A genetic basis for a Low Methane Phenotype ?

Studies with divergent cattle

Genotype affects gut function by:

- Diet selection
- Rate of eating
- Feed intake (LW or NFI)
- Gut microbes
- Digesta kinetics (Bloat, fleece lines ~ an indirect response to selection for other traits)

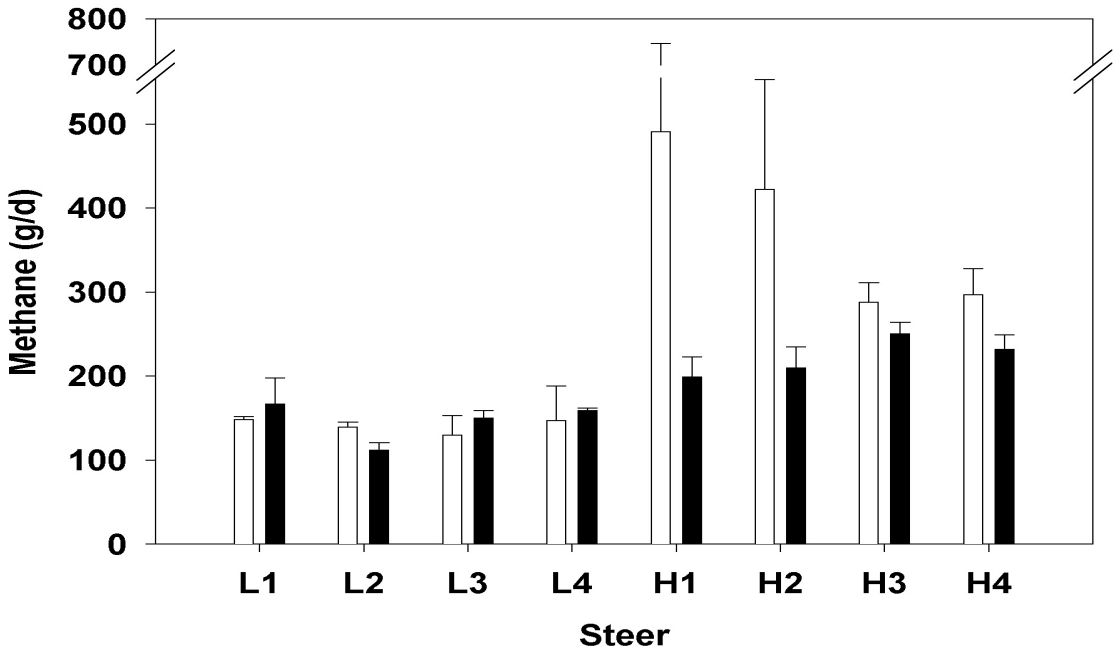
Identifying low methane cattle

- Objective was to collect data to substantiate the hypothesis that there was a negative association between NFI_{EBV} and daily methane production rate (MPR).
- SF_6 measurement of MPR in 76 steers from NFI selection lines.
- Measurements made over 10d during the 70d NFI test period on feedlot finishing diet

Steer evaluation

- Feed intake was less during MPR measurement than in surrounding non-measurement period.
- Very little evidence of an NFI:MPR association (J. Anin. Sci 2007).
- CV of MPR across days >16% (4-31%)
- Looked further at ‘low’ and ‘high’ methane animals (10 v 22 g CH_4/kg DMI)

Persistence over time ✓



10.3 to 11.9 g DMI and 22 to 18.2 g CH4/d

Figure 1. Mean daily methane emissions (± SE) of 8 steers consuming a high-grain ration *ad-libitum.* Emissions were measured over 6-10d in an initial screening (hollow bars) to identify steers with unexpectedly low emissions (steers L1, L2, L3, L4) or high emissions (steers H1, H2, H3, H4). Emissions were remeasured within 3 months (solid bars) on these individuals to confirm their methane phenotype as a prelude to further physiological studies.

Persistence over diet x

Same steers adapted to sorghum hay (8.1 MJ ME/kg DM) diet (*ad-libitum*) and methane remeasured.

