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THE EVALUATION OF MILKABILITY OF SLOVAK PINZGAU CATTLE BY LACTOCORDER

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ABSTRACT

This paper is focused on the evaluation of milkability of Slovak Pinzgau cattle, using mobile measuring device called Lactocorder. The main group of Slovak Pinzgau dairy cows was divided according to the order of lactation (according to parity) into the experimental groups in order to carry out a comparison of traits and parameters of milkability, obtained by Lactocoder within these groups. An important objective of our study was to detect the length and the thickness of the left rear teat of the cow after each measuring by Lactocorder and also to collect the samples of milk for somatic cell count. Totally 94 Slovak Pinzgau dairy cows were evaluated. All measurements were carried out during one weak on a farm located in the eastern Slovakia. The average total milk yield was 8.13 ± 2.42 kg per milking, with an average milk flow rate of 1.76 ± 0.49 kg.min^{-1} and average maximum milk flow rate of 3.08 ± 0.90 kg.min^{-1}. The total milk yield showed a positive correlations with average milk flow rate (r = 0.69+++) and with maximal milk flow rate (r = 0.42+++). Based on so called milk flow curves provided by Lactocorder, the course of milking can be evaluated. The milk flow curves display the occurrence of bimodality and duration of each phase of the milking process. The occurrence of bimodality (which can be characterised as a steep decrease of milk flow in time up to 96 seconds after the beginning of milking) was 32.98 %. Positive correlation was found between bimodality and duration of the incline phase (r = 0.74+++) and negative correlation was found between bimodality and quantity of milk acquired during first minute of milking (r = -0.46+++). The mean somatic cell count in our experiment was 297 426 cells.ml^{-1}. The average length of the teat was 50.84 ± 9.19 mm and the average thickness was 25.17 ± 2.55 mm. Information and results concerning milkability and milking, provided by Lactocorder can be very helpful for a farmer in connection with displacing the mistakes, which could be made during milking process or milking readiness.

Key words: milkability; lactocorder; somatic cell count; Slovak Pinzgau cattle

INTRODUCTION

Milkability can be considered as an important functional trait in diary cattle with regard to udder health as well as to labour efficiency. A cow should be milked out gently, quickly and completely, with no need for further adjustment of the milking unit and no need for machine stripping (Mein, 1998). Increased milking speed is associated with decreased milking labour time, and labour is one of the most significant costs in milk production. Moreover, lowering milking time per cow reduces costs for electrical power and weariness of milking equipment (Boettcher et al., 1998). Dairy farmers put considerable emphasis on milkability, because slow milking cows are hindering the milking process of the herd, especially in milking parlours. At auctions, where daily milk yield as well as milkability of freshly calved heifers is announced, milkability had a significant impact on the price (Krogmeier et al., 2006). On the other hand, there is evidence that faster milking cows have higher infection risk for mastitis (Grindal and Hillerton, 1991). Concerning milking speed, it is known, that it is not possible to exceed the biological thresholds of this attribute, because this could have a negative influence on relaxing of teat muscles. Göft et al. (1994) and Fürst (2000) reported that the result of this situation is opening the "input gate" for microbes and bacterium to the

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mammary gland. Milkability can be classified into the so called "functional traits of cattle". Functional traits can be described as the attributes which influence the production and the economy of rearing by decreasing of input costs. In addition to milkability there can be classified traits like calving easy, stillbirth, diseases resistance, longevity or adaptability to an environment (Pedersen, 1997; Rensing, 2005). An important part of our study was to take the samples of milk for somatic cell count measurement. A microbial infection of the mammary gland causes a rapid increase in the somatic cell count in milk and therefore SCC has been used as an indirect measure of udder health. As an indicator of mastitis, SCC has many desirable characteristics. SCC is objectively recorded on a continuous scale and it has a higher heritability than mastitis incidence (Pösö and Mäntysaari, 1996). Direct selection for clinical mastitis has often been considered inefficient because the heritability of mastitis is low (Lund et al., 1999).

Objectives of this study were to evaluate milkability traits of Slovak Pinzgau cattle measured by electronic mobile milk flow meters – Lactocorders, to make a comparison of these traits among groups of cows divided according to parity, to detect dimensional parameters of the left rear teat and to find out correlations between traits of milking, milkability and dimensional parameters of the teat respectively.

