VISTACELL – PROMOTING RUMEN PERFORMANCE

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Harnessing the power of the rumen

The industry-wide collective understanding of ruminant nutrition continues to progress with the advent of new insights into the rumen microbiome and subsequent improved feeding applications on-farm. Moving with the direction of the science, feed ingredients that work side by side with rumen microbes offer a best-practice approach to optimising the rumen. The addition of live yeast to the ration offers one such approach, providing a unique mode of action among yeast products that can not only influence rumen microflora in a manner that supports a stable pH and improved fibre digestion, but is also the subject of increasing research as an antibiotic alternative in markets where consumer trends and legislation are influencing beef and dairy production.

The progression of yeast technology

The yeast feed market is occupied by a number of different products including yeast cell wall, hydrolysed yeasts, yeast extracts, and live yeasts. However, live yeast is increasing in popularity as a feed additive in dairy, beef, and swine markets, to optimise rumen/gut function.

Live yeast products can be broadly split into two categories. Yeasts predominantly selected for use in the baking and brewery industries are often referred to as first-generation yeast, but are also used in ruminant nutrition; and yeasts specifically selected to work in the rumen, are commonly referred to as second-generation yeast. These products have been selected based on advances in yeast technology combined with nutritional expertise to find strains that are ideally suited to performing in the rumen environment.

A unique mode of action to optimise the rumen

The key factor that differentiates live yeast from other 'dead' yeast products is the ability to scavenge oxygen in the rumen (Newbold *et al*., 1996) as living yeast would preferentially use oxygen for metabolic processes. Oxygen enters the rumen through ingestion and rumination, as well as diffusion from blood vessels at the rumen wall. However, anaerobic fibrolytic bacteria in the rumen are sensitive to oxygen. The removal of oxygen from the rumen results in an environment that is optimised for fibrolytic bacteria to proliferate, leading to improved fibre digestion and, ultimately, better animal performance.

The potential of a live yeast to remove or 'scavenge' for oxygen can be evaluated by measuring redox potential

(E_h). The more negative the E_h, the greater the potential to scavenge oxygen. During feed and water intake, the E_h is increased due to oxygen stress. Feeding live yeast maintains a lower redox potential even at times of feeding (Krizova *et al*., 2011).

Selecting on size – micro yeast and redox potential

The selection of a second-generation live yeast strain for use in animal nutrition involves a series of screening tests, with the first step being the selection of a small cell size, or a 'micro yeast'. Small yeast cells have a larger cell surface area allowing for a greater potential to scavenge oxygen. A smaller cell size also enables a higher colony-forming unit (CFU) per gram to be delivered, allowing for the best possibility for live yeast to change and optimise the rumen environment through the removal of oxygen. These features, as well as other important characteristics including survivability in the rumen and volatile fatty acids (VFA) production as a measure of fibre fermentation, are taken into consideration when selecting a second-generation live yeast strain that is best suited to improving rumen function and animal performance.

The diagram in Figure 1. shows the redox potential of live yeast strains versus a hydrolysed yeast product. The live yeast with the highest CFU count per gram had the greatest redox potential, demonstrating the relationship between cell size and the ability to scavenge oxygen.

Through feeding a live yeast such as Vistacell with a high CFU count and, therefore, increased capacity to scavenge oxygen, greater benefits can be seen in the rumen including a higher rumen pH, increased VFA production, reduced lactic acid production, and improved organic matter digestibility (Denoyers *et al*., 2009).

In dairy trials, Vistacell has shown performance benefits from improved fibre digestion around +1,2 kg of extra milk per day, on average, with additional improvements in milk components (Ondarza *et al*., 2010). Depending on feed cost and milk price, this can give a return on investment of at least 6:1. Further trials with Vistacell at the recommended dose of 3 g/h/d have shown improvements in both milk yield and feed efficiency together.

Recent studies in beef cattle have also shown that diets supplemented with 1,5 g/h/d of Vistacell had improved feed conversion ratios, better total tract digestibility, better gain to feed efficiency, and superior meat quality associated with the addition of Vistacell live yeast to the ration.

Figure 1. Relative difference in redox potential between live yeast products with different CFU counts, a hydrolysed yeast, and a negative control. The live yeast with 60 billion CFU had the largest redox potential and so all other results are compared to that as a % relative difference (AB Vista internal data).

