

Continuous monitoring of ruminal pH and redox-potential in dry cows using a novel wireless ruminal probe

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Introduction The metabolic activity of ruminal bacteria depends largely upon pH and redox-potential (Eh, Marden *et al.*, 2005). If these are not measured correctly, i.e. under strictly anaerobic conditions, they can be a source of a considerable error. These measures have been previously performed using (i) potentiometry on rumen fluid samples collected by an oral probe, (ii) by rumenocentesis, (iii) from a rumen cannulae using suction-strainer devices (Duffield *et al.*, 2004) or measured directly in the rumen through a sealed rumen fistula (Barry *et al.*, 1977). In the recent study of Marden *et al.* (2005), pH and Eh values were measured by means of an adapted *ex vivo* method of sampling and measurement. To our knowledge, there is no study with direct long-term measurement of Eh within the rumen. Thus, the aim of this study was to continuously monitor ruminal pH and redox-potential of individual dry cows using a newly developed wireless device.

Material and methods Three dry Holstein cows fitted with rumen cannulas were used for the measurement of ruminal pH and Eh using a newly developed wireless device. The measurement was carried out over a period of 14 d (10-d preliminary period and a 4-d experimental period). Cows were fed on a diet of maize silage (477 g/kg), lucerne hay (416 g/kg) and concentrate (107 g/kg). The diet was fed as a TMR in two equal portions (6:30 and 16:30 h). Ruminal pH and Eh was monitored using a novel wireless device consisting of a measuring probe anchored to the cannula lid via an antenna cable. The probe was composed of a hermetically sealed cylindrical stainless steel enclosure with the front and end plate covered (Antico, Pohofelice, Czech Republic). At the end cover there was a cable grommet to allow the passage of an antenna cable which was exteriorised from the rumen through the cannula lid and attached to a transmitter. In the front cover there were cable grommets for passage of a combined glass electrode with a reference gel electrode and redox-potential platinum electrode (Elektrochemické detektory, Ltd. Turnov, Czech Republic). The data measured within the rumen was wirelessly transmitted from the probe antenna to a receiver via an interface and USB port connected to computer. Ruminal pH and Eh were measured every 20 s and averaged over 15-min intervals. The probe was inserted into the ventral sac of the rumen of each cow through the cannula on day 10 of the preliminary period. Ruminal pH and Eh were measured continuously during between-feeding interval (i.e. for 11 h, starting at 06:00 h). Data were analysed using model: $Y_{ij} = \mu + C_i + D_j + T_k + \varepsilon_{ijk}$, where μ = general mean, C_i = effect of cow ($i = 3$), D_j = effect of day ($l = 4$), T_k = effect of time ($k = 44$), ε_{ij} = residual error.

Results The mean ruminal pH was almost identical in Cows 21 and 26 being 6.80 and 6.83, respectively. The pattern of ruminal pH as presented in Figure 1 showed similar trend in all cows, with the rapid drop in pH value during 3 h postfeeding. The mean Eh of the ruminal fluid in Cow 21 was -275 mV and was lower than measured in Cow 25 (-268 mV, $P > 0.05$). The mean Eh in Cow 26 was -272 mV and did not differ from the other Cows. Diurnal pattern of ruminal Eh is presented in Figure 2. The Eh values of the rumen fluid showed similar trend in all Cows and were low before feeding and then increased, reaching a maximum 1 h after the feeding, after which they decreased until the subsequent meal.

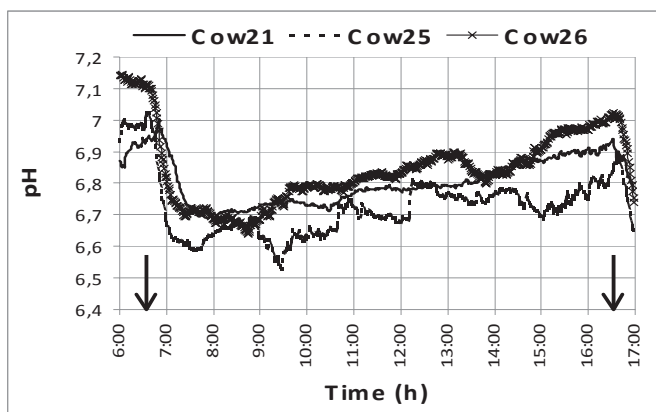


Figure 1 Effect of cow on the diurnal pattern of ruminal pH

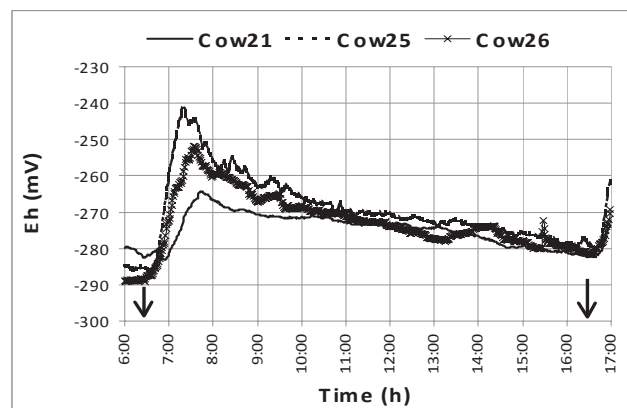


Figure 2 Effect of cow on the diurnal pattern of ruminal Eh

Conclusion This device allows the continuous, long-term measurement of ruminal pH and redox-potential remotely under strictly anaerobic conditions.

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References

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