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Swedish University of Agricultural Sciences

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Genetic and environmental influence on colostrum quality and absorption in Swedish dairy cattle

Juan Cordero, J.J. Wensman, M. Tråvén, A. Larsson, D.J. de Koning

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Background

- Passive transfer of antibodies and other immune system components
- IgG most abundant isotype
- Transfer
  - IgG concentration in colostrum
  - Uptake

IgG

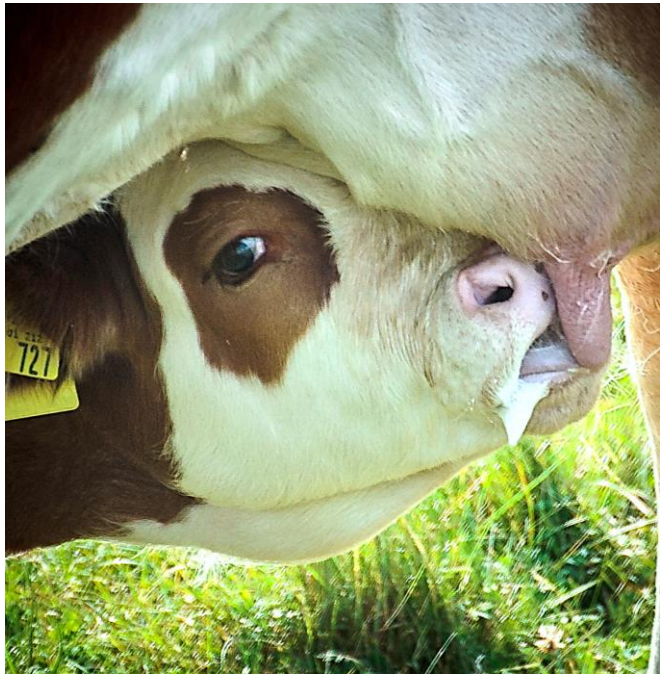
Background

Colostrum

- Good quality
  - >50 g/L IgG
  - >22% Brix Refractometer

Calf uptake

- Cutoff in serum at age 24-48 h
  - 10 g/L IgG
  - 52-55 g/L STP
  - or >7.8-10% Brix Refractometer



Background

Failure of passive transfer – FPT (Bielmann et al., 2010, Tyler et al., 1996)

- Increased risk of mortality, decreased health
- Delayed time to first calving, decreased milk and fat production at first lactation

Sweden, calf mortality 5.6%

- 10% farms up to 11% before weaning
- High proportion of FPT in Swedish herds (30-50%)
  (Hertel 2012; Silverlås et al., 2010; Torsein et al., 2011)

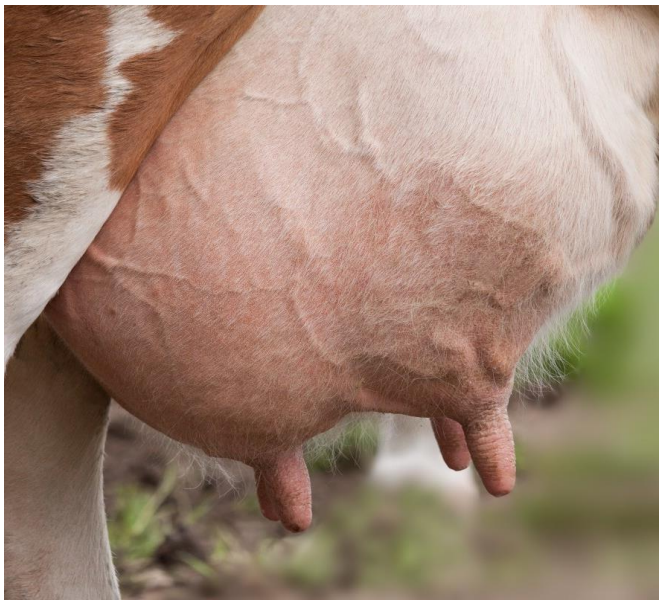
Methodology

- Sampling, Jan 2015 to Apr 2017
- 3 farms (Lövsta, Röbäcksdalen, Viken)
- Holstein and Swedish Red
  - Calves (L & R)
  - Cows

