



The effect of methane on properties of digestive physiology in dairy cows



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**University of
Reading**



Methane in herbivores

Ruminants:

→ Loss of 6-10 % of
dietary gross energy





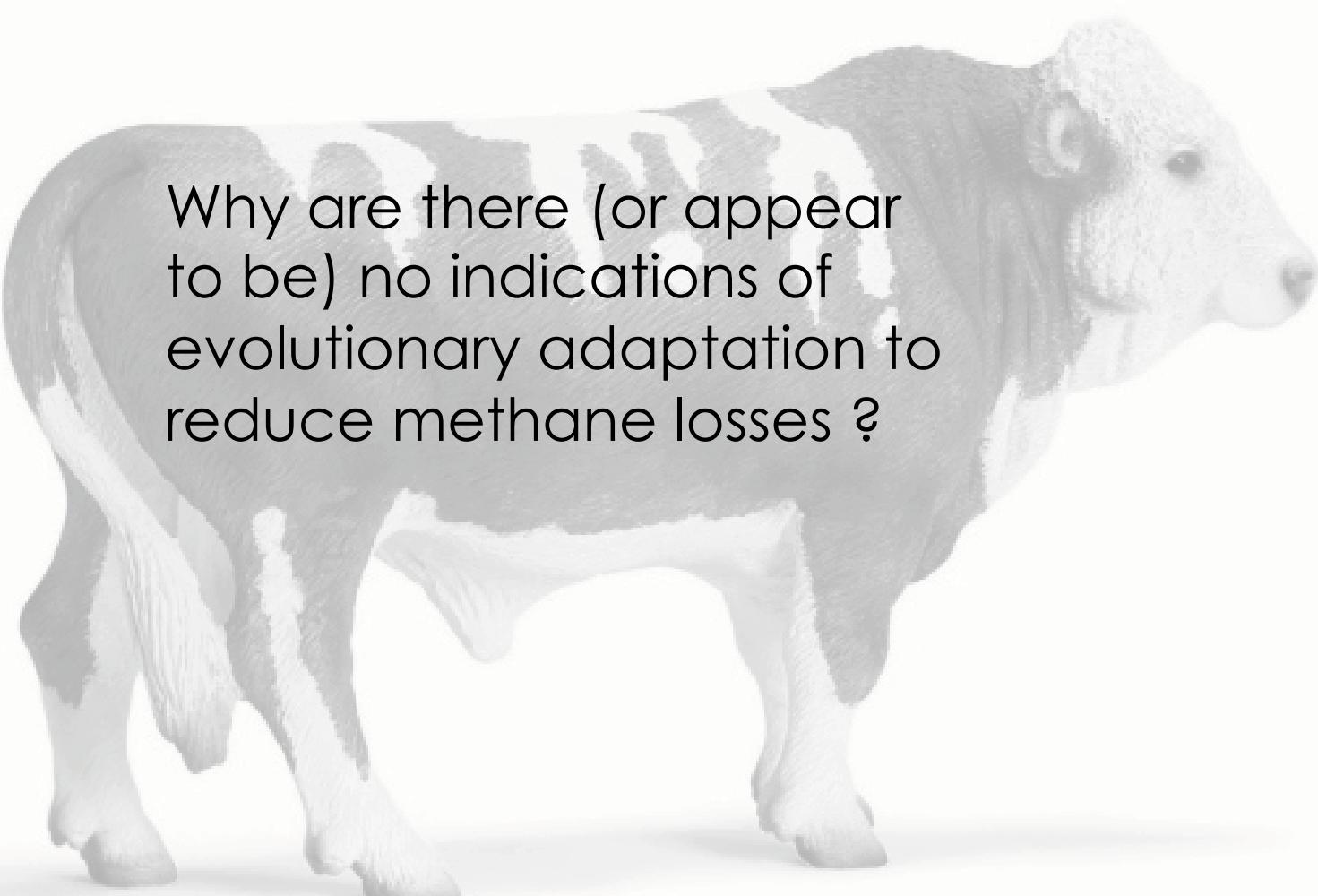
Methane in herbivores

Ruminants:

- Loss of 6-10 % of dietary gross energy
- Loss of app. 100 l CH₄ per kg digested NDF



