

THE KINETICS OF FIBRE DIGESTION IN THE RUMEN OF SHEEP

A.C. DUNLOP* and R.C. KELLAWAY*

Intake of low quality roughages in ruminants is determined primarily by the size of the fibre pool in the rumen and clearance rates from this pool by absorption and onward passage of undigested material. The relative contribution of these factors was determined with three forages with and without alkali treatment.

Chaffed forages were sprayed with a mineral solution supplying (g/kg forage) 12 N, 3 P, 1.5 S and (mg/kg forage) 4 Cu and 0.1 Co. Batches for alkali treatment also were sprayed with NaOH (50 g/kg forage) and H₂O (150 g/kg forage). Each forage was fed to four sheep *ad libitum* using continuous belt feeders, for 21 days, after which rumen contents were removed and sampled (Minson 1966). In the week before emptying, eight nylon bags each containing 6 g of the animals' diet were placed in the rumen and removed at intervals up to 96 hr. In of cell wall (CW) residues were plotted against time. Curve peeling techniques were used to determine the fractional sizes of three CW pools, fast digesting (PD₁), slow digesting (PD₂) and indigestible (ID) as well as the rates of digestion (%/hr) for PD₁ (k_{1.1}) and PD₂ (k_{1.2}). These data and measurements of CW intake (I) (g/kg^{0.75}/day) and rumen pool size of CW (R) (g/kg^{0.75}) were used to calculate passage rate constants (k₂) by solving the cubic form of the following equation:-

$$R/I = (PD_1/k_{1.1} + k_2) + (PD_2/k_{1.1} + k_2) + ID/k_2 \quad (1)$$

Rumen clearance rates (g/kg^{0.75}/day) of cell walls by digestion (RCRD) were calculated as:-

$$[(k_{1.1}/k_{1.1} + k_2) \cdot PD_1 \cdot I] + [(k_{1.2}/k_{1.2} + k_2) \cdot PD_2 \cdot I] \quad (2)$$

Rumen clearance rates by passage (RCRP) were calculated as:- I-RCRD.

TABLE 1. Digestion kinetic measurements in sheep fed oat straw (O) and wheat straws (W₁, W₂) ± alkali treatment

Diet	Alkali	PD ₁	PD ₂	ID	k _{1.1}	k _{1.2}	k ₂	I	R	RCRD	RCRP
O	-	0.21	0.46	0.33	5.3	2.1	2.9	32.1	32.6	10.9	21.2
	+	0.58	0.25	0.17	9.1	2.1	2.8	56.1	38.3	30.9	25.3
W ₁	-	0.11	0.52	0.38	7.7	2.0	3.0	26.4	26.9	7.7	18.7
	+	0.49	0.27	0.24	6.4	1.9	3.9	43.2	28.0	17.1	26.2
W ₂	-	0.13	0.50	0.37	8.2	2.0	3.4	26.8	25.6	7.9	19.7
	+	0.24	0.54	0.21	6.8	2.3	4.8	62.1	37.0	19.7	42.4
SEM							0.37	4.51	4.26	1.79	3.05

Alkali treatment of forages increased potential digestibility (PD₁+PD₂) and caused a shift from the slow-digesting to the fast-digesting CW pool. Intakes did not differ between untreated forages and were increased substantially by alkali treatment (P < 0.001). There was a trend (NS) indicating an increase in rumen pool size with alkali treatment. The proportions of increases in intake attributable to digestion in the rumen were 0.83, 0.56 and 0.33 for O, W₁ and W₂ respectively. This indicates that when intakes of low quality roughage are increased by alkali treatment, the mechanisms associated with these increases differ between forages.

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* Department of Animal Husbandry, University of Sydney, Camden, N.S.W. 2570.