MATERIAL AND METHODS

All of our evaluations done by Lactocorder were carried out on a farm located in the eastern Slovakia during one week. Measurement was performed by two electronic mobile milk flow meters – Lactocorders, which were installed between milking equipment and milking tube before each milking. Totally 94 Slovak Pinzgau dairy cows were evaluated during four consecutive milking. The cows were on their 11^{th} to 296^{th} day of lactation. In the second part of our study, we divided the whole group of Slovak Pinzgau dairy cows into 4 smaller units, according to the order of lactation (according to parity):

- Cows at the first lactation (n = 16)
- Cows at the second lactation (n = 33)
- Cows at the third lactation (n = 15)
- Cows at the fourth and higher lactations (n= 30)

The cows were milked twice a day.

Lactocorder evaluates only a so called main phase of milking, which begins after exceeding the milk flow 0.5 kg.min^{-1} and ends when milk flow drops down below 0.2 kg.min^{-1}. The samples for somatic cell count were collected by Lactocorder during each measurement and then sent (for analyses) to laboratories in Žilina (Breeding service of Slovak Republic). The dimensional parameters of the left rear teat after each measuring were measured. We measured the length and thickness of the teat using special type of calliper. A small ruler was used in order to detect the length of the teat.

In our study, these parameters were measured and evaluated:

- Total milk yield [kg]
- Milk flow rate [kg.min^{-1}]
- Maximum milk flow rate [kg.min^{-1}]
- Duration of main phase [min]
- Duration of incline phase [min]
- Duration of plateau phase [min]
- Duration of decline phase [min]
- Bimodality [%]
- The quantity of milk acquired during first minute of milking [kg]
- The quantity of milk acquired during first 2 minutes of milking [kg]
- The quantity of milk acquired during first 3 minutes of milking [kg]
- Somatic cell count [cells.ml^{-1}]
- Length of the teat [mm]
- Thickness of the teat [mm]

The results of our measurements were processed by the program pack "LactoPro 5.2.0" (Biomelktechnik Swiss). We used Microsoft Excel and SAS 9.1 for analysing and data calculation. Pearson correlation analyses were performed by using the CORR procedure (SAS 9.1)

RESULTS AND DISCUSSION

In our analyses 94 Slovak Pinzgau dairy cows were evaluated. We detected and analysed 14 parameters and traits related to milkability, milking process and milking readiness. The average total milk yield was 8.13 ± 2.42 kg per milking, with an average milk flow rate of 1.76 ± 0.49 kg.min^{-1} and average maximum milk flow rate of 3.08 ± 0.90 kg.min^{-1}. Similar results were published in Fleckvieh where the average milk flow rate ranged from 1.66 to 1.71 kg.min^{-1} depending on parity (Dodenhoff et al.,1999 - the dairy cows at the first lactation reached the average milk flow rate of 1.66 kg.min^{-1} and the cows at the third lactation reached 1.71 kg.min^{-1}). The average milk flow rate of Brownvieh cows ranged from 1.83 to 2.05 kg.min^{-1} (Dodenhoff et al.,1999).

The occurrence of bimodality (which can be characterised as a steep decrease of milk flow in time up to 96 seconds after the beginning of milking) was 32.98 % indicating not well prepared cows for machine milking (Tančin and Bruckmaier, 2001). Bimodality was positively correlated with a duration of the incline phase (r = 0.74+++) and negatively correlated with a quantity

of milk acquired during first minute of milking (r = -0.46+++). Similar results were recorded by Sandrucci et al. (2007), who noted approximately one–third (35.1%) of milk flow curves as bimodal. In accordance with our results, the duration of the incline phase showed a positive correlation with bimodality (r = 0.58) as a consequence of the longer time required to reach the plateau phase when a transient reduction of milk flow occurred (Sandrucci et al., 2007). A difference between an „optimal“ and „bimodal“ milk flow curve is shown in the Figures 1 and 2.