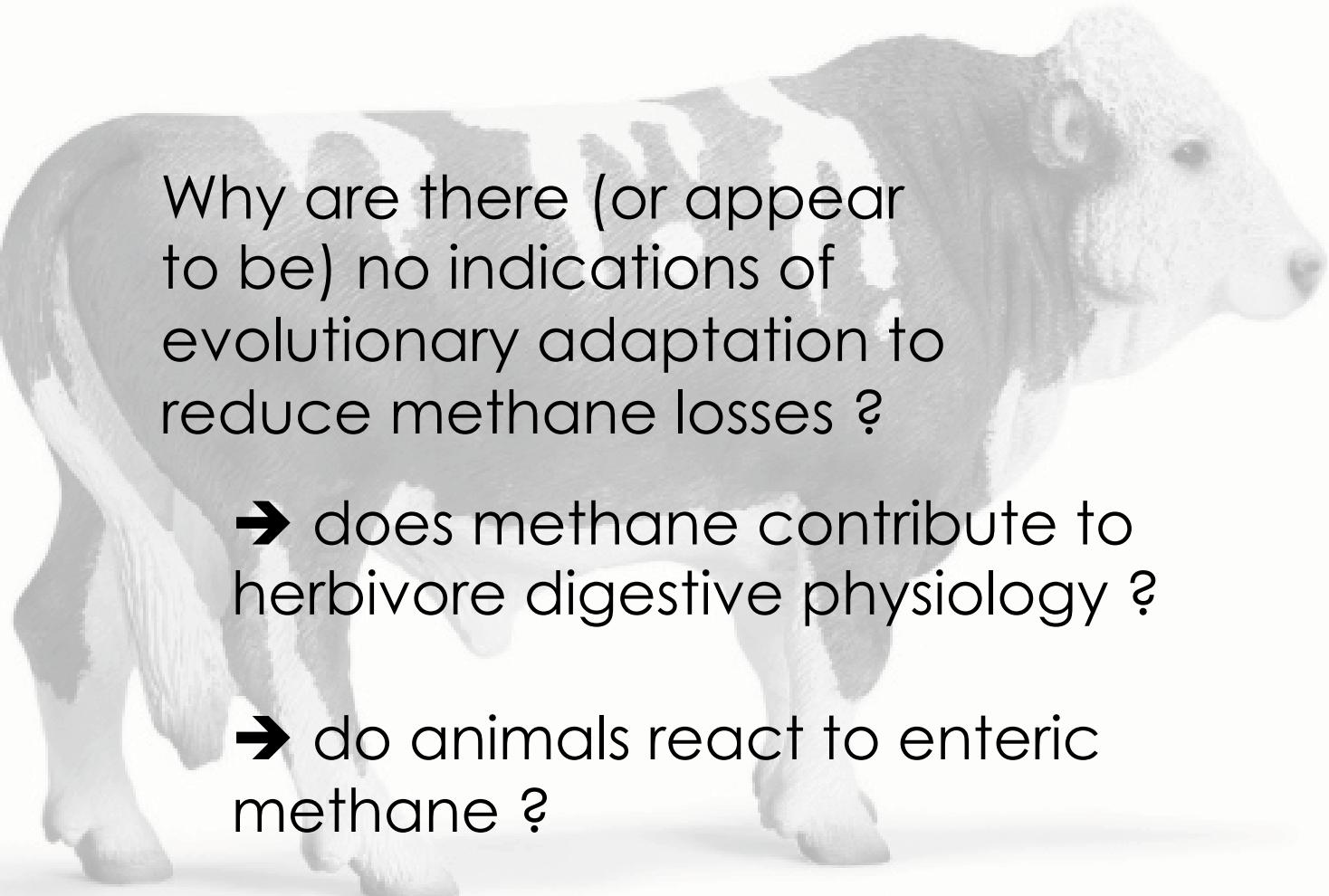
Methane in herbivores



Why are there (or appear to be) no indications of evolutionary adaptation to reduce methane losses ?



Methane in herbivores



Why are there (or appear to be) no indications of evolutionary adaptation to reduce methane losses ?

- ➔ does methane contribute to herbivore digestive physiology ?
- ➔ do animals react to enteric methane ?



Does methane increase digesta retention ?



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Am J Physiol Gastrointest Liver Physiol 290: G1089–G1095, 2006.
First published November 17, 2005; doi:10.1152/ajpgi.00574.2004.

Methane, a gas produced by enteric bacteria, slows intestinal transit and augments small intestinal contractile activity

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In this model, small intestinal infusion of methane produced a slowing of transit in all dogs by an average of 59%.





Does methane increase digesta retention ?

CSIRO PUBLISHING

www.publish.csiro.au/journals/an

Animal Production Science, 2010, 50, 801–806

Effects of dietary nitrate on fermentation, methane production and digesta kinetics in sheep

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Methane yield (MY, L methane/kg DM intake) was reduced by 23% in KNO₃-supplemented sheep ($P < 0.05$) and these sheep tended to have a shorter mean fluid retention time in the rumen (MRT).





Methods: treatments

4 dry fistulated Holstein dairy cows 4x4 Latin square



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timothy hay ad libitum / restricted pellets



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- i control
- ii CH_4 insufflation ($276 \pm 31 \text{ l/d}$)
- iii control N_2 insufflation ($313 \pm 37 \text{ l/d}$)
- iv CH_4 inhibition (bromochloromethane 0.45 g/100 kg bid)



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d 01-14 adaptation/measurement

d 15-28 recovery incl. RR contents reconstitution



Methods: diet

Mean nutrient composition (g/kg dry matter) of the diet offered to the cows over the four experimental periods

Nutrient	Chopped timothy hay	Pelleted concentrate
Dry matter (as fed)	874	861
Organic matter	969	922
Crude protein	39	182
Neutral detergent fibre	592	359
Acid detergent fibre	340	139



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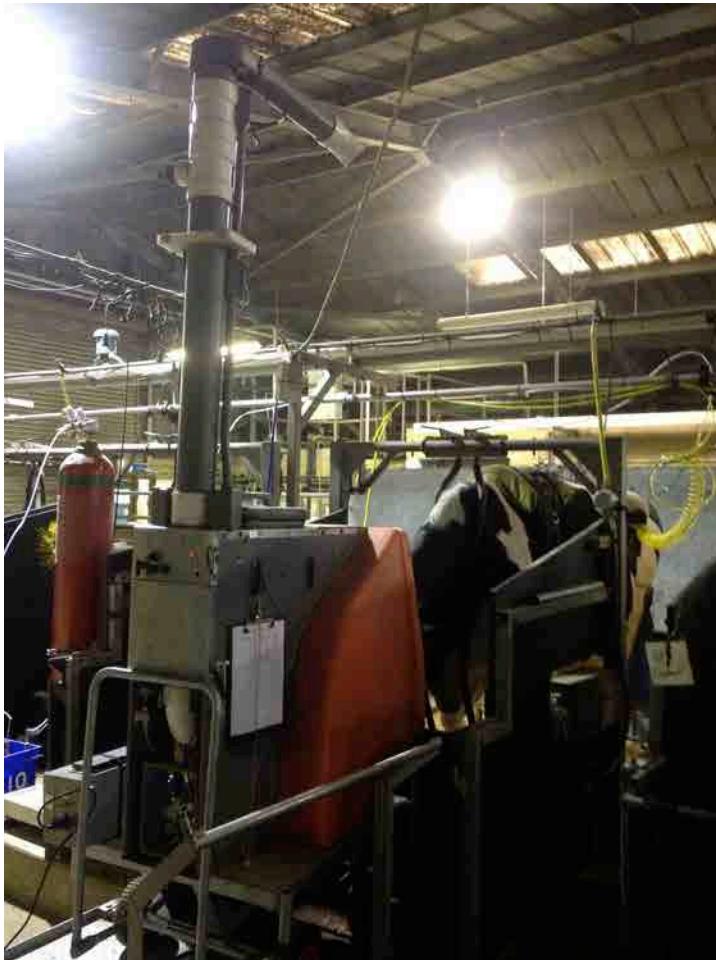
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Methods: CH₄ measurements

