CARBON FOOTPRINT FROM ENTERIC METHANE AND FEED PRODUCTION WHEN FEEDING EXTREME AMOUNTS OF CONCENTRATE

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BACKGROUND

- A severe drought in Northern Europe raised the question about how to feed dairy cows, when there is a lack of forage
    - Can extreme amounts of concentrate be used to replace forage
    - Can milk production and rumen function be sustained
    - What is the impact on enteric methane
    - Is there a breed difference in these effects
    - What is the total carbon footprint from feed and enteric methane

AIM

- The aim was to study the effects of feeding extreme concentrate diets to Holstein and Jersey cows with regard to
  - Dry matter intake, ECM yield and milk fat percentage
  - VFA composition in the rumen
  - Enteric methane emission
  - Carbon footprint from producing high concentrate diets
  - Total carbon footprint from feed and enteric methane

MATERIAL AND METHODS

- Two experiments were conducted with the same feedstuff composition

A **production trial** with 13 Holstein and 14 Jersey cows per diet for 8 weeks

An **intensive trial** with 4 Holstein and 4 Jersey cows per diet for 7 weeks to measure methane emission in metabolism chambers

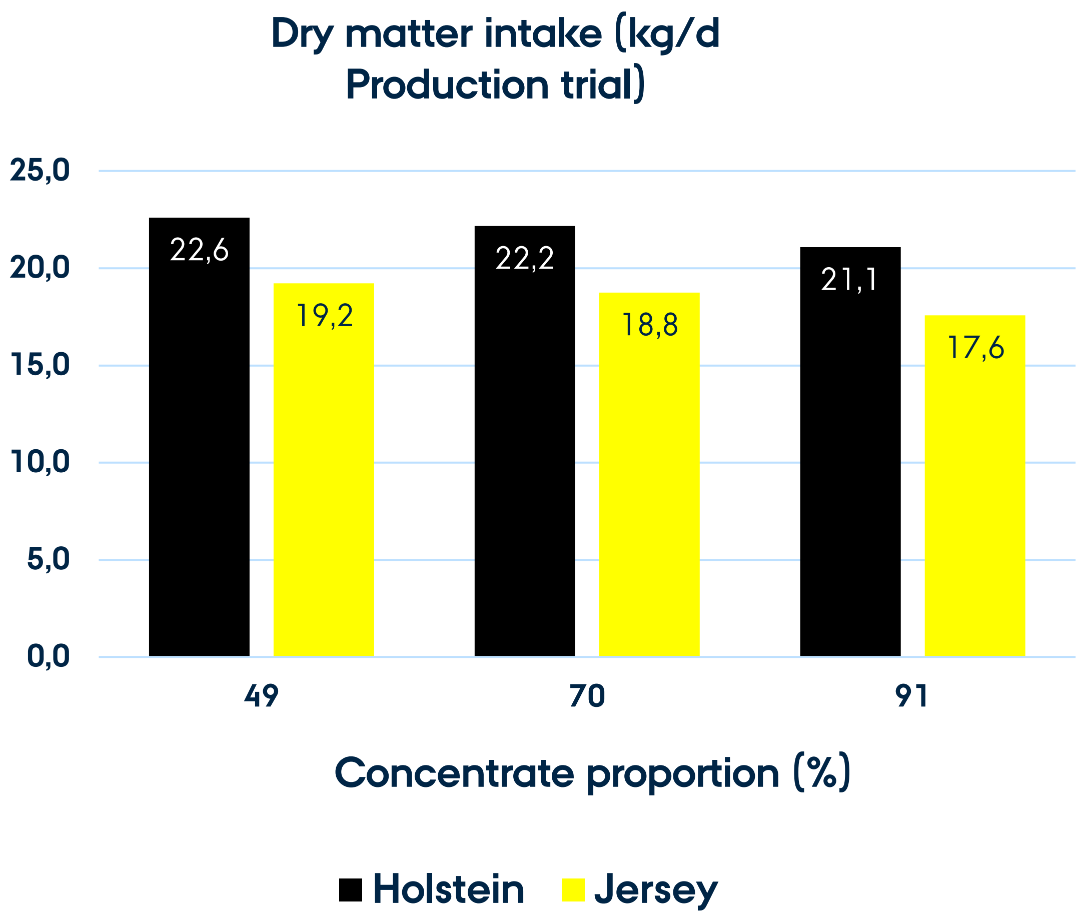
- Production data taken from the production trial were combined with enteric methane pr. kg DMI from the intensive study
- A Life cycle analyses (LCA) for carbon footprint (CF) was based on production data from the production trial and standard values for CF for production of each feedstuff
- LandUseChange (LUC) was not included in the calculations

