

Phenotypic and genetic variability of methane emissions and milk fatty acid contents of Walloon Holstein dairy cows

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Background

- Enteric methane (CH₄) emissions of cows
 - Losses of dietary energy
 - Contribution to climate change
- Growing interest in reducing CH₄ emissions
- Milk fatty acid (FA) profile is influenced by rumen fermentations

Material & Methods

Data

- Prediction of CH₄ emissions & milk FA contents from milk mid-infrared (MIR) spectra
 - Vanlierde et al., 2013. *Advances in Animal Biosciences*, 4(2), 433.
 - Soyeurt et al., 2011. *Journal of Dairy Science*, 94(4), 1657-1667.
- ≥ 5 records/cow
- ≥ 20 cows/herd
- 161,681 MIR spectra collected between January 2007 and June 2013
- From 5 to 305 days in milk (DIM)
- 22,642 first-parity Walloon Holstein cows from 489 herds
- Pedigree file
 - 79,736 animals

Model

- Bivariate random regression test-day models
 - Resolved using REMLF90 (Misztal, 2012)
 - MIR CH₄ (g/d) & 1 FA trait

$$y = Xb + Q (Wh + Zp + Za) + e$$

where y = Vector of observations

b = Vector of fixed effects

→ Herd x test-day

→ Classes of days in milk

→ Gestation stage x lactation stage

→ Lactation stage x age at calving x season of calving

h = Vector of herd x year of calving random effects

p = Vector of permanent environmental random effects

a = Vector of additive genetic random effects

Q = Covariate matrix for 2nd order Legendre polynomials

X , W & Z = Incidence matrices

e = Error

Objective: Estimation of phenotypic and genetic variability of CH₄ emissions & FA contents of milk

Conclusions

- SFA & SCFA are higher genetically & phenotypically correlated with MIR CH₄ emissions than UFA & LCFA
- These correlations reflected indirect link between milk FA & CH₄ emissions through rumen metabolism

