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Role of the nature of forages on methane emission in cattle

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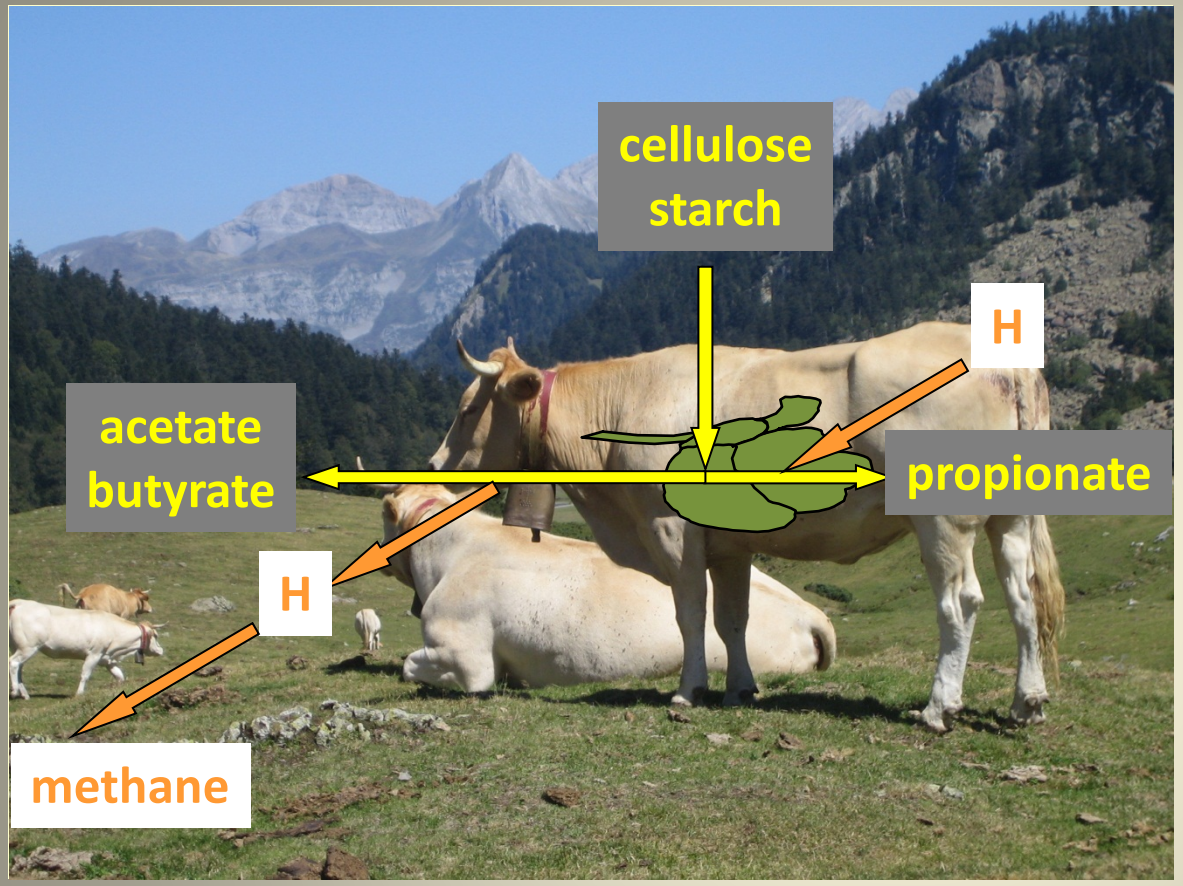
Forages and methane emission : what is known



Methane emission is related to VFA production and pattern

(acetate + butyrate) / propionate

↓

1 kg forage produces more methane than 1 kg concentrate

↓

1 kg maize silage should produce less methane than 1 kg grass

Differences between forages mainly depend on VFA production (i.e. on CHO degradation)

For a same VFA production, differences between green forages are moderate because differences in VFA pattern are low

Forages and methane emission : prediction

Numerous models to predict methane emission per kg dry matter for a range of diets:

Empiric equations

- **With chemical composition**
- **With milk production**
- **With feed intake**

Mechanistic models

Mainly mixed diets, including high-concentrate diets

A meta-analysis with forages alone (Archimède et al., 2011)

Few differences between grasses and legumes (except tannin-rich legumes)

More methane per kg dry matter with tropical forages (C4 vs C3 metabolism)

Questions

Does methane emission vary between diets differing in basal forage ?

→ Methane determination for diets given to productive animals (dairy cows, fattening bulls, etc)

Trial 1 – Dairy cows	Hay or maize silage in lipid-supplemented diets
Trial 2 – Dairy cows	Grass silage or maize silage in diets differing in protein source
Trial 3 – Young bulls	Hay or maize silage in finishing diets

Are differences in methane expandable to other GHG ?

