BovINE Webinar

How can enteric emissions be reduced in beef cattle production?

14th June 2021

This project has received funding from the European Union's Horizon 2020 rural renaissance programme | Project No: 862590 under call H2020-RUR-2019-1

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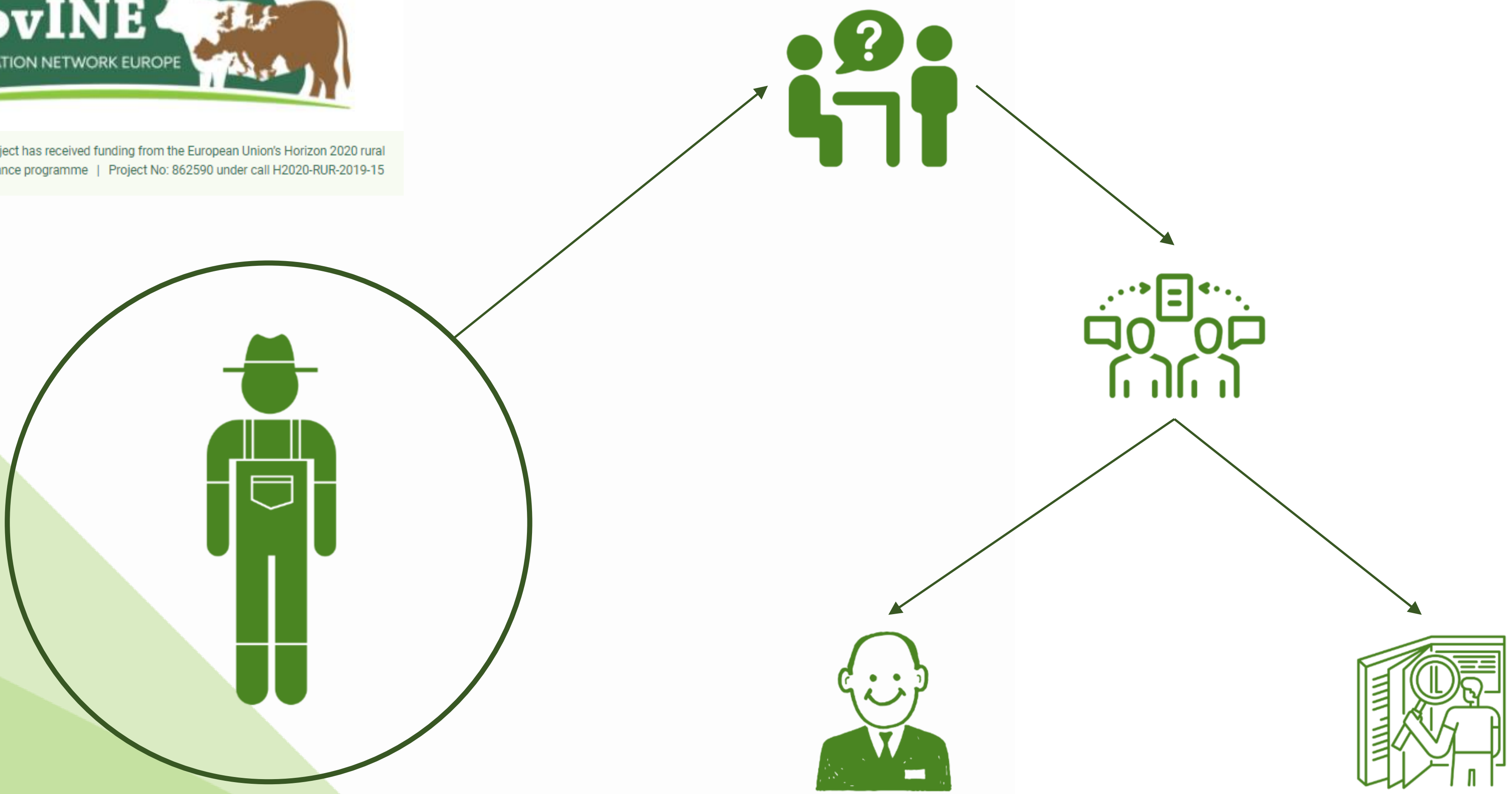

NETWORK MANAGER
Good practices per topic
Link to the practice

WP LEADER
Research innovations
Literature, thematic working group

Socioeconomic Resilience

- Initiatives to improve the image of and promote sustainable consumption of beef
- Examining economically efficient housing systems for beef cattle

Animal Health & Welfare

- Simple labour-saving tools to measure and communicate high animal welfare standards on beef farms
- Management, housing and environmental factors which affect animal welfare in rearing and finishing units

Production Efficiency & Meat Quality

- Animal feeding and stress on meat quality
- Optimizing the number of calves per cow per year in suckler beef herds

Environmental Sustainability

- Need to identify how best to reward farmers for environmental deliverables
- Carbon sequestration

Bovine Knowledge hub
BovINE website
Webinars
Seminars
National meetings
Transnational meetings
Newsflashes
Local magazines
…

Agenda

BovINE Webinar

How is enteric CH4 produced and what are emissions related to beef?
Riet Desmet, ILVO

Mitigation strategies to reduce CH4 emissions

How can fats and oils reduce enteric CH4 emissions
Joni Van Mullen, ILVO

What types of additives do exist
Gemma Miller, SRUC

How can a better youngstock management mitigate CH4 emissions
Karen Goossens, ILVO

Closing words
Marie Saville, Minerva

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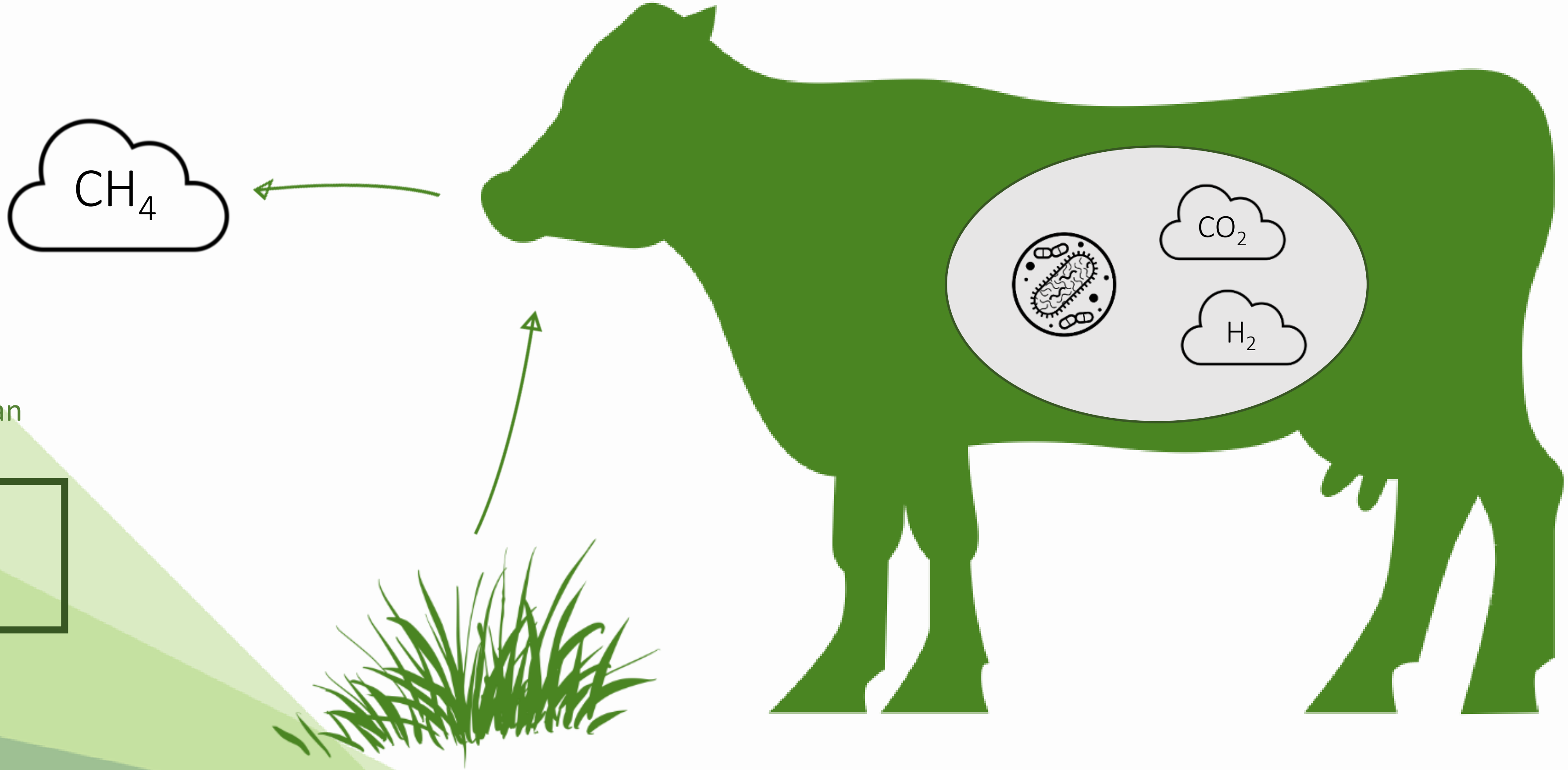
How are enteric CH_4 emissions produced?



Average for an adult cow

200-500 g/day

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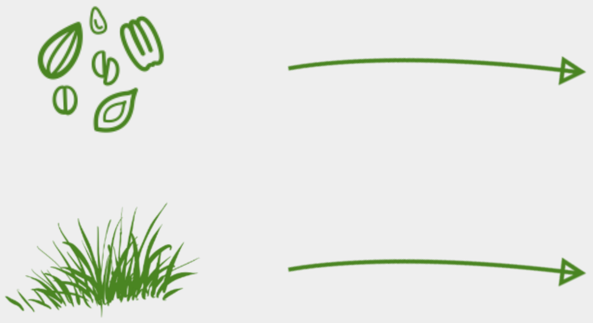
How are enteric CH_4 emissions produced?

