Polish Simmentals: early predictors of longevity

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Objective
Estimate genetic correlations between length of productive life and conformation to identify early predictors of longevity in dual-purpose cattle

Material and methods
• 166 Simmental sires
• Genetic correlations based on the correlation between EBVs of 20 conformation traits and functional longevity
Results

• Positive correlations for udder and legs: udder width (0.25), udder depth (0.11), rear leg set side view (0.27), rear leg set rear view (0.16)

• Unfavourable correlations for body capacity traits:
  moderate values: body depth (-0.36), chest girth (-0.24)
  smaller values: stature (-0.15), rump width (-0.16), muscularity of front end (-0.14), rear end muscularity (-0.13), chest width (-0.12)

Conclusions

• Estimates of genetic correlations low to moderate
• Traits with the largest correlations: body depth, chest girth, udder width and rear leg set side view as predictors of longevity
• Cows with smaller body capacity have a lower relative risk of culling
Genetic relationships between age at first calving, its underlying traits and survival of Holsteins

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Motivation

Age at first insemination

Birth

Interval first to successful insemination

First insemination

Successful insemination

Gestation length

First calving
Is it appropriate to correct for age at first calving in genetic evaluations of (functional) longevity?
### Results & Conclusion

<table>
<thead>
<tr>
<th></th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>AFI</th>
<th>FLI</th>
<th>AFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0.021</td>
<td>0.77**</td>
<td>0.42***</td>
<td>-0.08</td>
<td>-0.15</td>
<td>-0.07</td>
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<tr>
<td>S2</td>
<td>0.03</td>
<td>0.014</td>
<td>0.68***</td>
<td>-0.16*</td>
<td>-0.38**</td>
<td>-0.22*</td>
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<td>S3</td>
<td>0.03</td>
<td>0.03</td>
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<td>-0.40*</td>
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<tr>
<td>AFC</td>
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<td>-0.03</td>
<td>-0.04</td>
<td>N. est.</td>
<td>N. est.</td>
<td>0.101</td>
</tr>
</tbody>
</table>

S1: survival 0-49d from 1st calving; S2: 50-249d; S3: 250d to 2nd calving

Asterisks denote levels of significance, resulting from t-tests on the genetic correlations of the 4 samples (H0: genetic correlation is 0): *: p < 0.05; **: p < 0.01; *** p < 0.001

Results suggest that age at first calving should not be correct for in genetic evaluations of (functional) longevity.
Simulations to define the optimum lifetime management for Holstein cows

Objectives
Using a lifetime prediction model to determine:
1) the optimum duration of a lactation to ↑ lifetime efficiency and pregnancy rate
2) if lactation duration should vary with parity to ↑ lifetime performance

Lifetime efficiency (MJ/MJ) = energy in milk / energy intake

GARUNS - a lifetime performance model taking into account the changing physiological priorities of an animal during its life

Milk yield or dry matter intake, kg/d

⇒ GARUNS can fit milk yield, dry matter intake, milk components, body weight, and BCS curves of 16 months extended lactation cows
Conclusions

1) a 16 mo lactation is the optimum extended lactation length in terms of productive-reproductive performance,
2) managing the primiparous cows with a 16 mo extended lactation, followed by 10 mo lactations, ↑ lifetime efficiency to being similar to cows managed for a 16 mo lactation in their entire life.
39.15
Genetic correlations between energy balance and lactation persistency of Holsteins in Japan

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Division of Animal Breeding and Reproduction Research
Institute of Livestock and Grassland Science, NARO (NILGS)
In the early lactation stage...

Energy Input by feed intake $<$ Energy Output for milk production $\Rightarrow$ Negative Energy Balance

Improving lactation persistency (LP) may be better for energy balance (EB).

The objective of this study was to estimate genetic correlations between EB and LP.