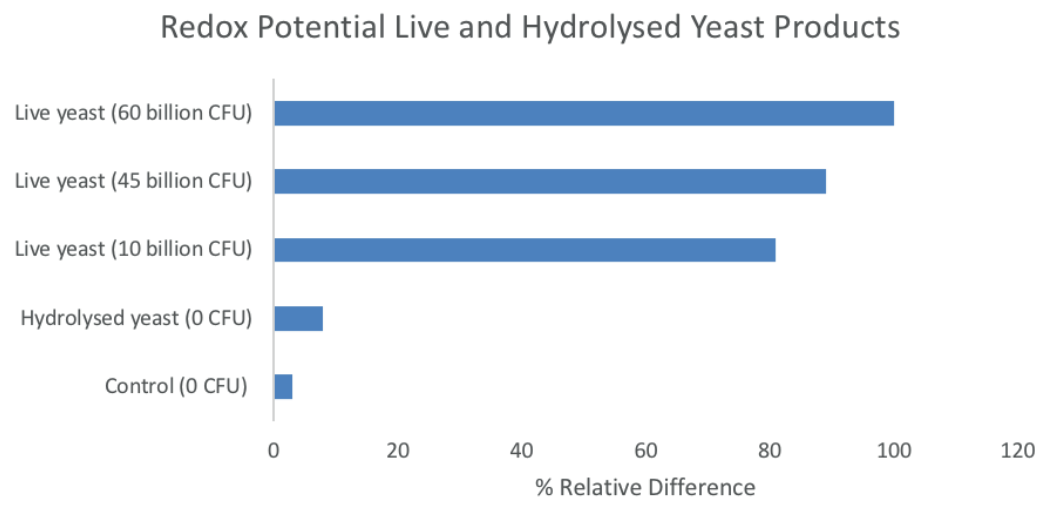
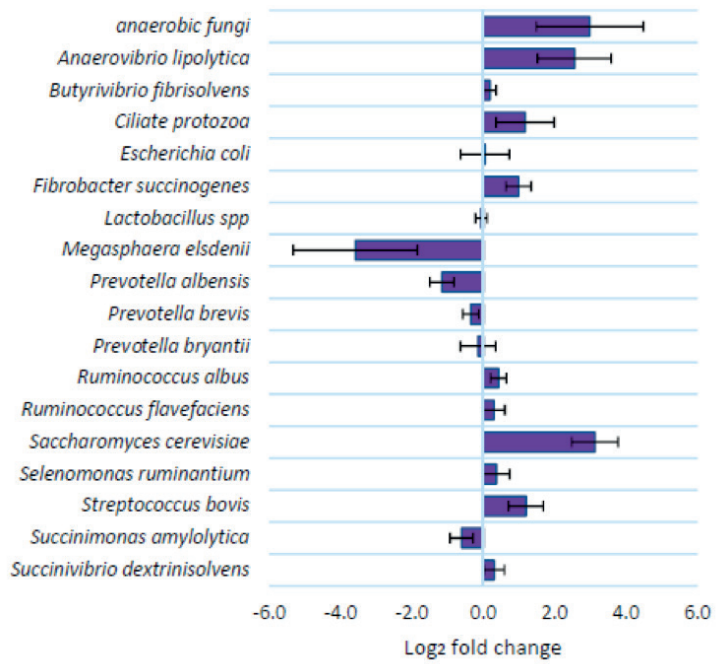


Figure 2. Effect of daily supplementation with live yeast on key members of the rumen microflora following a SARA challenge.



Putting rumen microbiology to work

The rumen of the cow contains up to 50 billion bacteria as well as hundreds of thousands of protozoa and fungi, the make-up of which play a critical role in influencing not only fibre digestion, but also rumen function. Throughout the day, rumen pH will fluctuate, with levels falling around the time of feeding, driven by factors including increased lactate production and VFA accumulation (Dijkstra *et al*., 2012). Cellulolytic bacteria are sensitive to a low pH (Newbold *et al*., 1996) and this poses a challenge to the maintenance of a stable rumen microbial population necessary for effective feed utilisation. Elongated periods of low rumen pH are also associated with a negative impact on feed intake and can contribute to milk fat suppression (Dijkstra *et al*., 2012).

