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Livestock Methane Reduction: A Global Challenge

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Abstract

Methane in the atmosphere has doubled due to human activity during the last 200 years. Methane is thought to be responsible for 23% of all greenhouse gas-induced warming, making it the second-largest contributor to global warming after carbon dioxide (CO2). CH4 emission from Indian livestock was 15.3 Tg in 2012. One of the major human-caused producers of methane (CH4) in the world is livestock farming in India. The largest source of naturally occurring methane is wetlands, and it is estimated that agriculture accounts for 27.3% of all methane emissions. One of the most significant GHGs, methane has a 28-fold greater potential to cause global warming than carbon dioxide. To diminish methane reduction various strategies can be used like the use of bacteriocins, change in dietary profile, defaunation, vaccinations against microbes or monensin as an antibacterial.

Keywords: Bacteriocins, Cattle, Defaunation, Methane

Strategies for reducing ruminant methane generation

Through a digestive process termed enteric fermentation, which is specific to ruminant animals, livestock emit methane. Several strategies have been developed to reduce the amount of methane produced by livestock and released into the atmosphere. All strategies aim to reduce the amount of methane produced by animals or by each unit of animal products. Rumen Biochemistry, ecology, animal breeding, and management options at the animal, farm, or national level are all taken into consideration when considering methods to reduce ruminant methane emissions. Most importantly, if we want farmers to make the adjustments, mitigation solutions must be economical or cost-neutral.

Various methods to lower methane emissions from agricultural animals

- Desirable genetic selection to create animals that emit less methane
- Supplementing with oil and ionophore, such as monensin and tannin
- Defaunation and microbial intervention in the rumen
- Methane emissions can be decreased by changing the diet by consuming molasses and ammonia.
- Raising the percentage of concentrate feeding
- Using cutting-edge technologies to cut down on methane production

Dietary Profile

Methane production can be significantly impacted by the type of feed provided to ruminants. It is also known that dietary starch encourages the synthesis of propionate by promoting the growth of amylolytic bacteria and lowering ruminal pH, which in turn reduces methanogenesis. But there is a problem of less digestion of fiber due to the death of lignocellulolytic bacteria in low pH. It has been routinely demonstrated that feed additives, for example the inhibitor 3-nitrooxypropanol (3-NOP), can reduce intestinal methane emissions in both beef and dairy cattle by up to 30%. There has been some evidence that feeding animals plenty of seaweed, often referred to as red, green, or brown marine macroalgae, can lower methane output, but the results have been wildly inconsistent. According to in vitro research, Asparagopsis taxiformis, a tropical/subtropical red seaweed, can cut methane production by 95% when mixed with feed at a rate of 5% organic matter inclusion.

Forage grinding and pelleting can significantly reduce methane generation. The impact of pelleting is most noticeable with low-quality forages, although it can reduce CH4 emission more than chopping.

Genetic selection of animals

Animals with better energy rations should logically result from genetic selection based on increased feed efficiency. These animals should emit less methane as a result. It might be viewed as a selection that pays more attention to an animal's capacity to produce less methane.

Lipid additions

In contrast to concentrates, dietary fat appears to be a promising nutritional option to suppress ruminal methanogenesis without lowering ruminal pH. In vitro, adding oils to ruminant diets can decrease CH4 production by up to 80%, and in vivo, it can reduce it by roughly 25%. Oil plants like cottonseed, sunflower seeds, and coconut kernels have the potential to be employed as

a feeding approach to reduce enteric methane emissions. The type of lipid utilized, the ruminant species, and the experimental diet are only a few of the variables that could be to blame for the variable effects of lipids on methane abatement. Since most in vivo studies on lipids as methane reduction strategies are short-term, it is very difficult to make judgments on their long-term repressive effects.

Bacteriocins

Feed efficiency may be increased by minimizing the quantity of carbon lost as methane, with help of bacteriocin-producing bacteria which are able to produce inhibitory bacteriocins against methanogenic bacteria. Bacteriocins might promote the dominance of cellulolytic bacteria in the rumen and accelerate cellulose decomposition. When cattle ingest grain-based diets, Streptococcus bovis is a kind of bacteria that causes acidosis, and BPB's ability to inhibit that organism may support rumen equilibrium.

Vaccine

Animals are given the vaccine to boost their immune systems and create antibodies against methanogens. This failure may be caused by the emergence of new methanogens following vaccination, and to succeed with the vaccination strategy, a much more comprehensive strategy and in-depth knowledge of the rumen methanogen population are undoubtedly needed.

Defaunation

Researchers have utilized defaunation, which involves removing protozoa from the rumen, to examine how protozoa affect methane generation and the function of the rumen. Ruminal methanogens have been seen connected to protozoal species, indicating a potential interspecies hydrogen transfer. Eliminating the protozoa could up to 50% lower methane generation, depending on diet. Eliminating the protozoa could up to 50% lower methane generation, depending on diet. Defaunation inhibits cell wall digestion while improving nitrogen digestion.

Ionophores

Ionophores reduce the number of rumen protozoa, and this decrease lowers the amount of methane because rumen protozoa accommodate methanogens on their cell surface and inside the cell. Consequently, it is thought that ionophores indirectly decrease the quantity and/or activity of methanogens. Since rumen protozoan populations that are suppressed by ionophores tend to increase in number when ionophores are used for an extended period, this is one of the reasons why methane reduction by ionophores only occurs at the early stages of feeding.

Plants secondary compounds

Some plant extracts can reduce the amount of methane produced in the rumen, especially those that contain elevated levels of bioactive compounds like saponins and tannins. By inhibiting rumen protozoa, saponins may lower methanogenesis and thus lower methanogen activity and population. Essential oils have negative effects on the digestion of fiber even though they offer some promise in preventing the growth of methanogenic archaea and reducing methane production in the rumen.

Conclusion

In India, methane emissions from cattle (192.4 million) are a substantial source of anthropogenic greenhouse gas emissions. Various tactics are presently being researched and created. Each strategy has a unique profile of viability, cost, and potential user adoption. On an experimental scale, attempts to decrease the CH4 synthesis by ruminants utilizing methanogenesis inhibitors as plant secondary metabolites (PSM), antibiotics, and biotechnological approaches as rumen defaunation produced interesting results. Methane production in the rumen can be reduced by encouraging a shift in fermentation favoring propionate formation, but it cannot be stopped without harming ruminant production.

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