Volatile fatty acids



Propionate
Consumes H+

Acetate, butyrate
Promotes H+

Rumen level

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Emissions in beef production systems

General

GHG: 14-32kg CO_2-eq (per kg edible beef)

→ differences due to different systems (or different methods)

- Origin calves
- Type of production system
- Type of feed diet
- Grazing

Devries *et al.* 2015

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Emissions in beef production systems

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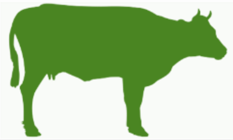
Origin calves



Lower GWP, acidification/eutrophication, lower E use and land use	Beef cow is dominant contributor - low reproductive rate All emissions allocated to beef In dairy based: impact attributed to milk

Better to use beef cows for crossbred calves from dairy or dualpurpose
→ grow better (lower GWP) and better quality (consumer)

Devries *et al.* 2015

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Emissions in beef production systems

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Type of production method

Organic vs conventional

GWP slightly lower in **organic systems**

Lower fertiliser use Lower concentrate use Lower E use	Higher CH_4 emissions Higher acidification

Devries *et al.* 2015

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Emissions in beef production systems

Type of feed

Concentrate based systems (>50% conc.)

GWP lower due to lower CH4 emissions

- higher growth rate of calves on

Contain more products edible for humans

Roughage based systems (<50% conc.)

Higher GWP

Longer finishing time and lower finishing weight

High productive grasslands (fertiliser)

Low productive grassland (lower animal growth and reproduction)

- GWP

Devries *et al.* 2015

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Emissions in beef production systems

Grazing

- Grazing: higher enteric CH4 production
- Eg. tropical forage types more CH4
- Spring grazing lower CH4 emissions

Deramos *et al*. 2003

Rotational grazing

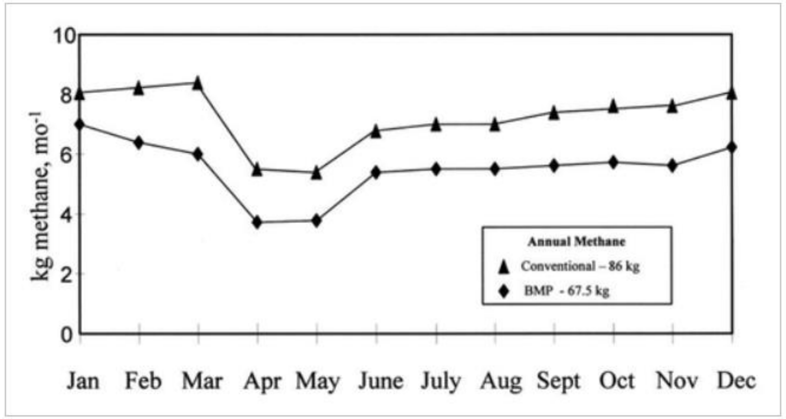

Figure 2 Open in figure viewer

Monthly methane emission projections in beef cows on best management practices (BMP) and conventional forage management systems.

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Emissions in beef production systems

Conclusions

- Dairy-based systems lower impact
- Similar impact organic vs conventional
- Concentrate based systems lower GWP
- Amount of studies is limited

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Mitigation strategies for enteric CH_4 in beef

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BEEF INNOVATION NETWORK EUROPE
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Feed		Management	
ADDITIVES • Tannins • Chemical additves (nitrate) • Synthetic additives (3-NOP) • Essential oils • Plant extracts	FEED INGREDIENTS • Seaweed • Fat-rich feed ingredients • Whole plants rich in …	GENETICS	YOUNGSTOCK
		GRAZING	PRODUCTION SYSTEM

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How can fats and essential oils reduce enteric methane emissions?

Bovine webinar
Joni Van Mullem
14 June 2021

ILVO

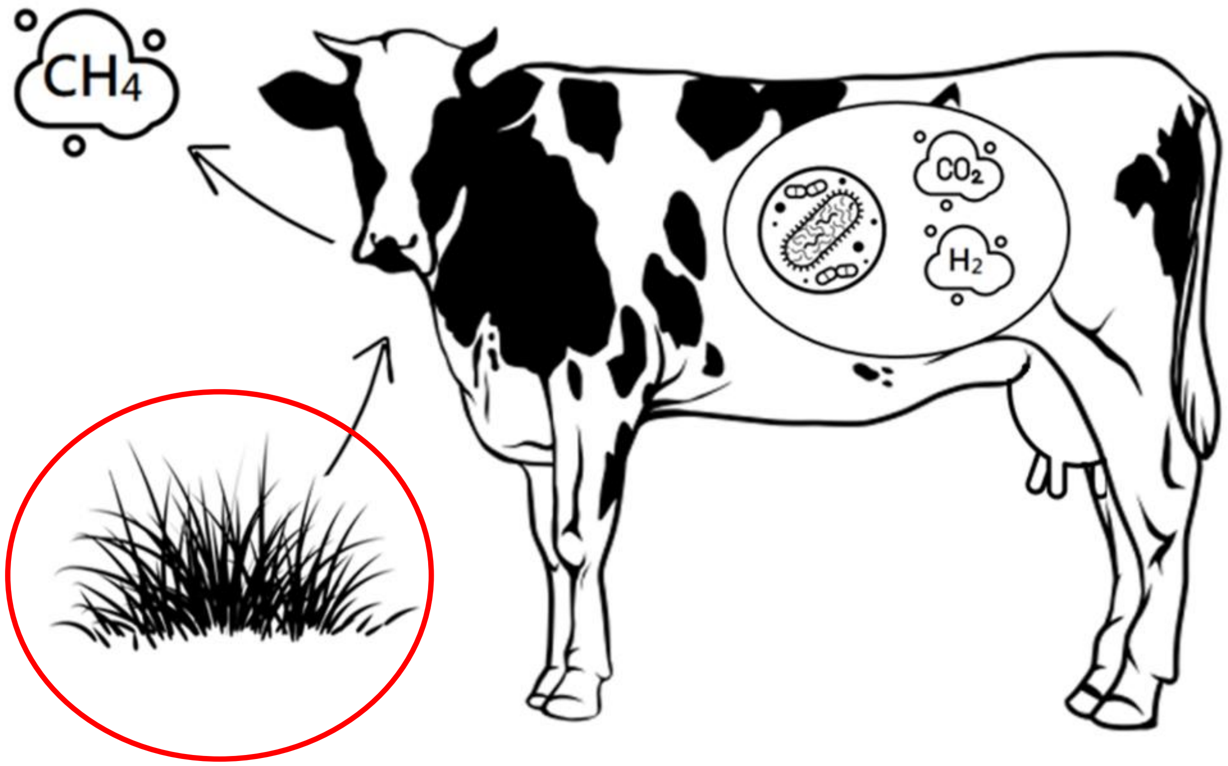
Dietary fats in cattle diets

ENERGY

METHANE PRODUCTION

How does the inclusion of fats reduce enteric CH_4 emissions?

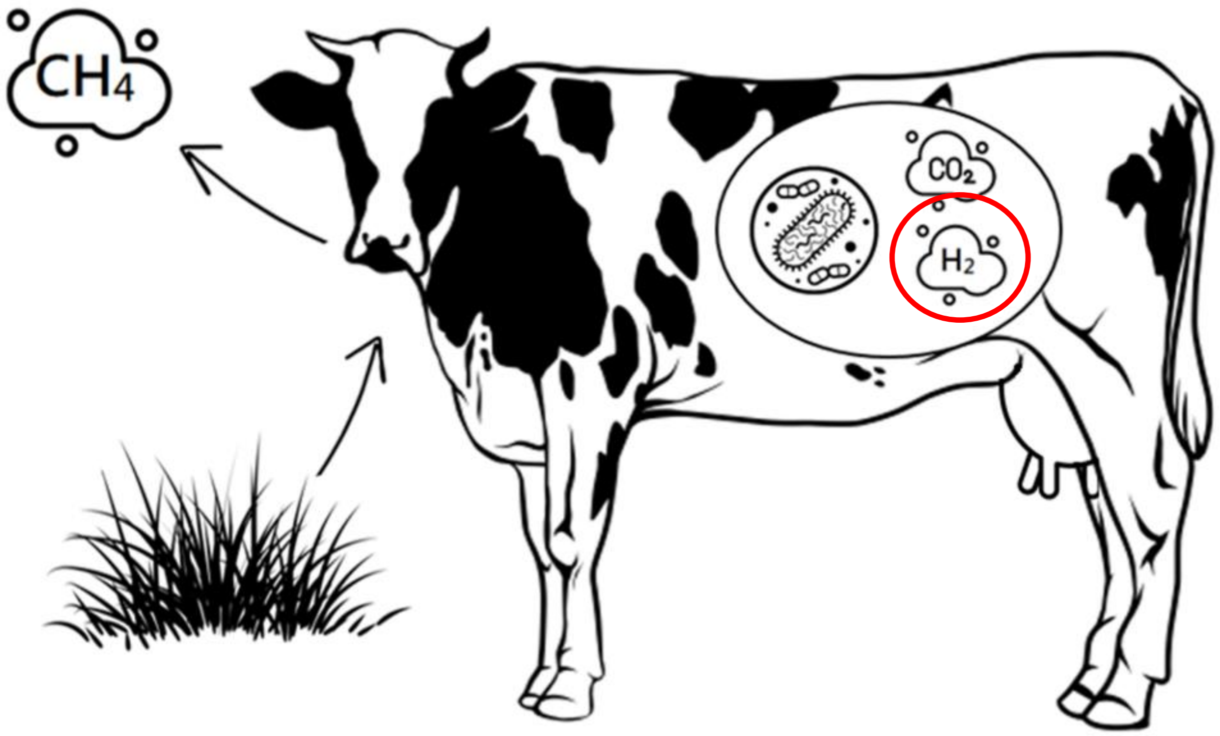
1 Lower amount of fermentable organic matter



ILVO

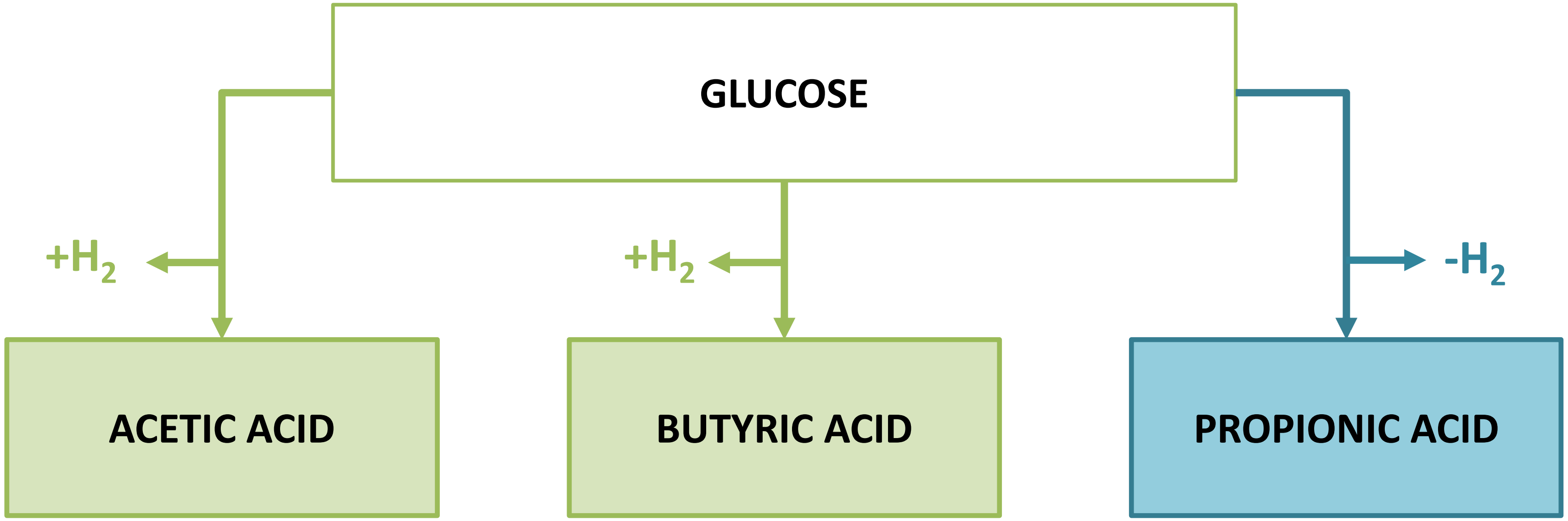
How does the inclusion of fats reduce enteric CH_4 emissions?