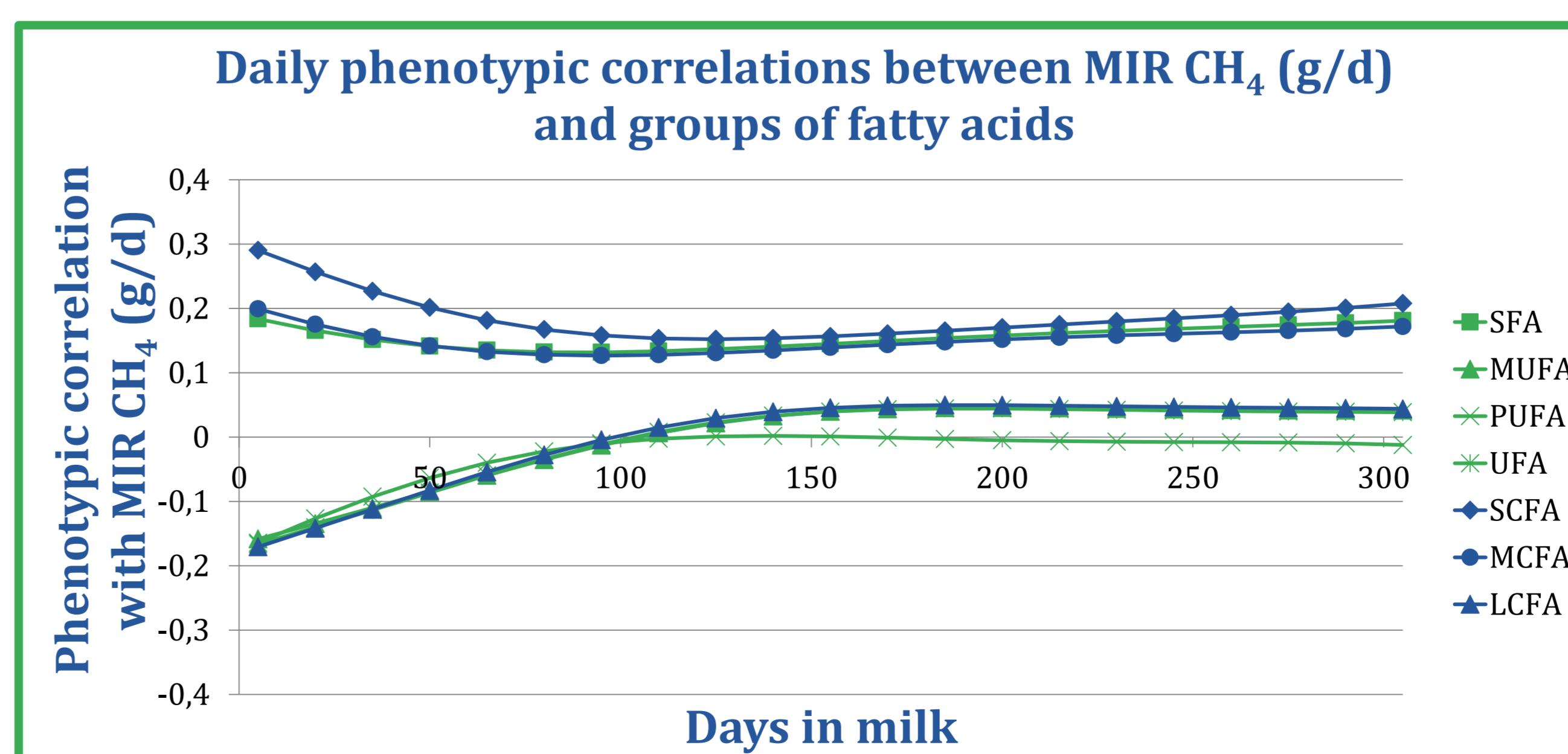
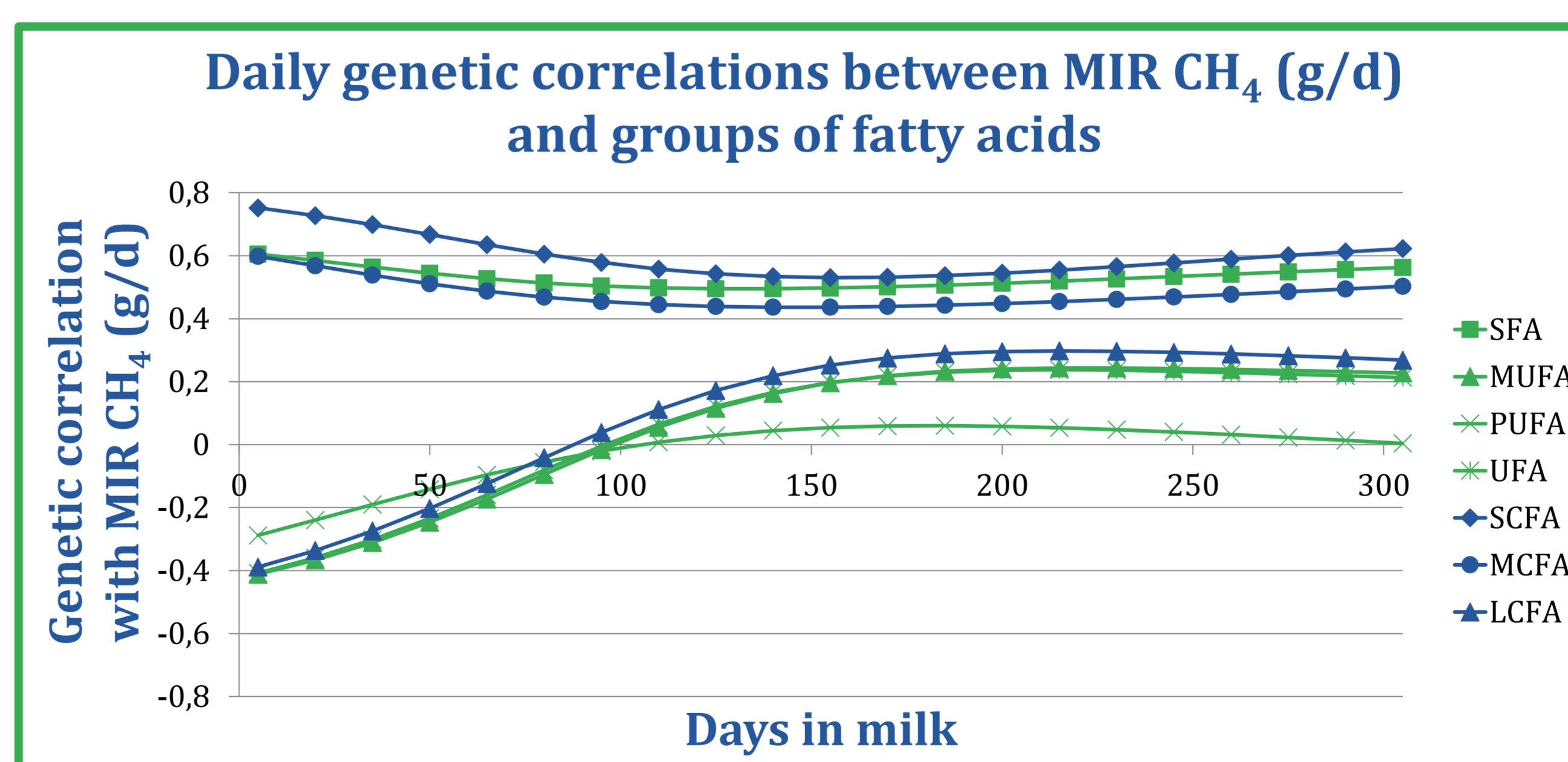
Results

