

New Feed Additives for Mitigating Methane from Ruminant Livestock

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Various attempts have been made in the last decade to mitigate methane production from ruminant animals. Although the approaches varied, the most popular method has been the use of dietary supplements. Moreover, after antibiotic use was banned in European countries, safer alternatives such as plant-derived materials including agricultural byproducts have been explored. Plant oils, their component fatty acids, plant secondary metabolites and plant extracts have been extensively studied and documented.

Of these materials, cashew nut shell liquid, a byproduct of cashew farming, is attracting attention for its strong effect on methane mitigation. The cashew byproduct contains a quite rare phenolic compound, anacardic acid, which alters rumen microbiota and fermentation toward less methane and more propionate production. These were confirmed by a series of in vitro experiments using batch culture and RUSITEC systems (Watanabe et al., 2010). Cattle fed this byproduct showed a 19% reduction in methane without adversely affecting digestibility and in vivo rumen microbial shift was the same as suggested by in vitro (Shinkai et al., 2012). Our recent studies show that feeding cashew nut shell liquid to dairy cattle also decreases methane production by 6% without affecting milk production and composition.

Ongoing researches are targeted for worldwide applications in which feeding of cashew nut shell liquid was found effective for even swamp buffaloes and native cattle in Thailand. These ruminant animals showed the decreased methane production and the increased propionate concentration with apparent shift of rumen microbiota that is essentially same with the shift observed in Holstein cattle of Japan. Furthermore, these shifts were greater in Thai ruminant animals than Japanese Holstein cattle, even though methane was measured by in vitro procedure to be regarded as methane production potential.

Another new additive candidate is ginkgo fruit that is an unutilized byproduct in ginkgo nut industry in eastern Asia including Japan, Korea and China. Ginkgo fruit contains anacardic acid as cashew byproduct but comprised of different molecule types. Supplementation of ginkgo fruit extract drastically decreases methane production from rumen fluid in batch and continuous cultures together with apparent shift of rumen microbiota (Oh et al., 2017).

This alkyl phenolic compound in cashew and ginkgo byproducts has the surfactant action that physically disrupts cell surface of specific microbes. Gram-positive bacteria are sensitive, while Gram-negatives are not, due to the presence of outer membrane as a protective barrier. Therefore, selection of bacteria occurs in the rumen, leading to fermentation changes toward less methane and more propionate production. Thus, understanding of the mechanism involved is important for farmers and animal product consumers to accept such new additives.

The application of a methane-reducing agent such as cashew byproduct and ginkgo fruit has the potential to contribute to the prevention of global warming, as well as to the economic production of farm animals. The choice of these new additive may depend on the availability of those materials and processing factory in each region, because distribution of those plants are not world-wide.

References

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