MEASURING THE COMPRESSION AND SHEAR ENERGIES OF GREEN PLANT MATERIAL

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The biomechanical characters of plant material are thought to influence the intake of forages by ruminants and hence their feeding value (Mackinnon *et al.* 1988). Whereas most studies have focussed on the biomechanical characters of dried feed samples and their effect on animal performance, there have been few attempts to study the biomechanical characters of fresh (hydrated) plant material, and its effect on voluntary intake. The objective of this work was to develop and evaluate a method to measure the biomechanical characters of hydrated plant material.

Subterranean clover (*Trifolium subterraneum*), cvv Trikkala and Dalkeith, were grown in a glasshouse, harvested in the vegetative stage of development, placed in a plastic bag with 4-5 drops of water, and the bag sealed. The material was chopped to 5-8 mm in length and its compression energy measured as described by Baker *et al.* (1993). Compression and shear tests were conducted in a constant temperature of 20°C and relative humidity of 65%.

The original compression chamber described by Baker *et al.* (1993) was modified to allow removal of liquid extruded from the material. Drainage holes were drilled in the base of the chamber and a porous, sintered metal disc 1.5 mm thick was placed on top of the base. A vacuum was applied to the underside of the base to assist with the removal of excess liquid. Application of the vacuum did not significantly ($P>0.05$) affect the measure of compression energy, nor did it affect the subsequent measurement of shear energy (Table 1).

Table 1. Compression and shear energies of fresh, green clover compressed with and without vacuum

	Compressed without vacuum (± SE)	Compressed with vacuum (± SE)
Compression energy (kJ/kgFW)	1.27 (± 0.038)	1.28 (± 0.093)
Shear energy (kJ/m^2)	1.65 (± 0.123)	1.49 (± 0.051)

The feed material after compression (above) was a coherent disc which was placed in a punch and die apparatus, and its shear energy measured (Baker *et al.* 1993). The original die described by Baker *et al.* (1993) was modified to prevent plant material lodging between the punch and the die, as this produced a high friction component and obscured the shear forces. The modified die had an internal die wall with a 0.3 mm land adjacent to the cutting surface, and was then tapered to provide increasing clearance.

When hydrated material was harvested from green, vegetative plants of subterranean clover, and dried material was harvested from mature (senescent) plants, the shear energy of Trikkala remained significantly lower than that of Dalkeith for both material types (Table 2). The dry, mature material had significantly higher shear and compression energies than the hydrated material. This indicates that ranking of varieties from low to high 'strength' may remain consistent, and that the plant characteristics that confer their biomechanical characters are important in plant material at both stages of development. Further work is in progress to determine the characteristics of plants that influence their biomechanical characters, and their subsequent effect on forage intake.

Table 2. Compression and shear energies of fresh, green sub. clover and dry, mature sub. clover

	Sub. clover cv Trikkala		Sub. clover cv Dalkeith	
	Fresh (hydrated)	Dry, mature	Fresh (hydrated)	Dry, mature
Compression energy (kJ/kgFW)[A]	1.36^a	4.25^b	1.47^a	4.99^c
Shear energy (kJ/m^2)	1.49^a	16.2^b	2.15^c	21.9^d

[A] Mean values in row with different letter in superscript are significantly different ($P<0.05$).

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