Methane mitigation potential of a garlic derivative, yucca powder and calcium fumarate in dairy cattle

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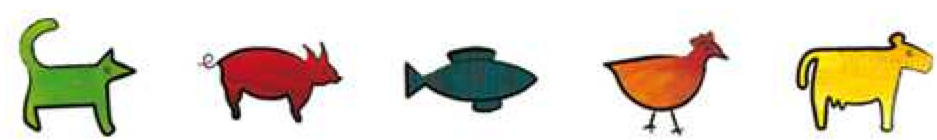


The Research Consortium

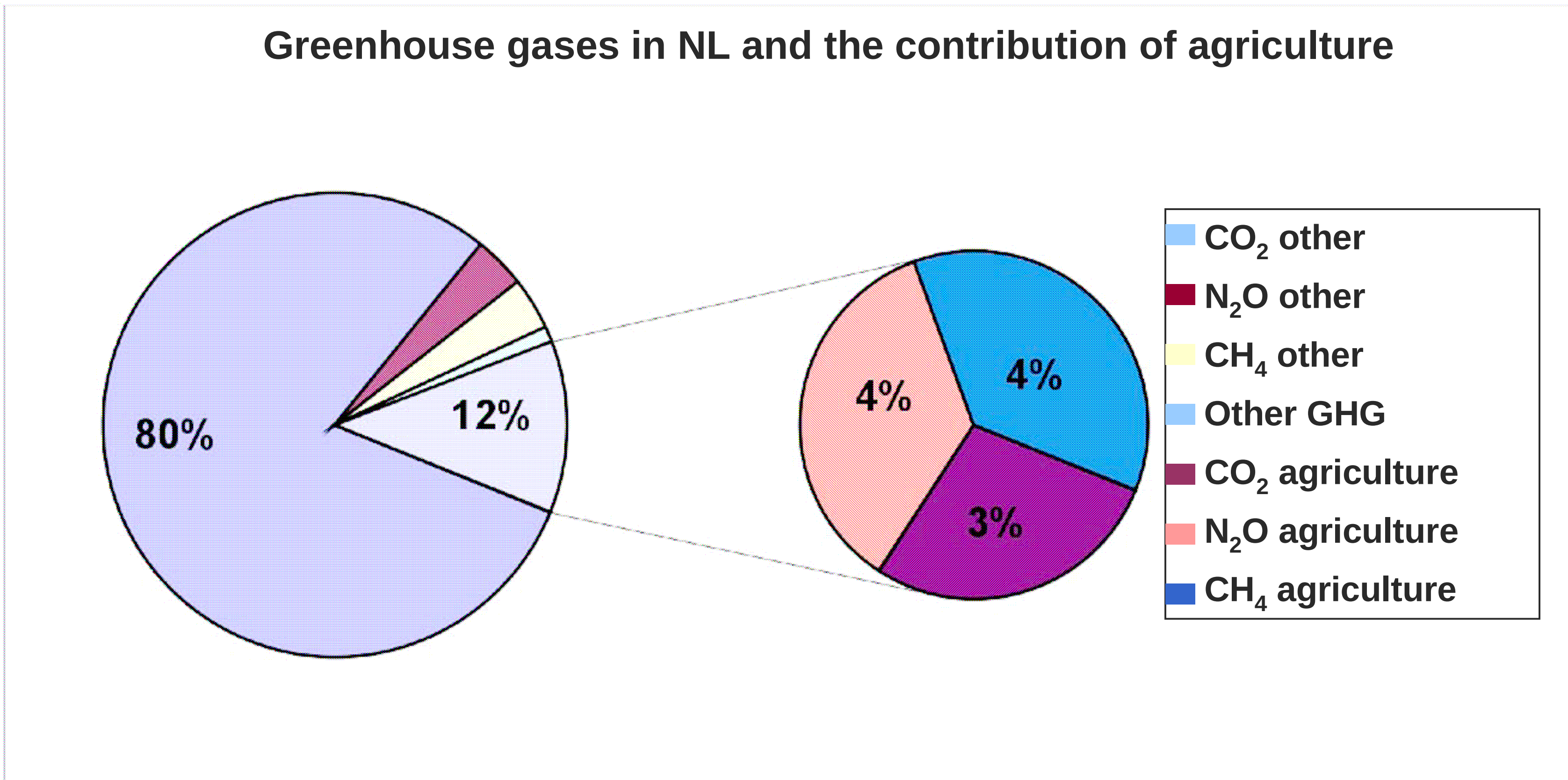
- Aim: To develop dietary additives for ruminants to reduce enteric methane emissions without negatively affecting animal performance

- Provimi
  - → Expertise in animal nutrition, worldwide network for distribution

- Wageningen University and Research
  - → Expertise in animal nutrition, excellent facilities for methane measurements

- Alimetrics
  - → Expertise in quantification of rumen organisms (Q-PCR)