2 Propionic acid production



ILVO

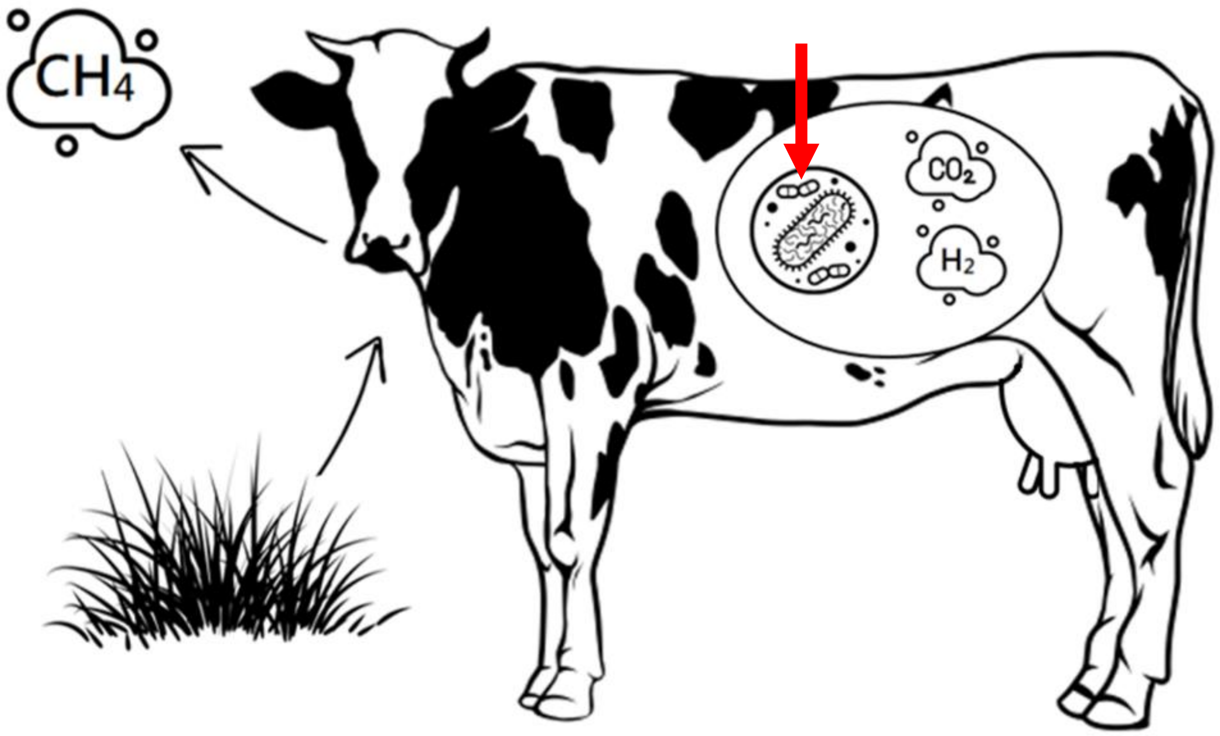
Volatile fatty acids in the rumen and influence on methane production



ILVO

How does the inclusion of fats reduce enteric CH_4 emissions?

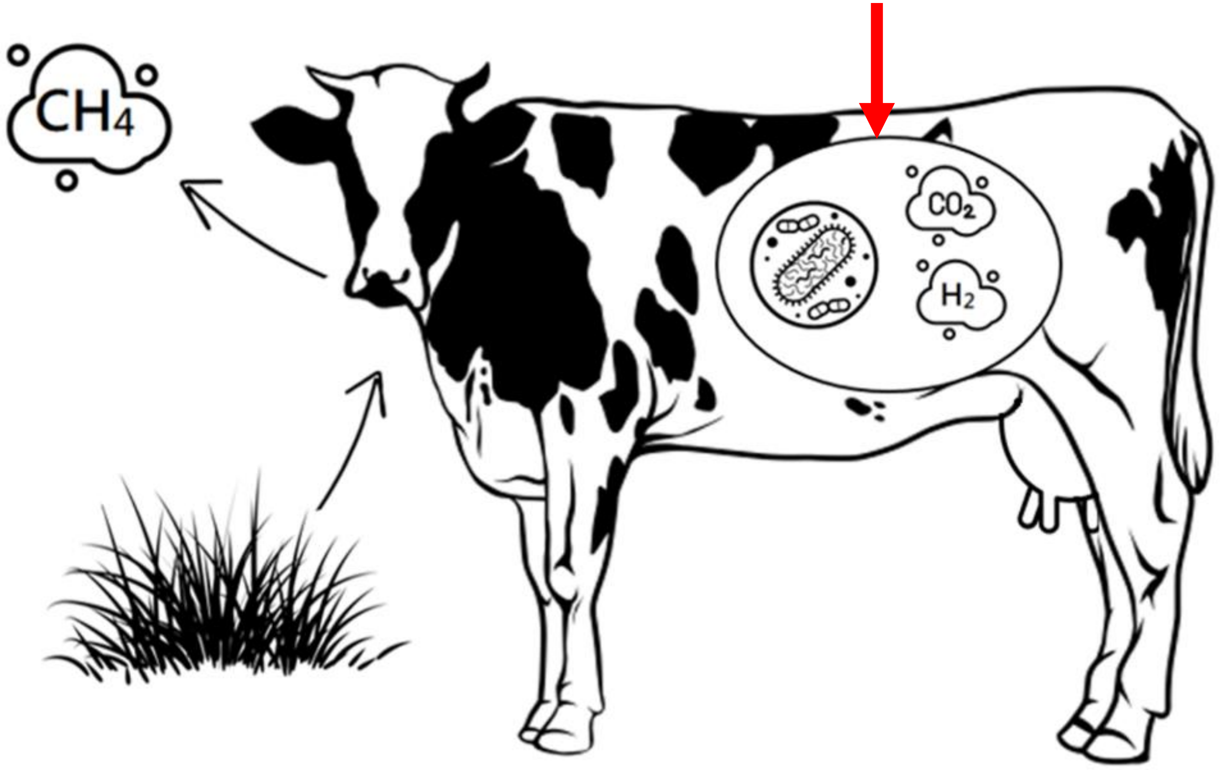
3 Inhibition of ruminal micro organisms

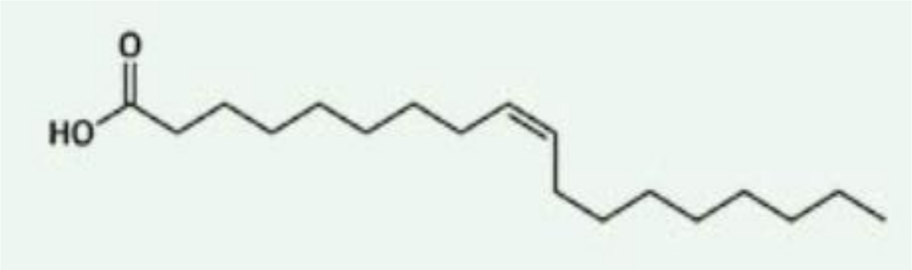


ILVO

How does the inclusion of fats reduce enteric CH_4 emissions?

4 Biohydrogenation of unsaturated fatty acids





H_2

Biohydrogenation → **Alternative H_2 sink**

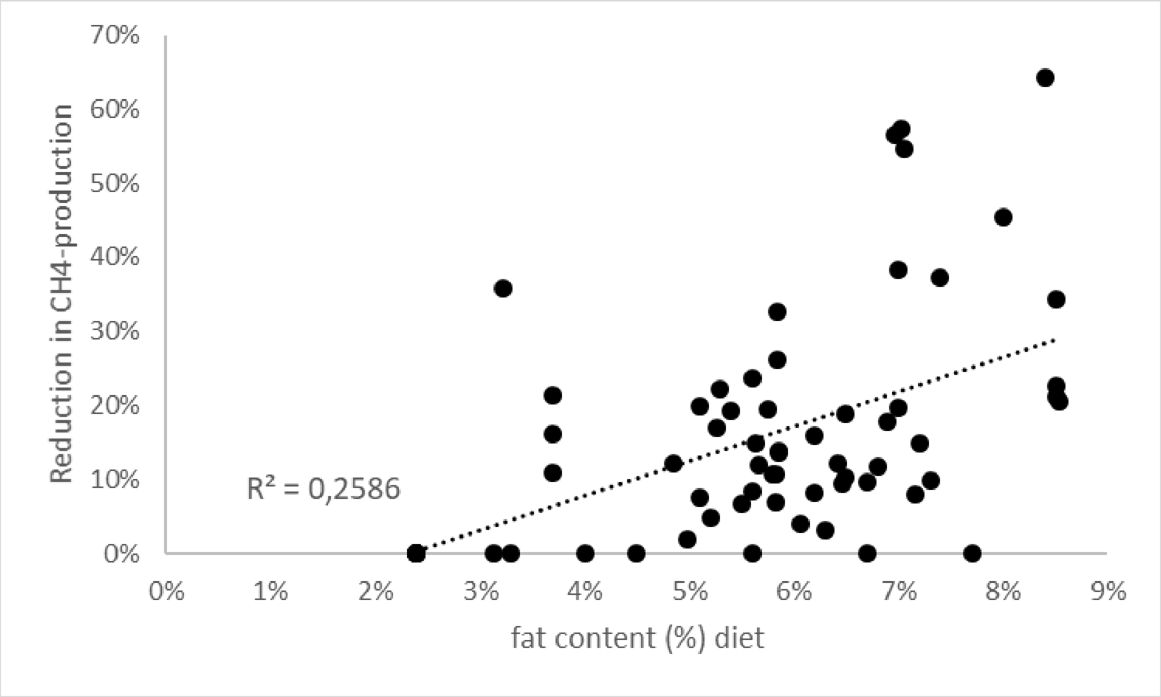
Lower methane production

But only responisble for a small reduction of 2-3%

ILVO

What are the influencing factors?

