Methane emissions from dairy heifers as affected by residual feed intake and breed

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Abstract

Reducing methane (CH_4) emissions without reducing milk production requires an improvement in feed conversion efficiency: that is an animal's efficiency in utilising feed for maintenance and production. Residual feed intake (RFI) is one measure of feed conversion efficiency; it can be defined as the difference between an animal's actual intake and its predicted intake based on its metabolic size and productivity. More efficient animals eat less than predicted (low RFI); inefficient animals eat more (high RFI).

Enteric CH_4 is an important source of digestible energy loss in ruminants, and research in beef cattle has reported a positive relationship between RFI and daily CH_4 production. Jersey (Jer) cows have also been reported to be more feed efficient than Holstein-Friesian (HF) cows. Thus, I hypothesized that high feed efficient (low RFI) animals would emit less CH_4 than the lower efficiency (high RFI) animals, and that Jer heifers would have lower CH_4 yield than HF heifers.

I measured the CH_4 emissions of 56 growing dairy heifers (20-22 mo old) in a 2 x 2 factorial arrangement: factors included two breeds (HF and Jer; n=28/breed) and two previously determined RFI categories (low RFI; -2.1 kg DM and high RFI; +2.0 kg DM; n=28/RFI category). All heifers were co-mingled and offered the same diet of dried lucerne cubes. Between RFI categories, heifers did not differ in body weight (BW) or BW gain (BWg); but low RFI heifers had 9.3% and 10.6% lower dry matter intake (DMI) and DMI/kg BW, respectively, than high RFI heifers. Similarly, RFI category did not affect CH_4/d or CH_4/kg BWg; but, CH_4/kg DMI was greater in low RFI heifers because of their lower DMI. These results might reflect more complete digestion of ingested feed in more efficient, low RFI heifers, consistent with previous reports of greater apparent digestibility of organic matter. Breed did not affect DMI/kg BW or BWg; Jersey heifers produced less CH_4/d, but not CH_4/kg DMI or CH_4/kg BWg. In conclusion, selecting dairy heifers for low RFI is unlikely to affect daily CH_4 production (g/d), but may increase CH_4 yield (g/kg DMI).

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ADF	Acid-detergent fibre
ATP	Adenosine triphosphate
BW	Body weight
$BW^{0.75}$	Metabolic body weight
BWg	Body weight gain
CH_4	Methane
CO_2	Carbon dioxide
CO_2-eq	Carbon dioxide equivalent
DM	Dry matter
DMI	Dry matter intake
FCE	Feed conversion efficiency
GHG	Greenhouse gas
HF	Holstein-Friesian
h^2	Heritability
IVGPT	In vitro gas production technique
Jer	Jersey
NDF	Neutral-detergent fibre
RFI	Residual feed intake
SF_6	Sulphur hexafluoride
VFA	volatile fatty acid
3NOP	3-nitrooxypropanol