Anthropogenic GHG in Dutch Agriculture

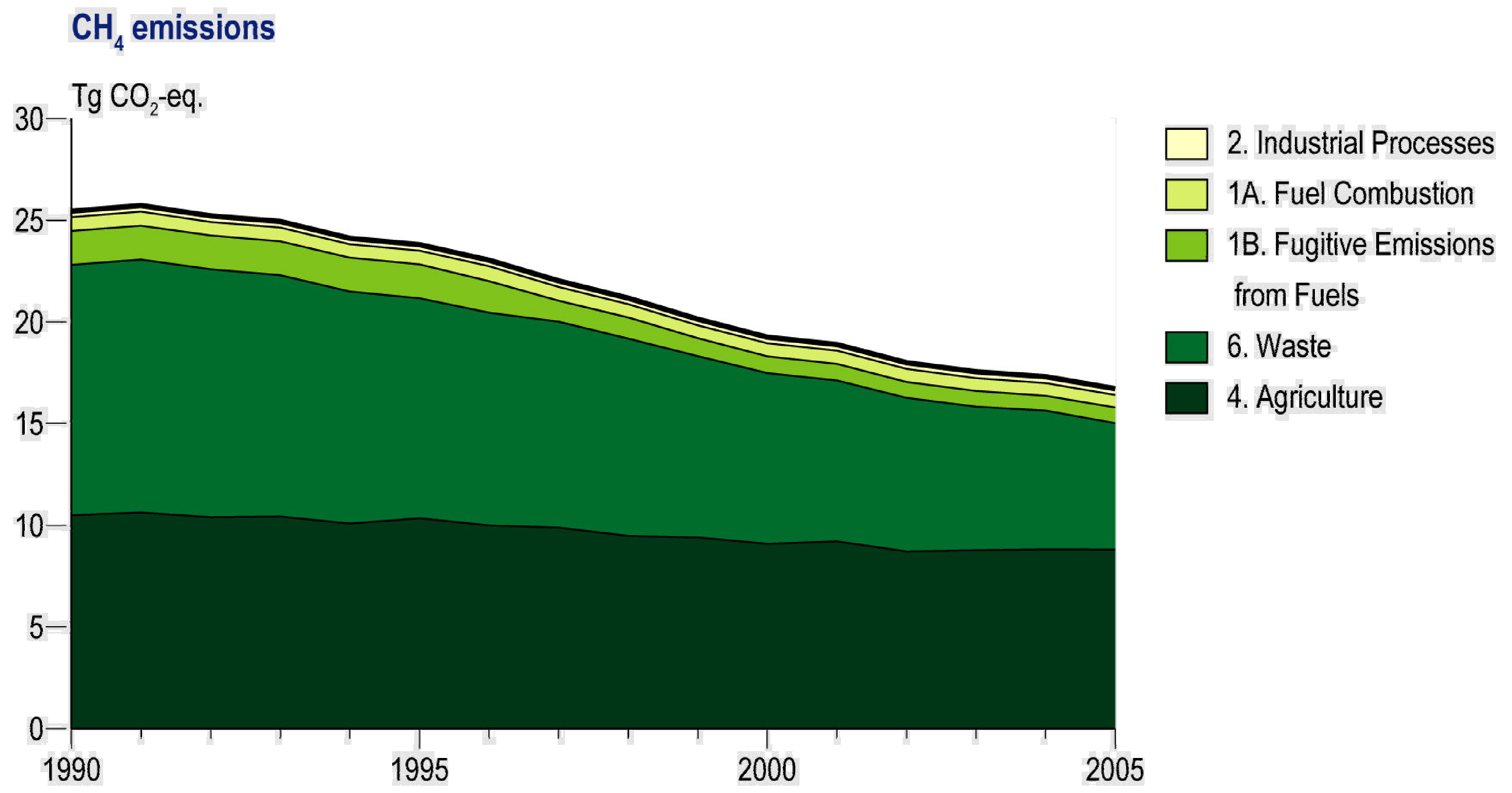


Adapted from Rougoor et al., 2008

The role of ruminants in methane production

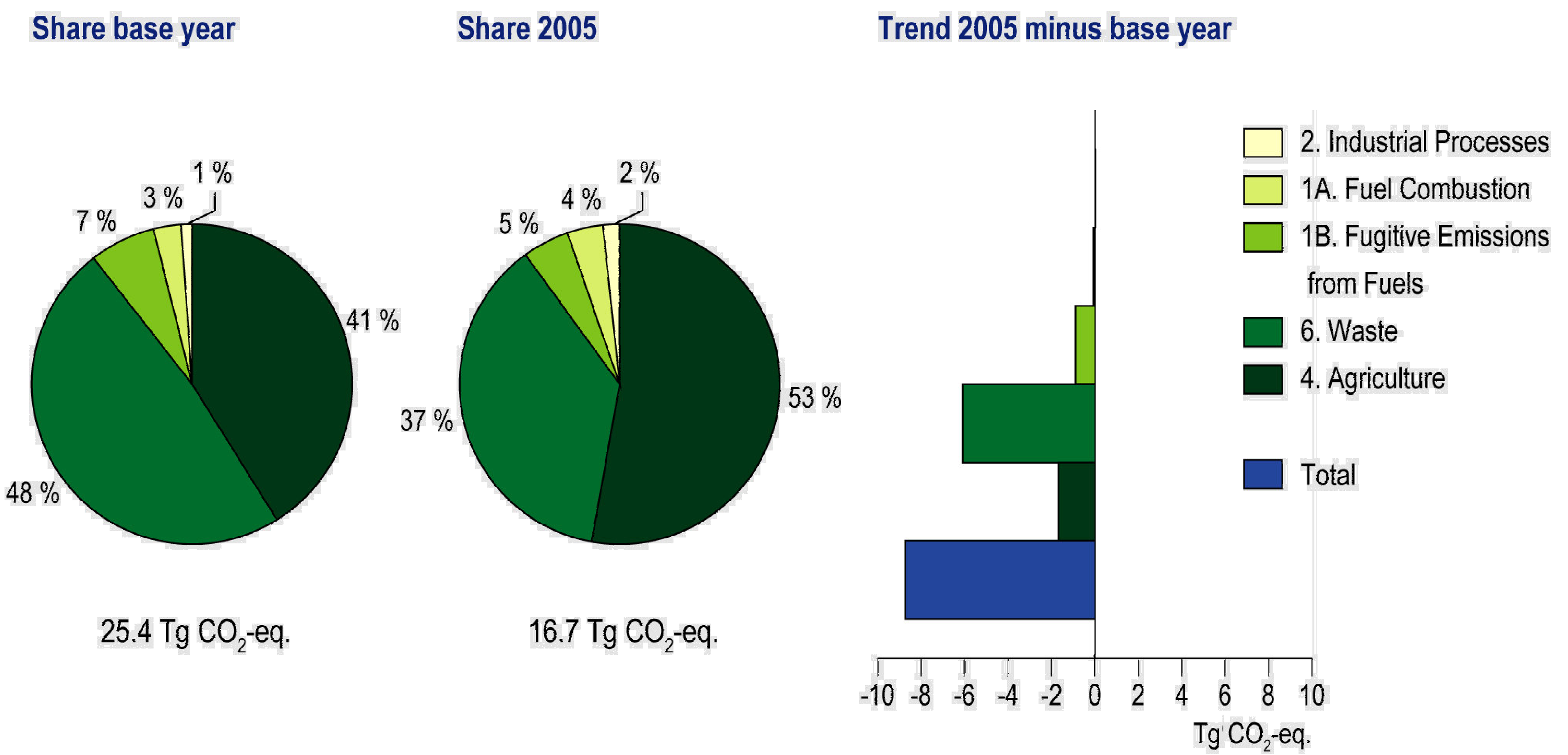
- 75% of agricultural methane emissions are a result of enteric fermentation
- 90% of enteric methane production is caused by rumen fermentation, mostly dairy cows
- Methane produced during rumen fermentation contributes approximately 2.7% of the Dutch greenhouse gas emissions (expressed in CO_2-equivalents)

