Benefits of fiber-degrading enzymes in dairy cow diets

The addition of enzymatic feed additives to dairy cow diets increases feed intake, animal performance

BY ALVARO GARCIA AND FERNANDO DIAZ

Fiber-degrading enzyme applications can enhance dry matter digestibility by up to 12 percent.

Constantin Oprus, Dreamstime

High feed costs and mounting consumer concerns about the use of antibiotic growth promoters (AGPs) in livestock production provide ample incentive to revisit and refine the use of enzymes in ruminant diets.

Enzymes can improve feed efficiency and reduce the cost of milk production. Feed additives with enzymatic fiber-degrading activity offer a potential to enhance forage digestion, feed efficiency and income over feed costs (IOFC). The application of a blend of cellulase and xylanase enzyme products to forages (corn silage and alfalfa hay) prior to feeding of 55:45 forage to concentrate diets can increase IOFC from $0.32 to $0.88 per cow daily.

When combining data from 20 studies and 41 treatments that added fiber-degrading exogenous enzymes to dairy cow diets, Canadian researchers reported overall increases in dry matter (DM) intake and milk yield of 2.2 ± 2.9 and 2.4 ± 3.3 lbs/day, respectively.

While the responses to the addition of fiber-degrading enzymes to dairy cow diets vary, the variability is not surprising because most of the commercially available enzyme products that have been evaluated as ruminant feed additives are produced for non-feed applications.

Feed enzymes for ruminants contain mainly cellulase and hemicellulase activities and are of fungal (mostly *Trichoderma longibrachiatum, Aspergillus niger, A. oryzae*) and bacterial (*Bacillus spp.*) origin.

Mode of action

Improvements in animal performance due to the use of feed enzymes have been attributed to increases in feed digestion.

In three studies conducted in lactating dairy cows, fiber-degrading enzyme applications enhanced DM digestibility, 4 to 12 percent, and neutral detergent

fiber (NDF) by 7 to 40 percent.

Three main factors explain the mechanisms by which fiber-degrading enzymes increase digestion and utilization of feedstuffs in ruminant diets:

1. Feeds are structurally very complex, containing a variety of polysaccharides, protein, lipids, lignin, and phenolic acids, often in intimate association.
2. Enzyme additives are usually blends of enzymes with many different actions, each of which differ in optimal conditions and specificities.
3. Ruminal fluid is, by nature, an extremely complex microbial ecosystem containing many hundreds of microbial species and their enzymes. Attempting to identify the individual mode of action of enzymes under such conditions would be nearly impossible.

Read more: How animal feed enzymes can improve producer profitability: www.WATTAgNet.com/articles/25854

Scientific review points to enzymes

Data obtained from 24 scientific articles published between 1999 and 2012, which studied the effect of dietary addition of fiber-degrading enzyme products on the performance of lactating dairy cows, included 27 trials and 94 treatments conducted on research stations and commercial dairy farms.

All studies evaluated exogenous fiber-degrading enzyme products with cellulase and xylanase activities, except two of them, which supplemented exclusively cellulases.

In addition to cellulase and xylanase activities, some enzyme complexes contained ferulic acid stearase, amylase, pectinase or protease activities.

ENZYMES CAN IMPROVE FEED efficiency and reduce the cost of milk production.

Enzymes were added to the diet at feeding time or only a few hours before; therefore, this article does not include trials in which enzymes were applied to forage at ensiling.

Several methods of adding enzymes to the diets were used across the studies. Enzyme products were applied to different portions of the diets including forage, concentrate, or complete, total mixed ration either in liquid or in powder forms.

Furthermore, some experiments compared the different methods of feeding enzymes to dairy cows.

Effects on feed intake

Fiber-degrading enzymes added to dairy cow diets are often accompanied by increased feed intake. This can be attributed to increased palatability due to sugars released on the feed itself before it is fed and/or enzyme effects once in the rumen that result in improved fiber digestibility, gut fill reduction, and increased intake.

Fiber-digesting enzymes increased intake by 2.4 to 7.0 lbs/day in 4 out of 27 of the trials examined (14.8 percent).

Dry matter intake (DMI) was not affected when 5.5 lbs./day of DM of an enzyme blend of cellulases and xylanases were added to the total mixed ration (TMR).

When the inclusion rate was doubled, however, DMI increased by 14.3 percent. In contrast, in other experiments DMI increased

regardless of the enzyme concentration. Moreover, the response of the addition of a fiber-digesting enzyme formulation to diets of dairy cows varied with stage of lactation. University of Idaho researchers detected increased DMI with enzyme addition, in weeks three to seven, but not weeks eight to 16 of lactation.

This difference observed on intake between early and late lactation may be due to the effects of ruminal fiber digestibility on feed intake. In early lactation, cows are usually in negative energy balance, suggesting fill, and not energy demand, regulates intake. Late-lactation cows, on the other hand, are usually in positive energy balance, suggesting energy demand, and not fill, regulates DMI. Therefore, intake of later lactation cows is less affected by increasing ruminal fiber digestibility because rumen fill does not limit intake in properly balanced TMR. ■

References available upon request.

Editor's note: This is the first installment in a three-part series.

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