Session 54
Abstract 3776
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Investigations on fat protein ratio of milk and daily energy balance in Holstein Friesians

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Introduction

Milk yield ⬆ ⟷ Feed intake ⬆

⬇

Energy deficit p.p. ⬆

⬇

Health & fertility ⬇

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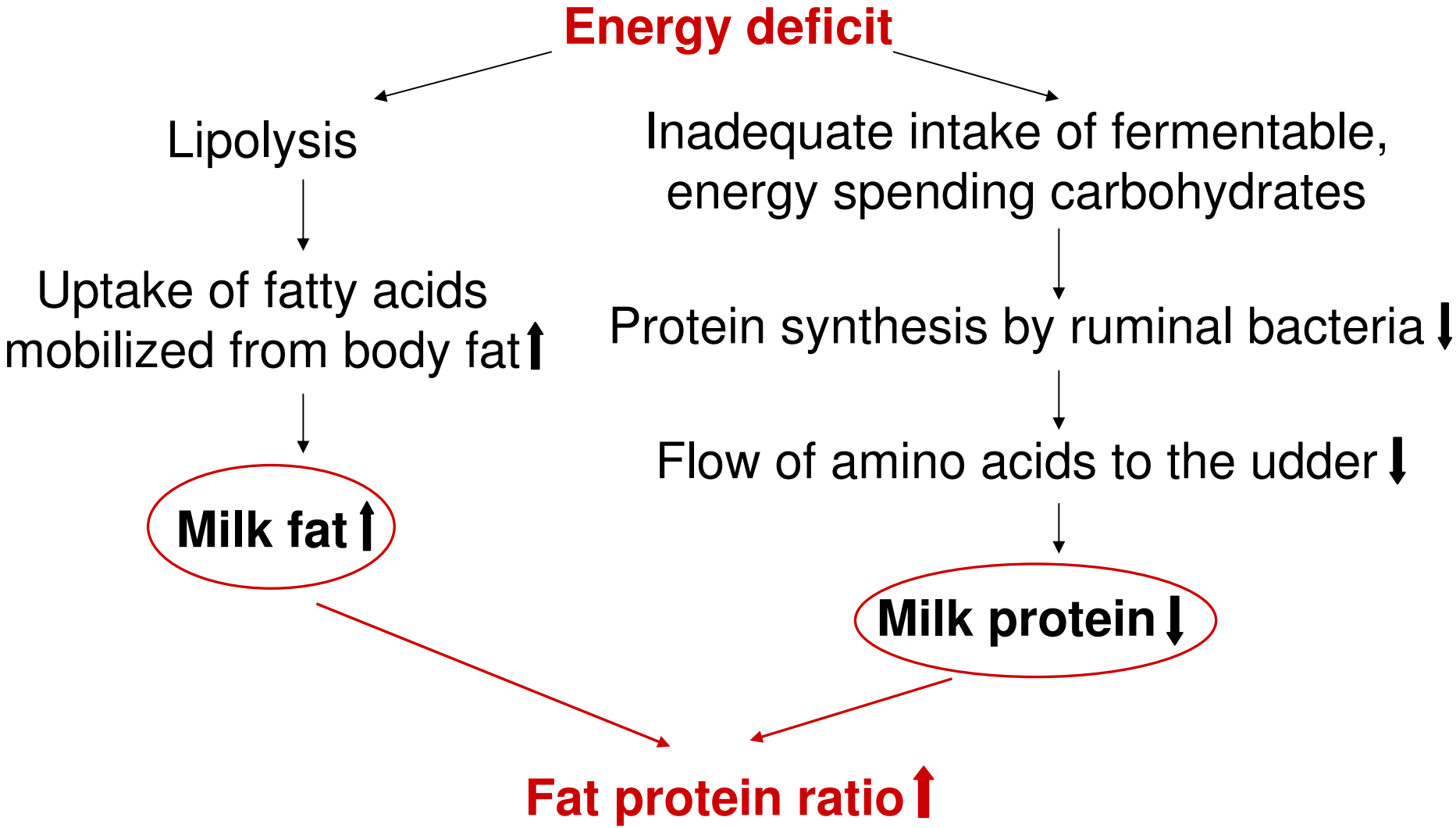
Breeding goal: Improvement of metabolic stability

- Measurement of energy balance itself too costly

  → Search for related traits

- Fat protein ratio of milk = useful selection criterion?