The first steps in the understanding of the interaction of yeast with rumen microbiology involved in vitro work which helped to establish the oxygen scavenging and competitive exclusion modes of action of live yeast. In recent years, ruminant nutrition has taken a deeper look into microbiology, with studies taking a wider view of the whole rumen microbial population. This advancement in science and methodologies is an exciting opportunity to better understand the mode of action and effect of live yeast in the rumen.

In a study by AlZahal *et al.* (2017) the rumen microbial population of dairy cows fed Vistacell following a sub-acute ruminal acidosis (SARA) challenge was studied. There were increases in the fibre digesters *Fibrobacter succinogenes, Ruminococcus albus,* and *Ruminococcus flavefaciens.* Ciliate protozoa and Selenomonads, organisms associated with stabilising the rumen pH, were also increased. Conversely, *Prevotella* spp. associated with the release of toxins under conditions of low pH resulting in an inflammatory response of the gut lining, were decreased (see Figure 2).

With the cost of SARA being up to US$1,12 (Enemark, 2008) per cow per day, the inclusion of live yeast in the ration has the potential to help mitigate against the negative economic consequences of this form of rumen dysfunction and subsequent loss of production.

The addition of Vistacell live yeast to the ration has been shown to reduce the time the rumen spends below pH 5,6 by more than half (Figure 3), contributing to improved fibre digestion, increased microbial protein production, and a reduced risk of sub-acute ruminal acidosis as a result of modifying the rumen microbiome (AlZahal *et al*., 2014).

Using a micro live yeast such as Vistacell with a high CFU count per gram and subsequent high oxygen scavenging potential, allows for the maximum possibility to have an effect in the rumen. Through optimising the rumen conditions, stability of rumen pH allows for a more stable microbiota and improved fibre digestion, leading to more consistent production in times of stress such as early lactation or receiving phase.

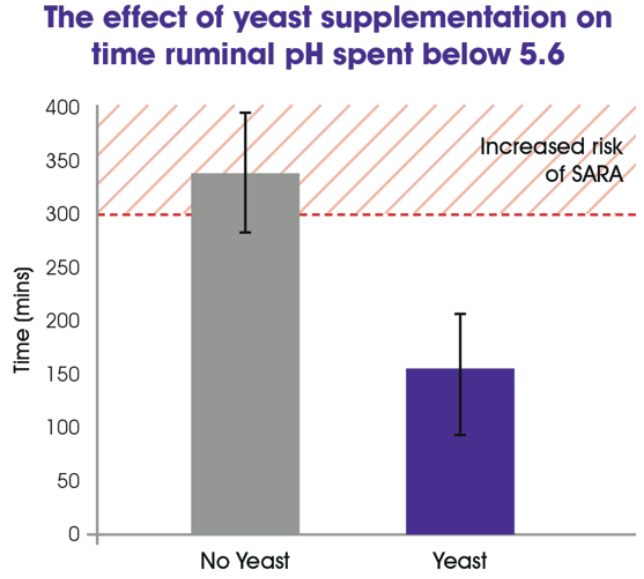
What next for live yeast?

Live yeast is a well-established probiotic ingredient that has traditionally been fed to bring improved performance through optimising the rumen environment for fibre digestion. As well as the possibilities to improve production, live yeast also offers the opportunity to be helpful in challenging high starch diets such as finisher beef cattle, and times of stress such as the receiving phase or in heat stress situations. Live yeast could also bring benefits in terms of immune modulation and pathogen binding (Posodas *et al*., 2017). This may have particular relevance in markets where there is a drive to reduce the use of antibiotics in beef and dairy production.

Conclusion

The rumen is the foundation upon which dairy and beef production is built. The profile of the rumen microbiome is a critical factor in influencing how effectively feed is utilised and will have a notable impact on economic success from the perspective of the producer. The addition of live yeast to the ration can help to create a rumen environment that enables optimal fibre digestion, and support effective rumen function through a unique mode of action that combines oxygen scavenging with probiotic effects. It is this ability to favourably modify the rumen environment that is driving increased research into live yeast as a means of supporting rumen function.

Figure 3. Time spent below ruminal pH 5,6 in cattle fed a no yeast control and a live yeast. Difference between treatments P<0,05.



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References available on request.