Meta-analysis of the association between oil supplementation, enteric methane emission and productivity of ruminants

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Recognising the urgent need to address climate change, nations have agreed to reduce greenhouse gas (GHG) output, aiming for net zero emissions in the second half of the century (UNFCCC, 2015). Livestock enteric methane (CH_4) contributes to 12% of global emissions, and efforts are being made to identify and encourage actions to reduce these emissions. In this regard, several industries and areas of Australia have proposed targets for emissions, with New South Wales seeking to reach net zero GHG emissions by 2050. Methane represents energy loss from the ruminant fermentation process, and it is the main source of GHG from agriculture. Among the proposed dietary strategies to mitigate CH_4, oil inclusion in the diet has been extensively tested for over 20 years and found to suppress some H_2 producing organisms (i.e., protozoa), as well as methanogens (Mao et al., 2010).

The objective of the study was to use previously published data to evaluate the methane abatement potential of oil supplementation to ruminants, as well as quantify co-benefits of oil supplementation. To accomplish this, a database was created with publications from *in vivo* ruminant trials in the last 20 years that compared measured methane emission of ruminants fed diets with or without added oil, such as soybean, rapeseed, and coconut oils. All data were from articles (n=35 studies) published in indexed journals retrieved using the Google Scholar search engine (https://scholar.google.com) using the keywords: "ruminant", "oil", and "methane". The present meta-analysis was analysed using the MIXED procedure of SAS (version 9.4, SAS/STAT, SAS Institute Inc., Cary, NC), considering study as random effect. To account for variations in precision across studies, the inverse of the squared standard error of the mean of CH_4 (g/kg DMI; dry matter intake) was used as a factor in the WEIGHT statement of the model.

The results revealed that, averaged across all studies, oil supplementation decreased methane emission by 14.3% compared with a control diet (17.2±0.873 g vs. 20.1±0.933 CH_4/kg DMI; P<0.01) in ruminants. Moreover, the reduction in CH_4 yield ranged from 12 up to 20% (95% confidence interval; CI), as oil inclusion increased from 2.85 to 6.20% (95% CI) in the diet. The oil supplementation decreased DMI from 2 to 6% (P<0.01; Figure 1a) and resulted in 6.3 to 13% reduction in fibre digestibility (i.e., NDF; P<0.01; Figure 1b). The overall reduction in CH_4 intensity (g CH_4/kg of milk or weight gain) ranged from 21.5 to 14.4% (P<0.01; Figure 1c).

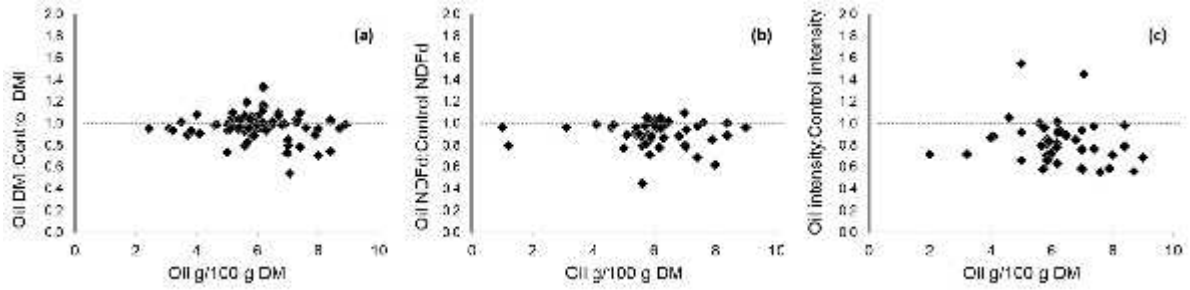

Figure 1. Mean effect of the estimated ratio of diets containing oil and control diets in DMI (a), NDF digestibility (b) and CH_4 intensity (c).

This study confirms that oil supplementation is a viable strategy for reducing enteric methane, leading to significant mitigation without adverse impacts on animal production. It is important to note that the CH_4-suppressing effect of oils is moderated by the basal diet, as oil can be added to low-fibre diet without impairing fibre digestibility, but not to high-fibre diets. Furthermore, the practicality of oil supplementation in the diet in a farm setting should be evaluated considering its benefits in methane mitigation, as well as animal performance and cost of feeding across production systems. When combined with information about costs, co-benefits and any practical constraints, the results presented here can be used in developing methane reduction pathways for livestock, to contribute to achieving GHG mitigation targets.

References

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