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Original Scientific Article

MILKABILITY EVALUATION OF JERSEY DAIRY COWS BY LACTOCORDER

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ABSTRACT

Since there is not enough data about milkability of the Jersey cows, the aim of this paper is to show basic milkability traits of this cattle breed depending on the parity and milk flow curve types. Cows had average daily production (DMY) of 22.23 kg, milk yield per milking (MYM) of 9.72 kg, and average and maximum milk flow about 1.66 and 2.49 kg/min, respectively. Statistical analysis showed that DMY and MYM of the cows in 4th parity was significantly ($p<0.05$) higher comparing to cows in 1st and 3th parity. The duration of entirely milking is similar regarding the paritiesand only the cows in 3th and 4th differ significantly ($p<0.05$). Regarding the effect of milk flow curve, the significant ($p<0.05$) difference between unspecified and rectangular milk flow curve has been found for the average milk flow (AMF) and descending phase of the milk flow curve (TD). Cows with unspecified milk flow curve, have significantly ($p<0.05$) lower AMF and longer TD compared to cows with rectangular curve. Cows with bimodal milk flow curve have significantly ($p<0.05$) longer duration of the ascending phase compering to: unspecified, descending and rectangular. The results of this study have shown that Jersey cows have lower production and milk flow compared to other dairy cattle breeds. Nonetheless, they have uniform milkability traits, and a large representation of desirable milk flow curves which are associated with a beneficial effect on the udder health.

Key words: Jersey cows, milkability, parity, milk flow curve types

INTRODUCTION

Of all dairy farm activities related to milking process account more than 50 % of the working time, which has a great economic importance (1, 2). The increase of the herd size has increased the need for faster passage of animals through the milking parlours (3, 4), which can be done with faster milk flow and selection of the adequate animals. Because of these reasons, having cows with good milking properties is crucial for the milking process, such as: start milking, milk flow, uninterrupted milk flow curve and duration of milking. All of these traits are marked as milkability, which are functional traits, of great importance in dairy cattle selection. Functional traits are traits that increase the profitability of production by reducing production costs (5, 6). Milkability traits can reduce the production costs by increasing the efficiency of milking (7, 8), consequently leading to better udder health and longevity of the cows (4). According to Gäde et al. (9), breeding for good milkability traits is very important, because of the high heritability of the main traits such as: average milk flow (h^2 = 0.55), maximum milk flow (h^2 = 0.55) and duration of milking (h^2 = 0.39). For the same traits, Gray et al. (10) established little lower values of the heritability, as follows: h^2 = 0.27, 0.40 and 0.11, respectively. Furthermore, Samoré et al. (11) determined following heritability values, for ascending phase (h^2 = 0.10), maximum milk

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flow (h^2 = 0.41), and descending phase, h^2 = 0,06. Heritability for milking duration for Jersey breed is h^2 = 0.16 (12), for Brown Swiss h^2 = 0.38 (13), and for the Holstein breed h^2 = 0.23 (7). Besides of that, a high correlation is known between milkability traits itself and also between milkability and health traits. A high correlation between milk yield and maximum and average milk flow (r^2 = 0.30 and 0.41, respectively), and between maximum and average milk flow (r^2 = 0,85) was established (14). In the research of the Zucali et al. (15) significant ($p<0.05$) correlation between average and maximum milk flow and somatic cell count (SCC) was determined. The same authors stated that cows with higher SCC hade shorter duration of plateau and longer duration of ascending phases of milk curve. The significant ($p<0.05$) correlation between milk flow and SCC was also confirmed by others (16, 17). Furthermore, a course of the milking and appearance of the milk flow curve, is very important and any interruption in milk flow, described as bimodality, can be a prelude to inadequate milking and can cause a problem with udder health (18). In addition, it has a negative effect on milking efficiency, causing increase of milking duration (19) and modified milk flow parameters (20). In previous researches on Holstein and Brown Swiss cows, the significant influence of the parity on the daily milk production and duration of the milking was established (21, 22). The same authors concluded that older cows have bigger production and longer duration of the milking. Guler et al. (7) and Antalik and Strapak (23) determined faster maximum and average milk flow for Holstein and Simmental cows in later lactation. The parity effects on the duration of the plateau and main milking phases of milk flow curve (24, 25) as well. According to Povinelli et al. (13) and Tančin et al. (26) by increasing the stage of lactation, the duration of milking and average milk flow is increasingly declining. The same as the parity, the stage of lactation has an impact on the milk yield, duration of the main, plateau and ascending phases of the milk flow curve (23, 24, 25).

Since there is not enough data about milkability of the Jersey cows, the aim of this paper is to show the basic milkability traits of these cattle breed depending of the parity.

