2011 INTERBULL Meeting
August 26-28, Stavanger, Norway

Genetic relationships between milk fatty acids and fertility of dairy cows

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Indicator traits for fertility

Fertility traits

- **potentially difficult to measure**
- **often not readily available**
- **have low heritabilities**

⇨ **Indicator traits are of interest to increase accuracy of EBVs for fertility**

- **if easier to measure, higher heritability, and well correlated with fertility**
- **e.g., milk yield, type traits, body condition score**
- **milk fatty acids profile?**

  → **in relation to body fat mobilization**

Objective

Investigate the opportunity to use fatty acid traits as indicators of fertility

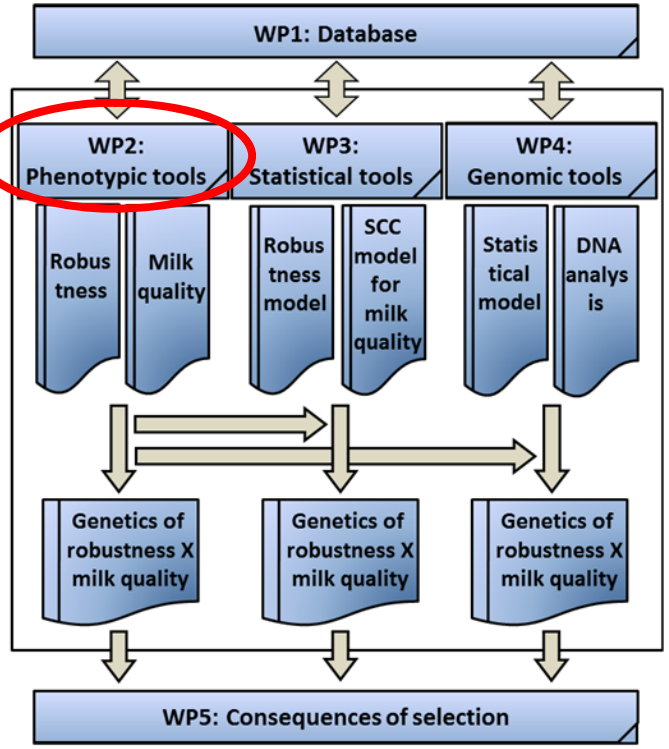
- **Estimate genetic correlations between days open and contents of major fatty acids in milk for 1st-parity Walloon Holstein cows**
- **Opportunity to include fatty acid EBVs into the Walloon fertility index ?**

Part of ROBUSTMILK project

ROBUSTMILK

SEVENTH FRAMEWORK PROGRAMME

Develop innovative and practical breeding tools for improved dairy products from more robust dairy cows



