FARMING PRACTICE
LIVESTOCK FEEDING TECHNIQUES

IMPACT: GHG EMISSIONS

Reference 4

Belanche, A; Newbold, CJ; Morgavi, DP; Bach, A; Zweifel, B; Yanez-Ruiz, DR 2020 A meta-analysis describing the effects of the essential oils blend Agolin Ruminant on performance, rumen fermentation and methane emissions in dairy cows ANIMALS, 10, 620. 10.3390/ani10040620

Background and objective

One of the alternatives that has shown promising potential is the use of additives based on plant-extracted essential oils (EO) to manipulate rumen fermentation, boost animal productivity and decrease CH_4 emissions. However, the available information in the literature generally involves studies that are either in vitro or of a short duration in vivo without the possibility of recording production data consistently. To quantitatively summarize the effect of Agolin® Ruminant on dairy cows' performance, physiology and enteric CH_4 emissions using both animal studies under experimental conditions and on commercial dairy farms to describe its short- and long-term effects. Here, results on methane (CH_4) emissions are reported.

Search strategy and selection criteria

The server of the CSIC (Granada, Spain) was used to conduct an electronic literature search including CAB database, Medline, PubMed, Sciences-Direct and Web of Sciences. There was no restriction to peer-reviewed journals, and the eligible publications included abstracts, conference proceedings and theses. In addition, different groups of investigators from Aberystwyth University (Aberystwyth, UK), INRAE (Clermont-Ferrand, France) and IRTA (Caldes de Montbui, Spain) were contacted asking for unpublished studies. Agolin SA put authors in contact with farms that have used the product to seek information from unpublished on-farm studies. 1) Only in vivo studies using dairy cows were considered; 2) For any variable, studies had to report mean value and its variability for both treated and control groups; 3) Only studies which used the EO blend Agolin®Ruminant at the recommended dosage of 1 g/d per cow were considered; 4) On-farm studies which did not collect data systematically were not considered.

Data and analysis

Studies were weighted according to the number of observations. Meta-analysis was performed using the Metafor package (Version 2.1.0) from R statistics (Version 3.6.1). In particular, the function rma was used since provides a general framework for fitting meta-analytic models. The meta-analysis was calculated fitting a random-effect model with a DerSimonian-Laird estimator for assessing heterogeneity ($\tau 2$) for each category separately. Forest plots were generated to illustrate the response ratio along with the estimated 95% confidence interval and sample size for each parameter considered. The heterogeneity or between-studies variability was determined using the Cochran's Q test as indicator of the inconsistency across studies. However, as the Q statistics does not provide information on the extent of true heterogeneity (only its significance), the I2 statistics was also calculated, which denotes the percentage of the total variability that is attributed to the between-studies variability. Since the repeated measures analysis revealed changes along time on the effect of esential oils, it was decided to conduct two more meta-analyses for the most relevant parameters. The first meta-analysis compiled short-term data (<28 days of Agolin treatment) derived from short-term studies and from the first 28 days of long-term studies. The second meta-analysis evaluated the long-term information (>28 days of Agolin treatment). A funnel plot analysis was performed to test the asymmetry across studies and to discard potential bias between published and unpublished studies and between different experimental designs considering the milk yield as the key response factor.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
23	Dairy cattle	Agolin® Ruminant essential oils blend supplementation	No Agolin® Ruminant supplementation	Metric: 1) CH_4 production (g/d); 2) CH_4 yield (g/kg DMI); 3) CH_4 intensity (g/kg FPCM); Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	87.5

Results

- Agolin supplementation decreased the CH_4 production (g/d, R = 0.954, p = 0.007) and intensity (g/kg FPCM, R = 0.925, p = 0.023) with a low level of inconsistency (I2 < 23, Q > 0.24). This decrease in CH_4 emission was not significant when expressed as CH_4 yield (g/kg DMI).
- The short-term treatment with Agolin slightly decreased CH_4 production (R = 0.978) and intensity (R = 0.974) but not CH_4 yield.
- Long-term treatment with Agolin decreased CH_4 production (R = 0.912), yield (R = 0.871) and intensity (R = 0.901) with a high consistency across treatments (I2 < 5, Q > 0.39).
- NULL
- NULL

Factors influencing effect sizes

- Duration of treatment : The short-term treatment with Agolin slightly decreased CH_4 production (R = 0.978) and intensity (R = 0.974) but not CH_4 yield. Long-term treatment with Agolin decreased CH_4 production (R = 0.912), yield (R = 0.871) and intensity (R = 0.901) with a high consistency across treatments (I2 < 5, Q > 0.39).

Conclusion

This meta-analysis suggested that supplementation of lactating dairy cows with the essential oil blend Agolin Ruminant® (at 1g/d per cow) during a period greater than 4 weeks decreased methane emissions (–10%) without affecting feed intake and milk composition.