Carbon footprint of Holstein bull calves fed two different total mixed rations from 4 to 12 months

Lisbeth Mogensen[2] & Mogens Vestergaard[1]
Aarhus University, [1]Dept Anim & Vet Sci and [2]Dept Agroecology
Foulum, 8830 Tjele
Denmark

INTRODUCTION

Despite the climate impact of 8-12 months rosé veal calf production is lower than most other beef types, it is still warranted that we find new ways of improving the climate impact of this production.

The objective was to estimate the carbon footprint (CF) of rosé veal production when calves were fed two different feed rations

Specifically, will feeding a **grass-based TMR** instead of a **corn cob-based TMR** lead to a higher CF per kg carcass?

MATERIAL & METHODS

64 Holstein male calves were fed and raised similarly from birth to 4 months, after which:

- **32 calves were fed a corn cob silage-based TMR (Yellow)**
- **32 calves were fed a grass clover-based TMR (Green)**

Yellow TMR included **40-50% corn cob silage,** share increasing with age. Also included barley, rape seed meal, and sugar beet pellets.

Green TMR included **25-35% 1st cut grass silage**, share increasing with age. Also included barley, fava beans (untoasted), rape seed, and rape seed meal.

Crude protein level was reduced twice during rearing (**16.5, 15.0, and 13.5% crude protein in phase 1, 2, and 3**)

DM%, crude protein, NDF, and NE were similar, but crude fat, starch, and sugar varied between the two TMRs

The two TMRs also differed in fill value and physical structure.

Feeding continued until slaughter at 12 months of age

FEED COMPOSITION OF TMR

Phase 2 (250 – 380 kg) % of DM	Yellow	Green
Corn cob silage	40.9	-
Barley, rolled	29.4	51.2
Rapeseed meal, 4% fat	25.6	-
Fava beans, raw, finely milled	-	14.4
Rapeseed, finely grounded	-	3.9
Grass silage, 1st cut	-	28.9
Sugar beet pellets	2.6	-
Mineral-vitamin-mixture	1.7	1.6
Water, added	14.0	-

CHEMICAL COMPOSITION OF TMR

NIR/NIT analyses (phase 1-3)	Yellow	Green	Diff.
DM, %	56.1	56.2	=
Crude Protein, g/kg DM	153	152	=
Crude fat, g/kg DM	**33**	**43**	**+30%**
Starch, g/kg DM	**358**	**300**	**-16%**
NDF, g/kg DM	205	208	=
Sugar, g/kg DM	**38**	**50**	**+32%**
Lignin etc., g/kg DM	103	116	+13%
Ash, g/kg DM	51	57	+12%
Net Energy, SFU/kg DM	1.08	1.11	+3%

M & M CONT.

- Calves were 155 kg at start of the experiment
- Calves were housed in 8 pens with 8 calves per pen
- Two Insentec feed bins per pen
- **Within pen, 4 calves had access to the Green TMR and 4 had access to the Yellow TMR**

RESULTS – ANIMAL PERFORMANCE

More details were presented at EAAP 2023, poster by Vestergaard et al....