Methane emissions in NL



Source: National Inventory Report 2007

Share of agricultural methane emissions



Source: National Inventory Report 2007

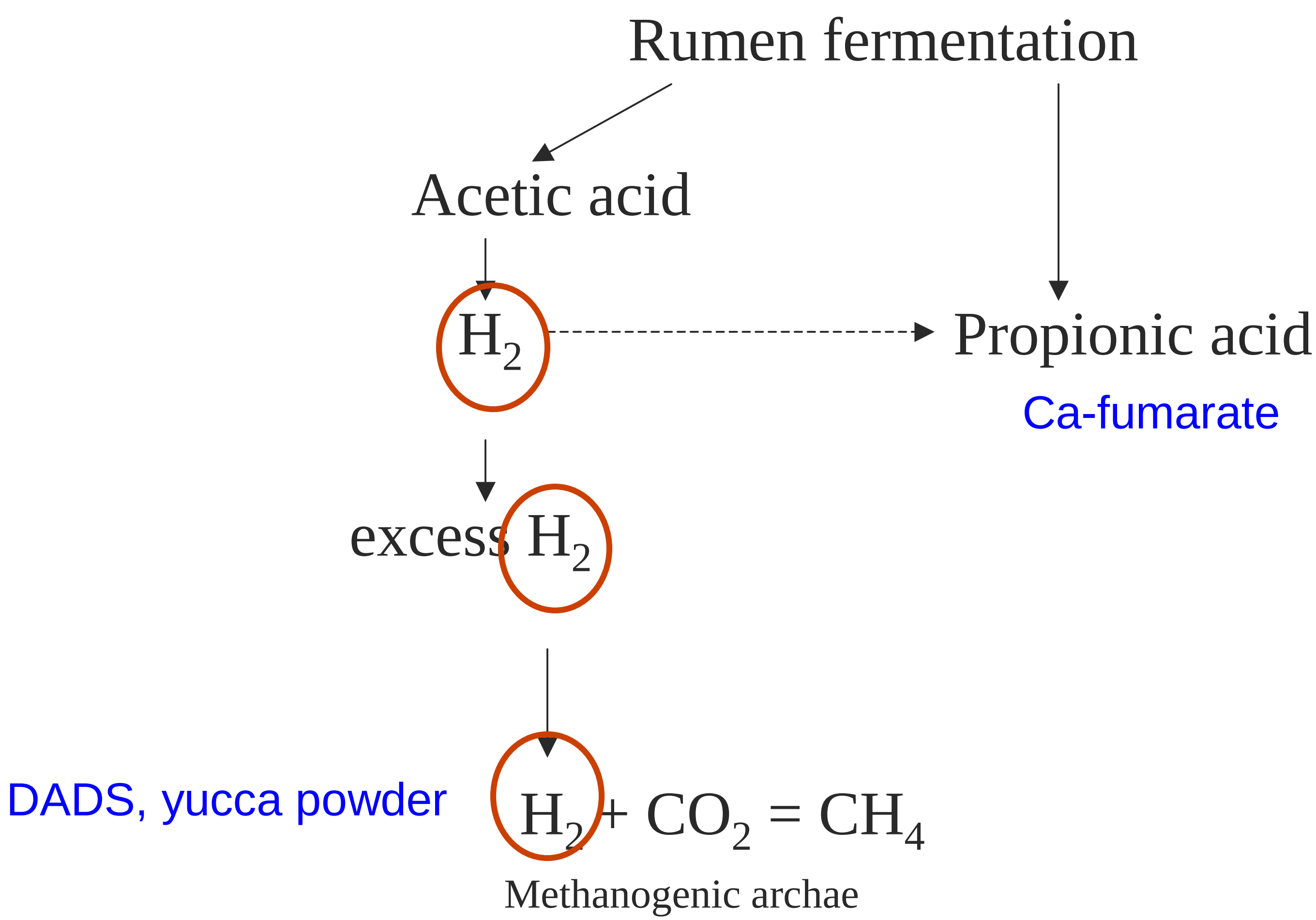
Ways to reduce methane production from ruminants

