Overview on methane proxies (COST Action 'METHAGENE')

Richard Dewhurst

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Short-term measurements not covered

Potential targets for proxies

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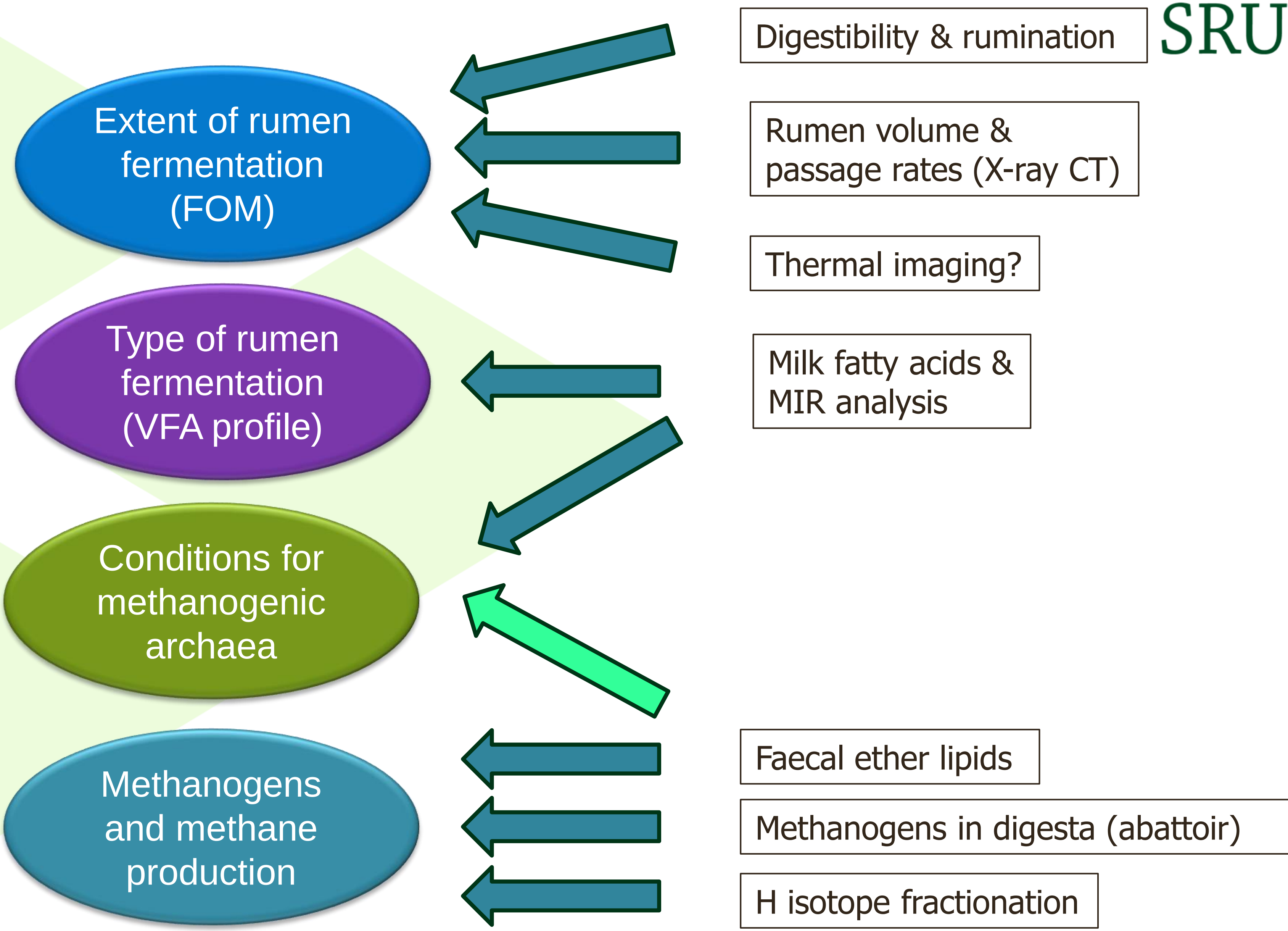

