Genetics of mastitis in the Walloon Region of Belgium

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Background

▶ **Mastitis = inflammation of the mammary gland**

▶ **Most frequent and costly disease in dairy cattle**

⇨ discarded milk, veterinary costs, welfare issues, decreased milk yield, increased culling rate, etc.

▶ **Reducing mastitis incidence?**

· **Improved management practices**

· **Genetic selection:**

  ○ inclusion of health traits in the breeding goal for more than 30 years in Nordic countries

  ○ direct selection based on clinical mastitis records

  ○ indirect selection based on correlated traits (e.g. SCS)

Halasa et al., 2007, Vet.Q. 29:18-31
Heringstad et al., 2000, Livest. Prod. Sci, 64:95-106

Background

In the Walloon Region of Belgium

► **Genetic selection for udder health based on somatic cell score (SCS):**

   ↳ **weighted random regression test-day model to better relate observed SCS to mastitis infection likelihood**

Mayeres & Gengler, 2003, Interbull Bull., 31:92-95

► **Recently, mastitis data collection started:**

   • **voluntary recording by dairy farmers in a limited number of farms**

   • **management tools**

   • **interest for genetic selection?**

      ↳ **preliminary study**

Objectives

1. Estimate genetic parameters for various mastitis traits

2. Estimate genetic correlations between these traits and milk, fat, and protein yields, SCS, and lactoferrin content

Mastitis data: edits

► **Edits on herds:**
  - recording period > 180 d
  - no. of mastitis/no. of cows over the period > 5%

► **Edits on cows within herds:**
  - cows in lactation 1 to 5
  - lactation started after the beginning of the recording period
  - lactation length > 100 d

► **Edits on mastitis data:**
  - 2 mastitis occurring within 7 d considered as the same event

3808 mastitis in 92 herds ⇨ 2001 mastitis in 37 herds
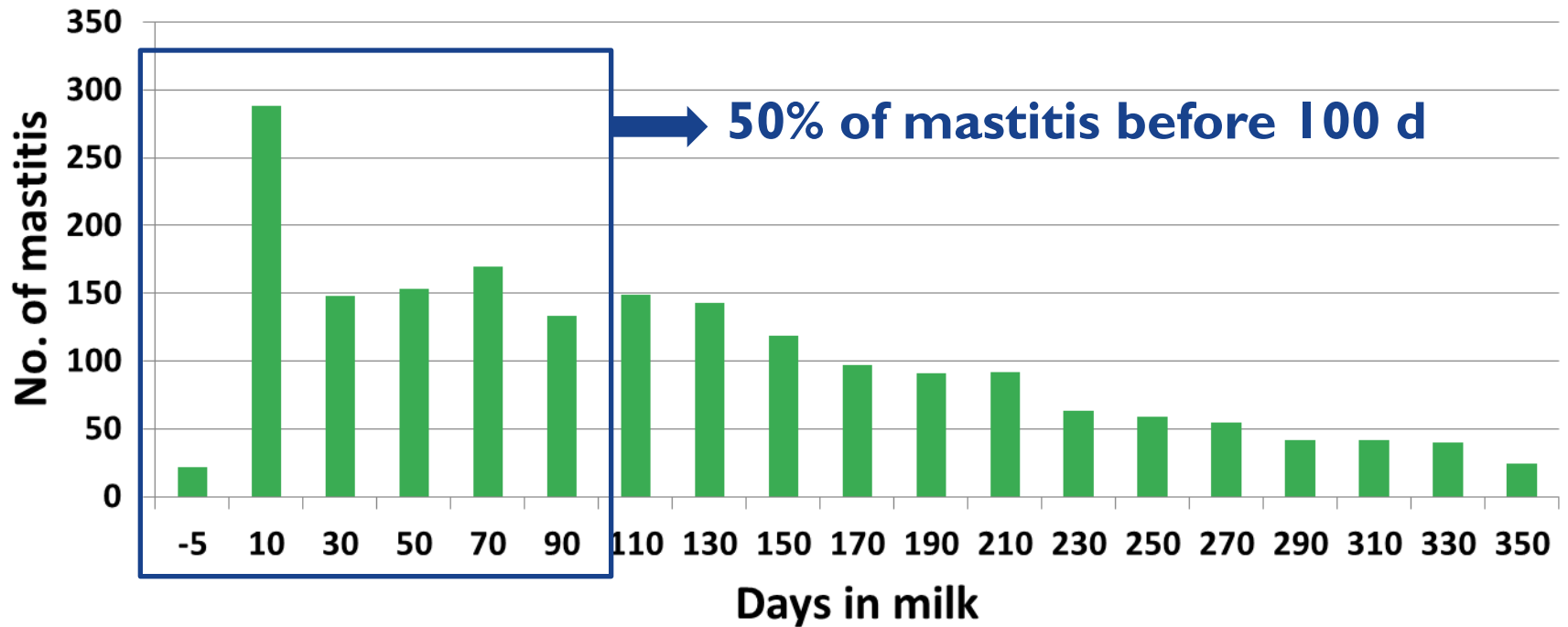
Mastitis data: edits

