STØTTET AF
Kvægafgiftsfonden

Vejene til en mere klimavenlig kalve- og oksekødsproduktion udgår fra malkekvægholdet
Indlæg *om metanproduktion og klimaaftryk fra slagtekalveproduktionen i Danmark og Spanien*
Del af et inviteret indlæg fra European Buiatrics Conference, Berlin, August 2023

Methane emissions and carbon footprint in the dairy beef production

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Objectives

- Give examples of methane emissions and carbon footprint from dairy beef production systems

  Effect of:

  - Feed ration
  - Protein level
  - Age and sex of animal
  - Production system

- Results coming from recent experiments in Spain (E) and Denmark (DK), and thus NOT a comprehensive review!

Which data will be presented ?

- Methane emissions:
  - Phase feeding with protein during growth if bulls (E)
  - Feed ration composition effects in 8 months Holstein bulls (3 exps from DK)
  - Effect of fat and poly-unsaturated oils (DK and E)
- Carbon Footprint (CF)
  - Contribution from feed produced (DK)
  - Various feed rations (DK)
  - Production systems (E and DK)

Methane emissions from growing cattle

Multiphase diets (reducing CP concentration) in fattening dairy beef cattle: a retrospective simulation of the environmental impact

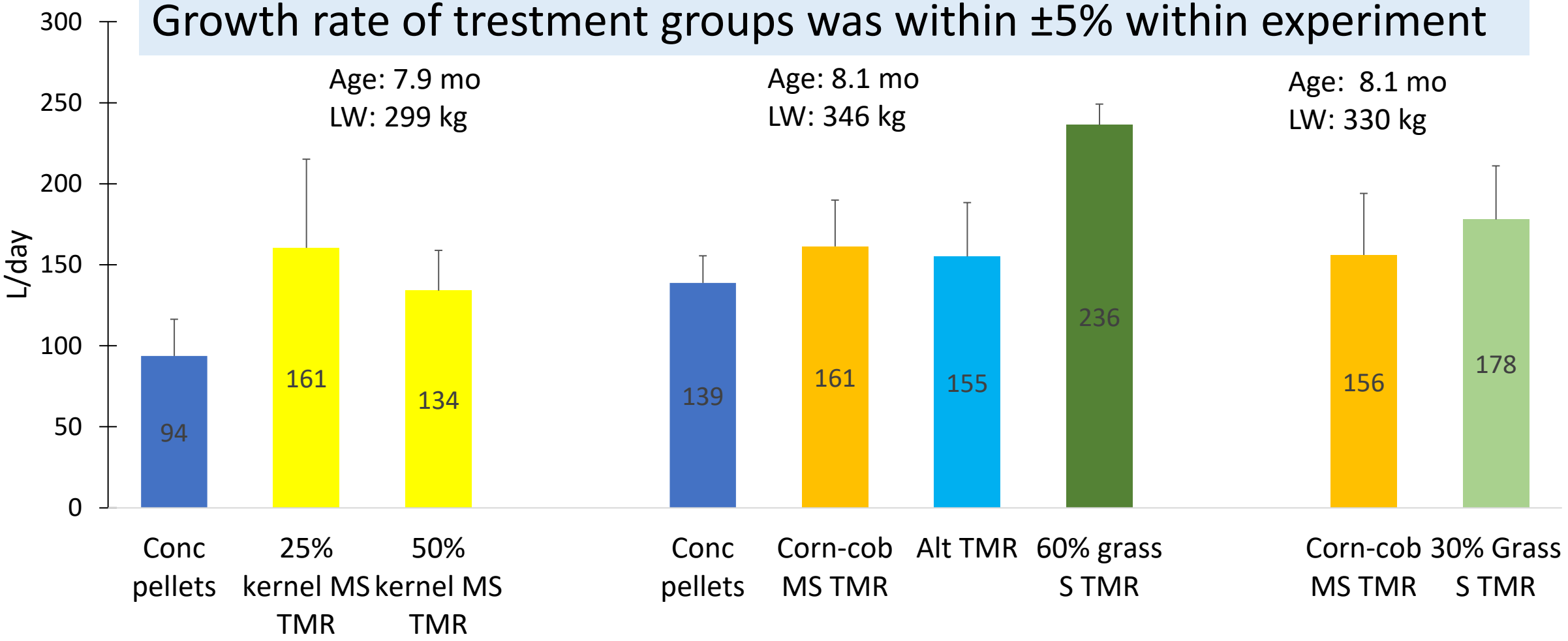
Observed/estimated animal performances	Commercial diet	Multiphase diet	P-values
	Mean	Mean	Anova
Second phase; 312 - 385 kg			
Total DMI_{av} (kg/d)	7,67	7,73	0,20
ADG (kg/d)	1,50	1,65	0,16
FCE (g:g)	0,217	0,214	0,44
CH_4 Emissions (MJ/d)	**86,5^b**	**140^a**	**<0,001**
CH_4 by intake (MJ/kg DMI)	11,3^b	18,2^a	<0,001
Total N excretion (g/d)	**118^a**	**102^b**	**<0,001**
N excretion by intake (g/kg DMI)	15,4^a	13,2^b	<0,001
Third phase; 385 - 600 kg			
Total DMI_{av} (kg/d)	8,66^b	9,53^a	<0,001
ADG (kg/d)	1,57	1,62	0,13
FCE (g:g)	0,201^a	0,174^b	0,02
CH_4 Emissions (MJ/d)	**101^b**	**191^a**	**<0,001**
CH_4 by intake (MJ/kg DMI)	11,7^b	20,1^a	<0,001
Total N excretion (g/d)	**132^a**	**108^b**	**<0,001**
N excretion by intake (g/kg DMI)	15,2^a	11,33^b	<0,001

