Continuously Monitored Reticuloruminal pH: What is normal, what is abnormal, and which abnormalities should we worry about?

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The pH of the reticulorumen in cattle has been linked to a variety of clinical diseases as well as production efficiency. Assessment of the pH was historically based on a small number of directly observed measurements, but more recently rumen bolus devices have made it possible to continuously monitor reticulorumenal pH over a period of several weeks or months. However, the challenges associated with summarising and evaluating the resulting data have not yet been sufficiently addressed. We obtained remotely sensed pH data from a total of 93 dairy and beef cattle from 8 dairy farms with milking frequency three times daily (Farm set A), 5 with milking frequency twice daily (Farm set B), and beef animals under 3 dietary regimes (Farm set C), over a time period of up to 50 days per individual animal. The data from each animal was individually fit to a non-linear model to describe the predictable variation in observed pH due to diurnal patterns, and a generalised additive model to describe the variation representing longer-term trends in the pH data. These models were used to compute the residual deviation from the expected pH pattern for each day of observations. A subset of 24 lactating animals from a single farm in set B were then used to examine the relationship between various summary measures of this pH deviation and the next day’s daily milk yield in the same cow. The results show a consistent pattern of predictable pH, although the patterns are more consistent within groups of animals (Figure 1). Predictable pH variation is able to explain typically between 25-75% of the total variation in observed pH. Using these predictions, the mean of the absolute residual deviation in the observed pH was significantly positively associated with future milk yield (p=0.002). Our results suggest that deviation from predicted reticuloruminal pH cycles could be a useful predictor of future subclinical disease.

![Figure 1](image_url): The predictable daily variation in pH obtained from fitting a non-linear model to data from 93 animals from 14 herds.