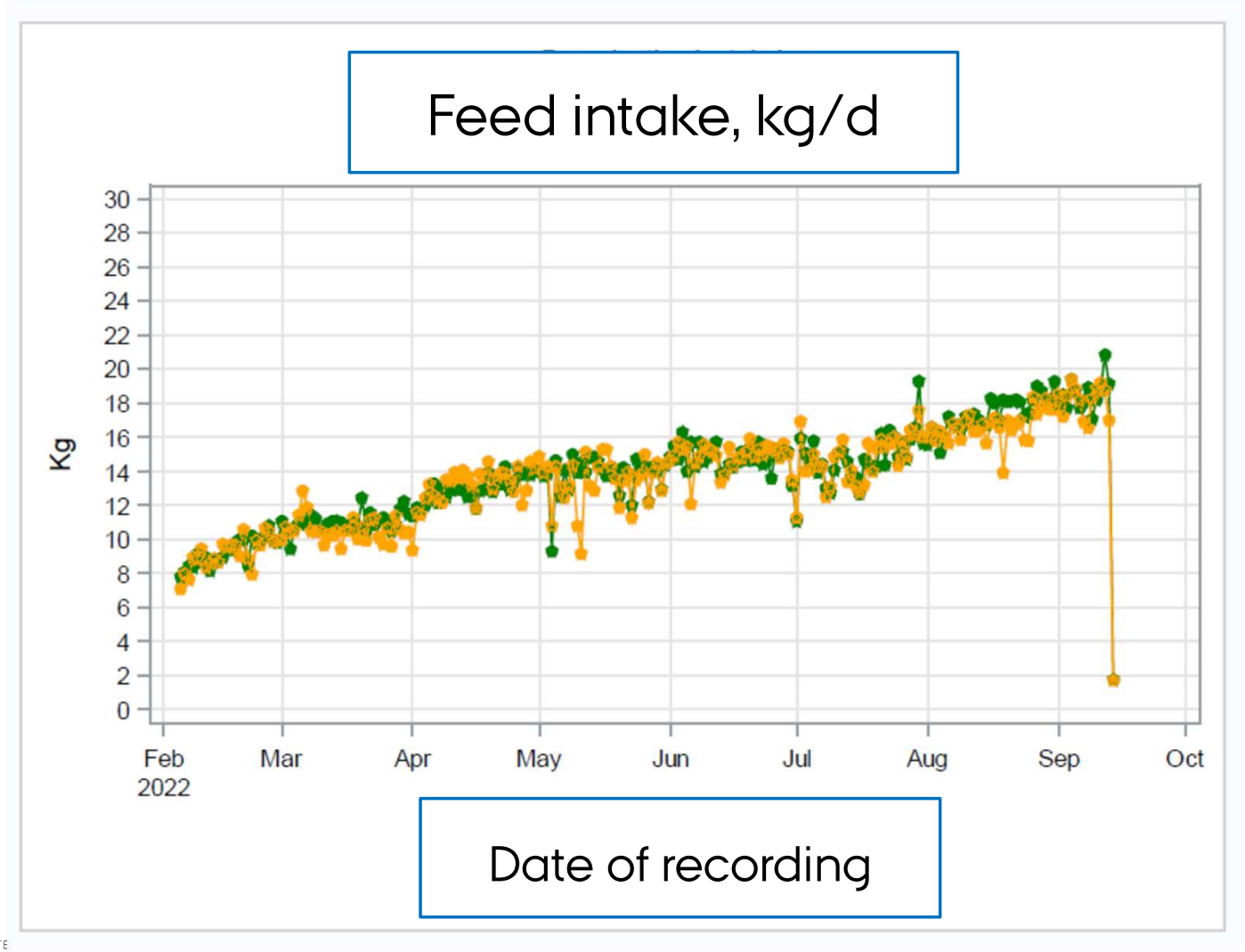
Feed intake (DMI and NEI) was similar for GRE and YEL.

ADG from birth to slaughter and carcass weight were higher (268 vs 261 kg) for GRE vs YEL ($P<0.03$).

