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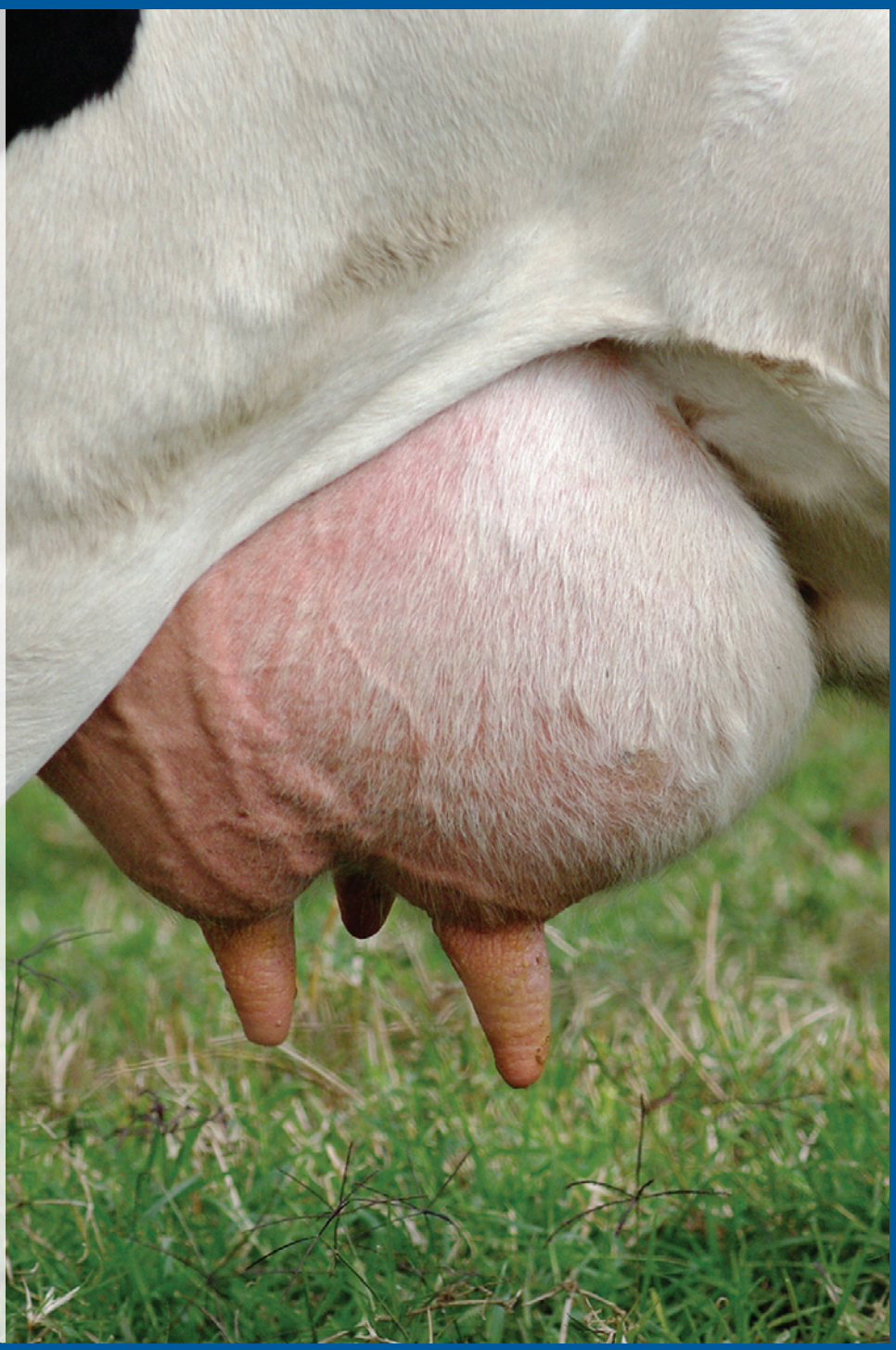
Practical information for progressive dairy professionals



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chewing the cud

Antibiotic resistance genes are currently a hot topic of debate in the fields of human and veterinary medicine.

What exactly are antibiotic resistance genes? Unfortunately, many people have the wrong perception of just what these genes are.

Common misperceptions include the view that they are free living entities that are causing havoc wherever they go; or that they are part of the cow's genetic material or genome which renders the meat or milk that comes from that cow dangerous to the consumer. Both of these are totally wrong!

Antibiotic resistance genes are those genes in bacteria that protect the bacterium from the effects of an antibiotic or group of antibiotics and are part of that bacterium's genome. The consequence of this means that if that antibiotic resistance gene is present in the genome of a specific disease or food poisoning bacterium and the cows or people are treated with an antibiotic covered by that gene, then that antibiotic will not work and disease or food poisoning will occur.

Another feature is that often the other bacteria that are present, but do not possess this gene, are killed off by the antibiotic, thereby leaving the antibiotic resistant containing gene bacterium with a micro-environment that favours its growth and multiplication to levels which dominate the microbial flora. Thus, the phenomenon of antibiotic resistance is based on the bacteria that are in the cow's digestive tract or the environment they inhabit. This is why an antibiotic resistant bacterium can be associated with a particular herd or farm.

The current concerns with antibiotic resistance are associated with certain serotypes of salmonella and campylobacter, both of which are associated with human food poisoning, and E. coli in calves.

Needless to say, antibiotic resistant bacteria are a real issue for the afflicted humans and for the supplier of the contaminated food.

These genes did not appear 50 years ago with the arrival of antibiotics – they arose millions of years ago for some other unknown function and then just happened to have a protective role against antibiotics. ■

Cover Picture:

Optimum health for optimum yield!
(Photo courtesy of Impextraco)

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worldfocus

An executive summary of key international issues

Canada

The raw end of Trump's new NAFTA?

Under a new trade agreement between the US, Canada and Mexico, which still needs to be ratified, US dairy farmers would get more access to Canada and this is worrying Canadian dairy farmers. Canadian cows are nearly twice as productive as they were four decades ago and this means that they are producing too much milk. Canadian farmers need to match supply with consumer demand, but Trump's NAFTA revisions – designed to help the US car industry – could have the opposite impact and give the Americans easier access to the Canadian market. This will compound the problem as under the new trade agreement Canada would give up almost 4% of its market to the USA.

East Africa

Who will invest in white gold?

Milk consumption figures in east Africa show that there is real potential for dairy farming in that region. Kenya consumes the most milk with a per capita figure of 120 litres per year (89 litres below the recommended WHO figure of 200 litres per person per year). Uganda, Tanzania, Rwanda and Ethiopia follow on behind with 53, 42, 38 and 20 litres respectively, with Ethiopia achieving just 10% of the WHO figure. A recent survey published by global packaging company Tetra Pak suggests that Africa will see an increase of more than 50% in liquid dairy consumption, growing from 15 billion litres in 2010 to almost 25 billion litres in 2020. What the milk sector of east Africa needs is investment.

China

The real cost of meeting milk requirements?

China's milk consumption could easily treble by 2050 and that could increase global greenhouse gas emissions from cows by more than one-third. China, as the most populous country in the world and with a growing appetite for milk, is predicted to consume an average of 82kg of milk per person annually by 2050. This is a significant rise from just 2kg in 1961. To meet this increase, greenhouse gas emissions from livestock shoot up by 35%, and global land-use increases by 32%, from 84 to 111 million hectares. This also comes with a 77% surge in water use and a 48% increase in nitrogen pollution – partly due to the increased need to farm resource-guzzling crops like soybeans and maize for feed.

The mycoplasma mastitis risk: what is it costing you?

The number one risk factor for mycoplasma mastitis is bringing new cattle onto the farm. If you have recently purchased new calves, heifers or cows, you may have exposed your dairy to mycoplasma mastitis. Mycoplasma mastitis is becoming an emerging disease as herds continue to expand globally, according to Dr Larry Fox, Professor at Washington State University.

by Dr Christina Boss,
Senior Global Product Manager,
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Mycoplasma mastitis is present in every cattle-producing country of the world, but prevalence varies by region. Due to the fragility of the pathogen and a lack of understanding about how to handle and culture mycoplasma mastitis, detection in diagnostic laboratories around the world has been a problem in the past and, according to experts, mycoplasma may be under-reported.

In a summary of surveys estimating the prevalence of mycoplasma mastitis over the last 13 years, most indicate that mycoplasma mastitis affects less than 5% of herds in the countries studied, with more extreme prevalence in some countries. Prevalence of mycoplasma mastitis also appears to be higher in Utah, a western US state, at 7% than in Canada, Japan, Saudi Arabia or some other European countries.

The US Department of Agriculture National Animal Health Monitoring Service (NAHMS) periodically provides industry with disease occurrence and exposure information. A recent NAHMS survey estimated that during any one year 20% of the 500+ cow dairy herds in the US would have a positive mycoplasma bulk milk tank test result. Thus, mycoplasma mastitis is affecting about one-fifth of all large US dairy herds annually.

"The NAHMS study suggests that prevalence is impacted by herd expansion, and out West, where the herds are expanding and there is a lot of cow movement, mycoplasma mastitis can be as high as 20%. However in the Midwest and Northeast, it might be closer to 5%," Dr Fox said. "This is why I think mycoplasma mastitis is becoming more of a worldwide problem. Even now in Europe, there is more herd expansion which means consolidation of herds. The 50-cow Dutch herd is becoming a 500-cow herd. We have already seen this happening in Britain and other parts of Europe."

Impact of clinical and subclinical infections

Mycoplasma mastitis infections with mild clinical signs or subclinical infections show a few clots in the milk. In a clinical case, typically multiple quarters or sometimes the entire udder is red and swollen and the milk is visibly altered. In both cases, somatic cell counts (SCC) are high, and cows are non-responsive to antibiotics.

"The main problem with mycoplasma is the fragility of the organism, both in transporting a fresh milk sample to the laboratory and then how the laboratory handles the samples to try and get a culture," said Dr Colin Lindsay, practicing veterinarian and consultant in the UK and Europe with Veterinary Consultancy Ltd.

"Thankfully with the advent of PCR technology, we can run the mastitis multiplex PCR using a fresh, frozen or preserved milk sample. PCR uses a fragment of the DNA, so we do not have to worry about organism viability and you will get report results usually within a day." In adult cows, acute mycoplasma mastitis can be accompanied by arthritis, and younger rearing heifers present with the respiratory form, including otitis media or middle ear infections. Occasionally, cows will present purely with swollen joints, and you do not know they have mastitis until conducting a SCC diagnostic analysis.

"In the UK, the problem historically has been that when we submit these samples for diagnostics, specific culture techniques are required to pick up mycoplasma, especially subclinical infections are grossly under-diagnosed," said Dr Lindsay.

"The largest incidence of infections in the UK tend to be cases with mild clinical symptoms and subclinical cases where we identify high SCC, but I have certainly seen mycoplasma storms or outbreaks of mycoplasma mastitis."

What makes mycoplasma untreatable?

The key difference in mastitis pathogen categories is their physiology or cell structure. Gram-positive bacteria have a thick cell wall, and the membrane is highly selective about how and what it allows to move in and out. Gram-negative bacteria have a thin cell wall with two membranes that are less selective. The outer membrane is designed to protect the cell wall.

Continued on page 8

Continued from page 7

"Because penicillin antibiotics need to attack the cell wall to be effective, Gram-positive bacteria tend to be more susceptible, and Gram-negatives are more resistant," explained Dr Fox. "Mycoplasmas do not have a cell wall; they only have a cell membrane. This makes them more fragile, but also makes them much more resistant to some antibiotics because there is no cell wall development to attack. Mycoplasmas have found a way to get around their issue of fragility, which a Gram-positive or Gram-negative would not have been able to do because it has not been necessary."

Another disadvantage of mycoplasma is that it is very slow growing. Some antibiotics work through the metabolism and reproduction of the cells, and bacteria that are growing, reproducing or metabolising as fast will be more resistant to the antibiotics.

Difficulty diagnosing with culture

Diagnosing mycoplasma through culture method is difficult due to the very characteristics that make it an unusual organism. It is less hardy than most micro-organisms and therefore can not grow and survive in just any environment. Given its physiology and its very slow growth, it has fastidious growth requirements and a high demand for particular nutrients, said Dr Fox.

"Mycoplasmas are sensitive to oxygen and require a lower oxygen level," he noted. "Therefore, an increased CO_2 incubation environment is often used to displace oxygen when growing mycoplasma in a culture situation."

Mycoplasmas also require a nutrient agar, which is different from the standard culture media that most mastitis pathogens are placed on to grow. The nutrient agar base is modified by adding additional nutrients like sterols. Antibiotics are also added to the agar plate to prevent other bacteria overgrowing the plate and, since mycoplasmas are generally resistant to antibiotics, their addition to the growth media does not inhibit mycoplasma growth.

Because of their slow growth, it can take several days to see colonies. Even after the elapsed time, the agar plates must usually be examined using a microscope because the colonies are so small they are not visible to the naked eye.

"Due to the length of time required to grow the organism, there is a real possibility of a contaminant working its way into the system, either while the organism is plated, or it may already be in the milk in very small numbers, and over time it becomes magnified and inhibits the growth of the mycoplasma," said Dr Fox.

A recent study led by Dr Fox indicated that sample handling can impact mycoplasma culture growth. Isolates obtained from field milk samples used in the study were frozen for up to 19 months before they were donated for use in the study.

Only 32% of the mycoplasma isolates grew by day seven of incubation and it is suspected that the repeated freeze-thaw effect and prolonged storage may have reduced the viability of the cells. The study also indicated that for all isolates, growth was significantly greater after seven days of incubation compared to three days.

"Patience is important when culturing with mycoplasma because they are so slow growing," noted Dr Fox.

Economic Impact

Mycoplasma mastitis impacts the health and welfare of the infected cow. It reduces milk production and increases SCC, which results in reduced milk premiums and unnecessary costs if the farmer chooses to treat before receiving a diagnosis. Since no treatment exists for mycoplasma, most farmers ultimately decide to cull infected cows.