- Methane production is the main route of hydrogen disposal for the animal

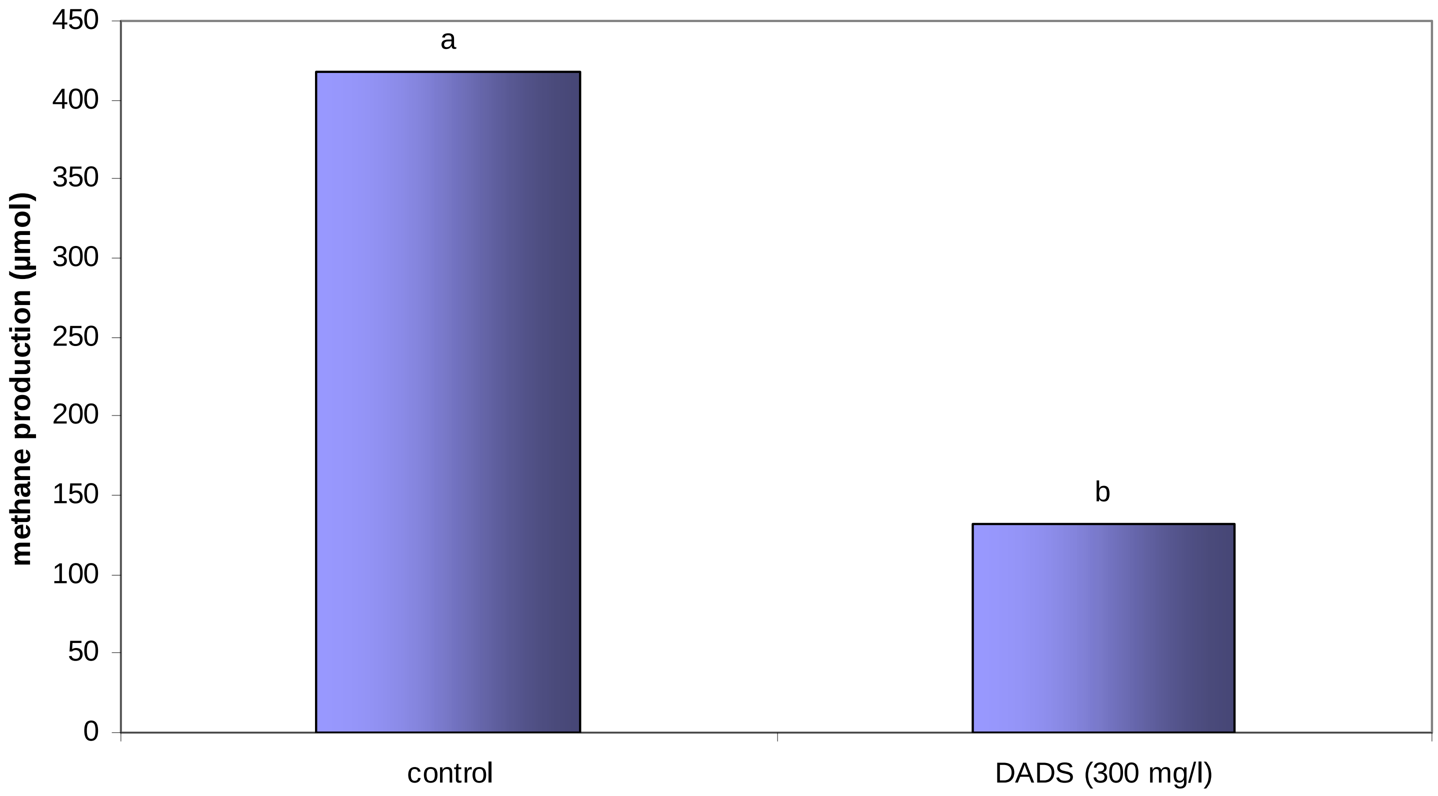
- Disposal of hydrogen is essential for efficient rumen fermentation

- Methane reduction strategies involve:
  - → Prevention of hydrogen formation (reducing level of fermentation)
  - → Use of hydrogen in other processes (sinks like propiogenesis)
  - → Prevention of methanogenesis (direct inhibition methanogens)

