

## 28. The effect of phenotypically ranking beef cattle for residual methane output on daily methane emissions, intensity and animal productivity

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**Application:** Beef cattle ranked as having low residual methane output had lower emissions intensity and similar overall productive performance as their high emissions ranking contemporaries. The concept of residual methane output is proposed as an appropriate trait to more equitably identify animals on the basis of low emissions beef production.

**Introduction:** The sustainability of ruminant livestock production can be enhanced with the inclusion of methane (CH<sub>4</sub>) output in a breeding index. Residual methane output (RCH<sub>4</sub>) is a promising CH<sub>4</sub> phenotype to aid more balanced selection, as it is strongly correlated with daily CH<sub>4</sub> (g/day) but independent of feed intake and body weight [1]. The objective of this study was to assess the impact of ranking cattle in terms of RCH<sub>4</sub> on CH<sub>4</sub> output and production traits in a population of similarly managed cross bred beef cattle.

**Materials and methods:** Intake, feed efficiency (FE) and CH<sub>4</sub> output was measured on 282 cross bred beef cattle (heifers n = 154; steers n = 128) housed at the Irish Cattle Breeding Federation (ICBF) performance test centre (Kildare, Ireland). Cattle were offered *ad libitum* access to a TMR diet (75% concentrate and 25% hay). Daily dry matter intake (DMI), average daily gain (ADG), feed conversion ratio (FCR) and residual feed intake (RFI) were calculated for all animals over a mean test period duration of 91 days (71–128 days). Enteric CH<sub>4</sub> emissions, using the GreenFeed System (C-Lock Inc) were estimated over a 21 day period during the performance test. RCH<sub>4</sub> was calculated by regressing CH<sub>4</sub> (g/day) on DMI and body weight on test day 30 with contemporary group (CG) included as a fixed effect. Cattle were ranked in terms of RCH<sub>4</sub> as high (RCH<sub>4</sub> > 0.5 SD above the mean), medium (RCH<sub>4</sub> ±

Table 1

Methane phenotypes of cattle ranked as high, medium and low in residual methane output.

	High RCH <sub>4</sub>	Medium RCH <sub>4</sub>	Low RCH <sub>4</sub>
CH <sub>4</sub> (g/day)	264.97 <sup>a</sup>	224.03 <sup>b</sup>	184.39 <sup>c</sup>
CO <sub>2</sub> (g/day)	8745.38 <sup>a</sup>	8292.25 <sup>b</sup>	8070.83 <sup>b</sup>
Residual CH <sub>4</sub> (g/day)	37.95 <sup>a</sup>	-0.11 <sup>b</sup>	-40.34 <sup>c</sup>
CH <sub>4</sub> (g/ kg DMI )	25.19 <sup>a</sup>	21.60 <sup>b</sup>	17.70 <sup>c</sup>
CH <sub>4</sub> (g/ kg ADG)	191.26 <sup>a</sup>	167.09 <sup>b</sup>	144.06 <sup>c</sup>
CH <sub>4</sub> (g/ kg Carcass Weight)	0.81 <sup>a</sup>	0.67 <sup>b</sup>	0.57 <sup>c</sup>

<sup>a, b, c</sup> Means within a row with different superscript differ (P < 0.05)

0.5 SD above and below the mean), and low (RCH<sub>4</sub> > 0.5 SD below the mean). The effect of RCH<sub>4</sub> ranking group (correcting for breed type, gender and CG) on various production traits was calculated in SAS (version 9.4) using Mixed Model ANOVA.

**Results:** No difference was observed for DMI, ADG, feed efficiency or carcass weight (CW) between the high and low RCH<sub>4</sub> groups. Low RCH<sub>4</sub> animals produced 30.4% less CH<sub>4</sub> (g/day) and 29.6% less CH<sub>4</sub> (g/kg CW) relative to high RCH<sub>4</sub> animals (Table 1). Amongst the CH<sub>4</sub> phenotypes investigated, RCH<sub>4</sub> was the strongest predictor of daily CH<sub>4</sub> output (r = 0.86; P < 0.0001).

**Conclusion:** Animal productivity was not impacted by RCH<sub>4</sub> ranking however a reduction in all measures of CH<sub>4</sub> output was observed in the low vs. high RCH<sub>4</sub> animals. Selecting animals for a low RCH<sub>4</sub> phenotype may therefore act to reduce both CH<sub>4</sub> (g/day) and CH<sub>4</sub> (g/kg CW) whilst maintaining animal performance.

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## Reference

- [1] Bird-Gardiner T, Arthur PF, Barchia IM, Donoghue KA, Herd RM. *Journal of Animal Science.* 2017;95:4391–4398.