

Acidosis and rumen health: a key challenge for precision farming

Rumen acidosis is recognised by nutritionists and livestock producers as a major nutritional disorder with many consequences on cattle health and performance. Even with its huge economic impact, rumen acidosis is not fully understood.

Report from the first Acidosis and Rumen Health satellite conference at the 10th International Symposium on the Nutrition of Herbivores (ISNH), Clermont-Ferrand, France, 2018.

The first international conference dedicated to acidosis and rumen health was recently co-hosted by Lallemand Animal Nutrition and INRA. The event gathered renowned international experts to 'put the pieces of the puzzle together' and look at new data on this real profit killer.

Professor Giulio Cozzi from the University of Padova, who chaired the seminar, showed how the number of scientific publications on the topic has exploded over the past decade. Today, this increased body of scientific data makes the definition of acidosis both more complex and better understood.

The conference clearly established that acidosis is a multi-factorial challenge, which originates in the rumen as a microbial imbalance and has many effects on the homeostasis of the entire gastrointestinal tract as well as on host physiology and behaviour. Practical outcomes were also discussed in terms of feeding management and nutrition to help mitigate the risks at the farm level.

Diagnosics: More than just pH

Sub Acute Rumen Acidosis (SARA) is a disorder of the rumen microbial ecosystem. Rumen pH is a classic indicator of SARA. Research has shown that rumen pH must not be considered as an absolute, or average, value but as a dynamic dimension. Today, the development of new wireless sensor technologies (rumen pH and temperature boluses) offers new opportunities for early detection of rumen

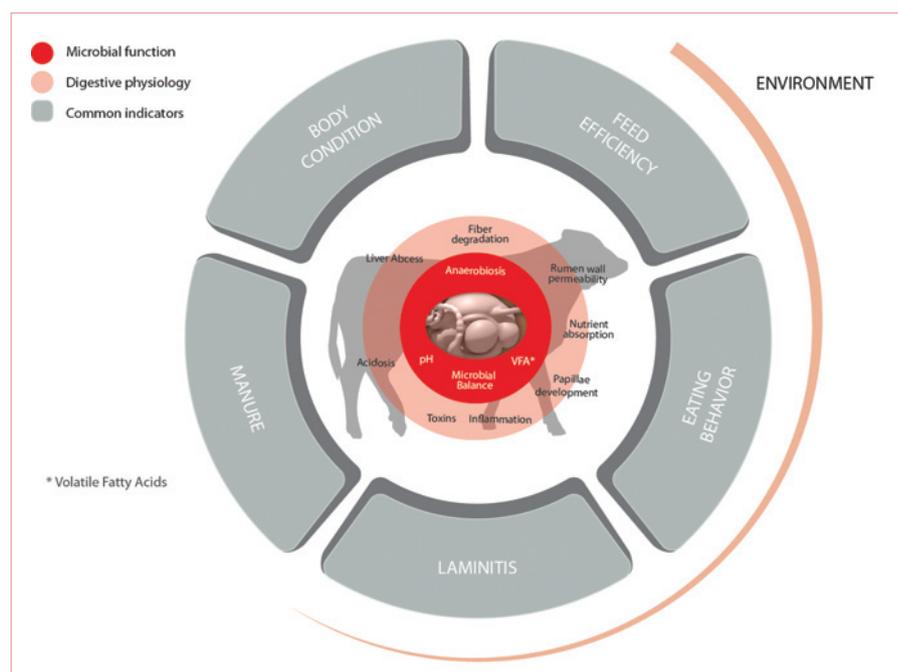


Fig. 1. Direct and indirect consequences of rumen challenges on animal nutrition and health.

health risks on the farm. Thanks to this technology, Dr Clothilde Villot from INRA-UMRH, France, has developed a new mathematical approach that takes into account individual variabilities. This new tool complements existing parameters. It is important to keep in mind that average rumen pH, time under low pH (5.6), etc, are not the only parameters. Other indicators of rumen health problems should be monitored, such as feeding and rumination behaviours.

What are the risks factors for acidosis?

Many changes at the farm level, big or small, represent stresses that can potentially impact the rumen environment and its microbial ecosystem: diet changes, transportation, pen changes, feeding transitions, weaning, calving, etc, can all lead to metabolic imbalance.

Dr Alex Bach from IRTA in Spain focused on a particular challenge for the rumen: The

transition from the dry to the lactating diet in the dairy cow.

Using endoscopic biopsy collection, his team recently looked at the impact of transition on the gene expression of immune biomarkers and rumen wall integrity, showing how transition weakens tight junctions in the rumen epithelium, increasing its permeability, with detrimental effects on rumen wall inflammation.

Dr Trevor de Vries from University of Guelph, Canada, further showed that it is not only about what the cows eat but how they eat. Feeding behaviour is very important (Fig. 2).

It is not only about total dry matter intake but also about meal duration and frequency, not to forget rumination activity. Particle size should be optimal – not too short for proper rumen function but not too long to avoid sorting.

All these behavioural parameters are becoming increasingly easy to monitor thanks to new technologies like rumination collars. In the near future, better monitoring of feeding behaviour shall allow early

detection of digestive issues on the farm for better health management and prevention of SARA.