1 Amount of fat



Total amount of fat should be limited to 6-7% of total DMI

ILVO

What are the influencing factors?

1 Amount of fat

The amount of fat in de diet is limited due to some side effects

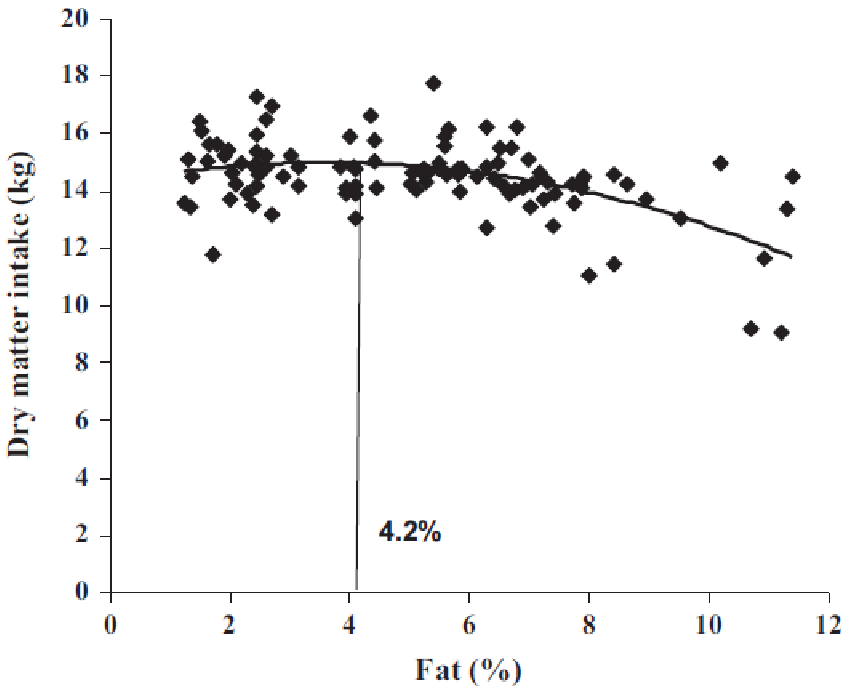
DIGESTIBILITY

DRY MATTER INTAKE

PRODUCTION

What are the influencing factors?

1 Amount of fat



Patra et al., 2013

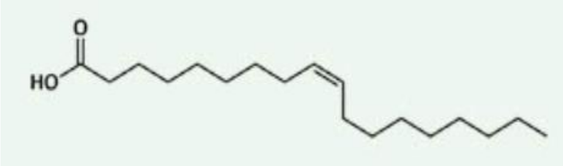
What are the influencing factors?

2 Source of fat

SATURATED FATTY ACIDS ↔ **UNSATURATED FATTY ACIDS**

palm oil, coconut oil

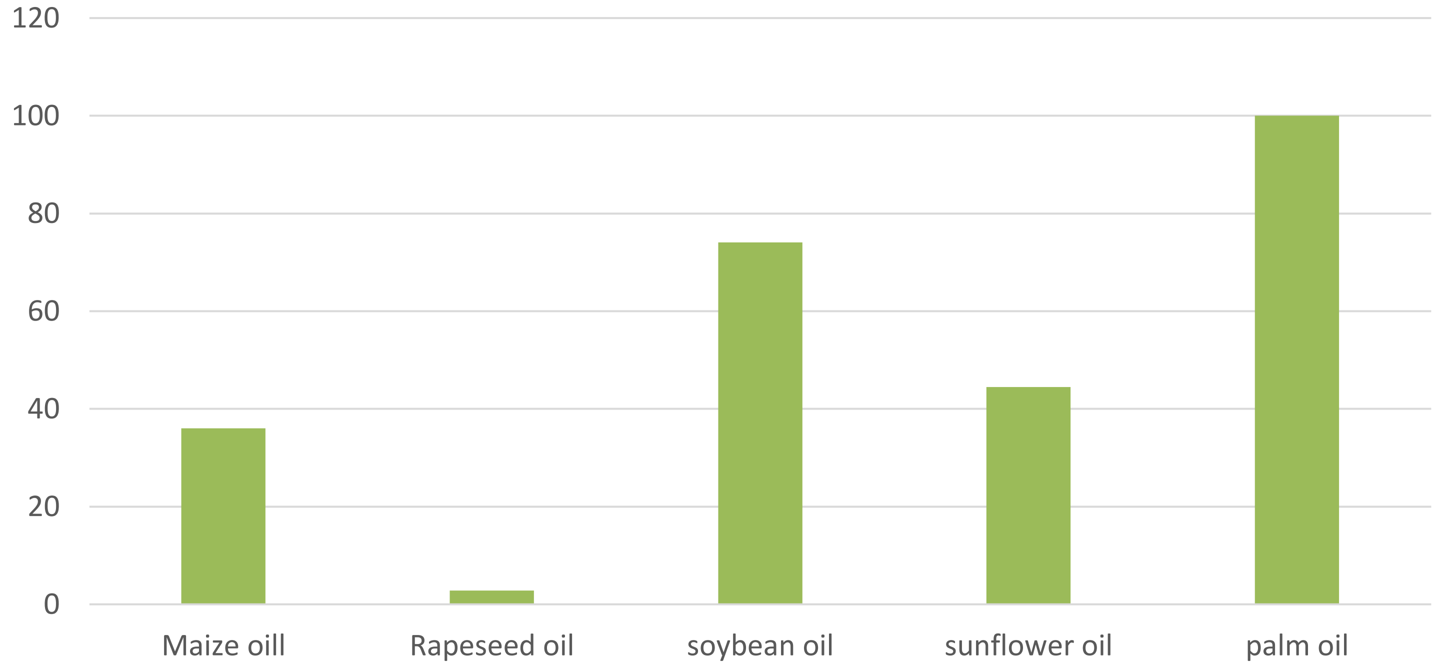
rapeseed, linseed



What are the influencing factors?

2 Source of fat

Although most fats reduce CH_4 emissions, the broader climate impact should also be considered



Relative ratio of CO_2 emissions from the production of 1 kg of oil from different raw materials

Method: IPCC 2013 GWP 100a V1.03

ILVO

What are the influencing factors?

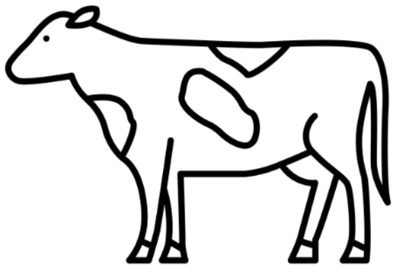
3 The form of the dietary lipid

RAW MATERIALS ⟷ OIL

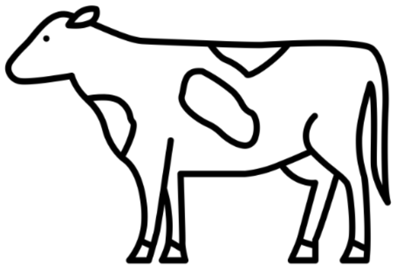
What are the influencing factors?

3 The form of the dietary lipid

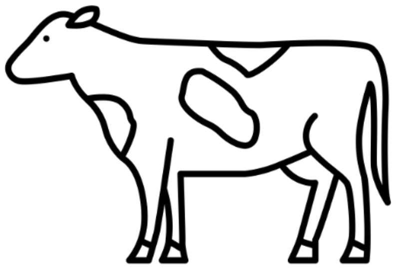
CONTROL



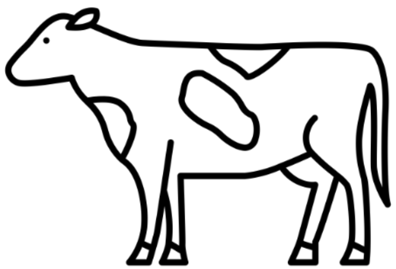
CRUDE LINSEED



EXTRUDED LINSEED



LINSEED OIL

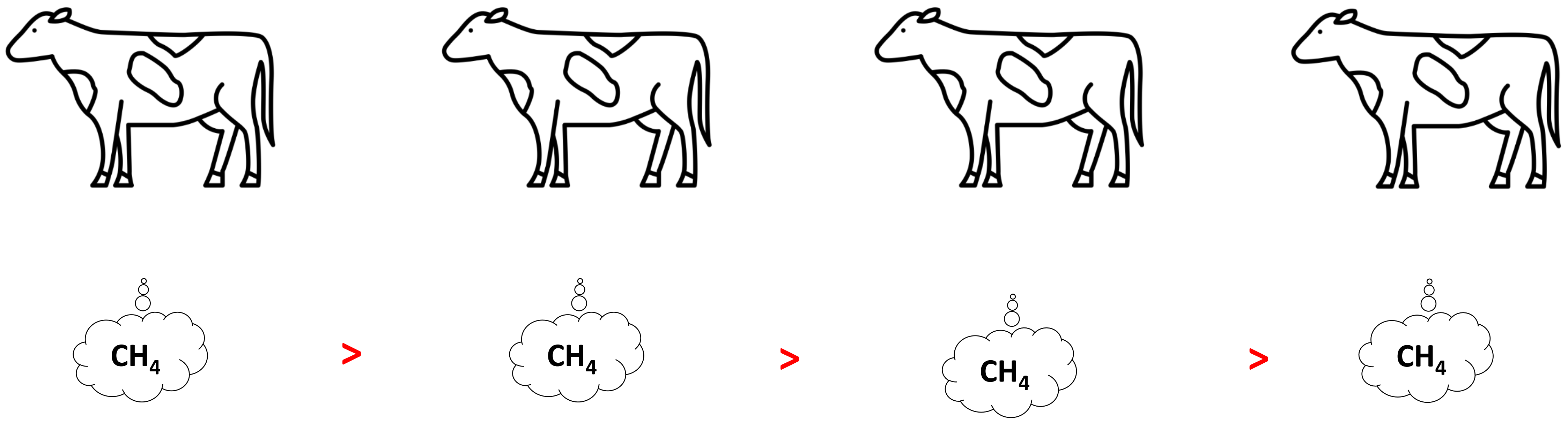


Martin et al., 2008

What are the influencing factors?