New Zealand's mycoplasma experience is the most recent example of the devastating emotional and economic impact an outbreak can cause. After careful consideration, the New Zealand Ministry for Primary Industries (MPI) has planned a phased eradication of Mycoplasma bovis. They projected that their 10-year eradication program of M. bovis, the most common mycoplasma mastitis pathogen, will cost NZ$886 million (US$586 million). To not act at all is estimated to cost the industry NZ$1.3 billion (US$860 million) in lost production over 10 years, with ongoing productivity losses across the farming sector.

"In parts of the UK, about 80-90% of the dairy herds have endemic mycoplasma," Dr Lindsay noted. "It is a grumbling infection that affects both the young stock and the adult cows, and it can certainly be economically significant. I have been involved with some situations where we have had mycoplasma outbreaks which turned into a culling exercise of clinical cases. Indeed, there have been a few herds which had to be culled out."

Unlike New Zealand's current situation, most countries have no compensatory mechanism, so financial losses must be borne by the farmer. Often mycoplasma mastitis starts out as an unseen loss, essentially a chronic subclinical problem.

In rearing systems, instead of a normal mortality rate of 3% or 4%, it can shoot up to closer to 10% or higher. For dairy heifers, rather than 80-85% of live born heifers reaching first calving, this can drop down to as low as 60%. The dairy will need to breed more heifers and retain more animals. This is further compounded by the problem of heifers calving down older, said Dr Lindsay.

"Each additional day after the target 24-month calving age it costs the farmer £2-3 (US$2.60-3.90) per animal, so it does not take long for costs to accrue due to higher cull rates and longer growth periods to get to your target weight for calving. These are hidden costs that farmers do not appreciate until they sit down and actually crunch the numbers," Dr Lindsay explained. "The reality of these numbers can be scary, and they take a real toll on a farmer's bottom line very quickly. Plus, mycoplasma has a significant impact on the overall herd health, which because it is unseen, is often unappreciated by most farmers."

An outbreak scenario, where you have the catastrophic situation of having to cull a group of animals, will have a huge economic impact as well.

"A dairy cow in the UK is currently valued at £2,500 (US$3,250). A farmer would cull her at about £1,000 (US$1,300), so you have lost £1,500 (US$1,950)," said Dr Lindsay. "A farmer could quite easily wind up culling more than 30% of the herd, so it is quite easy to see how devastating mycoplasma mastitis can be to the dairy. And, that is really a best-case scenario. Some of these affected animals are a total write off, then the farmer has to pay £80-100 (US$105-130) for their disposal."

Dr Lindsay advises clients to maintain a closed herd. However, if farmers do have a situation arise, whether it is repeat cases of mastitis or arthritis that can not be diagnosed, the only way to get on top of it is through diagnostic analysis.

"That brings me back to culture versus PCR diagnostics, and culture takes at least 10 days, whereas with PCR, I may have results back the same day," he said. "When we are talking about a disease spreading to other cows that may need to be culled during the 10 or more days while we are waiting for results with culture versus one day, that is significant economically to a herd and another reason PCR is my go-to for diagnostics." ■

References are available from the author on request

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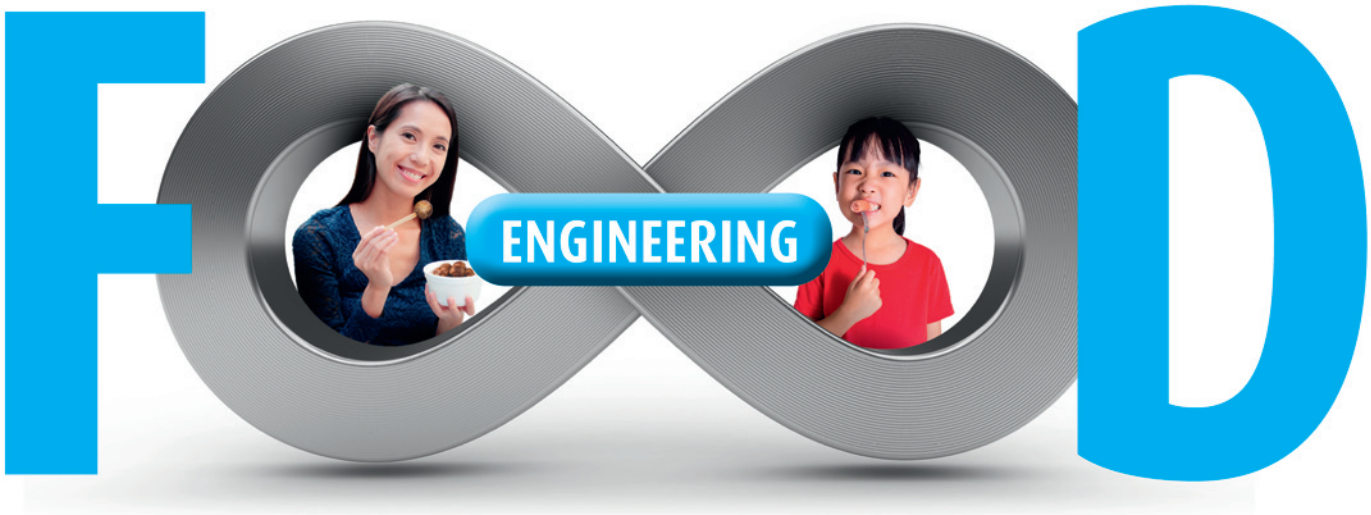

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Optimising milk yield and cow health and welfare, naturally

The two months before and after calving are a challenging period for dairy cows. Since 2009, herd observations made in partnership with the French Agronomic Public Research Institute (INRA) have showed a drop in antioxidant reserves one month before calving, with these reserves replenishing within two months of calving.

by Jean Pascard,
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A peak of inflammation was observed at the same time one week after calving, as well as a lack of antioxidant substances in some animals, leading to metabolic problems and a decrease in milk production.

The consequences of calving stress and inflammation on animal health have dominated the scientific news worldwide for the past 10 years.

The CCPA Group has been collaborating on this subject with various French and international research teams, including Dr Barry Bradford's team, from Kansas State University, to test natural alternatives to existing anti-inflammatory products.

Effect on milk yield

The CCPA Group's R&D team, and in particular its laboratory with recognised expertise in plant extracts, has developed a natural solution based on antioxidants, including Scutellaria baicalensis extracts, as well as vitamin C, green tea and grape extracts, since 2013 – entitled Axion Start.

This natural solution was first tested in 2014 in farms of the CCPA Group's national reference network, followed in 2014-2015 by trials in various European countries, including the Czech Republic, Hungary and Italy.

The results of these tests show an average improvement of 2.7 l/d of milk, with an even more significant improvement (+4.6 l/d), for the 2016 American Kansas trial (see below and Table 1).

Table 1. Impact of supplementation with Scutellaria baicalensis extracts (Axion Start) on milk production and quality 60 days after calving.

	Control	Axion Start
Milk production (kg/d)		
D1-63	42.46	47.19
D64-301	35.39	40.02
Fat content (%)		
D1-63	3.84	3.84
D64-120	3.24	3.29
Protein (%)		
D1-63	3.16	3.12
D64-120	2.97	2.97
Lactose (%)		
D1-63	4.87	4.95
D64-120	4.92	4.97
Somatic cells (log^{10} cells/ml)		
D1-63	2.19	1.86
D64-120	2.13	1.91

Source: Kansas State University, farm trial, 2016.

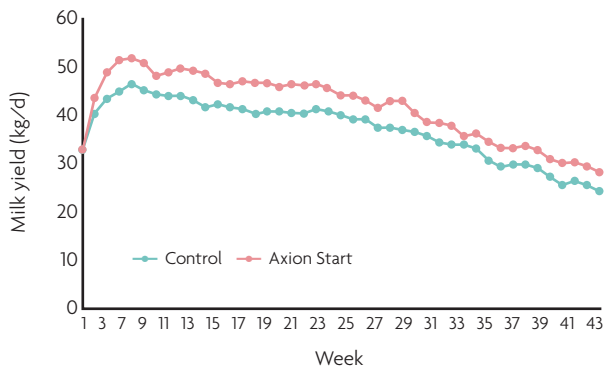


Fig. 1. Impact of 60 day supplementation with Scutellaria baicalensis extract (Axion Start) on milk yield.

An original mode of action

The work carried out as early as 2015 with INRA in Rennes had shown the positive effects of Scutellaria baicalensis on udder physiology, particularly on the continuous renewal of mammary cells during lactation, with higher number of milk secreting cells.

In summary, three modes of action of Scutellaria baicalensis can be distinguished: an antioxidant and anti-inflammatory effect improving peak lactation, a reduction in lactating cells mortality leading to better lactation persistence, and a better integrity of the mammary epithelium protecting it from external aggressions.

Milk production is therefore increased without negative consequences for the animal. The surveys carried out among French farmers have also revealed an indirect effect on the reproduction of Scutellaria baicalensis extracts.

The natural solution tested since 2015 by the CCPA Group to limit calving stress in cattle is an original approach, complementary to rationing optimisation.

Kansas University trial

A joint CCPA/Kansas State University trial was designed to measure the impact of supplementation with Scutellaria baicalensis extracts on milk production at the beginning of lactation in a group of 122 multiparous Holstein cows, as well as on markers of inflammation and metabolic functions in animals (haptaglobin, β-hydroxybutyrate [BHB] and glucose-6-phosphate [G6P]).

The effects of supplementation with Scutellaria baicalensis extracts were measured by comparing a control batch with a supplemented batch for 60 days (SBE60) after calving.

As for the results, if the SBE5 treatment did not lead to changes in milk yield and components, the SBE60 treatment increased milk production by more than four litres per day compared to the control, improved its composition (more lactose, fat and protein), while reducing the number of somatic cells (see Fig. 1 and Table 1).

In addition, the lot supplemented with Scutellaria baicalensis extracts had fewer mastitis frequencies compared to the control lot, as well as a better longevity of the animals: lower cull rate with SBE60 treatment compared to the control lot.

In conclusion, these results indicate that supplementing postpartum dairy cows with Scutellaria baicalensis extracts is effective at increasing whole lactation milk yield. ■

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.

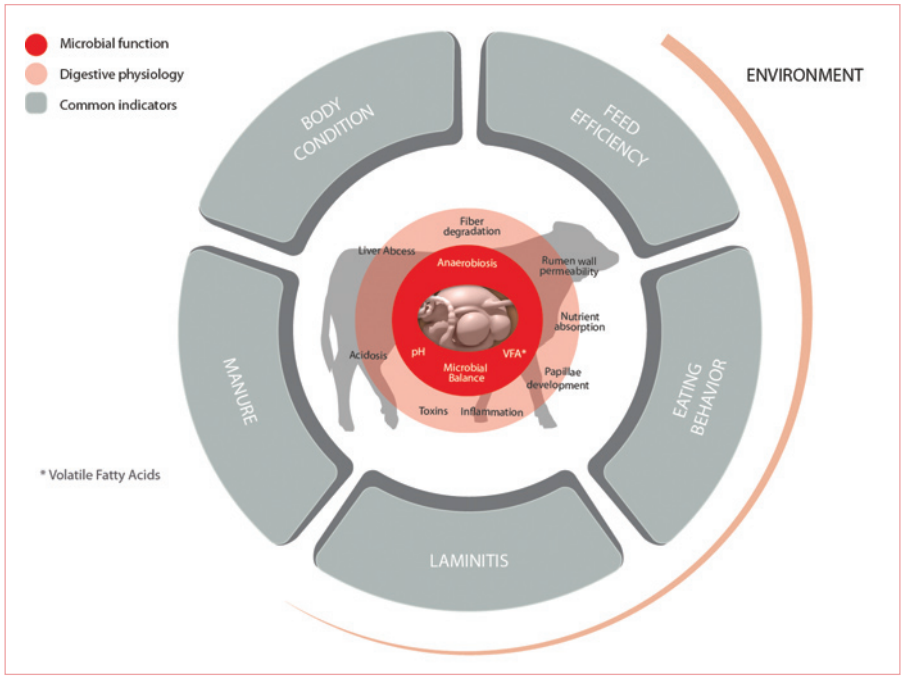


Fig. 1. Direct and indirect consequences of rumen challenges on animal nutrition and health.

Diagnostics: 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 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 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).

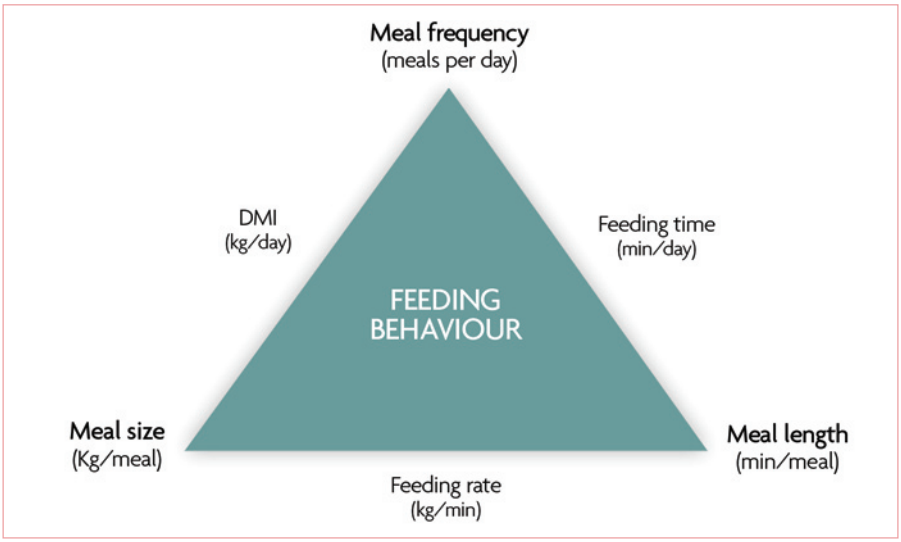


Fig. 2. The parameters that define feeding behaviour (B. L Nielsen, 1999).

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).

Efficacy of herbal spray in treating subclinical mastitis in cattle

In today's world, safe and wholesome milk production is a challenge for farmers due to increasing incidences of different types of disease and the emergence of new and resistant pathogens from the indiscriminate and unjustified use of antibiotics/ antimicrobials.

