The eCow Farm Bolus
Facilitates objective, non-invasive, assessment of rumen health
Mole Valley Feed Solutions understands your needs and is always looking for ways to encourage greater efficiency and productivity to add value to your enterprise.

Our continued investment and research allows us to develop new products and services tailored to you. Currently, Mole Valley Feed Solutions is working in partnership with Exeter based business eCow to develop boluses that measure rumen pH and temperature.

We have trialled the use of this technology to enhance our understanding of rumen function and key management factors of the dairy unit. This booklet highlights the findings of our trial period and explains the benefits of investing in this world-first technology exclusively available to livestock farmers through the Mole Valley Farmers Group.

Sub Acute Ruminal Acidosis (SARA)

SARA is defined as a period of moderately depressed ruminal pH, which does not cause a cow to become ill in the short term but instead leads to long term losses in productivity and longevity. This happens because the acidic conditions in the rumen damage the rumen wall and kill the microbes necessary for digestion.

The toxins released from this unhealthy rumen can cause laminitis and other conditions like mastitis may become more common. Whilst the benefit of the pH bolus goes well beyond SARA diagnosis, management of this condition is none the less greatly enhanced by the pH bolus.

Up until now vets and nutritionists only had clinical signs and invasive needle sampling to use for diagnosis and the nature of the condition left many unanswered questions. We now see why when we look at the pH bolus data and see how variable the pH and symptoms of SARA can be.

Not only are the boluses helping us eliminate SARA from commercial dairy herds, but they do so by revealing many of the management factors causing SARA. Reducing SARA by correcting the management at cow level increases milk production at the same time as eliminating SARA. More traditional approaches of just adding straw have their place, but are often at the expense of production.

pH boluses represent an exciting opportunity for everybody engaged in facilitating change on dairy farms. It is generally acknowledged by veterinarians and nutritionists that rumen pH is a parameter of utmost importance to keep a healthy rumen. Dramatic increases in milk yields in the last few decades, and new feeding systems, have implications for both rumen pH and rumen microbial health which ultimately will have an impact on dairy cow health and production. For example, SARA is an insidious, yet severe production-limiting condition that is associated with an increase in unexplained deaths, low productivity, high rates of lameness, low body condition score, diarrhoea, and, in some instances, pulmonary thromboembolism and haemoptysis (coughing-up blood).

Rumenocentesis (extracting ruminal content by rumen puncture or stomach tube) has been until now the only diagnostic procedure used to evaluate pH and protozoal activity in the ruminal fluid. Rumenocentesis is a common procedure that we use at Molecare Farmvets as part of our Rumen Health Visits giving us very useful information about rumen functionality and allowing us to diagnose SARA at herd-level. The main disadvantage of this procedure is it only gives us a snapshot of the rumen pH at the time of collection yet we know that the timing of rumen fluid collection in relation to feeding will also affect the rumen pH.

So until now we did not have a reliable indicator to tell us exactly what is happening in a cow's rumen over time. This new technology pH bolus data will be extremely useful to evaluate how ruminal pH and temperature changes during the day and in different systems. In practice this information could help us to:

- Evaluate changes in the diet formulated or in nutritional management. Cow signs (including pH of the rumen, body condition score, faecal sieving and scoring, rumen fill scoring and cudding) and cow outputs (milk records and metabolic profiling) will tell us if a diet or a nutritional management change is cost effective and improves health and production of the herd.
- Detect a SARA problem or illness at a herd level.
- Improve water trough and water uptake management. The pH bolus also provides information about changes in rumen temperature and water uptake so we can manage this very important factor that influences dry matter intake and milk yield.

In conclusion, pH boluses give the farm advisor live information of pH level and temperature in the rumen. That helps us to make decisions to ensure pH levels stay within the optimum range in order to increase feed efficiency on farm. Do not forget that the cow is the ultimate judge of a diet or a management change. Knowing the dynamic pH level allows us to see how the cows respond to the diet she actually eats. This can be very different to the diet on the nutritionists’ computer or the diet the farmer feeds!
The pH bolus has been developed by eCow (www.ecow.co.uk), a family run company based in Exeter. eCow was founded by Professor Toby Mottram of the Royal Agricultural University, Cirencester to design and build technology for modern dairy farming. The pH bolus is the result of a project that was started in 2003 and has undergone multiple design alterations and improvements to maximise life and durability all culminating in the product we have today.