Methodology

1313 Cows, 1 to 7 parities

- Colostrum
  - IgG estimate (% Brix Refractometer)
  - 1709 samples
- Information
  - Calving to colostrum sampling (m)



Methodology

831 Calves, 2 to 7 days old

- Serum
  - Total IgG (g/L) – ELISA
  - 786 samples
- Information
  - First meal volume (L), time (h) and from which cow, calving to blood collection time (days)

Methodology

- Linear mixed models
  - ASReml 4.1
- Pedigree
  - Växa Sweden
  - 20 generations
- Heritability estimates and variance proportions

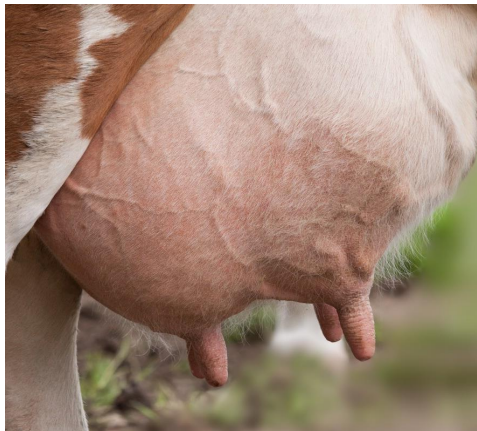
Methodology

Cows (colostrum) model

$$y_{ijkl} = \mu + \beta_1 sam_{ijkl} + Brd_i + P_j + HYS_k + a_l + e_{ijkl}$$

Fixed
- sam_{ijkl}: Calving to colostrum sampling time
- Brd_i: Breed
- P_j: Parity

Random
- HYS_k: Herd-Year-Season of calving
- a_l: Additive genetic effect



Methodology

Cows (colostrum) model

$$y_{ijklm} = \mu + \beta_1 csam_{ijklm} + Brd_i + P_j + HYS_k + a_l + pe_m + e_{ijklm}$$

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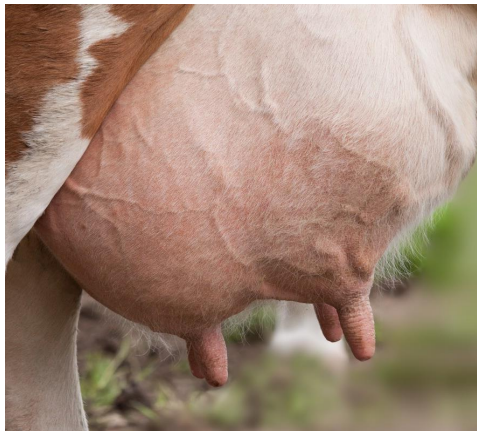
Random
- HYS_k: Herd-Year-Season of calving
- a_l: Additive genetic effect
- pe_m: Permanent environment effect



Methodology

Calves (S-IgG) model

$$y_{ij} = \mu + \beta_1 brx_{ij} + \beta_2 fmv_{ij} + \beta_3 bbs_{ij} + HYS_i + a_j + e_{ij}$$

Fixed
- brx_{ij}: Brix value of colostrum fed
- fmv_{ij}: Volume of first meal
- bbs_{ij}: Birth to blood sampling time

Random
- HYS_i: Herd-Year-Season
- a_j: Additive genetic effect

Methodology

Calves (S-IgG) model

$$y_{ijk} = \mu + \beta_1 brx_{ijk} + \beta_2 fmv_{ijk} + \beta_3 bbs_{ijk} + HYS_i + a_j + m_k + e_{ijk}$$

