Ensiling of Forage Crops

- This is because digestion is reduced in the rumen with ensiled forages due to the extensive fermentation that occurs during silage making

- Addition of enzymes during ensiling of forages is another alternate for reducing enteric methane emission from ruminants

Increasing The Amount of Green Fodder

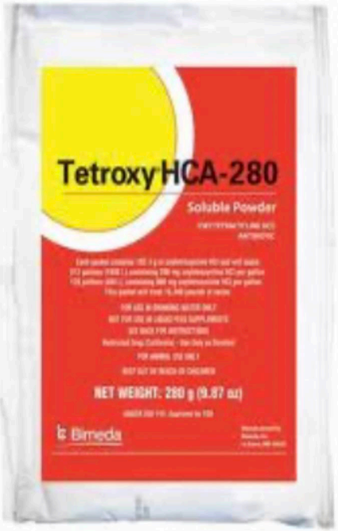
- Feeding of straws along with green fodders reduces methane emission by about 11-27% through changing the ruminal fermentation pattern

Addition of Fat in the Ration

- Fats are added in the dairy cattle ration to increase the energy density and to modify the milk fat composition
- Addition of fatty acids can cause greatest reduction in ruminal methane emission
- Unsaturated fatty acids (USFA) reduces methane production by acting as electron acceptor during biohydrogenation
- Excessive addition of fat in the feed is not recommended because it may suppress the fibre degradation in the rumen

IONOPHORE Antibiotics

- Ionophore antibiotics are
  - Monensin,
  - Lasalocid,
  - Lysocellin,
  - Narasin,
  - Salinomycin and
  - Laidomycin



- Ionophore antibiotics tend to depress fibre degradation and inhibit protozoal growth

- To enhance the efficiency of production and decrease the methane production

Defaunation

- Elimination of rumen protozoa reduce methane production by about 20-50% depending upon the diet composition

- Protozoa is responsible for production of more hydrogen in the rumen and more closely associated with methanogens

- The chemicals used for defaunation includes
  - Copper sulphate,
  - Sodium lauryl sulphate,
  - Dioctyl sodium sulphosuccinate

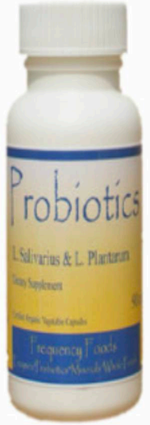
- However, many defaunating agents are toxic to the animals and practically defaunation is unsuccessful

Probiotics

- The effect of probiotic cultures on the methane production is minimal and very little information is available on this aspects

- Aspergillus oryzae was found to reduce methane emission by about 50% through inhibiting the growth of protozoa

- Addition of Sacchromyces cerevisiae reduced methane production by 10% in in vitro condition

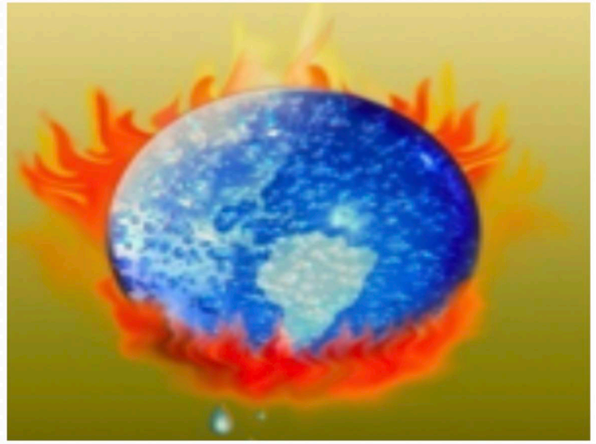


Sulphate Supplementation

- Sulphate supplementation helps in increasing the production of fibre degrading enzymes and fibre degradation in the rumen

- As sulphate / sulphite have high affinity for utilization of hydrogen for its reduction to sulphide