When we are talking about prevalent diseases, mastitis is one of the major diseases which can not only cause trouble to animals and farmers, but also significant losses to the economy of the farm, society and ultimately to the country.

by Dr Amit Kumar Pandey and Dr Praful Kumar, Ayurvet. www.ayurvet.com

Bovine mastitis (defined as parenchymal inflammation of the mammary gland) is characterised by a range of physical and chemical changes of the milk and pathological changes in the udder glandular tissues.

According to the symptoms, mastitis may be classified as clinical or subclinical. Subclinical mastitis usually leads to the clinical form as it is of a longer period, difficult to diagnose, adversely affects milk production and quality and comprises a reservoir of pathogens that can lead to disease of other animals within the herd.

Cost intensive disease

Mastitis is the most cost intensive production disease in the dairy industry, causing a considerable financial burden.

According to a recent report, annual economic losses sustained by the dairy industry in India on account of udder infections have been projected at Rs. 6053.21 crores.

Out of this, a loss of Rs. 4365.32 crores (70-80%) was credited to subclinical udder infections. Subclinical mastitis is important due to the fact that it is 15-40 times more prevalent than the clinical form.

Control of bovine mastitis is a challenge because of multiple aetiological agents. Mostly antibiotics are used for the treatment and control of mastitis, but an intra-mammary infusion of antibiotics for mastitis therapy was cited as a major reason for milk contamination and frequent use of antibiotic therapy leads to antibiotic resistance. Increasing emergence of antibiotic resistant pathogens is further suspected to complicate the effectiveness of mastitis treatment.

WHO has also emphasised the use of medicinal plants as an alternative to antibiotics. Several herbal extracts have shown in vitro antibacterial activity against major mastitis pathogens. Some of these are Cedrus deodara, Curcuma longa and Eucalyptus globules which also has an anti-inflammatory effect.

Detecting mastitis in the early stages and keeping the animal's udder in the utmost healthy condition is the only way to prevent physical and economic losses due to mastitis. A solution is required which provides all round protection to the udder, not only from pathogens but also relief from the pathogenic effects on the udder.

All the above recommendations are fulfilled by Mastilap which is a herbal spray developed by Ayurvet.

Ayurvet is continuing their research studies through clinical and field trials to ascertain the efficacy of their product in different situations.

In this context, the efficacy of Mastilap for the treatment of mastitis was compared with another herbal product which is very much known in the market.

Table 1. Therapeutic efficacy determined by Modified California Mastitis Test (MCMT).

Group	Animals found positive (%)		
	Day 5	Day 14	Day 21
Brand A group	60	60	60
Mastilap spray group	60	20	10

Treatment	Day 0	Day 5	Day 14	Day 21
Control group	1.68±0.26	1.44±0.35	1.32±0.28	1.16±0.41
Brand A group	6.67±0.10	4.19±0.10	6.47±0.17	5.54±0.08
Mastilap spray group	4.74±0.09	3.30±0.06	1.52±0.06	1.01±0.09

Table 2. Average somatic cell count (SCC x 10^5).

Plan of trial

A total of 30 cows were screened, as per the guidelines of the International Dairy Federation (IDF), with 10 healthy cows plus 20 cows exhibiting the signs of subclinical mastitis:

- Control group with 10 healthy cows.
- Second group with 10 cows suffering from

Continued on page 16

Continued from page 15
subclinical mastitis and treated with 'Brand A' (gel), applied gently by massaging the udder after each milking for five days.

- Third group with 10 cows suffering from subclinical mastitis and treated with Mastilap spray for five days.

Results

Therapeutic efficacy was determined on the basis of Modified California Mastitis Test (MCMT) readings, improvement in the somatic cell count and the milk yield.

Table 1 shows the results on day 0, 5, 14 and 21 of the trial. In the Brand A treated group 60% of animals were found to be positive after treatment on day 5, 14 and also on 21.

In the Mastilap treated group, 60% of animals were positive on day five after treatment, 20% remained positive at day 14, and on day 21 only 10% remained positive for subclinical mastitis.

Data shows the high antimicrobial potential and anti-inflammatory properties of Mastilap against subclinical mastitis.

In the control group the average somatic cell count ($x10^5$) ranges between 1.15 to 1.67. The average SCC ($x10^5$) of the Brand A treated group shows a 16.94% decrease in the SCC from day 0 to 21, whereas in the Mastilap treated group there is a 78.52% decrease in the SCC from day 0 to 21 (Table 2). A decrease in the average SCC is due to the antimicrobial and anti-inflammatory properties of the herbal ingredients of Cedrus deodara, Curcuma longa and Eucalyptus globules plants, which are the component ingredients of the herbal spray Mastilap.

There was a significant increase in the average milk production of the Mastilap treated group, from 9.040 litres/day on day 0 to 10.63 litres/day on day 21, whereas there was no significant increase in the average milk production of the Brand A treated group and the control group (Table 3).

A significant increase in average milk production may be due to the anti-inflammatory and antimicrobial properties of the ingredients of Mastilap, which leads to a quick recovery of the mammary glands from the infection and inflammation. As a consequence, the mammary gland becomes healthy and more milk is produced by the gland.

Treatment	Milk yield (litre/day)			
	Day 0	Day 5	Day 14	Day 21
Control group	7.78±0.07	8.09±0.08	8.02±0.12	8.27±0.26
Brand A group	8.00±0.08	8.31±0.07	8.66±0.06	8.02±0.09
Mastilap spray group	9.04±0.12	9.34±0.14	9.39±0.15	10.63±0.07

Table 3. Comparison of average milk yield between treatments.

Conclusion

The results of the trial show that the efficacy of the herbal spray Mastilap was better than that of the Brand A treated group. Mastilap has shown excellent results in the form of improved SCC and increased milk yield.

Therefore application may be recommended to cure subclinical mastitis. ■

For further information please contact
techsupport@ayurvet.com

Efficient mycotoxin protection to optimise rumen functions

Silage, as a source of mycotoxins, has recently gained more attention. For a long time, it was accepted that rumen microbes can detoxify mycotoxins, it is now clear that the capacity for mycotoxin detoxification in the rumen is lower than believed.

olmix.com

The rumen is the first target of mycotoxins, as various mycotoxins exert significant antimicrobial activity and modify the rumen microflora and also result in a decreased capacity to degrade other mycotoxins, which can then reach the duodenum where they are absorbed, resulting in non-specific subclinical or clinical symptoms.

Protecting animals against the effects of mycotoxins is very important to optimise rumen functions and thus herd performance. Olmix is a specialist in this field and has developed an efficient solution in a microgranulated form to optimise protection of ruminants, in a product called MMi.S.

Yeast probiotic to control rumen ecosystem balance

The rumen is arguably the most important organ in the ruminant digestive system. Ruminal microbial protein and volatile fatty acids (VFA) synthesis supply most of the ruminant's protein and energy needs.

phileo-lesaffre.com

Actisaf Sc 47 is a premium yeast probiotic which helps to improve rumen health and feed conversion efficiency, thus leading to better performance and overall condition of the herd.

Its action on the cow's ruminal ecosystem is multiple:

- **Strengthening of the reducing conditions of the rumen:**

Redox potential (Eh) is a physical chemistry measurement used to characterise an oxidising or reducing environment. It is one of the most complex indicators of the physiological state of microbiota, reflecting their activity and growth.

- **Stimulation of fibrolytic bacteria and bacteria utilising lactate:**

The lower redox potential due to Actisaf stimulates both fibre-degrading bacteria, improving feed digestibility and VFA production; and lactate-fermenting bacteria that helps to counter the buildup of lactic acid.

- **Increase in pH to reduce the risk of subclinical acidosis:**

By fermenting lactic acid to propionate, these bacteria contribute to reduce the risk of acidosis and its negative consequences on the animals.

Actisaf also reduces the between-cow variations in the microbiota, balancing and stabilising the rumen ecosystem. This stabilisation of the rumen environment leads to a more consistent and steady response to diet changes and other stress conditions (such as heat stress).

When added to the feed, Actisaf secures the cow's performance and response to any stress or challenges.

Natural alternatives for optimising rumen functions

The rumen is often referred to as the 'fermentation vat' due to the complicated and efficient routine it performs. The role played by the microbes is inevitable and if you look after the microbes they will look after the cow.

naturalremedy.com

Exclusive care is a must for the microbes, and this can be obtained by three simple targeted actions in ruminants:

- Salivation.
- Motility.
- Fermentation.

Science is extending its arm to optimise these three simple actions by customised balanced rationing, cud replacement and provision of rations with additives, probiotics and in the next level, microbial recombinant DNA technology and more. Weaving a blend of ancient and modern practice, phyto-compounds are remarkably effective in providing a natural solution for optimal rumen functions.

Phytocompounds from herbs like Terminalia spp., Andrographis spp., Zingiber spp., Allivum spp., Piper spp. are well known for acting on these three action areas.

- **Salivation**

Phytocompounds like gingerol are well known for their sialagogic property and increased salivation enhances the buffering capacity, increased antimicrobial actions and helps highly in carbohydrate digestion.

- **Motility**

Phytocompounds like andrograph-olide are well known for their rumenotoric actions which are brought about by inhibiting ACh inducing contractions in smooth muscles. They also increase the digestibility of protein and fibre feed.

- **Fermentation**

Phytocompounds are majorly safe to microbes at recommended levels and their rumenotoric and sialagogic actions help in providing the right environment for microbes and mutually support the animal.

Moreover, phytocompounds like Chebulin are known for their property to reduce CH4 production, optimising nutrient utilisation.

Boosting phytocompounds with probiotics potentiates the action on microbes in providing an optimal rumen function for a healthy productive animal life, naturally.

Optionsfor

The key to sustainable and cost-effective production

The rumen, as one of the most complex digestive organs of all, is the key to sustainable and cost-effective production. Its central location, between the intake of feed and the output of milk, makes it the trigger of farmers' incomes.

mixscience.eu

Making the most from the feed, meaning Metabolisable Protein (MP) and Volatile Fatty Acids (VFA), should be the aim of all diet computations.

Phytogenics, with their natural antimicrobial properties, can be selected, blended and tested to prove their effectiveness in improving the feed efficiency of dairy cows.

MiXscience offers research and field tested proven solutions, adapted to each farm target.

Proteoval is mostly focused on protein efficiency, improving the amount of MP by 16%. Energyval improves energy efficiency from a better degradability of starch and fibre, while digestive safety is reinforced. Both solutions are combined in a powerful and original solution: Valopro. Benefiting from several years of use, in different countries and feeding contexts, one of these products can be the solution to improve farm income.

Especially in times of low milk prices, phytogenic products are a tool to optimise diets and reduce feed costs, while improving animal performance.

Optimising rumen activity is the key to improving efficiency

As everyone knows, the rumen is the most influential site of digestion and microbial fermentation. Its activity provides much of the metabolisable energy and protein needed to maintain body condition, pregnancy, and lactation.

tecnozoo.it

The Volatile Fatty Acids (acetate, propionate, butyrate) derived from the rumen fermentation of the carbohydrates, supply part of the cow's energy requirements; moreover, the bacteria that escape from the rumen provides part of metabolisable protein (MP).

Talking about VFA, propionate is the first precursor of glucose, it is necessary for milk production, reproductive activity, and milk protein synthesis, whereas acetate and butyrate concur to produce around 30% of milk fat.

For all of these reasons, it is very important to optimise rumen fermentation and activity:

- Supply enough peNDF (21 to 23% of DM or around 80% of NDF): Effective fibre is estimated by effective NDF (eNDF). Effective NDF refers to the percentage of the NDF effective in stimulating chewing and salivation, rumination, and rumen motility.
- Provide the right quantity of carbohydrates and degradable protein to improve the growth of rumen bacteria. Also, trace elements, such as cobalt, improve rumen bacteria activity and vitamin B12 synthesis.
- Rumen buffer: 8-10g of buffer per kg of dry matter is needed to maintain an optimal rumen environment and a rumen pH around 6.1-6.3 is necessary for better fibre digestion.
- Probiotics: dietary inclusion of live yeast can rapidly promote an anaerobic environment helping desirable, fibre-digesting microbes to proliferate and efficiently colonise feed particles, resulting in lower rumen lactate concentrations, higher overall pH and a reduced risk of acidosis.

Optimising the rumen activity and fermentation is one of the keys to improving feed efficiency and having a healthy and productive cow.

Using DDGS to enhance rumen fermentation and performance

Producers and nutritionists often fail to recognise the benefits for rumen optimisation that occur when feeding dried distillers grains with solubles (DDGS). Ingredients such as DDGS enhance rumen fermentation and animal performance by providing a source of digestible fibre and rumen-available protein that promotes rumen microbial growth.

dakotagold.com

Ethanol production involves a biological process in which yeasts convert the starches and carbohydrates in a grain or fibre source to ethanol. The remaining products from this process (DDGS) consist of nutrients not converted to ethanol (fat, minerals, protein, and some carbohydrates) as well as microbial biomass generated during the fermentation process.

Although sometimes difficult to quantify, researchers have estimated that the yeast biomass comprises between 15 and 20% of the protein in DDGS. This represents a high quality protein that potentially offers some functional benefits.

All ethanol producers have the same objective of converting starch to ethanol; however, the specific processes between producers vary. For example, POET's unique process for ethanol production differs from other processes in that the POET process exposes the DDGS to 80% less heat.

This results in a DDGS with 32% greater digestibility and a lower fibre content than other DDGS. POET Nutrition markets this unique DDGS as Dakota Gold.

The improved digestibility of Dakota Gold promotes rumen optimisation. University, independent, and internal research have all demonstrated how the unique nutritional characteristics of Dakota Gold affect rumen function.

In addition, producers and nutritionists have recognised that feeding Dakota Gold can improve animal performance.

Formulated to facilitate ruminal function

Boviestimul is an oral powder from Livisto, which is especially formulated to prevent and correct dysbiosis in ruminants.

It is composed of ruminal flora together with substrates, cofactors and buffer substances, which contribute to stabilise ruminal pH and thus create the appropriate environment to avoid and correct any imbalance in the ruminal flora.

livisto.com

Its administration is usually recommended for the prevention and treatment of digestive disorders and to accelerate the recovery of the digestive function after situations of stress such as surgery or heat. Also, by enhancing rumen activity Boviestimul optimises nutrient utilisation, which may be related to an increase in milk production.