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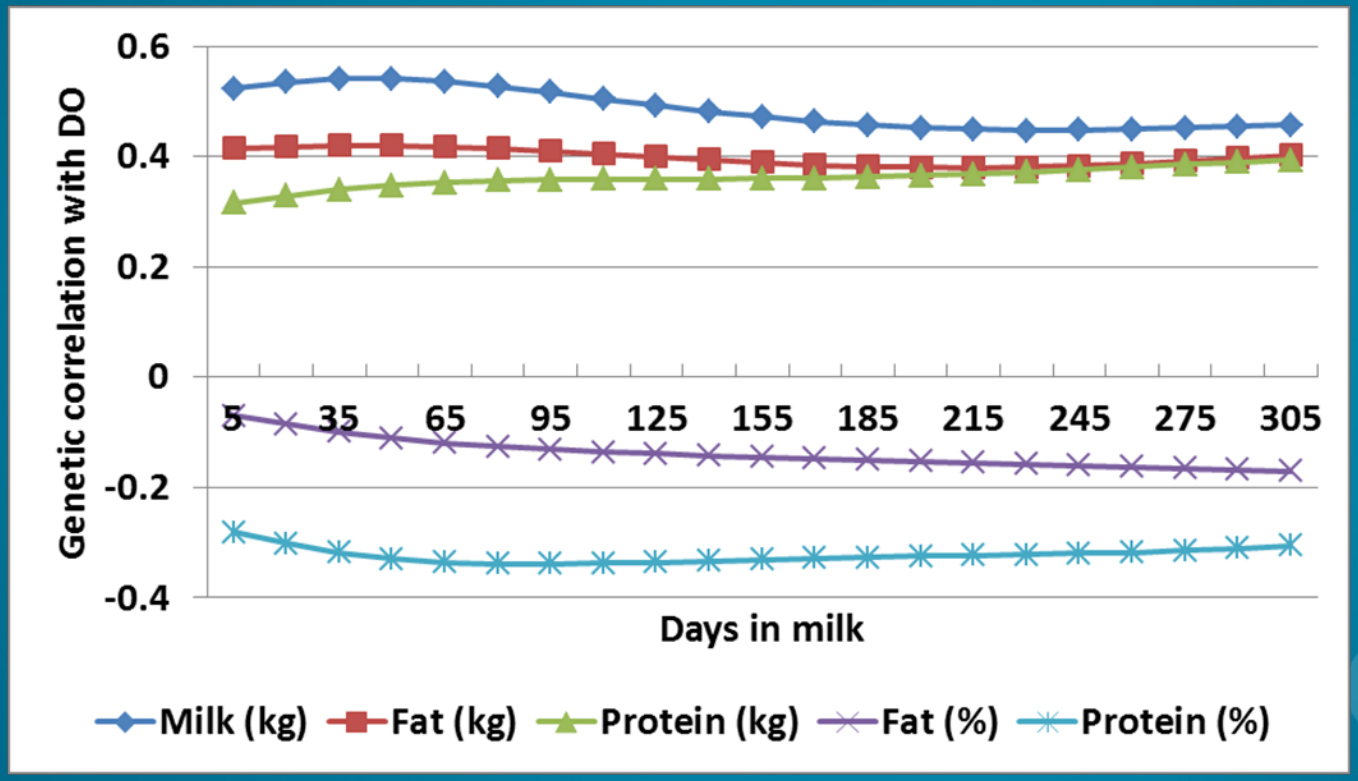
Data & model

- 22 bivariate models: DO and one of the following traits
  - Milk, fat, protein yields, fat and protein contents
  - Fatty acid (FA) contents (g/dl of milk)
    - predicted by MIR (Soyeurt et al., 2011; MIR spectra are routinely collected through milk recording)
- 29,792 first-parity Holstein cows with both DO and FA records and at least 2 FA records
- 143,332 FA records and 29,792 DO records
- Effects of the models similar to those used for genetic evaluations

