Preventing SARA

Maintaining dairy cow performance **by Alex Bach, PhD, DVM**

Subacute ruminal acidosis or SARA causes significant losses to commercial dairy producers in many countries. SARA is especially costly in intensively managed, high-producing dairy herds, with detrimental impact on milk yield, milk fat and protein, fertility, and foot health. Preventing SARA means controlling rumen pH, especially in situations that render cows susceptible to acidosis, including feeding high-concentrate diets, transition feeding periods, and periods of heat stress.

Recent research with high-producing dairy cows under 'real-life' conditions provides evidence of SARA prevention through live yeast supplementation. This work also helps in understanding the mode of action of live yeast and draws some interesting links between acidosis and cow eating behaviour.

What the producer notices

In cases of SARA, dairy farmers first notice effects on cow appetite as feed consumption and rumination decrease (see figure 'SARA effects'). They also notice changes in consistency of faeces, which can vary greatly from dry and firm to very liquid. Then, more dramatic consequences appear: A decrease in milk yield and quality, laminitis, and longer-term effects such as fertility and reproductive problems. By this time, the acidosis is well-advanced and effects of disease may be irreversible. On slaughter, the cow may show liver abscesses and other signs of disease.

A recent Danish study estimated that 22% of newly calved cows suffered from SARA. In Wisconsin, USA—one of the USA's leading dairy farming states—the incidence of SARA was estimated at 20% in 1999. While the decreases in milk production and weight gain due to SARA and acute acidosis are the most obvious economic impacts, the health-related costs also are important. A recent UK survey estimated the mean annual incidence of clinical lameness to be over 20 cases per 100 cows. A French survey estimated veterinary costs related to lameness and locomotive disorders to be around €11.1 per cow per year. This survey also estimated the costs of metabolic and digestive disorders linked to rumen condition at around €31.9/cow/year. Moreover, in the last 10-20 years, there has been a continuous decline in conception rate-to-first service. The associated financial loss has been more than €40cow/year.

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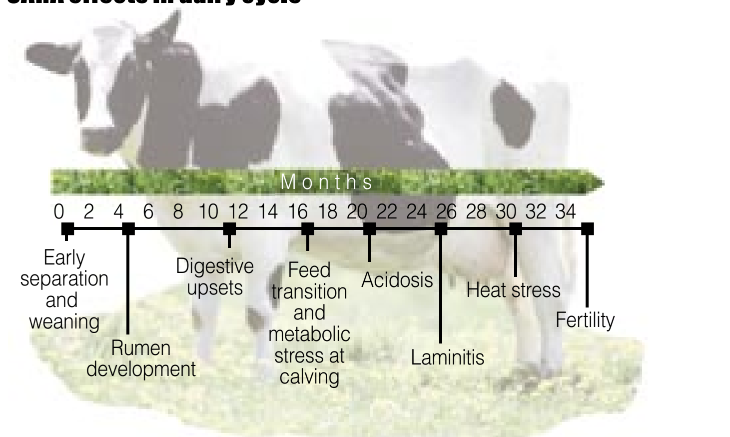
SARA effects in dairy cycle



Dairy farmers first notice changes in consistency of cow manure in cases of subacute ruminal acidosis. However, the condition can cause cow performance and health problems throughout the breeding and life cycles.

A US study added up the economic impact of SARA—measured in lost milk yield, reduced milk fat and protein, increased laminitis, and reduced fertility—to estimate the total cost in the range of €3,347-3.969 per cow per year (Stone, 1999). It is of paramount importance, therefore, to detect acidosis as early as possible, and to prevent it as much as possible. Prevention of SARA focuses on means to control rumen pH, especially in acidosis-prone situations.

Study under 'real life' conditions

Researchers have shown a close relationship between feed intake and rumen pH (Cooper, 1998). Between meals, rumen pH normally decreases. In the case of SARA, rumen pH is low, which affects the cow's appetite and reduces meal frequency. Reduced eating frequency and feed intake in turn further affects rumen pH. This downward-trending spiral can be referred to as the acidosis cycle.

To date, most of the research relating to rumen fermentation mechanisms has been conducted either *in vitro*, or in fistulated cows maintained in tie-stalls. However, most commercial dairy farms keep their cows in loose-house conditions. Eating patterns may be different in these conditions compared to cows in tie-stalls due to social hierarchy or competition for feed or other limited resources. Thus, rumen fermentation and pH also could be affected.