Boviestimul can be used as a coadjuvant in the treatment of acute ruminal dysbiosis (ruminal acidosis, indigestion, meteorism) and to prevent microbial imbalance after antibiotic treatments. It is also suitable when there are changes in the diet, when there is a suspicion of accidental ingestion of large quantities of readily digestible carbohydrates, at the beginning of grazing, and in diets containing poor-quality fibre.

Boviestimul can also be used as an additive in carbohydrate-rich diets.

Proper silage management to improve aerobic stability

Questions have often been raised as to whether silage inoculants are adding any value in corn silage making, due to the presence of readily available sugars and resulting 'easy' spontaneous fermentation.

chr-hansen.com

A recent study compared low and high density silages at different ensiling times with or without adding a commercial silage inoculant (SiloSolve FC). It was confirmed that increasing ensiling time improved the aerobic stability from as short as two days of fermentation.

Although classic fermentation parameters, such as lactic acid levels, did not show significant differences between treatments, it was observed that the aerobic stability was significantly improved when SiloSolve FC was included in the treatment in the high density silages.

No significant differences in yeast and mould counts were observed between treatments, although in general both spoilage organisms were reduced. During ensiling, the storage related mycotoxin (Roquefortine C) was reduced in the SiloSolve FC treated silages.

Surprisingly, the field originating mycotoxin (Fumonisin B2) was also reduced, indicating that this silage inoculant could play an important role in mitigating the risk of negative impact of these substances as well as enhancing the aerobic stability.

This study also points to the importance of proper silage management, as the pay off from using SiloSolve FC was clearly most evident when good compaction levels were achieved.

Natural enhancers to stabilise rumen fermentation

The use of natural enhancers like citric flavonoids to stabilise rumen fermentation is a clear option to antibiotics usage, which has been restricted by the European Union.

bioflavex.com

Flavonoids are powerful phenolic compounds and their intake has evinced improvements in efficiency and performance in production animals. In ruminants, the grain diets (or concentrate rations) are an important part of the main rumen fermentable carbohydrates.

However, the high doses of concentrate rations promotes some particular disorders, such as fermentation dysfunction rising acidosis risk as starch is rapidly broken down by α-amylases, also glucose is fermented by rumen bacteria increasing the concentration of VFA and lactate.

The use of citric flavonoids has shown positive results improving rumen acidity, being an alternative to antibiotics treatments used to suppress fermentation dysfunctions at a latent stage. Bioflavex is a balanced mixture of flavonoids substances extracted from bitter orange.

When tested in vitro, Bioflavex has shown to improve rumen acidity. The addition of Bioflavex into the concentrate of growing cattle fed grain improves and stabilises rumen acidity and also the proportion of propionate and acetate/propionate ratio in the rumen fluid, when compared to control concentrate.

Furthermore, the presence of Bioflavex under acidotic induced conditions alleviates pH reduction and also decreases significantly the number of hours below rumen pH 5.5 (when rumen had a pH below 5.5). The mechanism of Bioflavex could be explained by modulation of titers of lactate-consuming micro-organism such as M. elsdenii.

Optimise forage quality to improve dairy performance

With high quality forage the microbes in the rumen will flourish. Dairy herds fed with high quality forages show the best performance. They perform better in terms of dry matter intake, milk production, fertility and economics.

promyr.com
perstorp.com

Perstorp's ProMyr solutions are organic acid based silage and crimping additives that support the ensiling process and help you to optimise forage quality.

Properly ensiled silage and crimped grain maintain a high nutritional value and taste over long periods with minimal losses of dry matter, valuable protein and carbohydrates.

Silage properly treated with ProMyr takes a lot longer to heat up when you start feeding the forage to your herd, compared to untreated silage. ProMyr silage and crimped grain solutions consist of organic acids and salts of organic acids that have proven to preserve the quality and nutritional value of forage in the best possible way.

ProMyr products are easy-to-use and non-corrosive (non-ADR).

Improving animal health with phytogenic feed additives

Due to growing demand, Dostofarm is further expanding its feed supplement and aroma premix product range. Regionally tailored products are even available for on farm mixing and for feed manufacturers.

dostofarm.de

The phytogenic feed supplements promote the performance-enhancing and healthy rearing of dairy cows, calves and cattle.

They are dosed into the feed either in powder or liquid form. The active ingredient in all additives is pure natural oregano oil from continuously controlled contracted production. It has proven to be highly effective compared to numerous other alternatives: DOSTO Oregano not only stimulates the appetite, it also promotes rebuilding of the body's own immune defences in cases of feed-related gastro-intestinal problems.

Improved feed efficiency can also be expected. DOSTO special preparations are available for special cases such as periods of stress or for short-term energy supply.

Dostofarm from Germany is known as a global market leader in this segment. The company supplies more than 40 countries both directly and through distributors. Over 15 years ago, the company succeeded in extracting and processing the oregano oil into a pure natural product with standardised properties: the prerequisite for successful use in cow farming. This is also why Dostofarm was recently distinguished as one of the 100 most innovative companies in Germany.

Optionsfor

An efficient rumen means a healthy and profitable cow

The rumen consists of a complex ecosystem where nutrients consumed by ruminants are digested through a fermentation process. Cows rely on rumen microbes to convert feed components into useable sources of energy and protein.

alltech.com

An efficient rumen means a healthy and profitable cow, and microbial fermentation is the key to both. Two fundamental factors that drive microbial fermentation are stabilising the rumen environment and feeding the rumen microbes.

The rumen is an unstable fermentation vessel that relies on intimate relationships with various micro-organisms.

The majority of beneficial bacteria in the rumen rely on a stable, anaerobic environment in order to function and, thus, both oxygen and acid are threats.

Live yeasts are known to scavenge oxygen and produce stimulatory compounds that have a beneficial impact on both the rumen ecosystem and subsequent animal performance, though there is a wide variation in their efficacy.

Not all live yeasts are able to drive the growth and activity of both lactate-utilising and cellulolytic bacteria.

However, Yea-Sacc from Alltech is a proprietary strain of the live yeast Saccharomyces cerevisiae that performs exactly this specific rumen activity, and its benefits are supported by a plethora of controlled animal performance data. Yea-Sacc enhances digestibility, promotes normal pH and results in increased milk and beef production.

Microbes also rely on a supply of both energy and nitrogen, and by adequately balancing the supply of these and avoiding excessive crude protein levels in the diet, the detrimental impact of excess nitrogen can be mitigated.

The use of feed ingredients designed to satisfy the nitrogen requirements of ~95% of rumen microbes, such as Optigen from Alltech, can aid in providing a balanced ration and result in increased fibre digestion. Optigen is a non-protein nitrogen (NPN) that aids in providing constant and consistent levels of nitrogen in the rumen, optimises milk production and reduces nitrogen excretion.

From rumen health to fertility, Alltech's nutritional technologies help dairy producers overcome challenges to support cow health and profitability.

Fighting ruminal acidosis in dairy cows promoted by heat stress

Heat stress and also acute forage deficiency due to draught pose a continuous challenge to dairy cows.

agromed.at

The dairy cow reacts to heat stress by reducing its feeding time and thus feed intake. The most affected is the intake of forage. The risk of rumen acidosis increases since in ratio, more concentrate is eaten than forage. A reduction in forage intake also reduces the rumination, as a result of which the reduced levels of saliva are insufficient to adequately buffer the sinking pH values in the rumen.

Silages are also in heat stress. High temperatures offer silage pests (yeasts) optimal propagation conditions. In addition to disproportionately high energy losses, the sensory quality is impaired. These qualitatively impaired silages further reduce the forage intake.

In regions affected by lack of feed due to drought, the use of concentrates should be carried out wisely. Feeding higher quantities of concentrates to counteract the threat of milk losses does not solve the problem, but rather allows the animals to get into the 'vicious circle' of acidosis. Especially then, when insufficient amount of forage can be eaten.

Agromed TIME305 is a novel lignocellulose that reduces fluctuating and unphysiologically low pH levels in the rumen and thus reduces the risk of rumen acidosis.

Likewise, constant pH levels also stabilise feed intake, and high levels of concentrated feed become more tolerable. Consequently, Agromed TIME305 acts as a safety factor during heat stress.

Reduce the risk of acidosis and improve sanitary conditions

Acidosis is a major physical and economic issue that can be caused by a disruption of rumen microflora. An unbalanced ration may lead to this disruption.

nutri-concept.com

Ruminal acidosis has two forms:

- Acute acidosis, due to a massive intake of quickly fermentable carbohydrates.
- Sub-acute acidosis, a chronic form leading to important economic losses due to reduced feed intake, diarrhoea and poor body condition. The cost of treating acidosis can be as high as €300 per cow per year.

Immu Flor is composed of:

- Vitamins and trace elements (organic selenium, zinc, natural vitamin E Natu-E) to stimulate the immune system.
- A combination of two specific clays to protect the intestinal wall, bind mycotoxins and stabilise the rumen pH and microflora, thanks to their cation exchange capacity.
- Live yeast to improve digestibility and prevent acidosis.

According to a trial performed with dairy cows in France, the distribution of Immu Flor resulted in an improvement in milk production and fat and protein content.

A subsequent trial using Immu Flor, observed a reduction of somatic cells counts (SCC), particularly for cows with counts higher than one million at the beginning of the trial.

It was noted that mastitis incidences also decreased and milk production, protein and fat content improved.

Nutri-Concept is a subsidiary of Global Nutrition International which manufactures breeding products mainly for ruminants.

Tackle pathogens while enhancing rumen productivity

Celmanax from Arm & Hammer helps optimise rumen health and resiliency in dairy cows and calves. Celmanax sets animals up for success by yielding highly bioavailable compounds, known as Refined Functional Carbohydrates (RFCs), from the yeast cell. These RFCs provide a healthy foundation for dairy cattle.

ahanimalnutrition.com

RFCs can prevent pathogens from attaching to the intestinal wall, allowing harmful organisms to pass through the animal. Incorporating Celmanax in dairy rations establishes proper immune and rumen function and a defence mechanism against pathogenic bacteria. Research also shows Celmanax can bind to mycotoxins and prevent them from being absorbed through the gut wall and into the bloodstream and milk.

The RFCs found in Celmanax support udder health. In three separate studies, dairy cattle fed Celmanax had numerically lower somatic cell counts than control groups. Celmanax also promotes efficiency in the rumen. With feed being the single largest cost for producers, it is important that cattle can be as efficient as possible with that feed. RFCs reduce pathogenic pressure on the rumen and allow dairy cattle to utilise feed more efficiently for growth and production.

Celmanax also helps animals cope with challenges arising from their environment. For example, milk replacers and starters powered by Celmanax have been shown to be effective in preventing scours in calves.

Because it is difficult to predict when pathogens are going to challenge a herd, feeding Celmanax ensures the immune system is prepared.

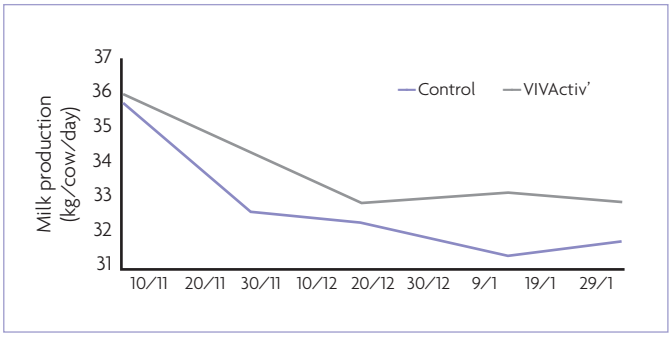


Fig. 1. Milk production of two groups of cows receiving a xylose treated rapeseed meal (control) or a VivActiv' Rumiviv' treated rapeseed meal (CCPA Group's experimental farm, France, 2016-2017).

Innovative nutritional technique to increase by-pass protein

Based on CCPA Group's expertise in natural solutions, with more than 15 years of experience, VivActiv' is an innovative nutritional technique which improves protein valorisation in diets.

groupe-ccpa.com

Including plant extracts and essential oils, VivActiv' protects the protein from degradation in the rumen and stimulates the rumen flora activity to increase microbial proteins. The result is an increase in PDIA and PDIM or RUP (Rumen Undegradable Protein).

Compared to formaldehyde and xylose protections, VivActiv' has always proven itself to be at least as efficient. Some trials even show a higher production and reduced feed cost (Fig. 1).

VivActiv' has been fully tested in a various set of conditions, including on dairy cows. It has been used either to increase milk production, or to decrease ration costs in removing some of the protein sources (soya, rapeseed).

Further on, VivActiv' technique offers a product that acts on the rumen flora to increase energy. Thanks to a higher feed efficiency, getting more nutrients with the same ration, nutrient waste is decreased and ammonia production reduced with a clear benefit on the environment.

VivActiv' has so far shown its profitability and is currently successfully used on many farms worldwide, with more than 1 million tons of feed including this technique in 2017.

In a market more and more receptive to money savings, animal welfare and respect for the environment, CCPA Group's new approach is definitely an interesting way to improve breeding profitability.

Table 1. Feed costs evaluation (CCPA Group experimental farm, France, 2016-2017).

Xylose treated rapeseed meal	VivActiv' Rumiviv' treated rapeseed meal	Feed cost savings with VivActiv' Rumiviv'
€500/ton of feed	€300/ton of feed	€200/ton of feed

Optionsfor

Rumen dysbiosis induced by mycotoxins

Mycotoxins, such as aflatoxin B1 and roquefortine C present in cattle feed, negatively impact the rumen microflora and thereby rumen efficiency is impaired.

impextraco.com

Previously, it was believed that the rumen microflora was able to detoxify mycotoxins very easily, now, mycotoxins are more and more being seen as antimicrobial toxins reducing the microbial population causing rumen dysbiosis. This rumen dysbiosis majorly impacts the general health status of the animal.

As stated by Fink-Gremmels (2008) "Mycotoxins often act as confounding factors, contributing, and in some cases even causing, the adverse effects of nutritional imbalances and related diseases in dairy cattle".

