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Impact of concentrate supplementation on two Holstein cow strains in a pasture-based feeding system

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Introduction

Is it necessary to feed concentrate to ruminants in a pasture-based feeding system?

Reasons against:

→ Ethical (feed no food)

→ Physiological (fibre digestion)

→ Economical (high costs)

Reasons for:

→ Meet nutritional demand (avoid strong negative energy balances)

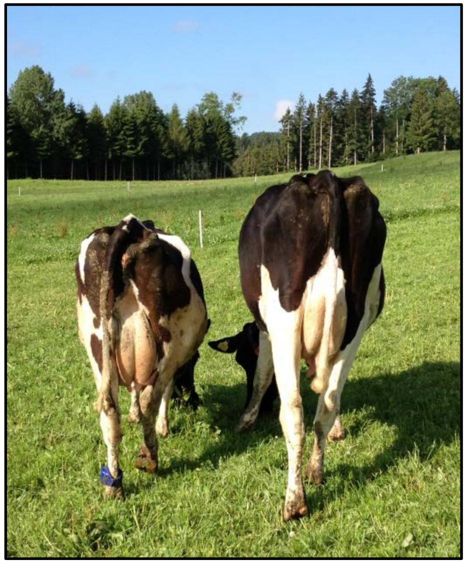
→ Higher milk yield (use genetic potential)

→ Independent from pasture offer

Introduction

Using the best fitting cow strain

- New Zealand Holstein cows are bred for efficient use of pasture.
- They differ in body condition score and body weight (BW) compared to other Holstein-Friesian cow strains. (McCarthy et al., 2007)
- Cows with different BW may differ in grazing efficiency. (HOLMES et al., 1999)



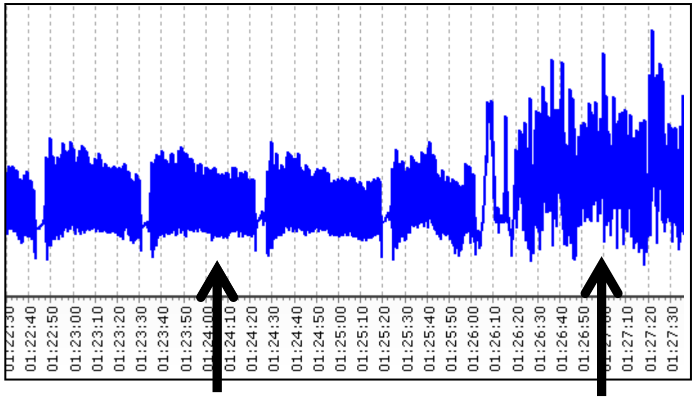
Material and methods

- Place: Organic farm in Switzerland (824 m.a.s.l.)
- Experimental design: Crossover study
- Animals:
  - 12 Swiss Holstein cows (HCH)
  - 12 Holstein cows of New Zealand origin (HNZ)
  - BW: HCH, 621 ± 100 kg
    HNZ, 567 ± 83 kg
  - 91 ± 18 d in milk
- Feed:
  - Pasture (6.5 MJ NEL/kg DM, 173 g CP/kg DM)
  - 0 kg or 6 kg of cereal grain mix concentrate (Conc) offered in 2 meals

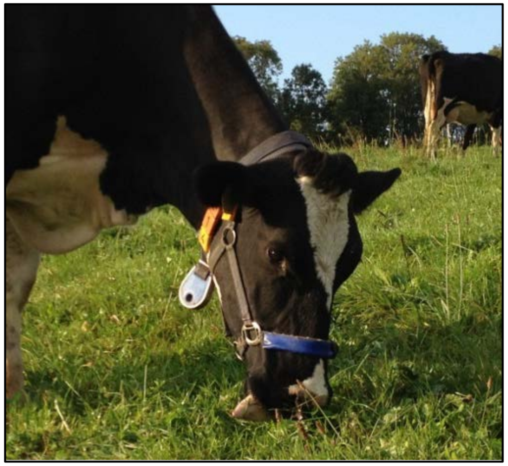
NEL = netto energy lactation CP = crude protein (N * 6.25)

Material and methods

- Measurements:
  - Milk yield and milk composition
  - Feed intake → n-alkane double indicator technique (MAYES et al., 1986)
  - Eating behaviour → chewing recorders (NYDEGGER et al., 2011)
  - Blood parameters
- Statistic: Mixed-model analyses concerning cow strain and concentrate