Thus, we can reduce N-excretion by multiphase feeding…
However, as this feeding includes more fiber, at the same time it increases methane emissions….
So, we need to find alternative feeding schedules to reduce methane emission when we decrease CP concentration

P. Guarnido-Lopez, M. Devant, L. Llonch, S. Marti, M. Ben Aouda, in press

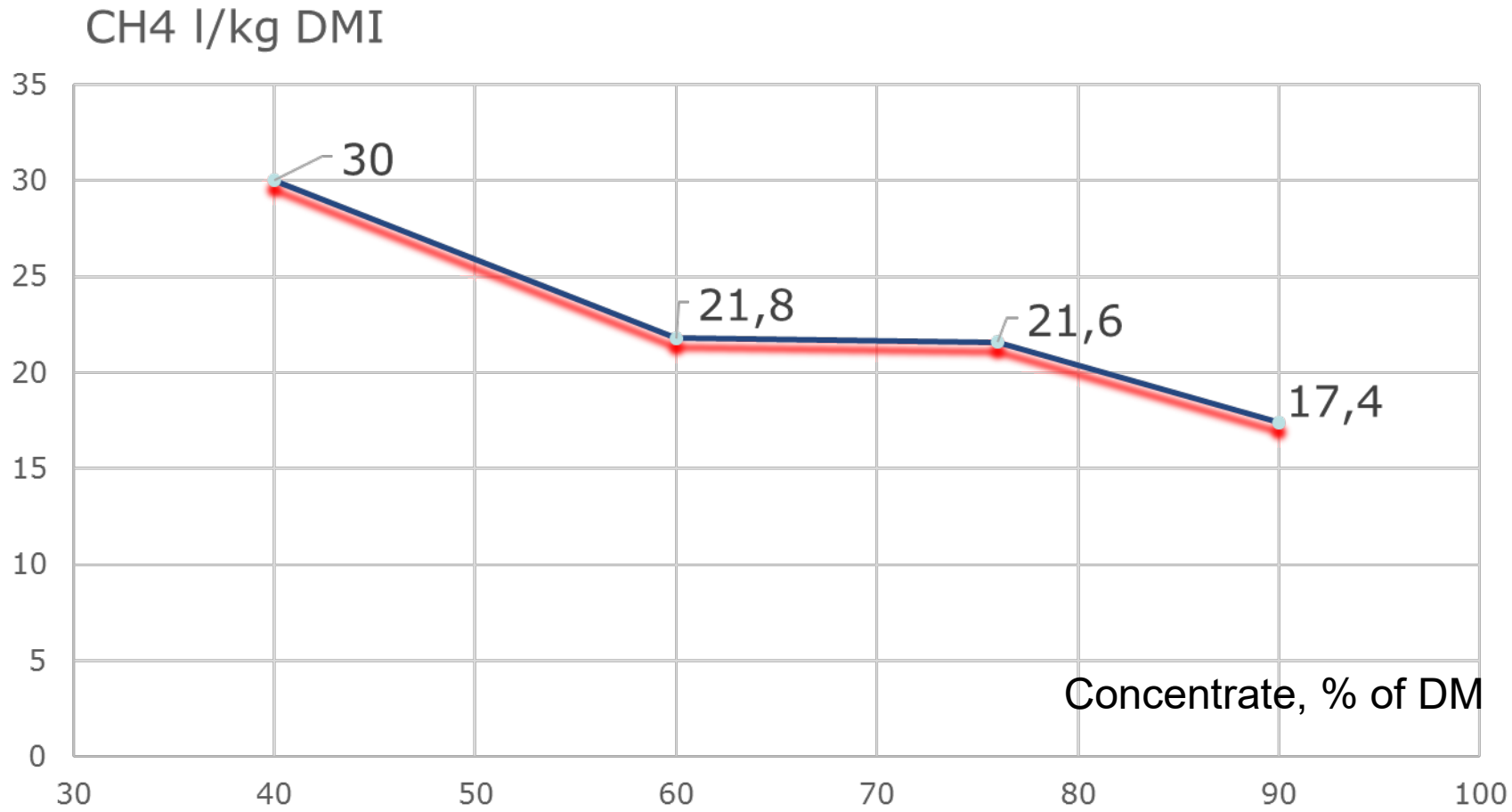
Effect of feed ration on CH_4 emissions (L/day) in bull calves at 8 months of age (300-350 kg)

