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Anatomy of chewed leaf blade particles of *Cenchrus ciliaris* and *Lolium perenne* in relation to digestion

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The thickness and accessibility to microbes of forage cell walls has a major effect on the rate and extent of digestion of forage by ruminants (Wilson, 1993, Chapter 1 of Forage Cell Wall Structure and Digestibility, eds HG Jung *et al*, American Society of Agronomy). There are large differences between forage species and between different parts of plants in the proportion of thick-walled cells, the thickness of the walls and the extent to which the forage is broken down in the mouth when eaten.

As part of a larger programme, we have examined the anatomy of chewed leaf blade particles and intact blades of *Cenchrus ciliaris* L. (buffel grass), a tropical grass of low digestibility, and *Lolium perenne* L. (perennial ryegrass), a temperate grass of high digestibility. The two grasses were grown in identical conditions in a heated glasshouse (mean daily minimum and maximum temperatures 15 and 31°C, respectively) by Mtengeti (1993, PhD thesis, University of Wales, Aberystwyth). Meals of the two grasses were fed to sheep by Mtengeti and the chewed grass collected via an oesophageal fistula. Within the chewed grass it was possible to distinguish between leaf blade, leaf sheath and stem. The sheep ate *C. ciliaris* more slowly than *L. perenne*, producing smaller, but heavier, particles. The results in the Table are means of two replicates and of two dates of harvest in each of two years. The standard errors are derived from the years x dates x species interaction.

The chewed particles of *C. ciliaris* leaf blades, compared with those of *L. perenne*, had a higher proportion of thick-walled cells, a higher proportion of thick wall within the total area of wall, thicker cell walls in all types of cell, and a much greater volume of wall per mm^3 of particle.

On the basis of Wilson (1993) there is time to digest away only about 0.5 µm of cell wall thickness during the period leaf particles remain in the rumen (about 25 hours), even if rumen microbes have immediate access to a wall. Thus much of the total volume of wall in *C. ciliaris* will pass out of the rumen undigested, compared with a relatively small proportion in *L. perenne*. This appears to be a major reason for the difference in digestibility between the two grasses.

	Cenchrus ciliaris	*Lolium perenne*	SE (3 DF)
Volume per particle (mm^3)	1.58	3.40	0.213
Number of cells per mm^3 of particle ('000) :			
thick-walled	101	96	21.5
thin-walled	1	12	0.8
epidermal	3	8	0.6
Area of wall, mm^2 per mm^3 of particle :			
thick-walled cells	115	83	12.9
thin-walled cells	16	91	2.0
epidermal cells	58	65	3.4
Thickness of walls (µm) :			
thick-walled cells	1.30	0.85	0.038
thin-walled cells	0.24	0.15	0.029
epidermal cells :			
inner wall	0.45	0.22	0.038
outer wall	3.22	0.87	0.163
Total volume of wall, mm^3 per mm^3 of particle	0.239	0.113	0.0123