HOARD'S DAIRYMAN

by Fernando Diaz-Royon, D.V.M., and Alvaro Garcia

Will feeding fiber-degrading enzymes pay?

LOWER milk prices and higher feed costs have producers looking for alternatives to improve feed efficiency and budgets. Forages are in general the least expensive source of energy. However, the efficiency of converting forages to milk is limited by the digestibility of its fiber.

Under ideal conditions, total diet digestibility is still generally less than 65 percent. Fiber-degrading enzymes added to the forage fraction of the ration were introduced to the feed-additive market as an alternative method of improving energy availability.

Feed enzymes for ruminants are those that degrade the principle fiber fractions in forages: cellulose and hemicellulose. They are mostly fungal and bacterial in origin. Enzyme products have been applied to different portions of the diets, including forage, concentrate, or complete TMR either in liquid or in powder forms. It has been suggested that their use may allow dairy producers to feed higher forage diets without compromising energy intake and milk production.

What we know so far

Responses to adding fiber-degrading enzymes to dairy cow diets has been variable. Some of this variation can be explained by the initial design of most commercial enzyme products for nonfeed applications. Their use in rations was relatively minor until recently given their previously high cost, inconsistent response, and the potential of other emerging technologies to improve animal performance.

Feeding fiber-degrading e nzymes to dairy cows has usually been associated with additional feed intake. Some researchers attribute this effect to improved palatability of the forage as a result of sugars released by the enzymes. Another possible explanation is that more fiber degradation in the rumen speeds passage of feed particles reducing gut fill and allowing the cow to reinitiate feed consumption.

Regardless of the biological mechanism, positive effects on dry matter intake have been observed from 2.4 pounds up to 7 pounds of gained feed dry matter per day. It seems, however, not all cows respond similarly, particularly depending on days in milk.

Cows in early lactation respond better to fiber-degrading enzymes, particularly between Weeks 3 and 7. Since cows early in their lactation are in greater need of energy, it is quite possible that improved fiber digestibility and greater intake help meet these requirements. This would obviously not be the case in late lactation where the intake of the TMR is enough to fulfill their energy needs.

More feed, more milk

Optimizing nutrient utilization is key to achieving highly profitable production per cow. This is a different concept from the old approach of maximizing feed intake. There is an optimum intake for a certain production target, which we call feed efficiency. Several factors affect this efficiency, including days in milk, age or lactation number, pregnancy requirements, body weight gain, diet digestibility, rumen fermentation enhancers, excessive heat or cold stress, feed additives, and the use of growth hormone.

More recent studies, however, suggest that the digestibility of the TMR is the best predictor of feed efficiency. Taking this into consideration, one would expect that the profitability of fiber-degrading enzymes depends on their ability to influence more milk with at least the same amount of feed.

The milk production response of dairy cows fed fiber-degrading enzymes, however, has been inconsistent. Cows responded with higher milk production in only eight out of 27 experiments reported in the literature. Of the experiments that showed positive results, production improved on average 5.5 pounds per day, ranging from 2.6 up to 13.9 pounds. When combining data from 20 studies that added fiber-degrading enzymes to the TMR, intake and milk yield improved 5.1 and 5.7 pounds per day, respectively. The response was dependent on the amount of enzyme and type of enzyme, as well as the method used to apply them to the TMR.

What about components?

Milkfat improved in only three of the 19 fiber-degrading enzyme experiments reviewed. In one of the experiments, more total fat was the result of greater milk production. However, in another experiment conducted at South Dakota State University, cows fed enzyme-treated forages had higher milkfat concentration regardless of the enzyme dose or stage of lactation.

In order to comprehend why fiber-degrading enzymes can result in more milkfat, it is important to understand how milkfat is synthesized. The two main contributors to milkfat synthesis are circulating fatty acids (of dietary origin or body fat mobilization) and fat synthesized "from scratch" in the mammary gland of the cow. The building blocks for this "from scratch" fat are the circulating fatty acids, the acetate produced during rumen fermentation, and a form of butyrate synthesized in the rumen walls.

The way in which fiber-degrading enzymes affect this synthesis is still under speculation. Although the fiber breakdown resulted in more total volatile fatty acids (particularly acetate) in the rumen, this has not been the case in all experiments. In fact, most studies have reported no effect at all on the volatile fatty acid concentration in the rumen.

Feeding fiber-degrading enzymes resulted in greater milk protein yield in only four of 20 experiments. Other studies, including one conducted at South Dakota State University, reported a bump in milk protein concentration but not protein yield. The response to more total milk protein has been variable and has ranged from 7.3 percent up to 27 percent. This was the result of higher milk production and/or its interaction with milk protein concentration.

As far as at what point in the lactation cycle cows respond better to fiber-degrading enzymes, most experiments suggest they have the greater influence very early in the lactation and as late as peak production.

Researchers predict the efficiency of microbial protein synthesis in the rumen goes up resulting in more of it reaching the intestine. It is a well-known fact that feed additives that enhance fermentable energy in the rumen boost microbial cell protein production, and as a result more of this protein reaches the duodenum of the cow.

Higher costs of production, combined with the availability of newer enzyme products, have renewed the interest in the opportunities of fiber-degrading enzymes as feed additives for dairy cows. The total feed enzyme market has expanded fourfold during the first decade of the 21st century. Their use by species has remained broad, with the highest sales occurring in poultry, followed by swine, and the ruminant market remains in its infancy. Effectiveness, price, and the future overall economic situation of the dairy sector will ultimately determine if feeding enzyme additives become a routine practice.

Diaz-Royon is a dairy nutrition and management consultant and Garcia is in the Department of Dairy Sci-ence at South Dakota State University, Brookings.