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111 Bioactive forages: a promising path to mitigate enteric methane emissions in the livestock sector

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Dietary modification is deemed to be one of the most effective and pragmatic mitigation strategies to reduce methane (**CH_4**) from enteric fermentation, as it not only influences rumen fermentation patterns and their end-products but also has the potential to concomitantly enhance animal productivity. The inclusion of bioactive forages is particularly promising in pasture-based livestock systems where they can achieve these goals, and simultaneously reduce food-feed competition compared to concentrate-rich rations with antimethanogenic feed additives. Therefore, we conducted a greenhouse experiment to screen eight temperate forage species with different concentrations of tannins and flavonoids as bioactive compounds. The species were analyzed for their agronomic potential, plant specialized metabolite (**PSM**) profile, as well as their in vitro antimethanogenic potential. In general, the largest reductions in CH_4 were observed from the tannin-rich forages (2 to 48%), sulla (*Hedysarum coronarium*), big trefoil (*Lotus pedunculatus*), birdsfoot trefoil (*Lotus corniculatus*), sainfoin (*Onobrychis viciifolia*) and salad burnet (*Sanguisorba minor*), in comparison to lucerne (*Medicago sativa*) as a tannin free control. However, this reduction was also accompanied by a reduction in total gas production (**GP**, -2 to 42%) in some species, indicating a negative effect on rumen degradability. The variation in the antimethanogenic activity at the species level was found to be significantly linked with the variation in their tannin composition, particularly influenced by tannin (proanthocyanidins (**PAs**) and hydrolysable tannins (**HTs**)) concentration and PA polymer size. Additionally, forage quality parameters played a significant role, highlighting the need to consider multiple interacting factors to understand bioactivity comprehensively. Based on this, a follow-on study was conducted, using big trefoil (PA-rich) and salad burnet (HT-rich) as model species, as they had the lowest variability in terms of their antimethanogenic activity and tannin composition across harvests. Of these, 200 individual plants from each species have been screened for their PSM profile and were subsequently genotyped via next generation sequencing. Subsequently, all plants will be analyzed for in vitro gas and CH_4 production, and fermentation characteristics. The data is expected to be ready in early 2025. In conclusion, we have previously identified the antimethanogenic potential of tannins from these species to suppress CH_4 in ruminants in vitro, but the potential is affected by covariables, such as the forage quality. Our next experiments will enable us to identify how much of this variation is genetically determined, and to which degree these forages can be improved to provide strong and reliable antimethanogenic effects without reducing digestibility.