PRIFYSGOL ABERYSTWYTH UNIVERSITY

Sefydliad y Gwyddorau Biolegol, Amgylcheddol a Gwledig
IBERS ABERYSTWYTH
Institute of Biological, Environmental and Rural Sciences

Decreasing Methane Production in the Rumen

Jamie Newbold

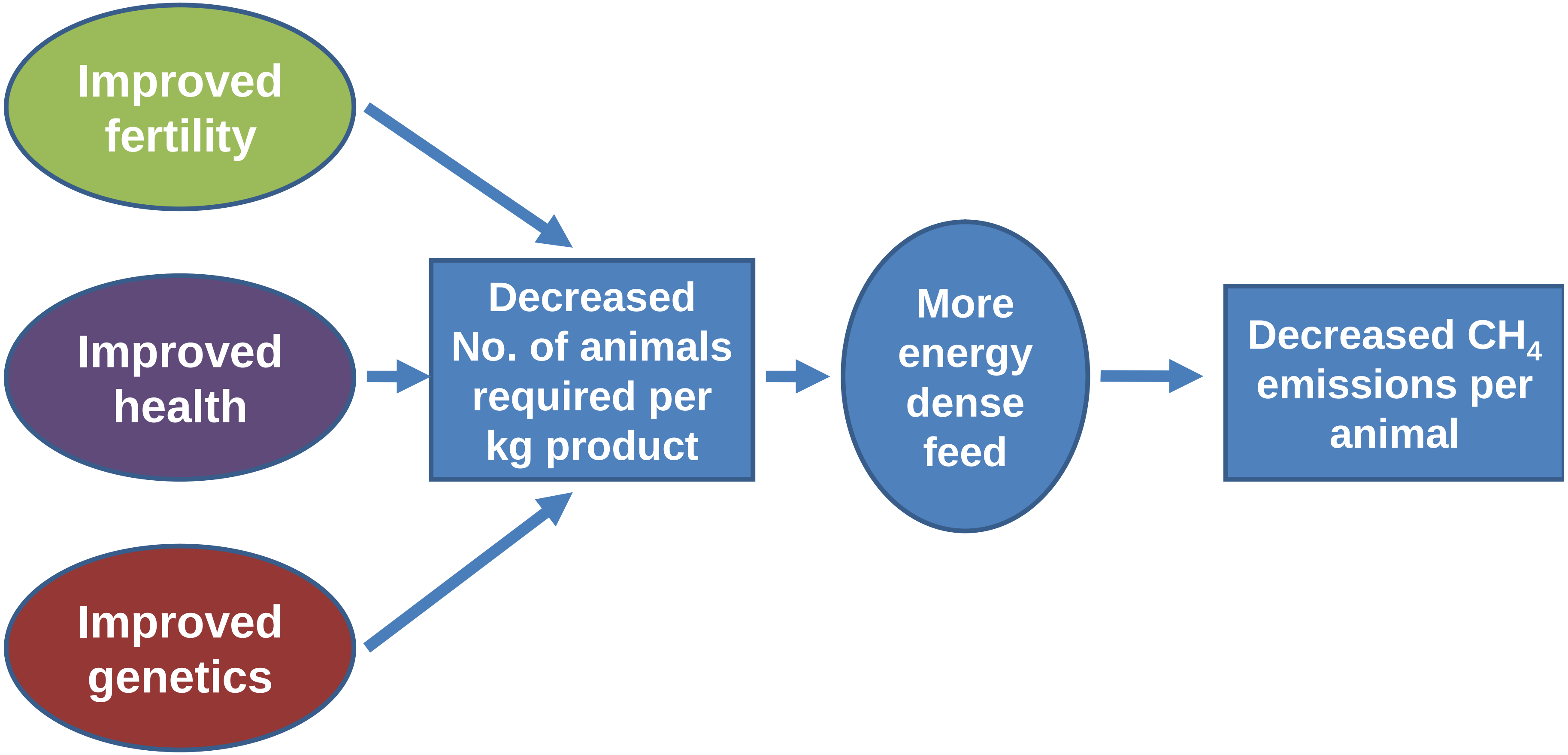
Potential for mitigation of GHG emissions from livestock

ü Lifestyle change (i.e. less reliance on products with a high carbon cost associated with their production and reducing food waste)

ü Changing farming practice

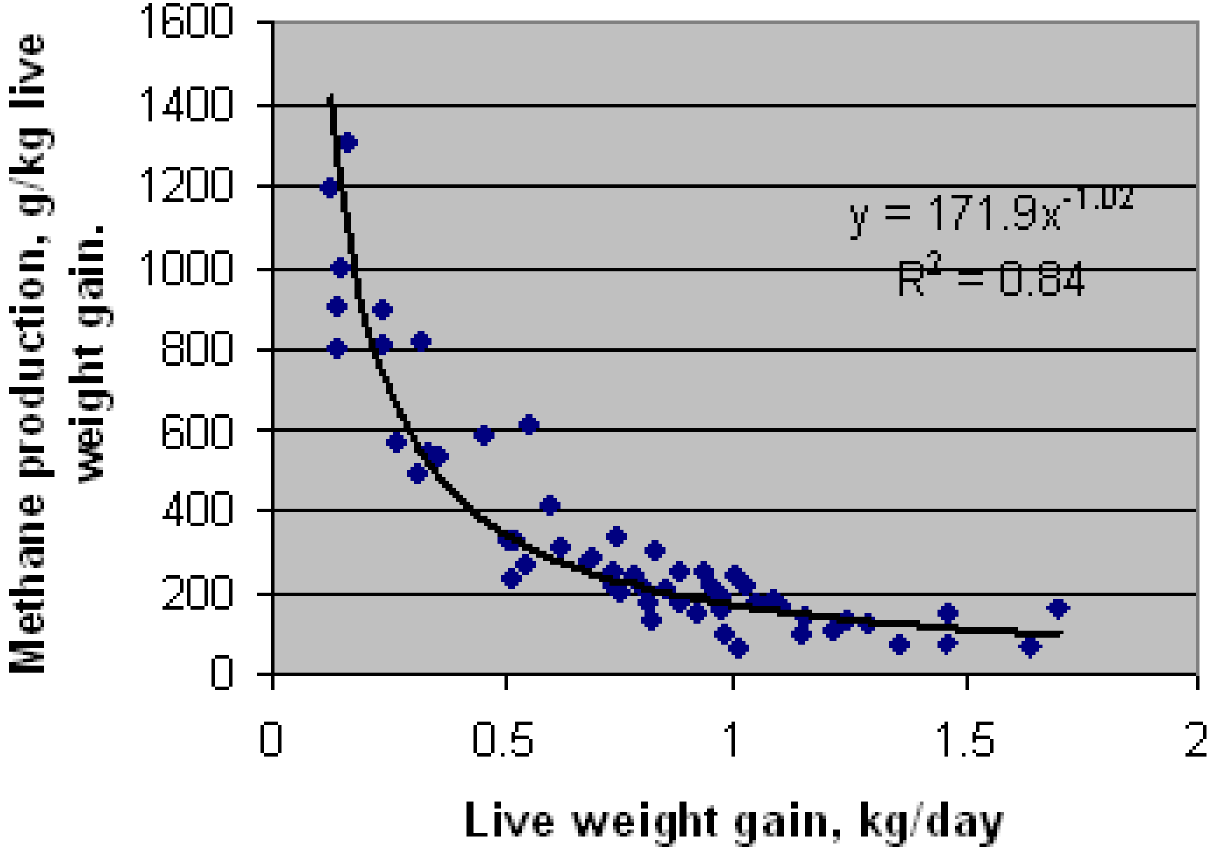
ü Using new technologies

(Gill et al. 2009. *Mitigating climate change: the role of domestic livestock*. **Animal** doi:10.1017/S1751109004662)



Routes for impact of management and technology interventions designed to improve productivity on GHG emissions from livestock (Gill et al. 2009)

The relationship between live weight gain (LWG) of cattle and methane production per kg of gain



(Kurihara et al 1997, Klieve. and Ouwerkerk 2007, Howden and Reyenga 1999)

