The influence of a lignocellulose feed supplement on ruminal pH

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Unphysiological fast ruminal fermentation is one key factor for ruminal acidosis, not only for the acute form, but also for the subacute ruminal acidosis (SARA).

In a feeding trial with six fattening bulls the influence of two different inclusion rates of a lignocellulose feed supplement on ruminal pH was evaluated at LFZ Raumberg-Gumpenstein (agriculture academy and research centre, Austria). Lignocellulose is a feed component produced from fresh wood. In this special case the raw material was selected for its high level of natural amylase inhibitors. Amylase is an enzyme responsible for degradation of complex carbohydrates.

The target of using an amylase inhibitor is to slow down carbohydrate digestion avoiding production of excessive amounts of acids in the rumen. The effectiveness was monitored by intra-ruminal pH-sensors.

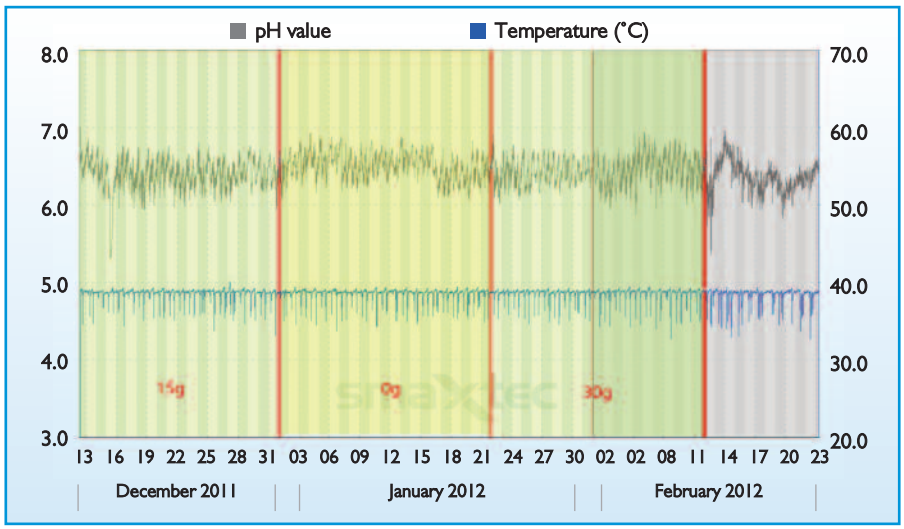

Fig. 1. pH and temperature curves with hardly any acidotic period.

Estimates of SARA cases

Field studies in the United States estimate that 19% of early lactating cows and 26% of mid-lactating cows are suffering from SARA. In Germany and The Netherlands approximately 11% of early lactation and 18% of mid-lactation cows are suffering from this digestive imbalance. SARA is characterised by an accumulation of volatile fatty acids in the rumen due to a fermentation process running out of control. Ruminal pH falls below 5.8 for minutes or hours.

The ruminal mucosa suffers from these acidotic periods; if the acidotic periods last for about three or four hours the mucosa integrity is impaired. As a consequence, permeability for bacteria, bacterial toxins like lipopolysaccharides (LPS) and biogenic amines increases. This process is suspected to trigger systemic inflammation and to promote liver damage and lameness.

Symptoms are infrequent rumination, decrease of milk quantity and fat content, diarrhoea, laminitis etc. Health, performance, fertility and life expectancy of the animals are affected.

The individual sensitivity for SARA varies between animals. Factors like feed intake and frequency, preference for certain feed components, saliva production, rumen microbiota (bacterial flora), rumen passage and others seem to play an important role with a hardly predictable influence in any individual case. It is worth mentioning that every single disturbance of rumen mucosa caused by an acidotic attack increases sensitivity for SARA in the future. Without any doubts, balanced ruminal fermentation avoids acidotic problems and maintains the physiological community of ruminal bacteria.

Table 1. Inhibition of rumen amylase by amylase inhibiting lignocellulose in vitro.

	Amylase activity in U/l		Amylase activity in
Time (mins)	Control	Test substance	% of control
60	209	129	61.7
90	212	153	72.2
120	197	149	75.6
150	211	159	75.3
180	204	153	75.0
210	194	163	84.0
240	181	167	92.3

Feeding trials

During the feeding trial all six fattening bulls were fed a feed ration rich in carbohydrates, basing on maize silage with hay and concentrate. Bulls were preferred to dairy cows to avoid an influence of milk production on the metabolic pool of lactic acid and volatile fatty acids. A 3 x 3 Latin Square trial model was used.

The entire trial period was nine weeks, one experimental period lasted for three weeks so that each animal was fed without lignocellulose (control period) and received the lignocellulose supplement on top at a dosage of 15g and 30g per meal (30g and 60g per day), respectively.

During the entire trial ruminal pH-sensors were used. The sensor is 132 x 35mm and is administered through a balling gun into the rumen.

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Due to its weight the sensor remains at the bottom of the reticulum where it measures ruminal pH and temperature in intervals of few minutes. Several times a day data are transmitted to a PC where data are finally recorded. The appropriate software is able to generate pH and temperature curves for any requested time period.

