MODIFYING THE DIET CAN have a huge effect on the amount of methane produced in the rumen.

Divert energy from methane to milk

Reducing methane emissions is an economic and environmental "win."

by Mary Beth de Ondarza

DIGESTIVE fermentation of feeds produces methane. It has been estimated that 4 to 10 percent of the energy taken in by the cow is wasted as methane. According to a recent *Journal of Dairy Science* research review, about 17 percent of all global methane and 3 percent of all greenhouse gases (GHG) are attributable to enteric methane production. This contributes to the problem of global warming.

de Ondarza

The author has a dairy nutrition consulting business, Paradox Nutrition, LLC, in West Chazy, N.Y.

Methane that is belched out by the cow is wasted energy that could otherwise be used for milk production. Finding strategies to reduce methane emissions is an economic "win" for the dairy producer as well as the right thing to do for the environment. Agriculture and Agri-Food Canada researchers estimated that 20 percent less methane waste per day would provide enough energy for a high-producing cow to make an additional 1.3 pounds of milk per day. Experts have suggested that nutritional changes alone can result in 2.5 to 15 percent less methane produced per unit of milk.

More starch, less methane

Rumen microbes primarily make acetate and butyrate as energy for the cow when fiber is digested. Extra hydrogen resulting from this process is converted to methane. Starch, on the other hand, yields propionate without as much surplus hydrogen and methane. When Wisconsin researchers elevated dietary starch from 20 to 29 percent of dry matter, methane emissions were reduced by 17 percent (from 648 to 538 grams per cow per day). In a study conducted in the United Kingdom, as more grain was fed to grazing cows (4.4, 8.8, 13.2, or 17.6 pounds per cow per day), methane emissions per unit of milk dropped and milk yield improved.

Adding digestible dietary starch typically increases energy intake and milk yield in high-producing cows. However, optimal digestible starch levels depend on many factors including: level of production, days in milk, ration forage, ration fats, levels of other dietary nutrients (protein, soluble fiber, and sugar), and feeding behavior. Too little digested starch yields insufficient propionate, lactose, energy, and microbial protein. Possible consequences of too much rumen digested starch include rumen acidosis, laminitis, milkfat depression, reduced intake, reduced fiber digestion, and too much body fat gain by the cow.

Fat's a double-edged sword

Canadian researchers reduced methane by 5.6 percent with each percentage point of dietary fat, up to 2 to 3 percentage points in most diets. Fats can lower the activity of methane-producing bacteria and reduce the fermentation of organic matter to shrink rumen methane production. Dietary fats are typically used to enhance ration energy density for high-producing cows. One pound of fat supplies approximately 2.25 times more energy than a pound of carbohydrate.

However, care must be taken with fat supplementation. High levels of rumen available unsaturated fatty acids in the diet can cause a number of issues. Too much fat can disrupt the cell membrane of rumen bacteria, especially in those that primarily digest fiber. This results in reduced fiber digestion. The rumen microbes convert unsaturated fats to saturated fats by a process called biohydrogenation. But high levels of unsaturated fatty acids and low rumen pH can cause an abnormal rumen fermentation.

The microbes change their fatty acid biohydrogenation process altering the types of fatty acid intermediates produced and more conjugated linoleic acid (CLA) isomers escape from the rumen. When even very small amounts of these CLA isomers escape from the rumen, they can cause milkfat depression.

Ionophores divert energy

Researchers estimate that monensin helps the cow get 2 to 4 percent more energy from her feed, reduces methane loss by 4 to 13 percent, and improves feed efficiency. Monensin is an ionophore, which changes the movement of certain ions in to and out of the microbial cells. (An ion is a charged particle like sodium (Na+) or potassium (K+) formed by the loss or addition of electrons by a neutral atom.) The result of this ion exchange is that the affected microbes don't have as much energy to grow and reproduce.

Gram-positive bacteria are primarily inhibited by ionophores. Included in the gram-positive category are: bacteria that produce a lot of lactic acid and drive down rumen pH creating acidosis, bacteria that digest and waste a large amount of dietary protein, and bacteria that produce hydrogen ions, which must be converted to methane. By feeding ionophores, more energy is diverted from methane production to propionate production leading to more energy for milk production.

Higher milk production per cow reduces the overall percentage of energy necessary for cow maintenance (walking, breathing, ruminating, and so forth) and reduces the number of cows needed to make the same amount of milk. For example, many U.S. dairy producers have reduced methane output per pound of milk produced by harvesting highly digestible forage fiber, and improving milk yield and productive efficiency. Improving reproductive efficiency with better heat detection, synchronization programs, heat stress reduction, and greater transition success results in less culling and fewer replacement heifers are needed. Experts estimate that these management improvements can reduce methane per unit of milk by 9 to 19 percent.

The Canadian dairy industry reduced methane emissions by 24 percent between 1990 and 2008 by elevating milk yield per cow and reducing cow numbers. In a recent collaborative study by researchers in the U.S., UK, and Ireland, it was concluded that improving milk production had the greatest positive influence on methane emissions. Top-performing herds had a carbon footprint that was 30 percent lower than average herds.

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