British Journal of Nutrition (2014), **111**, 578–585
doi:10.1017/S0007114513002936

Low-methane yield sheep have smaller rumens and shorter rumen retention time

John P. Goopy[1]*†, Alastair Donaldson[1], Roger Hegarty[2], Philip E. Vercoe[3,4], Fay Haynes[2], Mark Barnett[2] and V. Hutton Oddy[1]

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[2]*School of Environmental and Rural Science, University of New England, Armidale, NSW 2351, Australia*
[3]*School of Animal Biology, University of Western Australia, Perth, WA, Australia*
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(Submitted 14 December 2012 – Final revision received 1 August 2013 – Accepted 3 August 2013 – First published online 8 October 2013)

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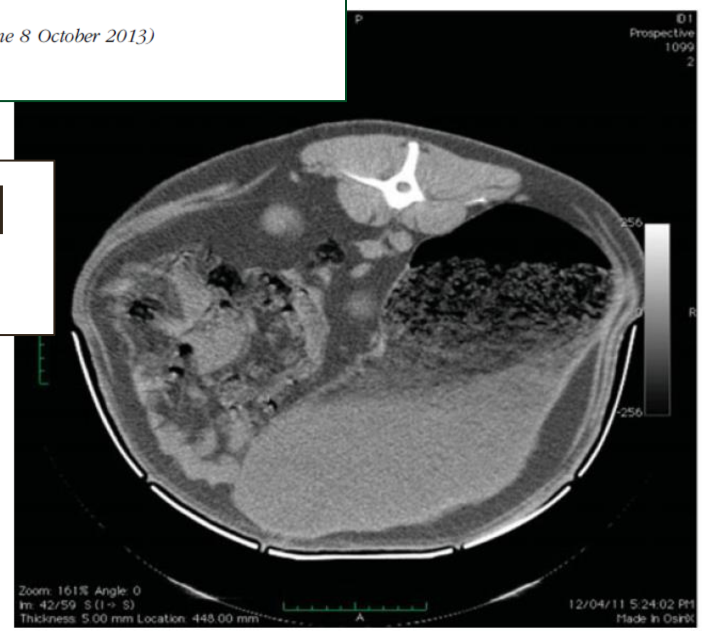
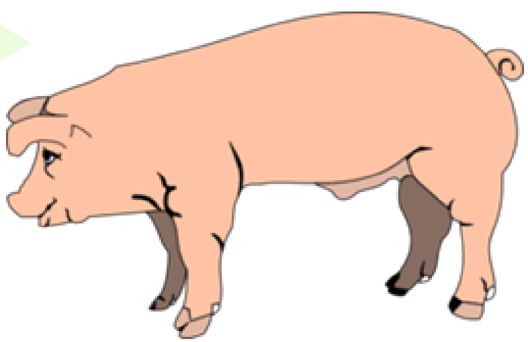


Do we want smaller rumen and shorter rumen retention time?



