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Dairy farm evaluation of rumen pH bolus data: identifying the benefits

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Abstract

Ruminal pH is an important parameter for nutritional status particularly of dairy cows and studies using rumenocentesis showed 25% of cows have rumen pH values below 5.5 pH. Since 2005, boluses measuring pH continuously and using wireless telemetry have been used for research purposes, mainly in fistulated cows. This paper reports the use of 120 rumen pH telemetry boluses on 30 farms in South West England in 2013/14. The farms were selected to represent a range of farm types from continuous grazing, through mixed grazing and concentrate feeding in a robotic milker to TMR fed continuous housed cows milked three times a day. The data were collected by a nutritionist visiting the farm regularly with a handset to download data, analysing feed and talking to the farmer about events that affected rumen pH. The pH data were recorded in the reticulum which has a pH level approximately 0.25 pH units above that in the ventral sac from which rumenocentesis was conducted. Fewer than 5% of recordings were below 5.75 indicating that SARA was not common in this sample of cows. The variety of responses to the rumen data will be presented as narrative case studies, they include one farmer saving 70 p per cow per day by removing a minor food ingredient from the diet that raised mean rumen pH and increasing the amount of night time feeding without affecting milk yield. In a grazing situation one farmer changed his fence moving routine which optimised rumen pH and raised milk yields. Several farms detected irregularities in rumen pH probably caused by changes in feed offered to the cows by different staff. Optimal pH values in different feeding systems will be discussed but the most important parameters to create pH targets for dairy farmers appear to be the daily range of pH, the mean daily pH, the number of feeds per day and detection of management changes.

Introduction

Reports of rumen wireless telemetry pH measurement boluses used in research have been available since Mottram et al. 2008. However, there have been no reports of the use farmers and their advisers make of rumen pH and temperature data. Existing methods for detecting SARA in commercial cows are based on either rumenocentesis or through use of a sampling tube (Tajik & Nazifi, 2011). Both methods are invasive and can only gain one data point from an unknown location within the rumen whereas the rumen pH was highly variable in time with up to 2.5 pH range through the day and varying spatially up to 0.5 pH units from top to bottom within the rumen (Gasteiner et al 2008) . The wireless telemetry bolus was intended to replace these crude techniques with a continuous recording of data from a fixed location within the rumen-reticulum thereby overcoming the variability in data. The study described here had the intention of both checking the operability of the bolus in farm conditions and the use the farmer and his nutritionist made of the data.

Materials and Methods

The boluses used were the farmBolus from eCow Ltd. The farmBolus was 115mm long by 26.5 mm diameter weighing 200g. The sensor end was made of stainless steel which inverts the bolus into a normally sensor down position in cows with a normal shaped reticulum. The electronics was encapsulated with a cold poured resin coat that has proved resilient against rumen liquor in trials and obviates the need for vulnerable seals. The sensor was a combined electrode pH probe routinely used in applications in industry. The temperature probe was embedded in the stainless steel end cap, which has machined holes to allow rumen liquor to flow past the sensor tangentially without permitting direct impact of stones or grit on the glass sensing bulb.

The weight of the bolus allowed it to remain in the reticulum for the life of the cow. The bolus contained no toxic materials at doses harmful to the cow. The bolus measured pH and temperature every 60 s and took an average value every 15 minutes and stored up to 2700 lines of data in a .csv format date, time, pH, temp, battery V, which was 96 lines of data per day stored over 28 days of data. If data was not collected the file on the bolus was overwritten from the beginning.

The bolus was administered by mouth with a standard bolling gun, the only restriction on operation was that a period of 2 hours should be allowed before reading for it to migrate to the reticulum. The bolus has a temperature switch which causes it only to activate when the temperature was above 31C, this enables a long shelf life. As with all pH sensors the device needs to be calibrated before use and the calibration was accurate for four weeks in normal storage. Once in the cow drift was said to be less than ±0.1 pH unit per 30 days but this was impossible to verify in non-fistulated animals. The radio frequency used was in the free to use ISM band, in this study we wanted to compare the utility of two available frequencies 433 MHz and 868 MHz and identify any operational issues with the different frequencies.

The nutritionist visited the farms of with an adapted mobile phone handset and stood near the cow on the left front side to download the data. The farmer inserted boluses in 2-3 cows often in the ante-partum period to monitor through the transition phase and early lactation.

Over 120 boluses were shipped to 30 farms in South West England in a collaboration between Mole Valley Farmers, eCow Ltd and the University. The farms were selected to represent a variety of systems found in this area from grass based low input/output systems to very high yielding continuously housed TMR systems.