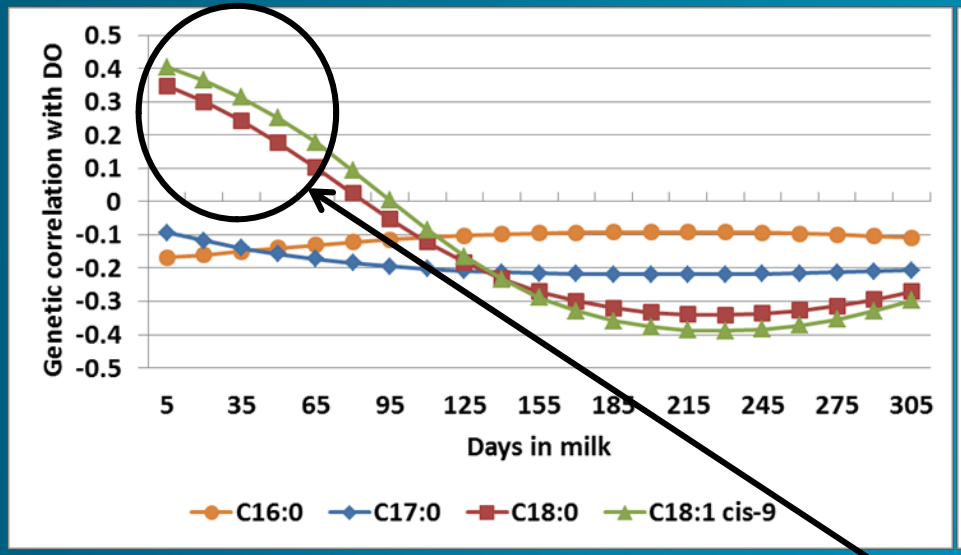
Daily genetic correlations with DO

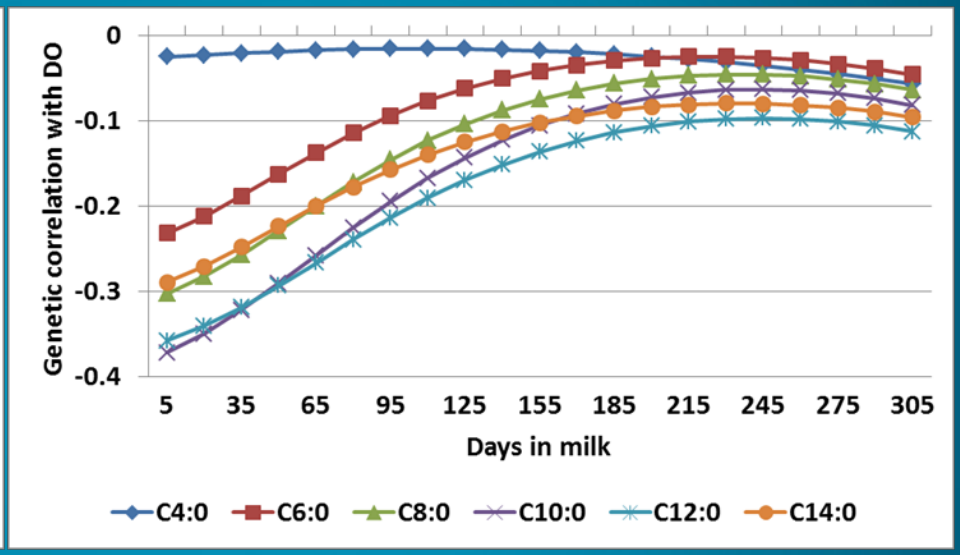


- **Correlations did not change greatly over DIM**
- **Higher yields → higher DO**