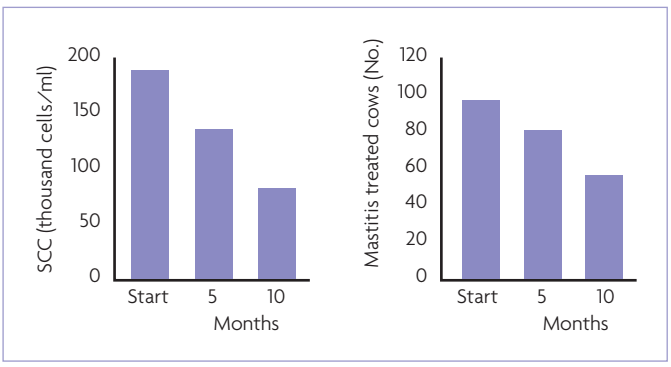
High yielding cows (starch-rich diets) are especially susceptible to metabolic and reproductive disorders.

To stimulate the efficiency of the rumen and reduce the negative impact of mycotoxins, a broad range mycotoxin solution Elitox is offered by Impextraco NV.

Since 400 different kinds of mycotoxins exists, from which only a limited number are well documented, the development of Elitox is based on different strategies. Elitox is designed to tackle the negative impact of mycotoxins by acting as a mycotoxin binder and by supporting the animal's natural immune system.

Consequently, economic losses due to secondary bacterial infections are reduced (Fig. 1) as well as energy losses by inflammation are avoided. To conclude, Elitox safeguards the animal's performance during mycotoxicosis and ensures optimum technical and financial results.

Fig. 1. Mycotoxins are a predisposing factor in the development of mastitis, a bacterial infection of the udder. The use of Elitox reduces the incidence of mastitis and the somatic cell count (SCC) of the milk.



Global approach to foster transition from monogastric to ruminant

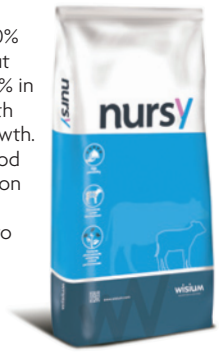
The long-term performance of dairy cows is determined by the first few months of its life as an heifer. This phase is highly critical. According to Soberon & al. 2012, lifetime performances are influenced by early life development which can be manipulated via nutrition.

wisium.com

This manipulation should start immediately after birth and continue for at least five weeks. The 0-6 month period represents less than 10% of a dairy cow's life but accounts for about 25% in terms of weight growth and 54% of height growth. Furthermore, this period represents the transition for heifers from monogastric animals to ruminants.

Wisium has developed the expertise for rearing young stock and provides the solution to farmers through Nursy – a program combining milk replacers, starter feed and nutritional specialties to raise heifers in the best conditions. Above all, the main benefit of Nursy is to foster the rumen development in order to facilitate the transition towards ruminant. Formulation of starter feed includes:

- Highly digestible fibre; for their chemical effect on cellulolytic flora and mechanical effect on rumen wall.
- Plant extract to maximise butyrate production.



Effectively, both actions are mandatory for an optimal development of the rumen. The mechanical fibre stimulates the rumen wall and increases the volume of it. Butyrate is a volatile fatty acid used as a source of energy for animal growth but moreover, for rumen papillae development.

The product of choice for stimulating ruminal activity

XVET have developed several different approaches for optimising and stimulating ruminal activity. One of them is through supplementation of the feeding rations with monoglycerides of short and medium chain fatty acids.

xvetgermany.com

Their product NovoVital, containing four different fatty acids (C4, C8, C10, C12), has proven its positive effects on ruminal activity and appetite in several field assessments.

Especially in cases of low quality feed raw materials, due for example to a high mycotoxin concentration resulting from wet harvesting conditions or in cases of unbalanced feeding rations, NovoVital is a product of choice for optimising ruminal activity.

In four different field studies, increased ruminal activity, milk production and milk fat content were observed.

An increase of up to 17% of the milk fat content after using NovoVital has been observed. Positive results were obtained as well when using the product in calves and fattening cattle, especially when administered after arrival at the fattening facility.

Adding value to nutrition for excellent results

With more than 25 years of experience with biotechnological products, ICC Brazil developed RumenYeast – a fermentation soluble solids derived from yeast. The use of this additive has shown excellent results in the diet of dairy cattle.

iccbrazil.com

A study was carried out at the University of Florida, USA, to evaluate the effects of RumenYeast supplementation on the performance of dairy cattle fed diets with different starch concentrations.

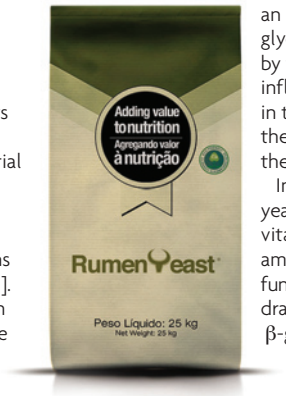
For this purpose, 56 Holstein cows, 45 days postpartum, were distributed in a factorial arrangement 2x2 [2 starch level 22% (low) and 28% (high); 2 RumenYeast inclusions (0 and 15g/head/day)].

The milk production and composition were measured.

Blood samples were collected, and the concentration of glucose, urea-n, and haptoglobin were analysed. The addition of 28% of starch increased the protein level of the milk (% and kg/day), whereas the use of RumenYeast increased the milk production (with fat correction, about 3.8% or 1.5kg/day), the fat level of the milk (+0.06% and +0.1kg/day) and protein level (0.06% kg/day).

The glucose and urea-n concentrations were higher in the treatments using 28% of starch.

Nevertheless, RumenYeast reduced the blood haptoglobin concentration, which is an acute-phase glycoprotein produced by the liver during inflammatory processes; in this case, caused by the high level of starch in the diet.



Indeed, the supply of yeast extracts containing vitamins, peptides, free amino acids and functional carbohydrates such as MOS and β-glucans, provides a substantial gain in animal performance, representing higher milk production.

Securing optimum rumen health and longevity

Successful dairy production relies on optimal ruminal health, indicated by a ruminal pH of 5.8-6.8 and commensurate with an increased bacterial count. Securing optimal rumen health leads to greater digestibility and feed intake.

biomin.net

In addition to acute health or production problems in a dairy herd, mycotoxins contribute to chronic problems, for example increased incidence of disease, poor reproductive performance and suboptimal milk production.

Before impacting the animal itself, mycotoxins disrupt the rumen function by exerting antimicrobial, antiprotozoal and antifungal activity. Mycotoxins frequently occur even without clinical signs, hence the need to implement a mycotoxin risk management strategy including Mycofix which directly counteracts their negative effects.

Further improving rumen health should focus on developing the ruminal flora.

A novel autolysed yeast, Levabon Rumen E directly increases the bacterial count in the rumen and improves digestibility.

These tools offer farmers ways to boost rumen health and thus support production.

Feed additives that stimulate and assist the rumen

Nutriad has developed a diverse range of smart feed supplement solutions for ruminants at all stages of the production cycle. The range enables farmers all over the world to produce healthy animals that are capable of optimum performance throughout their life, from birth through to adulthood whether for milk or meat production.

nutriad.com

Adimix and Apex concepts are used in milk replacer (CMR) and starter feed for calves.

Apex Calf is a mixture of five plant extracts that supports the calf's natural defence mechanisms and its digestive system to prevent the establishment of disease and to improve digestibility, nutrient absorption and feed utilisation.

Adimix is based on coated Na-Butyrate and is proven to have a positive effect on performance parameters due to enhanced proliferation, differentiation and functioning of the tissues of the gastrointestinal tract, in addition to supporting immunity.

Optimal rumen function is the most important factor influencing feed utilisation efficiency in ruminants. Nutri-Ferm and Nutri-Ferm Prime, mixtures of fungal fermentation extracts and cultures, stimulate rumen fungi and cellulolytic bacteria leading to an increase in fibrolytic enzyme secretion and improved fibre breakdown and feed utilisation.

Nutri-Pass, a mixture of tannins, saponins and botanical extracts which can reduce protein degradation in the rumen, increase by-pass protein and microbial protein flow to the intestine, and generally improve nitrogen utilisation efficiency.

A phytogenic solution to improve fibre digestion

Ayurvet's herbal digestive tonic and appetiser, Ruchamax, is scientifically proven to maintain a balance between beneficial bacteria and pathogens for intestinal and general health. It also facilitates optimal absorption and utilisation of nutrients and thus improves feed conversion ratio, productivity and weight gain.

ayurvet.com

Ruchamax consists of a combination of many such synergistic herbs with standardised phytochemicals which work as a digestive tonic, carminative and rumen microflora booster. Ruchamax is known to improve

- Salivary secretions ensuring optimum ruminal pH for the growth and survival of microflora leading to better digestion.
- Promotes digestion of non-starch polysaccharides (NSP) through improved fermentation

Optionsfor

Live yeast improves rumen wall integrity in transition dairy cows

The transition around calving is a critical time for the dairy cow, with major metabolic, dietary and physiological changes.

ruminantdigestivesystem.com

In particular, the transition from a high fibre to a high non-fibre carbohydrate diet represents important challenges for rumen health with a negative impact on inflammatory status.

Using endoscopy and quantitative RT-PCR as an innovative approach to rumen health, the team of Alex Bach (IRTA, Spain), and Lallemand Animal Nutrition conducted a survey on the impact of transition challenge on rumen health and the effects of rumen specific and live yeast Saccharomyces cerevisiae CNCM I-1077 (Levucell SC) at rumen wall gene expression level.

Using a medical endoscope, the researchers could biopsy rumen and colon epithelium and study histological and immune-related gene expression changes during diet transition. The trial was conducted on 21 Holstein dairy cows from 21 days before calving to 21 days after calving. It showed that by feeding S. cerevisiae CNCM I-1077 around transition:

- The rumen wall barrier integrity is better prepared to face the stress of diet transition (increased occluding expression, involved in tight junction integrity).
- The rumen wall is more resistant to LPS and inflammatory challenges related to diet changes (reduced Il10 gene expression post calving, increased pre-calving).

These beneficial outcomes on rumen health needed endoscopy and gene expression analysis to be seen and understood.

However, they were visible at the farmer's level: milk yield and feed intake were also significantly improved.

Brain-microbiota connection, the key driver to enhance performance

Phodé considers 'Better-Being' in animal farming as the cornerstone for reaching optimum performance. The microbiota-gut-brain axis is a unique system called the 'cerebral ecosystem'

phode.com

Based on this original approach, Phodé offers specific and innovative solutions adapted to modern farming expectations.

Oleobiotec is an exclusive blend of essential oils and spice extracts designed to optimise transmission of the 'Better-Being' message through the microbiota-brain connection. Essential oils and spices are widely known in human medicine and are also used in animal medicine.

They regulate microflora and stimulate the secretion of enzymes, gastric juices and motility of the gut. Phodé draws on 20 years of expertise to carefully select active ingredients and create unique solutions. It guarantees consistent and effective solutions, thanks to a sourcing commitment and strict quality standards.

Phodé's expertise and know-how foster enhanced efficacy, combining natural active compounds in order to benefit from their synergistic effects. This expert use of synergies resulted in the Oleobiotec range.

Oleobiotec for Ruminant is a unique solution, proven effective in promoting the balance and diversity of gut microbiota for 'Better-Being'. Acting on the whole cerebral ecosystem is the key to helping cows reach their full potential.

Respect the calf's nutritional needs for optimal weaning

When a calf is born the rumen does not yet function. At birth, the rumen makes up only 25% of total stomach capacity. In maturity, however, the rumen should make up 80%, and contain trillions of microbes to supply the majority of the daily energy and microbial protein.

joosten.nl

As the rumen is the engine of the future cow, rumen development is the most important goal in calf rearing.

For rumen development it is necessary to:

- Supply fresh water ad libitum from day two. Rumen microbes live in a water environment: no water is no microflora.
- Feed a calf starter from five days of age. Start early, so calves can get familiar with solid feed. Starter feed enhances papillae development for nutrient absorption in the rumen.
- Supply roughage from four weeks of age. Roughage stimulates the rumen muscular layer needed for rumination.
- Feed a quality calf milk replacer like Joosten Milk to meet the calf's nutritional needs. Fat content in cow milk is too high, causing rapid saturation in the calf. This will negatively affect calf starter intake and consequently rumen development.

A well-functional rumen is key for a good weaning transition. Therefore a more reliable criteria for weaning is quantity of starter feed intake instead of body weight or age.

A calf is ready for weaning when it has a starter intake of 2kg per day for two consecutive days.

Reducing the negative effects of heat stress

RumenFerm is a complementary feed for cattle which stabilises ruminal pH and keeps the rumen well-functioning under heat stress conditions.

r2agro.com

● **Dual functions**
Lithothamn from calcareous marine algae provides a long-lasting rumen buffer effect and reduces the risk of SARA (sub-acute ruminal acidosis). The other important ingredient in RumenFerm is hydrolysed yeast, which assists the rumen fermentation function and supports the rumen fibre digestion.

Last, but not least, RumenFerm contains natural polyphenols with proven high antioxidant activity, which can reduce oxidative stress and is an alternative to high levels of vitamin E and C.

● **Decrease negative impact of heat stress**
When a cow experiences heat stress, it will increase the breathing rate, sweating and water intake. It will decrease its feed intake, and thereby the rumination and saliva to the rumen will decrease. The decreased saliva provides a drop in ruminal pH and impairs fibre digestion.

The overall effect is a drop in milk yield, but also in milkfat and protein content. With regard to the health condition of the cow, it will have a higher risk of developing SARA because of the drop in ruminal pH.

Longer term consequences of heat stress can negatively influence the cow's health conditions with an effect on immune function or reproduction, especially as heat stress generally increases the production of free radicals, leading to oxidative stress. Oxidative stress in dairy cows can lead to increased mastitis frequency and a higher somatic cell count in milk.

● **Application**
Dairy cows: 50-100g per cow per day.

Image of a heat stressed cow.

Gut agility activator empowers ability to adapt for better efficiency

How the rumen adapts to nutritional stressors in the feed determines rumen efficiency and subsequent milk production response in dairy cows.

anco.net

The adaptation formula in ANCO FIT is based on ingredients which have been specifically selected to help cows adapt to dietary stress factors and perform to their performance potential.

Regulating appetite favourably has been shown to be a major benefit of Anco FIT. Positive effects on rumen fermentation have also been shown to enhance milk component yields in dairy cows.