Results and Discussion

The main conclusions from the field testing was that monitoring rumen pH gives unique insights into farm management practice and the data when matched to the events and circumstances on each farm can trigger major management changes to improve rumen stability.

Case 1. Farm with Low pHs (SARA)

This farm of 350 cows used a home mixed diet which used bread meal for fast release energy. The herd yield was over 12,000 litres and cows were milked three times a day, TMR was offered daily. Three boluses were inserted in lactating cows on 1st May. The boluses showed a strong daily cycle with high pHs at night and regularly dipping below pH 5.8 usually in the evening. This is the closest case we had to SARA as described in the literature.

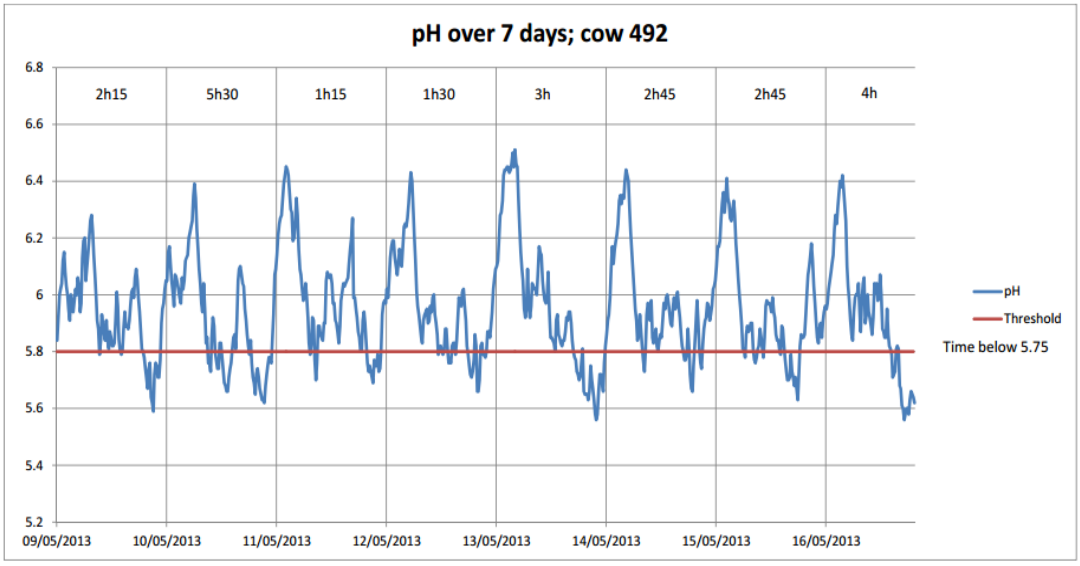

Figure 1The numbers above each day are the hours below pH 5.8

Removing the bread meal from the TMR very quickly brought the pH above 5.8 and also reduced the night time peak indicating that cows were eating little and often. There was no effect on milk yield but feed cost was reduced by 70 per cow per day.

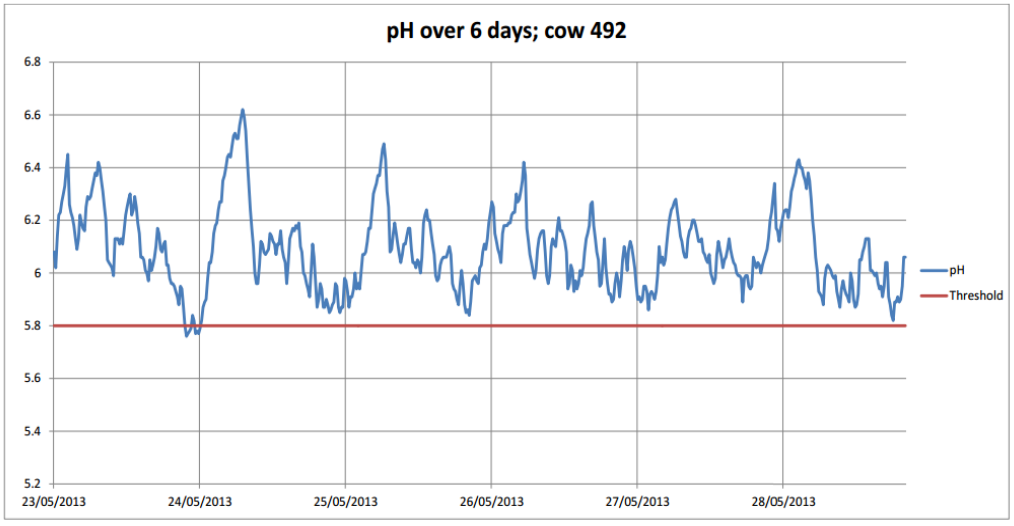

Figure 2 The same cow during and after the feed change showing how rapidly the rumen pH changed to a less dangerous level

Case 2. Farm with grass as the main feed

Some commentators assume that grass is the natural feed for cows, that may be so but not all grass is the same. On this farm which was predominantly grazed there was a major difference between pastures. Between 9/06 & 12/06/13 this cow was on new “high sugar” grass ley and then returned to one sown many years ago.