Growth rate of trestment groups was within ±5% within experiment



Hellwing et al.

Enteric methane emission as a function of concentrate share

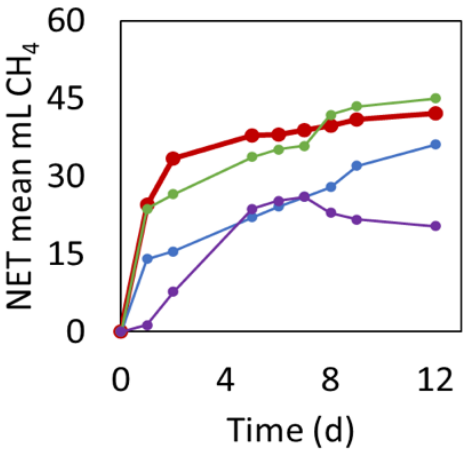


Substituting palm oil by polyunsaturated fatty acid rich oils reduces CH_4 emission: The reduction is depending on the concentrate formula

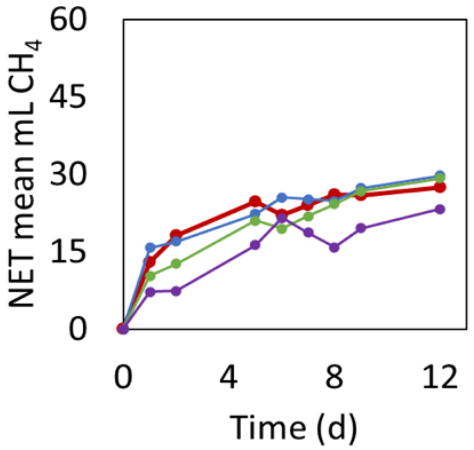
Depending on the concentrate formula of the basal diet (SBM or DGG as main protein source), the effect of fat source used to substitute palm oil and reduce CH_4 emission may differ !

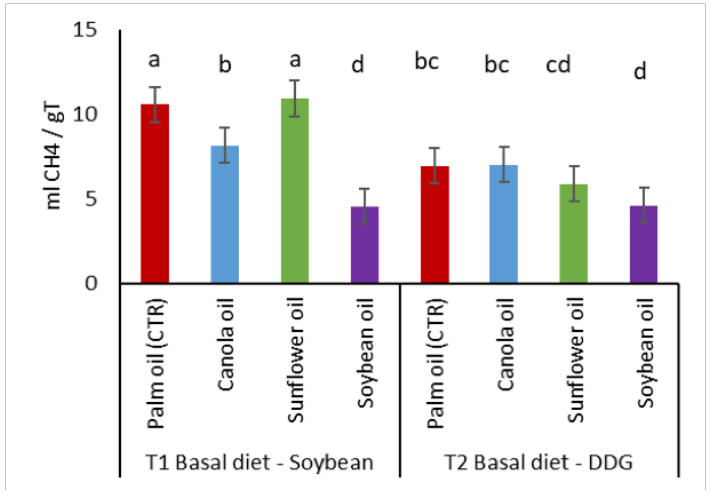
These *in vitro* studies show a reduction effect only when soybean meal was the protein source !