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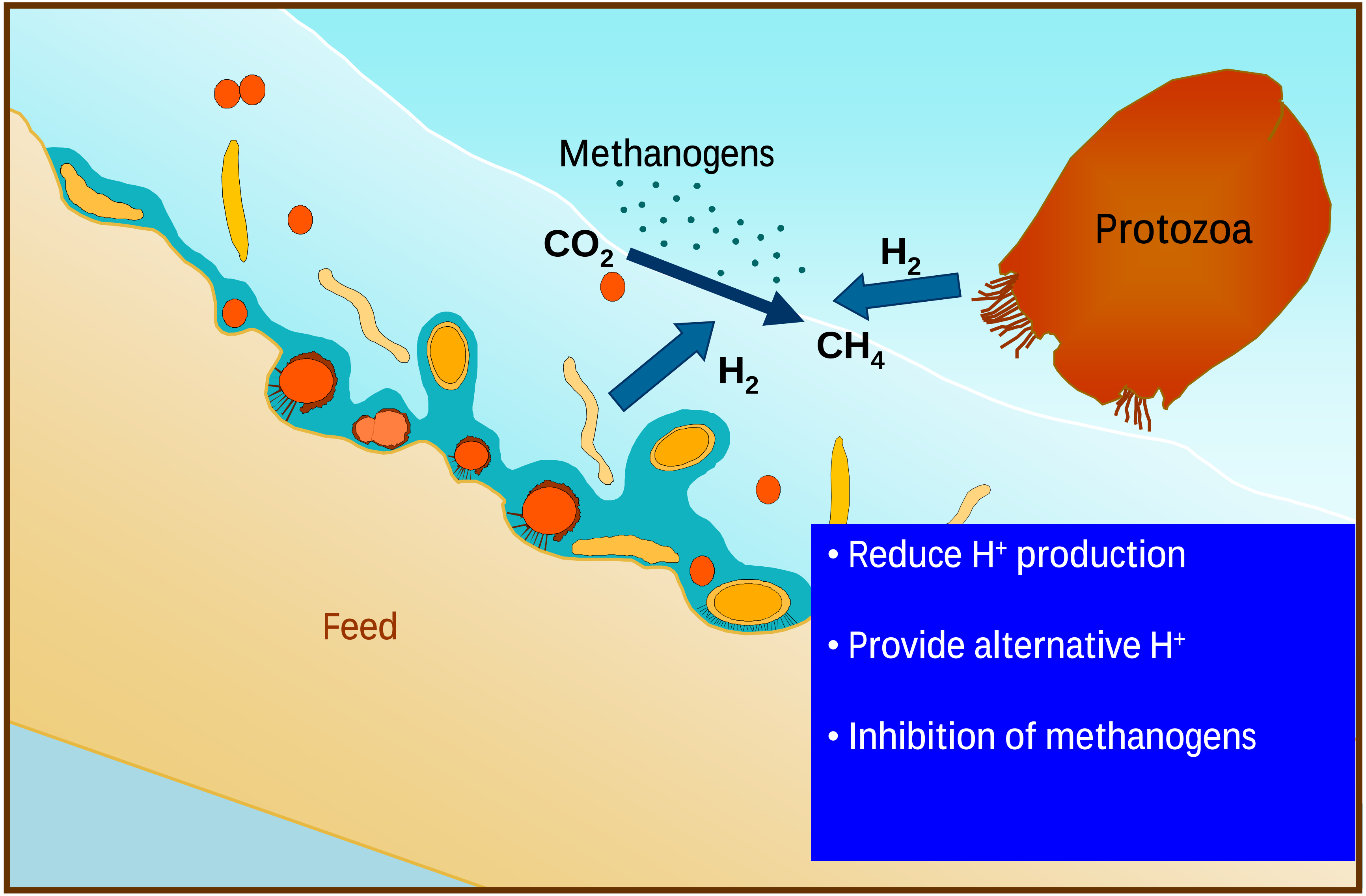
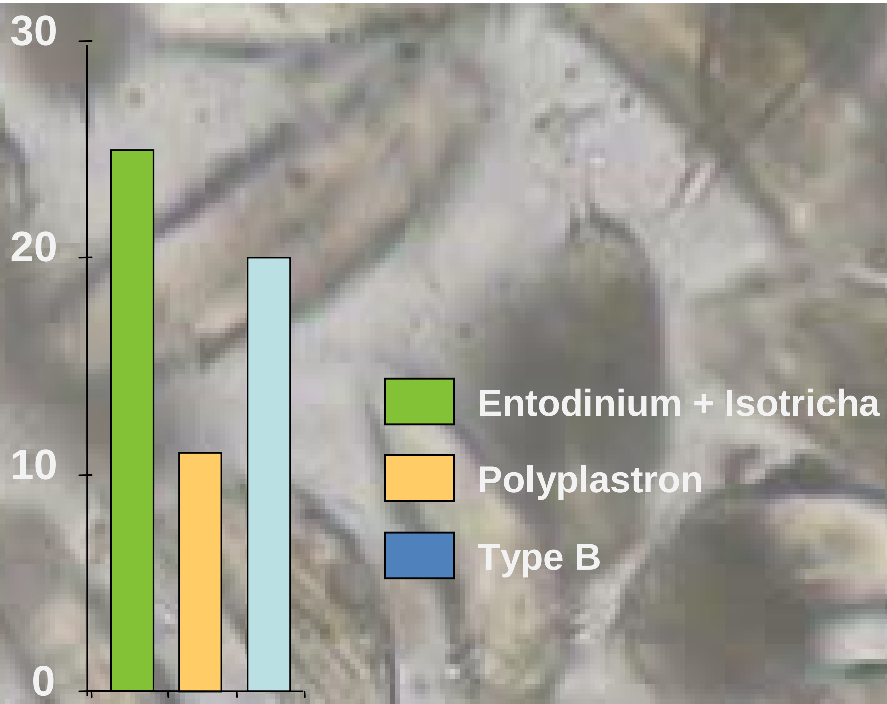
Methane production
a microbially driven process to remove hydrogen

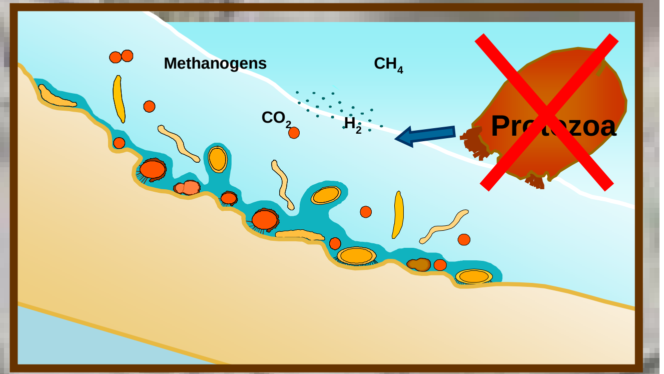


- Reduce H^+ production
- Provide alternative H^+
- Inhibition of methanogens

Methods of methane mitigation:



Methanogenesis associated with protozoa (%)