3 The form of the dietary lipid

CONTROL | CRUDE LINSEED | EXTRUDED LINSEED | LINSEED OIL



-12% | -38% | -64%

Martin et al., 2008

ILVO

Dietary fats in beef cattle: example

- Charolais fattening bulls

CONTROL

87% concentrate
13% straw
Fat content: 2,4%

LINSEED TREATMENT

81% concentrate
6% extruded linseed
13% straw
Fat content: 4,4%

-19%

Eugene et al., 2009

What are the influencing factors?

4 The composition of the diet

Roughage rich ↔ Concentrate rich

Essential oils

Essential oils (EO) are complex aromatic substances derived from plants

ILVO

Effect of essential oils on enteric CH_4 emissions

Many experiments where carried out

in-vitro

Promising results

in-vivo

variable results

Thank you

Research Institute for
Agriculture, Fisheries and Food
Scheldeweg 68
9090 Melle – Belgium
T + 32 (0)9 272 26 00

dier@ilvo.vlaanderen.be
www.ilvo.vlaanderen.be

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Methane reducing feed additives – what’s out there and how do they work?

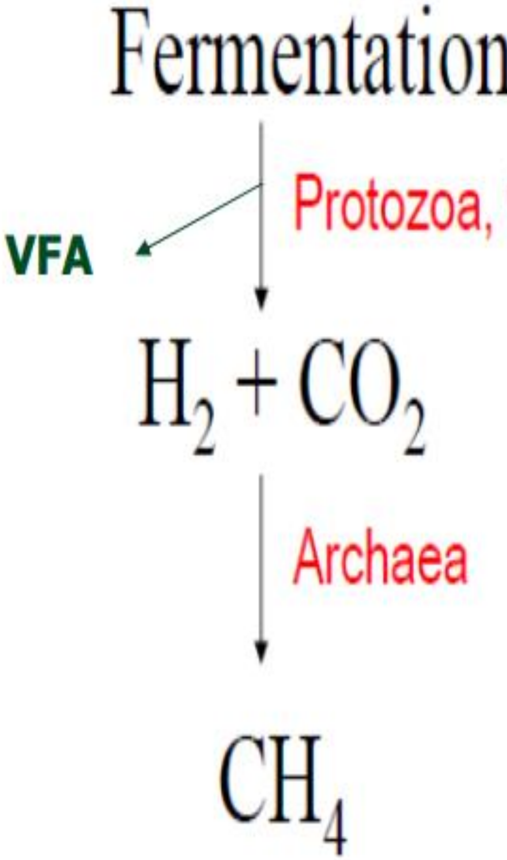
Gemma Miller
SRUC, Beef and sheep Research Centre

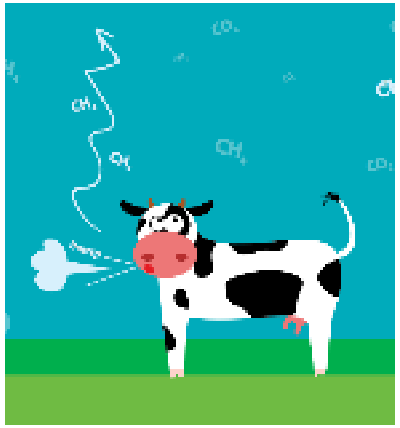
Leading the way in Agriculture and Rural Research, Education and Consulting

Enteric methane

- CH_4 is a loss of 2-12% of feed energy

- In beef cattle, around half of lifetime CH_4 emissions are emitted during the finishing phase

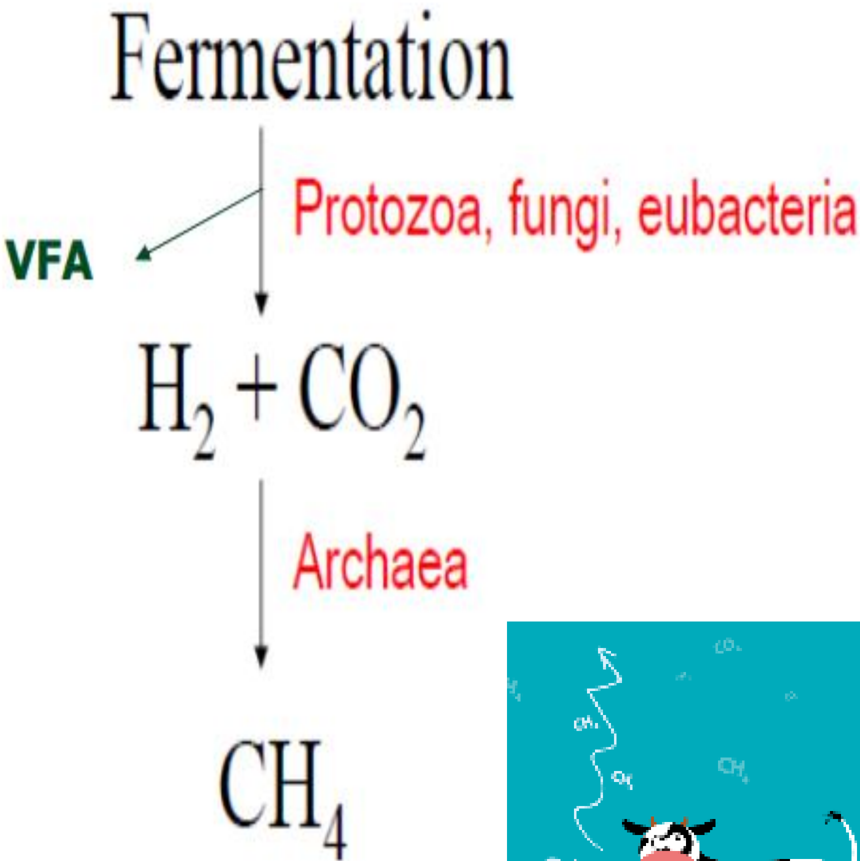


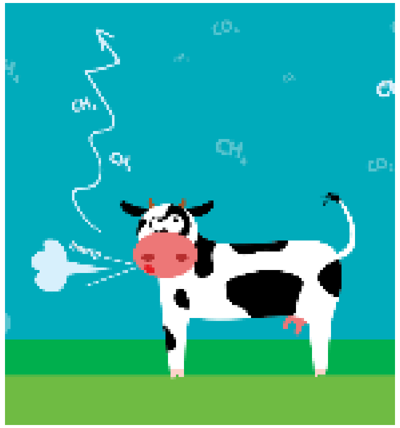


What types of methane reducing feed additives are there?

- Enteric fermentation: Two stage process
- Opportunities to reduce enteric CH_4:

1. Divert hydrogen to another chemical pathway
2. Inhibit methane producing microbes
3. Change fermentation products
4. Suppress rumen microbes





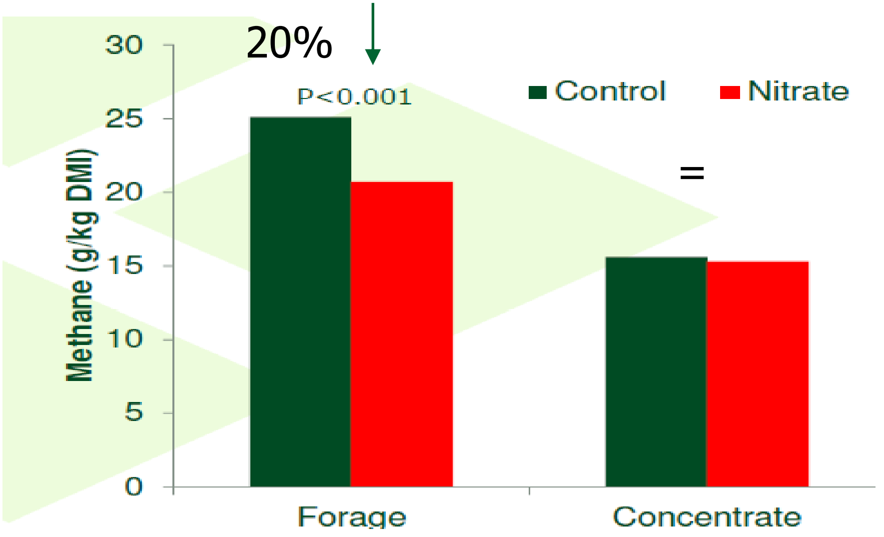
Divert H_2 to another chemical pathway

- **Nitrates**: electron acceptor which diverts H_2 to production of ammonia
- Yields more energy than reduction of CO_2 to CH_4
- Nitrate toxicity: may cause reduced productivity and adverse health effects (death in extreme cases)

