Breeding of cows suitable for an automatic milking system

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Introduction

- Currently increase in use of automatic milking systems (AMS)
- Efficient use of the AMS
- Breed cows that are suitable for this system
  - AMS efficiency
  - Milking interval
  - Habituation of heifers

Aim: Genetic analysis for AMS traits

Trait definition

AMS efficiency =

Produced amount of milk in kg per total AMS time in minutes

Milking interval =

Time between 2 consecutive successful milkings in minutes

Habituation of heifers =

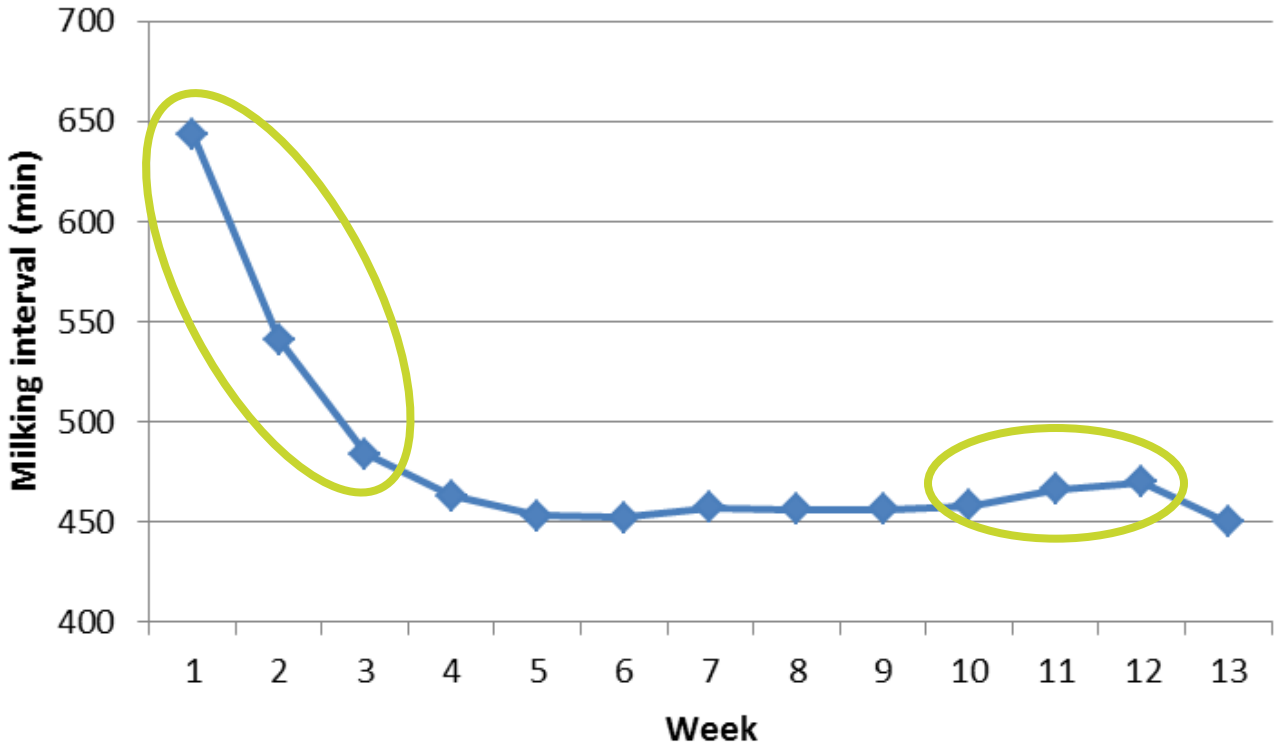
Time period a heifer needs to get familiar with the AMS =

Comparing the milking interval in the first three weeks after calving with a period later in lactation (week 10 – 12)

Successful milking

- AMS marks milking as 'True'
- Milkyield between 1.6 – 40.0 kg per milking
- Milking interval between 240 – 1200 minutes

Trait definition – Habituation of heifers



Week 1, 2, 3 = average interval 578 min
Week 10, 11, 12 = average interval 492 min