Methane production in the rumen

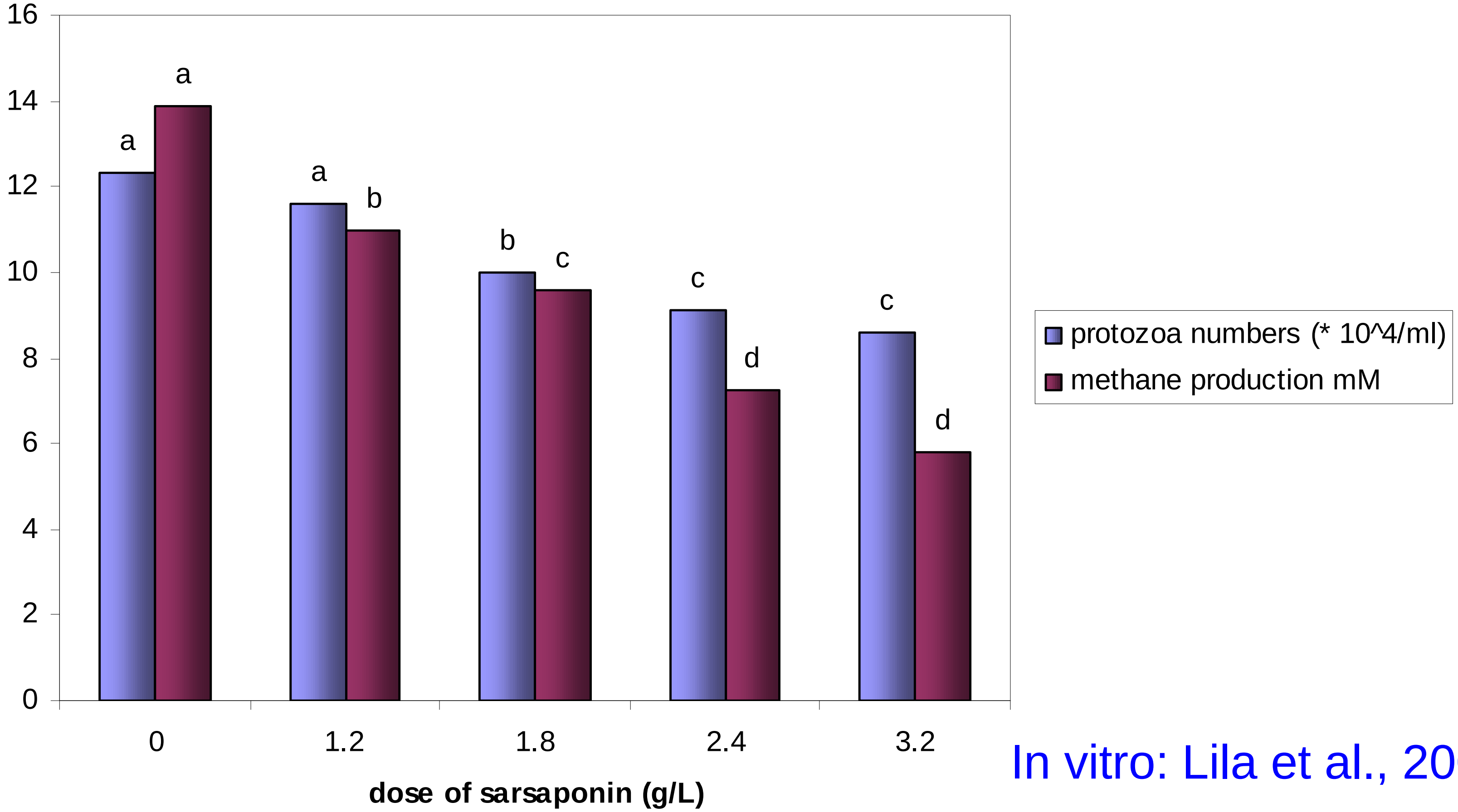


Diallyldisulfide and methane production



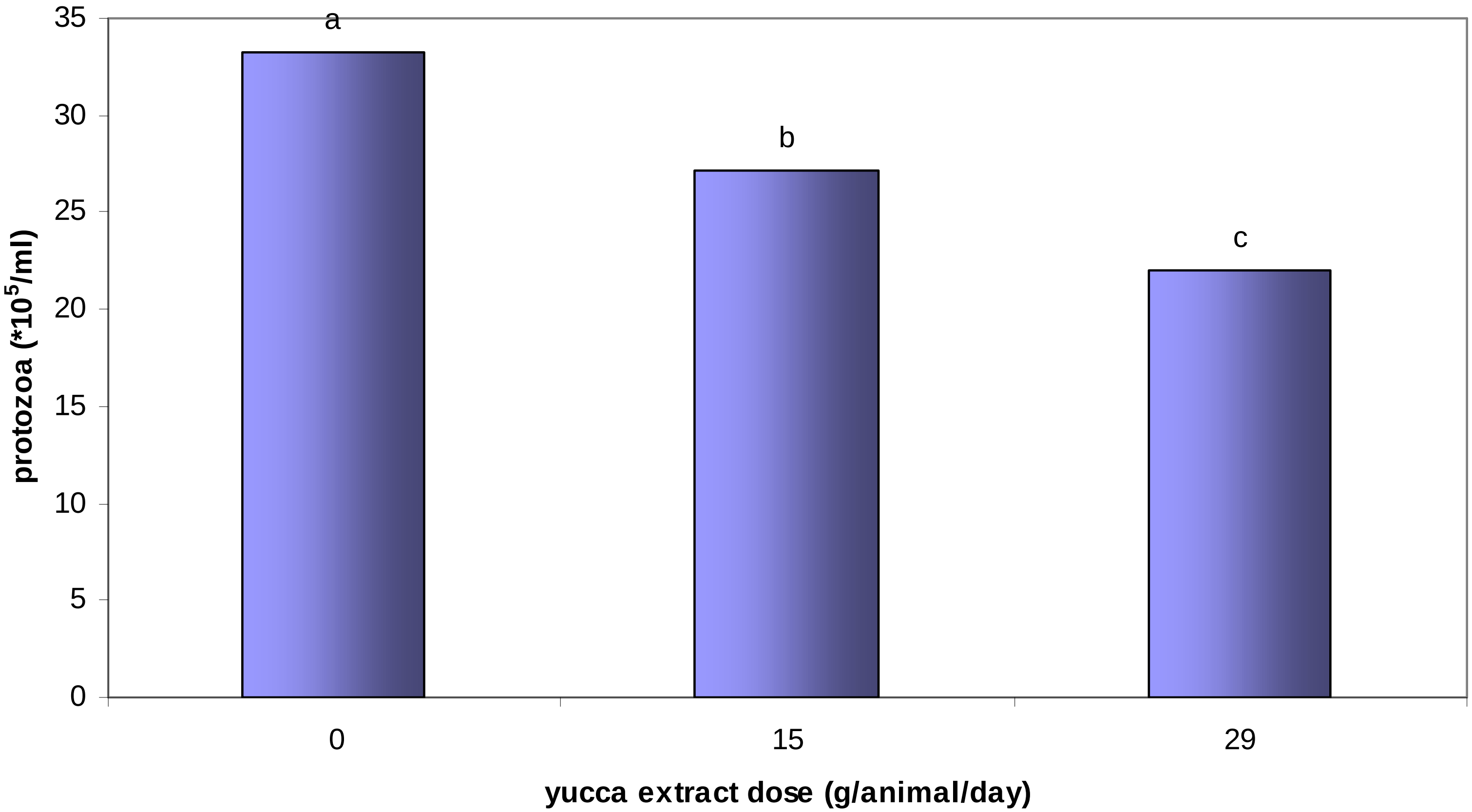
In vitro: Busquet et al., 2007

Saponins and Methane Production



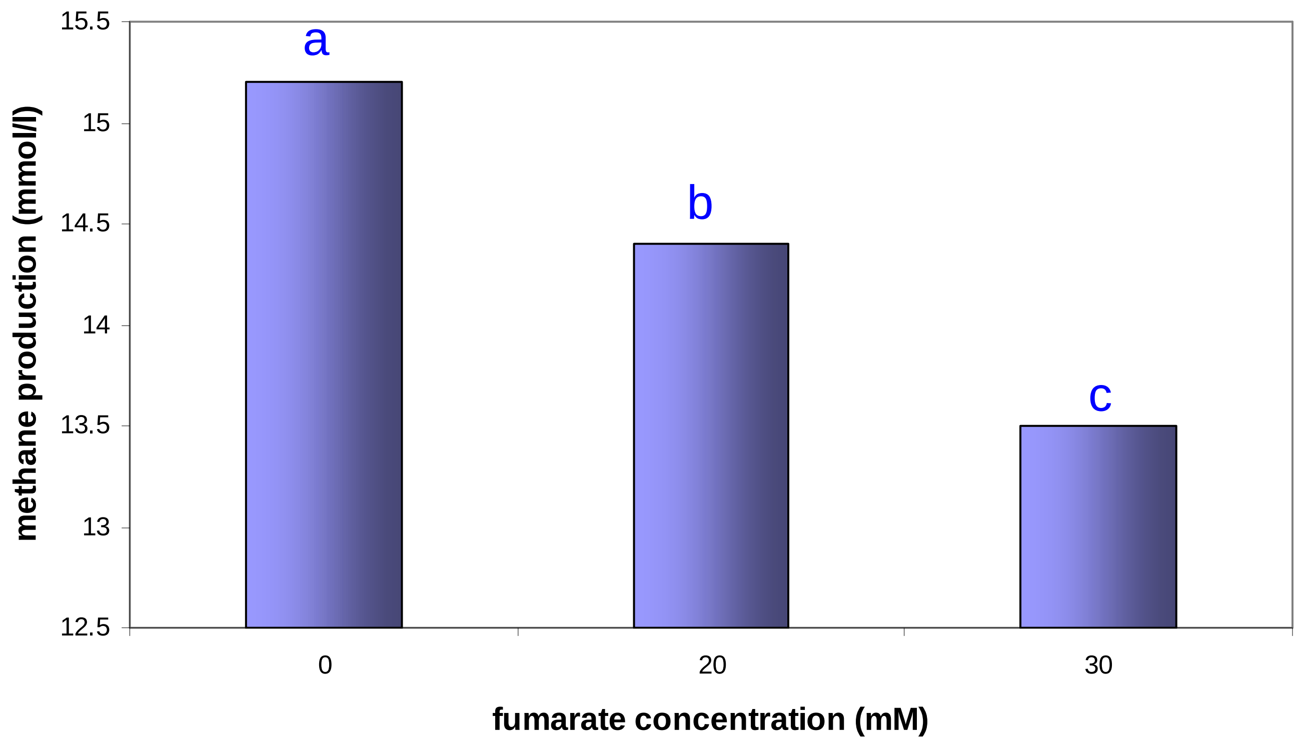
In vitro: Lila et al., 2003

Saponins and Protozoa



In vivo: Lovett et al., 2003

Fumarate supplementation



In vitro: Asanuma et al., 1999

Objectives

- To determine the *in vivo* effects of yucca powder, DADS and Ca-fumarate on:
  - → Methane production
  - → Milk production and composition
- Cows were fed restrictedly to avoid interactions between feed intake and methane production

Experimental Design

- Randomized block design
- 40 lactating Holstein Friesian dairy cows
- 17-day experimental periods
- Restricted feeding from day 8 onwards

