



Department of Large Animal Sciences



A fast, reliable and cheap method to measure the methane production from animals

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Livestock and Methane

□ Livestock:

Ruminant livestock has been recognized as a major contributor to greenhouse gases (Steinfeld et al., 2006).

- About **80%** of all emissions from the agricultural sector and
- **35-40%** of the global anthropogenic emissions of methane

□ Methane:

The three major greenhouse gases are CO₂, CH₄ and nitrous oxide. Among these

- CH₄ has a positive radiative force on the climate
- the global warming potential of methane is **21-times that of CO₂ over 100 years** (UNFCCC, 2007),
- Energy loss through CH₄ is **2-15%** of their ingested energy (Giger-Reverdin and Sauvant 2000).

So it is important to reduce methane production from the rumen, because its associate with huge energy loss from animal as well as contributing to global warming

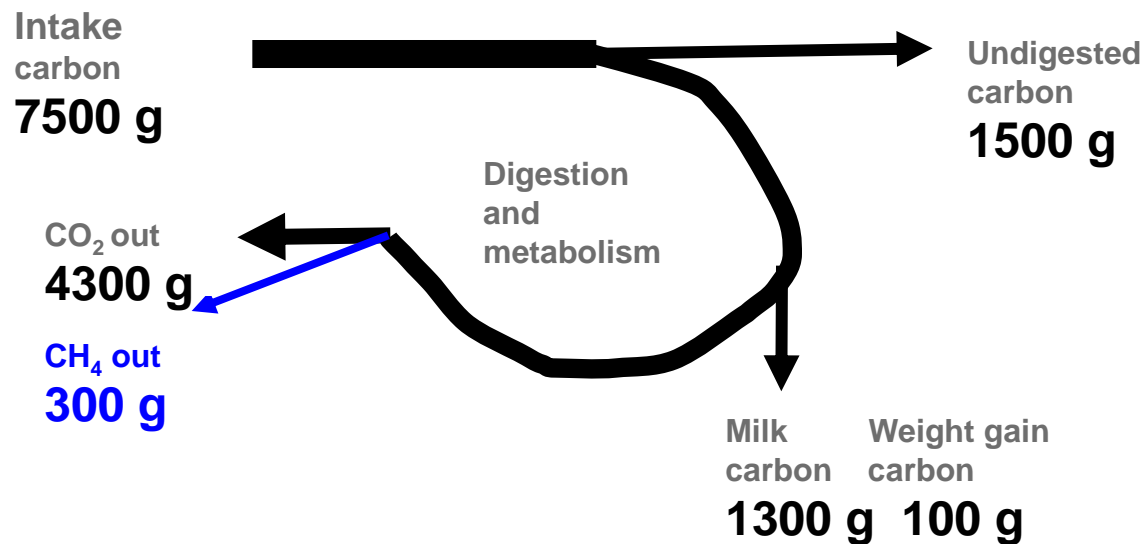


Example of a dairy cow:

Intake 18 kg dry matter/day

Production 20 kg milk/day

Weight gain 500 g/day



Methane production from various animals

Champ et al 1990, Jensen, 1996)

	<u>Weight, kg</u>	<u>CH₄, L/day</u>	<u>CH₄, L/kg^{0,75}</u>
Cow	700	600	4,41
Cow	500	230	2,18
Sheep	40	30	1,89
Elephant	1700	110	0,42
Hippopotamus	1000	70	0,39
Rheino	800	60	0,40
Horse	500	80	0,76
Donkey	250	40	0,64
Zebra	200	20	0,38
Pig	100	10	0,32
Man	50	2	0,11
Warthog	45	4	0,23
Wallabe	16	1,8	0,23
Goose	0,4	0,05	0,10
Rat	0,3	0,001	0,00