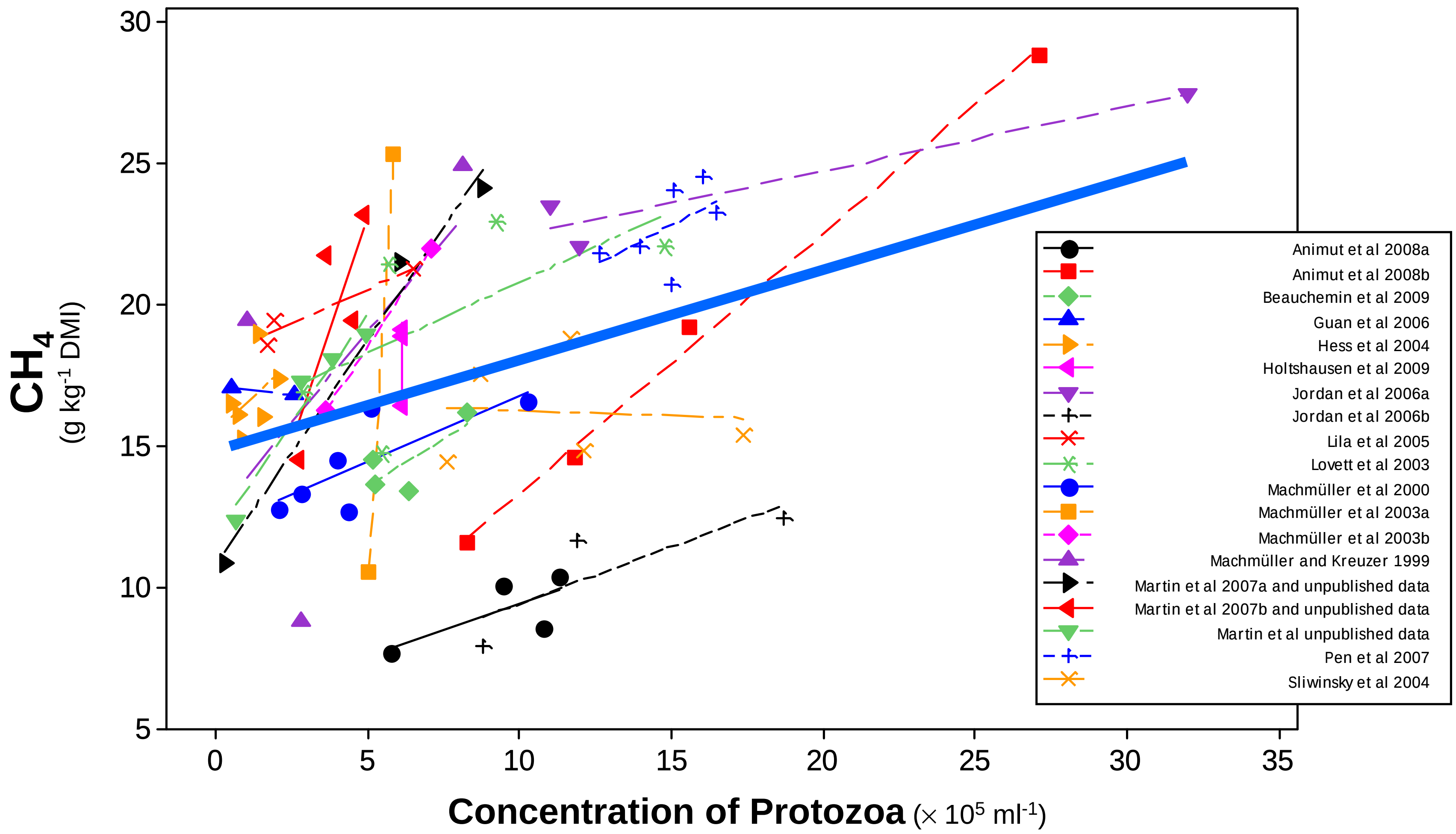


Decrease H_2 production

CH_4 production	PF	F	s.e.m.	*P*
L per day	26.0	35.2	2.82	0.049
L per kg LW	0.52	0.71	0.044	0.024
L per kg DMI	21.6	29.0	1.41	0.006

PF: protozoa-free lambs; F: faunated lambs.
LW: liveweight; DMI: dry matter intake

Is there a relationship between methane emissions and protozoal numbers?



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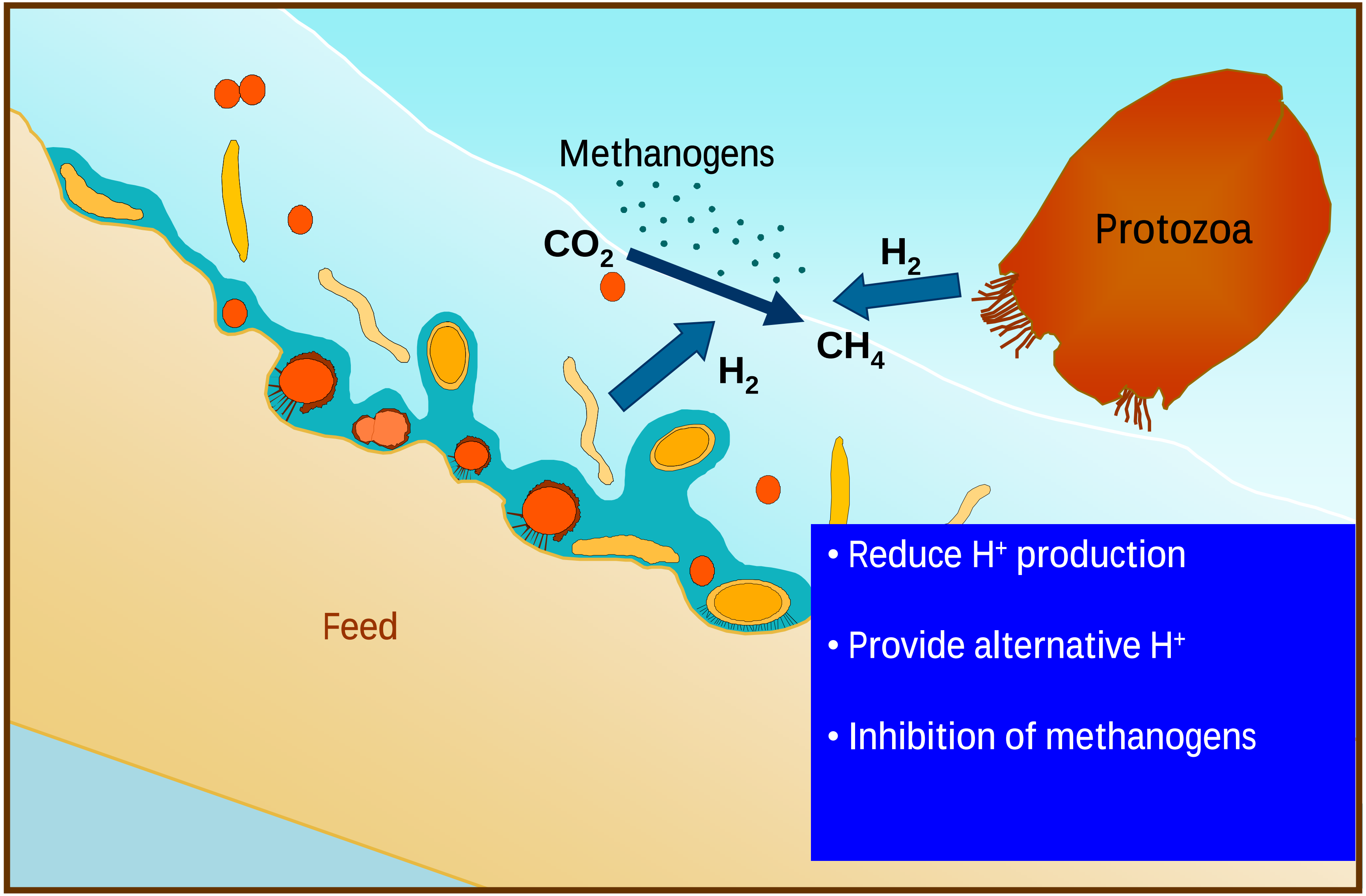