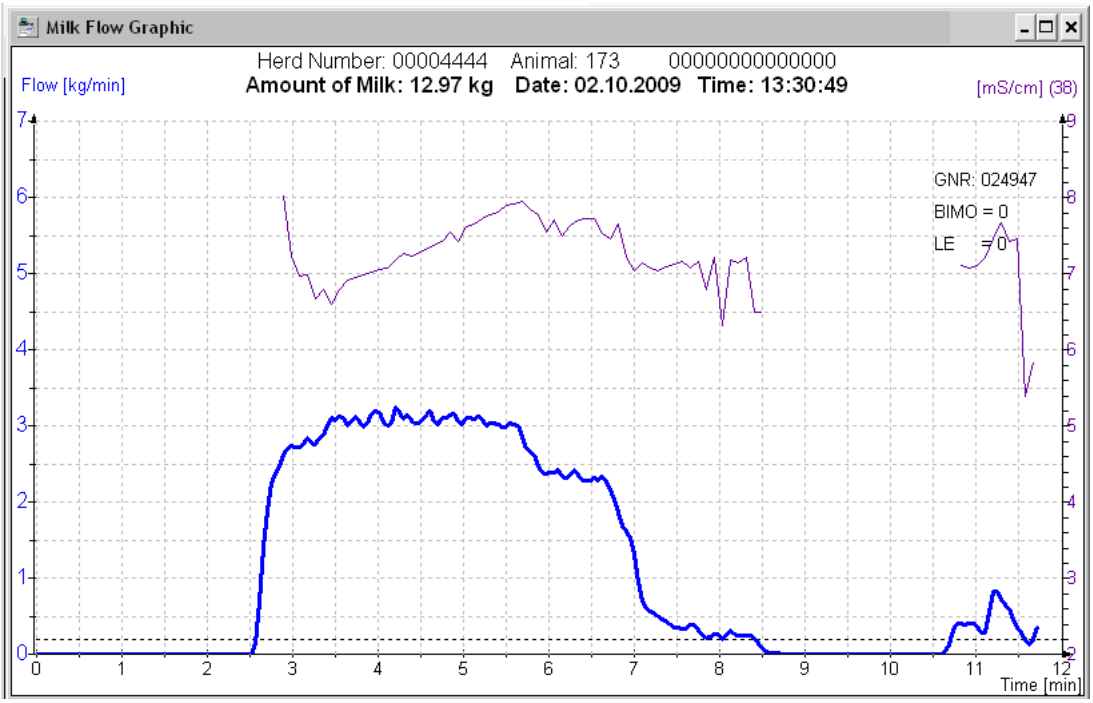

Fig. 1: An example of a milk flow curve without bimodality

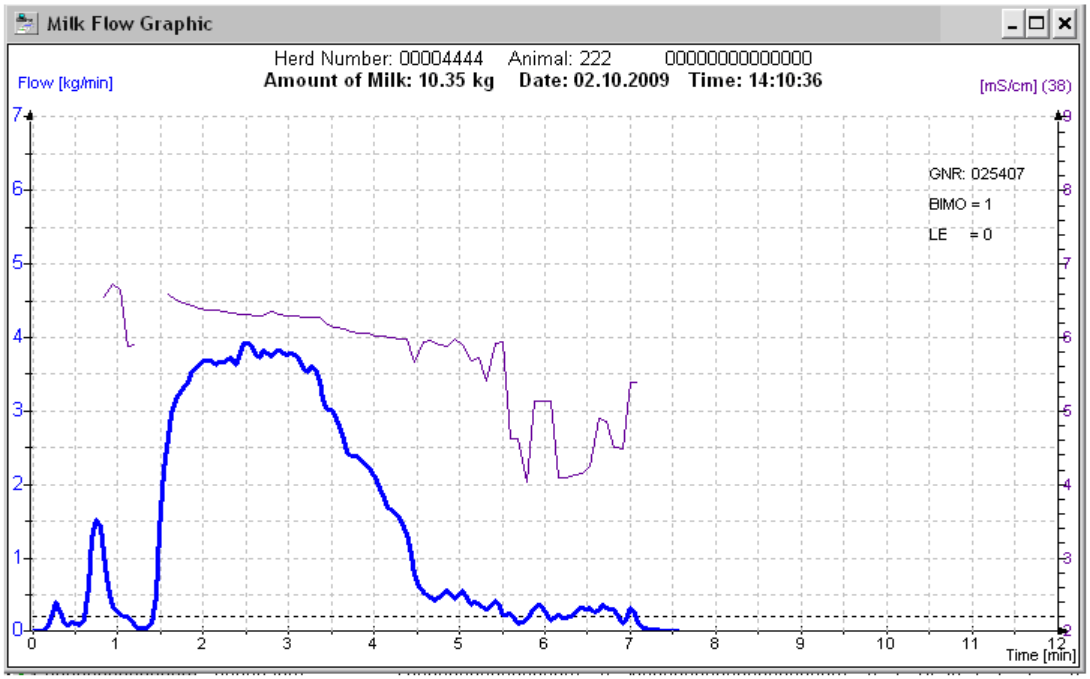

Fig. 2: An example of a milk flow curve with bimodality

The mean somatic cell count in our study was 297 426 cells.ml^{-1}.

