FARMING PRACTICE
LIVESTOCK FEEDING TECHNIQUES

IMPACT: GHG EMISSIONS

Reference 12

Dai, XX; Faciola, AP 2019 Evaluating strategies to reduce ruminal protozoa and their impacts on nutrient utilization and animal performance in ruminants - A meta-analysis FRONTIERS IN MICROBIOLOGY, 10, 2648. 10.3389/fmicb.2019.02648

Background and objective

Several studies have evaluated the effects of complete or partial ruminal protozoa (RP) inhibition; however, to this date, no practical suppressant has been identified and used in large scale. The objectives of this meta-analysis were to: 1) evaluate the effectiveness of different partial RP inhibition strategies (lipids and phytochemicals); 2) evaluate the effects of complete and partial RP inhibition strategies on ruminal microbial fermentation, nutrient utilization, and performance; and 3) evaluate changes on ruminal microbial fermentation, nutrient utilization, and animal performance in partial RP inhibition related to the treatments (phytochemicals and lipids), or RP numbers or their interaction.

Search strategy and selection criteria

The database searched included publications from 2000 to 2018, reporting in vivo data from experiments published in the English language, in which RP count numbers were measured to systematically review different strategies on controlling RP numbers in the past 20 years. To access publications, the editorial platforms of the US National Library of Medicine National Institutes of Health through PubMed1 and the ISI Web of Science were searched with the following keywords: ruminant, defaunation; ruminant, lauric acid, protozoa; ruminant, myristic acid, protozoa; ruminant, coconut oil, protozoa; ruminant, longchain fatty acid, protozoa; ruminant, oilseed, protozoa; ruminant, tannins, protozoa; ruminant, saponins, protozoa; ruminant, essential oil, protozoa. Publications were included if: 1) Treatment interventions included complete and partial inhibition of RP and RP numbers was reported as cells/mL; 2) The method used to control the RP numbers had to be described for each selected publication. Publications were excluded because of the following reasons: 3) Publications using 18S rRNA sequencing to determine protozoa concentration; 4) Publications in which one treatment that combined more than one RP inhibition strategy; 5) Publications in which there were no control group.

Data and analysis

Data were analyzed by mixed models with the MIXED procedure of SAS (SAS ver. 9.4). All mixed models included the random effect of experiment identification, and responses were weighted using the WEIGHT statement in SAS with the inverse of pooled SEM squared (1/SEM2) that was centered for each response analyzed as suggested by Wang and Bushman (1999). The slopes and intercepts by experimental identification were included as random effects, and an unstructured variance-covariance matrix (type = un) was performed at the random part of the model.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
66	Ruminant	1) Ruminal protozoa inhibition; 2) Phytochemicals; 3) Essential oils; 4) Saponin; 5) Tannins; and 6) Lipids supplementation	1) No ruminal protozoa inhibition; 2-6) No feed additives	Metric: Methane (CH_4) production per dry matter intake (DMI) g/kg; Effect size: not applicable	56.25

Results

- Complete ruminant protozoa inhibition increased (P = 0.01) ruminal bacteria concentration (Log10 cells/mL) by 6% while decreased (P = 0.01) methane production by 18%.
- Overall, supplementary phytochemicals had no effects on ruminal bacteria concentration while decreased (P < 0.01) methane production by 20%.
- Essential oils had no effects on ruminal bacteria concentration and methane production; supplemental saponins and tannins both decreased (P < 0.01) ruminal bacteria concentration by about 11% and decreased (P < 0.01) methane production by 15% and 20%, respectively.
- Supplemental lipids had no effects on ruminal bacteria whereas decreased (P = 0.05) methane production by 15%. Among the lipids sources, methane production was decreased by 20% by MCFA whereas only by 9% by LCFA.
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The use of protozoa inhibitors and phytochemicals, saponine ans tannins showed positive effects on methane production, while lipids had no effect.