi of specific plant tissues including mesophyll, epidermis and sclerenchyma. There was even some attack on the normally refractory mestome sheath and metaxylem vessels. About 60% of the leaf dry matter was lost in 48 hours from leaf blades incubated with antibiotics plus inocula from +S sheep compared with a loss of 3% with inocula from −S sheep. The breaking strength, about eight Newtons with untreated leaves, declined after 48 hours incubation with antibiotics to about four Newtons with −S inocula compared with one Newton for +S inocula (Table 2).

Table 2 Dry matter degraded (g/100 g lost from non-inoculated control) together with breaking strength (Newtons) for matched intact leaf blades of *Digitaria pentzii* incubated 48 hours *in vitro*. Inoculum comprised rumen fluid from sheep fed +S or −S forage plus antibiotics

Inoculum from sheep fed:	Dry matter loss		Breaking strength	
	Trial 1	Trial 2	Trial 1	Trial 2
+S	61,9	63,1	0,9	1,0
−S	3,5	2,9	3,8	4,6
+S (autoclaved)	0,0	2,9	ND[a]	ND

[a]not determined

In conclusion, no differences were observed in plant anatomy or in rumen bacterial populations in sheep fed +S and −S *Digitaria pentzii*. In view of the large differences in ruminal fungal populations with the two diets and of the weakening of leaf structure in forages incubated with the fungus in the absence of bacteria, it is postulated that fungal activity in sheep fed +S *Digitaria pentzii* permitted a more rapid reduction in the size of feed particles in the rumen and hence greater DM digestion and feed intake.

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