Anco FIT offers ideal dietary support when dairy cattle are nutritionally stressed and is a cost-effective solution for more consistent and profitable dairy production.

The improved ability of cows to cope with nutritional stressors leads to a more efficient and agile operation, which can adapt to nutritional challenges in a natural and profitable way.

Fermentation products for increased rumen balance

The rumen is a delicate fermentation ecosystem responsible for digestion of ruminant feed. Although rumen microflora digests forage with high efficacy, the hemicellulose part of the feed is not converted into energy.

drbata.com

Rumino-Zyme increases the digestibility of the forage resulting in better feed utilisation and energy balance, which can be manifested in better meat and milk quality or increased meat and milk production.

Additionally, Rumino-Zyme helps in maintaining normal pH circumstances in the rumen and reducing the occurrence of subclinical ketosis.

The efficacy of Rumino-Zyme was tested in a dairy establishment in Argentina, using 56 second and third lactation Holstein cows 30 days prior to calving until 100 days after.

Animals in the trial group received 20g of Rumino-Zyme/cow/day feed supplementation. The diet consisted of corn silo, soy expeller, maize grain and vitamin-mineral concentrate.

The addition of Rumino-Zyme into the diet in 20g/cow/day concentration enhanced the milk production in the trial group with 9.5%, representing a difference of 1.4 litres in the lactation peak (Fig. 1).

Since the β-hydroxybutyric acid (BHBA) concentration in the blood is a suitable marker for determining subclinical ketosis (greater than 1.2 mmol/L at seven days after the calving is considered subclinical ketosis), BHBA concentrations were also monitored during the trial.

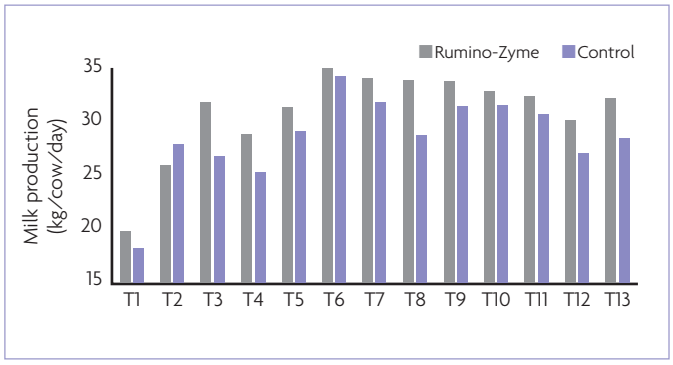
As a result of addition of Rumino-Zyme to the diet, 41.9% fewer cases of subclinical ketosis were detected in the trial group (18.8% vs. 32.4%). The incorporation of Rumino-Zyme into the diet decreased the occurrence of subclinical ketosis.

Due to the better feed utilisation and energy balance of Rumino-Zyme, the milk production was significantly increased in the trial group.

The reduced occurrence of subclinical ketosis in the trial group suggests an overall healthier herd.

With the addition of Rumino-Zyme, milk production can be increased and a healthier herd can be maintained, which results in significant cost reductions for the farmer.

Fig. 1. Average milk production of the control and the experimental group, receiving 20g/animal/day Rumino-Zyme supplementation. Each Tx represents 10 days.



Cow health monitoring: is rumination time really the gold standard?

International competitiveness and price-oriented consumer behaviour are the driving forces behind the increase in milking performance in dairy cows worldwide. Side effects of this development are diverse and involve amplified risk for various physiological, metabolic and immunological disorders.

by Dr Simona May,
GEA Farm Technologies GmbH.
www.gea.com

Thus, the stress increases between the conflicting goals of higher milking performance, on the one hand, and the maintenance of the health status of the herd, on the other. A lot, if not all disorders and diseases affect the individual feeding behaviour of ruminants and are accompanied by reduced dry-matter intake and decreased eating and rumination time. Even social stress can be linked to a decrease in time spent eating and ruminating, which is a direct response of ruminants to acute stressors.

Health problems have a negative impact on production in dairy herds and can lead to milk yield and quality reduction, increased mortality and veterinary treatment costs. Thus, consideration of eating behaviour is a high priority.

Monitoring daily eating and rumination time serves as a crucial and helpful parameter in gaining relevant information about the individual animal and its ability to cope with farm-specific feeding, housing and management situations. The earlier changes are visible, the earlier individual counteractions can start.

Eating behaviour of ruminants is characterised by feed intake, chewing and rumination activity. In this regard, a multitude of different measurement methods exists to assess eating behaviour. Also, their stage of development and practical usage is different and their reliability is variable.

Methods for assessing rumination activity

For several decades, many scientists have been engaged in the development of functional and reliable methods to measure, assess and evaluate individual chewing and rumination activity of cattle and sheep.

Until a few years ago, individual rumination time was the primary measurement method of eating behaviour and it was successfully used as a basis for calculations and as an evaluation method for deviating behaviour.

The reason for this was that the development of functional, reliable and applicable methods to assess and evaluate individual rumination time was easier to realise than for comprehensive eating behaviour.

As rumination behaviour is a very uniform and easy to recognise behaviour pattern of a ruminant (Fig. 1), the development has focused quite early on this measurement parameter. Also, the development of reliable and valid algorithms was easier in comparison to the detection of eating behaviour which is an irregular and challenging behaviour pattern to recognise that differs from individual animal to individual animal even more (Fig. 2). The comparison of both feeding patterns makes this clear.

Therefore, a lot of literature and studies with according results and recommended actions exist mainly for rumination behaviour as an indicator for possible health issues or changed behaviour. The gold standard for heat detection and health management was born. But in recent years progress has also been achieved within the development of algorithms to measure and assess irregular eating behaviour of ruminants. Thus, functional, reliable and applicable measurement methods for eating behaviour have arrived within the field of commercially usable Precision Dairy Farming systems as well. Since this development is only a short time ago, a lot of historical research was done with measurement systems for rumination time only. Literature about the meaningfulness of eating time as an early warning system for deviating behaviour is not so widespread yet. This is one of the main reasons why eating time is not usually considered as a useable

Fig. 1. Rumination phase.

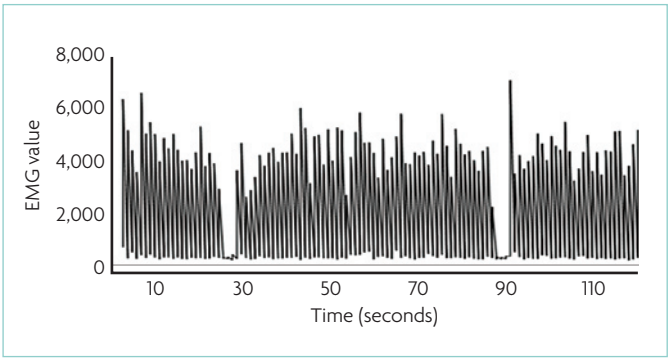
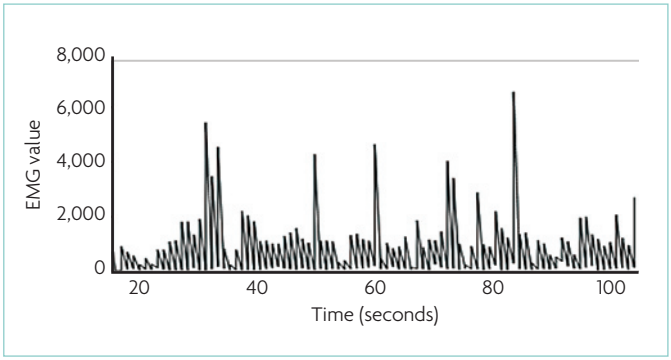


Fig. 2. Feed intake.



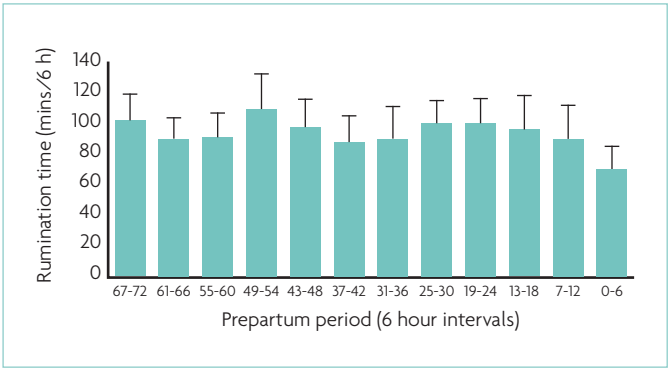


Fig. 3. Variance in rumination time of dairy cows (min/6 h) during the last 72 hours before the onset of calving (mean and SD; n=17).

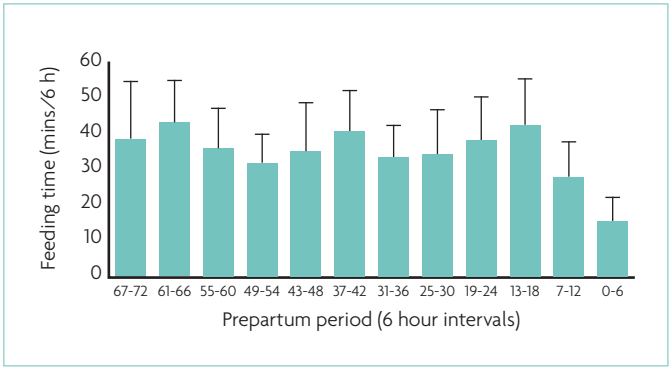


Fig. 4. Variance in eating time of dairy cows (min/6 h) during the last 72 hours before the onset of calving (mean and SD; n=17).

indicator of suboptimal feeding conditions, altered behaviour or as a monitoring parameter for health management in general, in comparison to rumination time.

But is this view still justified? Is the consideration of rumination time as the gold standard in regards to heat and health monitoring not outdated in the meantime? The advantages of the meaningfulness of eating time are quite obvious, such as shown in these different examples.

Example 1

Lameness, initially, does not directly lead to a decrease of rumination activity. Depending on the severity of the lameness, only the frequency of visits to the feeding table are reduced. The total eating time of the day stays the same as fewer visits are being compensated by longer eating periods per visit.

The identification of those minor changes depends on the analysis possibilities of the measurement method used. As a second step, taking into account the severity of the lameness, not only are the frequency of visits to the feeding table reduced, the total eating time of the day is also reduced.

With this change, an alarm can easily be generated by the used measuring system. Only in the third step, considering the temporal course, the rumination time is decreased because less feed was taken and the health condition in general is now poor for the cow. Thus, monitoring of eating time is the first choice in this scenario.

Example 2

Another example demonstrates the importance of measuring eating time as well as a stronger and more sensitive indicator for changed behaviour. The identification of the onset of birth is a crucial parameter for the prevention of dystocia.

Generally, the onset of birth is recognised by monitoring behaviour changes or external changes in the dam. Birth can also be monitored by measuring eating behaviour, such as eating time and rumination time. But the sensitivity of both indicators is different.

Büchel & Sundrum, 2014 found out that an obvious decrease in both eating time and rumination time exists shortly before calving. Within this study the last 6 h before calving were compared with the 72- to 7-h time frame before calving. During the last 6 h before the onset of calving, feeding time was reduced by 57% on average (20.8 min/6h). Within the same time frame, rumination time was reduced by 27% on average (25.6 min/6h). With a decline twice as strong, eating time measurement is a more valuable indicator for predicting the onset of calving than rumination time measurement.

Example 3

The measurement of eating time also has decisive advantages with regards to the monitoring of husbandry conditions of dairy cows. A changed and inefficient animal/feeding place ratio can easily be identified by reduced eating time, which especially can be found within the low-ranking cows of the herd or group. As an immediate reaction, the eating time is reduced directly. However, rumination time is compensated for a certain period before a decline can be detected.

It becomes clear that the rumination time no longer represents the gold standard as a reliable method for early detection of possible health disorders, diseases or as an indicator for increased activity because of being in heat. Also, the measurement of individual eating time provides valuable information about the ruminant and can be used as a meaningful parameter and early warning system for behaviour changes with even more accuracy.

In the end, the farmer decides which measurement method and measuring system is the most useful and which parameters might have the biggest advantage for his/her farm management.

The development progress which has been achieved recently within the field of Precision Dairy Farming for health monitoring systems is tremendous. But not all available features and benefits that different measurement parameters offer are useful for every farmer.

The cost-benefit relation should always be a high priority for a successful farmer.

The farm should work closely with their service provider to learn more about the management possibilities of different cow monitoring systems, and how they can be used on their individual herd to help improve cow health and performance. ■

Phileo
LESAFFRE ANIMAL CARE

Helping dairy cows cope with the heat

3

Heat stress is a serious problem on dairy farms across the world, often resulting in sharply reduced milk yields and significant follow-on health issues. The combination of rising summer temperatures and high levels of humidity can result in reduced feed intake in cows as they react to an uncomfortable increase in body temperature.

Immediate distress signs include panting, sweating and standing more than normal. This often leads to cows failing to eat as much as usual, due to the fact that digesting is itself a heat-generating process, especially in ruminants. In such conditions, a decline in performance can follow rapidly with research records showing that milk yield falls of up to 40% are not uncommon.

Once a cow's reaction to heat stress takes hold, a whole series of consequential health issues can follow. Increased standing by stressed cows, sometimes for as much as 60% of the day, has been linked to a subsequent rise in lameness. This is known to be more prevalent in cows which spend in excess of 45% of their time standing, compared to animals which rest normally.

The rise in panting, while a natural reaction designed to dissipate heat, also causes problems as the increase in respiratory rate leads to enhanced CO_2 being exhaled. This reduces blood CO_2 levels, triggering a chain reaction which can make the cow much more susceptible to rumen acidosis.

Rumen health is also affected negatively by the fact that panting cows drool more than normal. This reduces the quantity of saliva that would usually be deposited in the rumen, making digestion less easy. In seeking to manage heat stress in dairy cows, farmers try a range of strategies, such as differing feed regimes, environmental and mechanical strategies and the use of feed supplements.

Useful feeding ideas include altering feeding times to coincide with cooler parts of the day; giving feed in smaller amounts and increasing the number of feeding times; making sure high moisture feeds are dispensed before they undergo secondary fermentation, and minimising sorting of mixed rations by increasing feed presentation and evaluating particle size.