No difference between previously identified low methane yield and high methane yield groups (18.0 v 21.1 g CH4/kg DMI).

Revisit persistence using low and high methane bulls

Using SF_6 over 8d on 80 bulls, identified bulls who overproduced methane (6) or under-produced methane (6) relative to amount predicted for their LW & DMI (Blaxter & Clapperton 1965).

Lo/Hi Bull Data

Diet	Exp.	Methane (% prediction)		
		Low (n=6)	High (n=6)	Diff.
Finisher	1,2,3	**57**	**140**	<0.05
Intermed	4,6	**77**	**108**	<0.05
Lucerne	4,6	**91**	**111**	<0.05
Finisher	7	**75**	**125**	<0.05

Conscious of other data

- Münger & Kreuzer 10 cows x 3 breeds x (5x3d) chamber measurements over a season
  - no animals showed consistent underproduction of methane
- Pinares Patino
  - Effect lost when diet changed

Subsequently

Single-sire mated under-producing and over-producing Angus bulls to 240 Angus cows in Spring 2007.

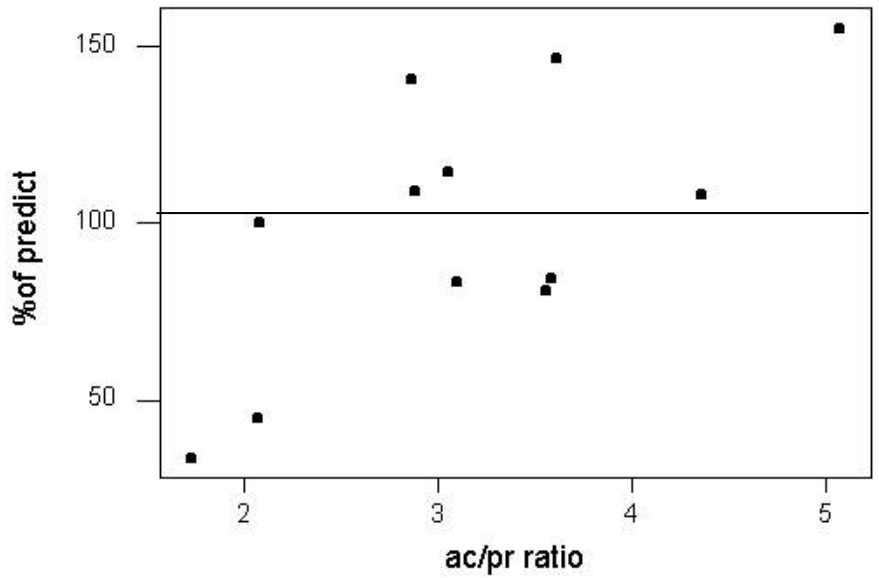
Intent is to measure methane production of yearling progeny in chambers late 2009.

Have re-mated cows to some of same bulls in Spring 2008.

Predictors of methane phenotype ?

- On feedlot diet, steers with low methane/kg DMI had less rumen protozoa than did steers with high methane/kg DMI.
- No difference in protozoa populations on sorghum hay
- Ac:Pr ratio a weak predictor of MPR (fig)