DIETS

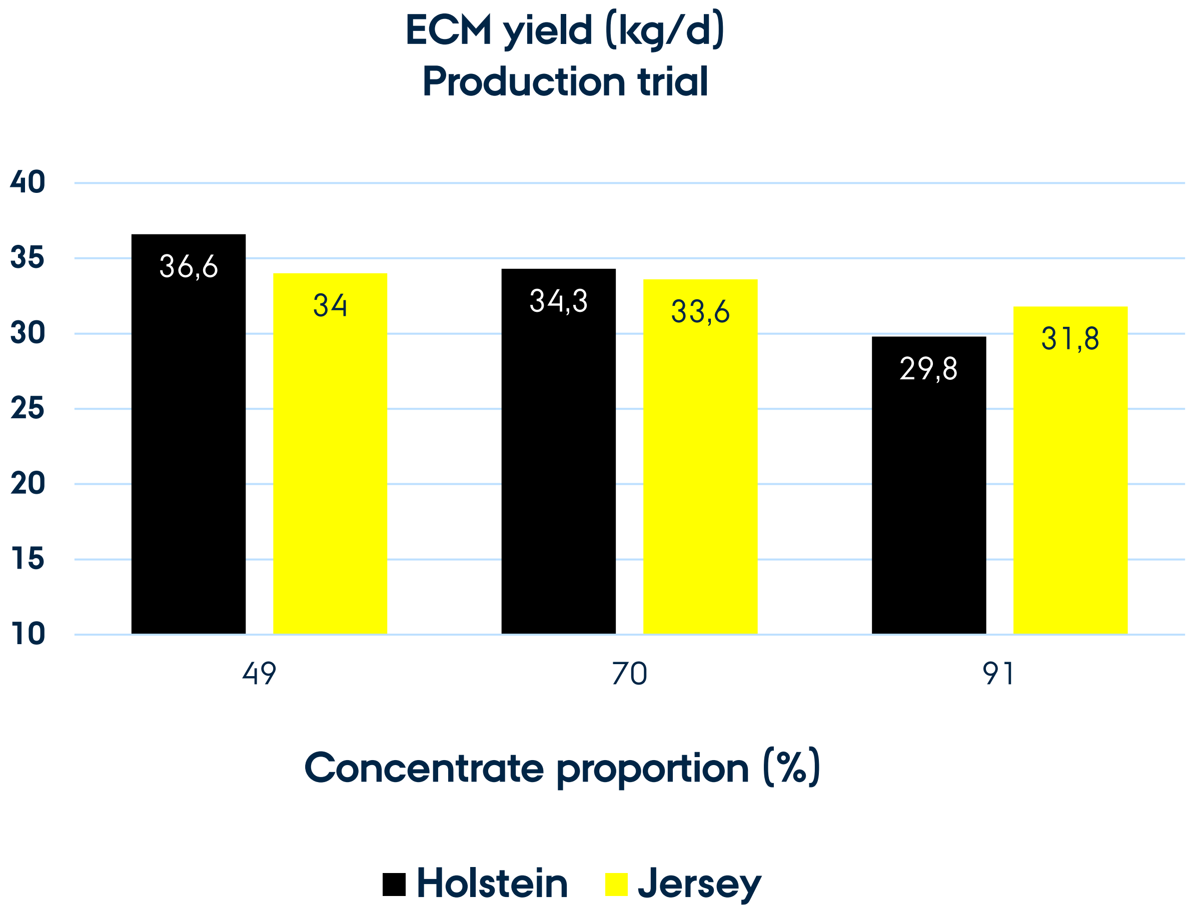
	Diet		
	C49	C70	C91
Roughage-to-concentrate ratio	**51:49**	**30:70**	**9:91**
Dietary composition (g/kg DM)			
Grass/clover silage	255	128	0
Corn silage	243	121	0.0
Soybean meal	54	27	0
AMS concentrate mixture	109	109	109
Chopped barley straw	13	50	88
Dried beet pulp	120	161	201
Barley	112	121	130
Wheat, NaOH treated	0	77	155
Dried distillers grain	0	69	138
Rape seed cake	79	106	134
Molasses (sugar cane)	4	13	21
Palm fatty acids distillate	2.1	2.9	3.6
Vitamins, minerals, $NaHCO_3$, salt, lime	6.9	12.8	18.8