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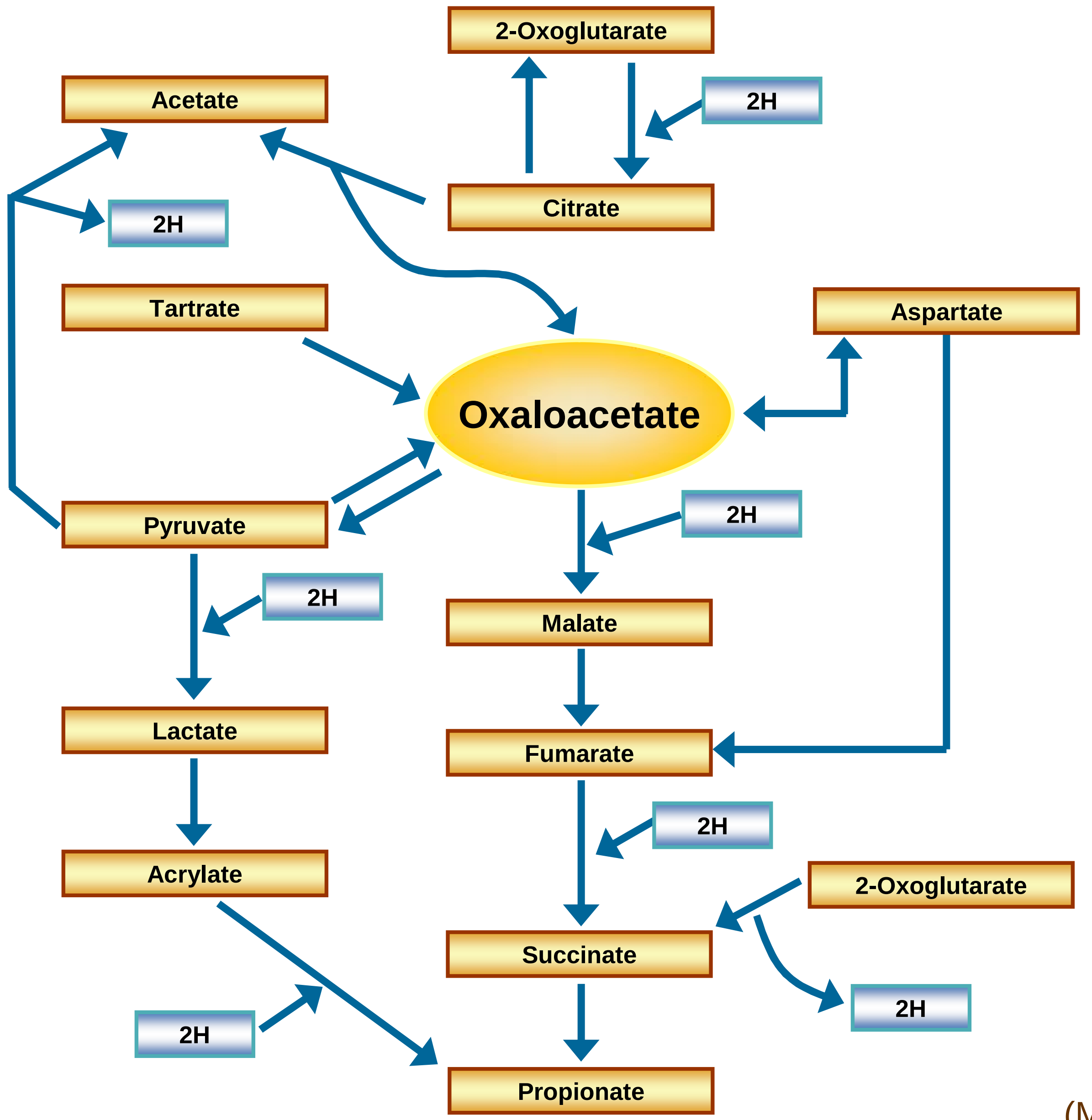
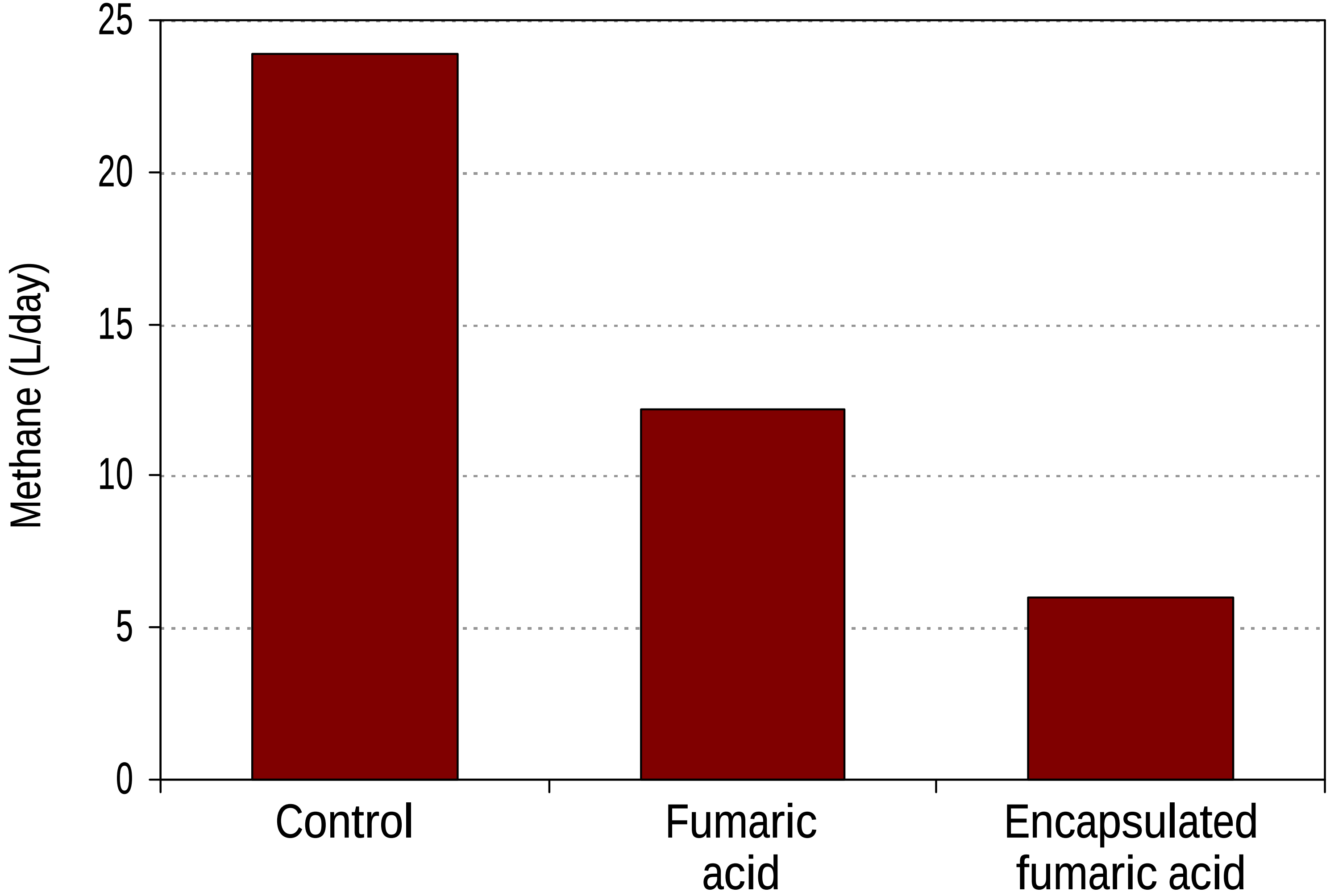
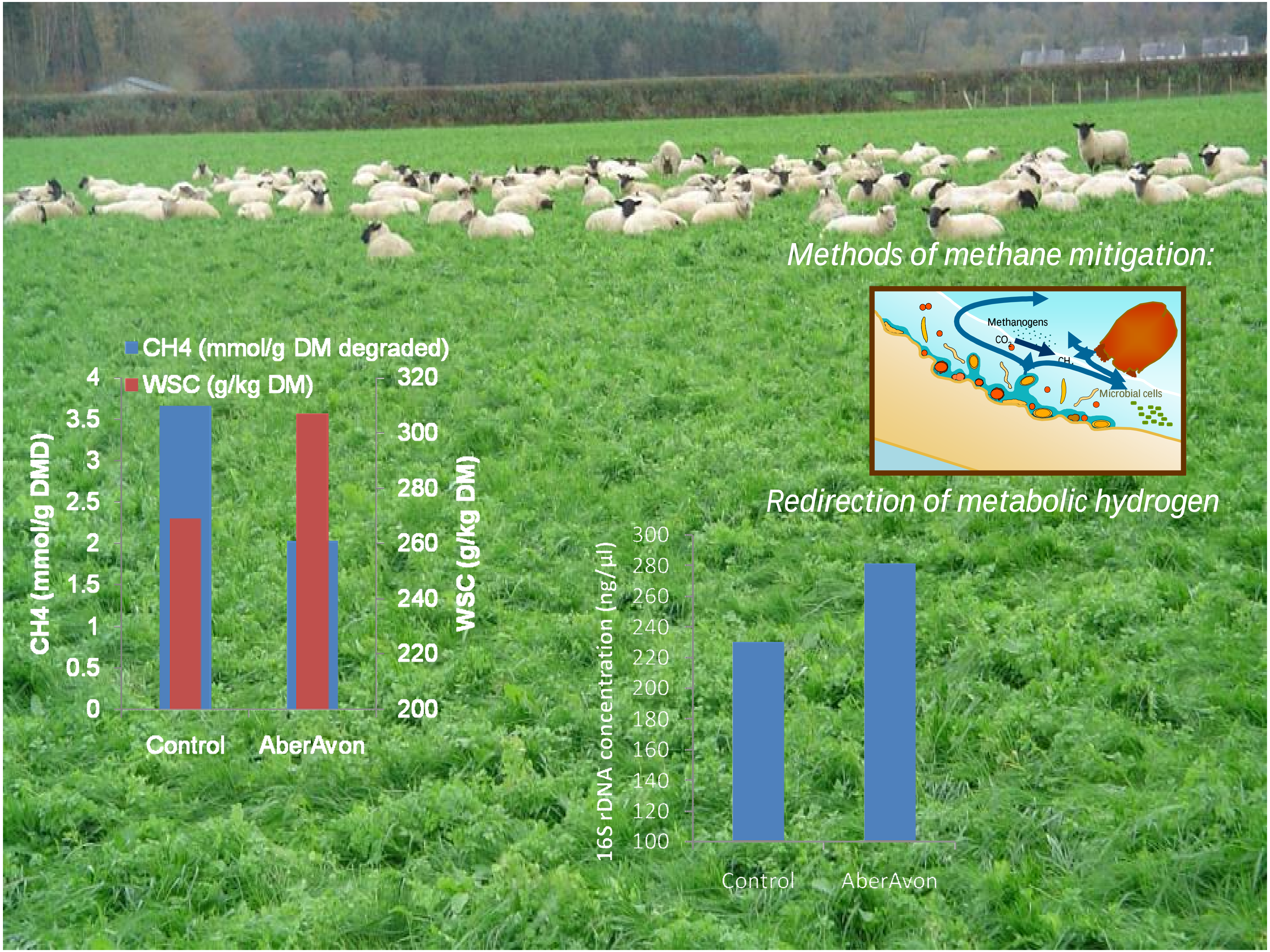