GreenFeed
exhaled air d 10-12
3x/d



Gas chromatography
rumen fluid d 9-11
1x/d

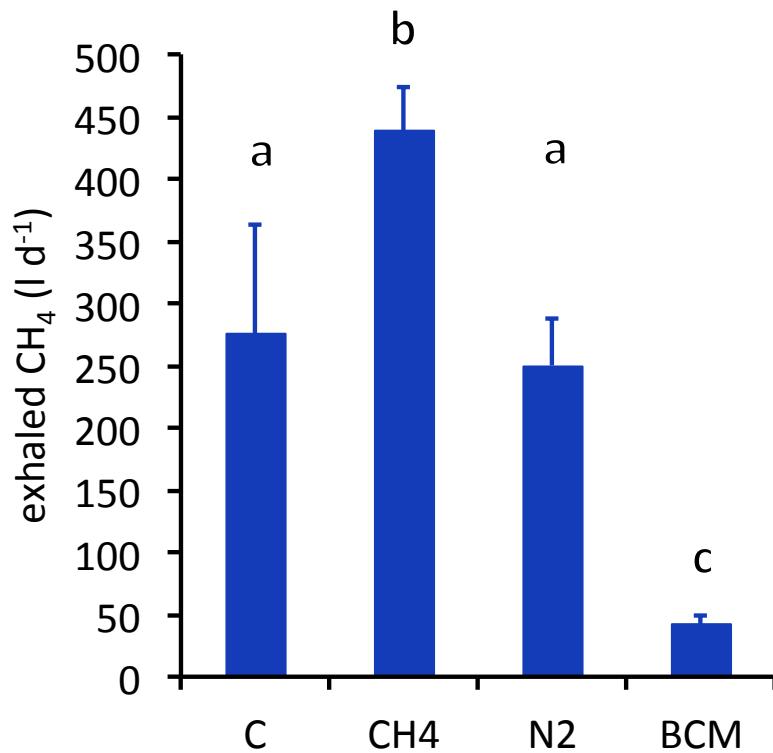




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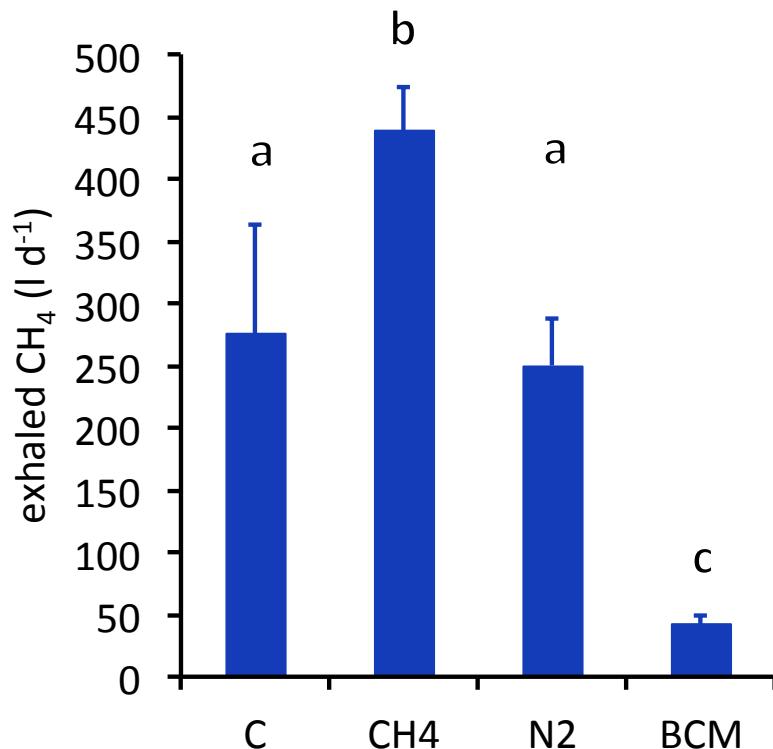
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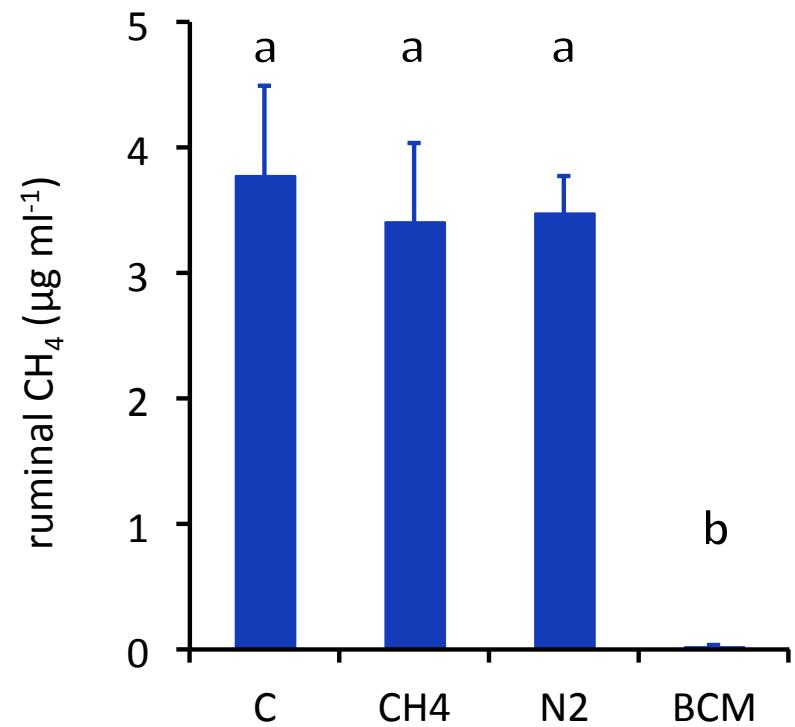


