FARMING PRACTICE
LIVESTOCK FEEDING TECHNIQUES

IMPACT: GHG EMISSIONS

Reference 27

Appuhamy, JADRN; Strathe, AB; Jayasundara, S; Wagner-Riddle, C; Dijkstra, J; France, J; Kebreab, E 2013 Anti-methanogenic effects of monensin in dairy and beef cattle: A meta-analysis JOURNAL OF DAIRY SCIENCE, 96, 5161-5173. 10.3168/jds.2012-5923

Background and objective

Monensin is a widely used feed additive with the potential to minimize methane (CH_4) emissions from cattle. Several studies have investigated the effects of monensin on CH_4, but findings have been inconsistent. To conduct meta-analyses to quantitatively summarize the effect of monensin on methane (CH_4) production (g/d) and the percentage of dietary gross energy lost as CH_4 in dairy cows and beef steers.

Search strategy and selection criteria

Literature searches of the Web of Science and CAB Direct online databases were conducted using the combination of search terms "monensin", "methane", and "cattle", or "cow". The period covered was 1970 to 2011. 1) To include a control treatment group that did not receive monensin; 2) To be conducted in vivo using cattle; 3) To include measured CH_4 production as an outcome.

Data and analysis

Separate meta-analyses were conducted for quantifying overall antimethanogenic effects of monensin in dairy cows, beef steers, and both dairy cows and beef steers using the metafor package (version 1.6–0) in R (version 2.12.2). Heterogeneity of the monensin effects were estimated using random effect models. Due to significant heterogeneity (>68%) in both dairy and beef studies, the random effect models were then extended to mixed effect models by including fixed effects of dry matter intake (DMI), dietary nutrient contents, monensin dose, and length of monensin treatment period. Values of each explanatory variable were first centered on their means and then regressed individually against mean differences (MD). The meta-analytic models were fitted using the rma function in the metafor package. Full mixed-effect models carrying all explanatory variables having effects ($P < 0.10$) when fitted individually were then fitted using the maximum likelihood (ML) method. Reduced models were formed via stepwise elimination of variables. The parameter estimates of the final model were obtained by fitting the model using the REML method. Forest and funnel plots were constructed. Publication bias was were assessed using Egger's regression test for funnel plot asymmetry.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
13	Dairy cattle and beef steers	Monensin supplementation	NO Monensin supplementation	Metric: 1) Methane (CH_4) production (g/day); 2) Dietary gross energy lost as CH_4; Effect size: Standardized difference of the considered metrics between intervention and control	93.75

Results

- Monensin showed a potential ($P = 0.065$) to reduce CH_4 production in dairy cows by 6 g/d with dry matter intake (DMI) and dietary ether extract (EE) content have significant independent effects on CH_4 production.
- Feeding monensin in a diet with average neutral detergent fiber (NDF) content (379 g/kg of DM) significantly ($P < 0.001$) reduced CH_4 emissions from beef steers by 19 g/d.
- Dietary gross energy lost as CH_4 decreased with monensin in dairy cows.
- None of the selected explanatory variables had a significant effect on the monensin effect on dietary gross energy lost as CH_4 in beef steers.
- NULL

Factors influencing effect sizes

- Dry matter intake (DMI) : A unit (kg/d) increase in DMI from its mean reduced ($P = 0.020$) potential monensin-induced CH_4 mitigation in dairy cows by 1.4 g/d. Also positively associated ($P = 0.017$) with the monensin effect on dietary gross energy lost as CH_4 in dairy cows.
- Dietary ether extract (EE) : A unit (g/kg of DM) increase in dietary EE from its mean increased the monensin effect in dairy cows by 4.3 g/d.
- Neutral detergent fiber (NDF) content : A unit increase in NDF content from its mean further increased monensin-induced CH_4 mitigation in beef steers by 0.05 g/d ($P = 0.095$).

Conclusion

Overall, monensin had stronger anti-methanogenic effects in beef steers than dairy cows, but the effects in dairy cows could potentially be improved by dietary composition modifications and increasing the monensin dose.