Ruminations on the rumen: rumination and acidosis

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Ruminant industries are really in the business of growing bugs – the efficient production of protein from the rumen is pivotal to profit. The role of rumination is important in providing an ideal environment for the breakdown or escape from the rumen of carbohydrates and proteins and their re-incorporation in the products of fermentation and microbial protein synthesis. We now have real-time insights into rumination behaviour in cattle with the advent of wearable monitoring systems. There are at least eight monitoring systems that report rumination available in New Zealand or Australia which suggests a strong need to be cautious about interpretation.

Interpretation will be best applied to a specific farm and deviation away from the herd or cow mean will be the best metric for interpretation. This is more important when differences in breed (Holstein ruminate more than Jersey) and age, older cows ruminate more than parity 1, are considered. The following Figure 1 provides estimates of rumination rates obtained from some of the herds Scibus works with and from the literature to give an indication of expected rates.

Use of these data will be enhanced by applying epidemiological considerations and observation. By use of other tests in parallel or in series, you can increase the sensitivity or specificity of an observation. This is a key application as decreases in rumination rate are associated with metabolic diseases (subclinical hypocalcaemia, subclinical ketosis), retained placenta, metritis, mastitis and lameness.

A difference of 70 below herd mates in rumination rate after calving was associated with disease incidence and cows with low rumination before calving were more prone to disorder. Further, lower rumination rates after calving have been associated with lower production. Changes in rumination with calving onset provide an alert for calving.

The rumination data are a non-specific but useful tool for screening for disorder. Figure 2 shows the distribution of mean daily rumination rates for a herd for 40 days during a period with some heat stress and heat does reduce rumination rates.

Figure 1. Average rumination rates per day for Scibus herd data and reports from the literature.

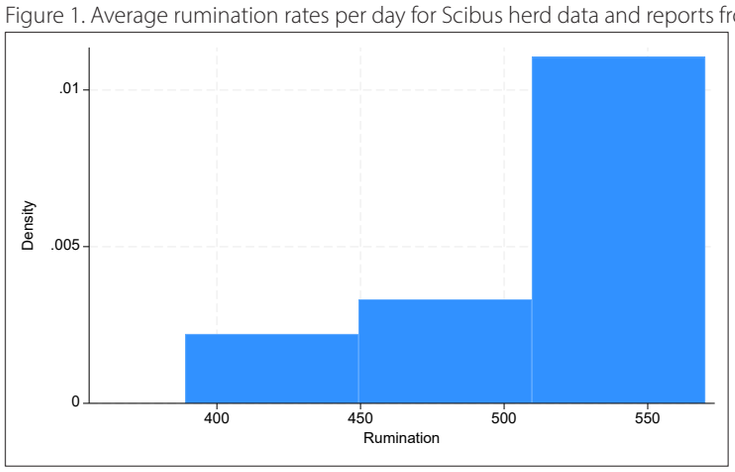
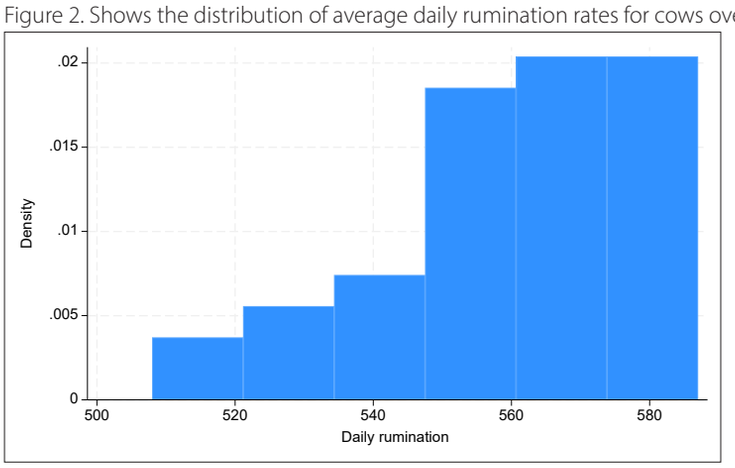


Figure 2. Shows the distribution of average daily rumination rates for cows over 40 days during a period with heat stress.