DIETS

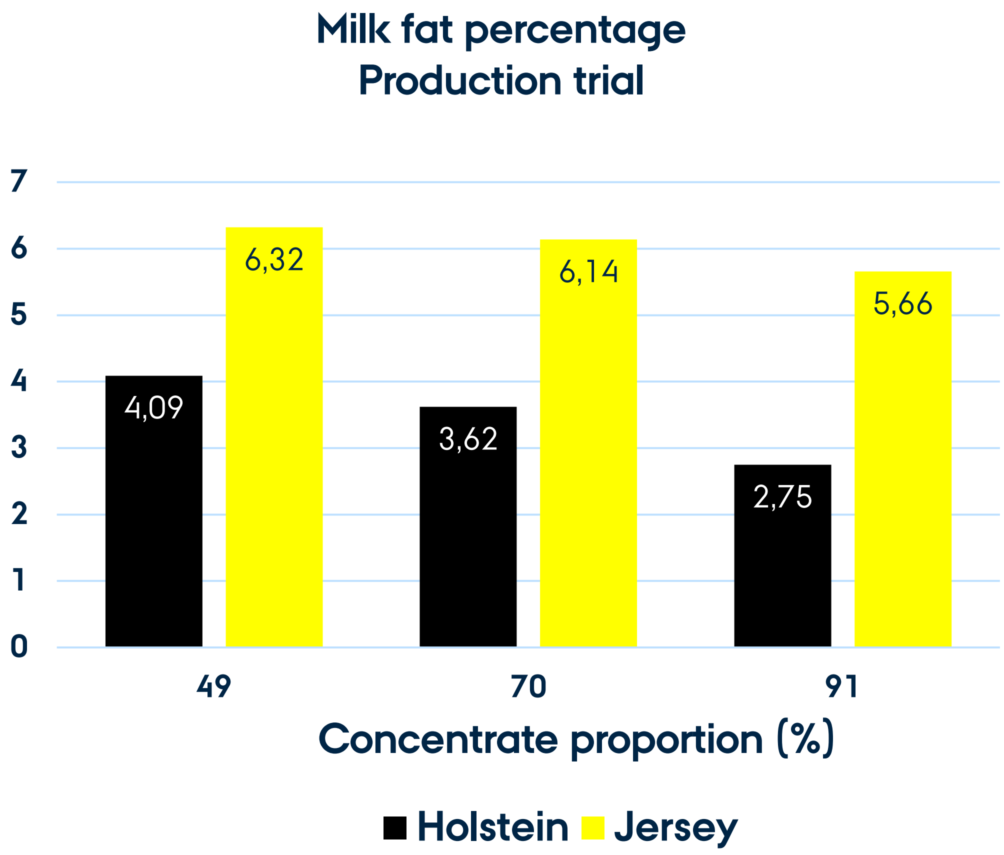
	Diet		
	C49	**C70**	**C91**
DM (g/kg of fresh matter)	404	408	400
(g/kg DM):			
Ash	58	61	63
CP	159	164	171
Crude fat	36	39	42
Starch	173	194	223
NDF	306	278	248
iNDF	76	78	78