T1: basal diet with SBM



T2: basal diet with DDG





Maria Devant[1], Lourdes Llonch[1], Sonia Marti[1], Gerard Verge[1], Joan Riera[2], Carles Medinya[3], Jordi Cucurull[4], Anna Pérez[1], Belén Fernández[1]. [1]IRTA, Torre Marimon, 08140, Caldes de Montbui, Spain. [2]NANTA SA. [3]SINUAL. [4]Grup BonArea.

Can fat reduce methane emissions? *Hellwing et al 2012*

Table III. LSMeans for methane emission, for the control diet (CON) and for the rapeseed supplemented diet (FAT).

	Diet			*P*-values
	CON	FAT	SEM	Diet
N	6	6		
CH_4 [L/day]	211	164	6.3	0.002
CH_4 [L/kg DMI]	31.9	30.3	0.76	0.21
CH_4 [L/kg live weight gain]	226	245	16.0	0.44
CH_4 [% of GEI]	6.8	6.4	0.16	0.08
CH_4/CO_2	0.079	0.073	0.0013	0.01

SEM, standard error of mean; DMI, dry matter intake; GEI, gross energy intake.

Fat can reduce CH_4 emissions by 5-20%
But several feed additives have the potential to reduce CH_4 emissions substantially:
3-NOP (e.g., Bovaer) => 40 (up to 90) % reduction
Nitrate (e.g., Silvair) => 14% reduction
Algae products (e.g. Asparagopsis species)=> unknown, potential exists
Other substances lack of data

In summary, doubling the fat content in the diet to 53 g fat per kg DM by inclusion of crushed rapeseed reduced total CH_4 emission and tended to reduce CH_4 emission per MJ GEI but not per kg DMI.

Carbon Footprint (CF) of growing cattle

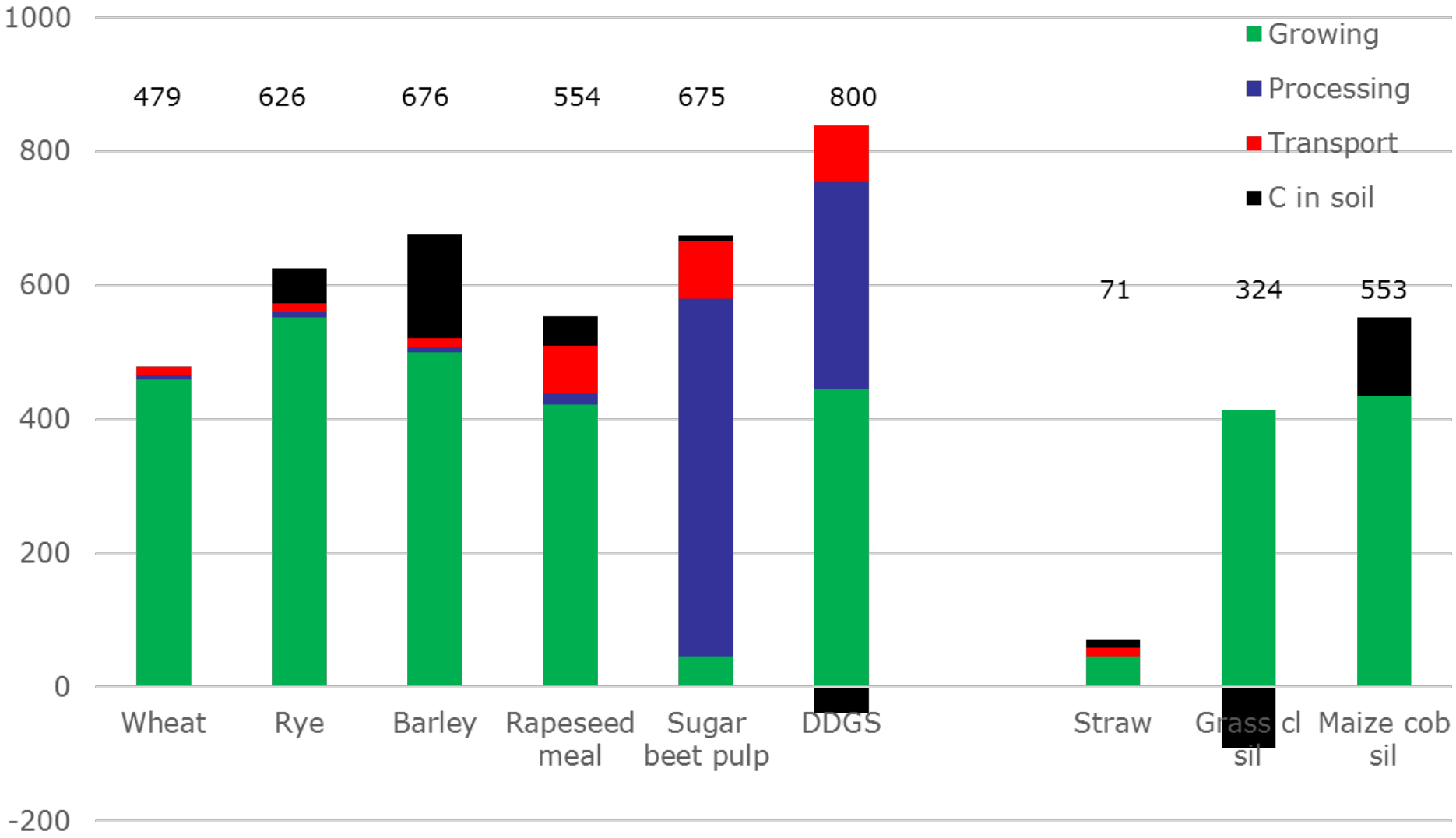
Is a CH_4 reduction equal to the Carbon Footprint reduction? NO !

