**Application**: Inclusion of calcium peroxide (CaO2) in concentrate feed can improve animal performance and reduce methane emissions of beef cattle.

**Introduction**: Irish agriculture accounts for over 38% of national greenhouse gas emissions with the greatest contribution resulting from enteric fermentation in ruminant livestock. Achieving a 25% reduction in Irish agricultural emissions by 2030 requires adopting feed management strategies that significantly reduce methane emissions from the national herd, ensuring sustainable livestock production in Ireland. Various feed additives such as 3-NOP (Stuart Kirwan et al., 2024), CaO2 (Roskam et al., 2024), nitrates, lipids, and seaweeds (Beauchemin et al., 2022) have been found to reduce methane emissions in cattle by 15-30%. However, there is inconsistent evidence of the co-benefit of increased animal performance following the use of these feed additives. Moreover, these feed additives are mostly applicable within the context of total mixed ration which makes it unsuitable for lower intensity forage based production systems. This led to exploring a novel calcium peroxide-based dietary additive (CaO2) which was developed by GlasPortBio, Ireland. A recent study conducted by Roskam et al., (2024) showed that CaO2 reduces methane emissions by 16-29% and can be administered in pelleted format without affecting its anti-methanogenic potential. However, this study indicated that CaO2 reduced nutrient digestibility, thus the need to optimise the inclusion level of the additive in cattle diet. As a result, the objective of this study is to evaluate the effect of dietary inclusion levels of a novel calcium peroxide-based feed additive on production performance and methane emissions of beef cattle.

**Methods**: Seventy-two spring-born Charolais cattle (n=36 steers and n=36 heifers) with an average body weight (±SD) of 455 ± 5.75 kg and age of 15 ± 0.4 months were enrolled in this study. The animals were blocked on body weight, baseline methane emissions and sex. Within each block, animals were randomly assigned to one of the four dietary inclusion levels of CaO2,based on total dry matter intake: control with 0% CaO2 inclusion (CON), a low inclusion diet with 0.4% CaO2 (LID), a medium inclusion diet with 1.2% CaO2 (MID), and a high inclusion diet with 2.0% CaO2 (HID) (n=18). Animals received their respective treatments over a 12 week period, during which dry matter intake (DMI) (American Calan Inc., Northwood, NH), average body weight (ABW), average daily gain (ADG), feed efficiency (FCE) and gaseous emissions (C-Lock Inc., Rapid City, SD) were measured. All animals were fed a basal diet of grass silage and concentrate in a 60:40 forage to concentrate ratio. The average weekly individual DMI, growth and gaseous emissions data were analysed using REML. Fixed effects included treatment and weeks, while blocks was treated as random effects with animal as the experimental unit and week as the repeated measure. The statistical analysis was conducted using R software version 4.3.2.

**Results**: The daily DMI was affected by the dietary treatments with animals on MID having the lowest DMI when compared to other treatment groups (P <0.001) (Table 1). Considering the ABW, ADG and FCE, animals on the HID treatment had the highest ABW and ADG when compared to other treatment groups but similar FCE with animals offered the MID dietary treatment (P <0.001). Table 1 shows daily CH4 values for the control group was 233 g/d, CaO2 supplemented diets ranged from 209 to 228 g/d, resulting in daily CH4 reductions of 2.2%, 9.4% and 10.3% for LID, MID and HID, respectively, compared to CON (P < 0.001). Animals offered HID has the lowest CH4 yield with a reduction of 2.6, 2.3 and 0.6 g/kg DMI compared to the CON, LID, MID treatment group respectively (P< 0.001). Similarly, the animals on HID treatment group had lower CH4 intensity up to 43, 52 and 13 g/kg of ADG when compared with CON, LID, MID treatment groups, respectively (P < 0.001).

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| *Table1: Effect of dietary calcium peroxide inclusion levels on production performance and gaseous emissions of growing beef cattle* | | | | | | | |
| Parameters | Dietary Treatments | | | | SE | P-value | |
|  | CON | LID | MID | HID |  | Treatment | Week |
| DMI (Kg) | 9.10b | 9.01ab | 8.91a | 9.11b | 0.065 | <0.001 | <0.001 |
| ABW (Kg) | 493b | 490b | 484a | 507c | 5.770 | <0.001 | <0.001 |
| ADG (Kg/d) | 1.03a | 1.00a | 1.09b | 1.16C | 0.027 | <0.001 | >0.05 |
| FCE (Kg ADG/Kg DMI) | 0.11a | 0.11a | 0.12b | 0.13b | 0.003 | <0.001 | <0.001 |
| CH4 (g/d) | 233b | 228b | 211a | 209a | 3.260 | <0.001 | <0.001 |
| CO2 (g/d) | 7865b | 7654a | 7589a | 7687a | 81.20 | <0.001 | <0.001 |
| H2 (g/d) | 0.308ab | 0.289a | 0.290a | 0.316b | 0.007 | 0.002 | <0.001 |
| CH4 (g/kg DMI) | 25.6c | 25.3c | 23.6b | 23.0a | 0.300 | <0.001 | <0.001 |
| CH4 (g/kg BW) | 0.47c | 0.47c | 0.44b | 0.41a | 0.005 | <0.001 | <0.001 |
| CH4 (g/kg ADG) | 231c | 240c | 201b | 188a | 7.770 | <0.001 | <0.001 |

a-c Means within a row with different superscripts differ (P<0.05). No significant treatment by week interactions

**Conclusion:** Supplementation of forage based diet with CaO2 incrementally improved the growth rate and feed efficiency of growing beef cattle with a 2.0% inclusion level while reducing methane and methane intensity up to 10% and 19%, respectively when compared with unsupplemented animals.

**Acknowledgments:** This project was funded by Department of Agriculture, Food and Marine (DAFM), Ireland and the Global Research Alliance on Agricultural Greenhouse Gases (GRA) (2022 CSSGRA854).

**References**

Beauchemin, K. A., Ungerfeld, E. M., Abdalla, A. L., Alvarez, C., Arndt, C., Becquet, P., ... & Kebreab, E. (2022). Invited review: Current enteric methane mitigation options. *Journal of Dairy Science*, *105*(12), 9297-9326.

Kirwan, S. F., Tamassia, L. F., Walker, N. D., Karagiannis, A., Kindermann, M., & Waters, S. M. (2024). Effects of dietary supplementation with 3-nitrooxypropanol on enteric methane production, rumen fermentation, and performance in young growing beef cattle offered a 50:50 forage: concentrate diet. *Journal of Animal Science*, *102*, skad399.

Roskam, E., Kenny, D. A., Kelly, A. K., O’Flaherty, V., & Waters, S. M. (2024). Dietary supplementation with calcium peroxide improves methane mitigation potential of finishing beef cattle. *animal*, *18*(11), 101340.