As New Zealand intensifies dairy production, ruminal acidosis will become more important to understand, however, this is a condition that occurs on pastures and crops alone. Ruminal acidosis occurs as a continuum of disorders, stemming from ruminal dysbiosis and disorders of metabolism, of varying severity. The condition has a marked temporal dynamic expression, resulting in cases expressing quite different rumen concentrations of VFA, lactic acid, ammonia, and rumen pH over time.

Clinical ruminal acidosis is an important condition of cattle and subclinical ruminal acidosis (SRA) is very prevalent in many dairy populations, with estimates between 10% and 26% of cows in early lactation. Estimates of the duration of a case suggest that the lactational incidence of the condition may be as high as 500 cases per 100 cows in the first 100 days of lactation.

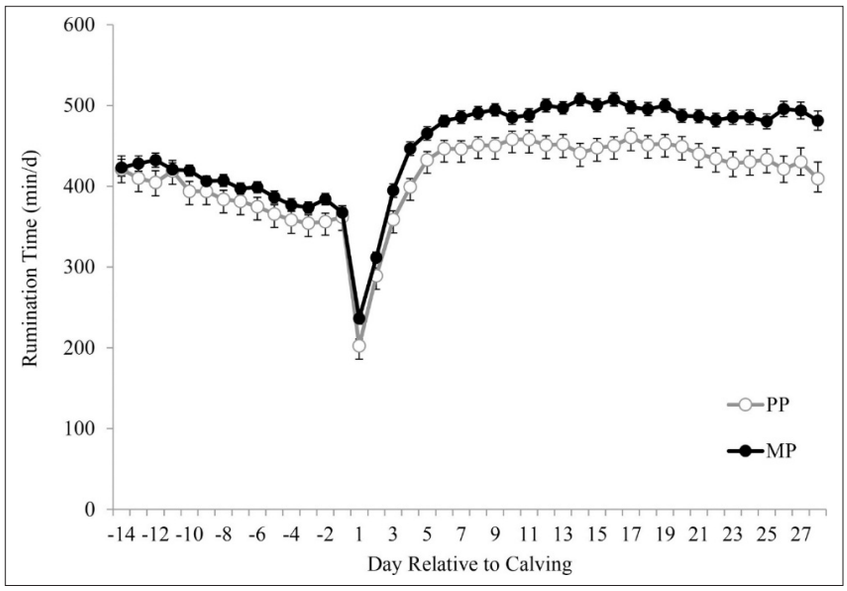
Historical confusion about the etiology and pathogenesis of ruminal acidosis led to definitions that are not fit for purpose, as acidic ruminal conditions solely characterized by ruminal pH determination at a single point fail to reflect the complexity of the condition.

Use of a model based on integrated ruminal measures, including VFA, ammonia, lactic acid, and pH, for evaluating ruminal acidosis is fit for purpose, as indicated by meeting postulates for assessing metabolic disease, but requires a method to simplify application in the field. Although it is likely that this model, which we have termed the Bramley acidosis model (BAM), will be refined, the critical value in the model is that it demonstrates that ruminal acidosis is much more than ruminal pH.

Disease, milk yield, and milk composition are more associated with the BAM than rumen pH alone. Two single VFA, propionate and valerate, are sensitive and specific for SRA, especially when compared with rumen pH. Even with the use of such a model, astute evaluations of the condition, whether in experimental or field circumstances, will be aided by ancillary measures that can be used in parallel or in series to enhance diagnosis and interpretation.

Sensing methods, including rumination detection, behavior, milk analysis, and passive analysis of rumen function, have the potential to improve the detection of SRA; however, these may advance more rapidly if SRA is defined more broadly than by ruminal pH alone.

Figure 3. Rumination time and day relative to calving (https://www.cambridge.org/core/journals/journal-of-dairy-research/article/abs/rumination-time-as-a-potential-predictor-of-common-diseases-in-highproductive-holstein-dairy-cows/9A2FF90F0467278B322DBBEC854897AC)



References

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