Fatness and lean/fat colour were similar

Liver abscesses were seen in 2 GRE and 5 YEL calves

FEED INTAKE – NOT AFFECTED



EAAP 2023

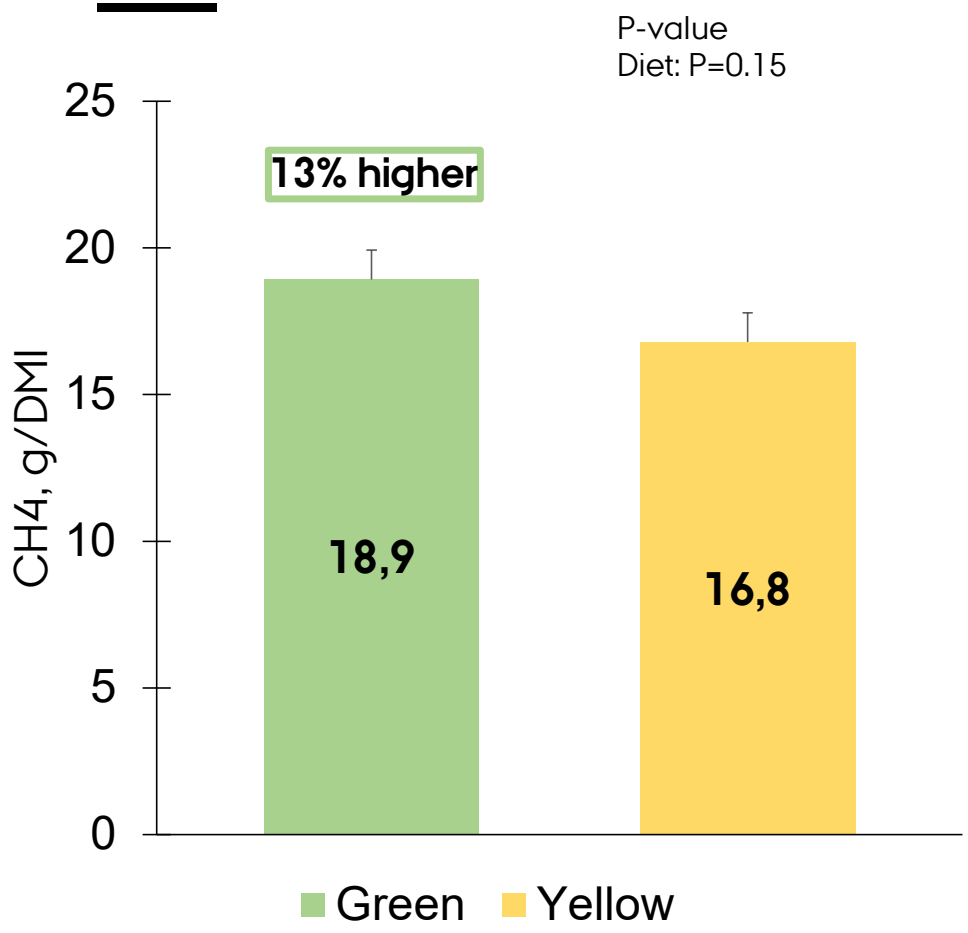
Methane emission from rosé veal calves feed a corn cob silage-based or grass silage-based ration

