Section 3: Feed Management

Greenhouse Gas Benefit

Improved feed efficiency increases productivity and reduces greenhouse gas emissions. Methane, released primarily by belching, represents a loss of dietary energy and feed inefficiency. It is a byproduct of enteric digestion by microbes known as methanogens. Rumen microbe species are specialized in their ability to breakdown either cellulose from forages or starch from grains. Changes in the composition of a ration need to be made gradually to allow time (about two weeks) for the rumen microbe population to adapt. In general, the faster feed passes through a ruminant, the less methane is produced. Changes in feed management that lessen the amount of feed utilized by the animal also reduce methane emissions. Because this results in a decrease in the amount of manure produced, both methane and nitrous oxide emissions are also reduced. Even small changes in management practice can increase feed efficiency and cut back on greenhouse gas emissions.

Current Research

Methane produced comes at a cost to the animal in energy used and represents a substantial loss in efficiency of animal production. Methane emissions from cattle range from 2 to 12 percent of the gross energy intake and translate to emissions of 150 to over 300 litres per day. It also contributes about 16-20 percent of global atmospheric methane. One of the main factors which effects methane production is the efficiency of feed used by cattle...[35]

Dietary strategies to reduce methane emission by beef cattle [have been reviewed]; fumarate, ionophores, tannins, oils, forage species, increasing grain content, feed particle size reduction and inclusion of brewers or distillers grain were considered the most promising strategies…Legumes generate less methane than grasses. Feeding grain reduces methane emissions relative to feeding forages but there is a need for more research to understand some of the variation in this response and how it is affected by feed processing.[37]

Ruminant livestock are the largest source of methane emissions from Canadian agriculture. Because methane generation from ruminants is closely linked to the efficiency of feed use, the factors affecting the rates of emission are reasonably well understood.[36]

Credit: Phil Boehme

Feed high quality feeds and balance rations

Greenhouse Gas Benefit

On pasture, a high rate of gain or high production per cow will result in less methane produced per acre and per unit of production. Improved feed quality creates an environment in a ruminant's digestive system that is not conducive to methane producing fermenters. The higher the quality of feed supplied, the greater the reduction in methane production. Providing rations balanced for energy, protein, minerals and vitamins results in greater feed efficiency and ultimately lower methane emissions per kilogram of live weight gain. Alternatively, an unbalanced diet will lead to a loss of nutrients through urine and manure outputs, reduced herd productivity, increased methane emissions and increased manure output.

Cattle use feed most efficiently when the nutrients in the daily feed match their daily requirements, hence the term, balanced rations. Producers know they can't "eyeball" feed value but they sometimes use traditional or book values to estimate feed quality against their livestock feed requirements. These can be useful guides but the quality of individual feed supplies can vary widely from the average. Not knowing the exact nutritional value of feeds can lead to underfeeding or overfeeding, both of which cost money. Nutrient content of feeds vary greatly from year to year because of differences in growing conditions, method of harvest, stage of maturity at harvest, storage and processing. Roughage mixtures of unknown proportions or use of unusual feedstuffs or screenings increases the need for precise information. A little time and a few dollars spent planning can lead to satisfactory performance on minimum feed while limiting the risks associated with thin cows, poor calves, low fertility and/or wasted feed resources. Adding the necessary protein supplements, vitamins, minerals, and grain to meet, but not exceed nutrient requirements, lowers production costs by optimizing performance and feed efficiency.[38]

To balance or check cattle rations, consider using Cowbytes, an easy to use computer software program available from Alberta Agriculture and Food Ag-Info Centre at 310-FARM (310-3276) (www.agr.gov.ab.ca). In addition there are professional nutritionists within the industry to assist with the development of an appropriate formulation.

Current Research

The quality of feed is one of the most important factors affecting methane emission. The amount of methane produced can be significantly reduced by improving animal diets, though many livestock operations already use high quality feeds, limiting the mitigative benefits from further improvements. Changes in feeding practices (e.g., increased grinding of feeds, lower feeding frequency or increased feeding level) may also reduce methane emissions somewhat, though many producers may already employ near-optimal practices.[39]

Chop, grind or pellet low quality feeds

Greenhouse Gas Benefit

When straw or low quality hay is utilized as part of the ration, grinding or chopping will make it more easily digestible. This leads to quicker digestion and reduces the amount of time food remains in the rumen, causing a reduction in the amount of methane produced.