Diet composition

	TMR	Concentrate
Ingredient composition (% as fed)		
Ryegrass silage	60.0	-
Distillers dried grains	-	9.9
Alfalfa hay	9.1	-
Barley	-	3.3
Cottonseed whole	5.2	-
Citrus pulp	2.6	-
Corn	13.1	29.6
Soybean meal	3.7	29.6
Corn gluten feed	5.7	16.5
Soybean hulls	-	6.6
Molasses	-	2.0
Sodium bicarbonate	-	1.6

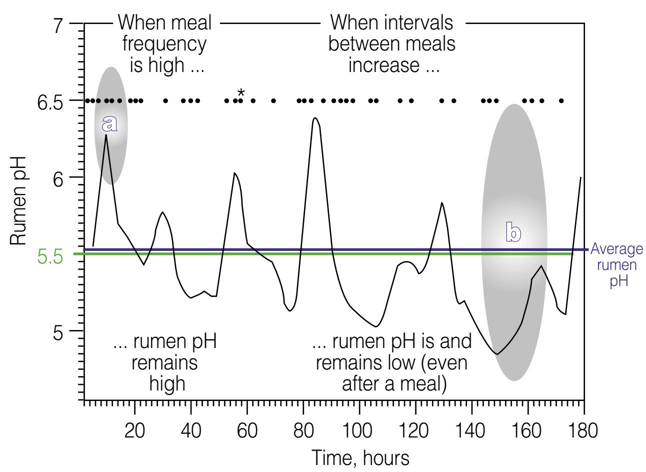
	TMR	Concentrate
Calcium carbonate	0.23	-
Dicalcium phosphate	0.05	-
Magnesium oxide	-	0.33
Salt	0.21	0.66
Micromineral-vitamin premix	0.05	-
Nutrient composition (DM basis)		
Energy†, Mcal/kg NE_L	1.56	1.89
Crude protein, %	15.6	25.8
Ether extract, %	4.9	2.9
Neutral detergent fibre, %	35.4	21.7
Acid detergent fibre, %	20.7	11.2
Absorbable calcium, %	0.4	0.2
Absorbable phosphorous, %	0.3	0.4

Diet composition of IRTA-Barcelona trial, showing concentrate and total mixed ration. *Note: TMR (total mixed ration); DM (dry matter); NE (net energy for lactation).*

A recent research project at IRTA-Barcelona sought to account for key parameters of commercial production, studying rumen pH and cow appetite in dairy cattle kept in 'real-life' conditions of loose-housing. The project also measured the effect of live yeast supplementation on rumen pH and cow appetite under these conditions (Bach, 2005).

This work required a new approach in monitoring rumen pH in real-time with limited disruption of cow behaviour. Earlier experimental protocols had involved fistulated, immobilised cows, while in this study, canulated cows were used and kept in loose-house conditions. A specially-designed system allowed researchers to record pH fluctuations within the rumen every 15 minutes, using an automatic pH meter which was placed inside a custom-made PVC cylinder, maintained in the rumen through a canula.

In the IRTA-Barcelona study, three multiparous lactating rumen-canulated cows kept in loose-house conditions received the same basal high-energy ration (36% non-fibre carbohydrates, see table 'Diet') once daily. In a cross-over experimental design, the cows' diet was supplemented or not with live yeast *Saccharomyces cerevisiae* I-1077 (Levucell SC from Lallemand) for two periods of 2 weeks each, following a cross-over design. The three cows were placed in a group of 50 cows in total, with access to 28 feeding spaces. Cows were milked with a robotic milking system. During milking, the cows received 1.5 kg of concentrate (see table 'Diet'). Individual feed intake and feeding patterns were automatically recorded.



*Each feed intake is represented by a dot.

Meal frequency

Higher rumen pH—and lower risk of acidosis—is positively correlated to frequency of feed intake or 'meals'.

Feeding pattern and rumen conditions

The IRTA-Barcelona study confirmed the relationship between frequency of feed consumption and rumen pH (see figure 'Meal'), such that as time since the last 'meal' increased, rumen pH decreased. Thus, when meal frequency was high, rumen pH remained high—in the 'safe zone', even between meals. But, when the intervals between meals were longer, rumen pH was lower, and, even after a meal, the pH peak remained low.

When cows were supplemented with live yeast, the number of meals per day as well as the duration of meals increased, and the time between meals decreased (see table 'Live yeast' and figure 'Intervals'). Also, average maximum and minimum rumen pH were significantly higher for live yeast-supplemented cows than for non-supplemented cows (see figure 'Rumen pH'). In addition, the decrease in rumen pH observed in-between meals was less marked in live yeast-supplemented cows than in non-supplemented cows.

Statistical analysis of this trial showed that the percentages of time within the days with rumen pH below 5.6 and 6.0—conditions associated with SARA—were greater in non-supplemented cows than in live yeast-supplemented cows. Also, the areas 'under the curve' of pH 5.6 and 6.0 were greater in non-supplemented than in live yeast-supplemented cows. Therefore, the non-supplemented cows underwent SARA conditions for longer periods of time than live yeast-supplemented cows, and the SARA condition was more severe without live yeast supplementation.