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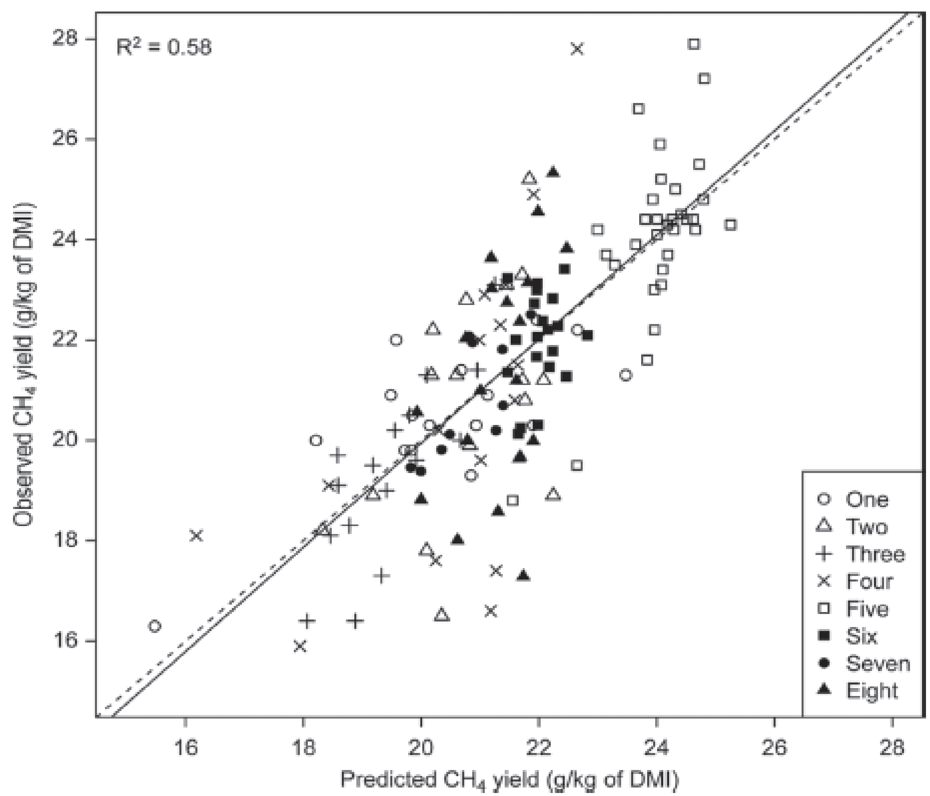
Recent meta-analysis (8 studies)

J. Dairy Sci. 97:7115–7132
http://dx.doi.org/10.3168/jds.2014-8268

Meta-analysis of relationships between enteric methane yield and milk fatty acid profile in dairy cattle

H. J. van Lingen,*†[1] L. A. Crompton,‡ W. H. Hendriks,†§ C. K. Reynolds,‡ and J. Dijkstra†
*TI Food and Nutrition, PO Box 557, 6700 AN Wageningen, the Netherlands
†Animal Nutrition Group, Wageningen University, PO Box 338, 6700 AH Wageningen, the Netherlands
‡Division of Food Production and Quality, School of Agriculture, Policy and Development, University of Reading, Reading RG6 6AR, United Kingdom
§Faculty of Veterinary Medicine, Utrecht University, PO Box 80.163, 3508 TD Utrecht, the Netherlands

$$CH_4\text{ (g/kg of DMI)} = 23.39 \pm 1.21 + 9.74 \pm 3.23 \times \text{C16:0-}iso - 1.06 \pm 0.17 \times trans\text{-10+11 C18:1} - 1.75 \pm 0.49 \times cis\text{-9,12 C18:2}, \quad [3]$$



Infrared milk analysis

Animal (2012), 6:10, pp 1694–1701 © The Animal Consortium 2012
doi:10.1017/S1751731112000456

animal

Potential use of milk mid-infrared spectra to predict individual methane emission of dairy cows

F. Dehareng[1*†], C. Delfosse[1*], E. Froidmont[2], H. Soyeurt[3,4], C. Martin[5], N. Gengler[3,4], A. Vanlierde[1] and P. Dardenne[1]

[1]Valorisation of Agricultural Products Department, Walloon Agricultural Research Centre, B-5030 Gembloux, Belgium; [2]Department of Production and Sect Agricultural Research Centre, B-5030 Gembloux, Belgium; [3]Animal Science Unit, Gembloux Agro Bio-Tech, University of Liège, B-5030 Gembloux, Belgium Fund for Scientific Research, B-1000 Brussels, Belgium; [5]UR1213 Herbivores, INRAClermont-Theix Research Centre, F-63122 Saint Genès Champanelle, Fra