Carbon Footprint (CF) includes the CO_2 production due to:

- Feed production (including soil carbon sequestration e.g., with grassland)
- Calf
- Bedding materials
- Methane emissions (rumination, digestion)
- Land Use Change (LUC) – correct method still debated

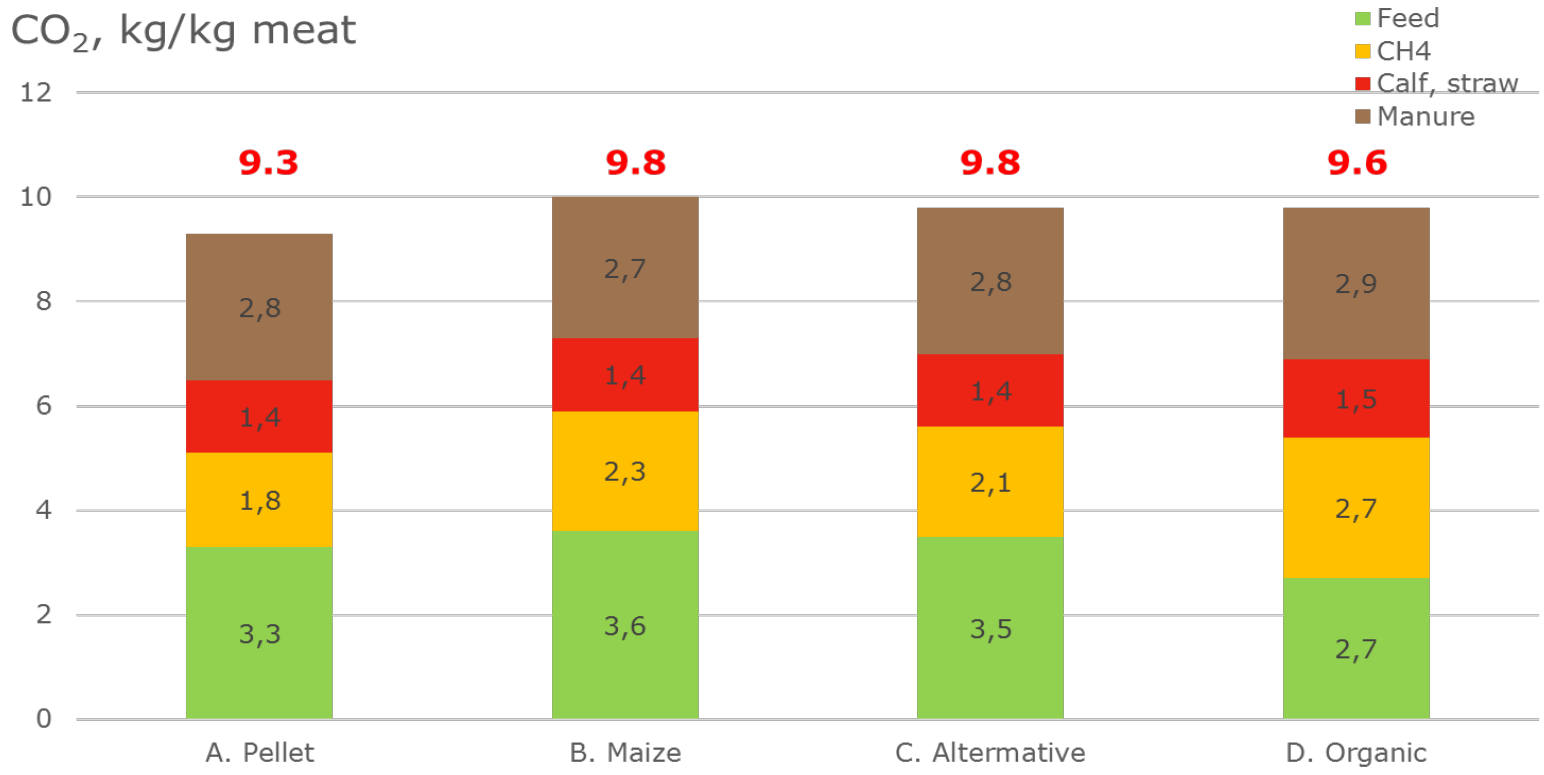
The total calculation is often called LCA (Life Cycle Analysis)