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Methods: measurements

Dry matter intake

Body mass change



Methods: measurements

Dry matter intake

Mean retention time MRT (solutes and 3 particle
markers)

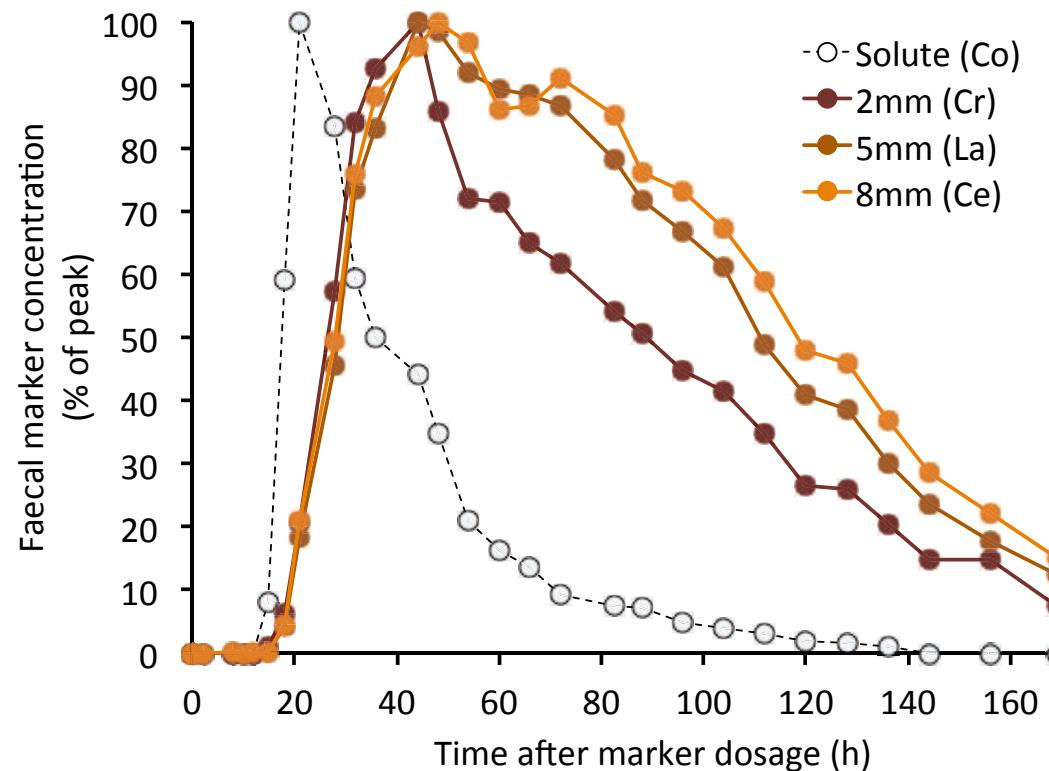
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Methods: measurements

Dry matter intake

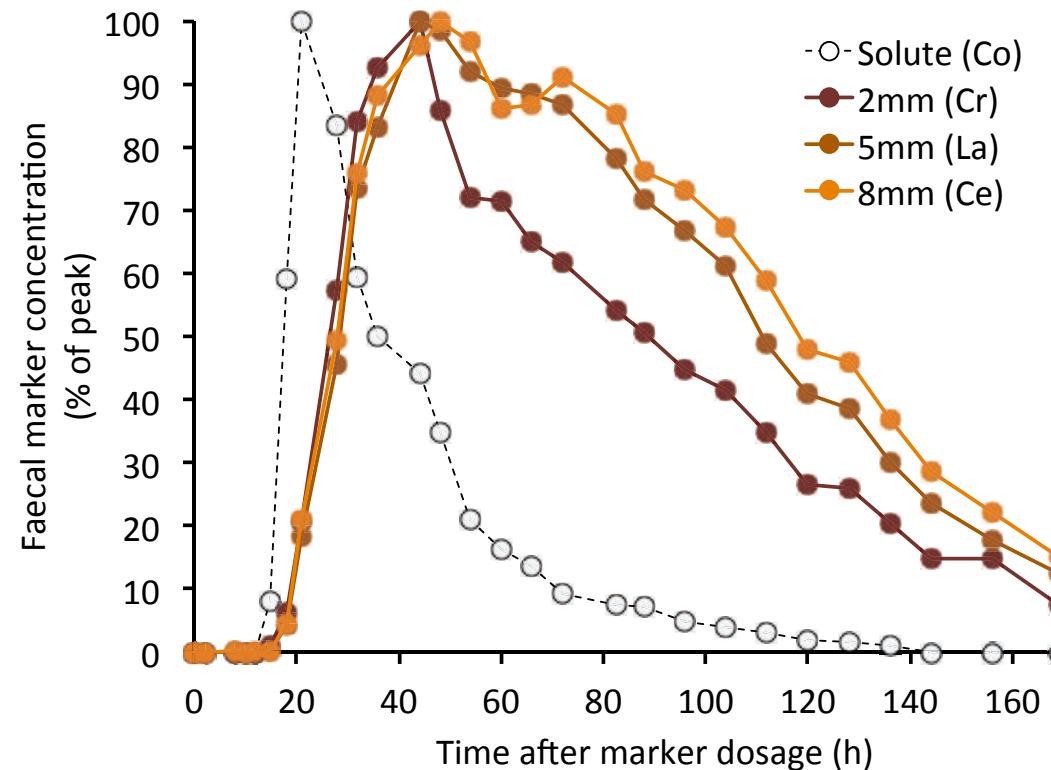
Mean retention time MRT (solutes and 3 particle markers)