Fat protein ratio



Aim of the study

I. Model evaluations for fat protein ratio & daily energy balance

   → suitable models for further genetic analyses

II. Investigation of the relationship between fat protein ratio & energy balance

Data

Trait		Data set			
		Heifers DIM 11-180	Heifers DIM 11-305	Cows DIM 11-305	
				Parity = 2	Parity ≥ 3
FPR	Animals	577	613	72	76
	Records	10,800	14,452	1,853	1,908
EB	Animals	443	455	16	28
	Records	40,931	53,032	1,056	2,686

EB: daily energy balance, FPR: fat protein ratio, DIM: days in milk

Model testing for fat protein ratio (FPR) & daily energy balance (EB)

Random regression model

$$y_{ijkl} = TD_i + AFC_j + \sum_{m=1}^{n} b_m * x_{ijklm}(d) + \sum_{m=0}^{n} cow_{km} * x_{ijklm}(d) + e_{ijkl}$$

y_{ijkl}	k^{th} observation of the FPR or EB
TD_i	fixed effect of the i^{th} test day (FPR: i = 1,…,155, EB: i = 1,…,735)
AFC_j	fixed effect of the j^{th} class of age at first calving (j = 1,…,5)
	(1: AFC ≤ 25, 2: AFC = 26, 3: AFC = 27, 4: AFC = 28, 5: AFC ≥ 29)
b_m	fixed regression coefficients on the function term of lactation day d
cow_{km}	m^{th} random regression coefficient of the k^{th} animal
	(FPR: k = 577 EB: k = 383)
e_{ijkl}	random residual effect

Function terms of lactation day d

Functions of lactation day d	Function terms				
	x_{ijk0}	x_{ijk1}	x_{ijk2}	x_{ijk3}	x_{ijk4}
Ali & Schaeffer	1	d/310	$(d/310)^2$	ln(310/d)	$(\ln(310/d))^2$
Wilmink	1	d	$e^{-0.05d}$		
Guo & Swalve	1	$\sqrt{d}$	ln(d)		
Legendre 3	1	sd	$(3sd^2-1)/2$	$(5sd^3-3sd)/2$	
Legendre 4	1	sd	$(3sd^2-1)/2$	$(5sd^3-3sd)/2$	$(35sd^4-30sd^2+3)/8$

$sd=1+2(d-d_{min}/d_{max}-d_{min})$

$d_{min}=11$, $d_{max}=310$

Model testing

- <u>Goodness of fit → Evaluation criteria</u>

- AICC
- BIC
- Correlation between real observations & estimated values
- Inspection of residuals plotted against days in milk