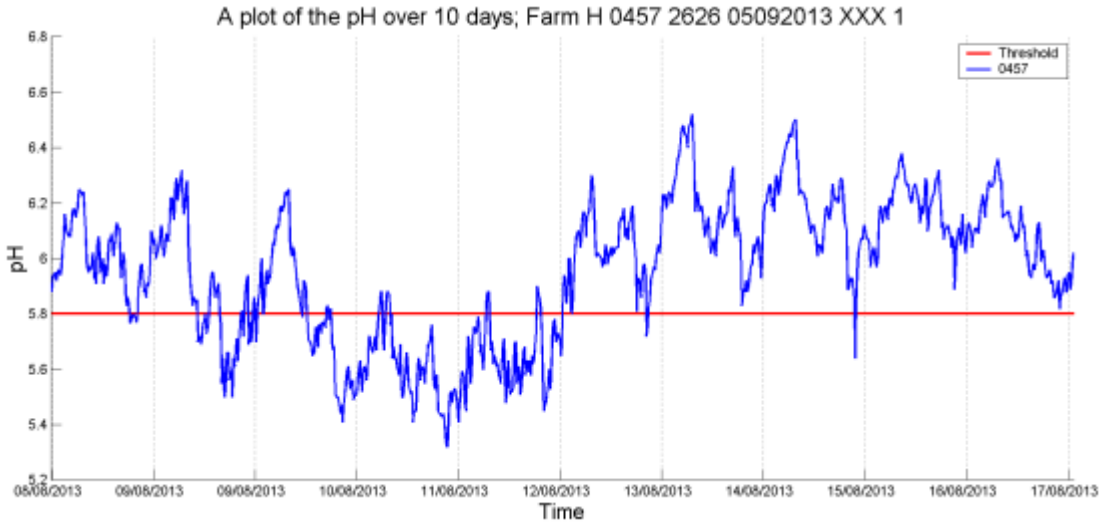

Figure 3 Digestible grass from a new high sugar ley can depress pH into the acidosis zone

Case 3. TMR feeding

This farm with a yield of 11,000 litres is milked 3 times per day (orange arrows) and main feed is distributed at 7 am. Feed is pushed up seven times a day (red arrows). The blue lines are the daily pH profile and the red line is the mean daily pH profile. Each push up stimulates an eating bout and a consequent dip and recovery of pH.

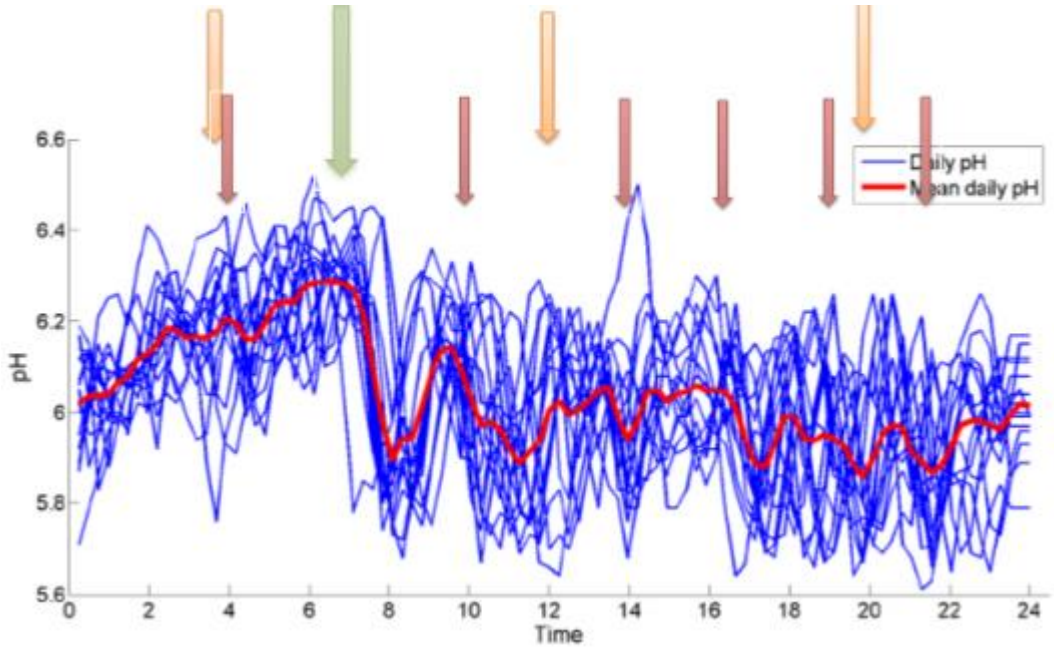

Figure 4 Blue lines are the daily pH, Red line is the mean value of pH over 10 days, Green arrow is the daily feed, orange arrows milkings, red arrows push ups