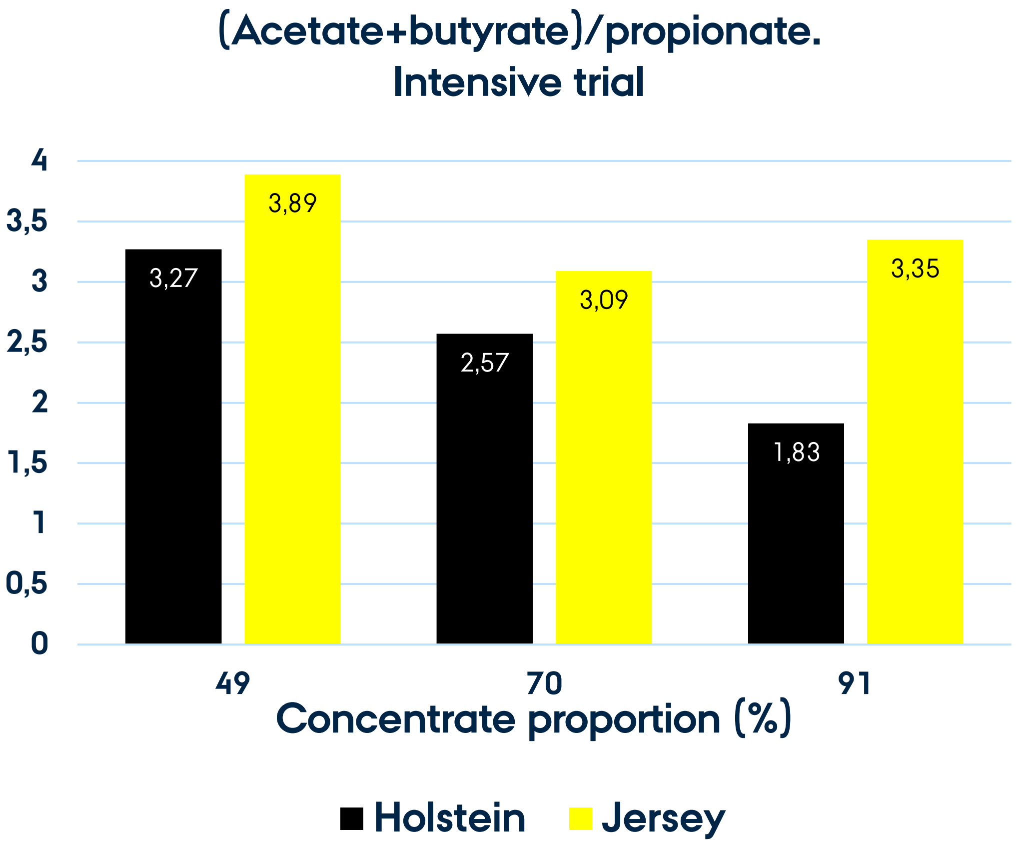
P-values
Diet 0.001
Breed 0.001
Diet x Breed 1.0