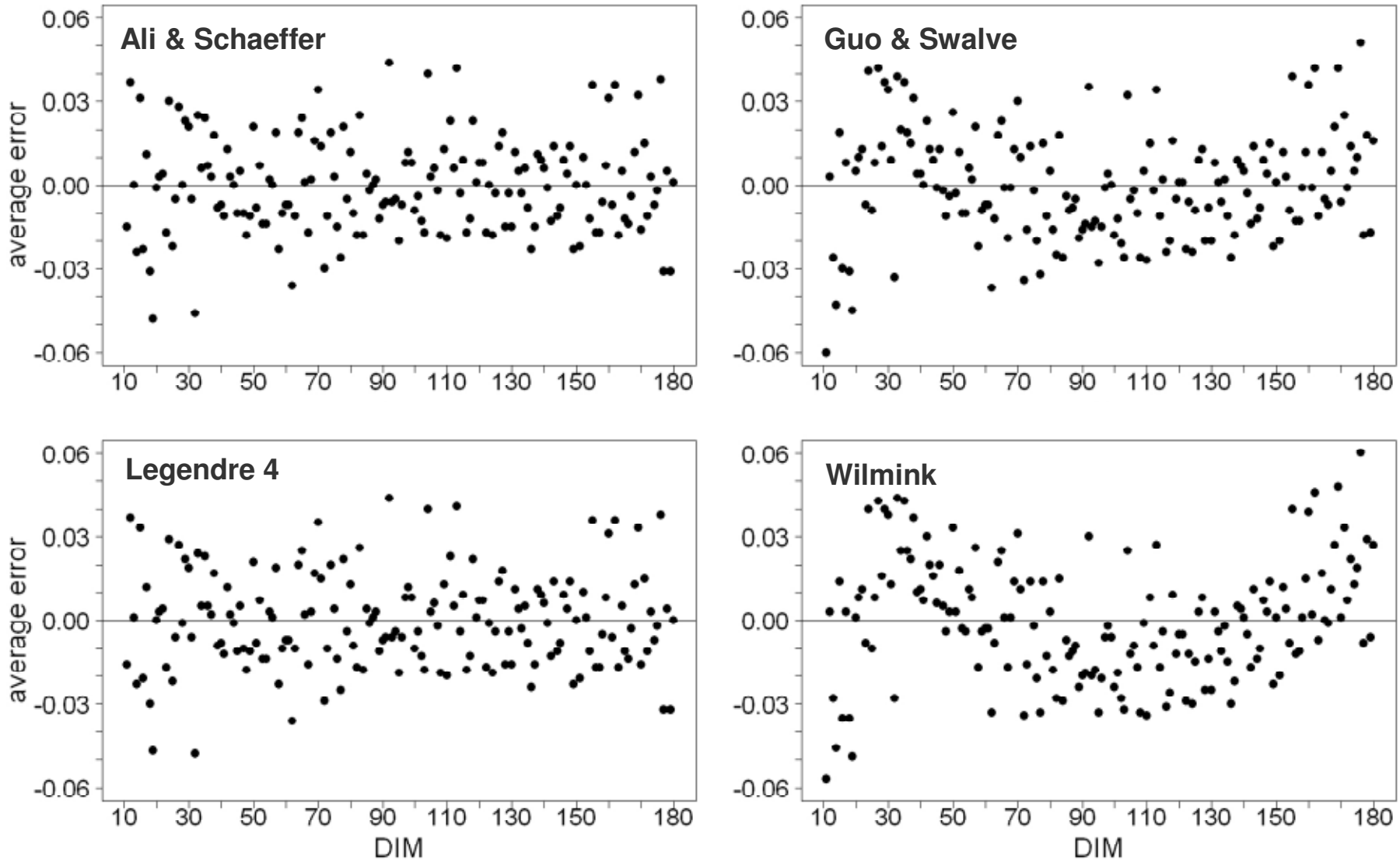
- <u>Results</u>

→ Random regression superior to fixed regression models

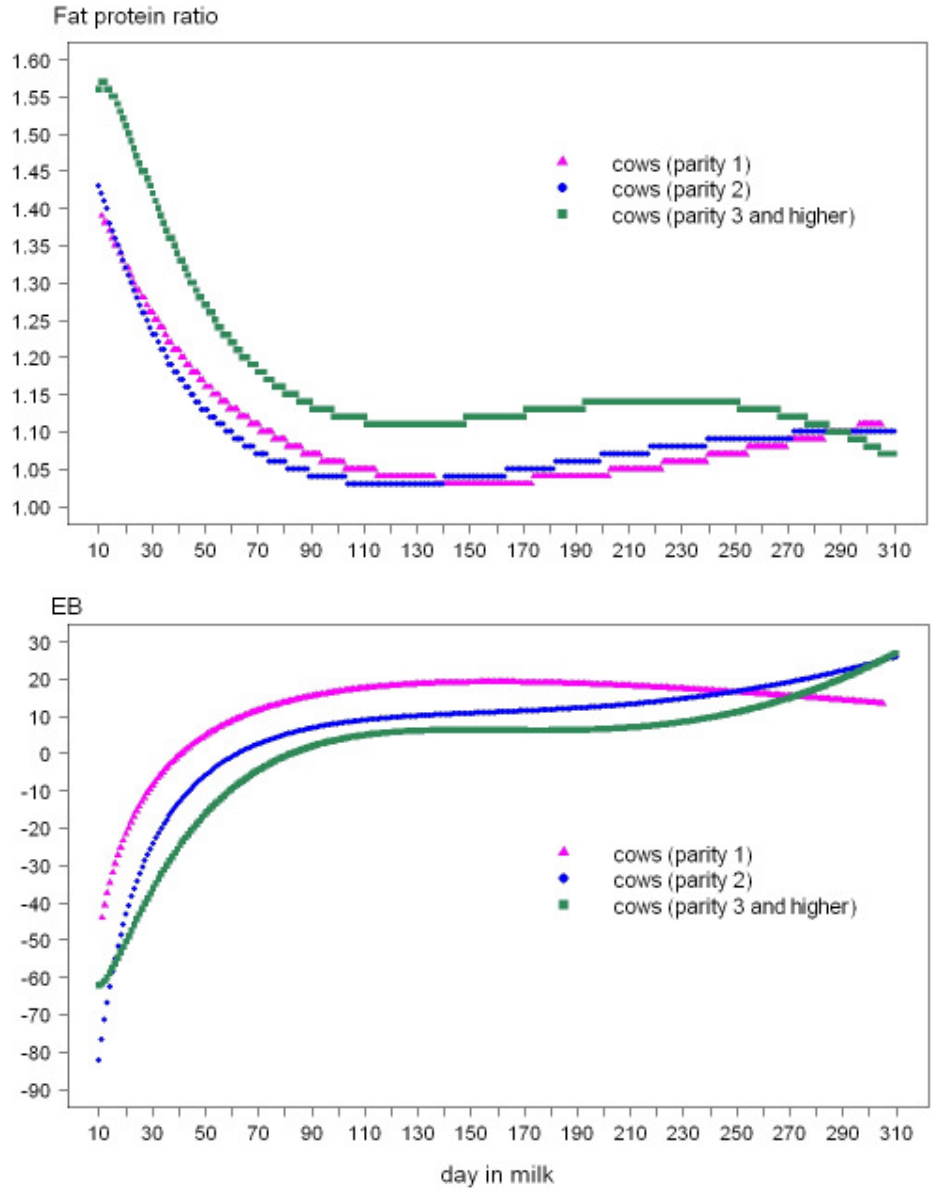
→ Ali & Schaeffer function most suitable for modelling both the fixed and the random regression part of the mixed model

→ Ali & Schaeffer RR model used for further investigations

Mean residuals of fat protein ratio plotted against days in milk for four functions of days in milk



