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Estimation of the dynamics of rumen water during the meal in sheep fed lucerne hay *ad libitum*

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Fitting the dilution curve of a liquid marker to an exponential model enables the volume of liquid in the rumen to be estimated with its turnover rate under steady-state conditions (constant volume) (Warner and Stacy, 1968). However, these conditions are not satisfied when animals are fed once or twice a day. We propose a mechanistic interpretation of the dilution curve of a liquid marker during the meal when rumen volume increases.

Four rumen-fistulated wethers had free access to lucerne hay for 6 h per day. They were dosed with 300 ml Cr-EDTA 2 h before feeding and rumen fluid was continuously sampled over an 8-h period to measure Cr concentration (C) every 15 min. Feed intake, water consumption and rumen motility were simultaneously recorded. During the following 2 wk the volume of water in the rumen was estimated by manual emptying 0, 2, 4 and 6 h after feeding (Baumont, 1989). Rumen water outflow was assumed to be proportional to motility and water inflow to feed intake.

For a meal lasting from time O to T, the liquid volume (V) and the amount of marker in the rumen $(V \cdot C)$ varied according to the following equation:

$$V_T = V_0 + (k_1 \cdot FI) - (k_2 \cdot NC) \qquad [1]$$

$$V_T \cdot C_T = (V_0 \cdot C_0) - k_2 \cdot \sum_{t=0}^{t=T} NC(t) \cdot C(t) \qquad [2]$$

where FI is feed intake and NC the number of contractions. From V_0, V_T, the intake and motily kinetics, k_1 (net inflow of water in ml/g ingested) and k_2 (outflow in ml/contraction) were calculated (5.22 for k_1 and 6.08 for k_2) and then V and C for each time step (5 min) using equations [1] and [2].

The predicted dilution curves matched the observed curves well (mean of the differences ± SD = 4.21 ± 2.92%) and the model was able to predict the non-linear increase in rumen volume during the meal (mean of the differences ± SD = 2.67 ± 2.78%) (fig 1). However during the first h, the lower decrease of C than had been predicted may be related to the absence of water consumption during the first h after feeding. This approach can be useful for mechanistic modelling of rumen function under non steady-state conditions.

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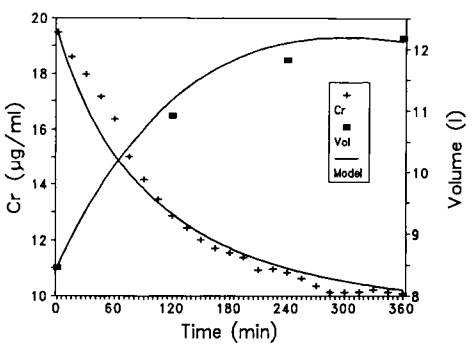

Fig 1. Observed values of Cr concentration in the rumen (Cr) and rumen water volume (Vol), and predictions of the model (—) during a 6-h lucerne hay meal (mean values of 4 sheep).