Faeces dry matter

Digestibility (total collection)

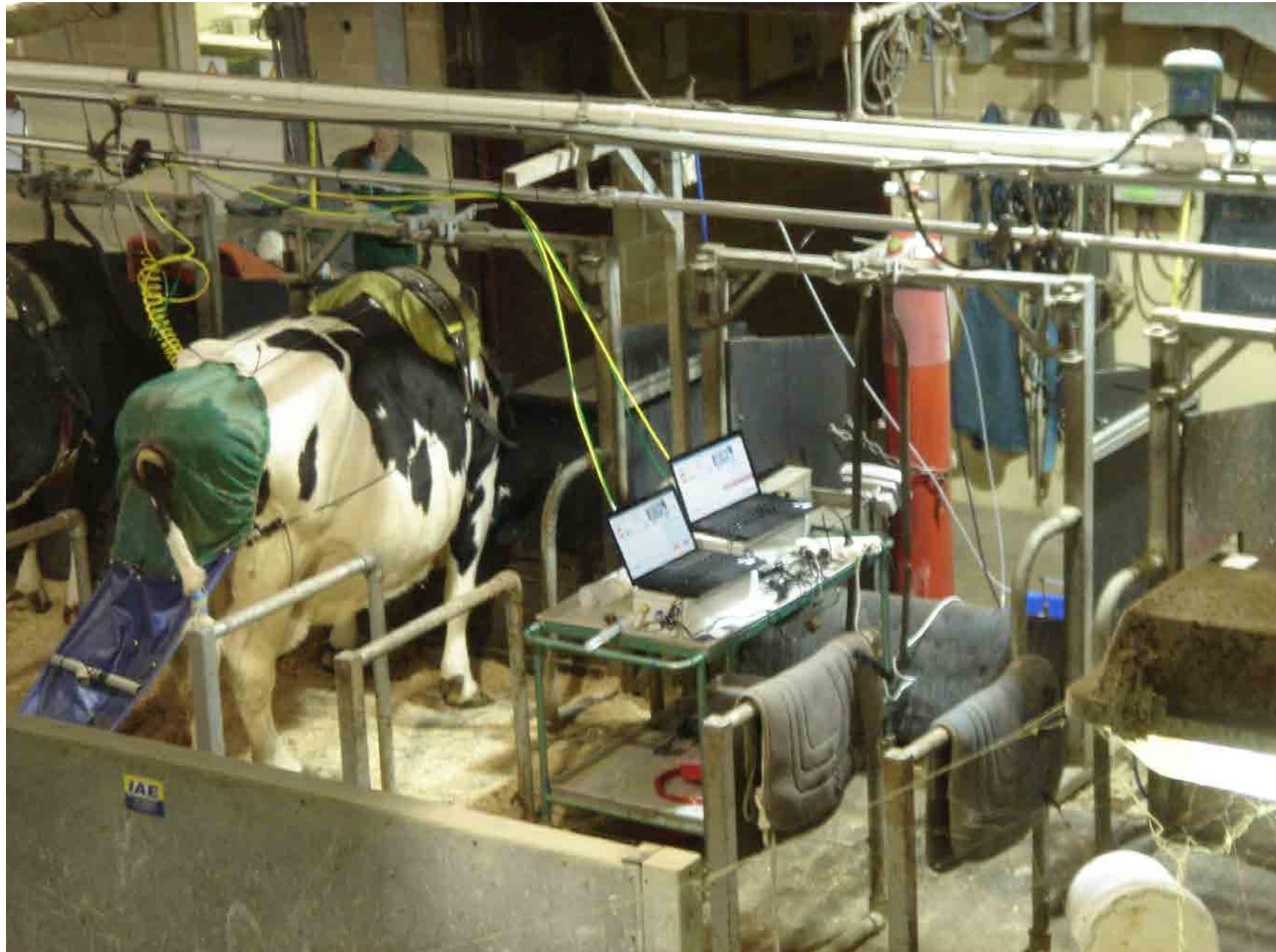
RR motility

Chewing activity



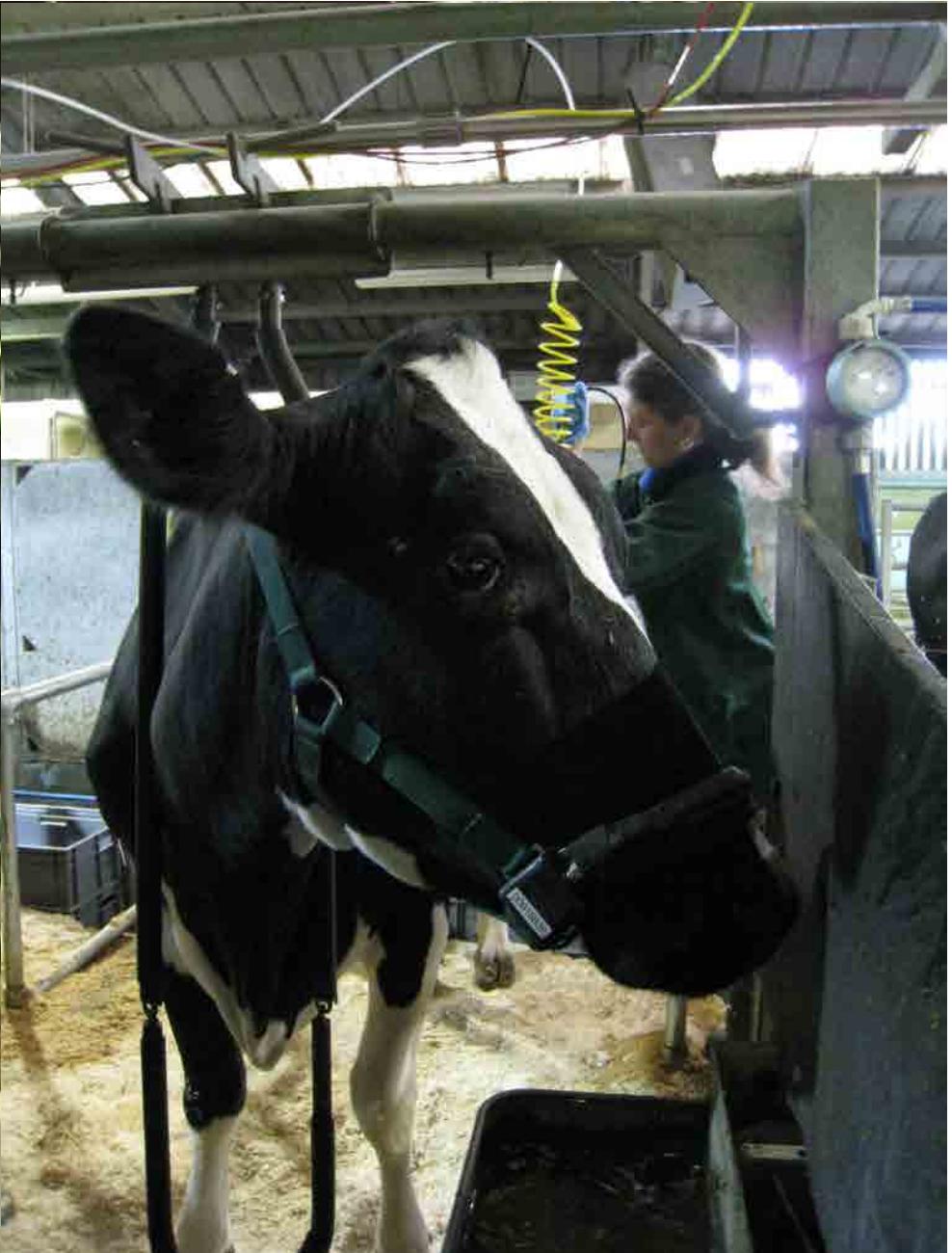