Case 4. Robotic Milking

We had several robotic milking farms and they all showed a very consistent pattern with regular shallow dips in rumen pH and a narrow range (0.4) of pH during the day.

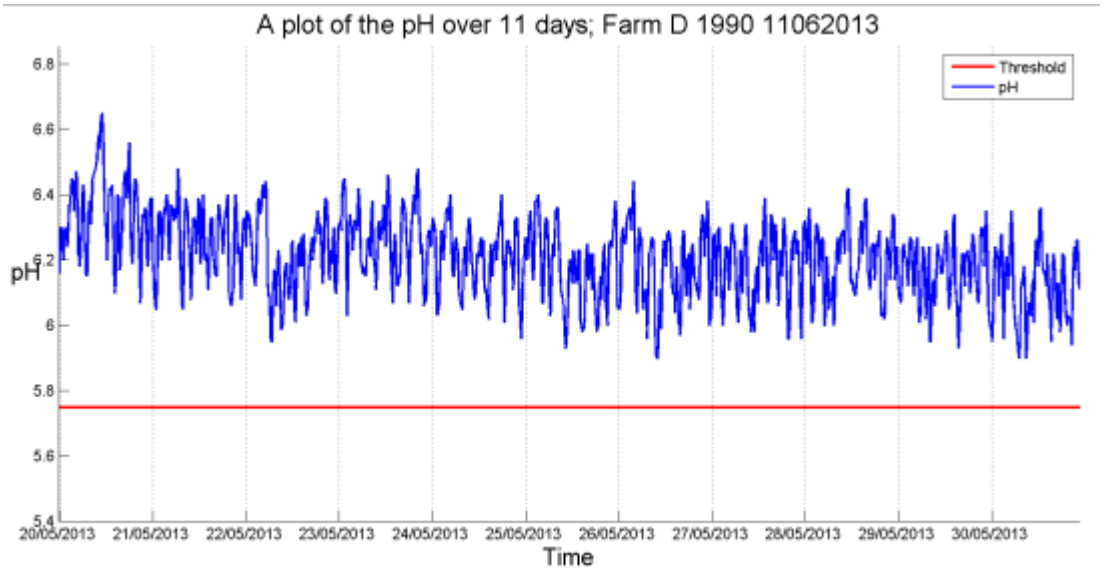

Figure 5An example of little and often concentrate feeding driven with plenty of activity at night

Case 5. Concentrate and Grass

This is a very traditional method of feeding and milking. The cows are fed at milking and then go out to grass leading to a twice a day cycle of rumen pH rise and fall with a daily range of 0.6 pH units.