Useful environmental and technical suggestions include improving roof insulation for summer housed herds to reduce solar penetration; increasing the amount of available water; installing fans or opening the sides of the barn to increase air flow and fitting misters in combination with fans to further reduce temperatures.

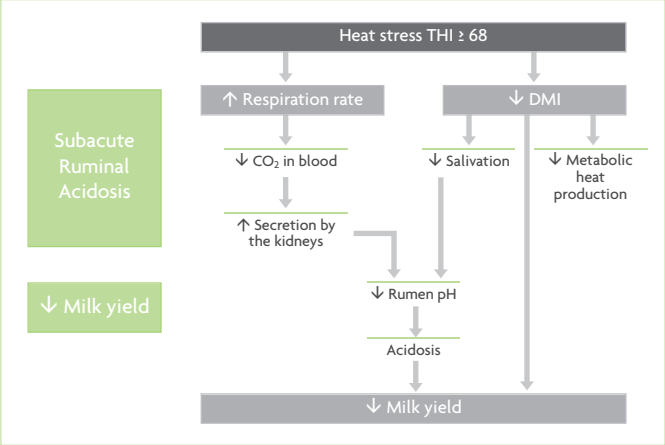


Fig. 1. Effect of heat stress on milk yield.

Useful supplement solutions include adding yeast solutions to diets. According to Valentin Nenov, Phileo's Global Ruminant Manager, trials with yeast probiotic Actisaf, resulted in improved fibre digestion in heat stressed dairy cows; helped stabilise the rumen and reduced respiratory rates, leading in turn to increased milk and milk solids production. The company has also achieved positive results with its premium yeast parietal fraction, Safmannan, and its selenium-enriched yeast, Selsaf.

References are available from the author on request
www.phileo-lesaffre.com

Quick mastitis detection

About 40% of clinically abnormal milk samples tested with traditional bacterial culture come back with a 'no growth' result, leaving farmers exactly where they started – with a mastitic cow and no diagnosis.

To overcome this reoccurring dilemma, Thermo Fisher Scientific has launched the Applied Biosystems VetMAX MastiType Multi qPCR Kit. The new diagnostic test quickly identifies the most common mastitis-causing pathogens, enabling dairy farmers and veterinarians to take immediate and informed action.

The new kit is designed to detect 15 mastitis-causing bacteria and an antibiotic resistance gene with just one diagnostic test. It provides reliable results with individual cow samples or bulk milk samples, which can be fresh, frozen or preserved.

Real-time PCR kits, such as the new VetMAX MastiType Multi Kit, offer laboratory results in two and a half to three hours, enabling same-day results even for mycoplasma species.

Mycoplasma mastitis, which can be difficult to culture, can take up to 10 days with traditional bacterial culturing. The pathogen can spread swiftly, making rapid diagnosis critical for the health, welfare and productivity of the herd.

Laboratories also benefit from VetMAX MastiType Multi Kit's fast and convenient new workflow using the MagMAX CORE nucleic acid extraction. It uses the Applied Biosystems QuantStudio 5 instrumentation which employs cloud-based software solutions.

"Dairy farmers and veterinarians want better, faster diagnostic solutions," Martin Guillet, global head and general manager for AgriBusiness at Thermo Fisher Scientific, told International Dairy Topics.

"VetMAX MastiType Multi qPCR Kit joins the recently launched VetMAX MastiType Micro4 Kit and VetMAX MastiType Myco8 Kit to complete our mastitis veterinary diagnostic portfolio. It offers an additional qPCR solution for mastitis detection to our portfolio that will help veterinarians and farmers take fast, well-informed action toward eliminating mastitis in the dairy herd."

thermofisher.com/animalhealth

Global animal welfare awards

Ceva Santé Animale (Ceva) and the World Veterinary Association (WVA) are continuing their commitment to promote ever better international standards of animal welfare by organising the Global Animal Welfare Awards, recognising and rewarding veterinarians for their outstanding efforts to protect and improve the welfare of animals.

Veterinarians are not only essential for the treatment and prevention of animal diseases, but also in research and the education of politicians, public health authorities, the media and general public.

The aim of the WVA Animal Welfare Awards is to recognise and reward veterinarians who in their daily lives contribute to the protection and welfare of animals and have provided outstanding and exemplary welfare-related services to animals, animal owners, fellow veterinarians and the public.

Following the successful deliverance of the WVA Animal Welfare Awards in 2017 and 2018, Ceva and WVA in collaboration with the International Veterinary Students' Association (IVSA) have this year agreed to expand the scope of the awards by adding a new category recognising a veterinary student for his/her involvement and engagement in animal welfare.

The WVA Animal Welfare Award 2019 will be presented to six selected veterinarians from the WVA six geographical regions and to one veterinary student from around the world.

The Award Ceremony will take place during the 35th World Veterinary Association Congress on 28th April 2019 in San Jose, Costa Rica where the selected winners will be invited to receive the WVA Animal Welfare Award and a monetary prize of €5,000.

In addition, Ceva and WVA are actively studying a plan to expand the AW Awards categories to include veterinary schools in future editions, rewarding them for Animal Welfare Excellence in Veterinary Education.

ceva.com

Innovation in fermentation

The increased interest in fermented foods due to their potential contribution to gastrointestinal microbiota modulation and the impact on human health is leading food scientists to pay greater attention to their role in diets.

Promoting innovation in fermented dairy for human well being was the focus of the 6th Symposium on Science and Technology of Fermented Milk which took place recently at the IDF World Dairy Summit in Daejeon, South Korea.

The Symposium built on the discussions of the 5th Symposium held four years ago in Melbourne, Australia.

"Holding the 6th edition of this Symposium in Asia is of tremendous value as the scientific research on fermented dairy and the interest of these products are growing in the region," David Everett, Chair of IDF's Standing Committee on Dairy Science and Technology, told International Dairy Topics.

At the 6th Symposium, Dr Seppo Salminen of University of Turku, Finland, discussed the potential for fermented foods to fight diseases and improve nutrition.

The Symposium also explored ways to enrich food through product development and innovation, particularly to provide nourishment for vulnerable populations.

Dr Xueying Mao of the China Agricultural University examined the potential for new ingredients such as milk protein hydrolysate-calcium complexes to become a good calcium supplement in yoghurt production. Growth opportunities for yoghurt is encouraging, according to Dr Kwangsei Lim of Danone Pulmuone, South Korea, with the yoghurt market, including fermented beverages, accounting for close to 15% of global dairy sales value.

Other speakers included Dr In Kyu Lee of Catholic University's St Mary Hospital, South Korea; Dr Juhoon Lee of Kyunghee University, South Korea; Dr Guy Vergéres of Swiss Agroscope, Switzerland; Dr Mansel Griffiths of University, Dr Bruno Pot of Yakult Euro, France; Dr Sungsik Jang of Yakult, South Korea; Dr D. K. Sharma, National Dairy Development Board, India; Dr Yodai Kobayashi of Morinaga Milk, Japan; and Dr Nagendra Shah or University of Hong Kong.

idfwds2018.com

Neogen's new dairy hygiene range, which includes teat dips and sprays, CIP and bulk tank cleaners, hoofcare and dairy cleaning products, has now been launched worldwide. Neogen BioSecurity's range of teat dips and sprays are available for pre-milking, pre/post-milking, and post-milking. They are designed to help limit the transmission of mastitis-causing bacteria in dairy animals and to provide a high emollient content for teat protection and conditioning. The range includes products that are based on lactic acid, iodine, or a blend of both. The Ultra Circ alkaline and Ultra Acid range of clean-in-place (CIP) and bulk tank cleaners are essential to thoroughly clean pipelines and bulk tanks, ensuring milk safety and quality. Within the range, there are specialist products designed for tanks, pipelines and robotic milking systems, to remove milk proteins and fats; and prevent and remove build-up of mineral deposits. Specialist cluster flushing products can reduce the risk of mastitis caused by cross-contamination from infected milk residues on clusters. The cluster flush products by Neogen BioSecurity can be applied via automatic systems, using hand-held sprayers, or manual disinfection methods.

neogen.com

All-in-one feed pushing robot

Faro is a new and elaborate concept from Schauer that combines all the functions of equipment already on the market, and has even more to offer. This feed pushing robot is not only able to transport feed to the feeding fence in both directions, it is also capable of mixing two types of concentrated feed if required. Through innovative technology, the status and log data are uploaded directly to the Cloud and can therefore be accessed from any location. With the FaroSmart app, you can conveniently manoeuvre and teach the robot.

schauer-agrotronic.com

Proven solution on show

ICC Brazil will introduce a scientifically proven solution for improving the intestinal integrity of ruminants at Eurotier in Hannover, Germany this year.

ICC Brazil's booth will introduce RumenYeast, composed of yeast and high concentrations of metabolites that stimulate the development of micro-organisms responsible for fermenting and maintaining ruminal pH. It also has yeast cell wall, which is rich in β-glucans and MOS, responsible for improving the immune system and intestinal integrity and for enhancing animal weight and milk production.

Dr Melina Bonato, the R&D Coordinator, says yeast has been used in ruminant nutrition as a functional additive to diets.

RumenYeast is composed of 100% of the Saccharomyces cerevisiae yeast, which is originated from the sugarcane fermentation process to produce ethanol. Then, the yeast is submitted to autolysis (rupture of the cell membrane), which releases the intracellular content. The final product is highly digestible, as it contains amino acids, peptides, short-chain polypeptides, glutamic acid and a yeast cell wall, composed mainly of MOS and high levels of β-glucans.

Research and field studies have been showing that RumenYeast can increase milk production by +2kg/cow/day and milk quality (fat and proteins).

"Combining adequate ruminal nutrition with the strengthening of the cow's immune system enhances daily milk production and eliminates concerns with potential residues in milk, which is a key factor to reach an increasingly demanding consumer market," Melina told us.

iccbrazil.com

Cut nitrogen pollution

With agriculture responsible for 88% of the UK's ammonia emissions, improving nitrogen use efficiency will be critical to meet upcoming atmospheric pollution targets.

Better feeding can help, claims KW nutritionist Dr Anna Sutcliffe, and also offers an opportunity to cut costs and raise margins. Around 75% of the nitrogen fed to dairy cows is excreted in urine or faeces, much of which is lost as ammonia or nitrous oxide into the atmosphere. That is not only a pollution issue, it is also a massive waste of costly nutrients.

Research at CEDAR has shown that improving nitrogen use efficiency can allow dairy ration crude protein levels to be cut from 18% to 16% with no loss in performance.

Grass silage is the major source of rumen degradable protein (RDP) in most dairy rations, but levels can vary hugely. Yet balancing that RDP with the right spread of energy from sugars, starch and digestible fibre is essential if the nitrogen is to be efficiently captured by the rumen microbes.

"Regular analysis of silages is therefore critical to keep rations on track. Combined with targeted use of high value rumen-bypass proteins like NovaPro hot-pressed rapeseed expeller or SoyPass heat-treated soyabean meal to meet remaining cow requirements, the result can be a reduction in both nitrogen wastage and ration costs," Anna told us.

kwalternativefeeds.co.uk

Optimising consumption

Protonat 2C from MiXscience is now also available in a granulated mineral. This simplifies the incorporation of this product, composed of essential oils and plant extracts, into mash feed for calves. Protonat 2C Gr is enriched with vitamins and palatable factors to optimise consumption. It is used until weaning, ideally up to six months for dairy heifers.

mixscience.eu

ARM & HAMMER

www.AHanimalnutrition.com

Risk of subclinical clostridial infections

Dr Joel Pankowski,
Field Technical Services Manager,
ARM & HAMMER Animal Food Production

The impact of clostridia on dairies is often underestimated. But new evidence reinforces the prevalence of clostridia on dairy farms across the United States and demonstrates its widespread risk. ARM & HAMMER researchers collected data[1] from 39,000 cows in 16 representative dairy herds in California, Idaho, Iowa, Texas and Wisconsin. Almost three-quarters of total mixed ration (TMR) samples on the dairies tested positive for clostridia. Researchers measured clostridia and C. perfringens counts in faecal samples prior to and after feeding CERTILLUS for 90 to 150 days. Each sample was assigned a level of clostridial risk:

- High risk >1,000 CFU/g faeces
- Moderate risk 100 to 1,000 CFU/g faeces
- Low risk <100 CFU/g faeces

Tests showed that clostridial risk rates varied across dairies and regions, but all had significant numbers of at-risk cows prior to feeding CERTILLUS.

CERTILLUS delivers proprietary strains of Bacillus to combat harmful pathogens. After feeding CERTILLUS, producers in all five states saw their rates of high-risk levels significantly decrease (Table 1).

State	Prior to feeding CERTILLUS (% high-risk for clostridia)	Post-feeding CERTILLUS (% high-risk for clostridia)
Idaho	60.0	25.0
Texas	39.7	14.6
Wisconsin	39.5	18.4
California	26.6	16.7
Iowa	25.0	22.5

Table. 1. Results by state showed significant decreases in high-risk levels.

Averages across all dairies (Fig. 1) showed that feeding CERTILLUS:

- Reduced high-risk category by 26.4%
- Increased percent of cattle in low-risk category by 83.8%
- Decreased high-risk associated with C. perfringens by 25.6%
- Increased percent of cattle in low-risk category of C. perfringens by 23.3%

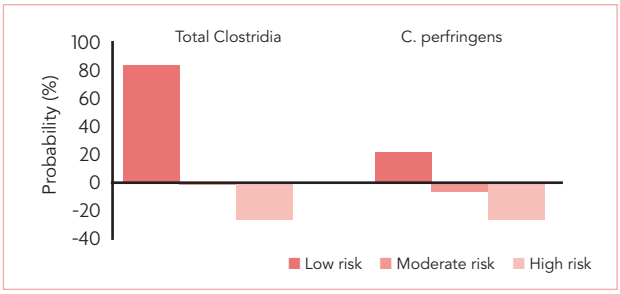


Fig. 1. Shift in risk associated with total clostridia and C. perfringens before and after treatment with CERTILLUS (16 farm summary).