Nitrate Additive

$NO_3 + 4H_2 = NH_4 + 2H_2O$

$CO_2 + 4H_2 = CH_4 + 2H_2O$

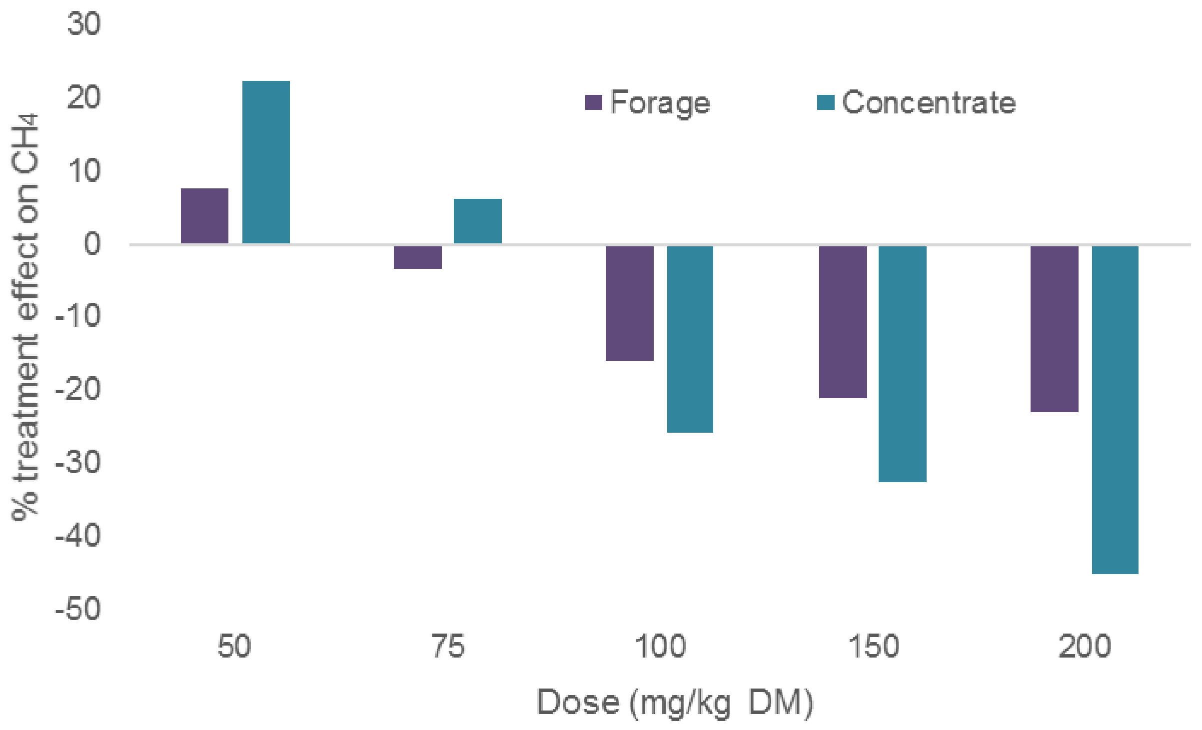


Troy et al (2015) J. Animal Sci. 93:815

Inhibit methane producing microbes

- **3-NOP**: inhibits methyl-coenzyme M reductase which catalyses the final step of methanogenesis

- Average ~30% CH_4 reduction in literature but highly variable due to the variation in dose and method of administering. Also seems to be affected by diet composition.



Vyas et al (2018) Animal. Prod. Sci. 58:1049

Inhibit methane producing microbes

- **Bromoform** – found in seaweed, particularly red species (*Asparagopsis taxiformis)*

- Large CH_4 reductions in lab based studies but few *in vivo* studies

Inhibit methane producing microbes

Seaweed Unknowns

- Bromoform is a carcinogen? Only very low dosages fed to cattle

- Bromoform damages the ozone – risk of seaweed cultivation?

- How long does the methane reducing effect last?

Change fermentation products

- **Monensin:** anti-biotic growth promoter. Favours production of propionate, over acetate. While H_2 is produced in the formation of acetate, it is consumed in the formation of propionate.

- Growth promoters are currently banned in the EU

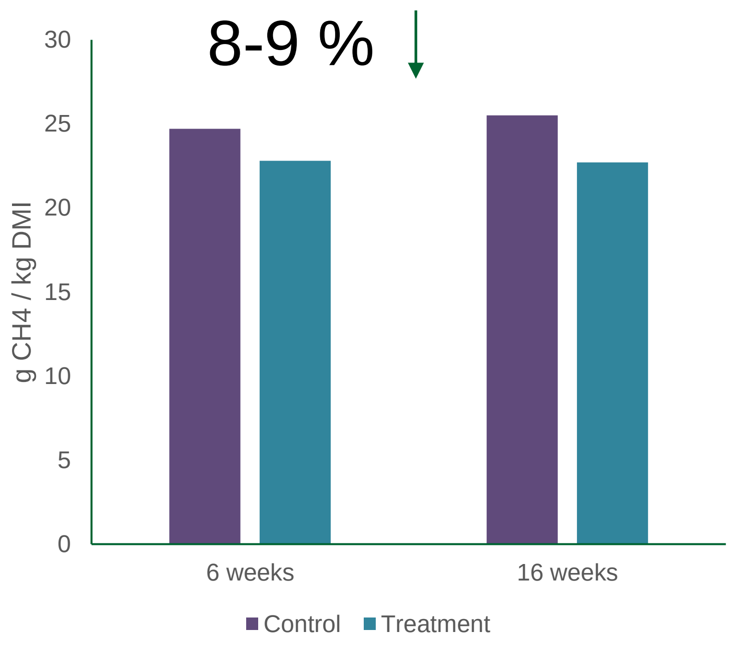
Suppress rumen microbes

- **Essential oils**: disruption of microbial cell membranes or inactivation of microbial enzymes

- In the literature: garlic, eugenol, cinnamon, coriander, eucalyptus, rosemary, sage, oregano, dill, thyme, mint, cumin, citrus, clove, anise, angelica, yarrow, lemon grass – as well as blends!

- Results variable, short term measurement and generally not significant

Blend of essential oils



Miller et al (unpublished)

Further thoughts and conclusions

- Some issues of toxicity and safety still to be overcome / investigated
- Life cycle assessments need to be conducted to understand the true environmental impacts
- None are yet approved for use as methane reducing feed additives through EFSA

SRUC

Leading the way in Agriculture and Rural Research, Education and Consulting

Webinar ES

Strategies to reduce enteric emission from beef production:

Youngstock management

Webinar Environmental sustainability - June 14th

Karen Goossens - ILVO

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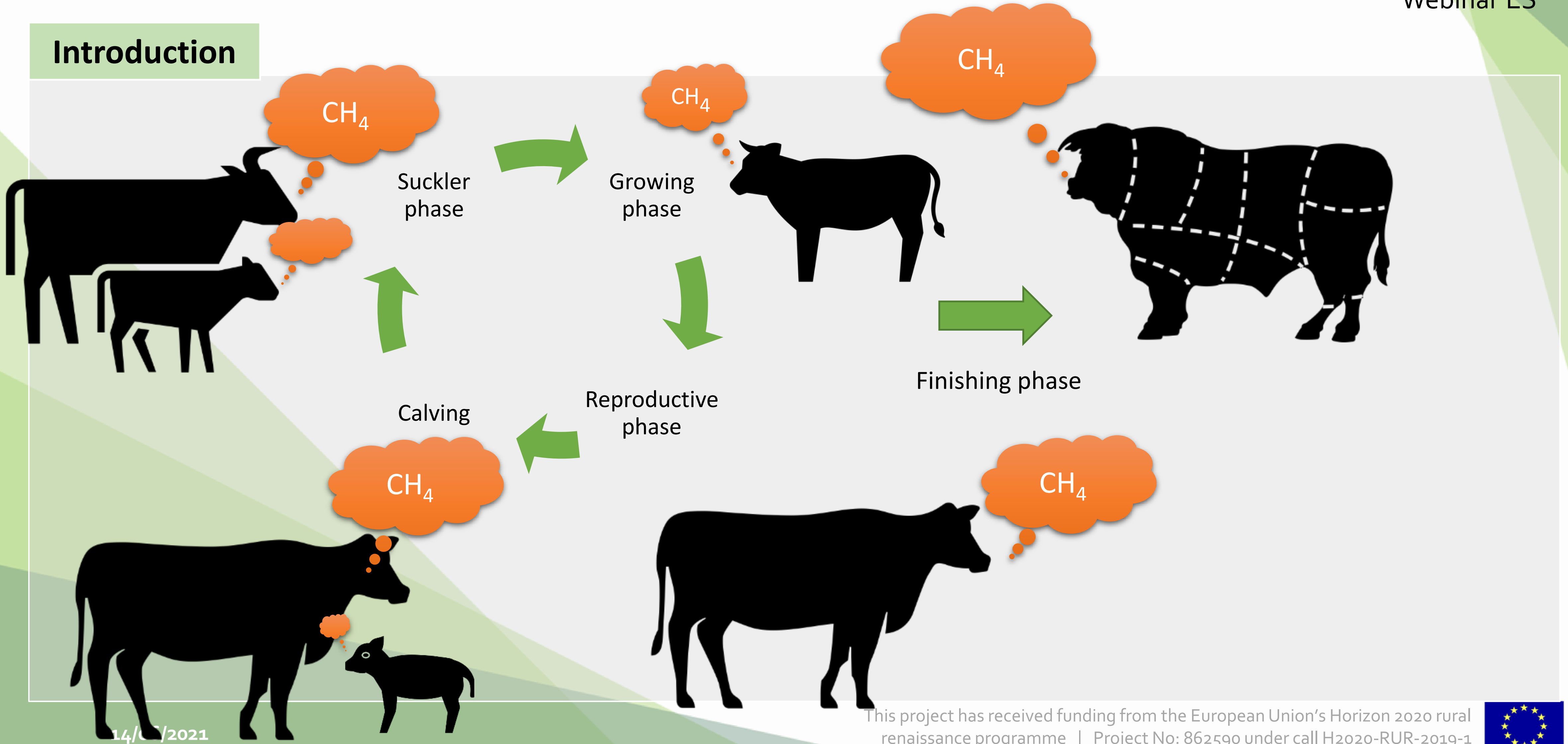
Youngstock management

Webinar ES

Introduction



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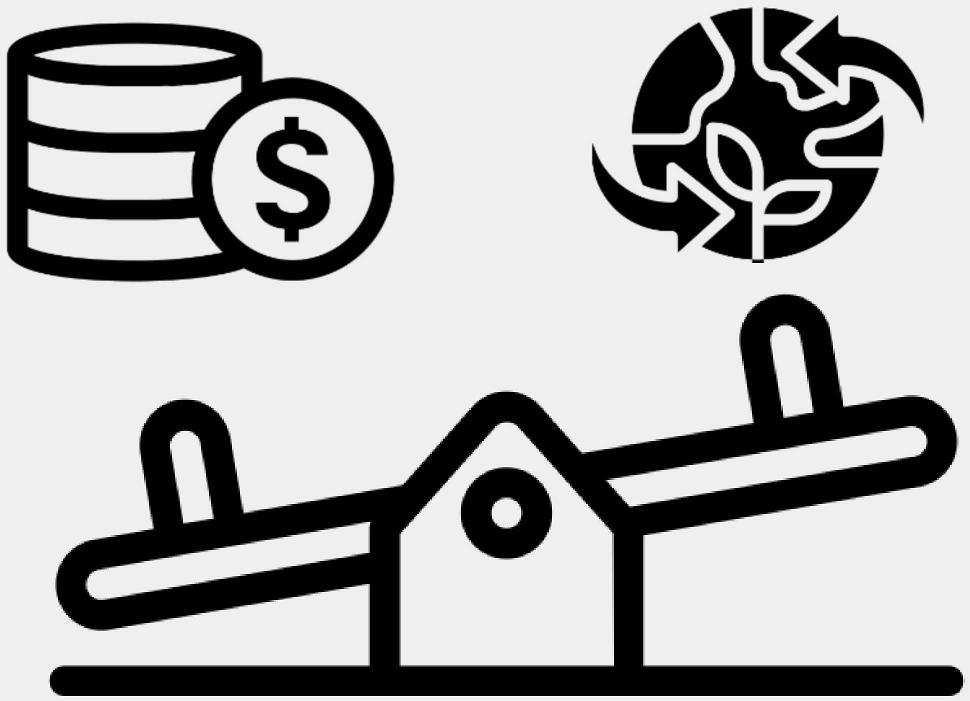
Youngstock management

