Methane emissions and their correlation to feed choices – why do we care?

Caitlyn M. Welty for *Progressive Dairyman*

AT A GLANCE

Mint, oregano and garlic – while essential oils and plant secondary compounds have been, and are being, researched for health benefits, they're also being studied as one way (among many) to reduce methane production.

Caitlyn M. Welty
Nutrition Assistant
Renaissance Nutrition
caitlynmmarie@gmail.com

The Food and Agriculture Organization (FAO) of the United Nations estimates that 18 percent of greenhouse gas emissions can be attributed to livestock production, of which 37 percent is methane. According to a Cow of the Future Research council, the U.S. dairy industry has set a goal to decrease methane emissions per pound of fluid milk by 25 percent by the year 2020. So how do our feeding choices impact methane production? Generally, there are six ways that feed choices can affect methane production in ruminants: electron acceptors, propionate enhancers, inhibit protozoa and methanogens, and overall health and productivity.

Fed ionophores in methane production

Nitrate and sulfate are electron acceptors that thermodynamically outcompete methanogens (bacteria that produce methane in the rumen) for hydrogen in the rumen, reducing methane production by 30 percent. Nitrate does not cause milk depression, but it can cause toxic effects in the blood of cattle. However, with rumen adaptation over time, this toxicity can be prevented, and the ammonia produced can be utilized by rumen microbes for milk production and growth. Ruminants can consume nitrates beyond feedbunk supplementation – for example, forages can also be high in nitrates in early mature stages, or following a drought or excessive fertilization.

By feeding an ionophore, we can decrease methane anywhere from 11 to 30 percent by shifting the volatile fatty acid (VFA) production in the rumen towards propionate. This can utilize metabolic hydrogen before methanogens can use it to produce methane. However, this is not a long-term effect; once the ionophore is no longer being fed, the rumen returns to its normal state. Enzymes, bacteriophages and methanogenesis inhibitors can reduce methane by up to 50 percent.

Organic acids or plant secondary compounds

Organic acids or plant secondary compounds such as oregano, thyme and mint, which contain compounds like tannins, saponins and essential oils, have antimicrobial properties (disrupting cell membranes of gram-positive or gram-negative bacteria) that can increase rumen pH and decrease ammonia and VFA concentration, which can decrease methane production by 8 to 14 percent. Saponins can also inhibit protozoa growth, which can also have a decrease on methane levels. Garlic has a compound (diallyl disulfide) that can decrease methane production by up to 70 percent. Certain plants like forage rape and birdsfoot trefoil are high in these methane-reducing plant secondary compounds. Fungal metabolites such as mevastatin and lovastatin have also been found to decrease the number of methanogens in the rumen, thereby decreasing methane production.

The role of fat and carbohydrates in methane production

Adding fat to the diet can decrease methane by up to 33 percent, as well as have a positive effect on milk production by serving as an electron acceptor, thus reducing the metabolic activity of protozoa, as well as some methanogens, especially with the addition of C12:0, C18:3 and polyunsaturated fats in the ration. Feeds high in these fats include palm fat, brewers grains, hominy and whole cottonseed. Fish oil has also been found to reduce methane production by inhibiting rumen bacteria.

Improving animal production by improving nutrition, management, reproduction or genetics can reduce methane by 20 to 30 percent. Many of the above-described feed additives, such as ionophores and fat, can have a positive effect above methane reduction and increase feed efficiency and milk

Continued on page 70

Methane emissions and their correlation to feed choices – why do we care? cont'd from page 69

production. Probiotics such as yeast (*Saccharomyces cerevisiae*) stimulate lactic-utilizing bacteria, which helps maintain pH and promotes cellulolytic bacteria fiber digestion, improving digestibility, enhancing ammonia utilization and increasing propionate production – resulting in a 10 to 50 percent decrease in methane when probiotics are added into the rumen.

The type of carbohydrates that cows consume dictates the VFA profile of the rumen. High-starch diets push for more propionate, thereby reducing methane production while high-roughage-based diets have more acetate production, leading to increased methane production. Generally, an increased rate of passage from high-concentrate diets can lower methane production by 25 percent due to increased propionate production and lowering the rumen pH, which inhibits the growth of protozoa and methanogens.

Forages and methane

The quality and type of forages fed can also have a big impact on methane mitigation. Legume forages have a lower methane production level than grasses due to their lower structural-carbohydrate makeup and faster passage rate, leading to increased propionate production.

Certain forages contain plant secondary compounds as stated above that can help mitigate methane production. Besides forage type, the higher stages of forage maturity can result in higher methane production by 20 to 25 percent. Methane can also be decreased by increasing forage passage rate by processing forages or feeding highly digestible forages. Pelleting or grinding forages can also increase passage rate.

Why do we care?

The big question with methane mitigation is why do we care? Obviously from a global environmental standpoint there is a desire to cut down on methane production, but there are other benefits as well for the local dairy. Dairy producers can gain positive consumerism, increase production and improve economic efficiency by decreasing their methane production on-farm.

Today's consumers are concerned about the carbon footprint their food is leaving behind and are trying to reduce waste. Knowing that the agriculture industry is consciously trying to reduce methane through feeding strategies and are utilizing feed waste byproducts to generate high-nutrient food like milk and meat is a big positive for the dairy industry in the eyes of consumers. When producers intensify their operations for more efficient cattle on-farm that eat less and produce more, it results in fewer cattle that supply the world with enough milk and milk products, which decreases the methane output of the dairy industry overall.

Besides the methane reduction and increased production, the intensification process also increases the producer's income over feed costs. Some of these feeding strategies can have big beneficial outcomes financially, but we will need to weigh the outcomes over the costs. For example, you might decrease methane and improve production by feeding palm fat, but does the initial cost outweigh the end result or could you have gotten better results from feeding an ionophore or a combination of feed ingredients and plant secondary compounds? In the end, methane reduction will be dictated by the economics of being a good steward.