Environmental impact from livestock

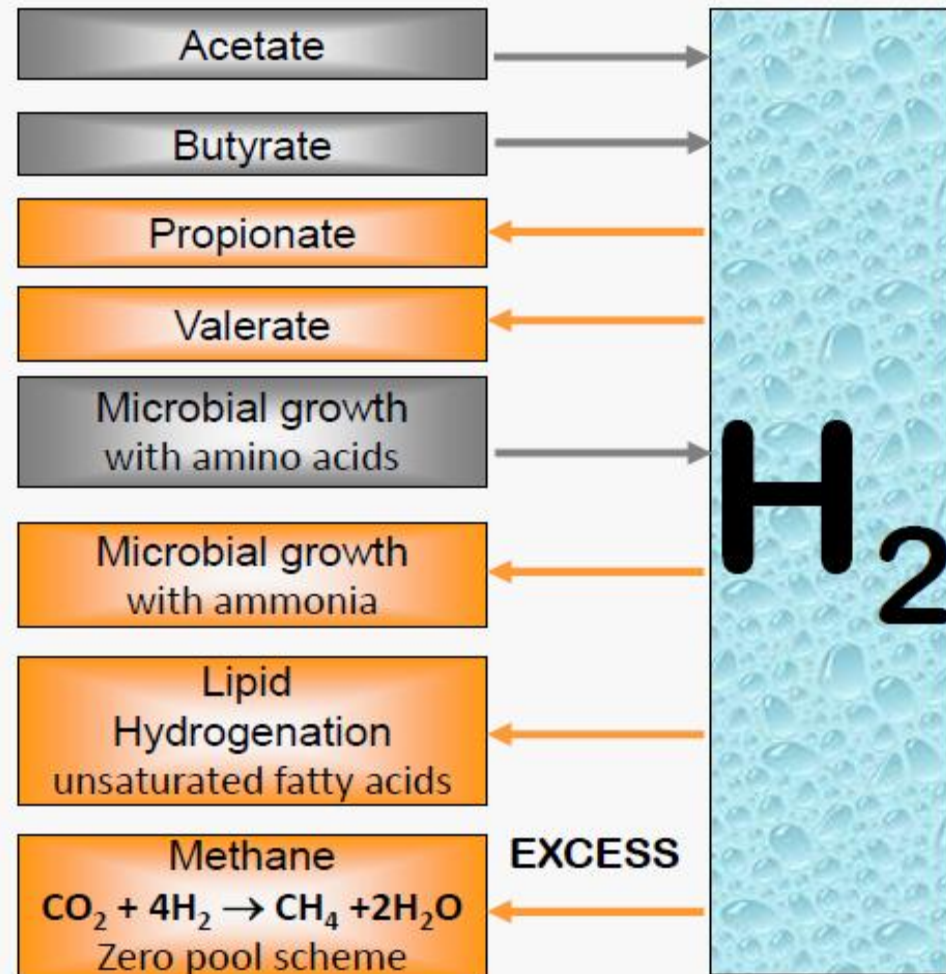
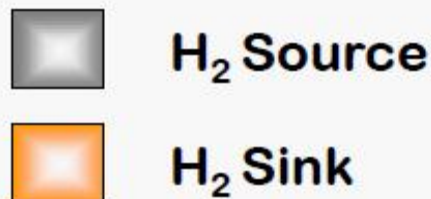
❖ Odour	Village
❖ Ammonia volatilisation	Regional
❖ Nitrate leaching	-
❖ Phosphorus loss	-
❖ Global warming	Global
❖ Methane	
❖ CO ₂ (Rain forest; Breath)	
❖ N ₂ O	
❖ Changed landscape	Regional
❖ Use of water	-
❖ Biodiversity	Global





Mechanism of Methane Production

- Rumen fermentation yields H_2
- Methanogenesis is a sink for H_2
 - CO_2 reduced to CH_4
- Fermentation also occurs in hind gut and in manure



Department of Life Animal Sciences

Methods for Measurement of CH₄



❖ In-vitro

❖ In-vivo:

➤ Respiration chambers measurements:

- can only be done on relatively few animals
- animals are not in their natural environment

➤ SF₆ measurements:

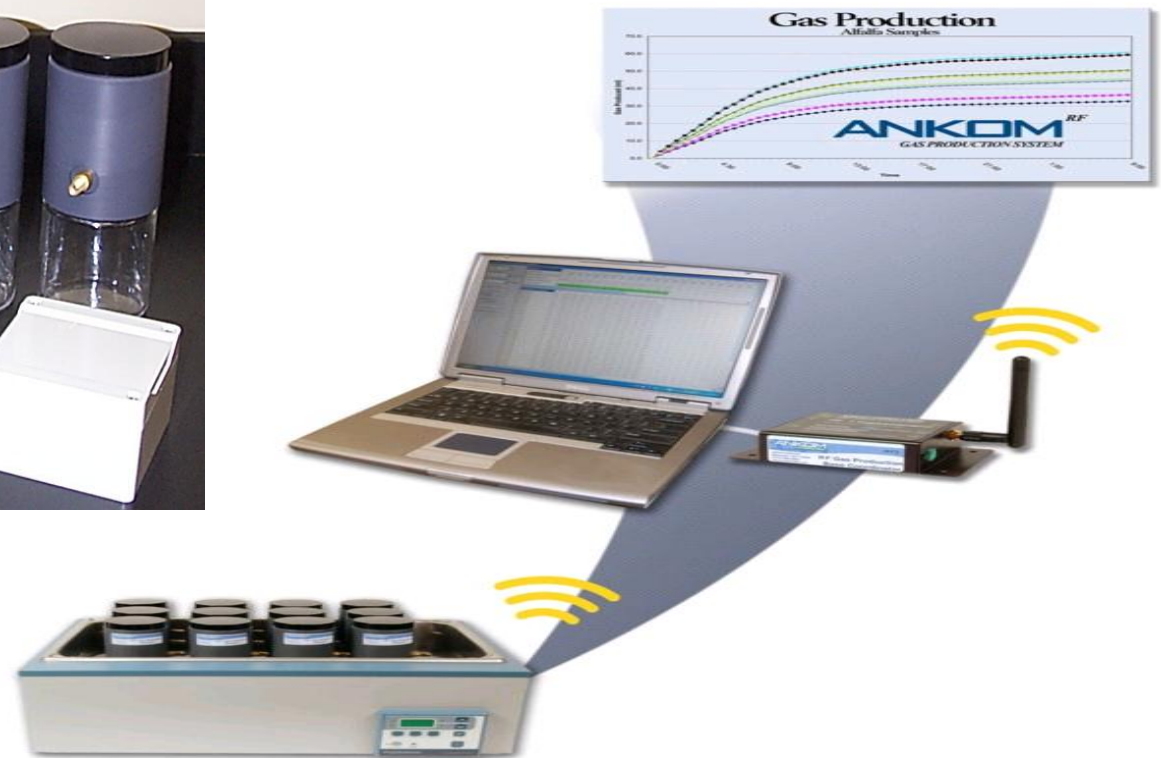
- are not very reliable
- SF₆ is a strong greenhouse gass

➤ Another option exist based on (Newly developed):

- CO₂ Method

In vitro methane production

Ida - gasproduktion



Respiration chamber



Madsen et al., ISEP 2010, Parma. A fast, easy and reliable method to measure the methane production from ruminants
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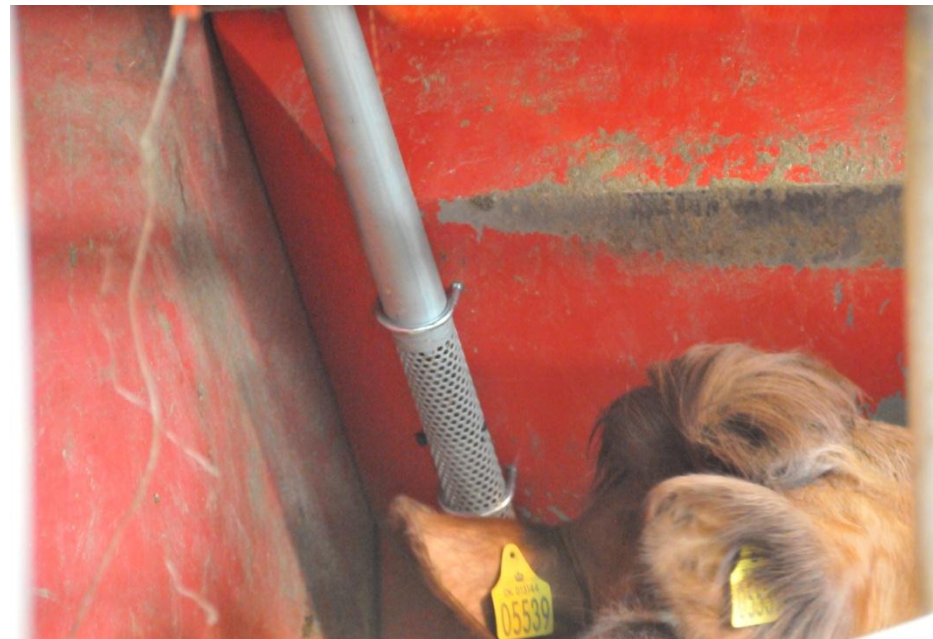




inants



Results from dairy cows



etho



Measuring the ratio between CH₄ and CO₂



Breath:

CO₂ = 30000 ppm

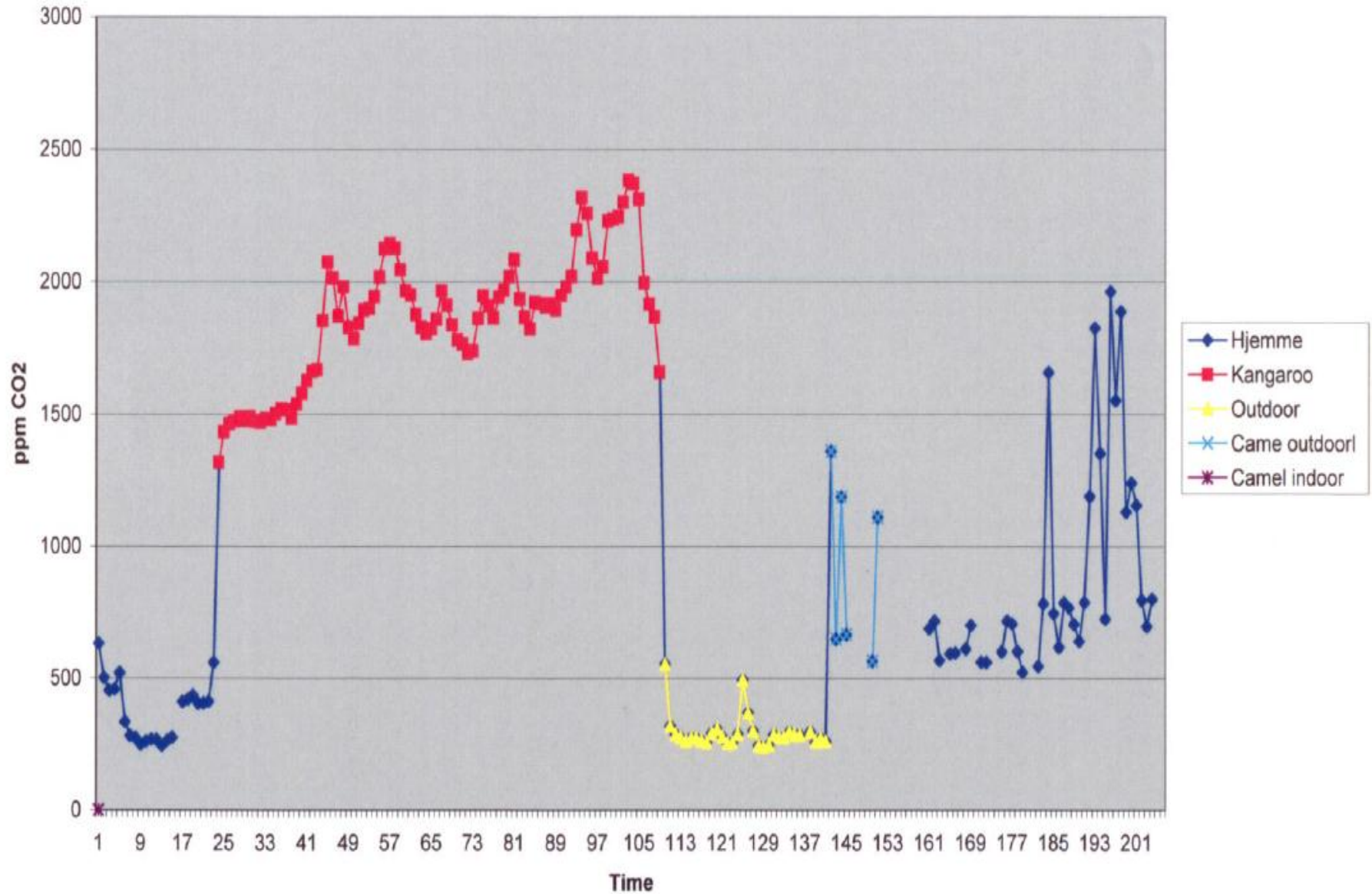
CH₄ = 2000 ppm

Air:

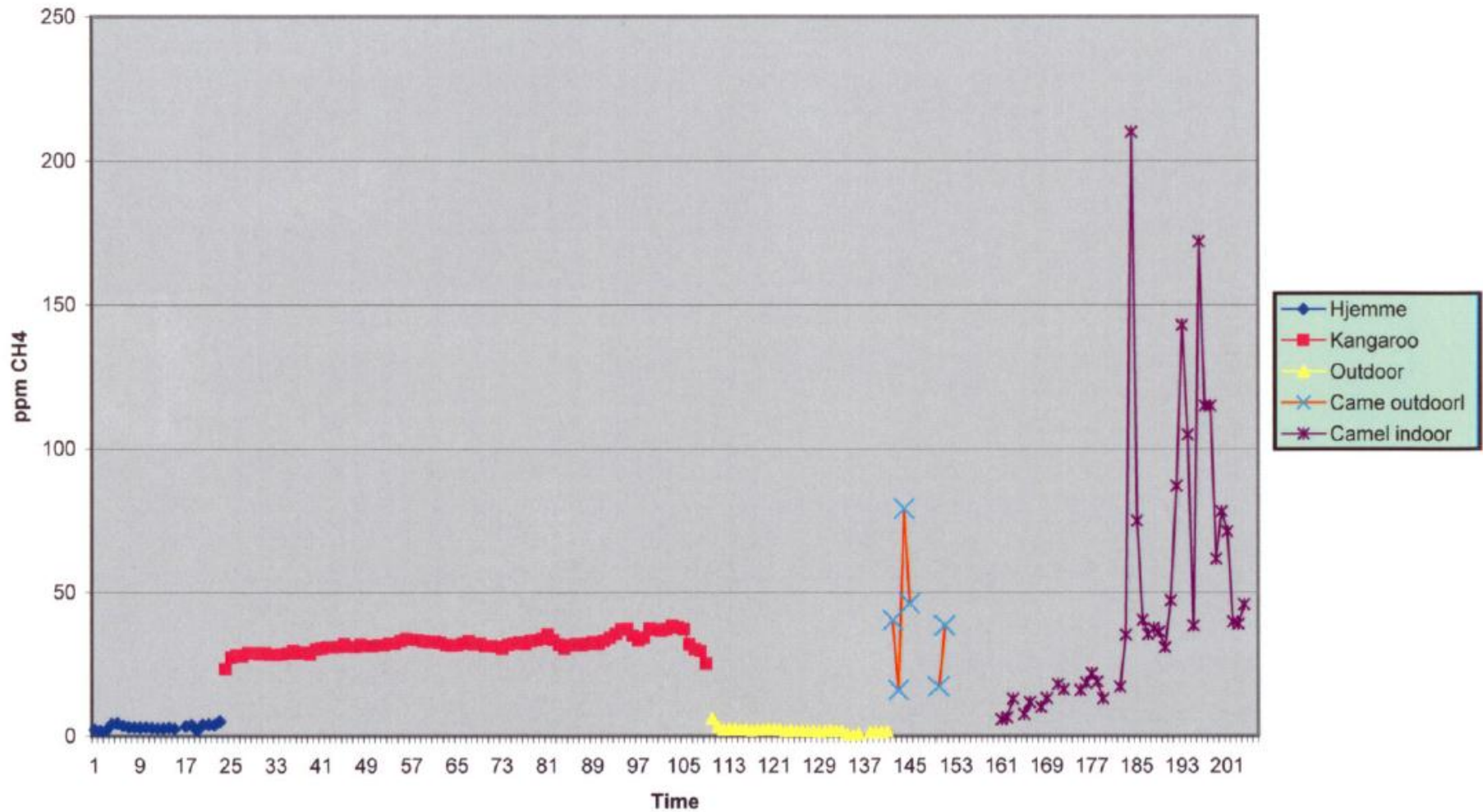
CO₂ = 380 ppm

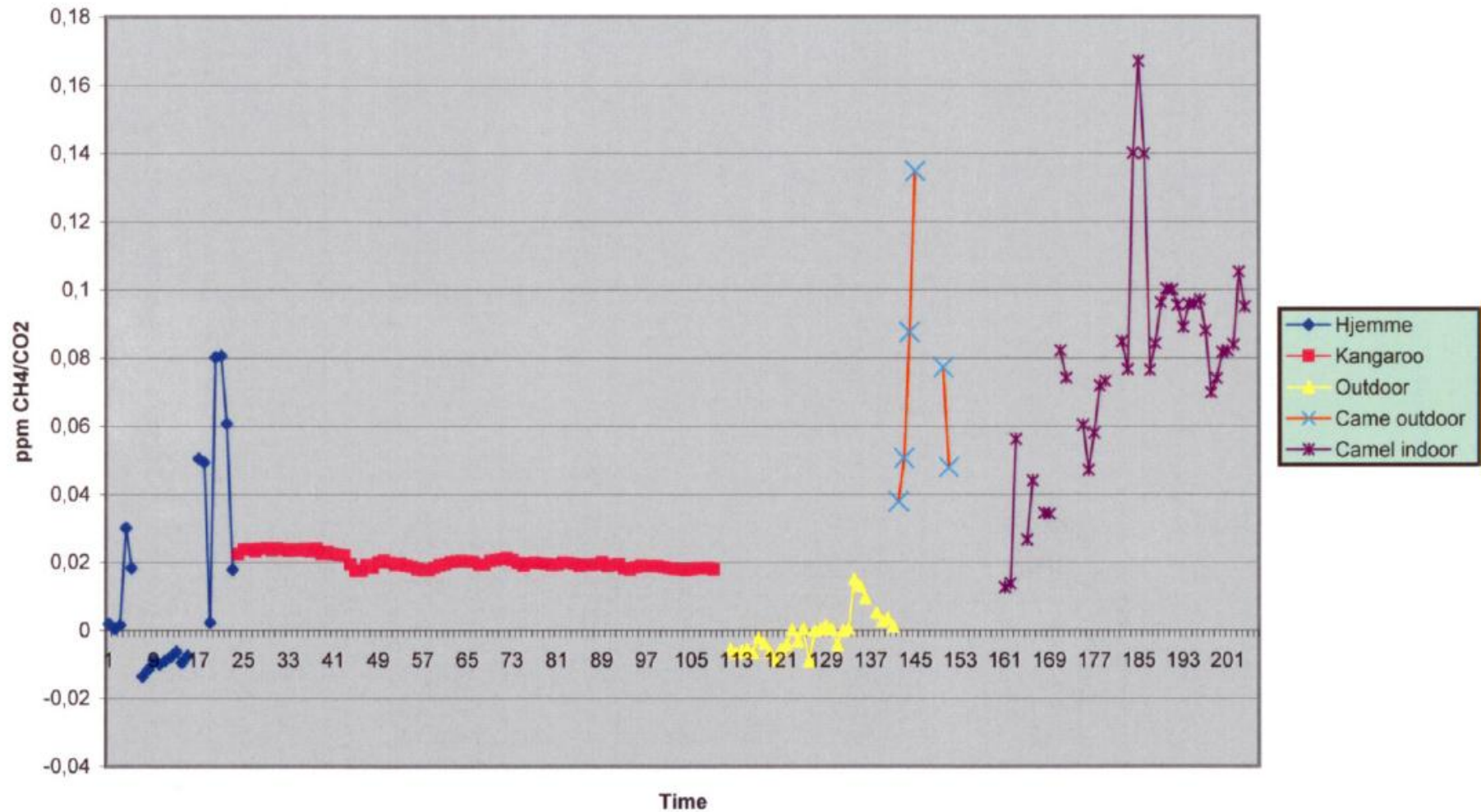
CH₄ = 1,8 ppm

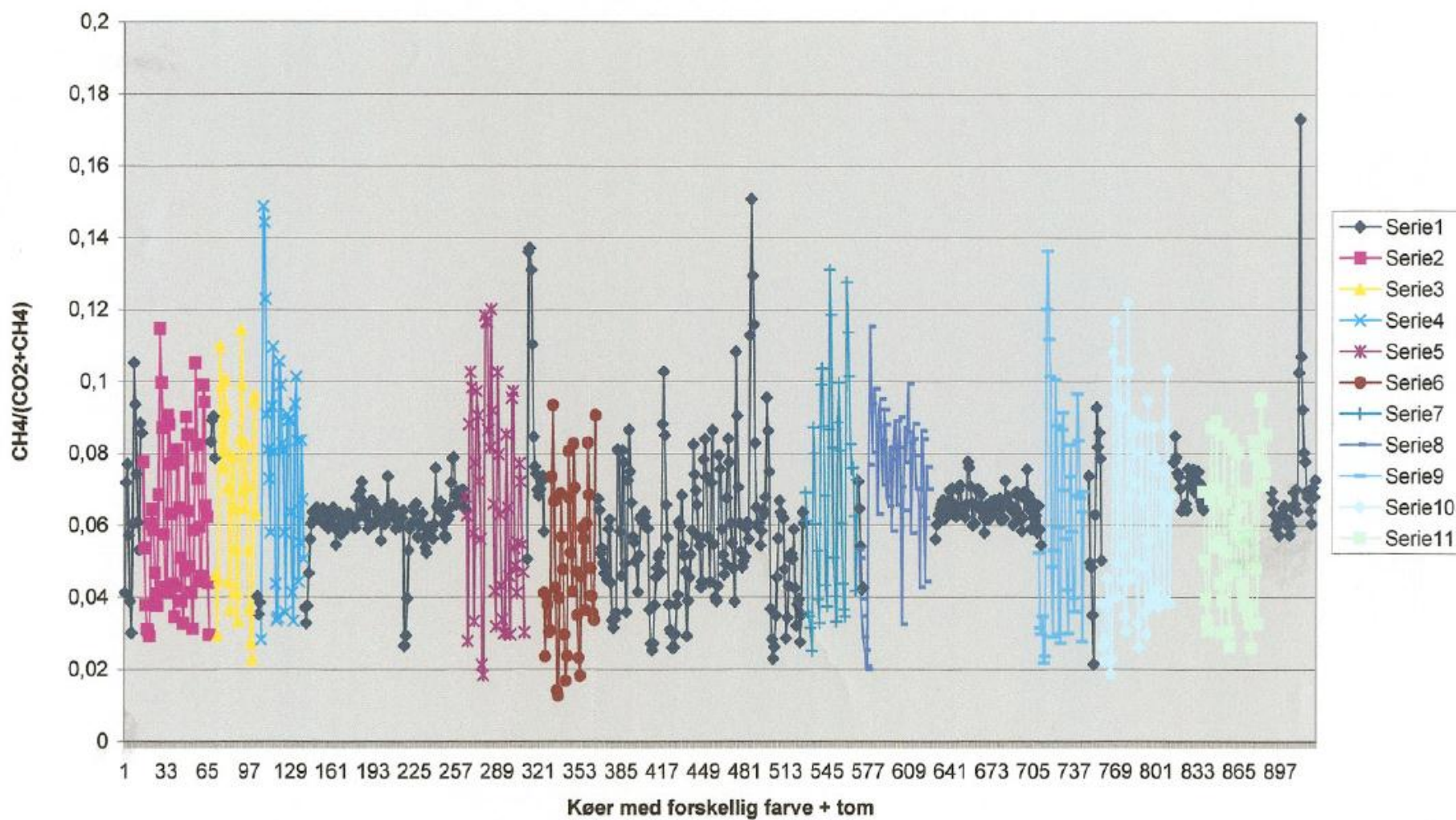




Private house, Kangaroo, Outside, Camels CH4



Private house, Kangaroo, Outside, Camels CH₄/CO₂

Enkeltkøer i AMS $\text{CH}_4/(\text{CO}_2+\text{CH}_4)$ 

Why fast and reliable method

- **Ability to take the measurement in every 5 second interval**
- **More precise result found (within 10 minutes of measurement) comparative to 24 hours measurement of respiration chamber**
- **Animals are in natural environments without hampering their normal activities**
- **Less energy labour and capital investment**



Methane measurements. – Literature and homepage

Literature:

[Madsen, J., Bjerg, B. S.](#), Hvelplund, T, Weisbjerg, M.R., Lund, P. 2010. [Methane and carbon dioxide ratio in excreted air for quantification of the methane production from ruminants.](#) Livestock Science. 129:223-227.

Madsen, J. & Bertelsen, M. F. 2011. Methane production by Bennet's wallabies (*Macropus rufogriseus*). J. Anim. Sci. (**Accepted**).

Bjarne Bjerg, B., Zhang, G., Madsen, J., Rom, H. B.. 2011. Methane emission from naturally ventilated livestock buildings can easily be determined from gas concentration measurements. (**Accepted**).

Lassen, J., Løvendahl, P. and Madsen, J. 2011. Experiences with large scale breath measurements in dairy cattle in order to select for lower methane production. J. Dairy Science. (**Accepted**).

Homepage:

<http://www.liveprod.clife.ku.dk/Methane%20measurements.aspx>



Thanks