(McAllister & Newbold)

Methane production by lambs supplemented with fumaric acid

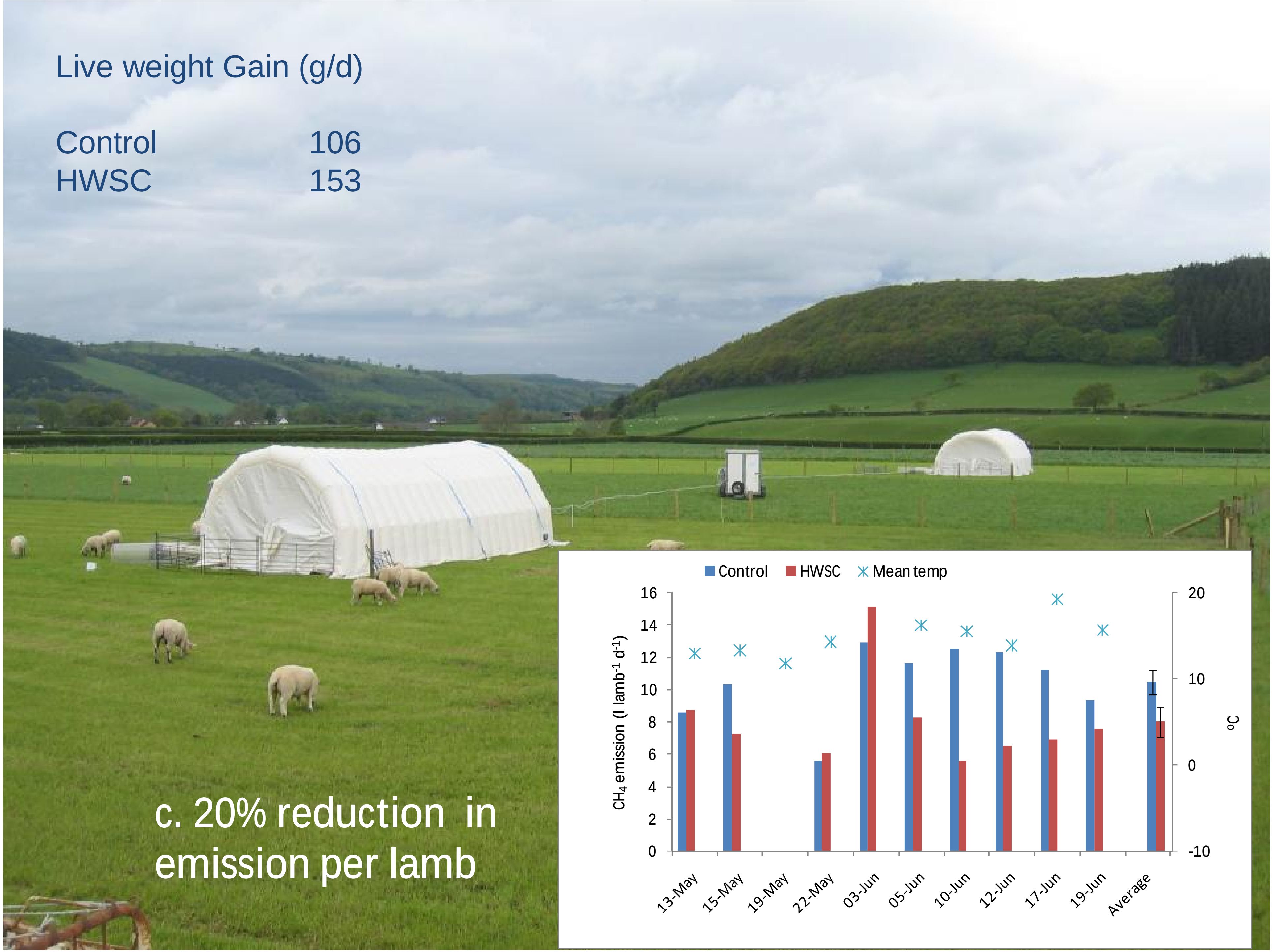


Wood et al. (2009)


Methods of methane mitigation:
Methanogens
CO2
CH4
Microbial cells
Redirection of metabolic hydrogen
CH4 (mmol/g DM degraded)
WSC (g/kg DM)
CH4 (mmol/g DMD)
WSC (g/kg DM)
0
0.5
1
1.5
2
2.5
3
3.5
4
200
220
240
260
280
300
320
Control
AberAvon
16S rDNA concentration (ng/µl)
100
120
140
160
180
200
220
240
260
280
300
Control
AberAvon

Live weight Gain (g/d)