- Heritabilities of FA and MIR CH₄ emissions

Trait	h ²	Trait	h ²
MIR CH ₄ (g/d)	0.11	C18:0 (g/dL of milk)	0.19
C4:0 (g/dL of milk)	0.34	C18:1 <i>cis</i> -9 (g/dL of milk)	0.15
C6:0 (g/dL of milk)	0.41	SFA (g/dL of milk)	0.42
C8:0 (g/dL of milk)	0.41	MUFA (g/dL of milk)	0.19
C10:0 (g/dL of milk)	0.40	PUFA (g/dL of milk)	0.30
C12:0 (g/dL of milk)	0.41	UFA (g/dL of milk)	0.20
C14:0 (g/dL of milk)	0.43	SCFA (g/dL of milk)	0.42
C16:0 (g/dL of milk)	0.40	MCFA (g/dL of milk)	0.42
C17:0 (g/dL of milk)	0.36	LCFA (g/dL of milk)	0.17

Abbreviations: SFA = Saturated FA ; MUFA = Monounsaturated FA ; PUFA = Polyunsaturated FA ; UFA = Unsaturated FA ; SCFA = Short chain FA ; MCFA = Medium chain FA ; LCFA = Long chain FA

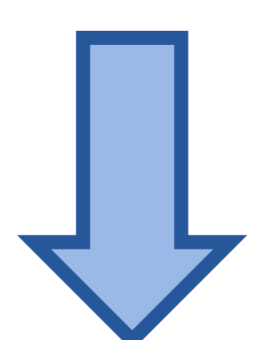
- Evolution of genetic and phenotypic correlations between MIR CH₄ (g/d) and individual FA or groups of FA



High & decreasing correlations between MIR CH₄ and SFA & SCFA through lactation

&

Low & increasing correlations between MIR CH₄ and UFA & LCFA through lactation



Emphasizing rumen metabolism related to energy status of cows