Ruminating Eating



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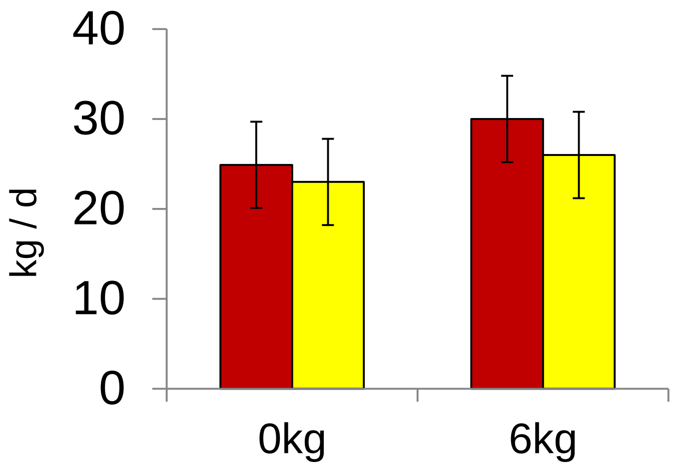
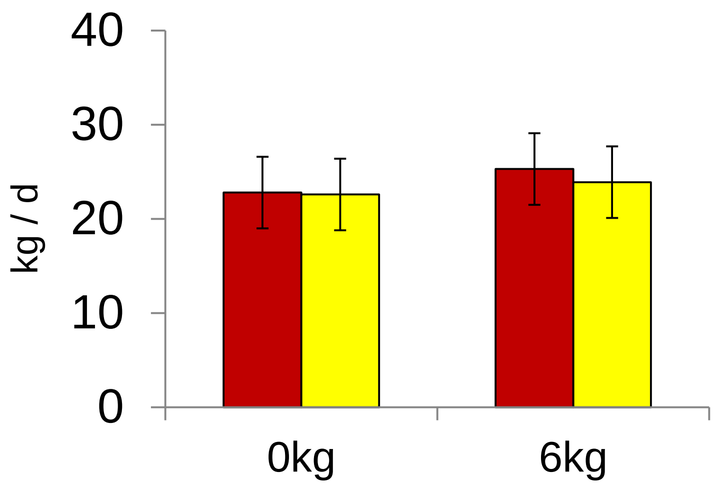
Results: Milk yield

Milk yield



Energy corrected milk yield (ECM)



Milk yield:

P (Conc) < 0.001; *P* (Cow) < 0.05
P (Cow x Conc) < 0.05

HCH =

HNZ =

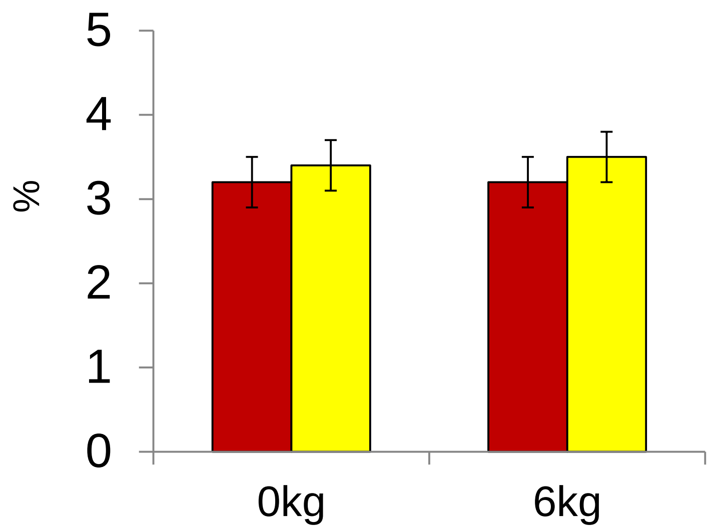
ECM:

P (Conc) < 0.001; *P* (Cow) = 0.41
P (Cow x Conc) = 0.16

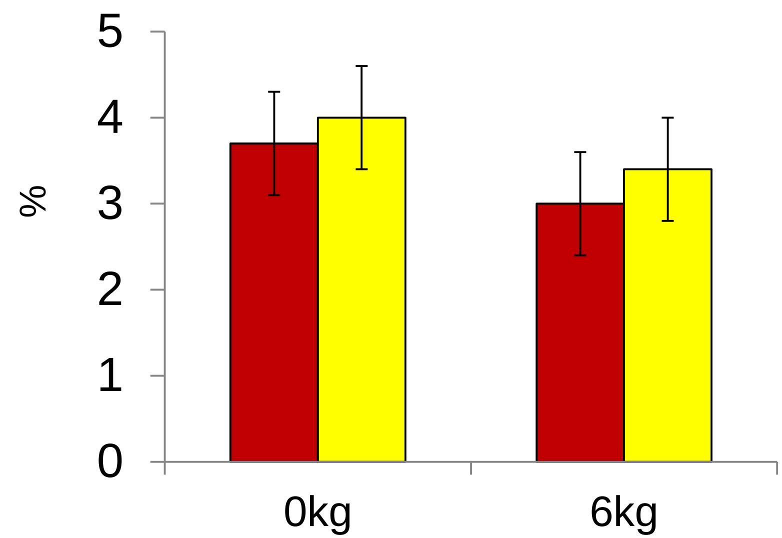
HCH produced more (*P*<0.05) milk per kg concentrate than HNZ (0.8 vs. 0.5 kg/kg)

Results: Milk composition

Milk protein



Milk fat



Milk protein:

P (Conc) = 0.13
P (Cow) < 0.01

HCH = (red)

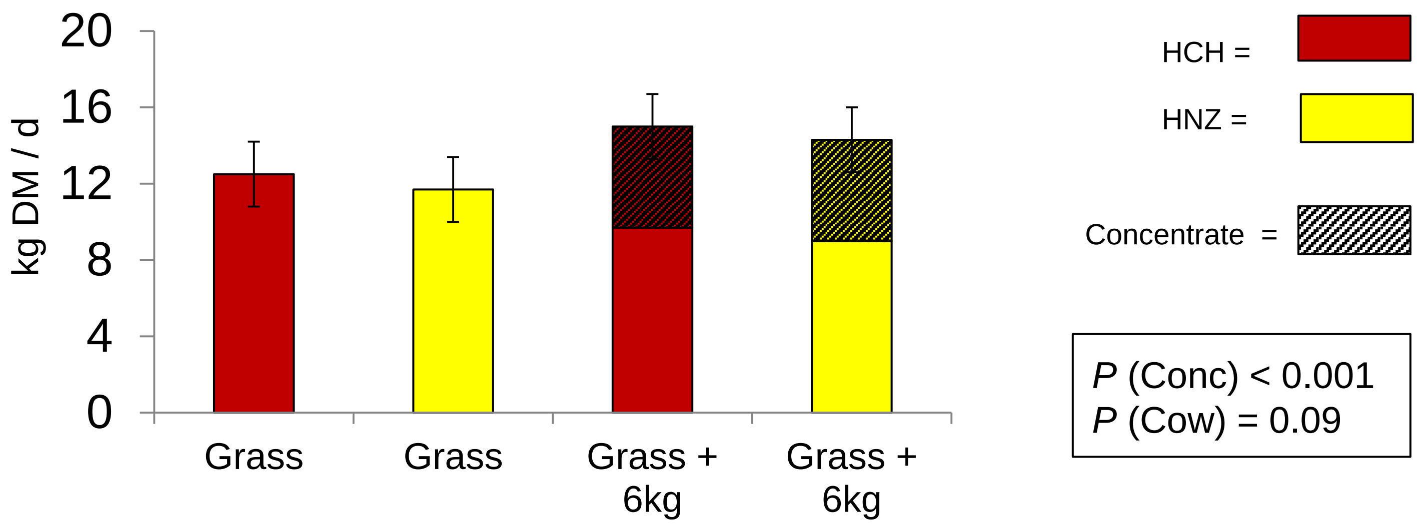
HNZ = (yellow)

Milk fat:

P (Conc) < 0.001
P (Cow) = 0.08

Results: Feed intake

Feed intake



P (Conc) < 0.001
P (Cow) = 0.09

Items	Conc 0kg		Conc 6kg			*P*-Values	
	HCH	**HNZ**	**HCH**	**HNZ**	**SD**	**Cow**	**Conc**
Intake / $BW^{0.75}$ (kg DM / 100 kg)	10.4	10.3	12.5	12.5	0.9	0.84	**< 0.001**
ECM / intake (kg / kg)	1.84	1.95	1.69	1.67	0.23	0.52	**< 0.001**

