GENETIC RESIDUAL FEED INTAKE AND ITS GENETIC ASSOCIATION TO OTHER BREEDING GOAL TRAITS

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Background

Equipment to measure individual feed intake, body weight, and methane emission at 14 commercial dairy herds

- All herds with automatic milking systems
- All cows genotyped
- ~ phenotyping **1.000** cows pr. Year
- Methane from GreenFeed
- Feed intake from BioControl

The gRFI calculation

- Why genetic residual feed intake – gRFI ?
- Promising feed efficiency trait for selection
- Define a trait uncorrelated with yield and body weight
- Cows eating less feed than expected → higher EBVs
- Genetic (co)variances for feed intake, milk yield, and body weight used to obtain regression coefficients and calculate gRFI EBVs

DAILY FEED INTAKE WAS MEASURED AS: SUM ROUGHAGE + CONCENTRATE

Feed efficiency in Norwegian Red (NR)

AIM

- Compute ***gRFI*** of NR cows based on feed intake records
- Predict EBVs for ***gRFI***
- Estimate genetic associations between ***gRFI*** to traits in routine genetic evaluations

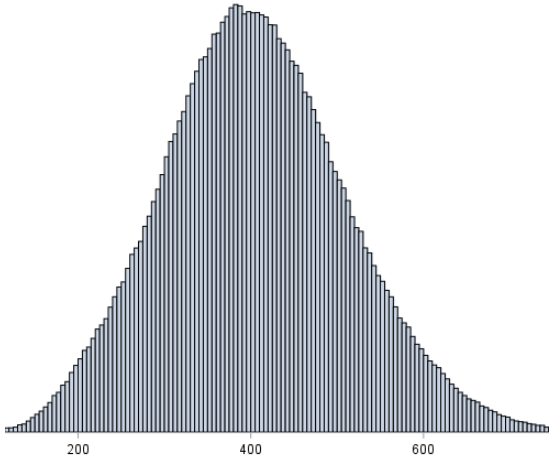
Data

Daily records on:

- Daily dry matter intake (DMI)
- Body weight (BW)
- Energy corrected milk yield, AMS (ECM[1])
- Methane emissions (CH_4)
- Daily records from 2019 to 2024
- Phenotypes on 2,412 NR cows
- In 14 herds with silage-based diet with additional concentrate

[1] *ECM calculated after Sjaunja* et al. (1990)

Phenotypic distributions

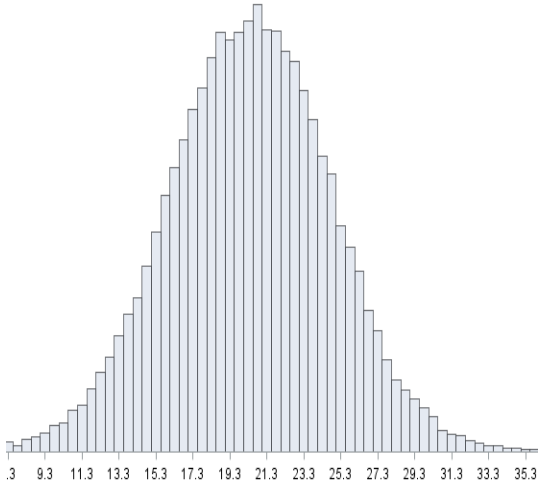


METHANE CH_4

Average per cow per day (gram)

Mean: 426 g

SD: 100 g

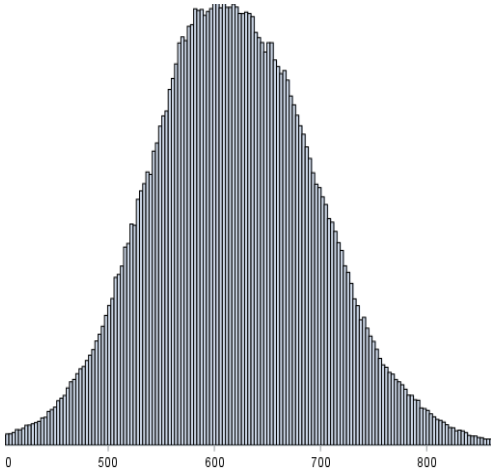


DRY MATTER DMI

Sum per cow per day (kg)

Mean: 20 kg

SD: 4.4 kg



BODY WEIGHT

Mean per cow per day (kg)

Mean: 619 kg

SD: 77 kg

Genetic correlations between measured traits

Trait	Yield	BW	DMI
CH_4	**0.53** (0.09)	**0.68** (0.06)	**0.81** (0.05)
DMI	**0.64** (0.07)	**0.66** (0.07)	
BW	**0.30** (0.10)		

Genetic correlation derived from multivariate linear animal repeatability model *(four-trait)*

