Dietary Management to Decrease Methane Emissions from Beef Feedlots

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Definition:

Methane is a potent greenhouse gas that is produced within the digestive tract of domesticated (cattle, sheep) and non-domesticated (bison, deer, elk) ruminants. Within the multi-compartment stomach of ruminants, feeds are digested by a community of microorganisms (bacteria, yeasts, protozoa). A natural byproduct of the fermentation of starch and cellulose is methane. Anywhere from 2 to 10% of dietary carbon and energy is converted to methane in the rumen. Methane is also produced in the large intestine of ruminants and nonruminants, and from feces after it is excreted. Dietary factors affect the community of microorganisms in the digestive tract and, thus, affect the quantity of methane produced.

Purpose:

Decreasing the quantity of methane produced by livestock will not only decrease the carbon footprint, it may also increase the efficiency of feed/nutrient utilization and possibly decrease production costs. One ramification of a decrease in ruminal methane production is typically an increase in the production of the volatile fatty acid propionate by the ruminal microbial population. Because propionate is used by the animal more efficiently than other volatile fatty acids, increases in propionate production can decrease the quantity of feed required per unit of weight gain.

How Does This Practice Work:

A number of dietary practices have been shown to decrease enteric methane losses from cattle fed high concentrate finishing diets. Some general rules of thumb are the following:

1. As the quantity of grain in the diet increases, the total quantity of methane produced in the rumen decreases; primarily because of a decrease in the pH of the ruminal contents and an increase in propionate production (Van kessel and Russell, 1996).

2. Feeding steam flaked- or high-moisture-corn decreases enteric methane production by about 20% compared to feeding dry-rolled corn-based high-concentrate finishing diets because of more efficient digestion of starch in the rumen (Hales et al., 2012). Steam flaking may also decrease methane emissions from manures because it decreases the concentration of starch in the feces.

3. Feeding ionophores such as monensin or lasalocid, which are included in a ration to increase the nutritional efficiency of feedlot cattle, decrease methane production by about 10 to 20%; however the effect appears to be transitory and to only last for 20 to 30 days (Guan et al., 2006).

4. Feeding supplemental fat decreases ruminal methane production by 5 to 20% in low-, medium- and high-concentrate finishing diets. Enteric methane production (g/kg of feed dry matter intake) decreased about 3.8 to 5.6% for each 1% of supplemental added fat (Beauchemin et al., 2008). Because of adverse effects of fat on ruminal fermentation, supplemental fat levels are usually limited to 3 or 4% of dietary dry matter.

5. Feeding of distiller's grains, a co-product of the grain ethanol industry, has variable effects on enteric methane production. Distiller's grains are high in fat (7 to 12%). Thus, when used in diets with low fat content, they may decrease enteric methane emissions. However, when fed in equivalent fat diets, distiller's grains do not affect enteric methane production (Hales et al., 2012).

Emissions Management Practices

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6. Feeding grasses or alfalfa as silage (high moisture), rather than as dry hay in high forage diets, will decrease enteric methane emissions (Beauchemin, et al., 2008).

7. In high forage diets, decreasing the particle size of the forage will decrease enteric methane losses by 5 to 20%; however, the effects in high concentrate diets are not as clear. Because roughage is included in finishing diets for physical gut health and integrity, it is probably not advantageous to finely chop or grind roughages in high concentrate diets.

8. A number of studies have demonstrated that a variety of halogenated analogues such as bromochloromethane have the potential to dramatically decrease ruminal methane production (Beauchemin et al., 2008), but their use in production settings is currently not practical because of costs and potential animal health and environmental risks.

9. Some studies suggest enteric methane production can be decreased via the feeding of various other compounds including: condensed tannins, yeast cultures, dicarboxylic acids, saponins and other related compounds and by use of vaccines and genetically engineered microbes (Beauchemin et al., 2008). These alternatives are all still in the experimental stage and typically are most effective in high-forage diets.

Where This Practice Applies and Its Limitations:

Many of these dietary strategies to decrease enteric methane emissions can be used in small or large cattle feedlots as well as in stocker operations or on cow-calf operations. In fact, many of these strategies are effectively used in the cattle feeding industry today. However, there are some potential limitations. For example, in some operations, feed mill facilities may limit the use of steam flaking or liquid supplements such as fats. In addition, many feedlot diets contain large portions of high protein byproduct feeds such as distiller's grains or gluten feed which provide supplemental fat indirectly.

Effectiveness:

The effectiveness of different dietary regimens in affecting methane emission is highly dependent upon the comparison made. For example, some strategies decrease methane emissions when diets are high in forage but not when high concentrate diets are fed.

Cost of Establishing and Putting Practice in Place:

The direct costs of the dietary modifications listed will depend upon the impact on production and feed conversion, and on the price of variables such as feed ingredients, natural gas (for steam flaking), electricity, and fuel (for hauling feed). Indirect costs such as changes in feed mill or feed truck facilities or management will vary with fuel and labor costs.

References:

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For Further Information:

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This practice falls under the NRCS Conservation Practice Standard 592 (Feed Management)