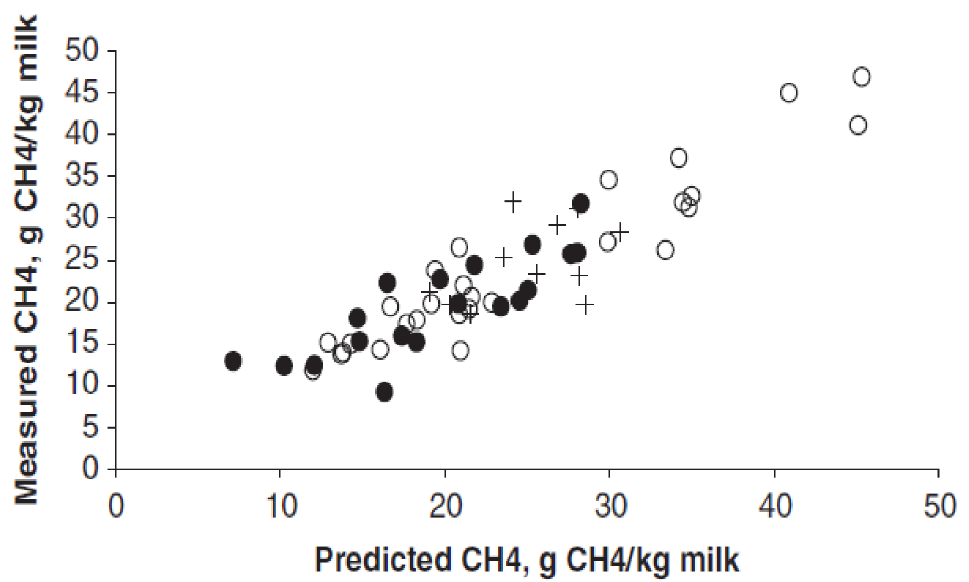


Figure 3 Infrared methane prediction on the basis of milk spectra of the day 1.5 for the different diets: corn silage (●), fresh pasture (○) and grass silage (+). PCA = principal component analysis.

Methanogen lipid markers

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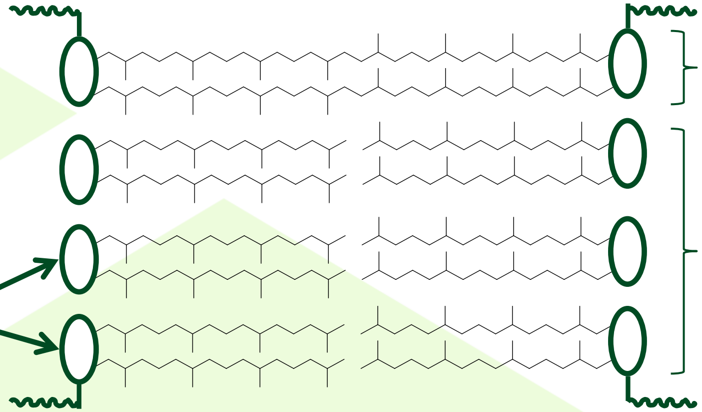
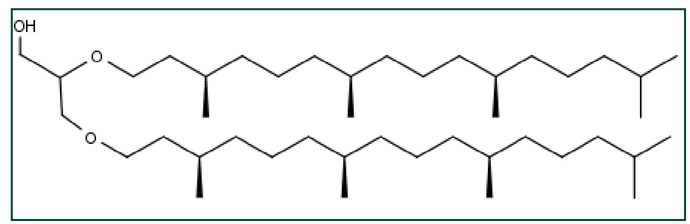