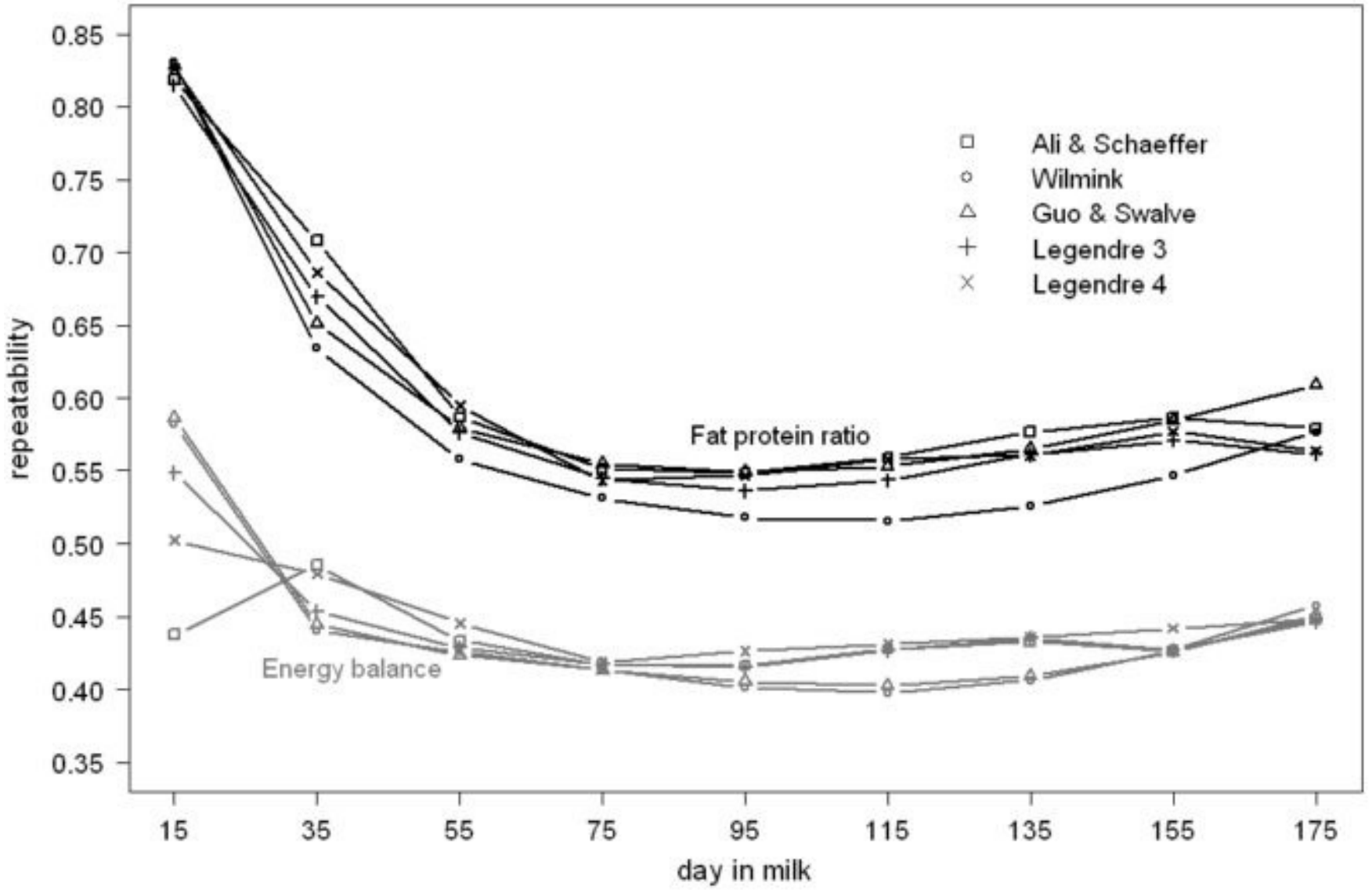
Lactation curves for fat protein ratio (FPR) & daily energy balance (EB)