Methods





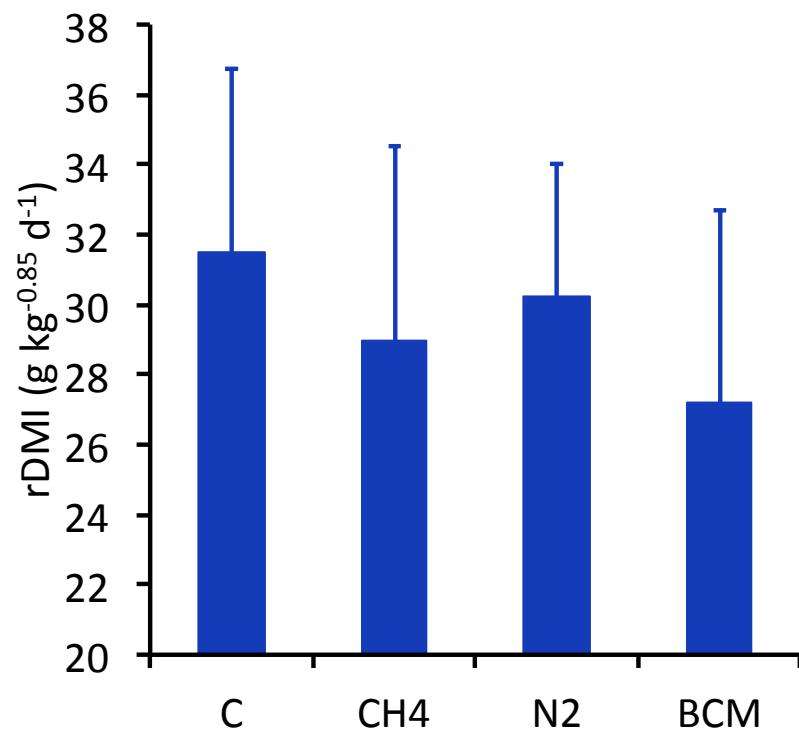
Methods





Results

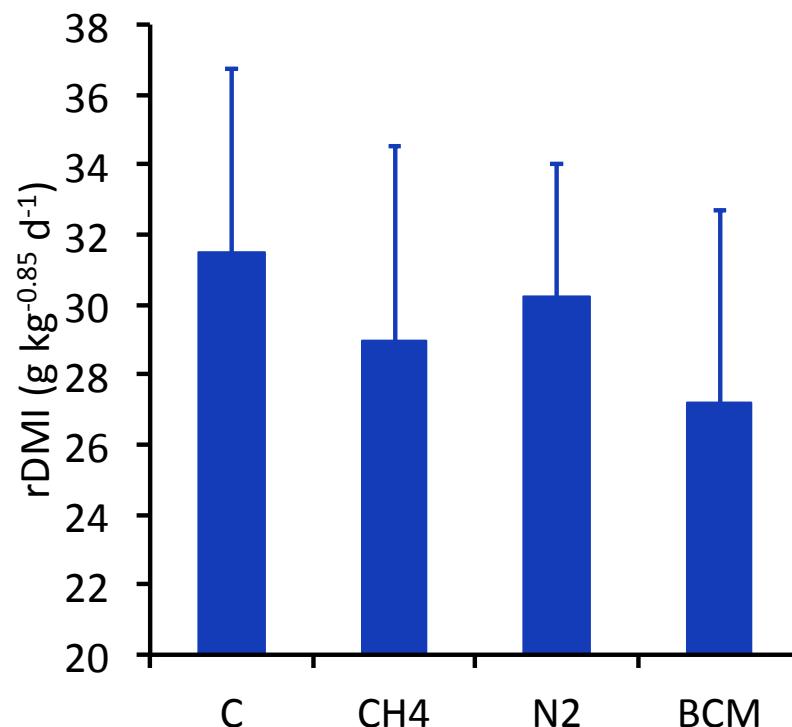
Dry matter intake



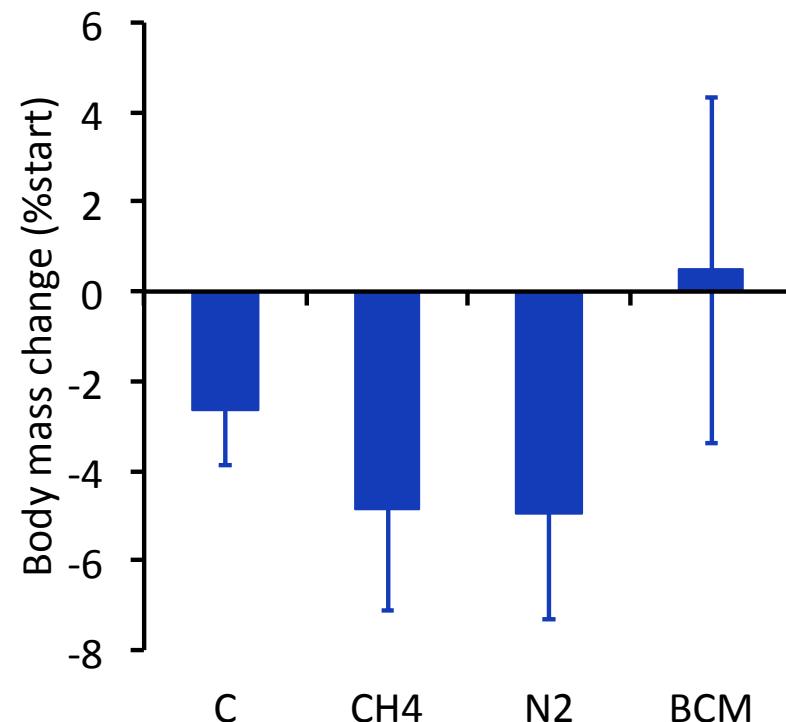


