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Live yeast rising in popularity as feed additive in livestock diets

By **SOPHIE PARKER-NORMAN***

THE industry-wide collective understanding of ruminant nutrition continues to progress with the advent of new insights into the rumen microbiome and subsequent improved on-farm feeding applications.

Moving with the direction of the science, feed ingredients that work side by side with rumen microbes offer a best-practice approach to optimizing the rumen. The addition of live yeast to the ration is one such approach, providing a unique mode of action among yeast products that not only can influence rumen microflora in a manner that supports a stable pH and improved fiber 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.

Yeast technology progression

The yeast feed market is occupied by a number of different products, including yeast cell wall, hydrolyzed yeasts, yeast extracts and live yeasts. However, live yeast is increasing in popularity as a feed additive in dairy, beef and swine markets, either fed in isolation or combined with other additives such as buffers, to optimize rumen/gut function.

Live yeast products can be broadly split into two categories. Yeasts predominantly selected for use in the baking and brewery industry are often referred to as a first-generation yeast and are also used in ruminant nutrition. Yeasts specifically selected to work in the rumen are commonly referred to as second-generation yeasts.

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.

Unique mode of action

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). Oxygen enters the rumen through ingestion and rumination as well as diffusion from blood vessels at the rumen wall.

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However, anaerobic fibrolytic bacteria in the rumen are sensitive to oxygen. The removal of oxygen from the rumen results in an environment that is optimized for fibrolytic bacteria to proliferate, leading to improved fiber digestion and, ultimately, better animal performance.

The potential of a live yeast to remove or "scavenge" for oxygen can be evaluated by measuring the redox potential (Eh). The more negative the Eh value, the greater the potential to scavenge oxygen. During feed and water intake, Eh is increased due to oxygen stress. Feeding live yeast maintains a lower Eh, even at times of feeding (Krizova et al., 2011).

Selecting based on size

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 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 level of colony-forming units (CFU) per gram to be delivered, providing the best possibility for live yeast to change and optimize the rumen environment through the removal of oxygen.

These features and other important characteristics, including survivability in the rumen and volatile fatty acid (VFA) production as a measure of fiber fermentation, are taken into consideration when selecting a second-generation live yeast product that is best suited to improving rumen function and animal performance. THE diagram in Figure 1 shows the Eh of live yeast strains versus a hydrolyzed yeast product. The live yeast with the highest CFU count per gram had the greatest Eh, demonstrating the relationship between cell size and the ability to scavenge oxygen.

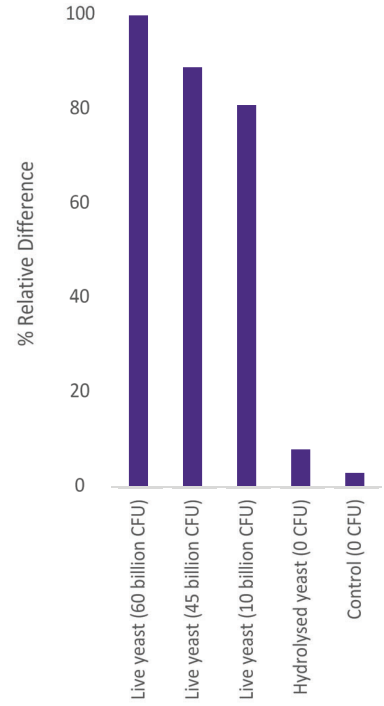
Through feeding a high CFU count and, therefore, increasing the capacity to scavenge oxygen, greater benefits can be seen in the rumen, including in a higher rumen pH, increased VFA production, reduced lactic acid production and improved organic matter digestibility (Denoyers et al., 2009).

In dairy trials, performance benefits from improved fiber digestion come in the region of 1.2 kg of milk per day, 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 between 6:1 and 15:1. Work in beef has shown improved total tract digestibility, gain:feed efficiency and meat quality associated with the addition of live yeast to the ration.

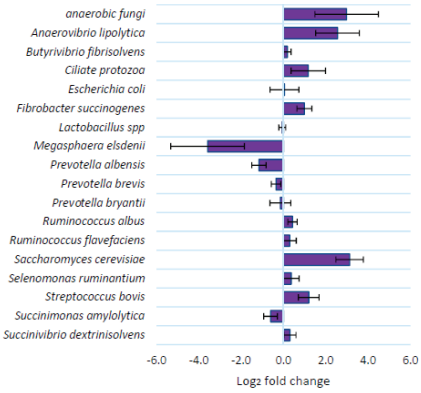
Using microbiology

The rumen of the cow contains up to 50 billion bacteria as well as hundreds

1. Redox potential of live and hydrolyzed yeast products



2. Effect of daily supplement with live yeast on rumen microflora following SARA challenge



of thousands of protozoa and fungi, the makeup of which plays a critical role in influencing not only fiber digestion but also rumen function. Throughout the day, rumen pH will fluctuate, with levels falling around the time of feeding, driven by factors like 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 maintaining the stable rumen microbial population necessary for effective feed utilization. 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 understanding the interaction of yeast with rumen microbiology involved *in vitro* work that helped 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 live yeast following a sub-acute ruminal acidosis (SARA) challenge was studied. There were increases in the fiber digesters *Fibrobacter succinogenes, Ruminococcus albus* and *Ruminococcus flavefaciens.* Ciliate protozoa and *Selenomonads*, organisms associated with stabilizing the rumen pH, were also increased. Conversely, *Prevotella* spp. associated with the release of toxins under low pH conditions, resulting in an inflammatory response of the gut lining, were decreased (Figure 2).

The addition of 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 fiber digestion, increased microbial protein production and a reduced risk of SARA as a result of modifying the rumen microbiome (AlZahal et al., 2014).

With the cost of SARA being up to $1.12 per cow per day (Enemark, 2008), 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.

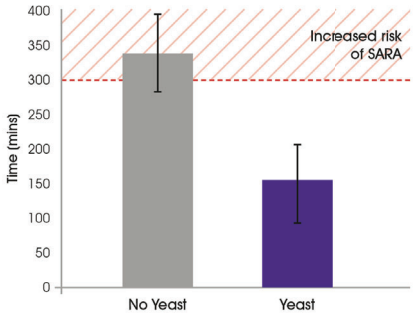
Using a micro live yeast with a high CFU count per gram and subsequent high oxygen scavenging potential offers the maximum potential to have an effect in the rumen. By optimizing rumen conditions, rumen pH stability allows for a more stable microbiota and improved fiber digestion, leading to more consistent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

What's next?

Live yeast is a well-established probiotic ingredient that traditionally has been fed to bring about improved performance by optimizing the rumen environment for fiber digestion. Beyond the potential to improve production, live yeast also offers the opportunity to be helpful in challenging high-starch diets such as for finisher beef cattle, times of stress such as the receiving phase or in heat stress situations.

Live yeast could also offer 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.

3. Effect of live yeast supplement on time ruminal pH spent below 5.6



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 utilized and will have a notable impact on economic success from the perspective of the producer. Adding live yeast to the ration can help create a rumen environment that enables optimal fiber digestion as well as supports effective rumen function through a unique mode of action that combines oxygen scavenging with probiotic effects.

It is this ability to favorably modify the rumen environment that is driving increased research into live yeast as a means of supporting rumen function in markets where antibiotic alternatives are being sought in response to consumer trends and government legislation.

References

References are available on request from NAM@abvista.com. ■