Habituation = 578 – 492 = 86 minutes

Available data

Data available

Period	Number of obs.	Number of animals	Number of herds
January 2013	150,000,000		
May 2014	500,000,000	453,138	3,377

Weekly increase of ± 5 mln observations

Data in the analysis

In the analysis	Number of obs.
Observations	25,000,000
Animals	40,000
Herds	500

AMS efficiency

Lactation	Milk yield (kg)	Time in AMS (min)	AMS efficiency (kg/min)	h^2	Repeatability
1			1.45 ± 0.46	0.23	0.58
2			1.66 ± 0.51	0.20	0.58
3+			1.70 ± 0.53	0.20	0.55
All	10.5 ± 3.1	6.9 ± 2.2	1.61 ± 0.52	0.23	0.55

Lower AMS efficiency for heifers, other lactations comparable

High genetic correlations between lactations (> 0.94)

AMS efficiency

$$\frac{Milkyield\ of\ the\ milking\ (kg)}{Total\ time\ in\ the\ AMS\ (min)} = \frac{10.5}{6.9} = 1.6$$

Milking interval

Lactation	Milk yield (kg)	Milking interval (min)	h^2	Repeatability
1		521 ± 149	0.09	0.34
2		497 ± 149	0.08	0.34
3+		504 ± 158	0.06	0.31
All	10.6 ± 3.2	507 ± 153	0.08	0.31

Estimation genetic parameters is possible
Genetic variation is 39 minutes

High genetic correlations between lactation 2 and 3+ (0.96)

Milking interval

Time between milking 1 and milking 2

Time milking 1 = 08:00h
Time milking 2 = 16:30h

16:30 – 08:00 = 8h and 30 min = 510 min

Habituation of heifers

Milk yield (kg)		Milking interval (min)		Habituation (min)	h^2	Genetic SD (min)
Week 1, 2, 3	Week 10, 11, 12	Week 1, 2, 3	Week 10, 11, 12			
9.1 ± 2.1	9.9 ± 1.9	578 ± 113	492 ± 104	81 ± 108	0.07	20

Difference between milking interval immediately after calving and later in lactation.

Difference in milking interval is 81 minutes.