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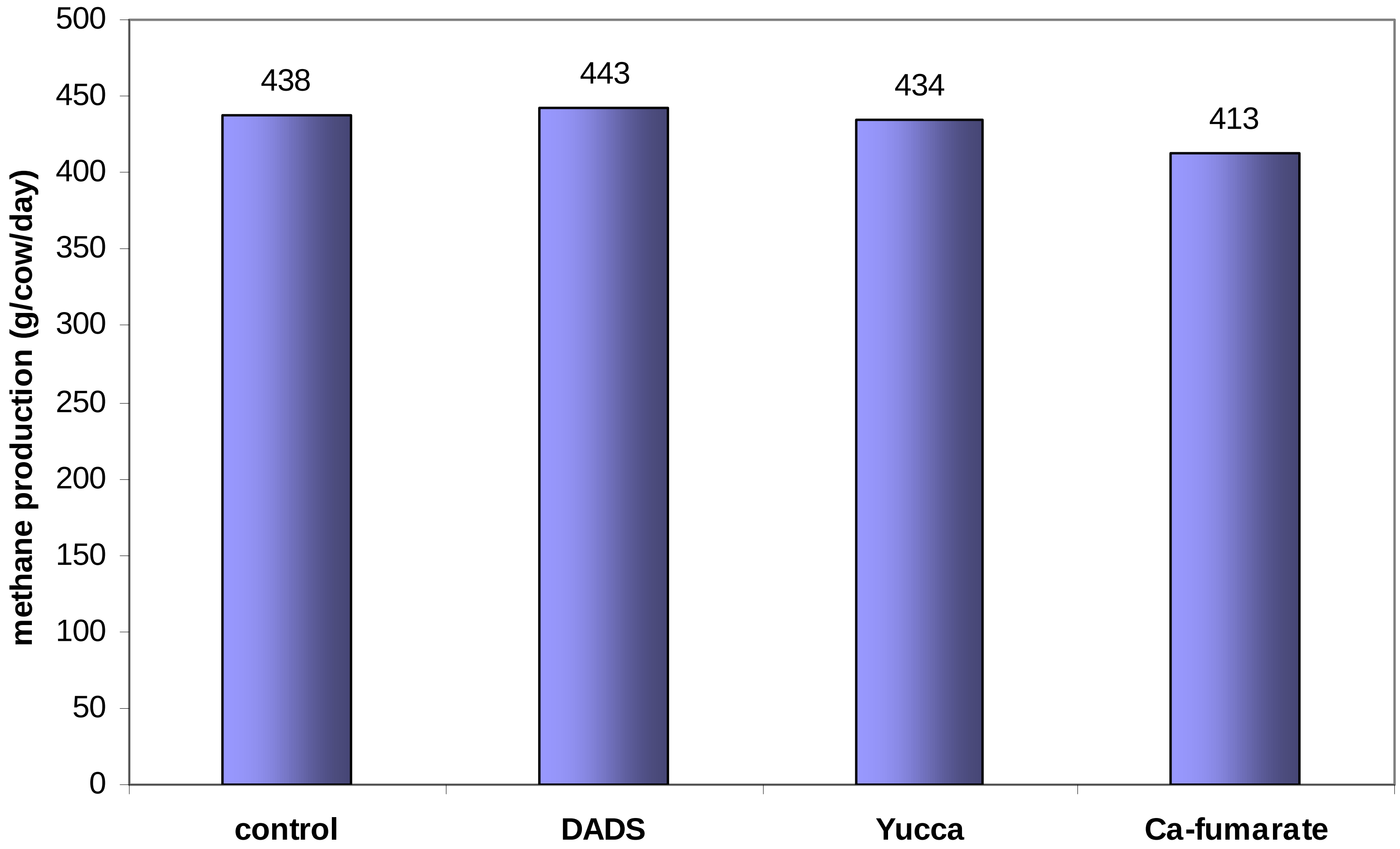
	Adaptation period
	Methane measurement period
	Fecal collection

Experimental diets

- Basal diet same for all cows
  - → 40% grass silage, 26% maize silage and 34% concentrates
  - → Fed as Total Mixed Ration
- Additives were mixed in the diet just before feeding
  - → 0.06 g DADS/ kg dry matter
  - → 3.3 g Yucca powder/ kg dry matter
  - → 27.8 g Ca-fumarate/ kg dry matter

Methane production



PROVIMI
ON TOP OF THE FEED CHAIN

Milk production

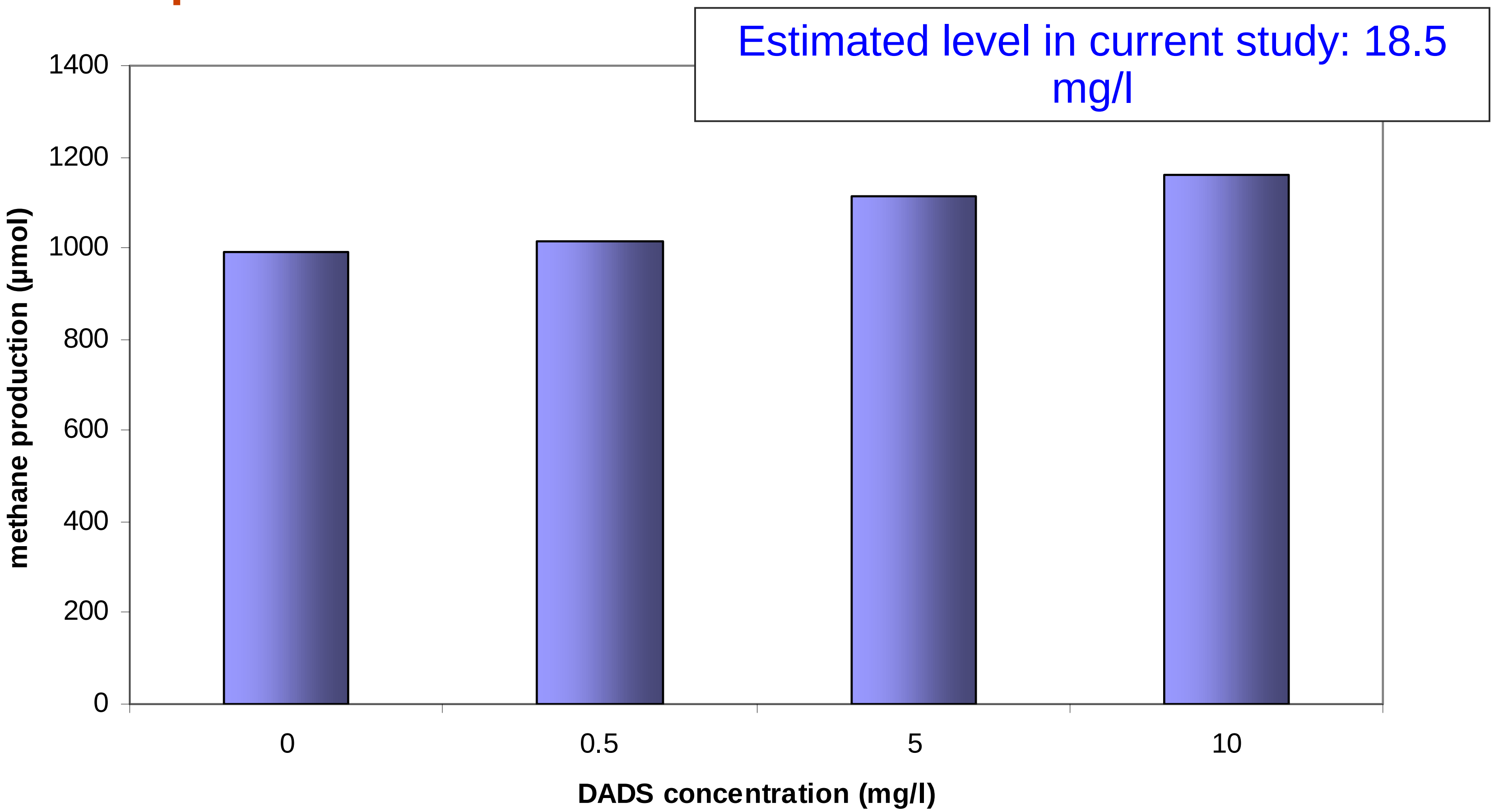
	Control	DADS	Yucca	Ca-fumarate	P-value
Dry matter intake (kg/day)	17.5	17.8	17.5	16.9	0.233
Milk production (kg/day)	30.3	29.6	29.8	28.7	0.819
Milk fat content (%)	3.97	4.01	3.96	3.95	0.997
Milk protein content (%)	3.15	3.24	3.27	3.18	0.755