⇨ **Selection for higher yields is likely to reduce fertility**

Daily genetic correlations with DO





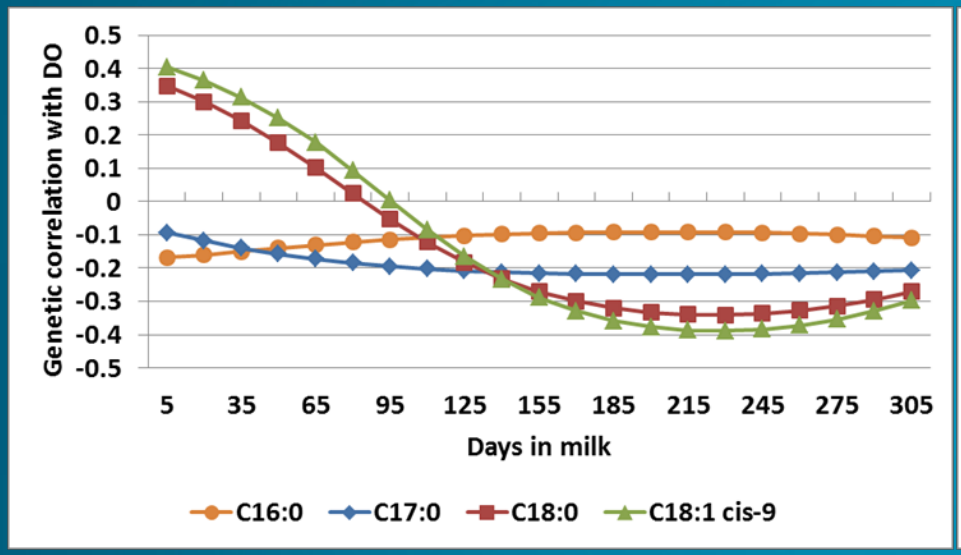
In early lactation

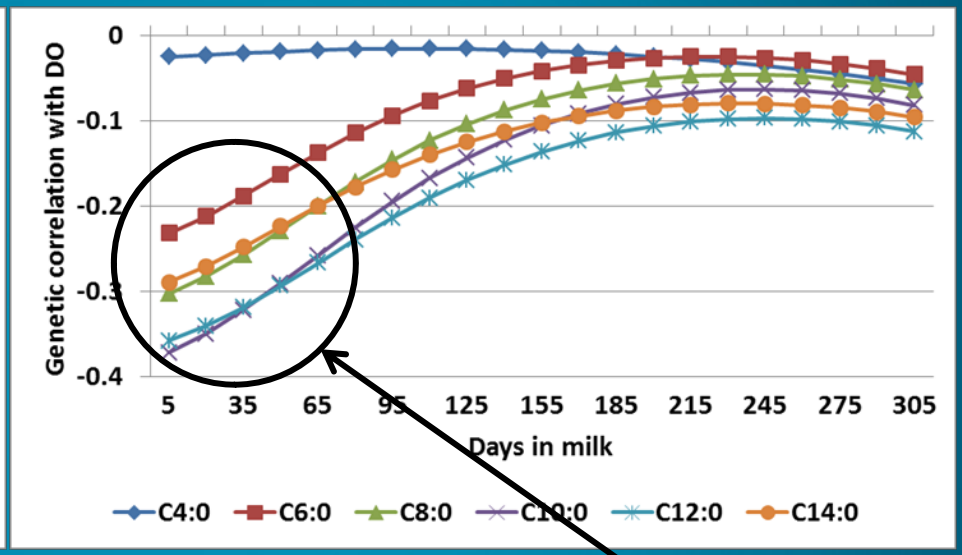
Milk production ↑ → **Body fat mobilization ↑** → **Release of C18:0 and C18:1 *cis-9* in milk** → **Inhibition of *de novo* synthesis in mammary gland**

