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The persistence over time of divergent methane production in lot fed cattle

J.P. Goopy [a,*], R.S Hegarty [b], R.C. Dobos [b]

[a] *Department Animal Science, University of New England, Armidale, New South Wales, Australia*
[b] *NSW Department of Primary Industries, Armidale, New South Wales, Australia*

Abstract. Steers (12) previously screened using the SF_6 measurement technique and found to have either high or low methane yield (MY: gCH_4/MJ DEI) were re-tested on the same diet. Several steers changed their MY, but the group characteristic of High (1.3 g/MJ) or Low (0.8 g/MJ) MY persisted between the measurement periods as did differences in propionate concentration and protozoal density. This suggests that one or more innate animal attributes must affect MY. The need to consider intake variation of cattle in extrapolating short term measures of methane measurements to annual emission estimates was also highlighted. © 2006 Published by Elsevier B.V.

Keywords: Methane; Feed intake; Cattle; Appetite; Feedlot; Protozoa; VFA

1. Introduction

A promising approach to CH_4 abatement in ruminants is the identification of animals which characteristically produce less methane than their peers. Individuals so identified could be used to elucidate the biological basis for the difference in levels of methane generated, or as the nucleus in a selective breeding programme. However, caution needs to be exercised in drawing conclusions from short-term or single measurements of CH_4 production, because such measurements may not provide an accurate assessment of an animal's "methane status". Both diet and ration influence methane production, but the CH_4 yield (MY) as well as CH_4 production (MPR) of a given diet changes as intake increases [1]. This implies that for animals consuming an unrestricted diet, both MPR and MY may be altered by changing intake.

Individual sheep which exhibit large differences in the amount of CH_4 they produce whilst consuming the same diet have been identified [2]. However the robustness of such

* Corresponding author. Tel.: +61 267701825.
E-mail address: manofcows@yahoo.com (J.P. Goopy).

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results may be compromised where intake has only been estimated, not measured, because substantial divergence from "normal" or "average" intakes during the measurement of methane production may obscure animals' true biological status. This study was conducted to determine the extent to which cattle, once identified as having either High (H) or Low (L) MY, conserve this characteristic over time.

2. Materials and methods

Two groups of Angus steers, chosen from an earlier study [4] according to their deviation of measured MPR from that predicted by the equation of Blaxter and Clapperton [3] were allocated to either high ($n=6$) or low ($n=6$) CH_4 groups. They were drafted into a single feedlot pen with ad. lib. access to the same standard finisher ration (12.1 MJ ME/kg DM) as earlier [4] and water, to measure feed intake and MPR a second time 1–3 months after the initial measurement. Daily feed intake was recorded automatically and MPR was measured on both occasions using a modified SF_6 method [4], with sampling of expired air continuously over a period of 6–10 days. At the conclusion of each sampling period a rumen fluid sample was collected from each animal by mouth.

Subsequently MY (g CH_4/MJ DEI) was deemed to better discriminate whether the MPR of individuals was unusually low or high relative to intake so data was regrouped into that of steers showing low (L) or high (H) MY. Two steers (251 and 338) originally identified as having unusually low MPR had similar initial MY to the overall average of animals measured in the first study [4] (0.94 v mean of: 0.98 g/MJ) so their data was not included with low MY steers. Steer 145 from the high MY group was found to have consumed ~160% of its long term intake during the final period so its data was also excluded from analysis on the basis of non-representative intake. Spectral analysis [5] was applied to intake data to determine if variation in intake occurred in identifiable cycles.

Table 1
Average daily intake, methane production rate (MPR), ratio of actual/predicted MPR and methane yield (MY) of steers selected for High (H) or Low (L) MPR in an initial measure, then 1–3 months later (final)

Group	ID	Intake (MJ DEI)		MPR (g CH_4/day)		Actual/predicted CH_4[a]		MY (g/MJ DEI)	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final
H	145	169	212	376	176	1.72	0.73	2.2	0.8
	102	231	139	359	243	1.54	1.10	1.6	1.8
	18	165	131	262	220	1.25	1.07	1.6	1.7
	62	243	134	270	184	1.16	0.85	1.1	1.4
	134	220	190	274	204	1.15	0.79	1.3	1.1
	42	201	244	254	189	1.03	0.74	1.3	0.8
L	338	150	147	141	151	0.73	0.73	0.9	1.0
	251	136	119	128	216	0.63	1.11	0.9	1.8
	93	187	123	134	93	0.60	0.46	0.7	0.8
	360	211	170	133	155	0.58	0.65	0.6	0.9
	322	189	140	109	103	0.57	0.48	0.6	0.7
	85	203	165	105	135	0.48	0.59	0.5	0.8

DEI: Digestible Energy Intake.
[a] Predicted MPR: equation taken from [3].