Fixed
- brx_{ijk}: Brix value of colostrum fed
- fmv_{ijk}: Volume of first meal
- bbs_{ijk}: Birth to blood sampling time

Random
- HYS_i: Herd-Year-Season
- a_j: Additive genetic effect
- m_k: Maternal effect

Results

Descriptive statistics

Trait	Mean (SD)	min	max	CV (%)	Below quality cutoff (%)
Colostrum Brix (%)	21.9 (4.20)	7.17	38.9	19	50.3
Calf Serum IgG (g/L)	23.0 (13.0)	1.11	72.0	57	14.4

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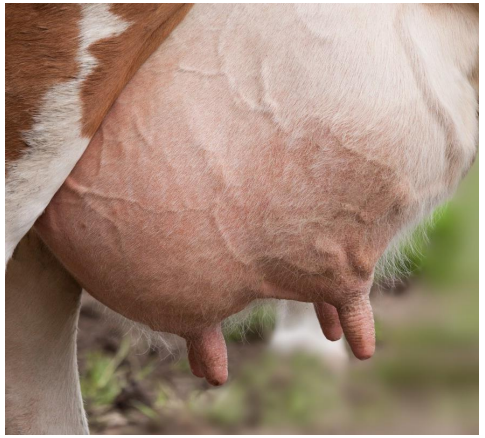
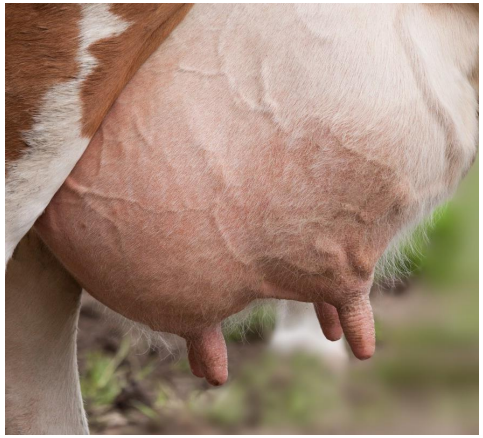
Colostrum Brix



Model	h^2 (SE)	R^2 (SE)	HYS_{vp} (SE)
With pe	0.35 (0.08)	0.51 (0.05)	0.01 (0.01)
Without pe	0.48 (0.05)	-	0.01 (0.01)

Results

Colostrum Brix



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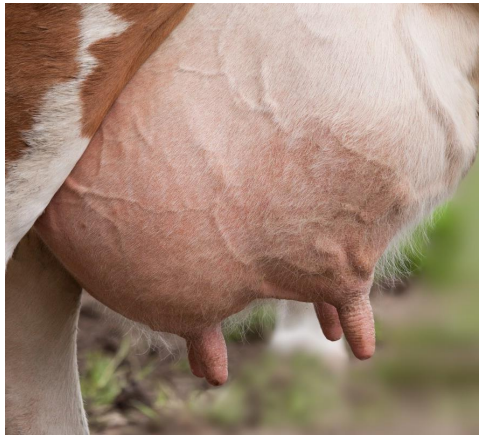

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Results

Calf serum IgG

Model	h^2 (SE)	m^2 (SE)	HYS_{vp} (SE)
With maternal effect	0.17 (0.11)	0.20 (0.07)	0.15 (0.06)
Without maternal effect	0.31 (0.12)	-	0.14 (0.05)

Results

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Conclusions

Colostrum

- Moderate heritability
- Pigs, Brix (Balzani et al. 2016)
  - $h^2 = 0.35$
  - $+r_g \rightarrow$ reproductive traits

Calf Serum IgG

- Low heritability
- Maternal effect additional to colostrum

What's next?

- Measure
  - ELISA IgG in colostrum
  - Natural Antibodies (NAb) in colostrum and serum
- Correlate colostrum antibodies with productions traits
  - Milk yield, protein, fat
- Calf health information, associate with antibodies in serum
- Genome-wide association studies

Acknowledgements

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