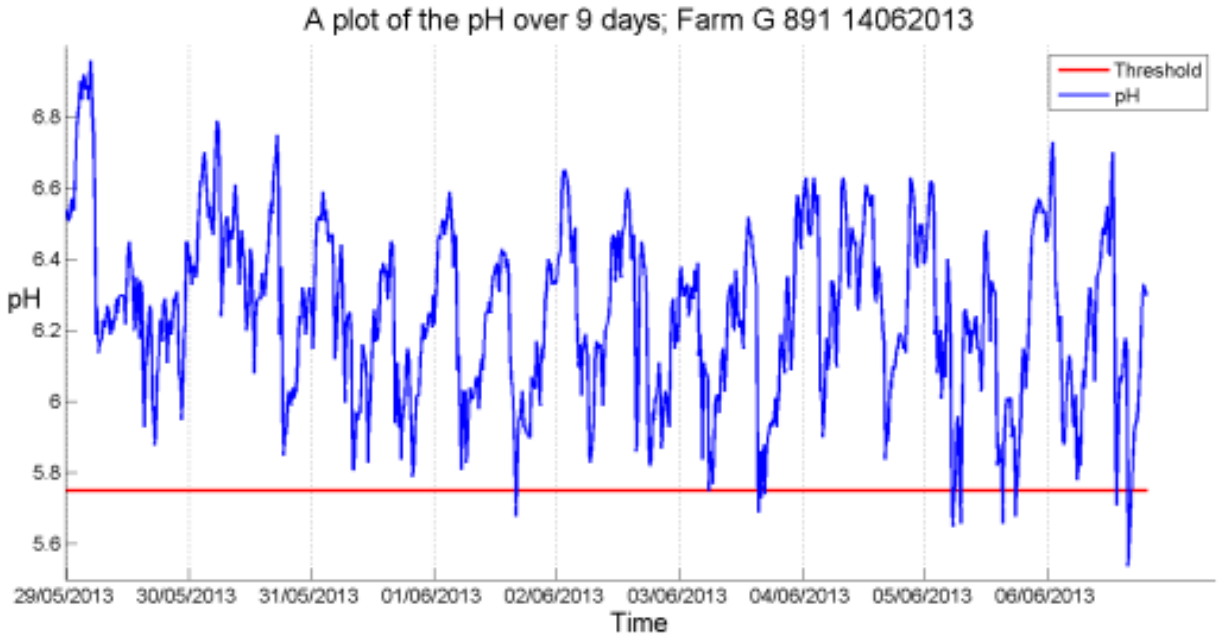

Figure 6 Twice daily dip in pH caused by the milking cycle

Case 6. Rumen buffer – is it always necessary ?

Veterinarians are convinced that high yielding cows automatically have SARA but we see no evidence of this in this study. Farmers are advised to feed acid buffer. Our data suggest that this is not always the case and a diagnostic should be performed before this expensive addition to diet is recommended.

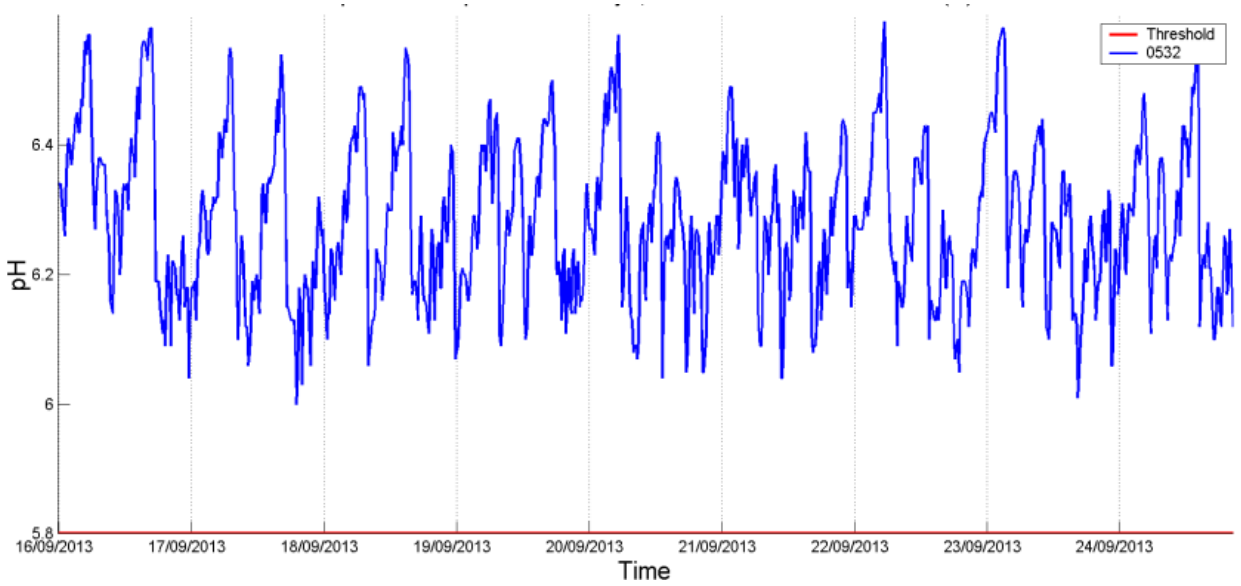

Figure 7This farmer was using rumen buffer, removing it made virtually no difference to pH levels

The main findings from this study is that few cows have pHs in the reticulum below 5.8 and by implication SARA was not found in this study. Each farm has specific management challenges and rumen pH monitoring permits farmers to make decisions better and earlier than waiting for milk yields to drop or health to deteriorate. The next stage is to determine optimum pH patterns and levels under different feeding regimes but by inspection it would appear that the main parameters to manage are mean daily pH level, daily pH range, speed of drop after a feed (energy density of ration) and the number of feeds per day.

The benefits of rumen pH are reductions in feed costs and a reduction in risk by identifying the immediate effects of management changes.

References

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