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Effect of linseed plus nitrate on methane emission in bulls, animal health and residues in offal

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Experiment granted by :



Background



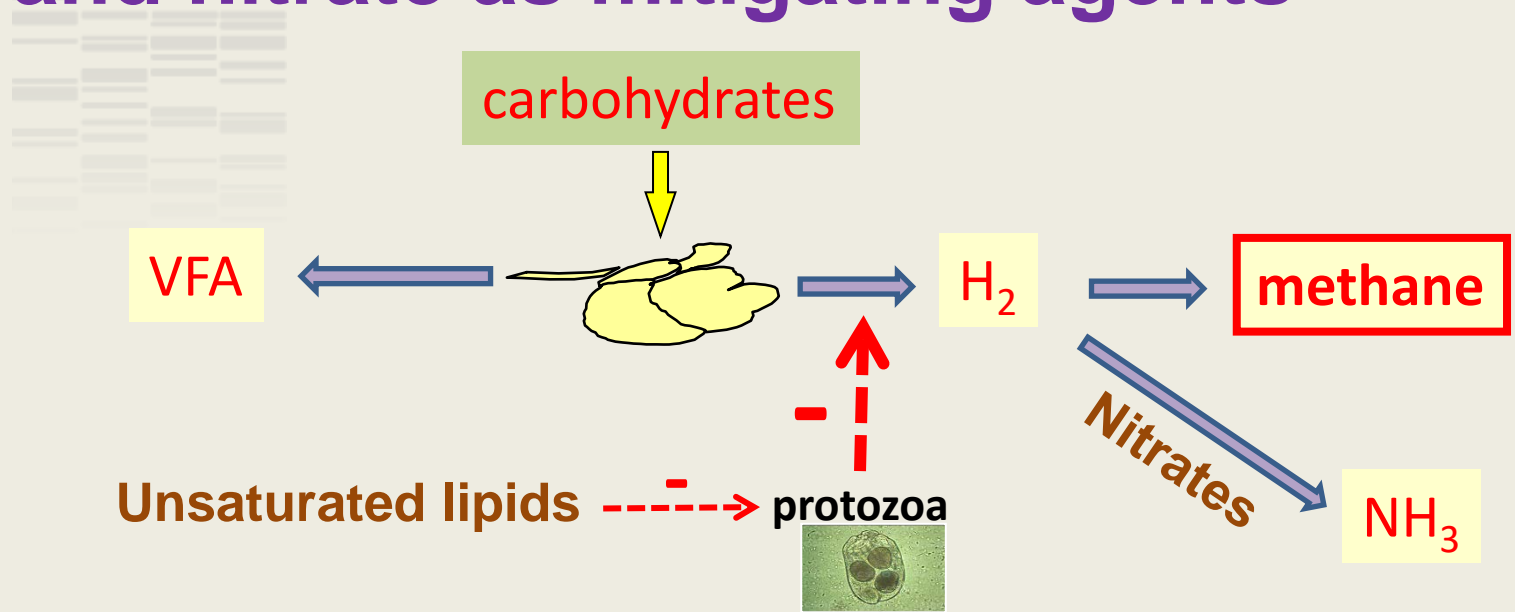
Livestock sector accounts for 14.5% of anthropogenic greenhouse gases (GHG) emissions, and methane (CH₄) represents 39% of these emissions (FAO, 2013)

Among dietary ways to decrease enteric methane, unsaturated lipids and nitrate as additive have proven to be efficient

(Martin et al., 2010, Animal, Hristov et al., 2013, J. Anim. Sci., Lee and Beauchemin, 2014, Can. J. Anim. Sci.)

Their use is possible to a large scale in farm conditions, leading to a significant abatement in CH₄ emissions while maintaining production and without adverse effects on other environmental issues (Doreau et al., 2014, Anim. Prod. Sci.)

Lipids and nitrate as mitigating agents



Unsaturated lipids : linseed

- + Among the most efficient ways
- May improve product quality (omega-3)

- Fails sometimes to reduce methane
- Expensive

Nitrates

- + Efficient in most experiments
- (dietary fermentable N to be controlled)

- Risk of nitrite toxicity for animals (methaemoglobinaemia)
- Possible residues in products

Objectives

Moderate mitigation to limit toxicity (nitrates) and cost (lipids)

Target : 10% decrease in methane (g/kg dry matter intake)