Control	106
HWSC	153



c. 20% reduction in emission per lamb

Methane production
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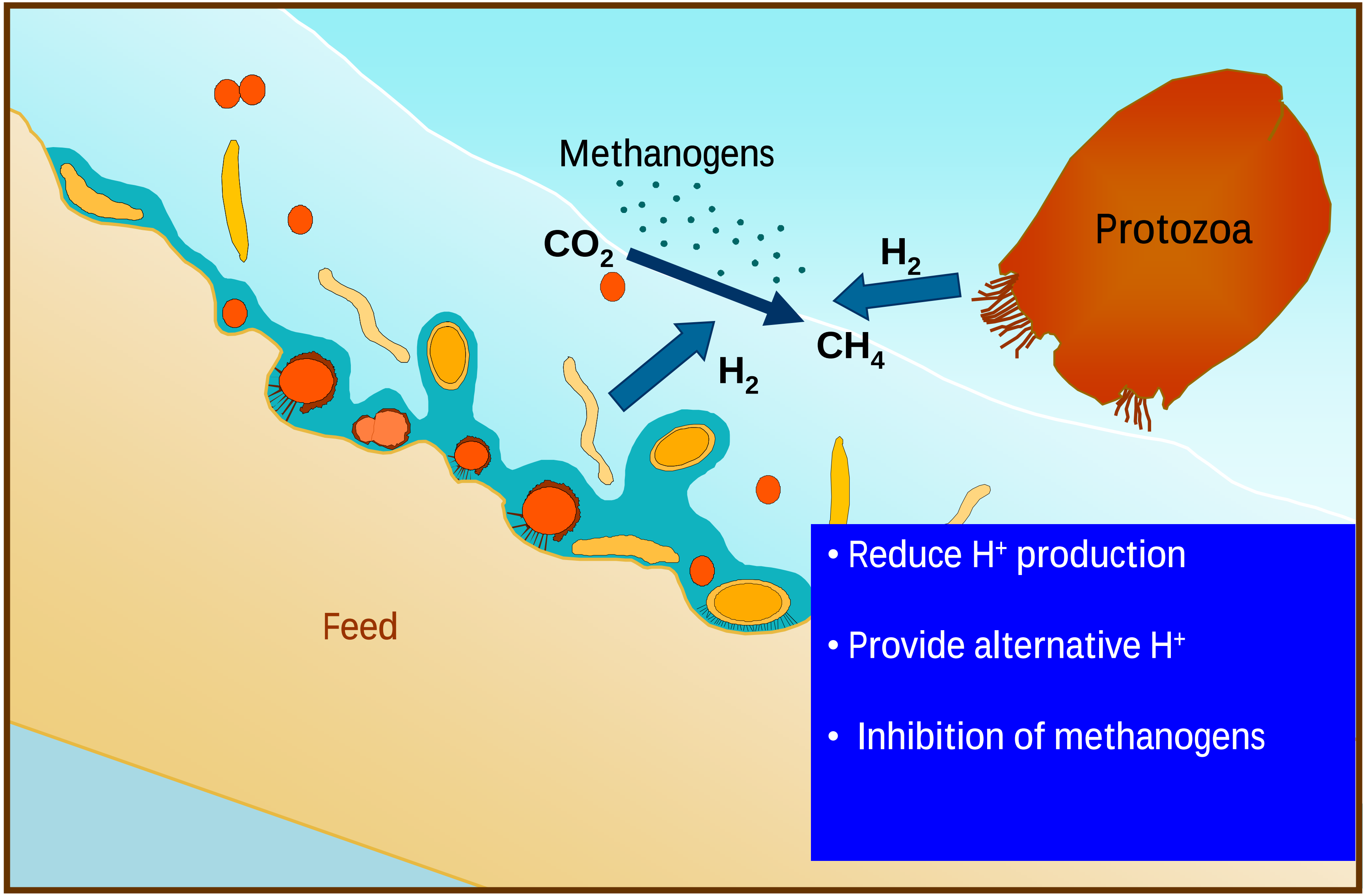
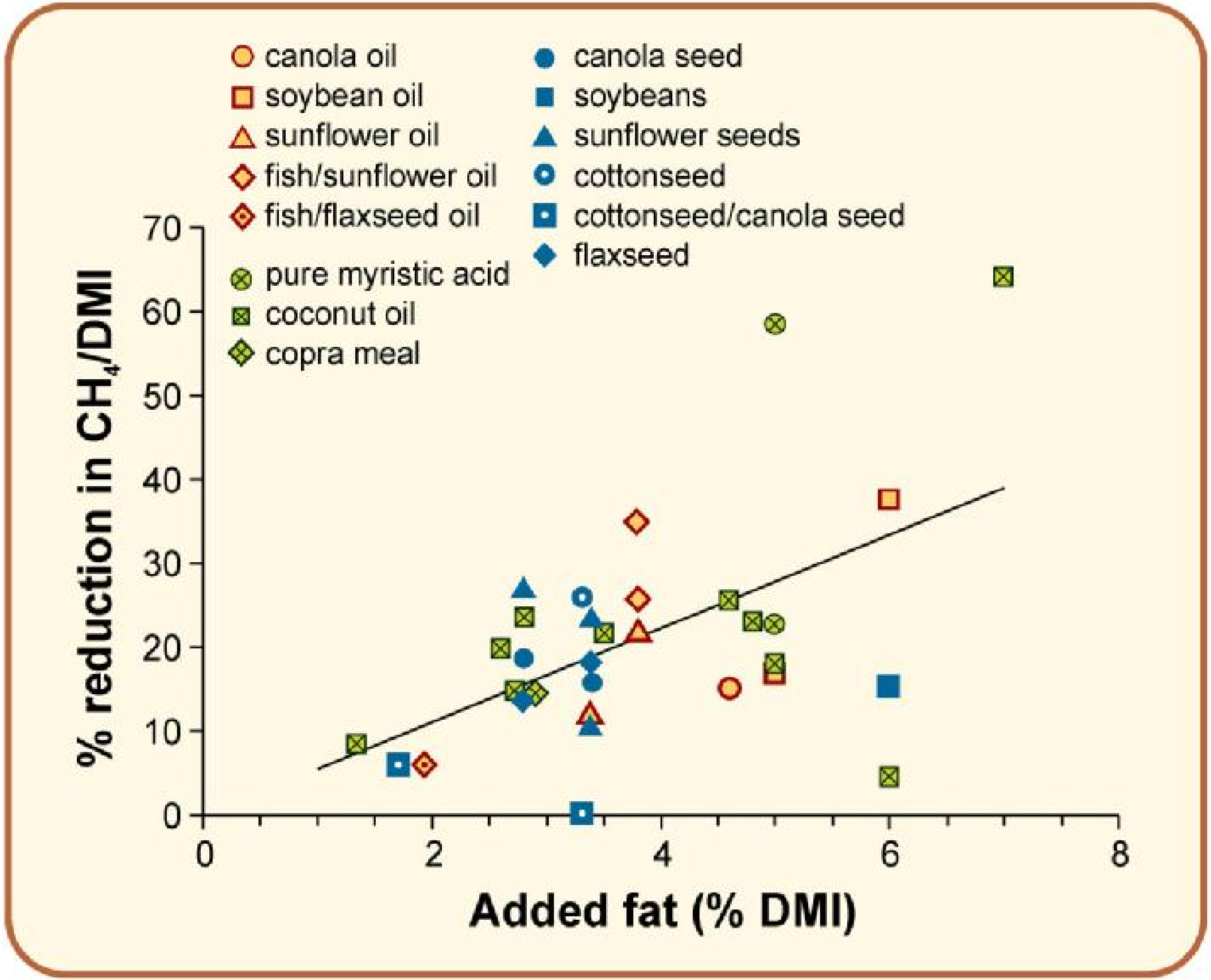
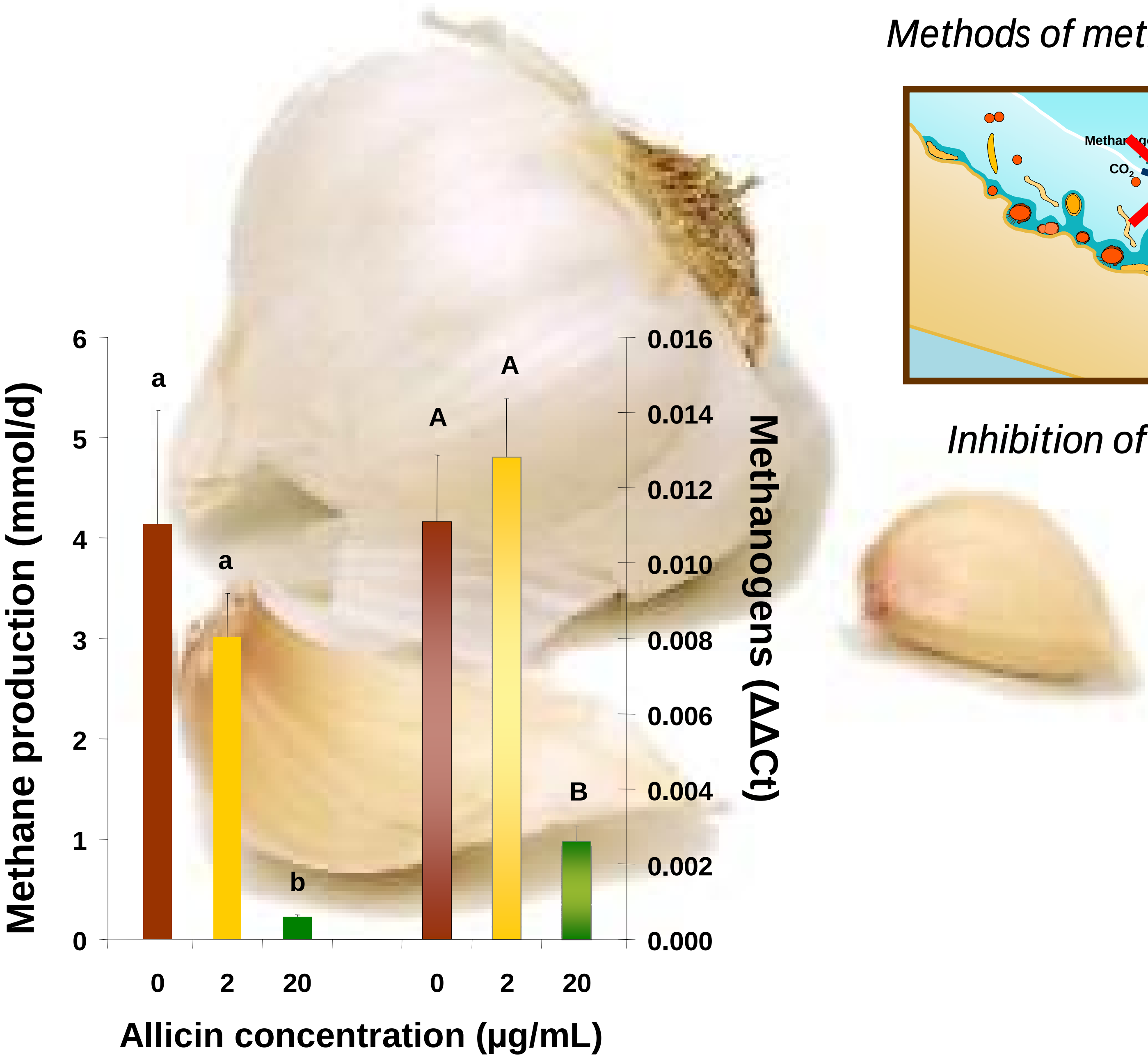