The vicious cycle of SARA: what happens in the rumen and beyond

Thanks to new ‘-omics’ and next generation sequencing technologies, the rumen microbial ecosystem is increasingly well described and the complex relationships between the host and its microbial ecosystem is better documented.

Dr Leluo Guan from University of Alberta, Canada, stressed the complexity of the multi-layered rumen wall and the associated microbiota, also called epimural microbiota, whose function is still being scrutinised.

The rumen wall plays key metabolic functions including nutrient absorption and energy metabolism as well as important barrier functions – contributing to balancing the rumen environment. A poor rumen environment is detrimental to the rumen barrier effect and nutrient absorption capacity. Histology demonstrates that acidosis weakens the epithelium of ruminal papillae.

Dr Greg Penner from the University of Saskatchewan, Canada, described the acidosis cascade: low rumen pH increases rumen fluid osmolality and rumen wall permeability (leaky epithelium), which, in turn, leads to the passage of endotoxins in the blood and potentially induces systemic inflammation.

As Dr Bach reminded us, SARA has a negative impact on feeding behaviour, rumination patterns and total feed intake, altogether leading to lower milk solids.

Prevention rather than cure

As the causes are multiple, so are the solutions. SARA is not, strictly speaking, a disease, with a distinct causative agent. Instead, it is a multi-factorial disorder.

Various solutions and strategies were discussed during the seminar. Certainly, early

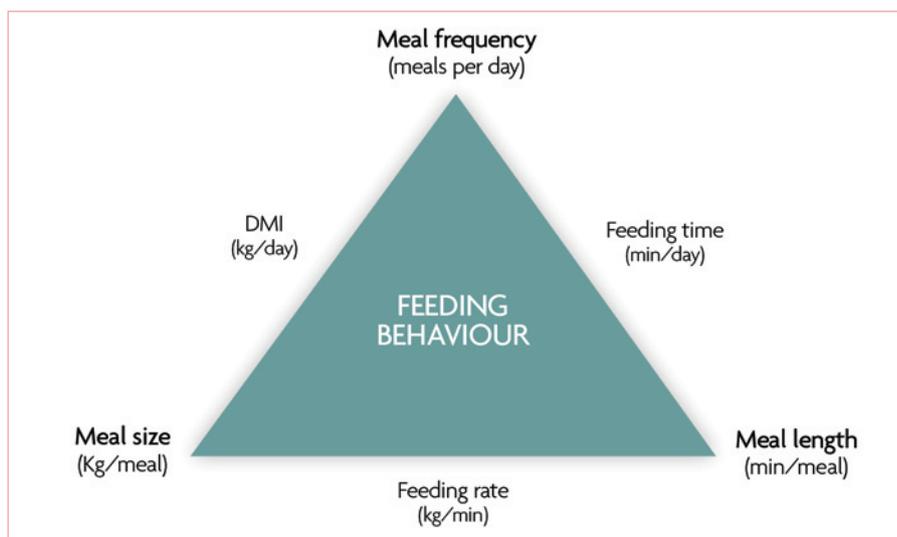


Fig. 2. The parameters that define feeding behaviour (B. L Nielsen, 1999).

detection and prevention remain the best options:

- **Diet structure:**

Provide sufficient physically effective forage, which will promote positive behavioural patterns: slower consumption of feed, in smaller and more frequent meals per day. This should also avoid sorting and, as a result of greater fibre content and particle size, increase rumination (T. de Vries).

- **Feeding the bugs:**

Dr Bach adds the diet should be formulated not only for the cow but also for the micro-organisms of the rumen. Appropriate fibre size and content will not only influence cow nutrient uptake but also the rate of fermentation.

- **Feed additives:**

Dr Helen Golder from Scibus in Australia discussed the benefits of feed additives, depending on local authorisations: antibiotics (outside EU), buffers, live yeasts or direct-fed microbials (DFM) and enzymes. Several results were presented showing how rumen modifying live yeast has a positive effect on various rumen health indicators including: rumen pH and rumen pH variations, inflammatory signals (histamine),

feeding behaviour (Bach, De Vries), and rumination patterns.

IRTA’s recent trial with rumen endoscopy also showed the ruminant specific live yeast *Saccharomyces cerevisiae* CNCM I-1077 helps the rumen better prepare for the stress of transition and calving (reinforcement of the epithelium tight junctions, lower rumen inflammatory status).

Conclusion

A better understanding of the rumen microbial ecosystems and tight interactions with the host, coupled with the development of new wireless sensor technologies (rumen pH and temperature boluses, rumination collars, etc) on the farm, offer new opportunities for defining visible criteria and allowing early detection of rumen health risks and early intervention through precision feeding systems. ■

For more information on rumen challenges and microbial ecosystems visit: <http://ruminantdigestivesystem.com>

The conference ended on a round table discussion moderated by Prof. G. Cozzi. From left to right: Leluo Guan (University of Alberta), Trevor de Vries (University of Guelph), Clothilde Villot (UMRH-INRA), Gregory Penner (University of Saskatchewan), Helen Golder (Scibus), Alex Bach (ICREA-IRTA), and Giulio Cozzi (University of Padova).