Introduction



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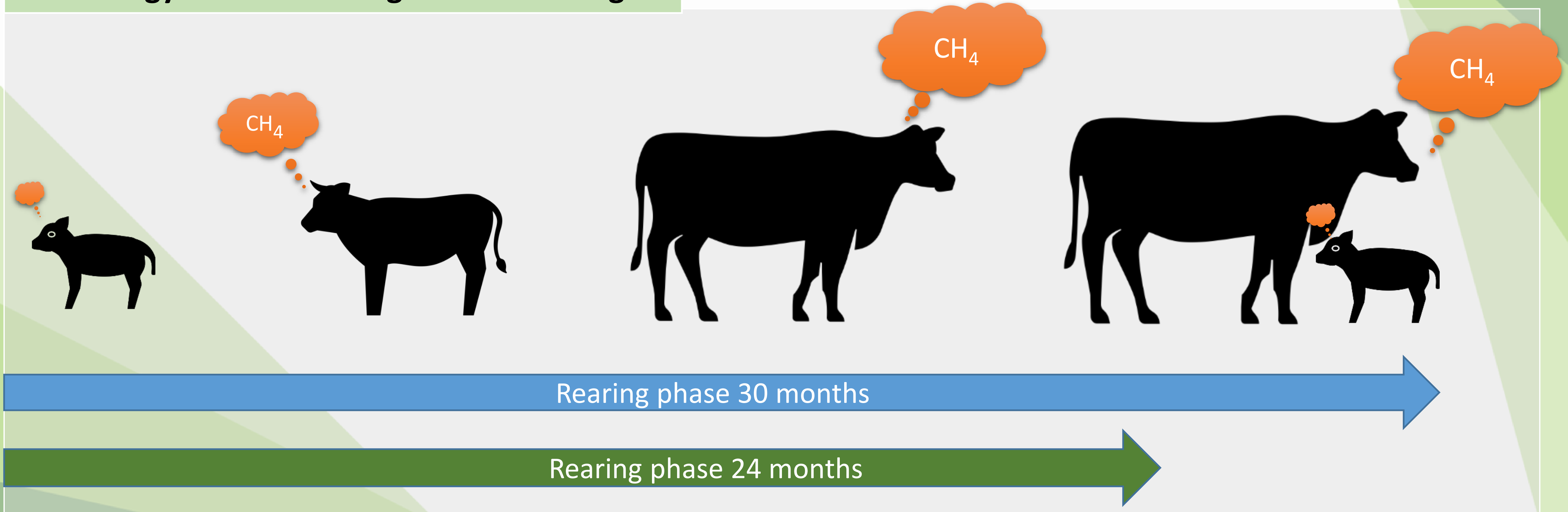
Youngstock management

Webinar ES

Strategy 1 : reduction age of first calving



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Youngstock management

Webinar ES

Strategy 1 : reduction age of first calving

-11% CH_4 (28 → 26)

Age first calving (months)	24	26	28	30
Methane emission youngstock rearing phase (kg/heifer)	115	133	150	168

-32% CH_4 (30 → 24)

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Youngstock management

Webinar ES

Strategy 1 : reduction age of first calving

Age first calving (months)	Control	Scenario 1 equal # calvings			
Average age of first calving (months)	35	30	24		
Livestock units per surface	1.14	1.08	0.98		
Kg concentrates per livestock unit	635	636	801		
Net carbon footprint of the farm (%)		**-8%**	**-14%**		

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Youngstock management

Webinar ES

Strategy 1 : reduction age of first calving

Age first calving (months)	Control	Scenario 1 equal # calvings		Scenario 2 equal lifestock units	
Average age of first calving (months)	35	30	24	30	24
Livestock units per surface	1,14	1,08	0,98	1.08	1.09
Kg concentrates per livestock unit	635	636	801	637	801
Net carbon footprint of the farm (%)		**-8%**	**-14%**	**-5%**	**-4%**

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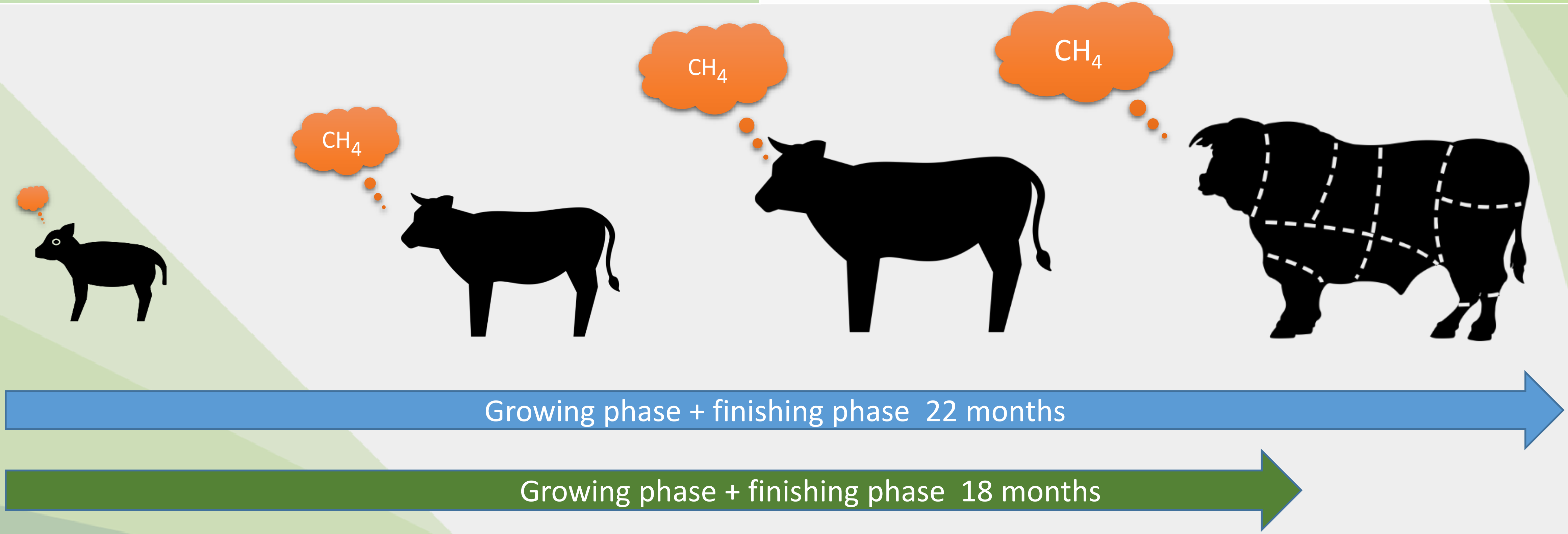
Youngstock management

Strategy 2 : slaughter of bulls at younger age



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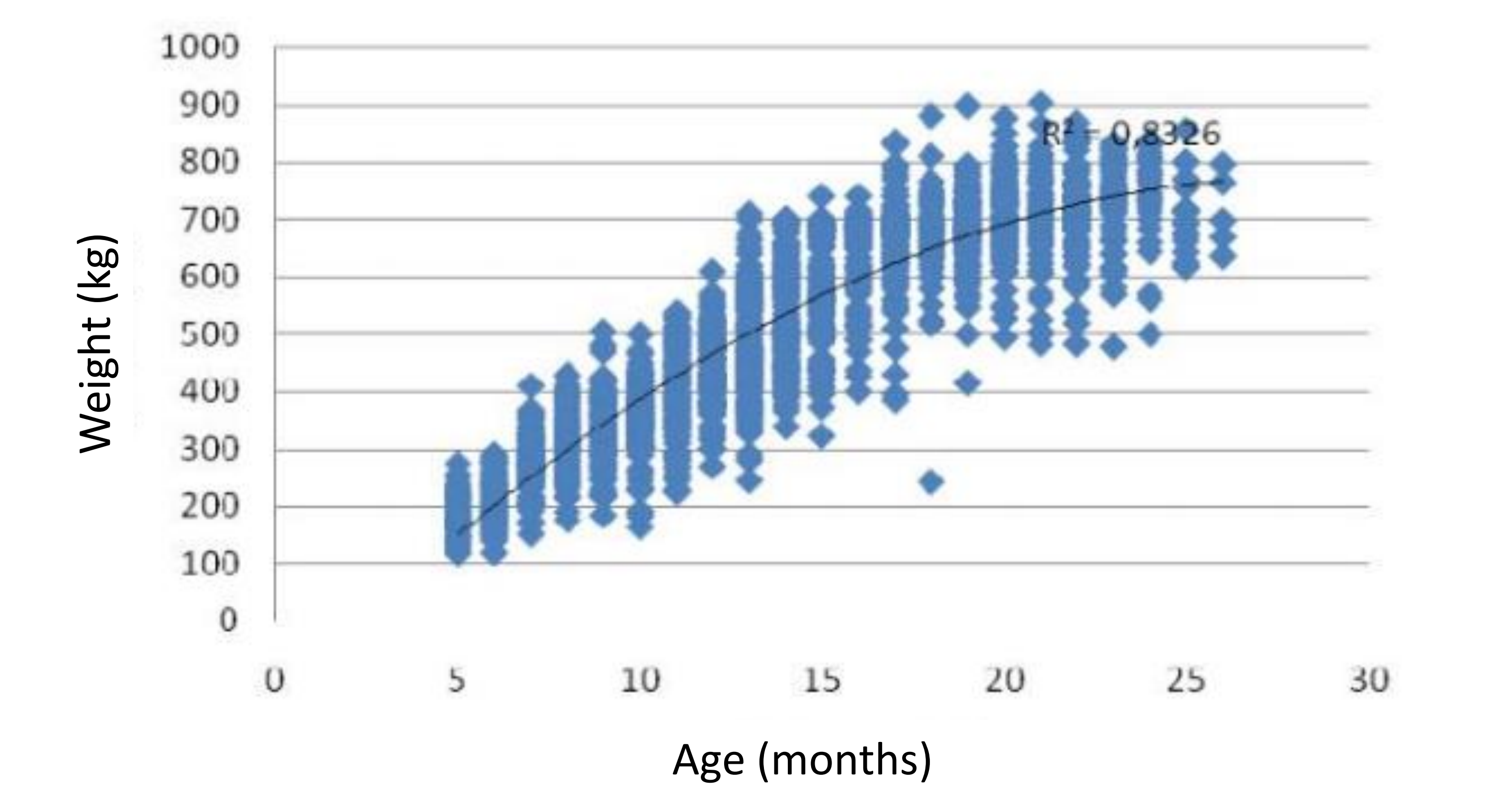
Youngstock management