- EB was calculated using the multiple regression equation of Friggins et al. (2007) or Løvendahl et al. (2010).
- LP was defined as the difference in estimated milk yield between 240 and 60 DIM.
- Genetic parameters of EB and LP were estimated using a random regression test-day model.
Negative genetic correlation in the early lactation stage

Negative genetic correlations were estimated between EB and LP in the early lactation stage, so we need to pay attention for improving EB and LP.
Voluntarily delayed rebreeding and double insemination effects on pregnancy rates of Holstein cows

C. Gaillard, M. Vestergaard, J. Sehested - Abstract # 23018

High milk yield & NEB

Extended lactation (EL)

Double insemination

↓ Reproductive performance

"Pregnancy rate"

′ Number of inseminations

↑ Reproductive performance

Different results on reproductive performance

Hypotheses

1) Delaying rebreeding to 8 months will ‘mounting behavior and estrus detection, and ‘pregnancy rate (PR)

2) The use of a double AI technique around estrus will ‘PR
Conclusions

1) Delaying rebreeding increased mounting behavior but did not increase PR

2) The double artificial insemination (AI) had a negative effect on PR
HERD DYNAMICS AND ECONOMICS OF DIFFERENT STRATEGIES FOR MANAGING A HERD FOR EXTENDED LACTATION

J. O. Lehmann, L. Mogensen, S. Østergaard, J. F. Ettema & T. Kristensen

Objective
To investigate the effect of different lactation management strategies on herd dynamics and economics.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Which cows?</th>
<th>Calving interval</th>
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<tr>
<td></td>
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</tr>
<tr>
<td>ALL17</td>
<td>All</td>
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</tr>
<tr>
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<td>15</td>
</tr>
<tr>
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</tr>
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<td>Multiparous</td>
<td>13</td>
</tr>
</tbody>
</table>
EXTENDED LACTATION COMPARED WITH STANDARD

Extended lactation scenario

- Kg ECM per annual cow
- Farm operating profit

Kg ECM per kg herd DMI
Farm operating profit - extra cows
Effect of curve traits and Age of first calving on productive life of Holstein primiparous Walloon cows

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Longevity, productive life, or lifespan of dairy cattle defined as the time from first calving to culling, death or sale, is an important and ambiguous trait resulting from many factors.

Aim

Linking cow's longevity to lactation curve characteristics and age of first calving.

Data

- Lactation curve traits for milk provided by the Walloon Breeding Association
- 20,764 primiparous Holstein cows calvings from 2003 to 2014
- 395 herds (> 50 cows)

Model

Linear model:

\[ LPL_{\text{predicted}} = \beta_0 + H_0 + C_Y + C_S + APC + M805 + \beta_1 \times PS + \beta_2 \times PK + \beta_3 \times DIM + \epsilon_{\text{predicted}} \]

- \( LPL_{\text{predicted}} \): length of productive life, in overall mean
- \( H_0 \): year of calving
- \( C_Y \): fixed effects of herd
- \( C_S \): fixed effects of season of calving
- \( APC \): fixed effects of API, BCS, and age at first calving
- \( M805 \): milk yield adjusted to 305 days (M805xCL) to 1.4
- \( PS \): persistence
- \( PK \): peak
- \( DIM \): days in milk
- \( \beta_1, \beta_2, \beta_3 \): regression coefficients
- \( \epsilon_{\text{predicted}} \): residual effect with \( \epsilon_{\text{predicted}} \sim N(0, \sigma^2) \)
Effect of curve traits and Age of first calving on productive life of Holstein primiparous Walloon cows

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5 Walloon Breeding Association, 3550 Gingy, Belgium

Results and discussion

![Diagram showing the effect of traits on LPL](image)

**Figure 1:** Effect of traits of interest on LPL.

- **LPL was affected by herd**, management and culling decisions.
- **The lack of significance for the regressions of PK and PS on LPL** should be considered as a preliminary result for two reasons:
  1. the simultaneous presence of other correlated effects as milk yield in the model and
  2. the use of a linear regression when non-linear relationship are more likely (intermediate optimum).

![Graphs showing LPL by season and age of first calving](image)

**Figure 2:** LSmeans of LPL by season (a), M-305d (b) and by age of first calving (c).
Lost in transition - a reaction norm model to breed cows that can better cope with metabolic stress

The Problem

In the transition phase in early lactation, dairy cows have higher energy requirements than can be satisfied by feed intake (Fig. 1).

