Feed intake genetic evaluation: progress and an index for saved feed cost

Interest in genetics of feed efficiency

- Feed efficiency
  - Feed important variable cost
  - Environmental/greenhouse gasses
  - “More for less”

- Develop (procedure to predict) feed intake (DMI) breeding values for Dutch bulls and cows

- First genetic evaluation in 2014
DMI data

• Data from 1990 onwards:

  – Data providers
    • Wageningen Livestock Research
    • ILVO
    • Trouw Nutrition
    • Schothorst Feed Research
    • AVEVE
  – CRV
    • Alders herd – 240 cows
    • in 2019 4 more herds to follow
DMI data

- Data criteria:
  - ≥ 3 weekly DMI records per cow per parity
  - ≥ 5 animals per experimental treatment
  - Standardise DMI (excl. experimental treatments)
  - Lactation 1, 2 and 3
DMI data in December 2018

5649 cows with dmi data
- 2380 cows with data and genotypes
- 3269 cows with data without genotypes
5649 total cows from 1085 sires
- 530 sires with genotypes
- 555 sires without genotypes
Model for dry matter intake

Multitrait animal model

\[
\text{DMI1 DMI2 DMI3} = \text{experiment} \\
+ \text{year*month} \\
+ \text{calving season} \\
+ \text{age at calving} \\
+ \text{stage of lactation} \\
+ \text{breed} \\
+ \text{perm. environment} \\
+ \text{cow} \\
+ \text{error}
\]

Cow: usage of pedigree and genotypes (H-matrix)
## Predictor traits

- Genomic EBV DMI directly from DMI genetic evaluation combined with national EBV for four predictor traits:
  - Kg milk
  - Kg fat
  - Kg prot
  - Liveweight

<table>
<thead>
<tr>
<th>Genetic correlations</th>
<th>DMI1</th>
<th>DMI2</th>
<th>DMI3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kg milk</td>
<td>0.55</td>
<td>0.58</td>
<td>0.56</td>
</tr>
<tr>
<td>Kg fat</td>
<td>0.58</td>
<td>0.60</td>
<td>0.58</td>
</tr>
<tr>
<td>Kg prot</td>
<td>0.59</td>
<td>0.61</td>
<td>0.59</td>
</tr>
<tr>
<td>LiveWeight</td>
<td>0.67</td>
<td>0.45</td>
<td>0.41</td>
</tr>
</tbody>
</table>

- Selection index weighted based on reliabilities
- Model reliability
Feed intake and response. Interbull meeting 2018
Milk versus dry matter intake
Body weight vs dry matter intake

Feed intake and response. Interbull meeting 2019
Saved Feed Cost (SFC)

- SFC = saved feed cost for maintenance
  = feed intake – feed for production

  -> feed for:
  maintenance
  difference in digestion
  activity

- Unit: euro/lactation

Feed intake and response. Interbull meeting 2019
Feed intake -> Feed Saved Maintenance -> Saved Feed Cost (SFC)

- DMI = EBV feed intake

- EBV Feed Saved for Maintenance = FSM
  - FSM = Feed for production - DMI
    \[
    1/0.94 \times (5.9 \text{ kg fat} + 3.0 \text{ kg prot} + 2.43 \text{ kg lactose})/301 \] - DMI
  - Unit: kg/day

- Saved Feed Cost for maintenance = SFC
  - FSM kg/day -> SFC euro/lactation -> 0.20 ct/kg during 305 day lactation
  - SFC = 60.2 * FSM
  - In euro / lactation
SFC – body weight

Body weight

y = -7.4282x + 748.88
R² = 0.7935

Feed intake and response. Interbull meeting 2019
SFC - Inet

Feed intake and response. Interbull meeting 2019
SFC – feed intake

Feed intake and response. Interbull meeting 2019
SFC - longevity

Feed intake and response. Interbull meeting 2019
SFC - fertility

Feed intake and response. Interbull meeting 2019
**Genetic trend bulls**
**direct feed intake (based on offspring and genomics)**

Feed intake and response. Interbull meeting 2019
Genetic trend bulls
direct feed intake (dmidir) and dmi+predictors (dmi)

Feed intake and response. Interbull meeting 2019
Genetic trend bulls
direct feed intake (dmidir) and dmi+predictors (dmi) and FSM

Feed intake and response. Interbull meeting 2019
Reliability bulls
direct feed intake (dmidir) and dmidir+predictors (dmi) and FSM

Feed intake and response. Interbull meeting 2019
Total merit index - NVI

NVI = 0.4*Inet +0.08*lon +4.7*UDH +6.3*FER +1.8*Udder +3.6*F&L +1.8*CAL +2.7*CLW + 0.23*SFC

<table>
<thead>
<tr>
<th>Trait</th>
<th>NVI 2018</th>
<th>Rel weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inet</td>
<td>0.40</td>
<td>29%</td>
</tr>
<tr>
<td>Longevity</td>
<td>0.08</td>
<td>12%</td>
</tr>
<tr>
<td>Udder health</td>
<td>4.7</td>
<td>12%</td>
</tr>
<tr>
<td>Fertility</td>
<td>6.3</td>
<td>16%</td>
</tr>
<tr>
<td>Udder</td>
<td>1.8</td>
<td>5%</td>
</tr>
<tr>
<td>F&amp;L</td>
<td>3.6</td>
<td>9%</td>
</tr>
<tr>
<td>Calving traits index</td>
<td>1.8</td>
<td>5%</td>
</tr>
<tr>
<td>Claw health</td>
<td>2.7</td>
<td>7%</td>
</tr>
<tr>
<td>Saved Feed Cost</td>
<td>0.23</td>
<td>5%</td>
</tr>
</tbody>
</table>
Final remarks

• 5600 cows with feed intake data
  – Increase over the years (about 1000/year)
  – Increase in genomic reliability

• DMI used to define SFC
  – SFC part of NVI

• Big step to breed for efficient cow