CF contribution from feed production (CO_2, g/kg)



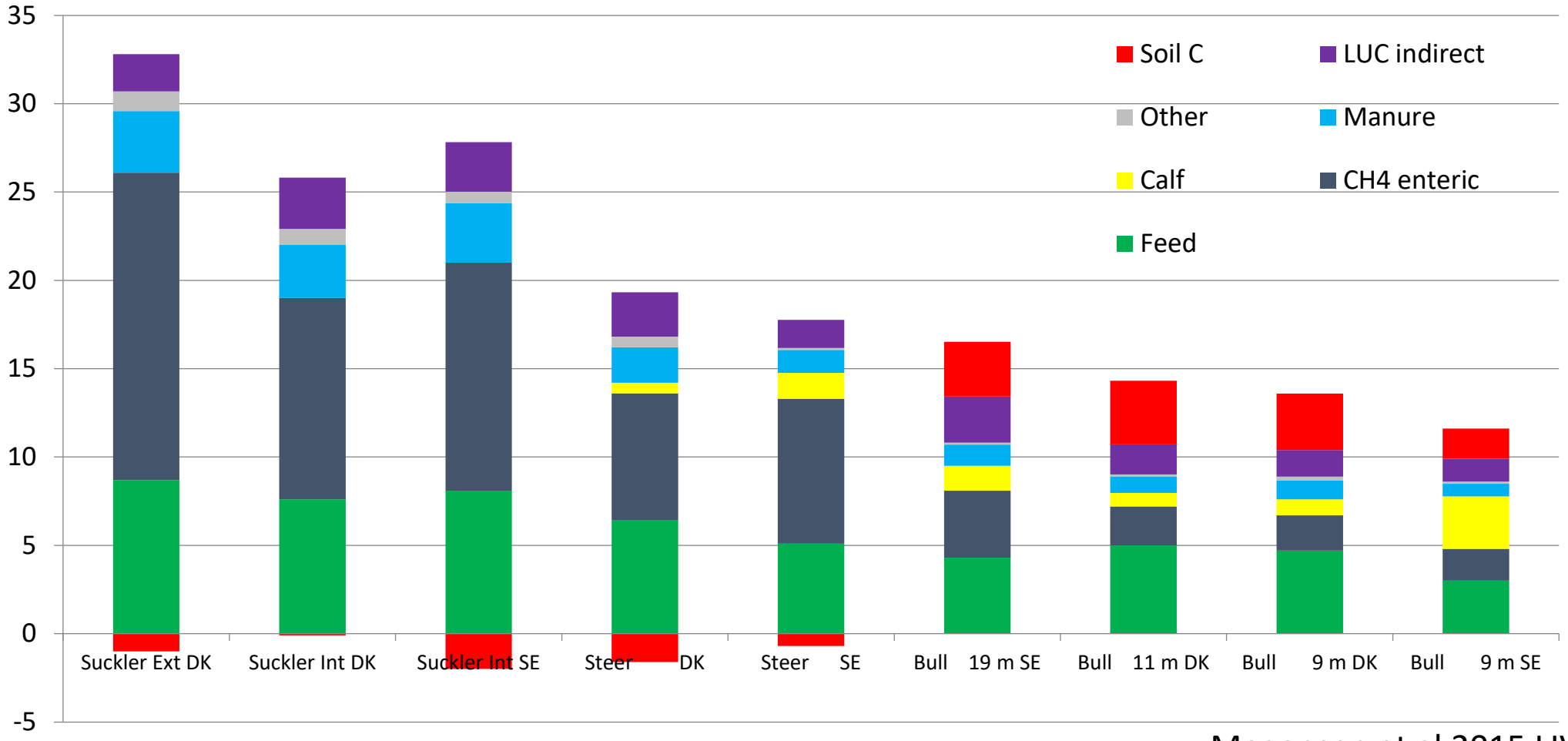
Mogensen et al.