We hypothesize, that some cows are genetically less well suited to cope with this metabolic stress than others, leading to adverse livestock productivity on long-term. Robust cows thus will remain unaffected by a metabolic load, while non-robust cows will react with a reduced fitness (Fig. 2). We use a reaction norm model to test whether this robustness has a genetic component.

Animals, Data and Methods

- 36 million test day records of ~1.4 million Brown Swiss dairy cows were available
- only bulls with >10 daughters that were born before 2011 and had an empty cow record were used (4,983 bulls and 579,994 daughters, 30,842 animals in pedigree)
- breed norm model

Response variable:
- functional longevity from SurvivalFit Model

Challenges variables:
- accumulated milk yield or accumulated fat + protein in ratio of 100 kg of milk (log pseudo records)

Reaction norms model:

\[ y_{ij} = \beta_0 + \beta_1 x + \beta_2 x + \beta_3 x + \epsilon_{ij} \]

- \( y_{ij} \): response variable of daughter \( j \) of sire \( i 
- \( \beta_0 \): fixed regression constant
- \( \beta_1 \): random regression coefficient
- \( \epsilon_{ij} \): random residual error

Models were fitted using ASReml-R 3.0.5 and random components were tested using a likelihood ratio test for biometrical model selection.

Results

- All estimated (co)variance components were significantly different from 0 (Fig. 3), and models accounting for \( \sigma^2_{\epsilon} \) were provided a significantly better fit compared to reduced models.
- Daughters of different bulls differed substantially in their ability to cope with metabolic stress seen in Figure (4).
- Heritabilities of the response variable under high challenge have been substantially decreased (Fig. 5).
- Robustness to metabolic stress thus has a genetic component.

Conclusions

The results of this study show that the ability to cope with metabolic stress in the transition phase clearly has a genetic component. The suggested reaction norm model can be used to identify bulls that inherit an improved ability to handle metabolic stress without adverse effects on longevity and thus resulting breeding values can be the basis for selecting more robust dairy cows.

References and Acknowledgements


We thank Dr. J. Olmstead for providing the data. This study was supported by the grant of the Swiss Commission for Technology and Innovation (CIT).
GOOD LEG MEANS GOOD STABILITY OF THE SOWS
AND GENOME-WIDE ASSOCIATION STUDY (GWAS) FOR LEG CONFORMATION

T. H. Le, E. Norberg, G. Sahana, P. Madsen, O. F. Christensen, B. Nielsen, K. Nilsson, N. Lundeheim
1. **Introduction**

**LONGEVITY**
- Late record
- Improved longevity

**CONFORMATION**
- Low heritability
- Improved selection accuracy

1. Estimate **heritability and genetic correlations** of conformation and longevity in Swedish and Danish pigs

2. Identify **genomic variants** affecting conformation in Danish pigs

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2. **Material and methods**

**LONGEVITY**
- Stayability to 2\textsuperscript{nd} or 3\textsuperscript{rd} parity, lifetime piglet production

**CONFORMATION**
- (B +@, 5 months, 100 kg)
  - Movement, Toes, Standing-under, Front leg, Back, Rear leg, Overall

**GWAS AND META-ANALYSES**
- Mixed linear model, software GCTA
- Multiple traits within breed, approximate test statistic
- Across breeds, software METAL

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**DMU**
- Linear / linear threshold model
3. Results

- Genetic parameters
  - Low to moderate heritabilities for conformation traits
  - Favorable correlation between conformation and longevity

- GWAS and meta-analyses
  - Genes affecting conformation: related to bone and skeleton development, muscle and fat metabolism (*LRPPRC, WRAP73, VRTN, PPARD*) and growth (*GF2BP2, GH1, CCND2, MSH2*)
  - Meta-analyses
    - Multi-trait within breed suggested QTLs with possible pleiotropic effect
    - Across breeds detected novel candidate genes *SOS2, TRIM24* and *ELMO1*

4. Conclusion

**BETTER LEG CONFORMATION – LONGER STAY** → possible to improve longevity through conformation

Conformation is complex, partly controlled by genes involved in development and growth

Meta-analyses increased power to detect QTLs