Discussion

- No effect on methane production, despite promising in vitro results

  → Different doses *in vivo*?
  → Other mode of action *in vivo*?

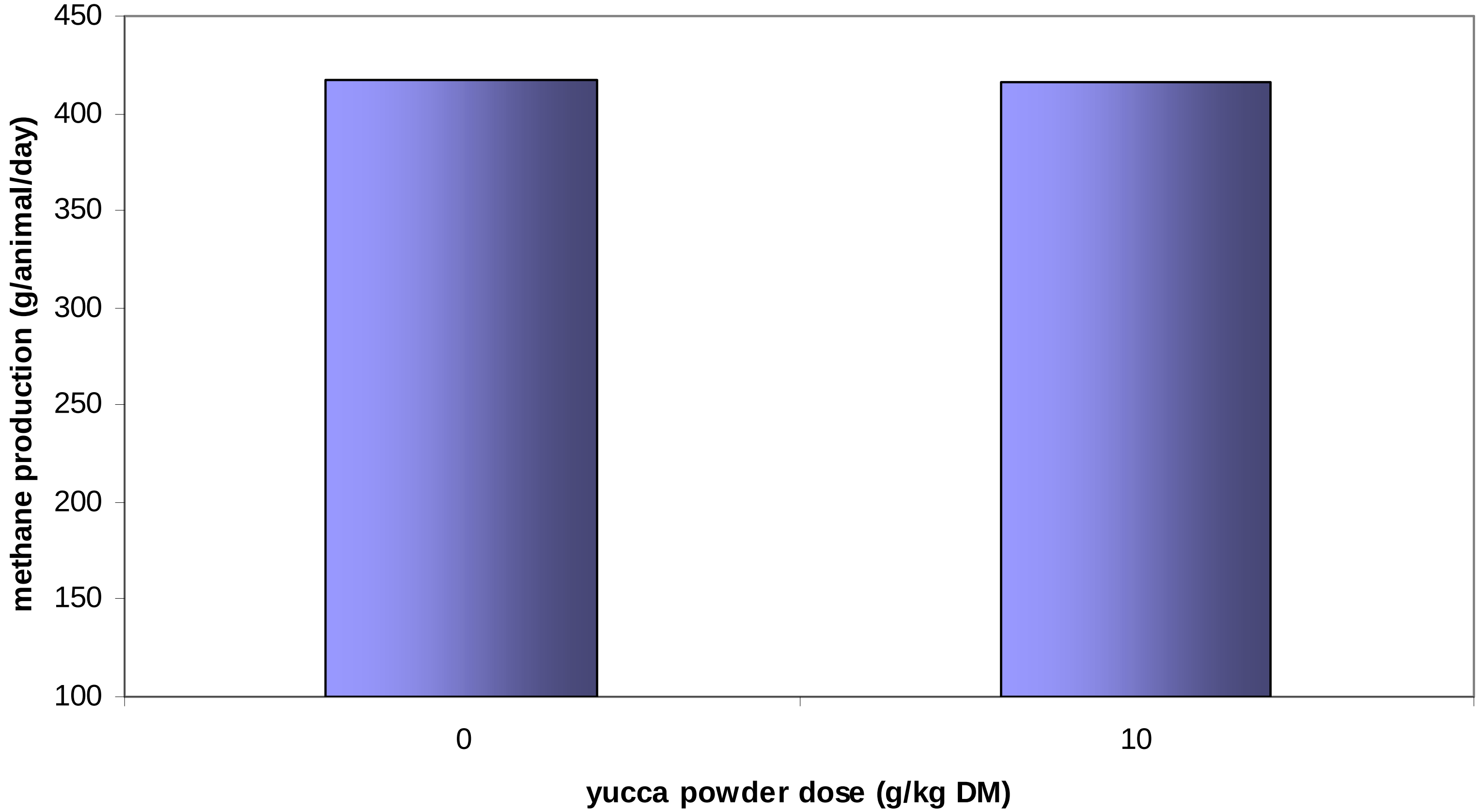
Diallyldisulfide and methane production



In vitro: Kamel et al., 2008

Saponins and Methane Production

Level in current study: 3.3 g/ kg DM



In vivo: Holtshausen et al., 2009

Conclusions

- Despite promising *in vitro* results, no *in vivo* reductions of methane

- Difficult to estimate proper concentrations of active compounds from *in vitro* studies

- *In vitro* data on methane reductions in ruminants should be carefully interpreted when extrapolated to the *in vivo* situation

Acknowledgements

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