About the bolus:
- Administered orally
- No larger than a worming bolus
- Sits within the reticulum
- Records pH and temperature every 15 minutes
- Downloaded by handheld device in 2-3 minutes
- Transferred to laptop for analysis

We are sometimes asked about the positioning of the bolus. It is weighted to sink into the reticulum, but as it is actually rumen pH that we want to monitor and we know from research that rumen pH is 0.25 units lower than the reticulum this is corrected for. Therefore the rumen acidosis threshold of 5.6 is translated to 5.8 in the reticulum and this is the threshold represented by a red line on graphs produced by eCow. A total time under this line is also produced on the graphs to indicate whether or not there is likely to be an underlying problem with SARA - a little time below the line is often insignificant, more sustained periods are the serious problems.

The eCow pH Bolus

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The bolus can be used to:
- Avoid onset of acidosis through early warning
- Keep high yielders performing and identify any potential for more litres through diet
- Help identify management issues which may lock up yield potential through irregular routine
- Justify the use and cost of rumen buffers and yeasts
- Monitor cows through calving and the transition from dry cow to milking cow ration
- Monitor problem groups
- Illustrate the suitability of feeds

Below is a graph of an example pH reading using the bolus. The green area is classed as the safe zone with regards to acidosis/SARA and the red zone represents the 5.8 pH line which we class as the acidosis risk zone. Cattle are not immediately at risk of acidosis when they drop below the line and it is dependent on the amount of time spent in the risk zone. Cows that spend >5 hours/day under the red line are at a significantly higher risk of SARA/acidosis.

Key benefits of the eCow pH bolus:
- Longest life bolus available with reliable data for up to 5 months
- 28 days of data storage on the bolus
- Smallest bolus available to measure rumen pH and temperature
- Accurate, stable pH sensor providing quality data
- Real time monitoring of changes in diet and condition

Changes in pH and temperature can be cross referenced with the existing records to measure the effect of diet and management on rumen function. This information directs whether changes need to be made to raise the pH for cow health and efficient fibre digestion, or alternatively when the pH is high, more high energy feeds can be fed resulting in more milk and better fertility. Management and dietary options can then be constantly considered to either prevent pH depression or increase milk yield.
In 2013 we began rumen pH monitoring on farms throughout the South West. Here are some of the findings.

Systems Review - A major goal of the bolus trial was to examine a range of dairy production systems as operated in the South West. No one has monitored cows in this way on commercial dairies before and naturally the different patterns produced by different feeding systems were of great interest to us. The results have given us the edge in understanding the particular patterns and issues associated with individual farm feeding practice and this edge makes for better planned nutritional management.

Different systems monitored were:

**Dry cows and the transition period**

In most cases we have put the boluses into dry cows that are close to calving to monitor the transition onto the milking ration. This in itself brought about some interesting results.

- When reviewing dry cows pH activity we noted that cows left to their own devices like dry cows will fall into a regular feeding pattern.
- As you can see on the right, although the pH varies the feeding times throughout the day are repeated at similar times each day.
- In this case, drier less acidic silage was offered towards the end of the graph and this reduced the variation in pH.

- This graph is a continuation of the same cow.
- She calved on the morning of the 04/11/13 as shown on the graph which you can tell from the pH.
- Note the dramatic decrease in pH as she starts the milking ration.
- The variation increasing as she adapts to several changes including social, environment and diet.

**Total Mixed Rations**

The characteristic of this system on South West dairies is the provision of the entire daily feed all at once. Therefore we expect to see most intake, and so the largest pH fall after this feed. This is what we have seen; the fall associated with the morning feed makes for a regular daily pattern. Generally TMR feeding improves rumen pH. However several smaller feeds a day leads to a more stable rumen pH, this is also facilitated by pushing the feed up more often.

Timings have revealed their vital importance. Changes in this pattern have been associated with low rumen pH and lower milk yield as cows are slow to adapt. If cow events do not happen at the same time every day then this is a management change every day!

**Robots**

Cows on robotic systems are fed little and often, and allowed to develop their own behavioural pattern. Therefore what we have seen are little pH drops often. Important in this is the ability of the system to allow natural movement and behaviour in the cows. Issues of heat stress in July and overcrowding have had the biggest impact on rumen pH in the robotic milked herds.

