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Long-term additive studies

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Many studies conducted to evaluate methane (CH_4)-inhibiting feed additives have examined short-term animal responses. These short-term studies are typically designed as cross-overs and Latin squares where control and treatment diets are evaluated sequentially within an animal over time, using relatively short (3 to 5 weeks) feeding periods. Short-term studies allow researchers to use a small number (4 to 12) of animals and thus limited quantities of feed and inhibitor are required. However, short-term studies cannot evaluate whether the CH_4 mitigation effect of a feed additive diminishes over time due to microbial adaptation of the rumen. Furthermore, animal performance (e.g., milk production, weight gain, and feed conversion efficiency), health and reproduction are not measurable outcomes due to the short feeding periods. Thus, the economics and practicality of using a particular feed additive to reduce CH_4 emissions cannot be assessed in these types of studies, yet these factors are critical barriers to on-farm adoption of technology.

Some longer-term studies have examined the continuous feeding of several CH_4-inhibiting additives, such as seaweed, 3-nitrooxypropanol (3-NOP), and essential oils, but most of these studies have been ≤ 15 weeks in duration. These types of studies allow animal performance to be assessed during part of the production cycle. In some cases, CH_4 measurements have been repeated over the feeding period, which is important for assessing whether the CH_4 mitigating property of the

feed additive is sustained over time as it is possible for the microbiome to adapt to rumen fermentation modifiers. For example, a few studies with continuous feeding of the CH_4 inhibitor 3-NOP to animals for 10 to 16 weeks have shown a decline in effectiveness over time. McGinn et al. (2019) reported a constant decline in CH_4 emission reduction (from 80% to 60% reduction over 13 weeks) in a beef feedlot cattle study; Alemu et al. (2021) reported a 22% reduction in efficacy of 3-NOP to decrease CH_4 in beef cattle when a low dose was fed for 16 weeks; and Schilde et al. (2020) observed the CH_4 mitigation effect of 3-NOP diminished after 7 weeks in dairy cows fed a high forage diet. However, a decline in effectiveness has not been observed in some other studies with 3-NOP, possibly due to the dose, diet composition, and method of providing the additive to the animals (Yu et al., 2020). Thus, there is uncertainty as to whether CH_4 reduction can be maintained in ruminants over the longer-term.

In addition to assessing the persistency of CH_4 mitigation, long-term studies are needed to evaluate potential impacts of CH_4-mitigating feed additives on animal performance, health and reproductive performance. The additional cost of using feed additives as well as any potential impacts on farm revenue are important considerations for economic assessments and on-farm adoption of technology. Studies with repeated measurements over the feeding period and over multiple years for mature beef cows and over several lactations for dairy cows are needed to ensure CH_4 mitigation can be maintained over the long-term in a safe and economically viable manner using CH_4-mitigation technologies.

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