CF from 4 different feedings of bull calves: GF per kg meat



Thus, rather similar Carbon Footprint per kg beef despite major differences in CH_4 emissions for the four slaughter calf rations

GHG emissions from beef production systems in Denmark and Sweden (g CO_2 per kg carcass)



Mogensen et al 2015 LIVEST

CF and LCA: Effect of genotype and production system (Organic beef) (DK)

Production of organic beef from dairy bull calves

- effect of different production strategies on productivity and carbon footprint

Lisbeth Mogensen, Troels Kristensen, Camilla Kramer,

Arne Munk, Per Spleth, Mogens Vestergaard (LIVEST 2023)

Conclusions

- production of young bulls has lower carbon footprint per kg meat than steers
- high feeding intensity and low age lead to lowest carbon footprint per kg meat
- Charolais crosses have lower carbon footprint per kg meat than Holsteins
- beef breed crosses prove their largest mitigation potential when fed at high intensity

How to improve sustainability in the future – i.e., lowering methane and carbon footprint of beef production

- Avoid diseases in calves – lower antibiotic medication, fewer deaths, and better performance
- Improve genetic potential of calves – use beef x dairy calves
- Reduce inefficient production systems – BUT utilize natural grasslands for cattle
- Improve feed ration – assure effective roughage and phase feeding of protein
- Improve eating quality of beef – ‘Less is more’

Holstein bulls and Beef x Holstein bulls at 7 mo

8 mo rosé veal calves	HOL bull	Beef x HOL bull
Carcass weight, kg	**162[a]**	**196[b]**
Dresing percentage	51.3[a]	55.5[c]
EUROP conformation	**3.5[a]**	**6.5[c]**

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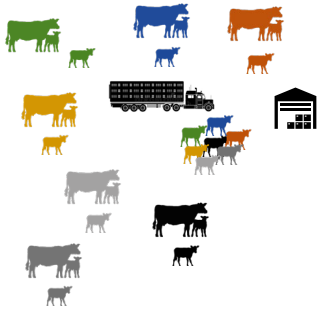
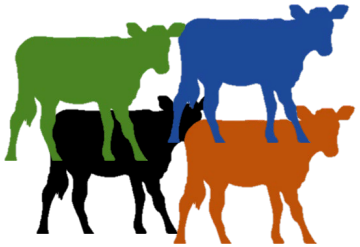
Calculate genetic value for the beef breed sires based on their crossbred progeny performance

X-Dairy producer (Traits and weights used in the X-Index)

Catalan Dairy Beef Production System 2023





Colostrum
MR
Concentrate

50-60 kg BW
2-4 wks of age

90-120 kg of BW
8-12 wks of age

330-350 kg
7-8 mo of age

450-470 kg BW
11-12 mo of age

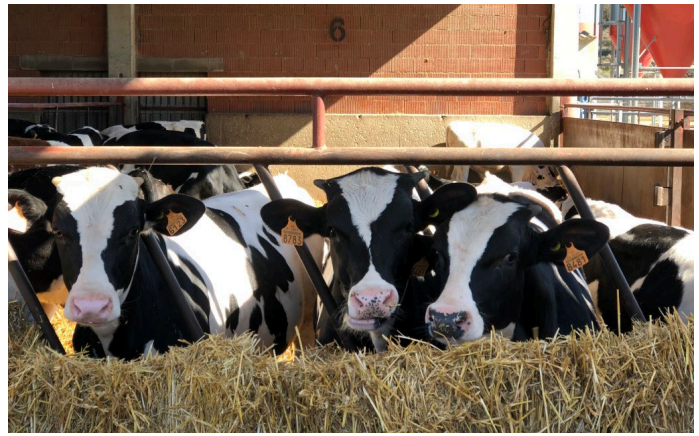
Concentration center- 2-5 days
Rehydration solution