- ► **Edits on herds:**
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- ► **Edits on cows within herds:**
  - · **cows in lactation 1 to 5**
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  - · **lactation length > 100 d**

- ► **Edits on mastitis data:**
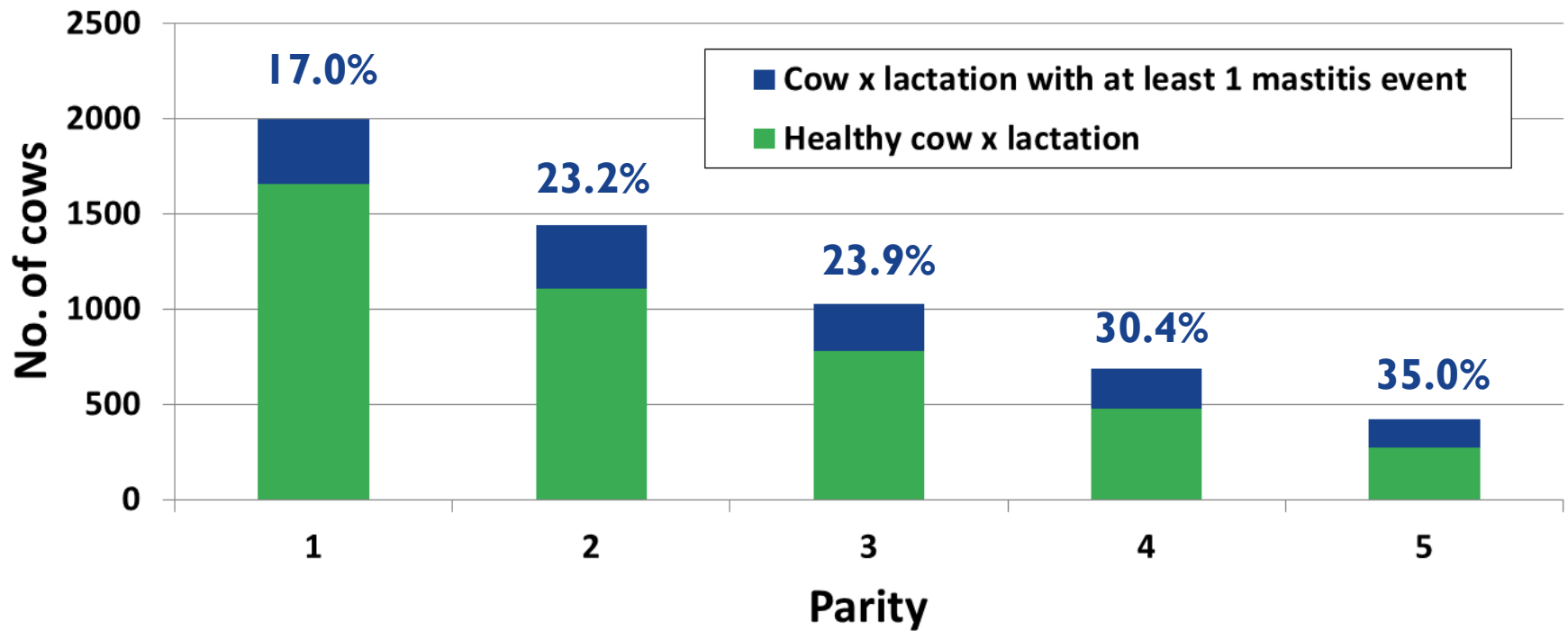 - · **2 mastitis occurring within 7 d considered as the same event**

