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| **Title:** Dietary supplementation with rapeseed oil and cake on animal performance, methane emissions, and digestibility of beef cattle  **Application:** Ireland has an ambitious target of reducing agricultural GHG emissions by 25% by 2030, which includes a recommended 10% reduction in enteric methane. Many potentially effective dietary additives are not feasible due to availability, requirement for regulatory approval, transient efficacy or cost. Practical and cost-effective dietary based methane mitigation regimens are necessary to reduce carbon footprint and improve the circularity of nutrient usage in beef cattle rations.  **Introduction:** Oilseed rape (*Brassica napus* L) is a popular break crop in Irish cereal production. Its high fat containing by-products have been suggested to be effective in reducing enteric methanogenesis in ruminants (Bayat et al. 2022). Rapeseed oil is rich in fatty acids including oleic (C18:1), linoleic (C18:2), palmitic acid (C16:0) and linolenic acid (C18:3), which are putatively responsible for the observed CH4 inhibition (Lewinska et al. 2015). Additionally, high fat diets have been shown to positively affect intramuscular fat content of meat (Hess et al. 2008). With high rapeseed oil by-products such as cold pressed rapeseed cake, there is an opportunity to also improve nutrient circularity by reducing reliance on imported ration ingredients for finishing diets. The objective of this study was to holistically examine the effect of fatty acid supplementation from different physical forms of rapeseed (cold pressed rapeseed cake and rapeseed oil) on dry matter intake (DMI), average daily gain (ADG), enteric gaseous emissions, haematological profile and poly unsaturated fatty acid (PUFA) content of *longissimus dorsi* muscle of beef cattle on a winter finishing diet.  **Materials and methods:** For the experiment, 54 crossbred Charolais steers and heifers; with an initial body weight (BW) of 384 kg (SD 39.5) at Teagasc Grange, Animal & Grassland Research and Innovation Centre were offered concentrate feed at 41% of total DMI (exclusive to silage) containing one of the following: 1. Unsupplemented control (CON), 2. Rapeseed cake (RSC) or 3. Rapeseed oil (RSO). Dietary inclusion of rapeseed oil and cake (2.5 and 14.5%, respectively) was balanced on oil, total fatty acid, PUFA and mono unsaturated fatty acid (MUFA) content. Cattle were offered their respective diets with grass silage on an *ad libitum* basis during which feed intake and gaseous emissions analysis (GreenFeed emissions monitoring system - GEM) were recorded over 88 consecutive days, including a 17 day pre- baseline period. Cattle were weighed weekly to calculate ADG. Ultrasonic muscle and fat deposition measurements were recorded at day 1 and 87. Blood serum samples were collected from the jugular vein on day 10, 53 and 88 of the experiment. A muscle biopsy was collected from 15 animals per treatment from the *longissimus dorsi* muscle on day 89 to assess the fatty acid composition. Statistical analysis was performed on SAS (version 9.4) where repeated measures was used to assess changes in gaseous emissions, DMI, and blood metabolites over time. Linear regression was used to calculate ADG. For muscle and fat deposition measurements and fatty acid composition of the *longissimus dorsi* muscle, data was analysed using the mixed-model procedure (PROC MIXED). The probability value for statistical significance is *P* < 0.05.  **Results:** Cattle achieved a mean DMI of 7.44 kg/day (SD = 1.3) and there was no statistically significant difference between treatments (*P* > 0.05). Cattle fed RSO and CON had a higher ADG than RSC (1.24, 1.17 and 1.05 kg/day respectively). A total CH4 reduction of 15.52 and 15.91 g/day was observed in RSC and RSO supplemented cattle, respectively, compared to CON. This equated to a lower CH4 intensity of 2.01 and 2.79 g/kg DMIfor RSC and RSO compared to CON, and 0.03 and 0.04 g/kg BW, respectively. The production of CO2 in the rumen was not affected however, H2 was reduced by RSO supplementation. There was an increase in serum concentrations of HDL and LDL cholesterol for RSC and RSO (*P* < 0.05). Diets had no effect on muscle and fat accretion, and did not alter the fatty acid composition of the muscle (*P* > 0.05).   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  | |  | CON | RSC | RSO | S.E.M | *P* value | | DMI; kg | 7.5 | 7.61 | 7.74 | 0.012 | 0.22 | | ADG; kg | 1.17a | 1.05b | 1.24a | 0.027 | \*0.01 | | Start weight; kg | 383.9 | 384.3 | 383.6 | 5.61 | 0.95 | | Middle weight; kg | 421.0 | 418.9 | 424.3 | 5.84 | 0.41 | | End weight; kg | 465.3 | 459.5 | 464.9 | 5.66 | 0.54 | | *Gaseous emissions* |  |  |  |  |  | | CH4; g/d | 199.11a | 183.59b | 183.20b | 0.661 | \*0.021 | | H2; g/d | 0.50a | 0.49a | 0.43b | 0.004 | \*0.031 | | CO2; g/d | 6978 | 6718 | 6843 | 15 | 0.25 | | CH4;g/kg DMI | 26.61a | 24.60ab | 23.82b | 0.108 | \*0.002 | | CH4;g/kg BW | 0.47a | 0.44b | 0.43b | 0.001 | \*0.005 | |  |  |  |  |  |  |   DMI = dry matter intake, ADG = Average daily gain, BW = body weight  **Conclusion:** Supplementing beef cattle diets with either rapeseed oil or rapeseed cake resulted in a similar reduction in ruminal CH4 emissions of approximately 8% when compared with an unsupplemented control diet. Animals supplemented with RSO achieved this without any notable effect on performance, however RSC reduced ADG. Rapeseed derived ingredients altered HDL and LDL cholesterol concentrations in the blood. Rapeseed oil has potential as an anti-methanogenic feed supplement with no impact on animal performance, showing consistent efficacy over the duration of the experiment and expeditious implementation due to no regulatory approval requirements.  **Acknowledgements:** This research is part of the ‘Integrity’ project funded by ‘DAFM through the ERA-GAS (Circularity) call (Contract no. 2021EN907).  **References**  Bayat, A., Vilkki, J., Razzaghi, A., Leskinen, H., Kettunen, H., Khurana, R., Brand, T. and Ahvenjärvi, S. 2022. Journal of Dairy Science, 105(2), 1211-1224.  Hess, B., Moss, G. and Rule, D. 2008. Journal of Animal Science, 86(14), 188-204.  Lewinska, A., Zebrowski, J., Duda, M., Gorka, A. and Wnuk, M. 2015. Molecules, 20(12), 22872-22880. |