Webinar ES

Strategy 2 : slaughter of bulls at younger age



Truyen et al., 2008

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Youngstock management

Webinar ES

Strategy 2 : slaughter of bulls at younger age

Age slaughter	18 months	22 months	
DM-intake Belgian Blue bulls (concentrates)	10.25 (7.07) kg	12.5 (9.35) kg	
Weight at slaughter	720 kg	850 kg	
Feed costs until slaughter		+ € 346	
Gross income	€ 2419	€ 2678	- € 87
CH_4 Emissions (kg / animal) till slaughter	55.7 kg	71.7 kg	+ 22%

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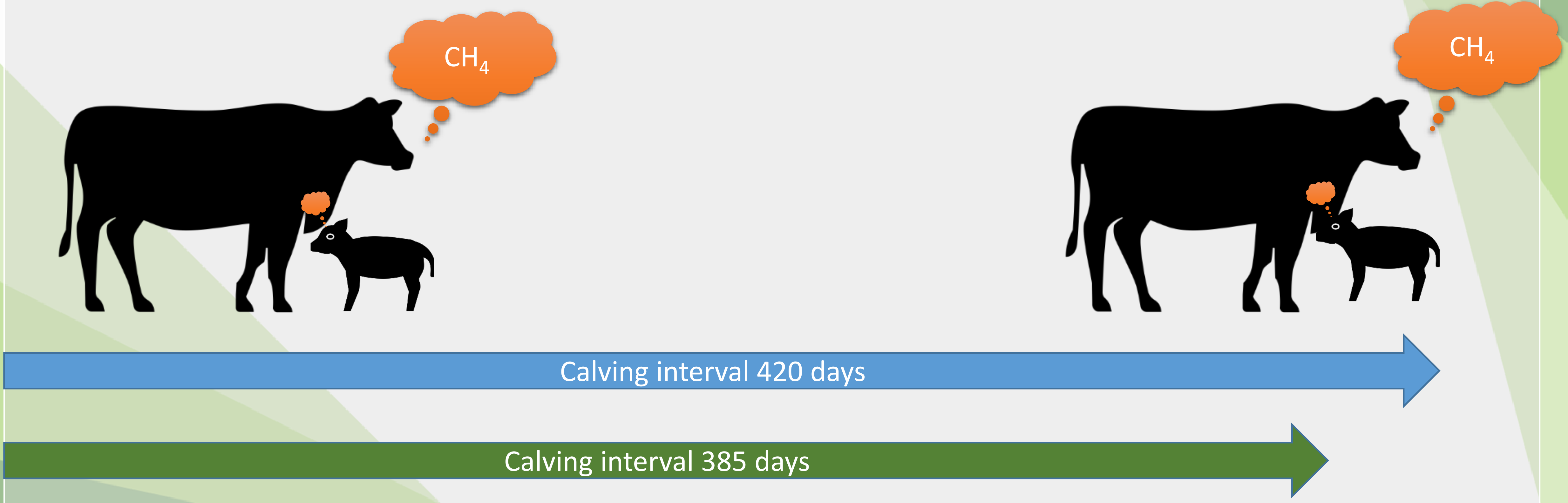
Youngstock management

Webinar ES

Strategy 3 : reduction calving interval



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Youngstock management

Webinar ES

Strategy 3 : reduction calving interval

Calving interval	385 days	420 days	
Feed costs calving interval Belgian Blue	€ 597	€ 651	- 54 €
CH_4 emissions (kg / animal) calving interval	98.8 kg	107.8 kg	- 8,4 %

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Youngstock management

Webinar ES

Strategy 3 : reduction calving interval

	Charolais 375 days	Charolais 390 days
Gross live meat production	47 T 880	46 T 410
Served calf / present cow	1.01	0.94
Gross income	€ 45 900	€ 43 297
Net emissions kg CO2 / kg gross live meat production	13.4	13.7

+ 4,4 %

- 2,2 %

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Youngstock management

Webinar ES

Conclusions

Improved youngstock management results in:

- Better profitability
- Lower carbon footprint of beef production

Different management strategies:

- Reduction age of first calving
- Optimized slaughter age
- Reduced calving interval

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Thanks to:

- Josselin Andurant – Idèle
- Lukas Cuyle – Bachelor student HoGent
- Dirk Audenaert – Boerenbond

Thank you

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Questions

Webinar ES

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This project has received funding from the European Union's Horizon 2020 rural renaissance programme | Project No: 862590 under call H2020-RUR-2019-1

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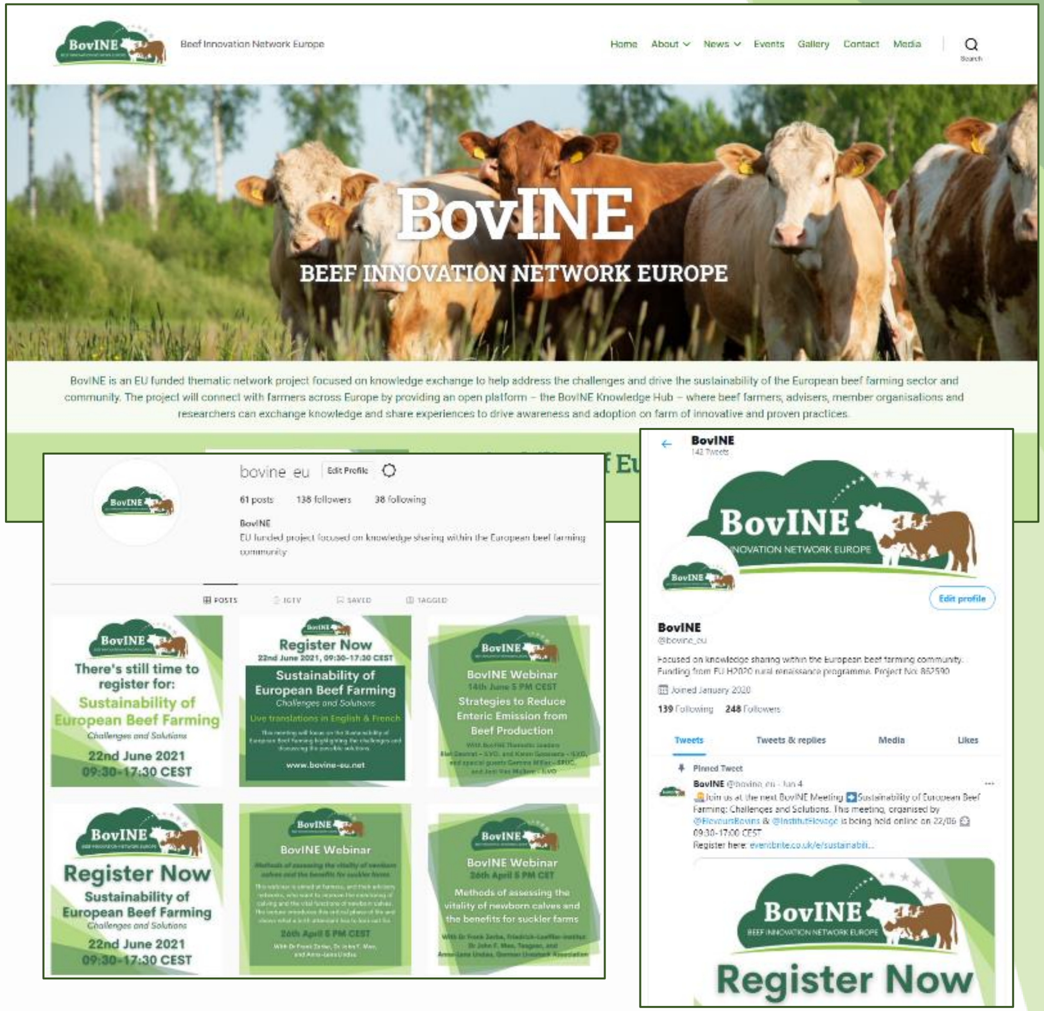

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Draft Agenda/Projet d'agenda:

(All times in CEST / Toutes les heures en CEST)

09:30 – 10:00 – **Opening & Welcome** / *Ouverture et Bienvenue*
– Teagasc, Idele, FNB

10:00 – 10:30 – **Pact for Societal Commitment** / *Pacte d'engagement sociétal*
– Caroline Guinot, Interbev

10:30 – 11:00 – **Break** / *Pause*

11:00 – 11:30 – **The French R&D framework for beef production research** / *Le cadre français de la R&D en matière de recherche sur la production bovine*
– André Le Gall, Idele

11:30 – 12:00 – **Suckler beef farms in Europe, what is the position between European and International policies? /** *Les élevages de bovins allaitants en Europe, quelle est la position entre les politiques européennes et internationales?*
– Jean-Pierre Fleury, COPA COGECA

12:00 – 12:10 – **Round up of morning session /** *Synthèse de la session du matin*

12:10 – 13:00 – **Lunch** / *Déjeuner*

13:00 – 15:00 – **Sustainability Challenges and Solutions addressed by BovINE in 2020/21** / *Défis et solutions en matière de durabilité abordés par BovINE en 2020/21*
– Chaired by Damiana Mais Barrutia, INTIA

15:00 – 15:30 – **Break with networking sessions** / *Pause avec sessions de réseautage*

15:30 – 16:30 – **BovINE insights for beef farmers – accessible, relevant and farmer friendly 'on farm' practice information and materials** / *BovINE insights pour les éleveurs de bovins – des informations et des documents accessibles, pertinents et conviviaux sur les pratiques agricoles*
– Rhonda Smith & Marie Saville, Minerva UK

16:30 – 17:15 – **Virtual farm walks** / *Promenades virtuelles dans les fermes*

17:15 – 17:30 – **Close of meeting** / *Clôture de la réunion*

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