Higher contents of C18:0 and C18:1 *cis-9* in milk

= indicator of body fat mobilization → poor fertility

Daily genetic correlations with DO





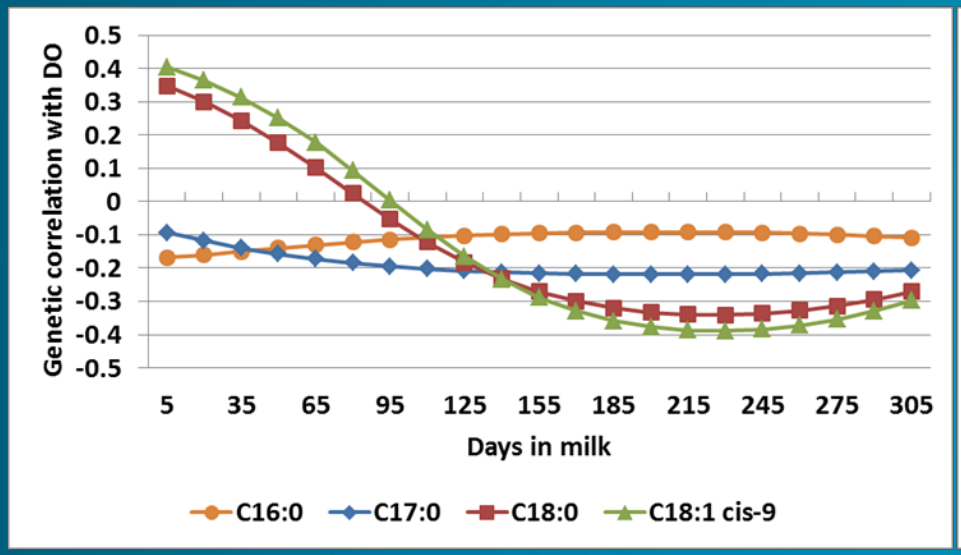
In early lactation

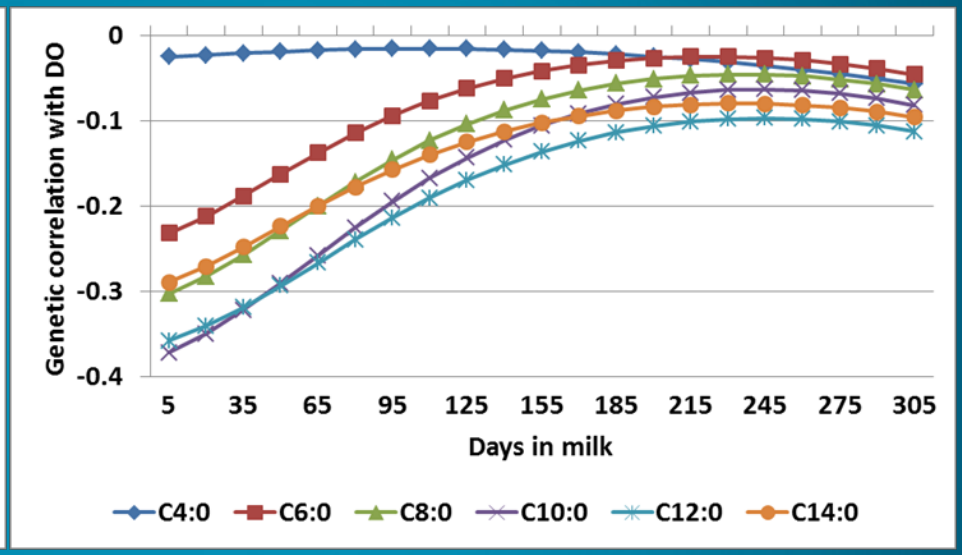
Milk production ↑ → **Body fat mobilization ↑** → **Release of C18:0 and C18:1 *cis-9* in milk** → **Inhibition of *de novo* synthesis in mammary gland**