Literature summary of added fat vs CH_4 production

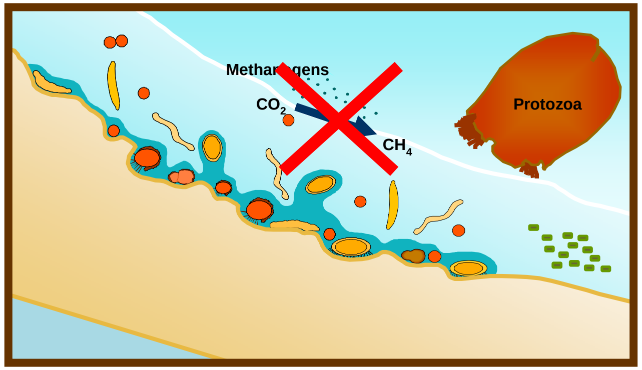
Y = 5.562 (SE = 0.590) × % added fat; $r^2 = 0.67$; $P = 0.004$



	Barley megalac	Barley linseed	Naked oats	Husked oats	SED
Methane (l/d)	36	28	24	36	4.7*
Methane (l/ kg intake)	31	24	21	31	3.4*
LWG (g/d)	106	105	107	119	19.3
Wool growth (g)	8	7.5	8.4	7.8	0.827
Methane / Kg LWG	447	286	232	320	106

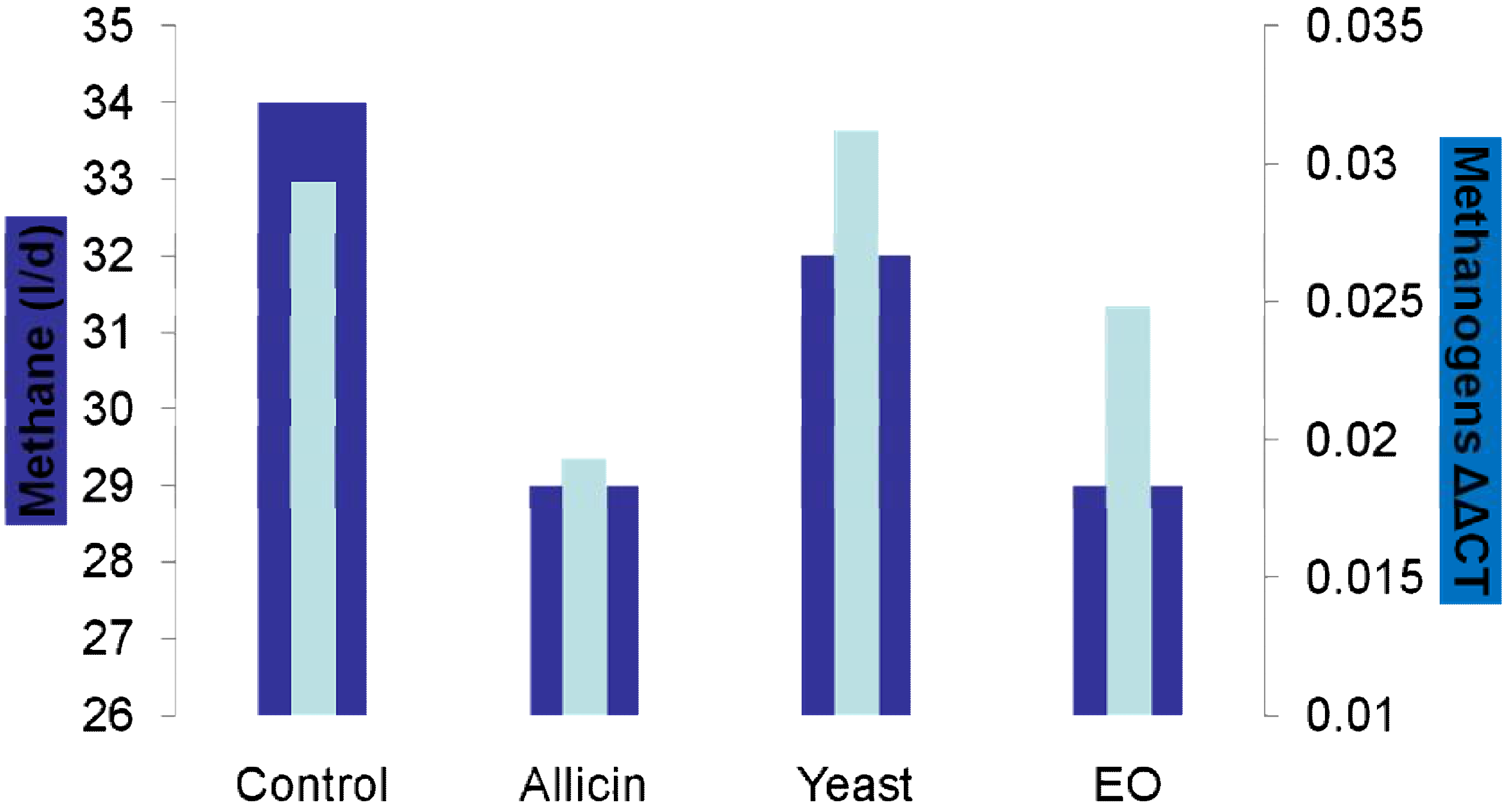


Methods of methane mitigation

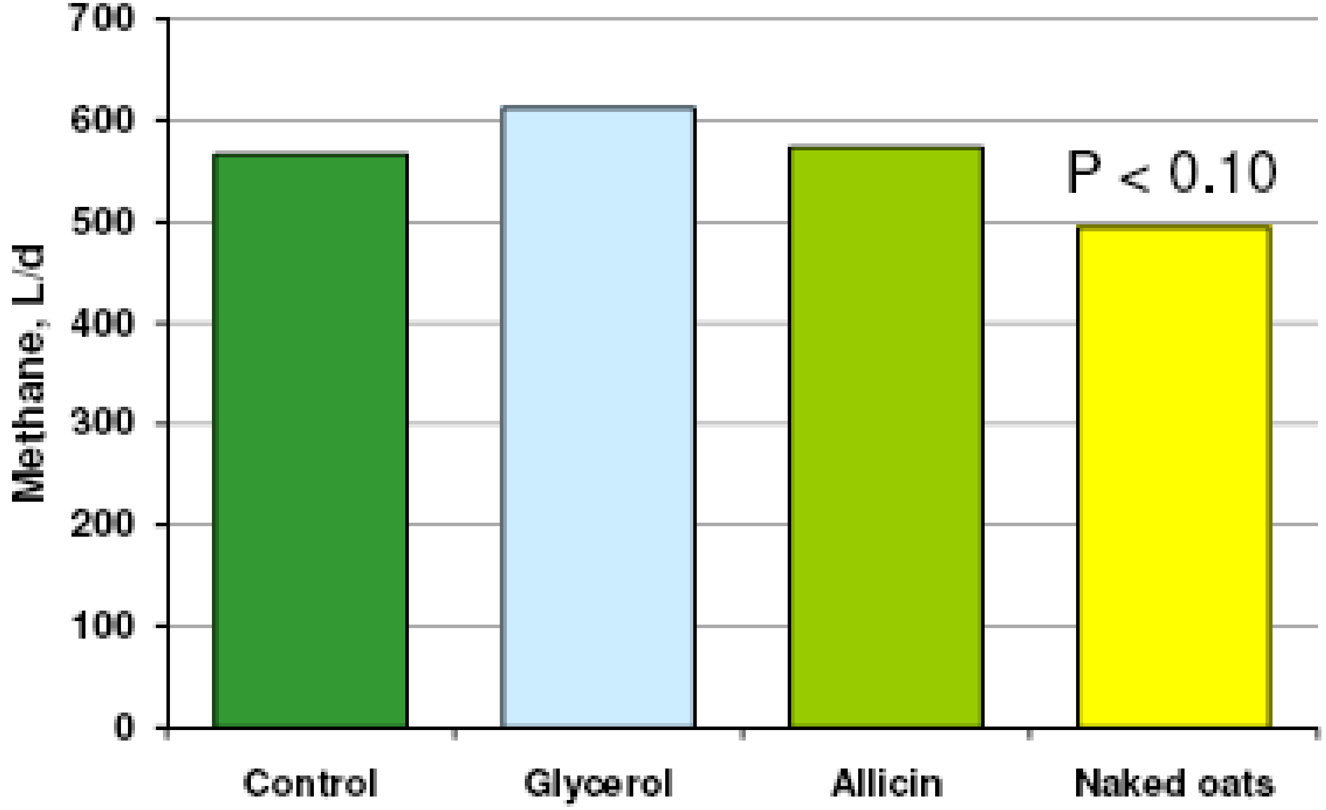


Inhibition of methanogens

The effect of a yeast based probiotic, Allicin an extract from garlic and the essential oil analogue on methane production by and methanogen numbers in the rumen of store lambs

