Title:

Short-term emission measurements in beef feedlot cattle to demonstrate enteric methane mitigation from dietary nitrate

JI Velazco, G Bremner, L Li, K luijben, RS Hegarty, H Perdok 2013. Advances in Animal Biosciences 4, 279.

Summary:

Introduction Methane emissions from ruminants make a significant contribution to anthropogenic greenhouse gas emissions in pastoral countries such as Uruguay and Australia. In those countries cattle are routinely supplemented with non-protein nitrogen (NPN) to promote rumen fermentation and microbial protein synthesis. Nitrate has been identified as an alternative NPN source to urea, offering the additional advantage of reducing enteric methane emissions (Nolan et al., 2010). Measurement of enteric emissions in the production environment is difficult, but short-term emission measures show promise in quantifying daily methane emissions. In association with a larger study (Hegarty et al., 2013), this investigation aimed to test the ability of short-term emission measurements to detect nitrate-induced methane mitigation in beef cattle using a GreenFeed emission monitoring unit (GF, C-Lock Inc, USA).

Material and methods Composite-breed steers (n=22; 521.3kg initial LW and 32.7kg SD) were allocated to two isonitrogenous and isoenergetic feedlot diets based on cracked-barley and maize silage (13.6% crude protein, 13.1 MJ ME/kg DM) using stratified randomization based on LW. The treatments differed in their NPN source, being either urea (1.00% in DM) or calcium nitrate (1.90% NO_3 in DM) (Hegarty et al., 2013). Each treatment was fed to a pen of 11 steers, with the ration provided in auto-feeders (GrowSafe Systems Ltd., Canada) which also recorded individual feed intakes. Animals were acclimated to the rations with inclusion rates of NPN and grain progressively increased. Steers were fed the finisher rations *ad libitum* for a period of six weeks and the GF device was swapped between treatments on a weekly basis (3 x 1 week periods/treatment) to provide measures of methane and carbon dioxide production rate. The GF device records gas concentrations when animals voluntarily visit the unit (eructation + breath events are recorded when animals are close and standing in the front of the unit). Data was only accepted when cattle kept their head in the GF for at least 2 minutes to ensure inclusion of adequate eructation events. For statistical analysis, only animals with at least 3 measures in the period were considered. Parameters were daily methane recovery (CH_4, g/d), daily carbon dioxide recovery (CO_2, g/d), feed intake (kg DM/d), length of the visits at the GF (min) and number of visits (visits/week). Analysis of variance was performed for all repeated measurements. Period and week effect were not significant so were dropped for final analysis.

Results No effect of dietary NPN source on the number (7.54 visits/week) or length (3.37 min) of the visits to the GreenFeed unit was apparent (P=0.626 and P=0.271 respectively). Average daily feed intake (kg DM/d) over the 6 weeks also did not differ (P=0.145; Table 1) between cattle on the urea or nitrate-containing rations. Calcium nitrate tended to be effective in reducing methane emissions relative to when urea alone supplied dietary NPN (P=0.056), but no differences were detected for carbon dioxide emissions (P=0.300). Dietary nitrate led to a significant reduction in the methane yield (g CH_4/kg DMI) of cattle (P<0.05; Table 1)

Table 1 Feed intake, breath emissions and methane yield of cattle offered isoenergetic and isonitrogenous diets containing non-protein nitrogen as only urea or with calcium nitrate

	Urea	Calcium Nitrate	SE	F prob.
Intake (kg DM/d)	9.19	10.04	0.332	0.145
CH_4 (g/d)	106.8	86.1	5.53	0.056
CO_2 (g/d)	4455	5005	326.8	0.300
Methane yield (g CH4/kg DM)	12.62	8.61	0.681	0.014

Conclusions The results show that calcium nitrate was effective in reducing enteric methane production without reducing feed intake, although intake reduction was observed in the larger study (Hegarty et al., 2013). Additionally, the short-term measurement technique was able to detect nitrate-derived methane mitigation. This led to a significant, over 30% reduction in methane yield, even though this was already low due to the high-grain ration. Future research should attempt to evaluate short-term measurements to validate mitigation achieved by other means.

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References

Hegarty, R.S., Miller, J., Robinson, D.W., Li, L., Oelbrandt, N., Luijben, K., Nolan, J.V., Bremner, G., McGrath, J. and Perdok, H.B. 2013. Advances in Animal Biosciences, This conference.

Nolan, J.V., Hegarty, R.S., Hegarty, J., Godwin, I.R., and Woodgate, R. 2010. Animal Production Science 50, 801–806.