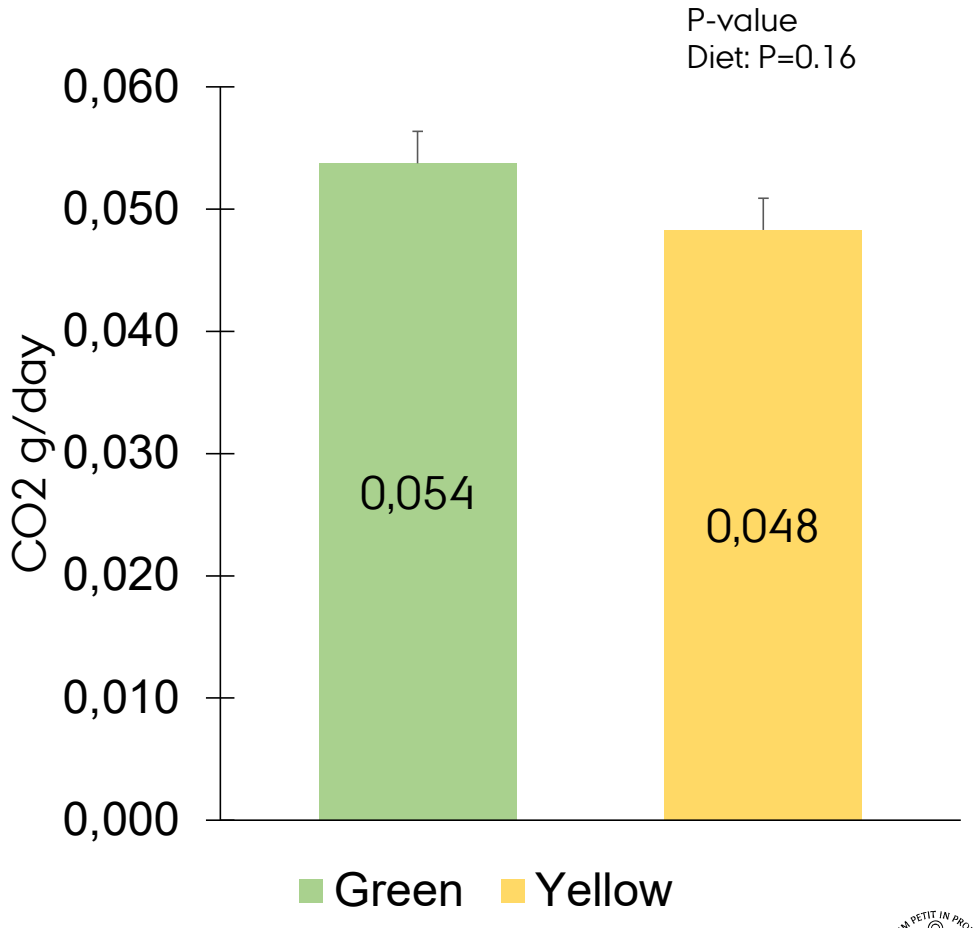
A.L.F. Hellwing and M. Vestergaard

Department of Animal and Veterinary Sciences, Aarhus University, Campus Viborg, AU Foulum, Blichers Allé 20, 8830 Tjele, Denmark.

AARHUS UNIVERSITY
DEPARTMENT OF ANIMAL AND VETERINARY SCIENCES

EMISSIONS – METHANE CHAMBER DATA





PERFORMANCE – HIGHER ADG WITH GREEN

	Yellow	Green	P<
# bull calves	29	32	
Age at start, d	117	116	ns
LW at start, kg	157	156	ns
LW at slaughter, kg	**492**	**507**	**0.06**
Feed intake, kg DM/d	6.85	6.70	-
Net Energy Intake, SFU/dg	**7.35**	**7.50**	**-**
ADG, kg/d	**1.36**	**1.44**	**0.01**
Feed efficiency, SFU[1]/kg ADG	5.35	5.20	-
ADG, birth - slaughter, kg/d	1.25	1.30	0.03

LEAN AND FAT COLOUR – SAME SCORING

LCA – METHOD AND DATA USED

Tabulated values for CF of the various feedstuffs were used in the Life Cycle Assessment (LCA) (*Mogensen et al. 2018, DCA report #116*).

Conversion factors used: 265 kg CO_2e per kg N_20 til CO_2e and 25.5 kg CO_2e per kg CH_4 (*IPCC, 2013*)

The contribution of feeds and feed intake in each of the three phases (phase-feeding) used

Methane production were measured in open-circuit respiration chambers at 8 months of age (used to estimate overall methane production from 4 to 12 months)

LCA - RESULTS

The contribution of feedstuffs to CF of meat including soil C sequestration was 7% lower for Green vs Yellow

The contribution from manure was slightly lower for Green vs Yellow

The contribution from enteric methane was 12% higher for Green vs Yellow

Total CF was 3040 (Green) vs 2006 (Yellow) kg CO_2e per calf produced (excl. soil changes)

Total CF was 2858 (Green) vs 2861 (Yellow) kg CO_2e per calf produced (incl. soil changes)

When CF was expressed per kg carcass, Green was 3% lower than YellowL (10.7 vs 11.0 kg CO_2e).