Lower contents of C6:0 to C14:0 in milk

= indicator of body fat mobilization → poor fertility

Daily genetic correlations with DO



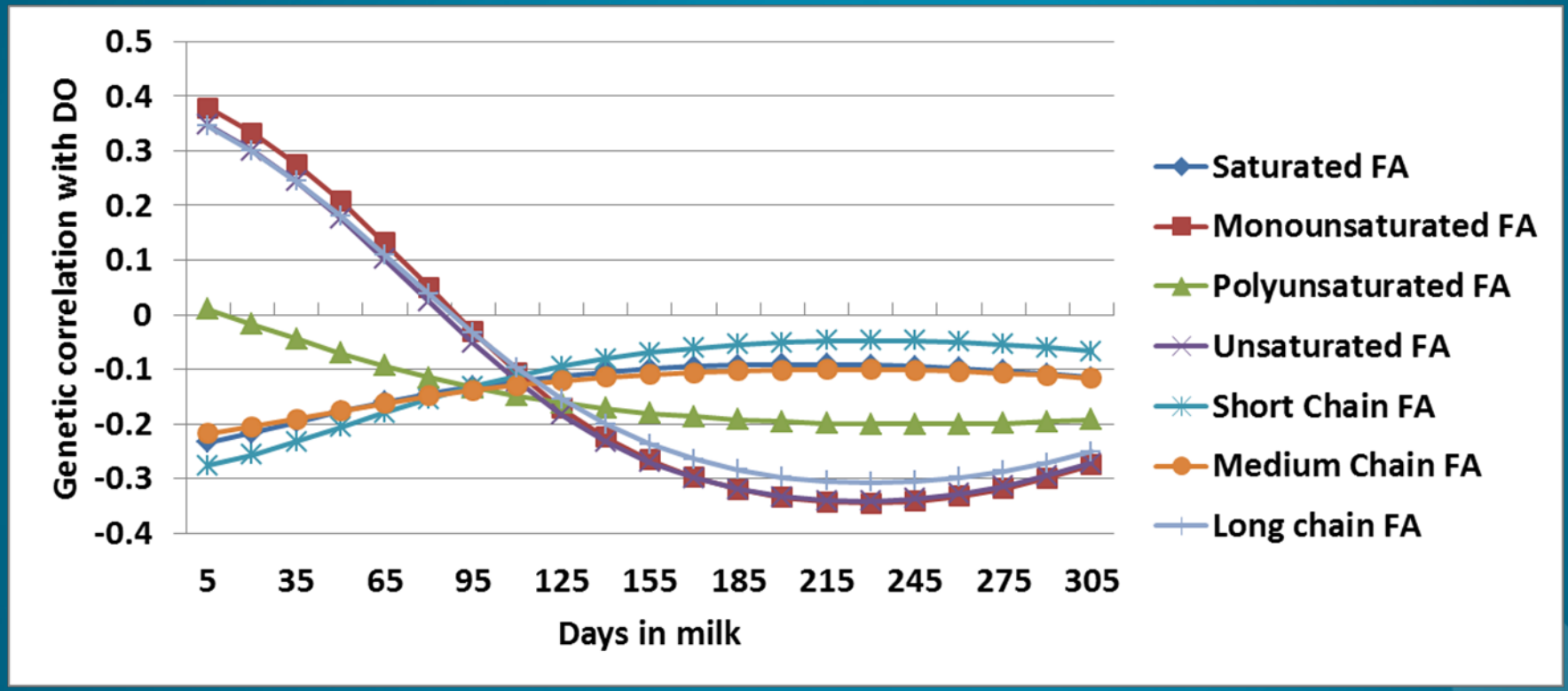


After 150 DIM

- **C4:0 to C16:0 → correlations between -0.20 and 0**
- **Higher contents in milk of C18:0 and C18:1 *cis-9***

  → better fertility

Daily genetic correlations with DO



- **Groups of FA: trends similar to individual FA**
- **Polyunsaturated FA: no strong associations**

Using FA to select fertility?

Fatty acid contents in milk are correlated to fertility and are therefore potential indicator traits for fertility.

How integrate FA into Walloon evaluation?

- **Genetic evaluation for saturated FA and monounsaturated FA → dUNSAT and dMONO**

  = 2 indices representing the relative part of milk fat that is unsaturated and monounsaturated

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- **Genetic evaluation for saturated FA and monounsaturated FA → dUNSAT and dMONO**
- **Walloon female fertility index (CFF) composed of:**
  - **Direct female fertility index (DFF)**

    = linear combination of Interbull international female fertility proofs available on the Walloon scale

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- **Genetic evaluation for saturated FA and monounsaturated FA → dUNSAT and dMONO**
- **Walloon female fertility index (CFF) composed of:**
  - **Direct female fertility index (DFF)**
  - **Indirect female fertility index (IFF)**

    = linear combination of EBVs of fertility-correlated traits including BCS (IFF_{BCS}) or angularity (IFF_{ANG})

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- **Walloon female fertility index (CFF) composed of:**
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  - **Indirect female fertility index (IFF)**

Gain in reliability when including dUNSAT and dMONO into IFF_{BCS} and IFF_{ANG}?

Using FA to select fertility?

Gain in reliability when including dUNSAT and dMONO into IFF_{BCS} and IFF_{ANG}?

No. of bulls in each class of rel

Classes of reliability	IFF_{BCS}	IFF_{BCS-FA}	IFF_{ANG}	IFF_{ANG-FA}	CFF	CFF_{FA}
rel < 0.75	1	1	1	1	15	13
0.75 <= rel < 0.80	16	13	5	1	11	11
0.80 <= rel < 0.85	54	42	20	13	23	20
0.85 <= rel < 0.90	162	118	84	55	34	34
0.90 <= rel < 0.95	455	501	509	535	214	195
rel => 0.95	91	104	160	174	482	506

Conclusions

- **Fatty acid contents in milk are correlated to fertility**
  - **correlations change throughout the lactation**
  - **it emphasizes relationship between body fat mobilization and fertility**
- **Interest of using milk FA contents in indirect selection for better fertility in dairy cows**
  - **further studies will investigate all FA (C18:1 *cis-9*)**
  - **but all features of FA should be considered**

    e.g., nutritional, sensory, and technological qualities of milk fat, relationships with methane emissions

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Study supported by:

- Ministry of Agriculture of the Walloon Region of Belgium (SPW-DGARNE; projects D31-1207 & D31-1224)
- National fund for Scientific Research through grants 2.4604.11, 2.4507.02F(2), F4552.05 (2.4.623.08.F)
- European Commission, Directorate-General for Agriculture and Rural Development, under Grant Agreement 211708 (project Robustmilk)

This study has been carried out with financial support from the Commission of the European Communities, FP7, KBBE-2007-1. It does not necessarily reflect its view and in no way anticipates the Commission's future policy in this area.