After each measuring using Lactocorder, we also detected the length and thickness of the left rear teat of the cow. The average teat length was 50.84 ± 9.19 mm and the average thickness was 25.17 ± 2.55 mm. No correlations were found between these dimensional parameters of the teat and milkability traits, like average or maximal milk flow rate. Similar results were published by Weiss et al. (2004), who also observed no correlations between milkability traits and externally measurable teat characteristics like teat length or teat diameter. The summary of results of this part of the study is shown in Table 1 and Table 3.

Table 1: Milk flow parameters and traits of milking of the whole group of Slovak Pinzgau dairy cows (n =94)

Trait	$\bar{x}$	Min	Max	s_x
Total milk yield [kg]	8.13	3.67	13.47	2.42
Milk flow rate [kg.min^{-1}]	1.76	0.63	2.74	0.49
Maximum milk flow rate [kg.min^{-1}]	3.08	1.27	5.17	0.90
Duration of main phase [min.]	4.34	2.33	8.17	1.19
Duration of incline phase [min.]	0.59	0.05	1.31	0.31
Duration of plateau phase [min.]	1.32	0.05	4.34	0.95
Duration of decline phase [min.]	2.43	0.75	4.76	0.85
The quantity of milk acquired during first minute of milking [kg]	2.13	0.34	4.39	0.82
The quantity of milk acquired during first 2 minutes of milking [kg]	4.85	1.74	7.62	1.46
The quantity of milk acquired during first 3 minutes of milking [kg]	6.46	2.50	10.53	1.95
Somatic cell count [cells.ml^{-1}]	297 426	9000	4 436 000	568 183
Length of the teat [mm]	50.84	27	72	9.19
Thickness of the teat [mm]	25.17	20	31	2.55
Bimodality [%]	32.98			

In the second part of our study we divided the whole group of Slovak Pinzgau dairy cows (94) into 4 smaller units according to the order of lactation (parity). The highest "average milk flow rate" was reached by the dairy cows in the third lactation (1.92 ± 0.53 kg.min^{-1}). On the other hand the lowest "average milk flow rate" was observed in the dairy cows at the first lactation (1.59 ± 0.40 kg.min^{-1}). The average milk flow rate increased from first to third lactation. This is in accordance with Dodenhoff et al. (1999) who detected that average milk flow rate in later lactations is larger than in the first lactation. Tančin et al. (2005) published in the group of dairy cows at the first lactation lower values of the maximal milk flow rate (3.41 ± 0,21 kg.min^{-1}) and average milk flow rate (2.17 ± 0,06 kg.min^{-1}) in connection with the group of dairy cows at the second lactation (3.49 ± 0.23 kg.min^{-1}; 2.26 ± 0,65 kg.min^{-1}) and also in connection with the group of cows at the higher lactation (3,84 ± 0.28 kg.min^{-1}; 2.33 ± 0.68 kg.min^{-1}). Positive correlations were found between total milk yield and average milk flow rate and also between total milk yield and maximal milk flow rate (r = 0.69+++ and 0.42+++ resp.). Based on our results and also on a previous study carried out by Strapák et al. (2009), it can be indicated that there is a relation between total milk yield and milk flow traits. This is one of the reasons, why primiparous cows reach lower average milk flow rate in comparison with multiparous cows. Our results are in accordance with Sandrucci et al. (2007), who also found a positive correlation between total milk yield and maximal milk flow rate (r = 0.33). Similar results were published by Mijic et al. (2003) who detected a positive correlation between total milk yield and average milk flow rate in Holstein Friesan and Simmental breeds (r = 0.39; r = 0.49).

In the case of total milk yield, the highest value was reached by the dairy cows in the third lactation (8.91 ± 2.83 kg). The lowest average total milk yield was detected in the group of dairy cows in the first lactation (7.03 ± 1.44 kg). The highest average maximum milk flow rate was determined in the case of the dairy cows at the second lactation (3.45 ± 0.75 kg.min^{-1}) – the lowest value was measured again in the group of dairy cows at the first lactation (2.58 ± 0.82 kg.min^{-1}). The occurrence of bimodality was the highest in the group of dairy cows at the second lactation (45.45 %). The lowest occurrence was detected in the dairy cows at the fourth and further

lactations (20 %). Recently Strapák et al. (2009) reported occurrence of bimodal milk flow curves in range from 50 to 56 % depending on parity. The highest percentage of bimodality was detected in the group of cows at the third and higher lactation.