Action of live yeast in the rumen

The modes of action of live yeast appear to be multiple in controlling rumen pH, based on work with the proprietary product used in the IRTA-Barcelona study and other studies (see figure 'Mechanisms'). These mechanisms appear to be primary:

- Live yeast supplementation controls rumen

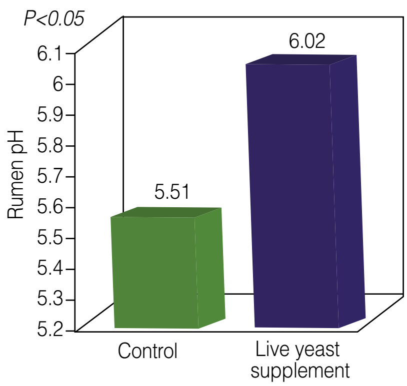
Live yeast supplementation

	Control	Live yeast product	P
Meal interval, hr	4.03	3.32	0.05
Meal duration, min	28.43	31.33	0.82
Total DMI kg/d	18.34	18.48	0.59

*Note: DMI (dry matter intake); live yeast product (*S cerevisiae *I-1077 as Levucell SC from Lallemand).*

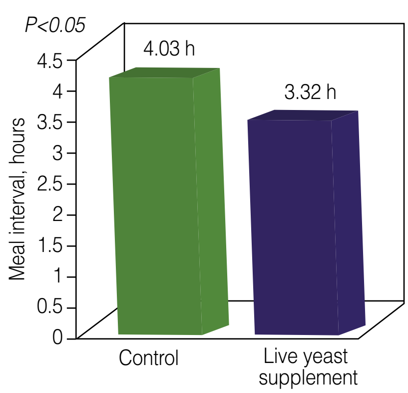
Effects of live yeast supplementation on feeding behaviour and feed intake.

Rumen pH with live yeast



Average rumen pH in cows with diets supplemented with live yeast (Levucell SC) and not supplemented (control).

Intervals between meals



Loose-housed cows fed diets supplemented with live yeast (*S cerevisiae* I-1077 as Levucell SC from Lallemand) ate more frequently and for longer periods.

pH by favouring the competition of lactic acid utilising bacteria (*Megasphera elsdenii*) over lactic acid producers (*Streptococcus bovis*), thus decreasing lactic acid production in the rumen (Chaucheyras *et al*, 2002); and

- Live yeast also improves fibre digestion in the rumen by creating conditions more favourable for the growth of certain fibre-degrading micro organisms in the rumen (oxygen and sugars uptake and supply of essential nutrients), thus speeding up passage of feed and increasing appetite and feed uptake.

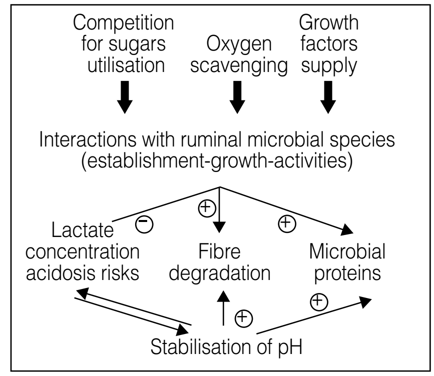
This latter mechanism could also explain the increased meal frequency observed in live yeast-supplemented cows, which, in turn, also helps control rumen pH.

Towards practical solutions for SARA

Studying diet-acidosis interactions under real-life conditions of commercial dairy farming informs our understanding of the benefits and modes of action of live yeast supplementation in SARA prevention. Such work also suggests some interesting links between acidosis and cows eating behaviour. In summary:

- Frequency of feed consumption or 'meals' appears to be an important factor regulating rumen pH—increased meal frequency seems to prevent conditions favouring acidosis;
- Live yeast supplementation can significantly increase meal frequency;
- Live yeast supplementation also can significantly increase average ruminal pH in practical, loose-housed conditions—this effect had been demonstrated repeatedly in fistulated cows; and
- Live yeast supplementation can improve average rumen pH within less than a week of supplementation and reduce the severity of SARA. ◄

Mechanisms of rumen pH reduction



Live yeast supplementation favours lactic acid consuming bacteria and fibre-degrading micro organisms.

A more detailed account of the IRTA-Barcelona study appeared in 'Effects of Live Yeast Supplementation on Ruminal pH of Loose-Housed Dairy Cattle' from the American Dairy Science Association Congress in 2005. For a complete list of references, contact Michel Vericat, Lallemand France, mvericat@lallemand.com.