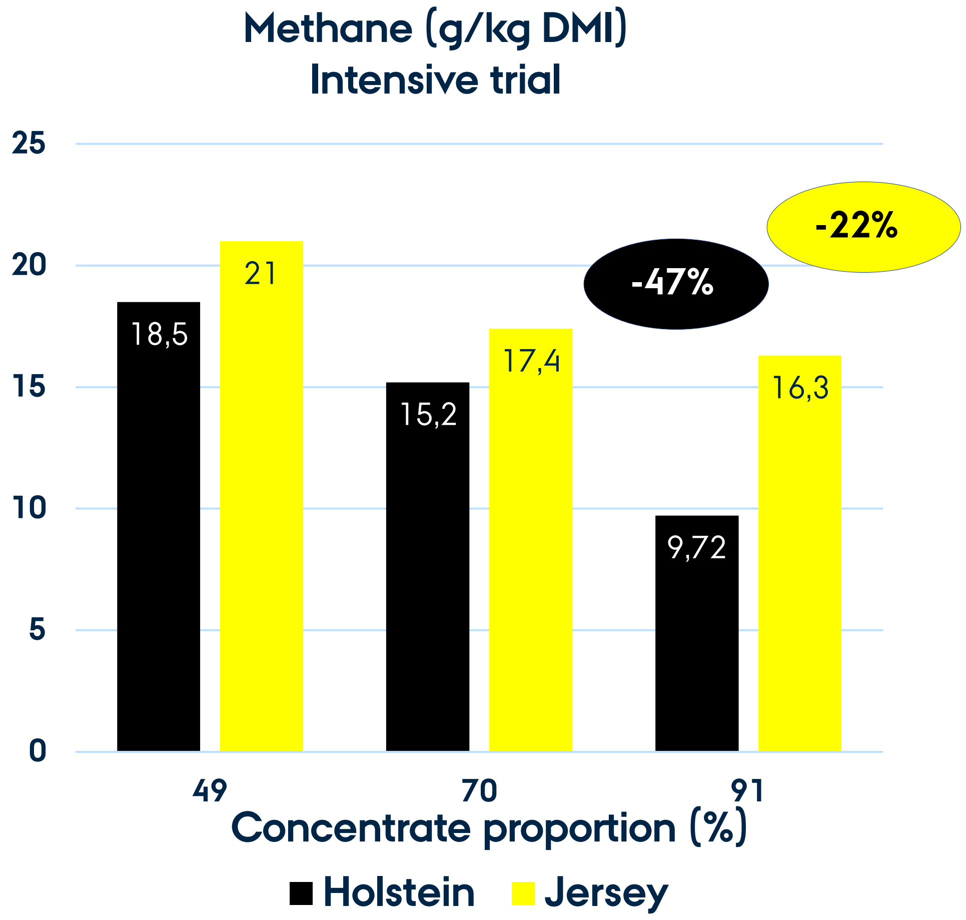
P-values
Diet 0.001
Breed 0.42
Diet x Breed 0.02