Ac:Pr ratio in Lo/Hi methane bulls

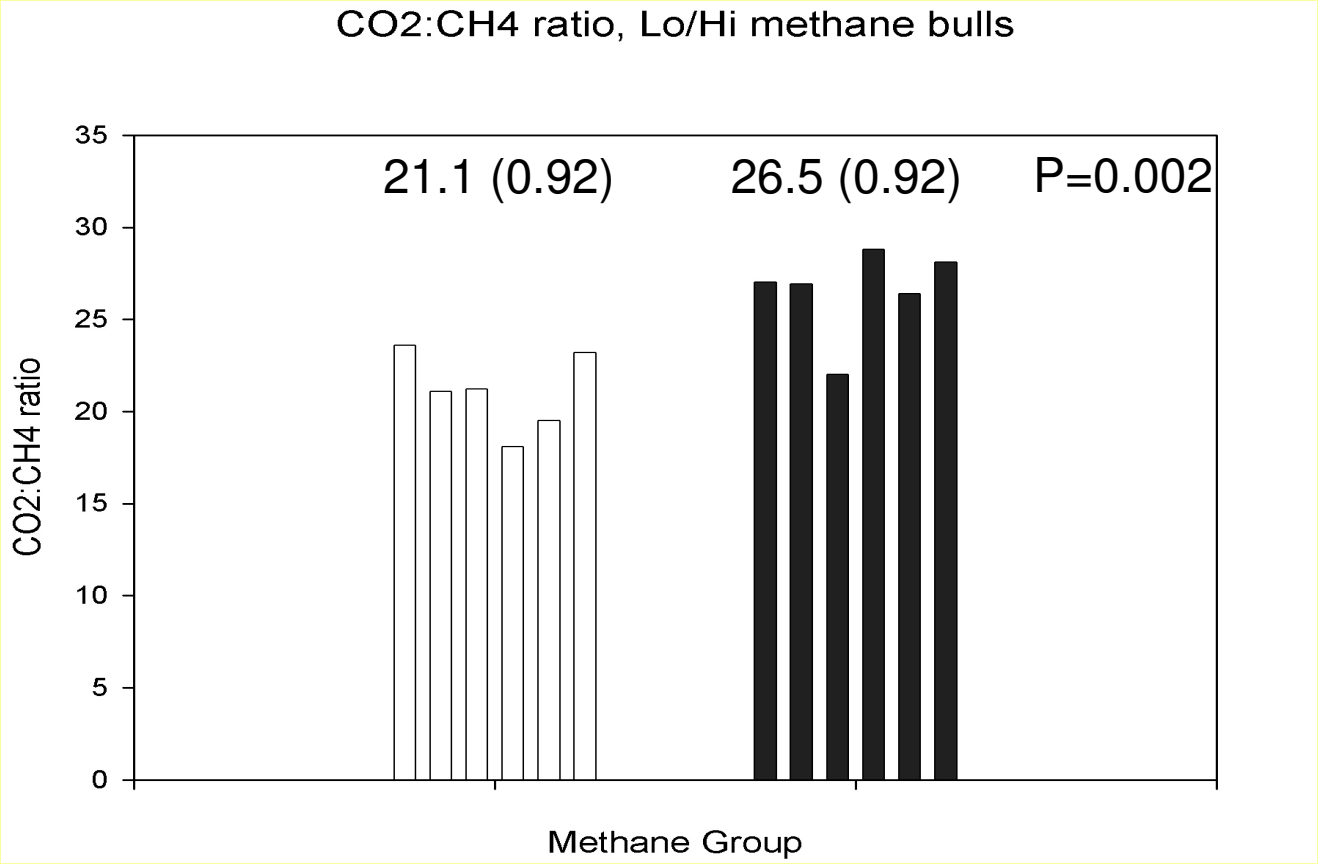


Lo/Hi methane bulls (fixed DMI)

Group	Ac:Pr	
BULLS (Intermediate ration)		
LO-CH4	2.57	
Hi-CH4	3.76	P= 0.02
STEERS (finisher)		
LO-CH4	1.12	
Hi-CH4	1.56	P= 0.01

Is the CO_2:CH_4 ratio different in low methane animals ????

Average of 4 x 2d collections of exhaled breath collected by nose 'sniffer'



Caveat

Need to check that ‘under-production’ of methane (or low methane/kg DMI) is not just arising from reduced DM digestibility at the time of methane measurement.

Conclusions

- Subgroups of ruminants that produce less or more methane than expected, can be identified within a population
- Group differences persist well with time, but not always with diet.
- We should be conscious for opportunity to not only breed for low methane but breed against high methane (if this is easier).

Implications of Breeding for NFI on Industry Emissions

After 25 years of including NFI in index selection for bulls, emissions can be expected to be reduced by:

- 15.9 % in adopting herds in year 25
- 3.1 % across all cattle in Australia in year 25 (61kt)
- 568,000 t methane emissions saved over 25years
- Works for the emissions that come from ALL cattle (96%grazing & 4 %feedlot).