Association between lipids and nitrates

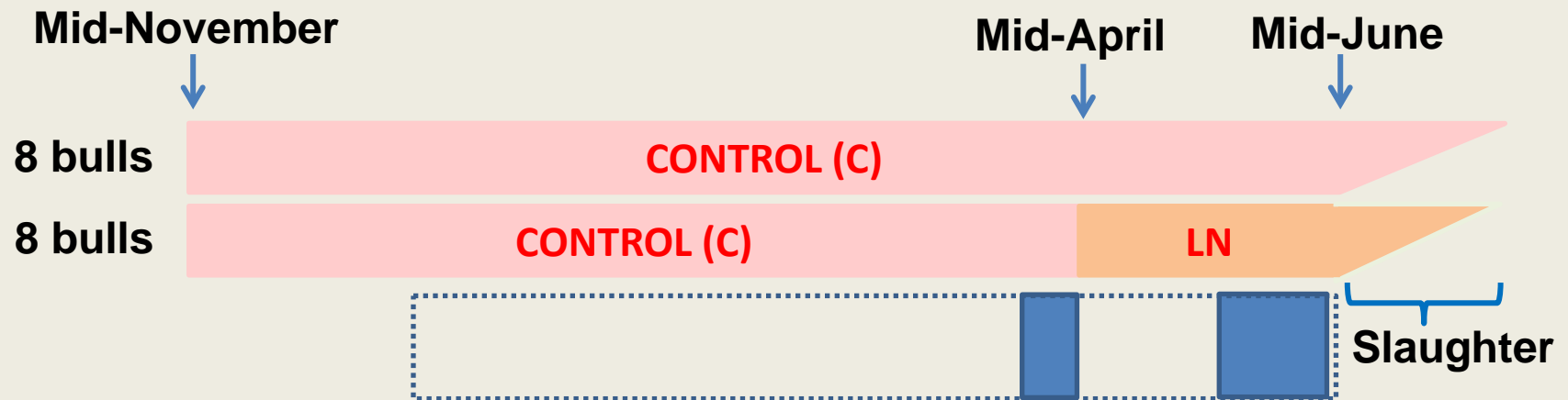
Proven to be synergistic in dairy cows (Guyader et al., 2015, J. Anim. Sci.)

Not yet studied for bull fattening

**➔ 16 Charolais young bulls
slaughtered at 600 kg liveweight (17 months)**

**➔ 67% haylage – 33% concentrates ad libitum
Control (C) vs Linseed + Nitrate (LN)
+ 1.9% FA from linseed and 1% nitrate in the diet**

Experimental design and measurements



- Intake and liveweight gain
- Methane (Greenfeed technique)
- Methaemoglobinaemia (spectrophotometry)
- Nitrite and nitrate in tongue, rumen and liver (colorimetry)

Methane measurement technique

Greenfeed (C-lock, USA) evaluated beforehand

(Arbre et al., 2016, Anim. Prod. Sci. and abstract in this meeting :

poster 54-08 - abstract p. 487)



1 device for 2 diets :

- only C concentrate in the Greenfeed for both diets
- expected linseed and nitrate concentrations in the diet achieved by giving in the trough a second concentrate rich in linseed and nitrate

Intake and performance

	C	LN	P
DM intake	11.5	10.6	0.08
Liveweight gain (g/d)	1596	1256	0.01

- **Trend to a lower intake for LN diet due to refusals of LN concentrate resulting in a higher proportion of forages observed in a previous trial in dairy cows (Guyader et al., 2016, Animal)**
- **Negative consequence on liveweight gain**

Methane emission

	C	LN	P
Methane (g/d)	271	239	<0.01
Methane (g/kg DMI)	24.0	23.2	0.34
Methane (g/kg LWG)	172	200	0.18


- **No direct effect of LN on CH₄ (g/kg DMI)**
- **Lipid and nitrate supply are probably too low for a significant decrease in methane in our experimental conditions (8 bulls per diet)**

Methaemoglobinemia

C diet: non detectable (ND) i.e. < 2 % of total Hb

LN diet: see Table below

Adaptation



Animal	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Wk 13
1	ND	ND	ND	ND	ND	ND	ND	ND	ND				
2	ND	ND	ND	ND	ND	ND	ND	ND	ND				
3	ND	ND	ND	2.33	4.21	5.56	ND	ND	3.60				
4	ND	ND	ND	ND	ND	ND	2.23	ND	ND				
5	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.71			
6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
8	2.72	ND	ND	ND	ND	ND	4.40	ND	ND	ND	ND	ND	ND

- Always lower than risk threshold (30-40 %, Lee and Beauchemin, 2014)
- Does not depend on time since first distribution

Residues in offal

Nitrate and nitrite concentration (mg/kg fresh tissue)

	C	LN	P
Tongue			
Nitrate	3.65	5.40	0.21
Nitrite	1.54	1.67	0.73
Liver			
Nitrate	4.87	4.21	0.69
Nitrite	1.42	1.58	0.65

➤ **No residues in offal**

Already observed in milk and dairy products (Guyader et al., 2016, Animal)

Concluding remarks

- ➔ **Non-significant mitigating effect (- 4%) for CH₄/kg DMI when moderate supply of linseed and nitrate is given**
- ➔ **Results for methane emission to be explained (or not) by microbial ecosystem sampled at slaughter (Popova et al., in progress)**
- ➔ **Results for metHb and residues are encouraging in well-monitored conditions of nitrate distribution**