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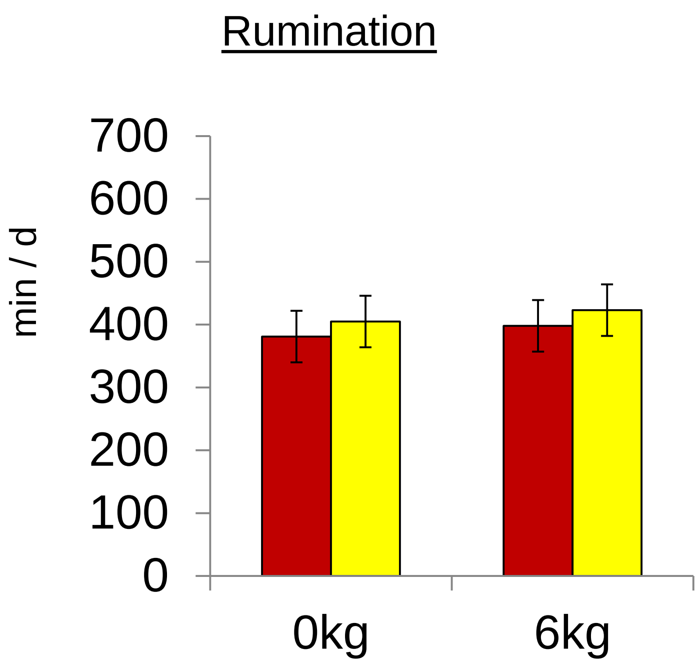
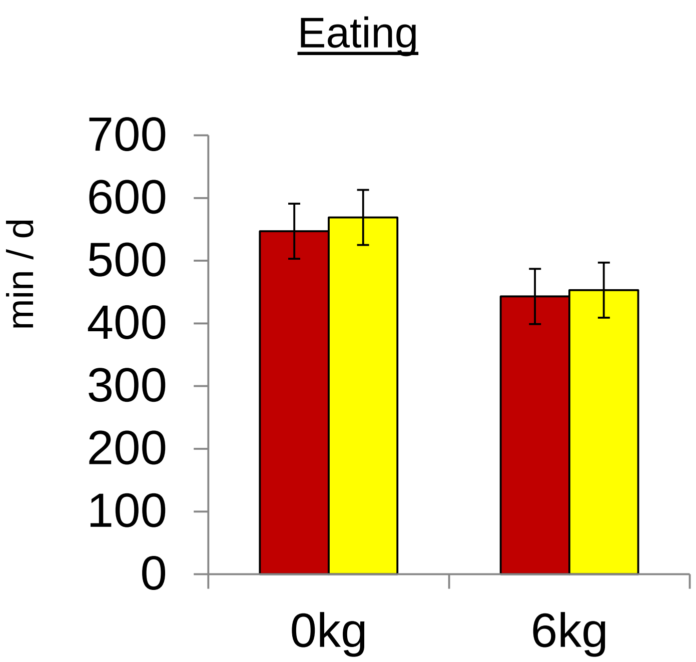
Results: Eating behaviour





Rumination: *P* (Conc) = 0.15
P (Cow) < 0.05

HCH =

HNZ =

Eating: *P* (Conc) < 0.001
P (Cow) = 0.20

No differences in bites per bolus (n/d): *P* (Conc) = 0.26; *P* (Cow) = 0.83

Results: Blood parameters

Items	Conc 0kg		Conc 6kg			*P*-Values	
	HCH	HNZ	HCH	HNZ	SD	Cow	Conc
Glucose (mmol / l)	3.15	3.31	3.25	3.46	0.18	**< 0.01**	**< 0.01**
Urea (mmol / l)	4.86	4.77	3.68	3.73	0.9	0.95	**< 0.001**
BHB (mmol / l)	0.91	0.82	0.68	0.69	0.17	0.45	**< 0.001**
NEFA (mmol / l)	0.12	0.14	0.08	0.09	0.05	0.48	**< 0.001**

BHB = ^{2} -hydroxybutyrate NEFA = non-esterified fatty acids

Conclusion

- HCH were better able to use concentrate for extra milk production → no differences without concentrate supplementation between HCH and HNZ
- HNZ had longer rumination time → better fibre digestibility? → no effect on feed conversion efficiency
- With supplementation:
  - Low milk fat content → changes in ruminal fermentation, but no difference in bites per bolus → indicate adequate fibre content in diet or inadequate indicator?
  - Less time spent eating, but total DM intake increased → more energy for milk production, but extra milk production less than 1 kg milk per kg concentrate → economical aspect
- Without supplementation: blood parameters indicate a small energy deficit

Thank you for your attention!