Current Research

The chewing time required per unit of dry matter (DM) is influenced by many factors, including proportions, lignification and anatomy of leaf and stem, particle moisture in the rumen and feed processing. Feed processing reduces both time and energy required for eating, but may not affect the amount of rumination required unless the feed is finely ground. Total chewing time per kilogram DM ranges from 20-40 minutes for pelleted forages to 70-100 minutes for long forages and from 100-220+ minutes for straws. In one study, mature cattle ate 0.84 percent DM from long straw, needing 212 minutes to chew each kilogram. Chopping the straw reduced chewing time per kilogram, enabling the animals to increase their intake to 0.95 percent. Chewing costs energy. Energy lost to chew feed is lost as heat, reducing the net energy available for maintenance.[40]

Use genetics to select for feed efficiency

Greenhouse Gas Benefit

In the early to mid 1990s Australian researchers identified net feed efficiency (NFE) as a trait that was independent of body size and growth. This trait is moderately inheritable. This implies that improvements could be made in feed efficiency through properly designed genetic selection programs. Net feed efficiency in simple terms can be defined as the difference between an animal's actual feed intake and its expected feed requirements for maintenance and growth. Some animals eat less than expected and are efficient (negative NFE). Other animals eat more than expected and are inefficient (positive NFE)…[41] In recent years, results from a research team headed by Dr. John Basarab of the Western Forage/Beef Group have clearly indicated that net feed efficiency is a trait that is independent of body size and growth. Since it reflects the maintenance requirements of individual animals, it was thought that cattle with low or negative NFE would produce less methane than cattle with high or positive NFE. …Results of the research suggested that the NFE trait as a selection tool for cattle would lead to savings in feed costs and also lead to a reduction in methane emission by cattle.[42]

Current Research

A preliminary study from the University of Alberta in conjunction with the Western Forage/Beef Group showed results indicating that low NFE cattle produced about 20 percent less heat and retained about 35 percent more of the energy consumed than the cattle with high NFE. Other differences included the production of 20 percent more manure, the loss of 18 percent more energy in feces and 21 percent more urinary energy loss in the high NFE compared to the low NFE cattle. In addition, methane production was approximately 6 percent or 14 percent higher as a percent of gross and digestible energy intake respectively in high as compared to low NFE steers… If accurate, these results indicate that differences in NFE in cattle may be partly due to differences in maintenance requirements, the efficiency of energy usage, methane production and energy retention.[43]

The Bovine Genome Project, led by Dr. Moore at the University of Alberta, is identifying genetic markers for net feed efficiency (NFE) that will have commercial application. Improving NFE will reduce methane and manure emissions from cattle. This may generate new agricultural investment due to greenhouse gas credits.[44]

Feed silage rather than dry feed

Greenhouse Gas Benefit

Silage is an effective method of preserving feed with minimum nutrient loss. During the fermentation process, the plant carbohydrates are broken down, resulting in lower methane emission as compared to feeding dried forages. This reduces the amount of fermentation time required in the rumen; the less time feed remains in the rumen, the fewer methane emissions result. More research is required in this area to fully evaluate this feeding strategy. The costs of growing, putting up and properly storing the silage would need to be carefully evaluated, both in financial terms and in greenhouse gas terms.

Credit: Duane McCartney

Add grain to the diet

Greenhouse Gas Benefit

Livestock diets high in grain tend to reduce methane production. However, the costs of growing, putting up and properly storing the grain would need to be carefully evaluated, both in financial terms and in greenhouse gas terms.

Current Research

Calculations showed that placing calves directly on a grain ration after weaning resulted in only 34 percent as much methane being emitted compared to a calf that goes through a backgrounding program before finishing. There is need for further work to estimate the impact of these systems on total greenhouse gas production and at the same time taking their economics and sustainability into account before conclusions on which is the best system to adopt. As improvements in feeding and management efficiency are associated with reduced methane emissions, methods to predict outcome from these approaches accurately still needs to be evaluated.[45]

Add lipids to the diet

Greenhouse Gas Benefit

Plant derived edible oils fed in appropriate amounts, add energy to the diet and inhibit methane production. Again, the costs of growing, putting up and potentially processing the oilseed would need to be carefully evaluated, both in financial terms and in greenhouse gas terms.

Current Research

Fatty acids [a component of oilseeds] are quite toxic to methanogenic bacteria. Free fatty acids, fats and oils are alternatives to decrease methane production by cattle and other ruminants. Unsaturated fatty acids act as sinks for metabolic hydrogen in the rumen, although it is generally agreed in the literature that toxicity on methanogenic bacteria, rather than a sink for hydrogen, is the major reason why these fatty acids inhibit methane output. Other organisms, besides the methanogens, can also be affected negatively by fatty acids. In particular, fibre digestion is often, but not always, negatively affected by them. The result is that in moderate or high fibre diets, this negative effect of the fat or oil implies that the theoretical energy value of the fat for cattle is not altogether recovered through improved performance, i.e. in energetic and gross feed efficiency. As many of the feed sources of fats are expensive relative to other feeds, the economic incentive to include oil or fat in ruminant diets may not exist. On the other hand, oils and fats can be used to enrich beef with nutraceuticals, such as conjugated linoleic acid (CLA) and omega-3 fatty acids. This acts as a counter to their negative impact on energetic efficiency and economics...[46]