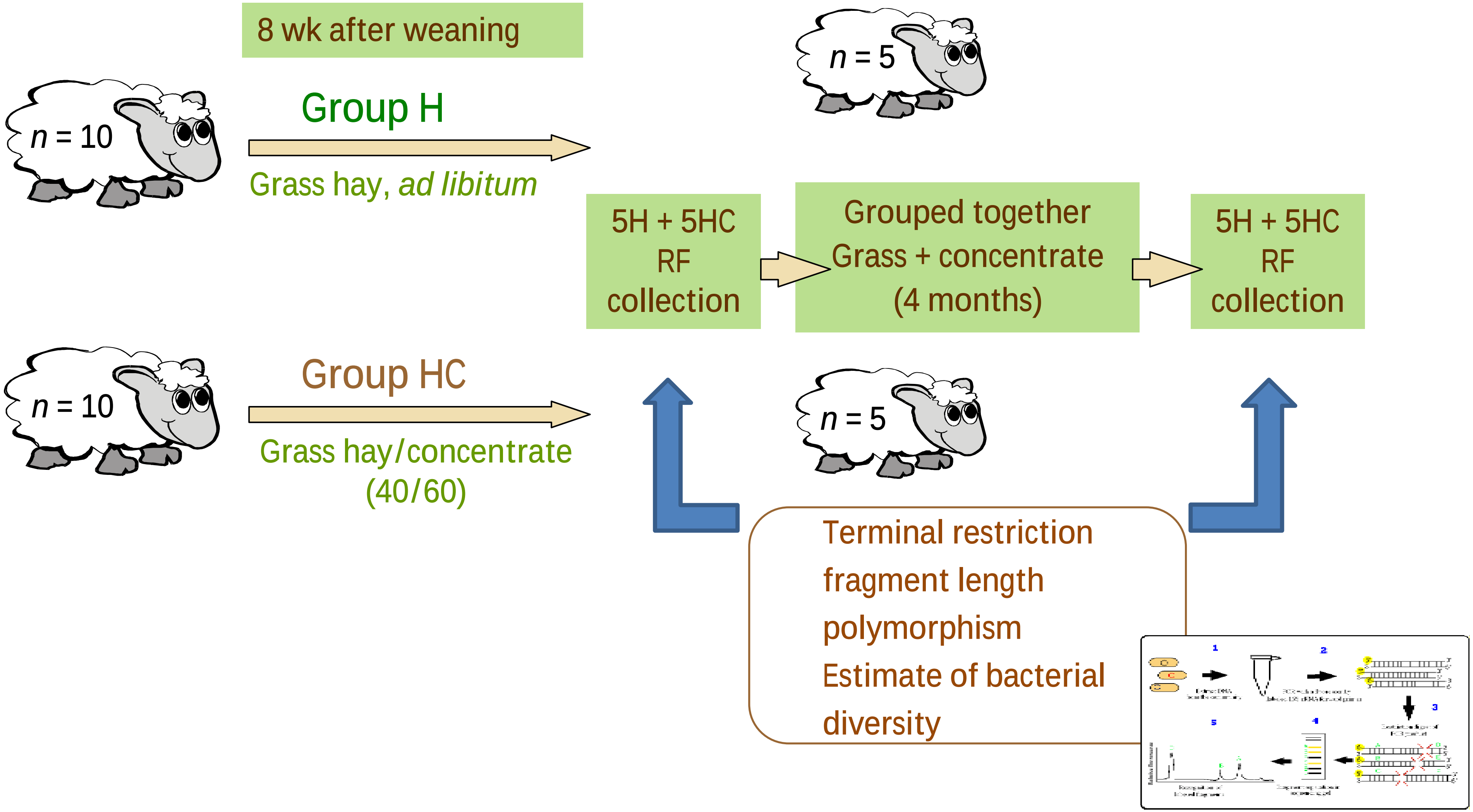


Effect of Supplements on Methane Production by Lactating Dairy Cows

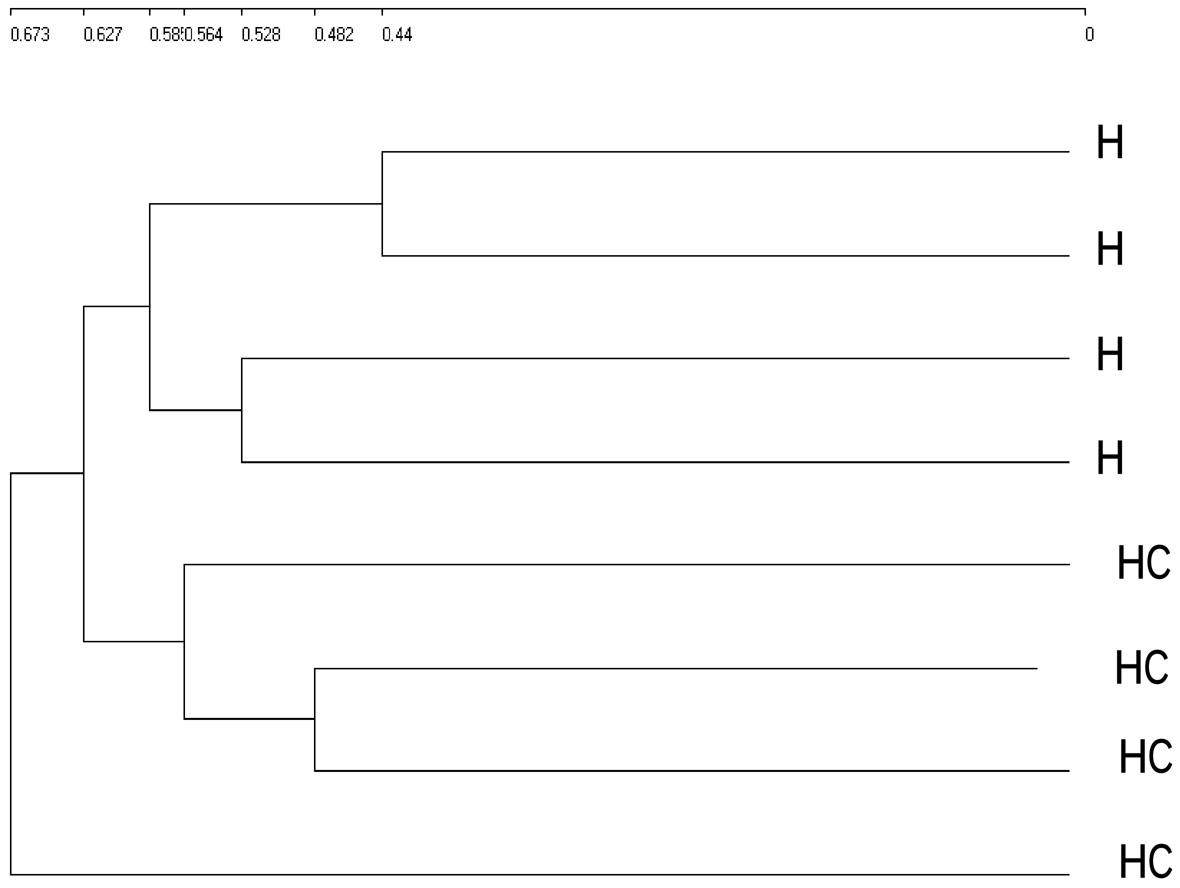


DEFRA Project AC0209

Effect of diet at weaning



Bacterial profile determined by T-FRLP of the 16S rDNA gene after 4 months on identical diets



Future plans

- Continue to investigate the use of plant extracts.
- Try to understand the microbial basis of responses.
- Try to understand the effect of early life nutrition on microbial populations in the rumen.
- Investigate the possibility of a link between the host genome and the rumen microbiome.
- Renew efforts to understand the role and control of protozoa in the rumen.

Questions