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Dry matter intake



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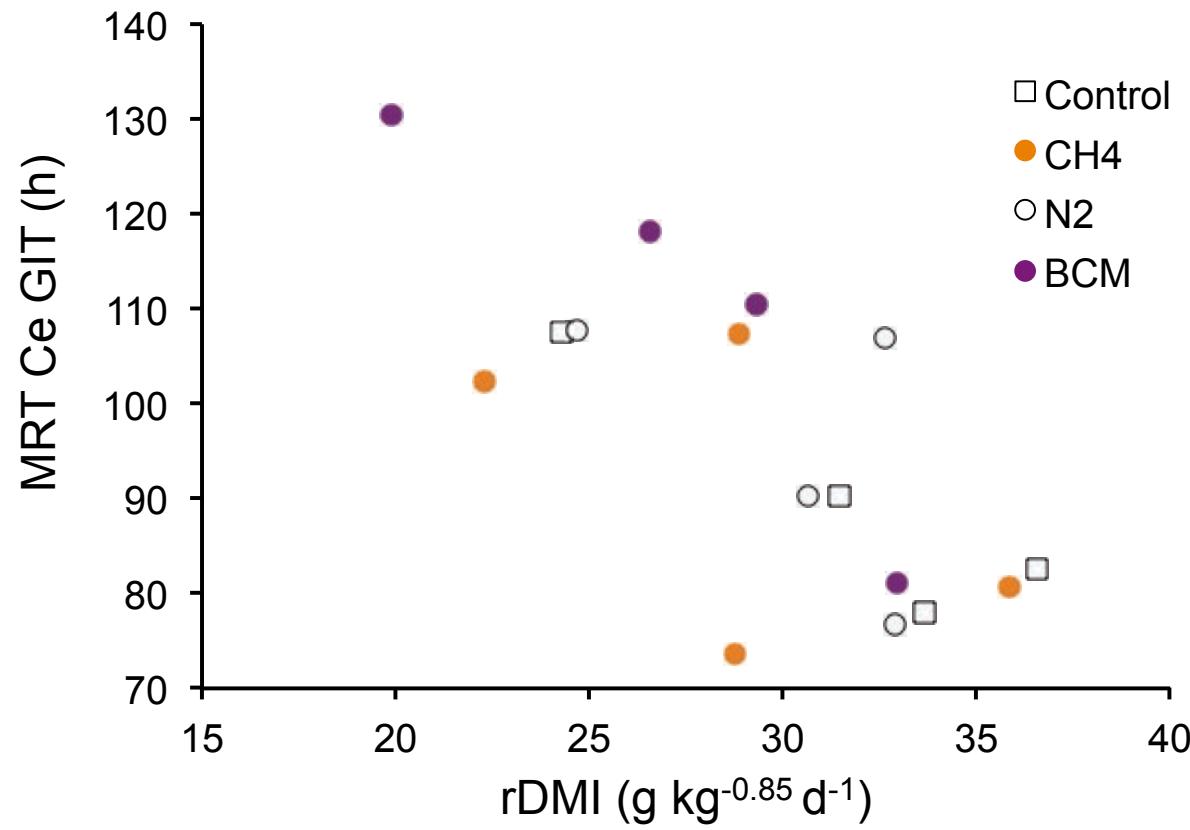




