



Role of Phytobiotics in Ruminant Nutrition

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Introduction

Phytobiotics are the plant derived bioactive compounds which are mainly known for their active role in maintaining good health in animals. These include substances like alkaloids, organosulphur compounds, essential oils, phytosterol, carotenoids etc. Their anti-bacterial, anti-fungal, anti-parasitic, anti-inflammatory properties along with immunomodulatory effects makes them a very crucial element to be added in animal feed. The phytobiotics, otherwise known as Phytogenic feed additives (PFA), phytogenic compounds (PC), plant secondary metabolites (PSM) or phytochemical compounds (PCC) can offer a very significant natural and nutritional benefits for the animal health. These compounds not only reduce the effect of environmental stressors, but also increases the feed utilisation and eventually increases the livestock productivity.

Role of phytochemicals in Ruminants

Ruminants share a major portion among livestock and so as the feed cost of a dairy farm among all other expenditures. A little cost cutting in feed cost can be very economical for the farmer in later terms. To maintain the economy of farms without hampering the health condition and productivity of animals, phytobiotics came into picture. These phytobiotics are very cheap, environmentally safe and help in methane mitigation strategy. They can alter the ruminal microflora and rumen fermentation process, reduces methane emission and protein digestion, which eventually increases the feed intake and palatability.

Different types of phytobiotics in ruminant nutrition

Tannins

These are widely distributed in tropical forages. It helps in reducing the methane

production by inhibiting the degradation of protein in the rumen. As a result, it increases the availability of protein for the animal. It increases the amount of conjugated linoleic acid content in animal products (milk & meat). Tannins are basically divided into two types, Hydrolysable tannin and condensed tannin. Condensed tannins directly inhibit the methanogenesis unlike the Hydrolysable tannins, which penetrate the protozoal cell membrane and breaks their association with the methanogens. Thus, tannins reduce the methanogenesis in both direct and indirect manner.

Tamarinds

The supplementation of tamarind seed husk causes significant reduction in the enteric methane emission by their cumulative effect on reducing rumen methanogen, partial defaunation and alteration in rumen fermentation pattern (Al-Ghamdi *et al.*, 2025). These are among the crucial elements that reduces the methane production in livestock.

Flavonoids

These compounds help in increasing the milk yield and lactational performance in dairy animals. They also reduce the methane production by inhibiting the formation of microbial cell components such as cell wall, cell membrane and nucleic acid *etc.* Flavonoids also help in decreasing the incidence of metabolic acidosis and enhance the performance of dairy cattle. In case of lambs, Flavonoids increases the body weight & daily gain in body weight. These compounds stimulate the rumen development by increasing the length and surface area of rumen papilla as a result it increases the nutrient uptake (Al-Ghamdi *et al.*, 2025).

Essential oils

These are also known as terpenes. These help in improvising the gut health especially in small ruminants by augmenting the ruminal microflora in small ruminants. The action of essential oils can be increased by the process of microencapsulation which not only increases the shelf-life of the compound but also protects it from ruminal degradation (Caroprese *et al.*, 2023)

Organosulphur compounds

These compounds increase the microbial protein synthesis. Compounds like Methyl-sulfonyl-methane (MSM), allium species, sulphur *etc.* play different major role in maintaining health and increasing productivity of animals. The anti-inflammatory effect along with immunomodulatory action of MSM increases the meat quality and growth rate in beef cattle. Similarly, sulphur is also considered as a crucial component in protein synthesis (Jiao *et al.*, 2026).

Phytosterol

These are the compounds that resemble cholesterol. These phytobiotics improve the milk yield by enriching it with omega-3 fatty acid, conjugated linoleic acid (CLA) and anti-oxidant compounds. It increases the digestibility of crude protein in ruminants.

Saponins

These compounds increase the efficacy of ruminant nutrition by reducing methane emission, acting as a defaunation agent, improving the nitrogen utilization *etc.* They can inhibit the protein utilization by causing cell rupture (interacting with the cholesterol in the cell membrane) and by eliminating protozoa (defaunation agent) (Rathod *et al.*, 2024).

Polysaccharide

Polysaccharides function mainly by improving Rumen microflora which increases the digestibility and reduces the methane production by depleting the methanogenic bacterial population. Along with the above beneficiary effects, the photobiotic feed preparation also enhances the taste sensation and increases the appetite. They also have a positive effect on the GI tract motility, digestive juice secretion, pH regulation and reduces the occurrence of gut disorders like diarrhoea. These compounds have potent anti-oxidant activity over the rumen. (Cheong *et al.*, 2023)

Limitation of phytobiotics feeding in ruminants

Despite the noble role played by phytobiotics as an alternative to several harmful feed additives, their concentration may reverse the impacts. One of the main factors to be considered while feeding phytobiotics is the risk of toxicity. The higher consumption of substances like tannin, alkaloid, saponins *etc.* may cause detrimental effects. Another factor to be considered as a major risk is the level of contamination. Contaminated phytobiotics with heavy metals, fungal toxins or pesticides may induce harmful impact over animal health. Apart from the above, the source of photobiotic compounds (tree part, geographical location, climatic condition), mode of extraction, post-harvest processes (steam distillation, maceration, solvent extraction, cold pressing) also influence the efficacy and detrimental effects in the animal body. Few phytobiotics get destroyed in the stomach or early intestinal part. In order to overcome this drawback these need to be properly encapsulated and should be followed by proper releasing technique

Conclusion

Phytobiotics are plant derived products very much helpful for ruminants as they help in improving nutrient absorption, act as a natural growth promoter for enhancing intestinal health ultimately leading to better immune response.

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