FARMING PRACTICE
LIVESTOCK FEEDING TECHNIQUES

IMPACT: GHG EMISSIONS

Reference 11

Yanza, YR; Szumacher-Strabel, M; Jayanegara, A; Kasenta, AM; Gao, M; Huang, HH; Patra, AK; Warzych, E; Cieslak, A 2020 The effects of dietary medium-chain fatty acids on ruminal methanogenesis and fermentation in vitro and in vivo: A meta-analysis J. ANIMAL PHYSIOLOGY & ANIMAL NUTRITION, 00:1–16. 10.1111/jpn.13367

Background and objective

The efficacy of methane (CH_4) suppression using medium-chain fatty acids (MCFA) remains inconclusive, despite a number of studies on this topic are available. The aim of the present study was to perform a meta-analysis of published in vitro and in vivo experiments to investigate the effects of various MCFA sources (mainly LA and MA) on methanogenesis, as well as on ruminal fermentation parameters, digestibility and microbial populations.

Search strategy and selection criteria

The search engines of journal collections such as Web of Science, Scopus and Science Direct were used to collect papers on the relationship between MCFA sources and CH_4 production. i) they described in vitro or in vivo studies in ruminants; ii) they involved adding MCFA to basal feeds; iii) CH_4 emission was directly measured (calculating CH_4 emission data were excluded); and iv) the articles were published in English.

Data and analysis

The collected data were statistically analysed using a mixed-model meta-analysis approach. The analysis employed the PROC MIXED procedure of SAS 9.4 software (University Ed., online). The studies were taken as the random effects, while the concentrations of MCFA supplementations were taken as the fixed effects.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
41	In vitro and in vivo studies on ruminant	Medium-chain fatty acids: 1) Lauric acid; 2) Mixed lauric and myristic acids; 3) Myristic acid; 4) Canola oil enriched with lauric acid; 5) Coconut oil; 6) Krabok oil; 7) Palm kernel oil	Basal diet	Metric: 1) CH_4 emissions; 2) CH_4 emissions/dry matter substrate; 3) CH_4 emissions/digested organic matter; Effect size: not applicable	62.5

Results

- In in vitro experiments CH_4 emission, both expressed as volume (Litre; $p = .03$; $R2 = 0.62$) and as L/g DM substrate ($p = < 0.01$; $R2 = 0.72$), decreased linearly with increasing doses of medium-chain fatty acids.
- In vitro experiments CH_4 production expressed relative to digested organic matter decreased linearly ($p < .01$; $R2 = 0.75$) by medium-chain fatty acids, but the levels of medium-chain fatty acids had no significant influence on gas production.
- The CH_4 emissions decreased with increasing concentrations of dietary medium-chain fatty acids in the in vivo experiments, when CH_4 production was expressed as L/d (linearly, $p < .01$ and $R2 = 0.94$) and L/kg DMI (quadratically, $p = .05$, and $R2 = 0.87$). The CH_4 emissions also tended to decrease quadratically when CH_4 production was expressed as L/kg OMD ($p = .07$; $R2 = 0.84$).
- NULL
- NULL

Factors influencing effect sizes

- in vitro/in vivo study : Coconut oil and myristic acif effectively suppress CH_4 production in in vivo experiments by as much as 21% and 38%, respectively, but that lauric acid diets were less effective in decreasing ruminal CH_4 emission. However, in vitro CH_4 emission was decreased by up to 42% by dietary lauric acid, and dietary mixed lauric and myristic acid, coconut oil and palm kernel oil were also effective in suppressing CH_4.
- fatty acid type : Among the sources of MCFA, suppression of CH_4 production was noted in the following order: coconut oil > lauric acid > myristic acid > mixed lauric and myristic acids > palm kernel oil > canola oil enriched with lauric acids > krabok oil.
- Concentration of dietary fatty acid : Greater concentrations of dietary MCFA resulted in the reduction of ruminal fer-mentation products and digestibility

Conclusion

Most medium-chain fatty acids sources proved their effectiveness against methanogenesis, although the magnitude of inhibition varied depending upon the type and concentration of fat, dietary composition and animal species.