Rearing phase- 6-8 wks
MR program- 6 wks weaning
Concentrate
Sometimes straw

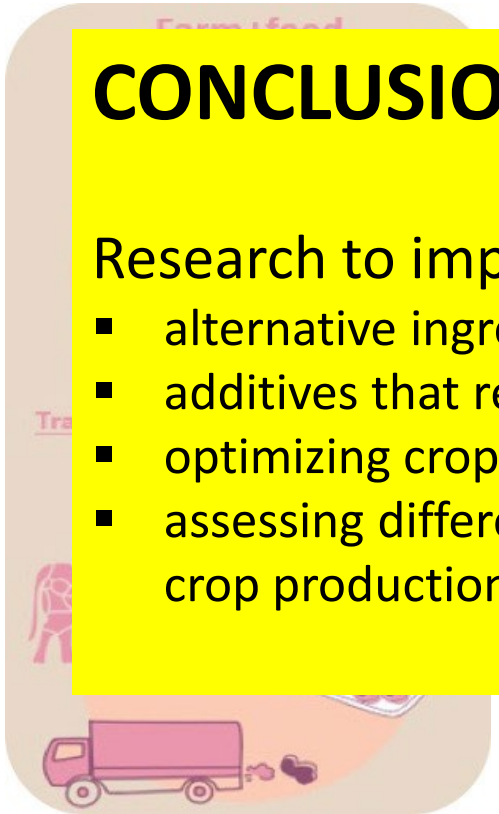
Growing phase 20 wks
Concentrate
Straw

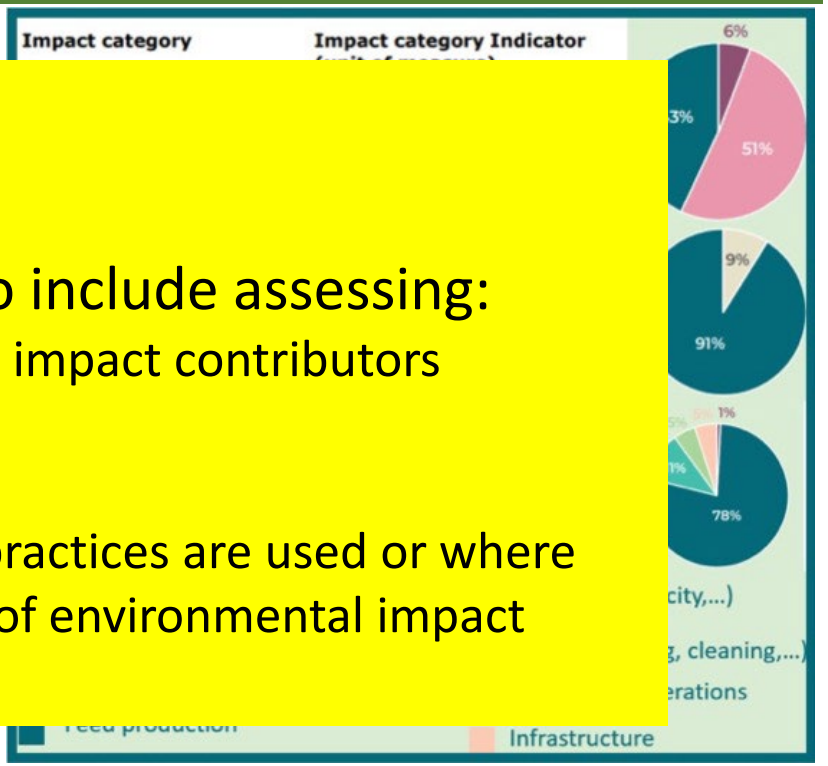
Finishing phase 12 wks
Concentrate
Straw

550-570 kg BW
13-14 mo of age



A case study of the environmental footprint of dairy-beef production in Catalonia: a tool to improve sustainability





CONCLUSIONS:

Research to improve beef production sustainability needs to include assessing:

- alternative ingredients that are nutritionally equivalent to the major impact contributors
- additives that reduce emissions
- optimizing crop production rates
- assessing different geographical origin where improved agronomic practices are used or where crop production takes place in ecosystems with lower susceptibility of environmental impact

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