→ LCA for evaluating the differences between forages in manure methane, nitrous oxide and carbon dioxide

Trial 3 – Young bulls	Hay or maize silage in finishing diets LCA for fattening phase

Trials 1 and 2 : design and methods

Trial 1

2 groups of 4 Holstein cows, each in a 4x4 Latin square design

Group 1 : 50 % hay, 50 % concentrates containing 0, 2, 4, 6% lipids
Group 2 : 60 % maize silage, 35 % concentrates containing 0, 2, 4, 6% lipids

Lipid source : extruded linseeds

Trial 2

8 Holstein cows in a 4x4 Latin square factorial design

Forage : 45% maize silage or 45% grass silage
Protein source : soybean meal or dehydrated lucerne

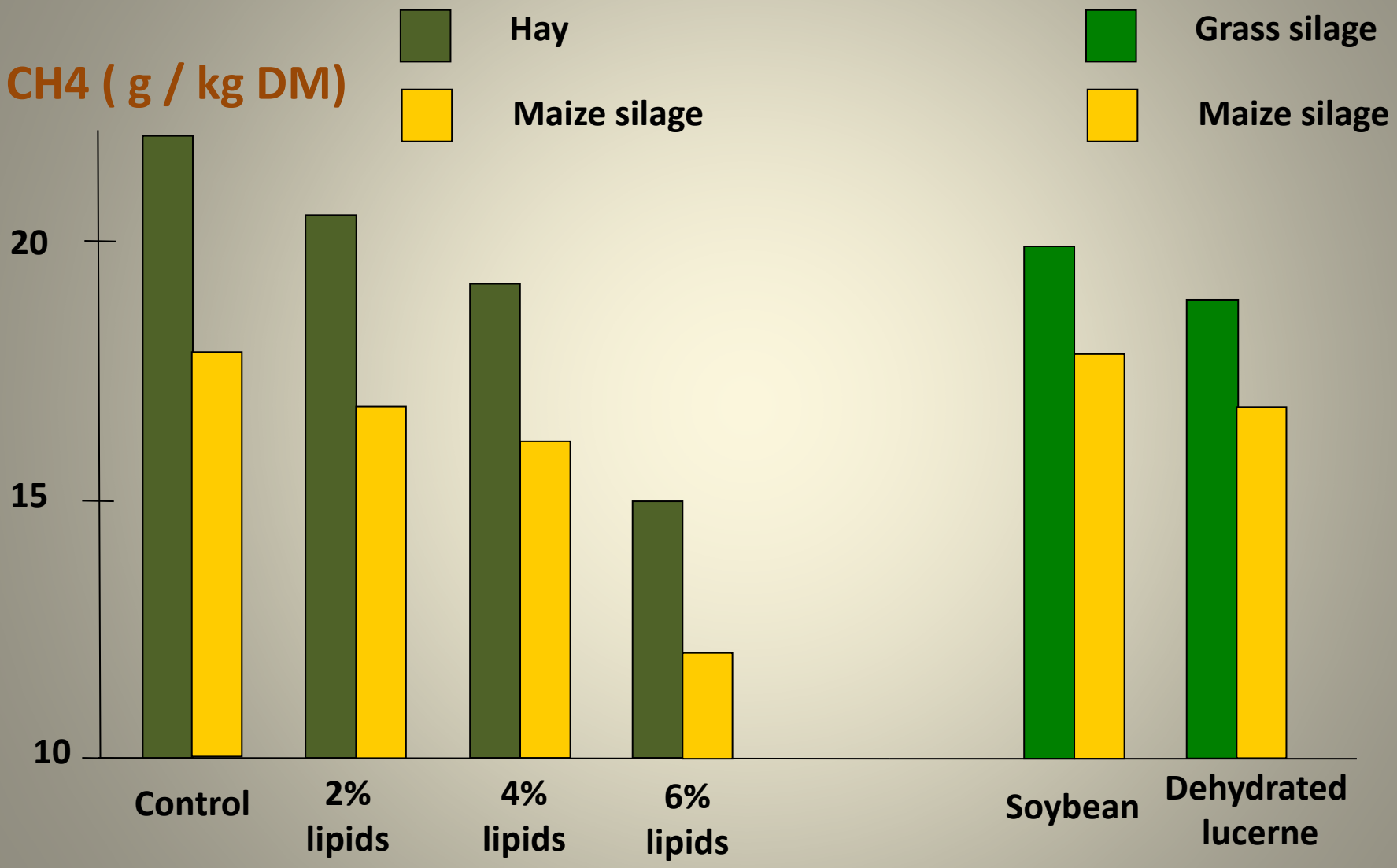
In both trials

Cows fed according to their requirements

Methane determination : SF6 method

Trials 1 : results

Trial 2 : results



Martin et al, 2009 and unpublished

Doreau et al, 2012 and unpublished

Trial 3 : design and methods

Blond d'Aquitaine bulls fattened from 9 to 17 months

Diet H : 45 % hay, 55 % concentrates (maize grain + soybean meal)
Diet MS: 60% maize silage, 40% concentrates (maize grain + soybean meal)

Both diets meet energy and protein requirements

Methane measurements using the SF6 technique with 6 bulls

LCA for the fattening phase from cradle to farm gate using performance data obtained with 8 bulls per treatment and data for feed production available for France

Trial 3 : results

g CH4 / kg DM	Maize silage	Hay
Enteric methane	22.6	20.2

Not in line with trials 1 and 2 in dairy cows , but similar to

Chung et al (2011) in dry cows and Staerfl et al (2012) in bulls

Trial 3 : results

kg CO2-eq / kg weight gain	Maize silage	Hay
Enteric methane	2.23	2.23
Manure methane	0.90	1.16
Nitrous oxide	0.85	0.80
Carbon dioxide	0.73	0.92
Total Global Warming	4.74	5.16
Including C storage in soil	4.74	3.65 – 4.56

Doreau et al, 2011

Eutrophication	higher	lower
Acidification	higher	lower
Energy demand	lower	higher
Land occupation	lower	higher

Nguyen et al, 2012

Conclusions

- **Present knowledge does not provide evidence for a lower methane emission with maize silage in any case**
- **Need for additional research with diets differing in basal forage**
- **Interest of a global approach for all GHG (at least)**