The product tested in this trial was a special form of lignocellulose (from fresh wood) selected for its high amylase inhibiting properties. In a first step the feed material was tested for its rumen amylase inhibiting activity in an in vitro trial.

Rumen fluid from a fistulated bull was divided into two samples. One sample was mixed with the test substance in a magnetic stirrer at a temperature of 39°C for a period of one to four hours. The other sample of rumen fluid, the control, was treated in the magnetic stirrer without adding test substance.

Every 30 minutes amylase activity of both samples (trial and control) was measured in an ELISA test system. In the first three hours after application the test substance inhibited the amylase activity in vitro by at least 25% (Table 1).

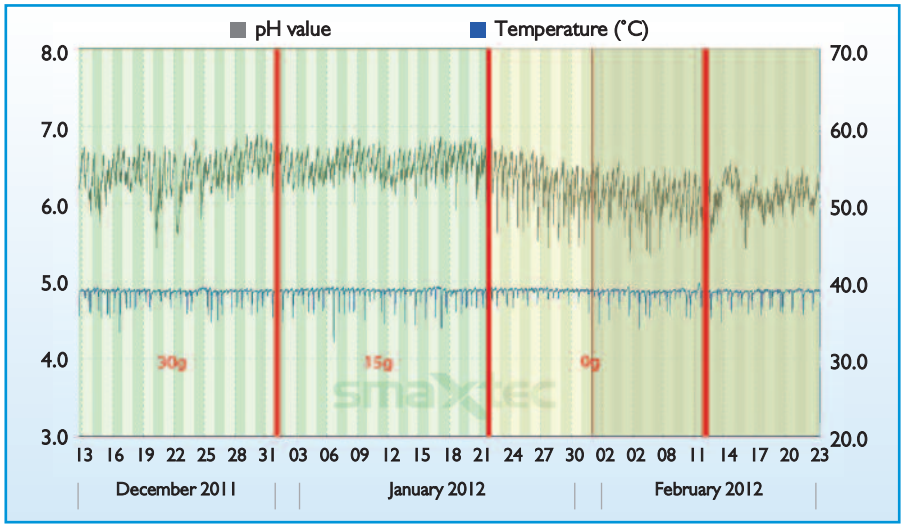
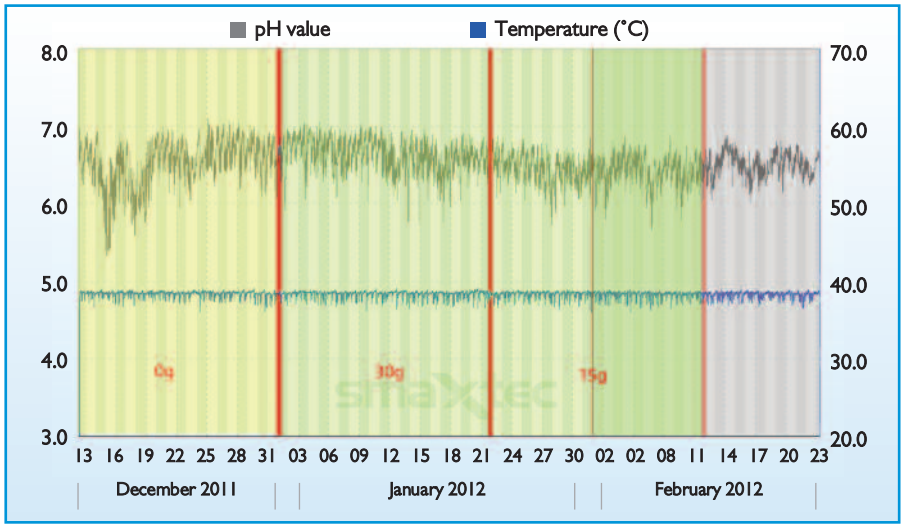


Fig. 3. Stable pH curve over 6.0 with lignocellulose supplementation, decrease of pH during control period.

Regarding the in vivo effects of the test substance it is important to mention that the amylase inhibiting effect is activated (triggered) by a decrease of pH, so that the product takes its full effect mostly in animals being actually under critical conditions of rumen pH.

Fig. 2. Constant pH during trial periods and slightly more acidotic incidents without lignocellulose supplementation.



In the described feeding trial the evaluation of the pH curve showed remarkable individual differences between the six animals. Two animals showed pH curves constantly over 6.0 unaffected by the carbohydrate-rich diet (Fig. 1). One animal showed constant pH during the trial periods and slightly more acidotic incidents during control weeks (Fig. 2). One animal clearly profited from the supplementation of amylase inhibiting lignocellulose.

The pH curve of this animal was stable during trial periods and decreased remarkably in the following control time (Fig. 3). Two animals showed uncharacteristic curves.

Data from this trial needs to be statistically evaluated which will allow a more scientific interpretation. In future, field trials with dairy cows will evaluate effects under practical conditions.

The use of a lignocellulose with amylase inhibiting properties in ruminant feeding could be a new, innovative concept to fight imbalances in rumen fermentation leading to problems like SARA. First reports from practice are promising. ■

References are available from the author on request