IMPROVED RESILIENCY

In addition to decreasing the risk associated with clostridia and C. perfringens on dairies, farms observed many other benefits of feeding CERTILLUS: more consistent feed intakes and fewer off-feed events; fewer cows in the sick pen with fewer gastro-intestinal related deaths; smoother transition and a positive milk response; increased rumination with more consistent manure.

[1] *Data collected and analysed by ARM & HAMMER. Data on file, 2018.*

To learn more, visit www.AHanimalnutrition.com

internationalnews

Veterinary digital content specialist Vetstream has extended its Vetlexicon service with the launch of Bovis – a peer-reviewed online clinical resource for vets working with cattle. Bovis contains more than 750 articles – and 1,500 images, videos and sounds – from more than 120 of the world's leading experts in cattle medicine. It also contains more than 50 fact sheets to support farmer education. The services are accessed via subscription and feature content from more than 1,000 leading veterinary clinicians from around the world. Vetstream has also partnered with Wiley and CABI, which have provided some of the content. Each service is updated weekly and is accessible from any internet-enabled device. Mark Johnston, managing director of Vetstream, explained: "As livestock veterinarians spend so much time out of the practice, either on farm or travelling between clients, we felt a Vetlexicon service would be an ideal resource as it can provide species-specific clinical information that they can access quickly and easily through their smart device. This saves them from having to rely on possibly out-of-date textbooks that are often not where they are supposed to be in the practice."

vetstream.com/bovis

Mycotoxin risk management

The weather conditions during spring 2018 over a large part of France were favourable for the development of fusariosis.

The annual control plan carried out by MiXscience on wheat highlights an increased risk for the development of deoxynivalenol (DON) in France compared to 2017. This year, 32% of the samples have shown a concentration over 1000ppb, whereas it was 8% in 2017.

To mitigate the risk and maintain animal performance, MiXscience offers products and services that are included into a comprehensive risk management program.

To locally assess the risk in raw materials and finished feeds, MiXscience offers a portable field tool to analyse quantitatively the main mycotoxins (AFLA, DON, FUM, OTA, ZEA, T2/HT2).

It allows mycotoxin values to be analysed in only 20 minutes in a very simple way that is accessible to all without any prior knowledge. The equipment was selected for its reliability and practicality (available mycotoxins, validated matrix, ease of extraction).

With the analytical values, and taking into account the animal species and its physiological stage, the diagnostic tool Mycoscope allows producers to figure out if the level is problematic for the animals.

If a risk is detected, then the tool recommends a solution from the MiXscience range adapted to each situation encountered.

mixscience.eu

Detecting Johne's disease

Johne's disease can be reliably detected in the blood of day-old calves for the first time using a new Actiphage diagnostic system. This was revealed by a UK-French team at the recent European Association of Veterinary Laboratory Diagnosticians (EAVLD) Congress in Brussels.

Johne's disease is a chronic wasting disease transmitted from mother to foetus or by bacteria shed in manure, colostrum and milk. Current tests only allow the reliable detection of Mycobacterium avium subspecies paratuberculosis (MAP) from 18-24 month calves and are unable to distinguish between active and passive infection

The 16-month trial, by researchers at BioSellal and PBD Biotech, involved monthly testing on calves from three different herds – born from MAP-positive and MAP-negative cows – using PBD Biotech's Actiphage Rapid kit and Biosellal's Bio-T kit MAP PCR on blood samples, and the same PCR on faeces. The trial proves that early detection of live MAP infection is possible, and paves the way for improved Johne's disease monitoring and control measures on farms.

Co-Author Dr Ben Swift, Research Fellow in Antimicrobial Resistance and R&D Director at PBD Biotech explains: "Young animals are highly susceptible to infection and being able to identify Johne's disease at this early stage is key to controlling disease spread. The trial showed that the sensitivity and specificity of Actiphage enables detection of lower levels of MAP than the current culture methods, and provides results in six hours rather than weeks."

The Actiphage Rapid technology used in the trial identified live MAP infection at least four weeks earlier than the faecal PCR in 75% of cases: in one case, the new diagnostic detected MAP in the blood of a one-day old calf born from a MAP-positive cow.

Claire Pelletier, Directrice Générale of BioDev, consultant to Biosellal, presented findings from the trial, which also showed the transient nature of the infection. "The study showed that two calves, identified as MAP-positive by Actiphage-PCR on blood during the first monthly sampling did not shed MAP into their faeces until 10 and 11 months. This emphasises that early detection provides a short window of time to control the disease.

pbdbio.com

Satisfying turnout at SPACE 2018

SPACE, one of the leading international events for livestock professionals, recently took place in Rennes, France. Attendance levels were high, the weather was superb and once more, the quality of the show was excellent.

The four day event underlined the show's international standing and it also served to highlight the strength of the agricultural industry in north-west France.

This year was the 32nd time that SPACE has opened its doors to the industry. This time there were 1,410 exhibitors from 42 different countries and a total of 108,347 delegates from 121 countries around the world. In terms of French visitor numbers, there was a slight downturn on last year (-6.65%), but all things considered, attendance was satisfactory. This small dip was mainly due to the fact that corn silage harvesting took place a fortnight earlier than expected this year and therefore clashed with the show.

International attendance was up slightly (by 2.8%), showing how SPACE has unique international appeal, despite the market being particularly competitive this year.

The exhibition was particularly strong this year in terms of international reach, with its focus on innovation in working conditions and excellence in health and safety.

Delegates came to Rennes from all over the world: India, Japan, China, Korea, Canada, Russia, Ukraine, North Africa and West Africa.

space.fr

Feeding sugar beets and beet pulp to dairy cows

by Fernando Diaz (DVM, PhD)

Sugar beet is a temperate climate crop grown mainly for production of sucrose. A recent study from the Atlantic Dairy and Forage Institute, NB, Canada, determined if sugar beets can be efficiently added to mid-lactating dairy cow diets as a source of energy.

The researchers (Evans at al., 2016) replaced corn and barley with sugar beets at 0, 8.0, 16.0, and 24.0% of the total diet dry matter (DM). Soybean meal was used to adjust protein content in the diets (16% protein).

Sugar beets used in the current study were harvested in the Port Dover region of Ontario, Canada, in early November 2014. Dry matter, protein, fibre (NDF), and sugar contents in the beets were 23.3, 2, 3, 11.6, and 71.2% of DM, respectively. They were chopped just before being added to the TMR at particles that ranged from 2-4cm in length and approximately 1cm in width. Sugar level in the diets increased with the inclusion of beets from 4.61% in the TMR without beets to 19.12% in the TMR with the greatest inclusion of beets.

The results, published in The Professional Animal Scientist, showed similar performance (26.33kg of milk/day, 31.2kg/day 3.5% fat-corrected milk, 3.68% milk fat, 3.47% milk protein) and feed efficiency (1.25kg of energy-corrected milk/kg of dry matter intake) among diets.

Sugar beet pulp is a co-product of the sugar industry high in fibre concentration and pectic substances that is used as a feed for ruminant. Using data obtained from 34 studies published from the last 26 years, researchers (Münnich et al., 2017) from the Institute of Animal Nutrition and Functional Plant Compounds in Vienna (Austria) performed a meta-analysis to evaluate the effects of beet pulp inclusion in cows' performance and the rumen environment.

The inclusion levels of beet pulp in these studies averaged 14.5% of diet dry matter (ranged from 0-44.7%), and the amount of beet pulp fed to cows averaged 2.79kg DM per day (0-5.56kg).

The findings, published in the Animal Feed Science and Technology magazine, showed that although milk and milk protein yield did not change, beet pulp inclusion had a positive effect on milk fat yield and milk fat percentage.

However, the highest yield and highest milk fat percentage were found in medium beet pulp inclusion level (10-20% of DM). The increase in milk fat yield is due to a greater production of ruminal acetate, since this volatile fatty acid is an important precursor for de novo milk fat synthesis.

In conclusion, these studies showed that sugar beets and beet pulp can be included in lactating cow diets without affecting performance.

Fernando Diaz works as a Dairy Nutrition and Management Consultant at Rosecrans Dairy Consulting, LLC. He provides consultation to dairies and feed companies including nutrition and feeding management, operational effectiveness, people capital management, and research and product development of new feedstuffs, additives and technologies for dairy cows. He can be reached at fernando@jration.com

internationalnews

Zoothermal water mattresses from Bioret Agri provide improved heat dissipation, reduced stress and increased production. Aquastar is their continuous roll water mattress which provides a dedicated full water pouch for each cow. The comfort of the lying position is improved, as is the zoothermic regulation in moderately hot and humid regions (oceanic climates for example). The Aquaclim free stall mattress recirculates cooled water using a cooling system. It provides maximum lying comfort and zoothermic heat regulation in even the most severe climatic conditions and/or for dairy cattle with very high production potential. The Aquaclim Thermo-dynamic is a free stall mattress that recirculates cooled water using a heat pump concept allowing heat recovery for on-farm applications. Cow comfort is improved as is performance. Energy recovered from the cows can be captured to heat water, heat the environment and create an eco energy system available all year long. Aqua Board is the company's water filled kneeboard which creates a soft, tissue friendly barrier and naturally positions the cow.

bioret-agri.com

APPOINTMENTS

WIM BEEKS
Joosten
Manager, Sales & Marketing, South Asia
www.joosten.nl

RICARDO COMMUNOD
Norel
Commercial Director for APAC region
www.norel.com

Hypocalcaemia & fertility

Studies have shown that hypocalcaemia has a negative impact on reproduction and cows with a low calcium level are having more empty days, lower pregnancy rate and a later heat than cows maintaining a calcium level above 2.125 mmol/L (8.5mg/dL) in the periparturient period.

X-Zelit, from Vilofoss, is a calcium binder for the prevention of hypocalcaemia. Supplementation of X-Zelit in the last 14 days of the dry period is increasing the plasma calcium level, and thus it is expected that X-Zelit has a positive impact on reproduction.

Last year Cornell University carried out trials with X-Zelit among multiparous cows with a yield around 15,000kg ECM. The trial showed, in line with earlier trials, that cows supplemented with X-Zelit in the close-up period could maintain a stable calcium level during calving. The trial also examined the reproductive performance of the cows, and it showed that cows supplemented with X-Zelit had a better pregnancy rate than the cows in the control group.

The cows in the X-Zelit group had fewer empty days than cows in the control group and median time to pregnancy was 19 days earlier.

These highly improved reproduction results correspond to a study in New Zealand in which pasture-fed multiparous cows were supplemented with X-Zelit. The cows that were given X-Zelit became pregnant 7.5 days earlier in lactation compared to the control group. In this study, pregnancy was also assessed in relation to start time of seasonal insemination, and it was found that cows in the X-Zelit group were pregnant 13.8 days earlier in the season than in the control group.

Also, in a trial conducted by Martinez et al. (2012) there was 15 less empty days in the normo-calcaemic group compared to the hypocalcaemic group. In the same trial the probability for a positive pregnancy for normocalcaemic cows were estimated to be 1.61 times as large compared to hypocalcaemic cows.

Thus, relationship between plasma calcium and reproduction is high, and reproduction is highly improved when X-Zelit is used.

vilofoss.com

Fast fodder analyses

Forage analysis is a highly anticipated strategic tool for farmers. Previously, MiXscience had developed a new analytical method by NIR (near infra-red) 'fresh unmilled'.

Today, MiXscience offers a faster technology, with the same reliability as the 'dried crushed' technique used previously. It allows a saving of 48 hours to get a result.

For a standard analysis, it is now possible to get a result in four days maximum. Another advantage is that the entire sample is analysed, which maximises the representative nature of the samples.

Each year, MiXscience carries out more than 8000 analyses (corn, grass) with DM, crude protein, fat, cellulose and starch measurements.

MiXscience also measures relevant and specific zootechnical criteria, such as GluRum (ruminal carbohydrates) and MaRum (ruminal nitrogenous matter).

mixscience.eu

Mycotoxin detection service

Biomin has recently introduced a new, innovative mycotoxin detection service for customers globally. Spectrum Top 50 allows for the identification of more than 50 different mycotoxins and metabolites in finished feed and raw materials. "Regular testing for regulated mycotoxins is an accepted part of an effective mycotoxin risk management program," Ursula Hofstetter, Head of Global Product Management Mycotoxins at Biomin, told International Dairy Topics. "With Spectrum Top 50, customers will have access to a powerful new method to uncover previously undetected masked and emerging mycotoxins lurking in their feed in addition to the regulated ones.

"Customers will benefit from a full view of the mycotoxin situation in their feed, and the speed and scope of Spectrum Top 50 is unmatched in the market," she added.

biomin.com

Diary

2018

Eurotier
13-16th November
Hannover, Germany
www.eurotier.com

Agromek
27-30th November
Herning, Denmark
www.agromek.com

2019

LankaLivestock
17-19th January
Colombo, Sri Lanka
www.lankalivestock.com

Mycotoxins 2019
12th March
Bangkok, Thailand
www.positiveaction.co.uk

VIV Asia
13-15th March
Bangkok, Thailand
www.vivasia.nl

Fima Ganadera
19-22nd March
Zaragoza, Spain
www.feriazaragoza.es/figan-2019

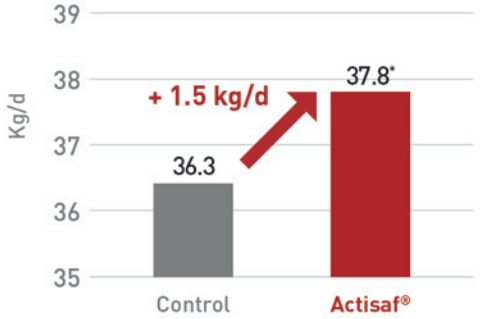
VIV Russia
28-30th May
Moscow, Russia
www.vivrussia.nl

Victam International
12-14th June
Cologne, Germany
www.victam.com

Livestock Philippines
26-28th June
Manila, Philippines
www.livestockphilippines.com

SAVE YOUR INCOME FROM GOING UP IN SMOKE!

↑ Milk yield under heat stress (69 ≤ THI ≤ 79)



Moallem et al., 2009. J. Dairy Sci. 92:343-351.
*p < 0.007

Program Heat stress

phileo-lesaffre.com/heat-stress/dairycows

Phileo
LESAFFRE ANIMAL CARE