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Ruminant Livestock and Greenhouse-Gases (a Nutritionist Perspective)

Review Article

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ABSTRACT

Greenhouse gases have been of serious global concern to environmentalists. Enteric ruminal fermentation and manure are seen to be responsible for global warming. Based on a better understanding of positive tannin effects on ruminant nutrition, the feeding value of browse trees and shrubs containing tannin, their roles on methanogenic rumen microbes in overcoming the production of enteric fermentation gases and the methods of efficient manure handling are presented in this review.

KEY WORDS browse plants, greenhouse gas, manure, ruminant, tannin.

INTRODUCTION

Global climatic changes had arisen the interest of environmentalist worldwide to raise to the challenges for the need to protect our earth. The International Panel on Climate Change (IPCC) published assessment reports based on the Physical Science Basis, concluded that warming of the climate system is very likely due to increased anthropogenic greenhouse-gas concentration.

IPCC (2007) reported that globally, agriculture contribute 10% to 12% of anthropogenic carbon dioxide (CO_2), 40% of methane (CH_4) and 60% of nitrous oxide (N_2O) emission. Platteplace *et al*. (2001); IPCC (2007), Mitlochner *et al*. (2009) reported ruminant's enteric fermentation (gases belched out from the stomachs of cattle, sheep and goats as the end products of fermentation in the rumen) and manure produce both methane and nitrous oxide, which are responsible for global warming. In the US, the livestock industry is estimated to contribute half of total US agricultural greenhouse-gas emission, with quarter each coming from ruminant enteric fermentation and animal waste (USDA, 2004).

The aim of this write up is look at the possibility of using browse plant as a source of feed and as means of suppressing the production of greenhouses-gases by ruminant animals and also to serve as a carbon sink.

Reducing livestock greenhouse-gases emission

USDA (2004) suggested that these strategies may include:

1) Increasing digestibility of forages and feeds by making feed digestion more efficiently.
2) Using feed additives to tie up hydrogen in the rumen because hydrogen in the rumen is an important intermediate product to produce methane.
3) Inhibiting rumen bacteria (methanogens) that produce methane.
4) Enhancing rumen microbes to produce usable substrate rather methane.
5) Improving production efficiency of milk and others to reduce animal number.

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The feeding value of forages of browse plant from trees and shrubs

By planting selected species of browse plants under the Kyoto protocol, they serve as carbon sinks, which can be traded as a greenhouse-gas offset and also serve as a feed resources for ruminant animals. The potential of leaf meals from tropical browse trees and shrubs has been recognized for feed resources of relatively rich protein and lower fiber than tropical grasses (Onwuka *et al.* 1989; D'Mello, 1992).

The significance of forages from browse trees and shrubs is associated with a number of advantages. With *Leucaena*, for example, it provides a valuable source of protein, energy and sulphur for the rumen bacteria. It is also valued in multipurpose use in fence lines and as a fuel (Devendra, 1990). With specific reference to their role in animal feeding, the advantages include: availability on the farm; accessibility; provision of variety in the diet; source of dietary nitrogen, energy, minerals and vitamins; laxative efficacy on the alimentary system; reduction in the requirements for purchased concentrates; and reduced cost in feeding (Devendra, 1988).

Browse forages containing condensed tannin may offer a nutritionally based system for controlling the effects of parasites; reduce dependence on the synthetic anthelmintics in sheep (Niezen *et al.* 2002) and farmed deer (Hoskin *et al.* 2000).

Wang *et al.* (1996) found that condensed tannin from *L comiculatus* increased milk yield, protein and lactose percentage, and reduced fat percentage. The higher protein percentage could be due as reported by the authors, to an increase of amino acid, especially essential amino acids flows into the small intestine.

Polyphenolics (condensed tannin) in browse tree and shrub forage

Secondary plant compounds are naturally occurring in leaves of most tropical browse plants function as a natural defense against pathogen attack. These plant factors have been reported to have varying positive and negative effects on browsing farm animals and wild browsers. However, the effect of the tannin can vary widely with the mode of administration of the leaf meal, whether it is offered as sole feed green, dry leaf meal or supplement to roughage (Kaitho *et al.* 1998); as a green foliage (browse on tree) or dried and/or treated in some way (Ahn *et al.* 1997).

Effect of forage having condensed tannin on methane production

Through feeding of tanniferous browse plants, it has been found to decrease methane production, which is beneficial for sparing of energy loss as methane. Many types of forages known to contain condensed tannins have been shown to decrease methane production both *in vivo* and *in vitro*. There was also a 16% reduction in methane production in lambs fed on *Lolium pedunculatus*, which is due to the presence of condensed tannins (Waghorn *et al.* 2002).

Other condensed tannins contained in the forage like *Sericea lespedeza* (17.7% CT) decreased methane emission (7.4 vs. 10.6 g/d and 6.9 vs. 16.2 g/kg DMI for *Sericea lespedeza* and crabgrass/tall fescue, respectively) in Angora goats (Puchala *et al.* 2005). Methanol extract of seed pulp of *Terminalia chebula*, which contains a substantial amount of phenolic compounds, reduces methane production and inhibits rumen protozoa (Patra *et al.* 2006a). Similarly, methanol extract of *Populus deltoids* leaves decreased methane production *in vitro* (Patra *et al.* 2006b).

Tannins present in *Callindra calothyrus* reduced nutrient degradation and methane release per gram of organic matter degraded in *in vitro* experiments with rumen simulation technique (RUSITEC) apparatus (Hess *et al.* 2003). Reduced methane production was also observed in RUSITEC as the proportion of incubated *Onobrychis viciifolia* was increased (McMahon *et al.* 1999).

Results from these studies indicated that condensed tannin action on methanogenesis can be attributed to indirect effects via reduced hydrogen production (and presumably reduced forage digestibility) and via direct inhibitory effects on methanogens.

Proper and efficient manure handling

The way and manner in which manure is handled in lagoons may be responsible for the non enteric emission of greenhouse-gases. If the manure can be handled properly instead of dumping in lagoon with poor aeration, it can be used as an organic fertilizer to enrich the soil. Cutting back on mineral fertilizer. De Gryze *et al.* (2009) indicated in their study, when manure was used instead of mineral fertilizer or when less mineral fertilizer was used, nitrous oxide emission decreased from -0.5 to -1.2 MtN_2O/ha/yr. Because manure release nitrogen to soil system slowly resulting in better synchronization.

CONCLUSION

The use of browse trees and shrubs foliage could provide ruminant animals with quality feed resource, which is chief, readily available and environmentally friendly. Besides the feeding significance, the browse plants help in moping excess carbon from the atmosphere and also the polyphenolics in their leaves has environmental significance in reducing methane production as an enteric greenhouse-gas emitted by ruminant livestock animals. Efficient use of animal manure against the chemical fertilizers will reduce the emission of anthropogenic greenhouse-gases.

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