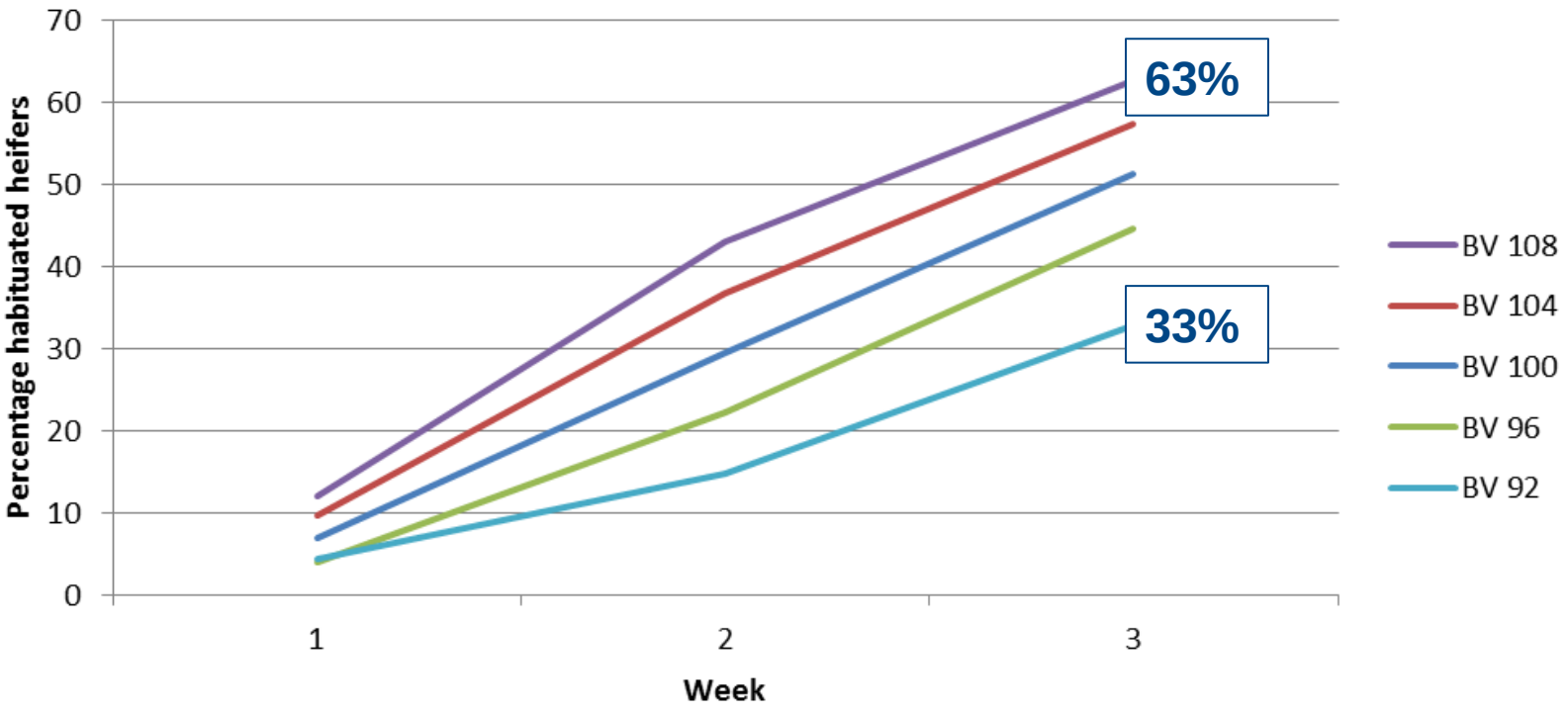
Habituation of heifers

Average milking interval week 10, 11 and 12 – average milking interval week 1, 2 and 3

Average week 1, 2, 3 = 570 min
Average week 10, 11, 12 = 480 min

Habituation = 90 min

Habituation of heifers



Relation between relative BV and percentage of heifers that are habituated at week 1 – 3.

What does a relative BV mean?

BV 100 = Habituation of 80 min
(= diff. in milk interval wk. 1-3 and wk. 10-12 is 80 min.)

BV 108 = Habituation 38 min = +2 SD
BV 104 = Habituation 59 min
BV 100 = Habituation 80 min = Average
BV 96 = Habituation 101 min
BV 92 = Habituation 122 min = -2 SD

Correlations with other traits

Breeding Values	AMS efficiency	Milking interval	Habituation of heifers
Milk production (kg)	0.14	0.40	0.16
Fat (kg)	-0.11	0.13	0.06
Protein (kg)	0.02	0.35	0.13
Milking speed	0.64	0.05	0.03
Temperament	0.20	0.07	0.04
SCS	-0.20	0.23	0.03
Udder health	-0.21	0.21	0.02
Fertility	-0.16	-0.11	-0.14
Feet & Legs	-0.18	0.12	-0.05
Locomotion	-0.13	0.09	-0.10
Udder	-0.05	0.28	0.07
Rear teat placement	-0.02	0.18	-0.12
Front teat placement	-0.04	0.20	-0.09
Teat length	-0.01	-0.11	0.05
Longevity	-0.11	0.21	0.00

The higher the AMS efficiency the higher the milking speed.

The shorter the milking interval the higher the milk production.

Habituation of heifers show only very weak correlations with other traits.

Practical example

	Average	High[1]	Low[2]
AMS efficiency (kg/min)	1.61	1.91	1.32
Extra kg milk / minute	0	0.30	-0.29

Available AMS time per day = 20 hour

Extra kg milk / AMS / day	0	360	-348
Extra number of cows per AMS, with production of 30 kg milk / day	0	12	-12

[1]High = based on daughters of the 13 sires with the highest AMS efficiency
[2]Low = based on daughters of the 13 sires with the lowest AMS efficiency

Conclusions

- Enormous amount of input data weekly

- The analysis showed that AMS efficiency, milking interval and habituation of heifers are heritable AMS traits.

  → Genetic improvement can be made

- Milking speed and milk production show the highest correlations with AMS traits.