Proxies for methane output in dairy cattle: evaluation of suitability as indirect traits for breeding goal

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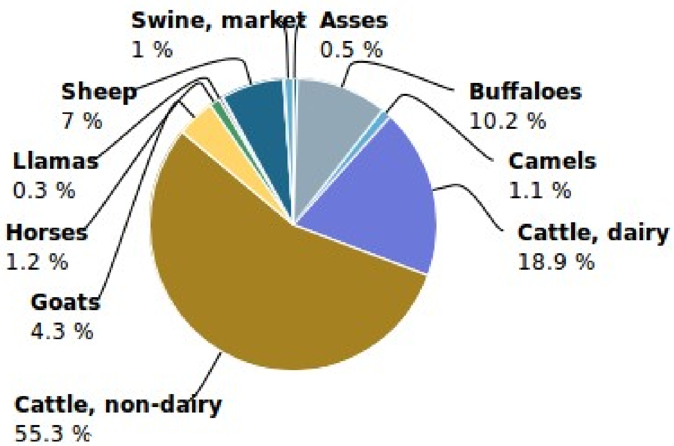
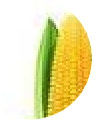
Why methane?

CH_4

GHG

→ (anthropogenic) climate change





Feed efficiency

Strong relationship between CH_4 and feed intake

Emerging phenotype

- **Environmental sustainability**
- **Farm efficiency**

Mitigation strategies

diet
e.g. < fibres, > starch (van Gastelen et al., 2015)

probiotics
e.g. yeasts

supplements
e.g. ionophore antibiotics, tannins, saponins

defaunation
i.e. elimination of protozoa

immunization
e.g. against methanogenic *Archaea*

breeding
cumulative and permanent results

reviewd by Martin et al., 2010

The breeding option

- **direct selection** against methane emissions
- **ruminal CH_4** to be measured on individual animals
- e.g. **respiration chambers,** GreenFeed
- cumulative, sustainable, long-term, least-cost strategy

methane emissions shown to be **heritable**

heritability estimates: e.g. **h^2 ~ 0.20** in beef cattle (Donoghue et al. 2013)

However

- **Direct measurement** of methane output is **expensive**, **time-consuming** and **labor intensive**
- Not really applicable on a large scale and routine basis (required for a breeding programme)

↓

finding **alternative measures** that are **related** to **methane** production/emission and can be **feasibly collected** on a **large scale** and **routine** basis

need for **proxies**

Proxies are traits/measurements that “approximate” individual methane output, and have desirable characteristics (cheap, easy to measure, robust ...)

Methane production in the rumen is related to many biological processes:

- **Feed intake**
- **Body weight**
- **Rumination**
- **Milk yield**
- **Milk composition**
- etc ....

Borrowing from a “minor” guitarist: this is the quest for our **“proxy” lady**

Types of proxies

proxy	easy	accuracy	cost	invasive	throughput
Milk MIR	***	high	low	no	high
Rumen fatty acids	*	moderate	high	limited	moderate
Rumen volume / sonogram	**	?	moderate	no	limited
Feed intake / efficiency	**	very high	high	no	moderate
Body weight / milk yield	*****	moderate	low	no	moderate
Rumen activity (sensors)	****	moderate	moderate	no	huge
Laser methane detector	****	controversial	high	no	high

A couple of illustrations

rumen sensors

(rumination tag)

measure rumination activity (time) and movement of the animals

rumination activity has been associated to **metabolism** (e.g. blood glucose, proteins, ...) and **DMI**
[Soriani et al., JAS 2012]

→ probably **related** also to **methane** emissions!

A couple of illustrations

predicting equations

e.g.

- from **DMI** [de Haas et al., 2011]
- from **combination of traits** (production, body weight, DMI, ruminal liquor parameters etc …) [Biscarini, unpublished]

	Model 1	Model 2	Model 3
correlation	**0.566**	**0.626**	**0.786**
std dev	0.124	0.118	0.056

future **perspectives**

Systematic review of possible proxies for CH4: pros and cons, suitability for breeding

This work is being carried on within two European projects:

- Ruminomics (FP7)
- Methagene (COST action)

An FP7 financed Project
RUMINOMICS

METHAGENE

Meta-analysis of results from literature/other studies

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Thanks!

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