

Reference 30

Ungerfeld, EM; Kohn, RA; Wallace, RJ; Newbold, CJ 2007 A meta-analysis of fumarate effects on methane production in ruminal batch cultures JOURNAL OF ANIMAL SCIENCE, 85(10), 2556-2563. 10.2527/jas.2006-674

Background and objective

A strategy to decrease ruminal methanogenesis has been the use of organic acids that are intermediates in ruminal fermentation and are alternative electron acceptors to methanogenesis. Because the reduction of fumarate to succinate can draw electrons away from ruminal methanogenesis, fumarate has been studied as a potential feed additive to decrease methanes (CH₄) production in ruminants but results obtained with fumarate supplementation in vitro and in vivo have been variable. To understand and interpret the effects of fumarate on ruminal methanogenesis and volatile fatty acids (VFA) production through a meta-analysis of its effects on batch cultures. Here, results on CH₄ production are reported.

Search strategy and selection criteria

Two unpublished experiments where fumarate was added to ruminal batch cultures were used in the meta-analysis, along with 6 published studies. Not reported

Data and analysis

The effects of fumarate addition on CH₄ and VFA production in ruminal batch cultures were studied through several regression analyses. Experiment effects were included in the models, both as a main random effect and, initially, as their random interaction with independent variables. The REML algorithm of JMP (release SAS 5.0.1.2) was used to fit the models. Treatment means were weighted by the reciprocal of their variance (n/SEM²) scaled to 1 to account for unequal replication and unequal variances of the means across experiments.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
6	Ruminal (beef steers and sheep) batch cultures	Fumarate supplementation	No fumarate supplementation	Metric: Methane (CH ₄) production; Effect size: Difference of of the considered metrics between intervention and control	50

Results

- The present analysis found a linear relationship between CH₄ decrease and fumarate concentration, with a decrease in CH₄ of 0.037 μmol/μmol of added fumarate (P= 0.03). The observed decrease was more than 6-fold lower than the theoretical stoichiometry of -0.25 mol of CH₄/mol of added fumarate.
- There was no interaction (P = 0.63) between the percentage of concentrate in the substrate dry matter and fumarate addition on CH₄ production.
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The average decrease in CH₄ in batch cultures was of 0.037 μmol/μmol of added fumarate, which is considerably lower than 0.25 μmol/μmol, the decrease predicted from the stoichiometry of the reactions involved.