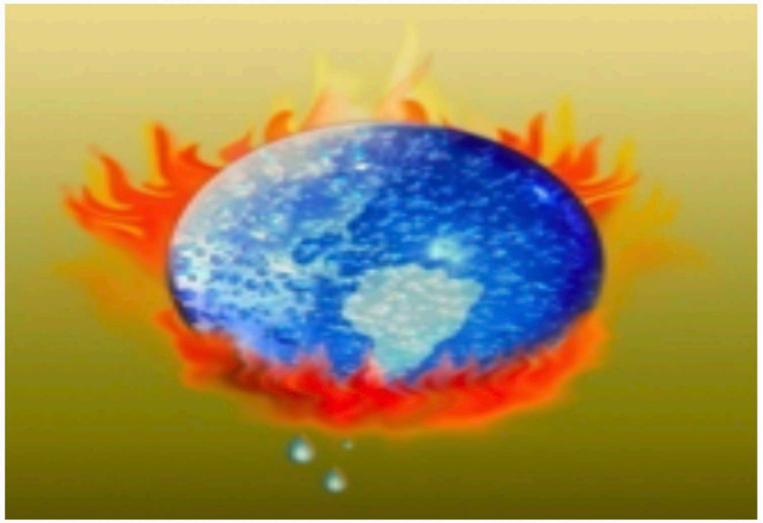
- This can be a good mode of rumen fermentation for improving fibre degradability and inhibiting methanogensis



Enhancing Acetogenesis in the Rumen

- In the gut of termites and rodents, acetogenic bacteria convert excess hydrogen to acetic acid

- Exogenous inoculation of these acetogens in to the rumen for competing against methanogens may be an option to reduce methane emission from ruminants



Propionate Enhancers

- Fumaric and malic acids have been studied in vitro as feed additive to enhance the efficiency of animal production and to reduce methane emission
- These acids act as hydrogen acceptor in the rumen and thereby they make hydrogen unavailable to the methanogens for methanogenesis
- Fodder crops rich in these acids can be used for feeding ruminants to reduce methane emission
- Methane emission was significantly ($p<0.05$) decreased by 3.26 % per animal per day in 0.39 % malic acid supplemented group than control in paddy straw based basal diet for indigenous dairy cattle
- Methane reduction by 12.62 % per animal per day was observed in 0.08 % malic acid + 0.04% fumaric acid supplementation through forages in paddy straw based treatment group than control in dairy cattle.

Use of Plant Secondary Metabolite

- Plant Secondary Metabolite selectively modulate the rumen microbial populations resulting in an improvement of rumen fermentation and nitrogen metabolism and decrease in methane production

- Saponins have been shown to suppress protozoal population and decrease methanogenesis

- Tannins especially decrease methane production and increase efficiency of microbial protein synthesis

  - Tannin at 3.09 % & saponin at 2.34 % through Acacia nilotica plant species reduced ($p<0.01$) the in vitro methane emission by 27.93 % than control.

- Essential oils

  Methane emission was decreased ($p<0.01$) by 10.6 % in essential oil mixture (garlic + peppermint oil) supplemented dairy cattle than control.

Ration Balancing

- Balancing the ration is one of the possible feeding strategy and small intervention on reducing the methane emission under filed condition.

Conclusion

- Methane is responsible for global warming and also represents a loss of feed energy (8-12 %) leads to lower animal production
- There is a need to find out a suitable feeding strategy to reduce methane emission from ruminants to enhance the productivity and save the earth from global warming
- Possible Feeding strategies reducing the methane emission
  - Supplementation of straw with concentrate
  - Modification of feeding practices
  - Selection of suitable fodder crops
  - Fodder preservation techniques
  - Feed additives
  - Plant metabolites from forage
  - Ration balancing

A STRATEGY WHICH IS ECONOMICALLY MOST EFFECTIVE, RESIDUE FREE, ENVIRONMENTAL AND FARMERS FRIENDLY NEEDS TO BE DEVELOPED

Thank you