

The effect of level of dietary fish oil inclusion on intake and methane emissions of beef steers

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Introduction Irish livestock account for 0.55 million tonnes of methane (CH₄) annually from enteric fermentation and manure management (EPA, 2006). However, recent studies have shown the potential to reduce ruminal methanogenesis through strategic dietary supplementation with polyunsaturated fatty acids (PUFA; Jordan *et al.* 2006). This is likely to be mediated, in part, through the unsaturated double bonds of PUFA acting as sinks for free hydrogen during ruminal biohydrogenation. Fish oil is acknowledged as the richest natural source of long chain n-3 PUFA such as eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids (Ruxton *et al.*, 2004). Despite this, there is little published information on the effect of dietary fish oil supplementation on *in vivo* ruminal methanogenesis in cattle. The aim of this study was to assess the effect of a novel concentrated n-3 PUFA fish oil, on the intake and CH₄ emissions of beef steers.

Materials and methods Six mature Limousin crossbred steers with a mean (\pm S.E.) initial liveweight of 662 kg (\pm 12.7 kg) were allocated at random to a replicated 3 x 3 Latin square design. Each period lasted 28 days. Animals were housed in slatted floor pens and individually fed using Calan Broadbent feed gates. Feed was offered in 2 equal portions at 08:00 and 16:00h daily. Steers were fed a 50:50 forage:concentrate diet, with barley straw as the forage source. Intakes were restricted to 95% of voluntary intake. Three concentrates were manufactured to supply fish oil at 0, 1 or 2% DMI and all diets were formulated to be iso-nitrogenous (14% CP DM). The fish oil contained 43% EPA and 19% DHA. Dry matter intake was measured daily. Forage DM, was determined daily by oven drying at 55°C for 72h and concentrate was sampled daily, bulked by treatment to provide three samples from each experimental period and stored at -20° C prior to subsequent analysis. Following a 21-day dietary adaptation period, daily CH₄ emissions were measured on all steers on days 23-27 of each period using the sulphur hexafluoride (SF₆) tracer technique of Johnson *et al.* (1994). The CH₄ and SF₆ samples collected from the steers were analysed by gas chromatography and adjusted for ambient concentrations. Statistical analysis was performed in accordance with the latin square design using the PROC MIXED procedure of SAS.

Results Dietary supplementation with 2% fish oil resulted in a decrease of both daily and intake corrected CH₄ production ($P < 0.05$). This was associated with a concomitant linear decrease in intake ($P = 0.0001$; Figure 1) in the animals fed at the 2% level. The greatest incremental decrease in both absolute and feed intake corrected CH₄ emissions was recorded between 1 and 2% dietary fish oil inclusion ($P < 0.05$; Figure 2).

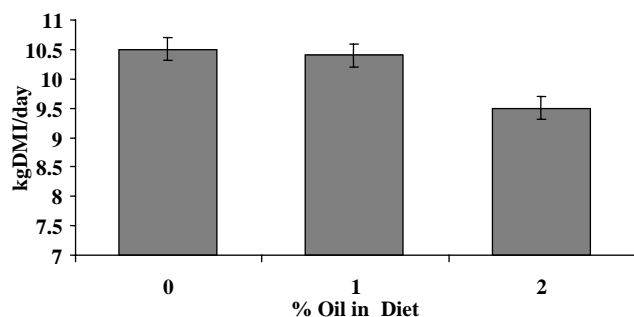


Figure 1 Effect of diet on feed intake (kg DMI/day)

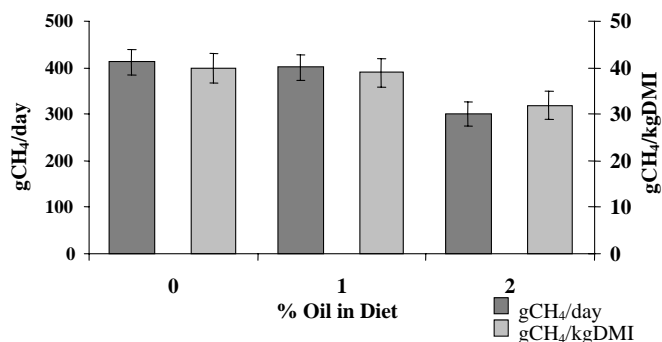


Figure 2 Effect of diet on CH₄ emissions

Conclusion Inclusion of fish oil at 2% DMI led to a reduction in daily and feed intake corrected CH₄ production. This reduction however, was associated with a 9.5% reduction in feed intake. Therefore, the effects of dietary inclusion of this high n-3 PUFA fish oil on animal performance and meat quality warrant further investigation.

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References

- E.P.A. 2006. Greenhouse gas emissions 1990-2004 reported to the UNFCCC. Johnstown Castle, Wexford, Ireland.
- Johnston, K., Huyler, M., Westburg, H., Lamb, B. and Zimmerman, P. 1994. Environmental Science and Technology. 28, 359-362.
- Jordan, E., Lovett, D., Hawkins, M., Callan, J., O'Mara, F. 2006. Animal Science. 82, 859-865.
- Ruxton, C., Reed, S., Simpson, M., Millington, K. 2004. Journal of Human Nutrition and Dietetics. 17, 449-459.