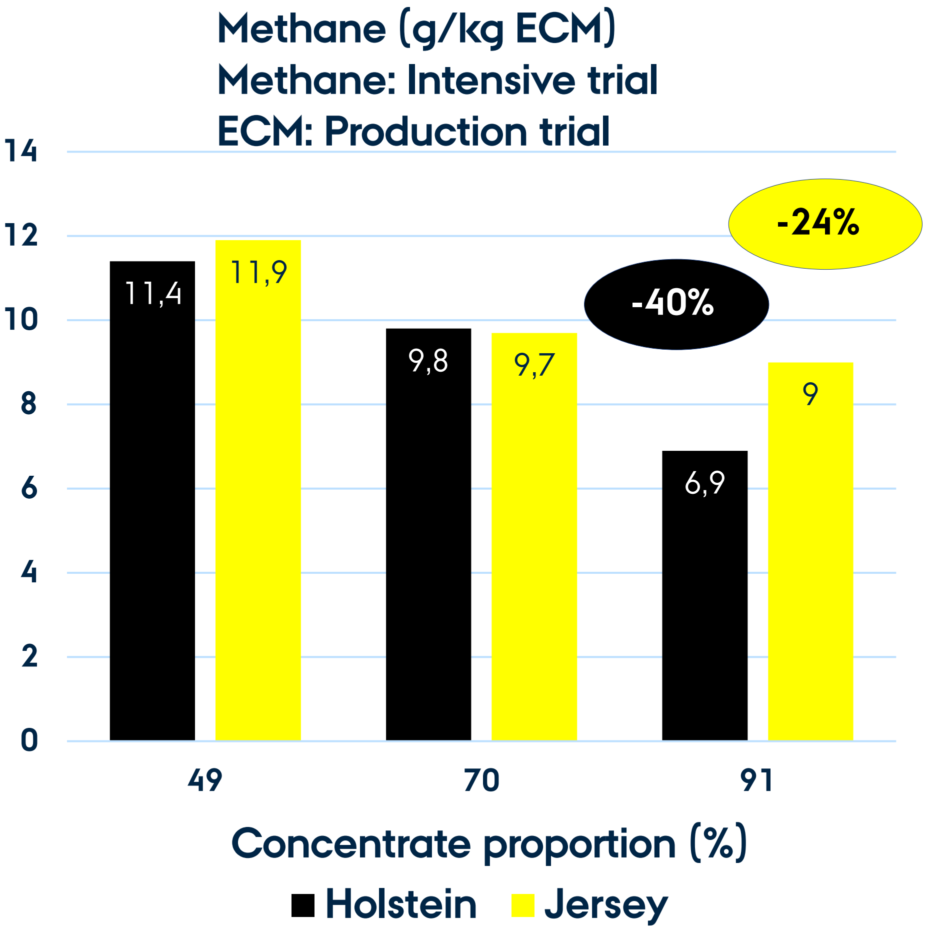


P-values	
Diet	0.001
Breed	0.001
Diet x Breed	0.001



P-values	
Diet	0.02
Breed	0.001
Diet x Breed	0.19





P-values

Diet	**0.001**
Breed	**0.001**
Diet x Breed	**0.03**

Carbon footprint from feed production ($g\ CO_{2eq.}$ per kg DM)

	Growing, transportation, processing	Growing, transportation, processing, carbon sequestration
Chopped barley straw	60	71
Grass/clover silage	418	328
Corn silage	263	359
Soybean meal	631	760
Molasses	379	392
Barley	522	676
Wheat	480	479
Dried destillers grain	839	800
Rape seed cake	510	554
Dried beet pulp	666	674

Carbon footprint (CF) from enteric methane and other factors

	Holstein			Jersey		
	C49	C70	C91	C49	C70	C91
From enteric methane (kg CO_2eq. per kg DMI)	0.47	0.38	0.24	0.53	0.44	0.41
% change from C49		-18	-47		-17	-22
[redacted]						

NB!
Errors in % changes in abstract

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Feed production, transportaion, energy, manure, carbon sequestration (kg CO_2eq. per kg DMI)	0,63	0,67	0,73	0,65	0,70	0,76
% change from C49		+7	+16		+7	+16
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]		[redacted]	[redacted]		[redacted]	[redacted]
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Total CF (kg CO_2eq. per kg DMI)	1.09	1.05	0.97	1.18	1.13	1.17
% change from C49		-4	-11		-4	-1
[redacted]		[redacted]	[redacted]		[redacted]	[redacted]

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Total CF per kg ECM Change from C49		+1	+2		-5	-3

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CONCLUSIONS

- Jersey had the highest methane emission per kg DMI and per kg ECM for all diets
- Holstein decreased methane emission more and altered rumen VFA pattern and milk fat percentage more than Jersey with increased concentrate proportion
- With the chosen concentrate feedstuffs, the carbon footprint of the feed increased with increased concentrate proportion
- The reduced carbon footprint due to decreased enteric methane with increased concentrate was almost counteracted by the increased carbon footprint of the feed
- If higher concentrate proportion should be used to reduce methane emission, it is important to use feedstuffs with a low carbon footprint and to ensure normal rumen health

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