Results: correlation with rDMI

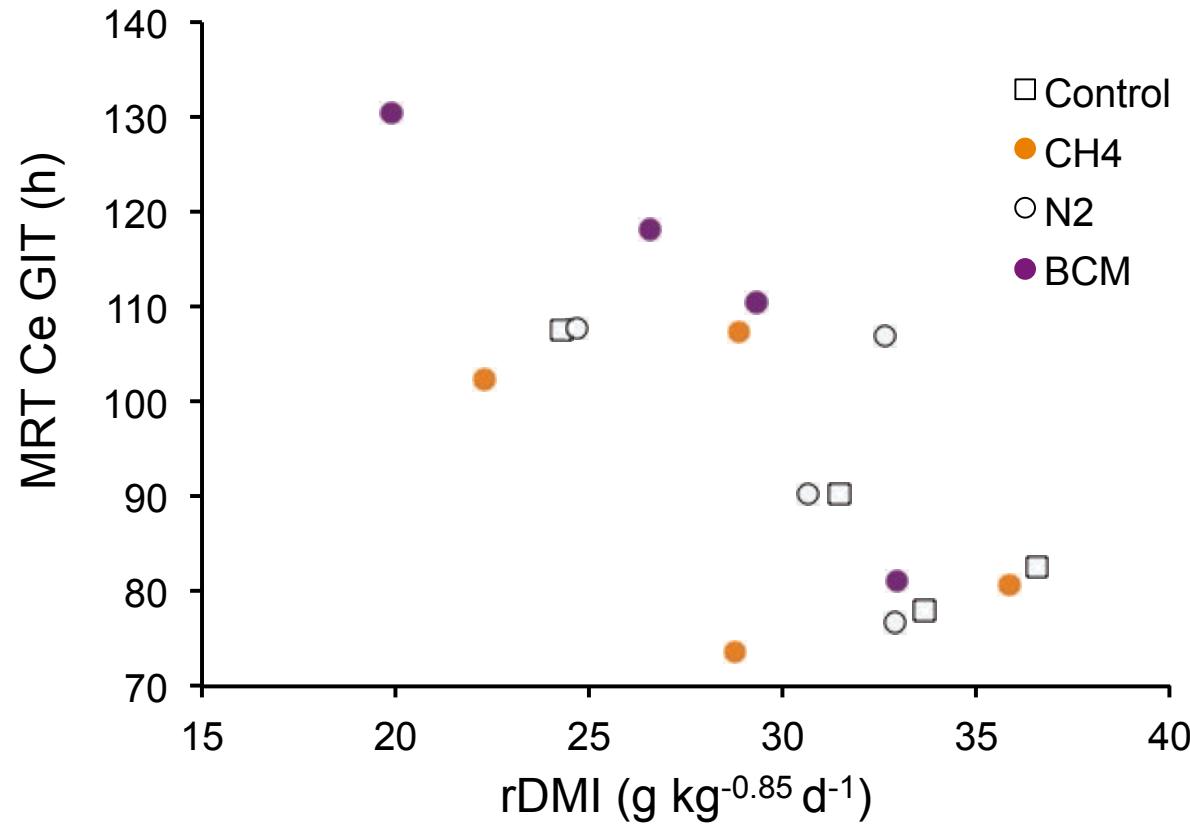


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=> Evaluation as linear mixed models
with individuum as random factor,
rDMI as covariate,
and CH4 exhaled (l kgDMI^{-1}) or in rumen fluid ($\mu\text{g ml}^{-1}$)
as independent variable



GLM Results

	CH ₄ exhaled		CH ₄ RR fluid	
MRT solute GIT	0·053	(-)	0·001	-
MRT 2mm GIT	0·003	-	0·007	-
MRT 5mm GIT	<0·001	-	0·012	-
MRT 8mm GIT	0·003	-	0·052	(-)
MRT solute RR	0·334		0·103	
MRT 2mm RR	0·027	-	0·127	
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The more CH₄
⇒ the shorter the MRT



GLM Results

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Apparent digestibility				
dry matter	0·129	-	0·058	(-)
NDF	0·028	-	<0·001	-
Faecal DM	0·171		0·013	-
Time ruminating (min/h)	0·002	-	0·013	-
Chewing rate (/bolus)	0·001	-	0·023	-
Rumen contractions (/min)	0.003	+	0.082	(+)
Intercontr. interval (s)	0·008	-	0·071	(-)

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Contrary to expectation!



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Indication of a feedback mechanism in the sense of an increase of motility and digesta passage to limit additional methane losses in the presence of methane?



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Methane receptors?



Acknowledgements

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