Monolayer with tetraethers

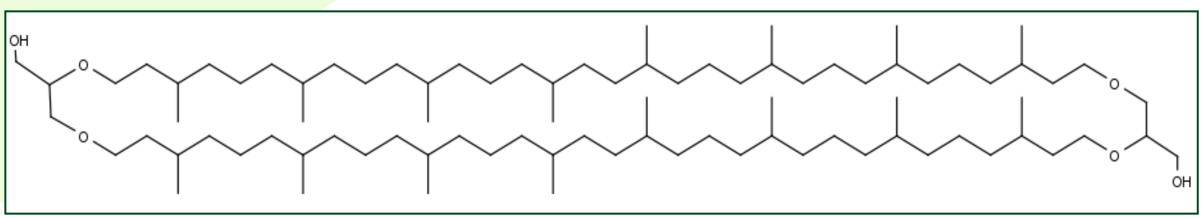
Bilayer with diethers

Polar head groups

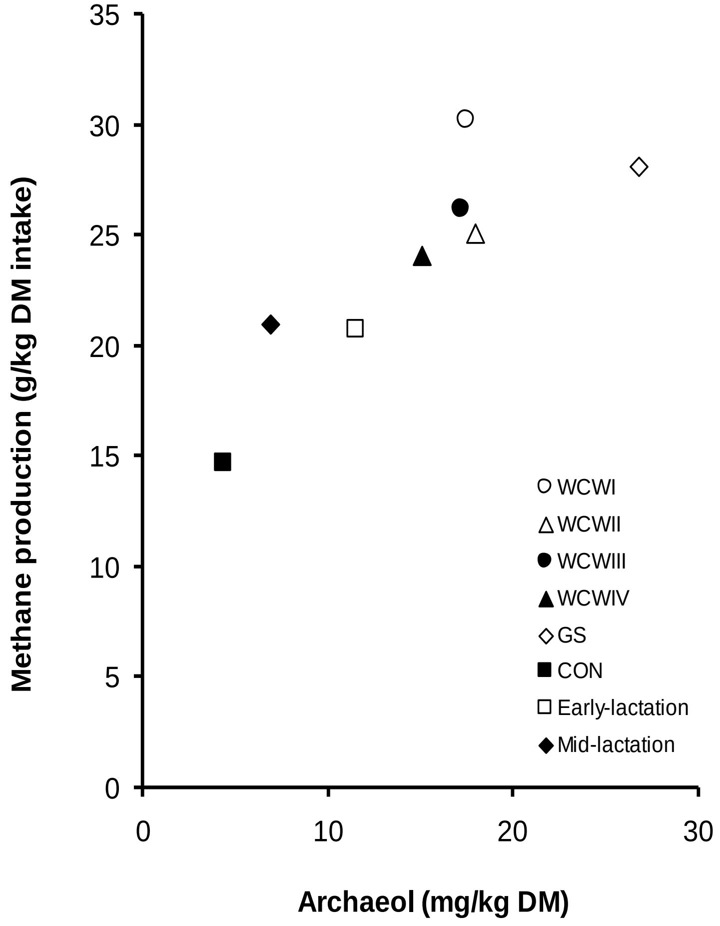
Archaeol - diether



GDGT - tetraether



Treatment means – across studies



Faecal tetraethers

	Dietary treatment			
	Concentrates	Grass silage	s.e.d.	Sig.
Archaeol (mg/kg DM)	9.4	71.1	6.57	<0.001
GDGT-0 (mg/kg DM)	87	147	36.9	0.138
Ratio (g/g)	10.4	2.09	1.95	0.002