There was found no correlation between parity and average or maximal milk flow rate. However, we detected a significant influence of parity on somatic cell count, duration of the decline phase, length and thickness of the teat (r = 0.33++, 0.32++, 0.41+++, 0.44+++).

Table 2: Milk flow parameters and traits of milking of Slovak Pinzgau dairy cows divided according to the order of lactation – parity

Trait	The order of lactation (parity)			
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Number of cows [n]	16	33	15	30
Total milk yield [kg]	7.03 ± 1.44	7.92 ± 2.14	8.91 ± 2.83	8.57 ± 2.79
Milk flow rate [kg.min^{-1}]	1.59 ± 0.40	1.86 ± 0.45	1.92 ± 0.53	1.66 ± 0.55
Maximum milk flow rate [kg.min^{-1}]	2.58 ± 0.82	3.45 ± 0.75	3.32 ± 0.91	2.81 ± 0.93
Duration of main phase [min.]	4.33 ± 1.65	3.97 ± 0.80	4.18 ± 1.05	4.83 ± 1.22
Duration of incline phase [min.]	0.56 ± 0.33	0.68 ± 0.26	0.53 ± 0.34	0.54 ± 0.33
Duration of plateau phase [min.]	1.76 ± 1.21	0.96 ± 0.60	1.29 ± 1.04	1.49 ± 0.98
Duration of decline phase [min.]	2.01 ± 1.02	2.33 ± 0.69	2.35 ± 0.70	2.80 ± 0.89
Bimodality [%]	31.25	45.45	33.33	20.00
The quantity of milk acquired during first minute of milking [kg]	1.61 ± 0.52	2.30 ± 0.81	2.33 ± 0.90	2.13 ± 0.86
The quantity of milk acquired during first 2 minutes of milking [kg]	4.01 ± 0.77	5.28 ± 1.32	5.27 ± 1.60	4.62 ± 1.65
The quantity of milk acquired during first 3 minutes of milking [kg]	5.49 ± 1.13	6.72 ± 1.77	7.04 ± 2.20	6.40 ± 2.25
Somatic cell count [cells.ml^{-1}]	127438 ± 118944	144788 ± 186874	210133 ± 255695	599633 ± 910016
Length of the teat [mm]	43.94 ± 6.60	49.12 ± 9.67	54.20 ± 9.15	54.73 ± 7.52
Thickness of the teat [mm]	23.88 ± 1.93	24.27 ± 2.30	25.47 ± 2.80	26.70 ± 2.29

Table 3: Pearson correlations of chosen milkability and milking traits

	Total milk yield	Average milk flow rate	Maximal milk flow rate	Bimodality	Parity
Parity	0.22+	-0.02	-0.05	-0.15	
Length of the teat	0.11	-0.07	-0.05	-0.15	0.41+++
Thickness of the teat	-0.02	-0.21	-0.16	-0.20	0.44+++
Somatic cell count	-0.10	-0.21+	-0.21+	-0.05	0.33++
Total milk yield		0.69+++	0.42+++	-0.23+	0.22+
Maximal milk flow rate	0.42+++	0.70+++		0.17	-0.05
Duration of main phase	0.47+++	-0.25+	-0.32++	-0.16	0.22+
Duration of plateau phase	0.47+++	0.02	-0.43+++	-0.35+++	0.03
Duration of decline phase	0.18	-0.40+++	-0.07	-0.11	0.32++
Bimodality	-0.23+	-0.13	0.17		-0.15
Average milk flow rate	0.69+++		0.70+++	-0.13	-0.02
1MG	0.46+++	0.63+++	0.66+++	-0.46+++	0.13
2MG	0.67+++	0.85+++	0.87+++	-0.17	0.04
3MG	0.88+++	0.88+++	0.70+++	-0.19	0.10
Duration of incline phase	-0.11	0.04	0.26++	0.74+++	-0.11

CONCLUSION

Using Lactocorder we evaluated 94 Slovak Pinzgau dairy cows. The average milk flow rate was 1.76 ± 0.49 kg.min^{-1} and the average maximum milk flow rate was 3.08 ± 0.90 kg.min^{-1}. With regard to the order of the lactation (parity) we detected the lowest values of the average total milk yield, milk flow rate and also maximal milk flow rate in the group of cows at the first lactation. The average occurrence of bimodality in our work was 32.98 %.

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