Genetic Contributions to Mitigating Methane Emissions in Dairy Cattle: Challenges and Opportunities

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Cattle, particularly dairy cows, contribute significantly to global methane emissions, accounting for approximately 16% of total methane output worldwide. Methane is a potent greenhouse gas with a global warming potential 28 times that of carbon dioxide, and its production in ruminants leads to substantial energy losses, reducing overall agricultural efficiency. Reducing methane emissions is critical for both climate change mitigation and enhancing livestock productivity. Over the past decade, various short- and long-term strategies have been explored to reduce methane emissions from cattle. Nutritional interventions, such as dietary modifications with fat supplements, nitrates, and seaweed, have shown potential for short-term reductions. Improved grazing strategies and forage optimization have also been investigated to enhance feed efficiency and lower methane emissions per unit of animal product. In the long term, genomic selection presents a promising avenue for breeding animals with lower methane emissions. However, the success of all these strategies is constrained by the lack of accurate, high-quality methane data. Current methane measurement methods, including spot breath tests, respiration chambers, and sulfur hexafluoride tracers, are indirect, labor-intensive, and provide intermittent data, failing to capture the complexity of methane production. These methods rely on short-term extrapolations and do not account for critical variables such as animal activity, rumen health, and feeding behavior, limiting their usefulness for both nutritional interventions and genomic selection. The inconsistency in available data prevents the widespread development of methane-efficient livestock on a global scale. In this talk, we will discuss the importance of mitigating methane emissions in dairy cattle and the various approaches that have been used to reduce methane production. We will highlight the key biological and environmental factors influencing methane production, as well as the role of genetics in mitigating emissions. Additionally, we will explore the potential applications of genomic selection to reduce methane emissions, ultimately contributing to more sustainable dairy production.

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