Enteric methane production of low-quality forage-fed dairy cattle with different genetic merit

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As a by-product of enteric fermentation, dairy cattle emit methane (CH_4) which is a greenhouse gas. Thus, reducing enteric CH_4 emission will become an essential trait for future breeding objectives in dairy cattle production, along with other production traits, for achieving sustainable dairy businesses (Hayes Lewin & Goddard, 2013). The objective of this study was to explore the enteric CH_4 emission difference of dairy cattle selected under current breeding systems in Australia and New Zealand.

Datasets from two separate experiments comparing production and intake of dairy cattle fed on low-quality forage were used to estimate enteric CH_4 production in this study. Experiment 1 was conducted in New Zealand using high breeding worth (HBW = 198) vs. low breeding worth (LBW = 57) Holstein-Friesian dairy cows. Eight cows were used in each group and they were compared through indoor feeding of pasture for five days in a nitrogen balance study as described in Cheng et al. (2014). Experiment 2 dataset was obtained from an unpublished dairy heifer experiment conducted at Dookie College, Australia. In this study, 48 Holstein-Friesian heifers with known Balanced Performance Index (BPI) were grouped into high (HBPI = 125; n = 6) and low (LBPI = 22; n = 6) genetic groups, allowed to graze for 29 days to measure pasture intake and weight gain. Dry matter intake (DMI) of the animal were computed using the grazed area, differences between pre- and post- grazing pasture mass and rate of the pasture regrowth. Metabolizable energy and crude protein contents of forage used in experiment 1 were 9.9 MJ/kg dry matter (DM) and 15.2% on DM basis, respectively and those values in experiment 2 were 9.3 MJ/kg DM and 5.9% on DM basis, respectively. Milk yield was corrected to 4 % fat corrected milk (FCM) using an equation published by Gaines & Davidson (1923): FMC = milk yield (0.4 + 0.15 fat %). The amount of enteric CH_4 production was estimated using the equation published by Charmley et al. (2016): CH_4 production (g/day) = 20.7× DMI (kg/day). Methane production of each cattle was divided by FCM production (cows) or average daily gain (ADG for heifer) to estimate the CH_4 emission intensity (EI) per unit of production. The data were analysed using one-way ANOVA (Genstat).

In experiment 1 HBW cows produced more CH_4 compared to LBW cows ($P<0.05$; Table1) as their levels of DMI were higher ($P<0.05$; Table1). However, heifer groups in experiment 2 were not different from each other in terms of CH_4 production and DMI ($P>0.05$; Table 1). Notably, the calculation of CH_4 EI in experiment 1 showed a higher level in LBW cows compared to HBW cows ($P<0.05$; Table1). The calculation of CH_4 EI for experiment 2 showed no significant difference between the groups ($P>0.05$; Table 1). This study demonstrated that current breeding system of the New Zealand farm has reduced the CH_4 EI in lactating cows and the result of experiment 2 showed that current breeding system in the Australian farm has not reduced the CH_4 EI of heifers in terms of ADG. This preliminary research should be explored further using a larger population of cattle.

Table 1. Average DMI, milk production and emission intensity of the two experiments.

	Experiment 1-cows				**Experiment 2-heifers**			
Parameters	HBW	LBW	SED	p-value	HBPI	LBPI	SED	p-value
DMI (kg/day/cattle)	16.0	14.8	0.48	0.03	11.5	10.8	0.91	0.5
Milk production (kg/day/cow)	13.6	12.4	0.49	0.03	-	-	-	-
FCM (kg/day/cow)	17.1	14.2	0.68	0.001	-	-	-	-
ADG (kg/day/heifer)	-	-	-	-	1.2	1.1	0.21	0.7
CH_4 production (g/day/cattle)	331	307	10.0	0.03	237	223	18.9	0.5
CH_4 EI (g/kg FCM or ADG)	19.4	21.9	0.86	0.01	206	230	51.8	0.7

References

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