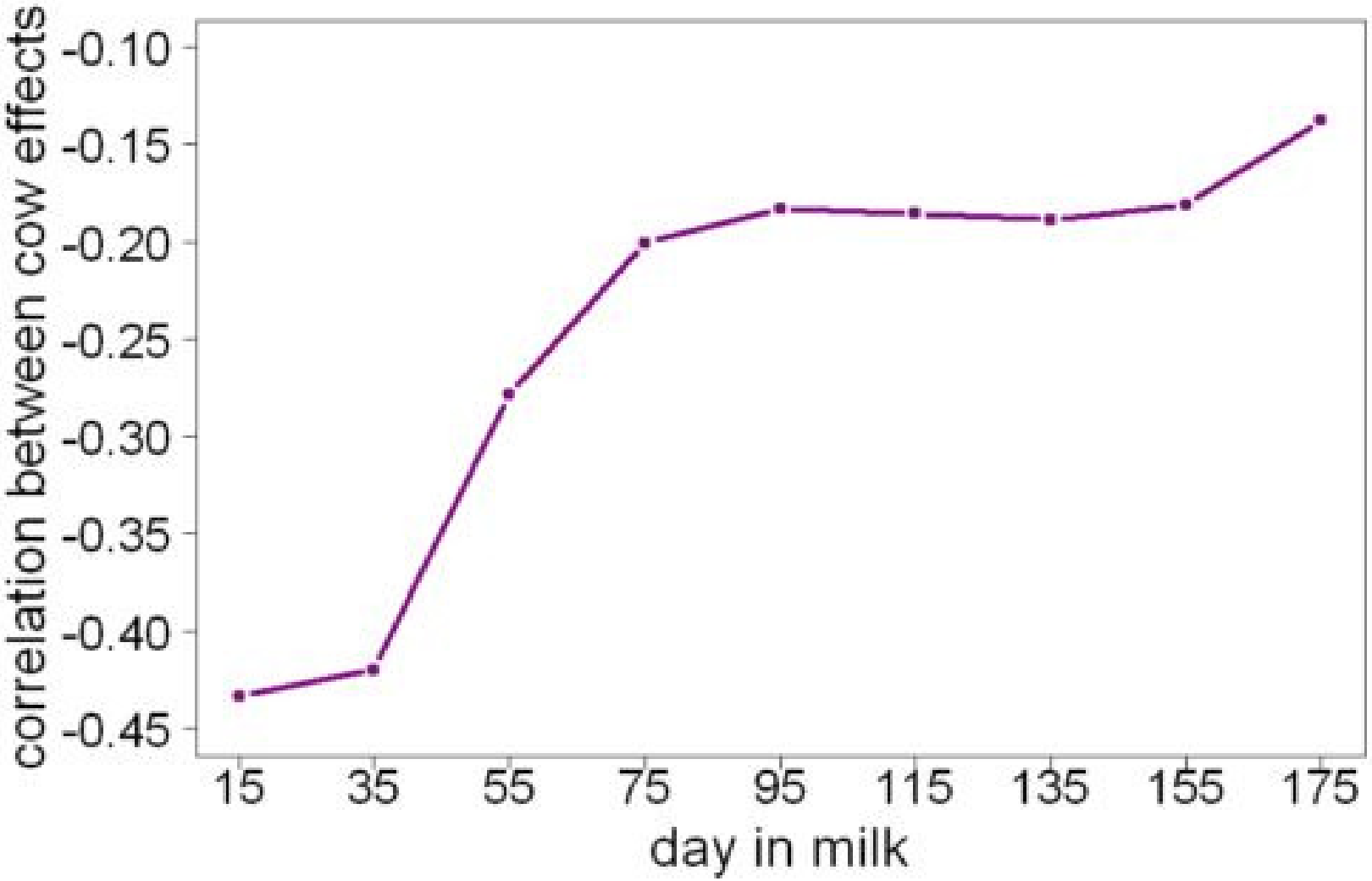
- FPR is highest in the initial lactation period when energy deficit is most severe
- EB stabilizes at the same time as FPR stops decreasing
- Mirror-inverted patterns

  → causal relationship between both traits?

Repeatability of fat protein ratio & daily energy balance for five random regression models



Correlation between cow effects for fat protein ratio & daily energy balance



Conclusion

- Metabolic stability needs to be improved
- Fat protein ratio of milk seems to be a suitable indicator for the energy status, at least during the most metabolically stressful stage of lactation
- Further genetic investigations are needed