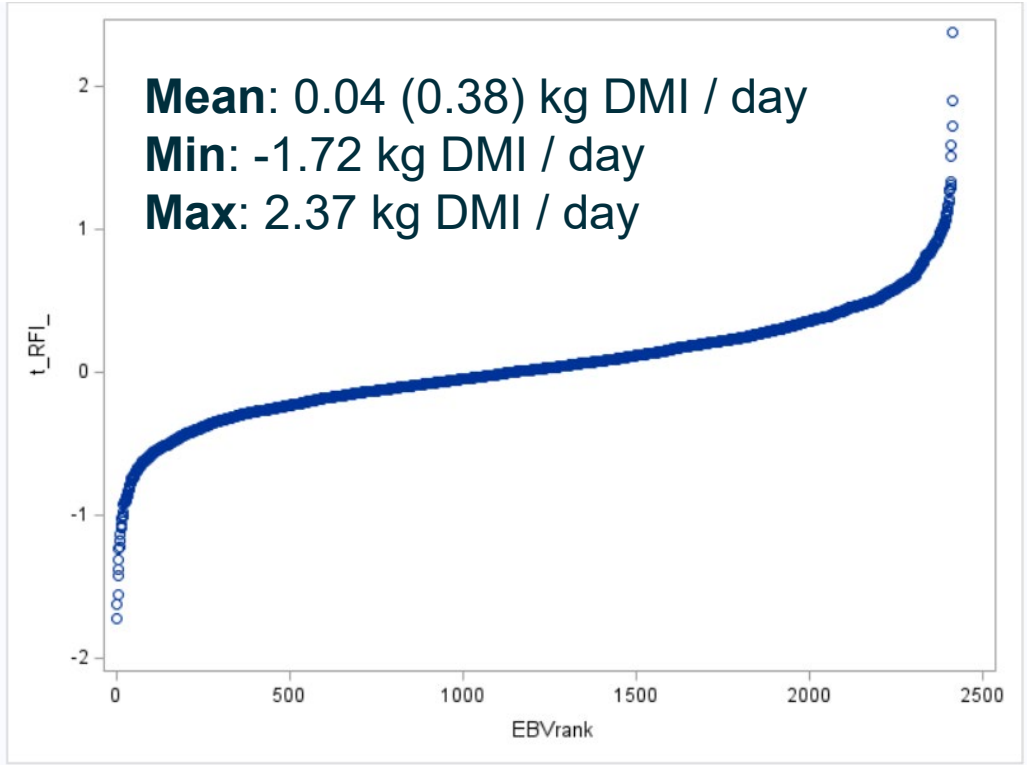
Results for genetic RFI

A MULTITRAIT MODEL INCLUDING:

- Four trait model with: DMI, BW, ECM and CH_4
- ECM and BW considered as energy "zinks":

	ECM on DMI	BW on DMI
Regression Coefficient $\hat{\beta}g_1$, $\hat{\beta}g_2$	0.285	0.016

- Heritability of gRFI was ***0.07***
- EBVs for gRFI showed variation



Estimated breeding values for gRFI sorted from lowest to highest (rank)

Low EBVs are desirable (not standardised EBVs)

Genetic associations between genetic RFI and other traits

- Index-correlations approximate genetic correlations
- Traits from Genos routine genetic evaluation of Norwegian Red
- Index correlations calculated for cows with own phenotype (DMI,CH_4, BW)

Genetic associations between genetic RFI to measured traits

Index correlations between EBV for gRFI and EBVs for measured traits in 14 “project herds”

Daily records on:

- DMI 0.56 (.001)
- BW 0.07 (.001)
- Yield, AMS -0.02 (0.3)

- gRFI indexes are uncorrelated to daily milk yield from AMS
- Slight correlation to daily average BW

Genetic associations between genetic RFI to other traits

Traits with strongest unfavorable correlation to gRFI	
Udder Exterior traits	0.13 to 0.19
Milk yield, **kg fat** 305d	0.19
Milk Protein % 305d	0.18
Milk Fat % 305d	0.17
Milk yield, **kg protein** 305d	0.16
Body Total Score[1]	0.14
Ketosis (Parity 1-5)	0.08 to 0.12
Angularity[1]	0.11
Stature[1]	0.11
Calving Ease (Maternal Parity 1)	0.10
Milk Fever (Parity 3-5)	0.06 to 0.08

- Correlations between EBV for gRFI and indexes from routine genetic evaluations for all other traits
- 2,412 cows with own phenotype
- Unfavorable genetic associations to body (size) and udder conformation traits, milk production traits, calving ease and milk fever

[1] Trait not included in the Norwegian total merit index
P-values < .0001

Genetic associations between genetic RFI to other traits

Traits with strongest favorable correlation to gRFI	
Somatic Cell Count (305d)	-0.10
Silent Heat (Parity 1-5)	-0.06 to -0.10
Calf Size (Direct)[1,2]	-0.10
Milk Leakage	-0.10
Calving Ease (Direct)	-0.07
Nmbr Inseminations (Parity 1)	-0.07

[1] Trait not included in the Norwegian total merit index
[2] Calf size: High score is small calf
P-values <.0001

- Correlations between EBV for gRFI and indexes from routine genetic evaluations for all other traits
- 2,412 cows with phenotype
- Favorable genetic associations to direct calving traits, cow fertility, and udder health

Conclusions

- Genetic variation for genetic RFI in Norwegian Red cows exists
- Udder health, calving traits and cow fertility had favorable association with the gRFI index
- Although selection for improved genetic RFI are possible, the current definition are correlated with 305d milk production traits in breeding goal
- Further improvement to define gRFI as independent of production traits in the breeding goal


geno
Avler for bedre liv
NORWEGIAN RED
spermvital
REDx
MbryO
trio