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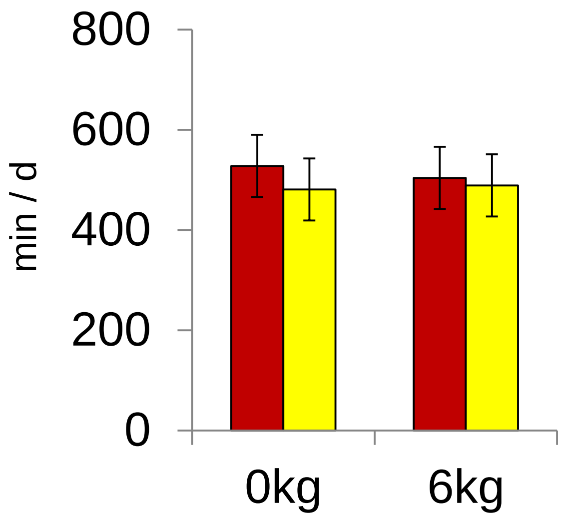
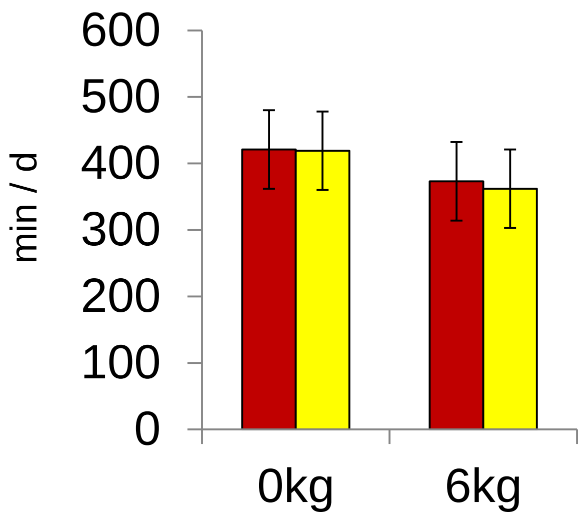
Results: Physical activity

HCH =
HNZ =

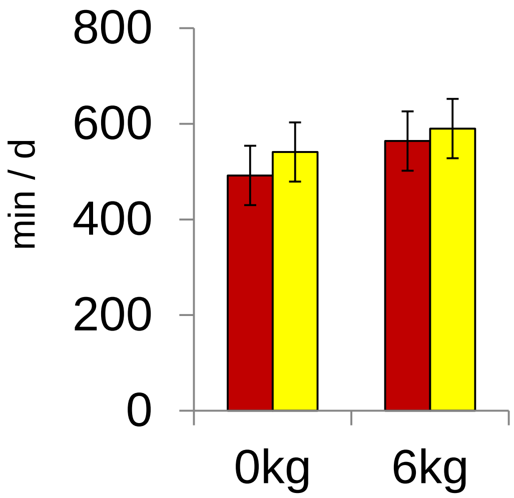
Standing



Moving



Lying



Standing:

P (Conc) = 0.39
P (Cow) = 0.31

Moving:

P (Conc) < 0.001
P (Cow) = 0.74

Lying:

P (Conc) < 0.001
P (Cow) = 0.053

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Results: Eating behaviour

Items	Conc 0kg		Conc 6kg			*P*-Values	
	HCH	HNZ	HCH	HNZ	SD	Cow	Conc
Bites per boli (n / d)	51.5	53.8	54.9	53.4	5	0.83	0.26
Bites eating (n / d)	41’232	42’102	32’070	32’865	3’859	0.51	**< 0.001**
Rumination mastication (n / d)	27’661	29’796	28’888	31’204	3’932	**< 0.05**	0.20