Final data set: 5566 lactations from 3427 cows in 37 herds

Mastitis data

No. of mastitis data over days in milk

50% of mastitis before 100 d

Mastitis data

Mastitis traits

MAS	at least one mastitis case from 10 d before calving to 10 d before the next calving (0/1)
early_MAS	at least one mastitis case from 10 d before calving to 50 d after calving (0/1)
late_MAS	at least one mastitis case from 51 days after calving to 10 d before the next calving (0/1)
NMAS	no. of mastitis cases during the lactation

Mastitis data

Trait	N	Frequency
MAS	5566	23%
early_MAS	5566	9%
late_MAS	5566	17%

NMAS	0	1	2	3	4	5	> 5
N	4292	847	267	83	45	20	12

Other traits

▶ **305-d milk (MY), fat (FY) and protein (PY) yields**

- estimated using modified best prediction

Gillon et al., 2010, Proc. of 37th ICAR meeting

▶ **Average SCS over the lactation (LSCS)**

▶ **Average lactoferrin content over the lactation (LLF)**

- predicted by mid-infrared spectrometry

Soyeurt et al., 2012, Animal, 6:1830-1838

- lactoferrin = iron-binding glycoprotein present in milk, important host defence molecule

- lactoferrin level in mastitic milk >>> normal milk

Kawai et al., 1999, J. Vet. Med. Sci. 65:319–323
Hagiwara et al.,2003, Vet. Res. Comm. 23: 391–398

Other traits: data

▶ **305-d milk (MY), fat (FY) and protein (PY) yields**

▶ **Average SCS over the lactation (LSCS)**

▶ **Average lactoferrin content over the lactation (LLF)**

Trait	N	Mean	Std
MY	5566	8198	1949
FY	5566	317	71
PY	5566	270	60
LSCS	4896	3.14	1.30
LLF	3217	186	53

Model

▶ **3 multi-trait linear models**

- **4 mastitis traits**
- **4 mastitis traits + LSCS + LLF**
- **4 mastitis traits + MY + FY + PY**

▶ **Fixed effects:**

- **herd (37) , year x season of calving (28), age at calving x lactation (12)**

▶ **Random effects:**

- **permanent environment, genetic additive**

▶ **Variance components estimated using GIBBSF90**

- **200,000 samples with burn-in of 20,000**
- **every 20th samples to compute estimates**

Misztal et al., 2013

Results

Heritabilities and genetic correlations (standard errors in brackets)

Trait	MAS	early_MAS	late_MAS	NMAS
MAS	**0.09** (0.02)	**0.70** (0.12)	**0.98** (0.01)	**0.99** (0.01)
early_MAS		**0.04** (0.01)	**0.53** (0.17)	**0.73** (0.11)
late_MAS			**0.08** (0.02)	**0.96** (0.02)
NMAS				**0.08** (0.02)

▶ **Heritabilities in the range of previous studies**

Heringstad et al., 2000, Livest. Prod. Sci, 64:95-106
Urioste et al., 2012, J. Dairy Sci., 95:3428-3434
Mrode et al., 2012, J. Dairy Sci., 95:4618-4628

Results

Heritabilities and genetic correlations (standard errors in brackets)

Trait	MAS	early_MAS	late_MAS	NMAS
MAS	0.09 (0.02)	0.70 (0.12)	0.98 (0.01)	0.99 (0.01)
early_MAS		0.04 (0.01)	0.53 (0.17)	0.73 (0.11)
late_MAS			0.08 (0.02)	0.96 (0.02)
NMAS				0.08 (0.02)

▶ **MAS, late_MAS and NMAS are similar traits
while early_MAS seems to be a different trait**

Negussie et al.,2008, J. Dairy Sci., 91:1189-1197
Mrode et al., 2012, J. Dairy Sci., 95:4618-4628