**Grazing/Silage and Parlour Compound Feeding**

The classic pattern for this traditional British system is two dips each day, one post each milking as can be seen on the graph. It’s been interesting how much of this dip has been associated with the compound and how much the grazing. Generally it has been possible to attribute 40-50% of the pH drop on these farms to the compound feed and the remaining to the fresh forage the cows have eaten afterwards. It has been possible to reach this conclusion due to the variability inherent in South West grazing conditions compared to the constant parlour feed. Also see the low input grazing system results overleaf. Again this information is invaluable in helping us formulate compound feeds to complement the grazing and silage feeds for these cows.
Routine

When we think about the fact that a cow is designed to ferment feed, then it follows that she has many mechanisms to maintain a healthy environment in her rumen for microbes to flourish. She will naturally move to correct ration imbalances as we see from cows choosing to eat fibre or salt at certain times. But to be able to do this she must have an idea of what is coming and if faced with a constantly changing feeding routine it is logical that it will be difficult for her to reach equilibrium. The pH bolus trial results include daily average pH graphs. These have turned out to be a great way to compare a cows feeding behaviour over time. Compare the graphs on the right– the blue lines are each day super imposed on top of each other, the red is the daily average. The first cow has a more consistent routine and this order allows her to self regulate. The result is better rumen health and more milk. The second graph is from a cow who is struggling to find her routine and she has at times a low pH.

Low Input Grazing

These systems have shown the potency of high sugar grass leys. The results on the right show the effect on rumen pH of lush seed grazing in a rotation which includes older pasture. We are not saying reseeds are bad, far from it, instead the results here highlight the issue of variability in grazing provision causing cows adaptation challenges.

Partial Mixed Rations

Again a very popular system in the South West, and one which can be difficult to get right. Patterns for PMR have been more like TMR than parlour fed cows. The dynamics of getting the ingredients, mixing and timing of the morning feed right in these herds has been the main factor in rumen pH. (Timing in particular has been more important than perhaps appreciated previously.)

Results across all the systems;

pH falls are associated with intake of fermentable carbohydrate. Feeding cows for health and productivity needs a more perceptive appreciation of the rumen effects of all feeds than is currently practiced by many nutritionists.

The dynamics of feed intake are fundamental to stable rumen pH. Cows eating irregular quantities caused by variable feed timing, feed access or grazing quality struggle to maintain a natural regulation of their rumen pH. Cow management has as much to do with a stable and productive rumen as the diet formulation.

Targeted Additives

Does this cow need rumen buffers? She has a stable pH well above the level damaging to rumen flora. Here with the aid of the bolus readings we were able to remove the rumen buffer. Conversely, it may also demonstrate where it is possible to safely increase the level of dietary starch, with benefits for milk protein levels. We see this improvement in targeting of additive usage as a big financial benefit of commercial farm rumen pH monitoring.
**Variable Intakes**

Take the graph on the right for grazed cows with variable times of fence movement. The milk production (litres per cow per day) is also included. There was a milk response when the natural impulse of the cow to graze was best harnessed by grazing management. The big drops in pH correspond to the greatest intake of fermentable feed – in this case grass in the morning!

**Managing Intakes**

The grazing and parlour fed herd below introduced a grass silage buffer after evening milking. Within a couple of days cows had adjusted their intakes to be focussed on this buffer as their main meal each day. This intake information is invaluable in helping design feeding systems which are economically efficient in trying to get milk from the feeds available on farm.

**Testimonial**

The Parkhouse family farm 1000 acres on the south coast of Cornwall. Neil Parkhouse runs just over 500 Holstein cows averaging 10,500 litres, on the farm which are housed all year round and milked three times a day. Neil says “The beauty of the rumen bolus is that it highlights issues which might seem minor, but are actually significant to the cow and it is an extra tool to monitor efficiency whilst being less invasive than rumen taps. The bolus generates extra data, to confirm, or not, assumptions that might be made regarding feeding and the cows’ responses and they are helpful in understanding changes in performance relating to on farm events. Overall the rumen bolus is helping us to better understand rumen health and digestion generating quality discussion linking nutrition, management and health on the farm”.

**Summary**

- Objective, non invasive assessment of rumen pH
- Encourages increased output via enhanced forage utilisation
- Facilitates informed management and nutritional decisions
- Encourages quality discussions between producer, vet and nutritionist
- Cost effective with flexible payment options

For further information speak to your Mole Valley Feed Solutions nutritionalist.
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