Tetraethers reduce membrane permeability and so are advantageous at low rumen pH

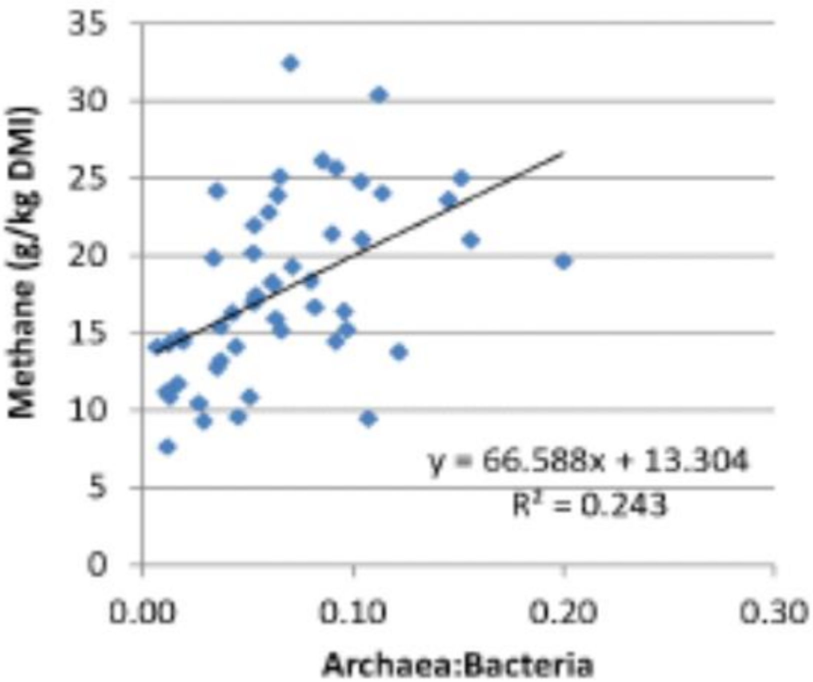
McCartney *et al.*, 2014

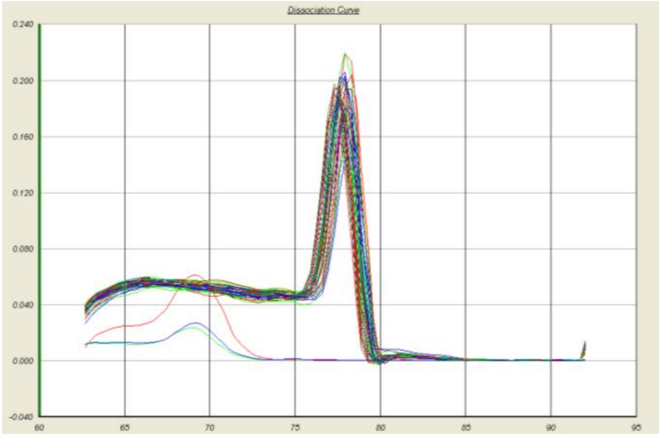
Methanogen abundance

Archaeal abundance in *post-mortem* ruminal digesta may help predict methane emissions from beef cattle

R. John Wallace[1], John A. Rooke[2], Carol-Anne Duthie[2], Jimmy J. Hyslop[2], David W. Ross[2], Nest McKain[1], Shirley Motta de Souza[1], Timothy J. Snelling[1], Anthony Waterhouse[2] & Rainer Roehe[2]

[1]Rowett Institute of Nutrition and Health, University of Aberdeen, Bucksburn, Aberdeen AB21 9SB, UK, [2]SRUC, West Mains Road, Edinburgh EH9 3JG, UK.





FACCE JPI Multi-partner call on Agricultural Greenhouse Gas Research

Understanding the development and control of stability in the rumen microbiome as a basis for new strategies to reduce methanogenesis

ACRONYM: RumenStability

Leading the way in Agriculture and Rural Research, Education and Consulting

Project partners

- Richard Dewhurst (SRUC; co-ordinator)
- Teagasc (Ireland): Sinead Waters
- UCD (Ireland): Evelyn Doyle
- CSIC (Spain): David Yanez-Ruiz
- Ghent University (Belgium): Veerle Fievez
- INRA (France): Diego Morgavi
- ILVO (Belgium): Sam De Campeneere
- FBN (Germany): Björn Kuhla
- AgResearch (New Zealand): Stefan Muetzel
- Aberystwyth University (UK): Jamie Newbold

Objective

- Investigate long-term effects of short-duration dietary treatments on rumen micobiome and methanogenesis: (i) weaning; (ii) diet transitions in adult ruminants (e.g. to grazing or high-concentrate feeding)

- Hypothesis: *initial microbial colonisation influences the microbial ecosystem in later life…. and that the development of host immune response to the microbiome is involved*

Application

- Identify short-term treatments that can give long-term reductions in methane production (reduced cost; easier to implement, particularly in grazing situations)
- Understand adaptation of the rumen – reasons for failure of treatments designed to reduce methanogenesis
- Understanding of the basis for between-animal variation in methane production (that will feed into genetic/genomic studies)

Components of the work

- New animal studies
  – Platform Experiments – biobanking and sharing samples for different experiments; and future funding bids
- Additional analysis on existing/planned studies (methane measurements; rumen microbiome analysis)
- Workshops, visits, training, standardisation
- Economic evaluation of strategies
- Dissemination

New animal studies

- Weaning age x animal type (dairy vs. beef) (Teagasc)
- Use of PUFA and medium-chain oils in diets of ewes/lambs (Ghent)
- Conventional vs. ‘step-down’ weaning strategy for calves (FBN)
- Methanogen inhibitors from birth to weaning (AgResearch)
- Dietary treatments for calves (ILVO)
- Diet treatments for ewes and lambs (INRA)
- Diet treatments for bull calves (INRA)