Results

Heritabilities and genetic correlations (standard errors in brackets)

Trait	h²	Genetic correlation with:			
		MAS	early_MAS	late_MAS	NMAS
MY	0.23 (0.03)	0.16 (0.13)	0.15 (0.17)	0.26 (0.12)	0.24 (0.13)
FY	0.22 (0.03)	0.10 (0.14)	0.08 (0.17)	0.19 (0.13)	0.16 (0.14)
PY	0.24 (0.03)	0.16 (0.13)	0.15 (0.17)	0.25 (0.12)	0.23 (0.13)
LSCS	0.20 (0.03)	0.59 (0.11)	0.44 (0.18)	0.61 (0.11)	0.64 (0.10)
LLF	0.31 (0.03)	0.18 (0.15)	0.02 (0.16)	0.23 (0.16)	0.29 (0.14)

Results

Heritabilities and genetic correlations (standard errors in brackets)

Trait	h²	Genetic correlation with:			
		MAS	early_MAS	late_MAS	NMAS
MY	**0.23** (0.03)	**0.16** (0.13)	**0.15** (0.17)	**0.26** (0.12)	**0.24** (0.13)
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LLF	**0.31** (0.03)	**0.18** (0.15)	**0.02** (0.16)	**0.23** (0.16)	**0.29** (0.14)

▶ **Moderate positive correlation with LSCS**

Heringstad et al., 2000, Livest. Prod. Sci, 64:95-106
Koeck et al., 2012, J. Dairy Sci., 95:432-439

Results

Heritabilities and genetic correlations (standard errors in brackets)

Trait	h²	Genetic correlation with:			
		MAS	early_MAS	late_MAS	NMAS
MY	0.23 (0.03)	0.16 (0.13)	0.15 (0.17)	0.26 (0.12)	0.24 (0.13)
FY	0.22 (0.03)	0.10 (0.14)	0.08 (0.17)	0.19 (0.13)	0.16 (0.14)
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LLF	0.31 (0.03)	0.18 (0.15)	0.02 (0.16)	0.23 (0.16)	0.29 (0.14)

▶ **Unfavorable correlations with production traits**

Heringstad et al., 2000, Livest. Prod. Sci, 64:95-106
Vallimont et al., 2009, J. Dairy Sci., 92:3402-3410

Results

Heritabilities and genetic correlations (standard errors in brackets)

Trait	h²	Genetic correlation with:			
		MAS	early_MAS	late_MAS	NMAS
MY	0.23 (0.03)	0.16 (0.13)	0.15 (0.17)	0.26 (0.12)	0.24 (0.13)
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LLF	0.31 (0.03)	0.18 (0.15)	0.02 (0.16)	0.23 (0.16)	0.29 (0.14)

► **Correlations with LLF positive, in the same range than for MY**

Conclusions

▶ **Preliminary study on a limited no. of records**
- ↳ **first results in line with the literature**
- ↳ **recording of mastitis by farmers further encouraged**

▶ **Genetic parameters for mastitis:**
- ↳ **heritability from 0.04 to 0.09**
- ↳ **correlations among traits moderate to high**

▶ **Unfavorable correlations with production (0.08 to 0.26)**

▶ **LSCS and LLF as indicators traits for mastitis?**
- ↳ **moderate positive correlation with LSCS (0.44 to 0.64)**
- ↳ **lower correlation with LLF (0.02 to 0.29)**
- ↳ **alternative SCS and lactoferrin traits might be more informative than lactation average**

Further investigations

► **Alternative SCS and lactoferrin traits?**
  ⇨ **based on the pattern over the lactation**
    ↳ **SCC peak, SD of SCS over the lactation, average SCS in early lactation, residuals of SCS from RRM, etc.**
    ↳ **account for both aspects of lactoferrin:**
      • **generally, lactoferrin content ↗ ↗ ↗ in case of mastitis**
      • **a certain level of lactoferrin required to prevent infection**

► **Other indicators traits?**
  ↳ **e.g., type traits, milk composition and chemical properties, mid-infrared spectra**

Thank you for your attention!

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