CARBON FOOTPRINT

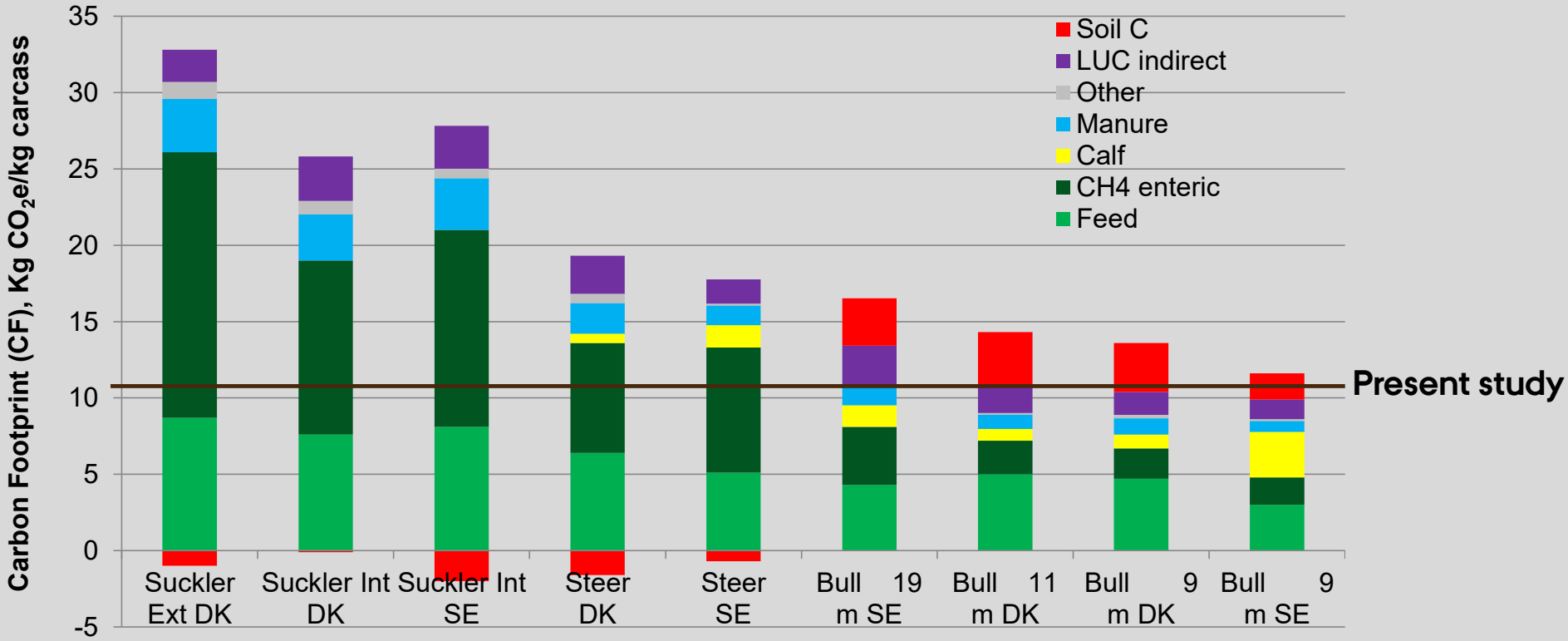
Kg CO_2e	Yellow	Green	Diff.
Inputs:			
CF of feed produced	1072	1148	
CF of processing	100	24	
CF of transportation	89	42	
CF of feed	**1262**	**1214**	**-4%**
Energy, straw, and calf produced	222	222	
Emissions:			
CH_4, enteric	**806**	**917**	**+13%**
CH_4, manure	300	288	
N_2O, stable and storage	323	310	
Indirect N_2O	80	77	
Application manure>fertilizer	91	87	
CF in total per calf (before soil changes from feed and manure production)	**3006**	**3040**	**+1%**

CARBON FOOTPRINT CONT.

Kg CO_2e	Yellow	Green	Diff.
CF in total per calf (before soil changes)	**3006**	**3040**	**+1%**
Feed production, C released into soil	167	118	
Manure production, C sequestrated into soil	-312	-300	
CF in total per calf (with C related to soil)	**2861**	**2858**	**0%**
CF per kg carcass:			
Without C in soil	**11.5**	**11.3**	**-2%**
With C in soil	**11.0**	**10.7**	**-3%**
Land use, m^2 per kg carcass	11.6	13.5	+17
Biodiversity loss#, PDF index per kg carcass	7.65	7.65	

#European forrest baseline

CF of beef production systems in scandinavia



Mogensen, Kristensen, Nielsen, Henriksson, Svensson, Vestergaard, Spleth, Hessle & Lindahl, 2015, LIVEST

CONCLUSIONS

Overall, this LCA confirms that rosé veal calf production has a low CF compared to other beef systems

- A high growth rate, a high feed efficiency, and a low age at slaughter are main drivers

There was a marked effect of feed ration, with a 13% increase in enteric methane with Green vs. Yellow TMR

- Despite the methane effect, the two feed rations led to a similar CF per kg meat as the contributions from feed, manure and C-sequestration counterbalanced this.

The use of land for feed production will be 17% higher for Green vs. Yellow TMR feeding

Considering the positive health effects on rumen and liver for Green TMR (not covered herein), this feeding might be the most sustainable feeding of the two TMRs tested

Thank you for listening!
Lisbeth and I are ready to take questions!