FARMING PRACTICE
LIVESTOCK FEEDING TECHNIQUES

IMPACT: GHG EMISSIONS

Reference 15

van Gastelen, Sanne, Dijkstra, Jan, Bannink, André 2019 Are dietary strategies to mitigate enteric methane emission equally effective across dairy cattle, beef cattle, and sheep? JOURNAL OF DAIRY SCIENCE, 102(7), 6109-6130. 10.3168/jds.2018-15785

Background and objective

Although all types of ruminant animals (e.g., cattle, goats, sheep) might have similar CH_4-forming pathways in the rumen, they differ considerably in their level of feed intake, rumen morphology, and rumen physiology. Consequently, the effectiveness of dietary strategies to mitigate CH_4 emission might also differ across different types of ruminants. 1) to provide a brief overview of differences in rumen physiology between dairy cattle, beef cattle, and sheep that are related to CH_4 emission; 2) to evaluate whether dietary strategies to mitigate CH_4 emission with various modes of action are equally effective in dairy cattle, beef cattle, and sheep.

Search strategy and selection criteria

The authors performed a literature search to evaluate the effectiveness of CH_4 mitigation strategies, using Web of Science and Scopus, with a focus on forage quality, forage type and forage replacement, forage to concentrate ratio, and feed additives that have been tested in multiple ruminant types. 1) an in vivo experiment was conducted; 2) the CH_4 emissions were measured directly (i.e., not estimated); 3) the composition of the basal diet was described; 4) the results were available on DMI, and on CH_4 production (g/d) or CH_4 yield [g/kg of DMI or % of gross energy intake (GEI)]; and 5) a statistical analysis was performed. Although preferred, the studies did not have to involve the testing of dietary strategies in multiple types of ruminants.

Data and analysis

The effect size of the dietary strategies was determined for each individual study, expressed as a proportion (%) of the CH_4 emission for the control treatment and based on the reported treatment means (percentage increase or decrease relative to the value established with the "baseline" or control treatment).

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
94	Ruminants (dairy cattle, beef cattle, sheep)	1) Forage with higher digestibility; 2) Maize silage; 3) dietary legumes; 4) Tannin-rich forages; 5) increased concentrate level in diet	1) Forage with lower digestibility; 2) grass pasture/grass; 3) silage/alfalfa silage; 4) grass pasture/silage; 5) no tannin-rich forages; 6) lower concentrate level in diet	Metric: CH_4 emissions; Effect size: not applicable	50

Results

- Improved digestibility of grass herbage or grass silage (on average 25%) for dairy cattle increased CH_4 production (g/d; on average 8%), whereas CH_4 yield (g/kg of DMI or as % of GEI) and, if available, CH_4 intensity (g/kg of milk) decreased 10 and 19%, respectively, on average.
- In dairy cattle, increased levels of maize silage resulted in increased CH_4 production (11 and 8%, respectively), whereas CH_4 emissions generally decreased [CH_4 yield (g/kg of DMI) 5%, CH_4 yield (% of GEI) 7%, and CH_4 intensity (g/kg of milk) 8%]. This dietary strategy did not affect CH_4 emission to the same extent in beef cattle; CH_4 production (g/d) decreased 5% with increased levels of maize silage while CH_4 yield (g/kg of DMI) being unaffected.
- Increased levels of legumes at the expense of grass pasture or grass silage for dairy cattle resulted in increased CH_4 production (9%), whereas CH_4 yield decreased [CH_4 yield (g/kg of DMI) 17%, CH_4 yield (% of GEI) 18%)] and CH_4 intensity (g/kg of milk) was unaffected. In sheep CH_4 production following the same trend, but CH_4 yield in g/kg of DMI and as % of GEI increased slightly by 2%.
- In dairy cattle, increased levels of tannin-rich forages did not affect CH_4 production (g/d) while CH_4 yield (g/kg of DMI or % of GEI) and, if available, CH_4 intensity (g/kg of milk) decreased 16, 11, and 18%, respectively. For sheep CH_4 production remained unaffected and CH_4 yield (g/kg DMI and % of GEI) decreased 23 and 36%, respectively.
- Methane yield (g/kg of DMI) generally decreased for all ruminants (6% for sheep, 14% for dairy cattle, and 26% for beef cattle) as well as CH_4 intensity (g/kg of product; i.e., milk yield for dairy, ADG for beef and sheep; 10% for sheep, 27% for dairy cattle, and 31% for beef cattle). Only CH_4 yield (as % of GEI) produced contrasting results, increasing 19% for sheep but decreasing 12 and 32% for dairy and beef cattle, respectively.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The effects reported are generally positive or no effect, but the uncertainty is high due to the limits of the methodology implemented.