MATERIAL AND METHODS

On the territory of the Republic of Croatia, the population of Jersey cows is very small, only about 100 heads. Most of the animals are located on two farms in the eastern part of the country. The study was conducted on one of them and it included 40 Jersey cows from first to forth parity, and in 6 to 440 days of lactation. During the three months of the research, the three repetition cycles were performed. Animals were milked during morning milking, in herring bone parlour with these settings: vacuum level of the 45kPa, 60 cycles/min pulsation rate and 60:40 pulsator ratio. In the time of the research, parlour did not have active automatic removing of the clusters, because of that, the ending of entire milking depended on the workers. The measuring of the milkability traits was done with a measuring device Lactocorder (WMB AG, Switzerland). For the purpose of this research, these milkability traits were taken: total amount of milk from begin to the end of milking (MYM), highest milk flow within 22 second (MMF), average milk flow in the main milking phase (AMF). As described in Figure 1, the milk flow curve phases were also taken: duration of the main milking phase (MMD), duration of total milking (MD), duration of the ascending phase (TA), duration of the plateau phase (TP) and duration of the descending phase (TD).

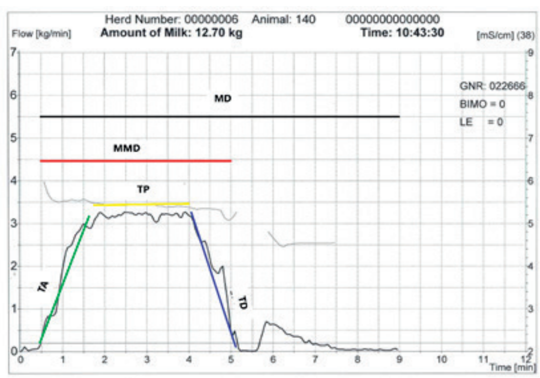

Figure 1. Phases of the milk flow curve

The individual test day records collected in regular milk recording were used for analysis of the daily milk yield and chemical compounds of milk: daily milk yield (DMY), daily fat content (DFC), daily protein content (DPC), lactose (LAC), urea (UREA).

Based on their appearance the milk flow curve was divided in four types: bimodal, unspecified, descending and rectangular (Fig. 2). The variation in milkability traits (DMY, MYM, MMF, AMF, MMD, MD, TA, TP, TD) due to parity and milk flow curve types was tested by least square analyses of variance using the PROC GLM procedure in

SAS (SAS Institute Inc., 2000). The significance of the differences between the parity and curve shape classes was tested by Scheffe's method of multiple comparisons.

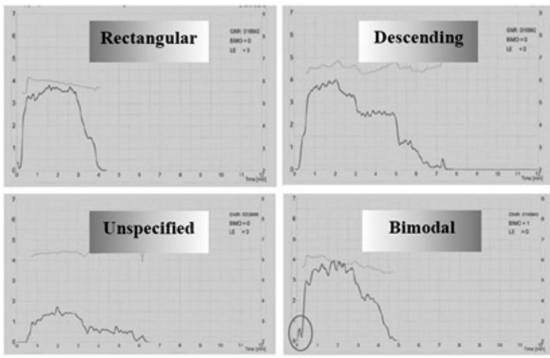

Figure 2. Types of the milk flow curve

RESULTS

In this research the Jersey cows had average daily production (DMY) of 22.23 kg, with daily fat content (DFC), protein (DPC) and lactose (LAC): 6.35, 4.25 and 4.44 %, respectively (Table 1). Daily urea content (UREA) was 21.06 mg/100 ml. Total amount of milk from the begining to the end of milking (MYM) ranged between 5.0 and 15.89 kg, with average (AMF) and maximum milk flow (MMF) between 1.04 and 2.64, and 1.58 and 3.43 kg/min, respectively. Duration of the main milking phase (MMD) was in average 5.71 minutes and entirely milking was 9.94 minutes per cow. Regarding the main milk curve phases, the duration of the ascending phase (TA) was shortest (0.74 minutes), while plateau (TP) and descending (TD) phases had similar duration (2.50 and 2.48 minutes).

The statistical analysis showed that DMY and MYM of the cows in 4th parity was significantly ($p<0.05$) higher compared to cows in 1st and 3th parity (Table 2). The duration of entirely milking was similar regarding the parity's and only the cows in 3th and 4th differ significantly ($p<0.05$) (8.60 and 10.67 minutes). The values of MMD were also similar regarding the parity's, and did not differ significantly. Furthermore, values of AMF, MMF, TA, TP and TD did not differ significantly due to parity.

Table 1. Basic statistics of daily milk traits and milkability traits (N = 1560)

Traits	Unit	MEAN	MIN	MAX	SD	CV
Daily milk traits						
DMY	kg	22.23	10.40	38.20	8.02	36.09
FET	%	6.35	3.21	8.72	1.50	23.69
PRO	%	4.25	2.94	5.62	0.53	12.57
LAC	%	4.44	4.04	4.88	0.16	3.58
UREA	mg/100ml	21.06	12.00	30.00	4.59	21.81
Milkability traits						
MYM	kg	9.72	5.00	15.89	2.98	30.62
MMF	kg/min	2.49	1.58	3.43	0.57	22.76
AMF	kg/min	1.66	1.04	2.64	0.36	21.87
MMD	min	5.71	2.47	12.51	2.34	41.01
MD	min	9.94	5.79	13.58	2.23	22.47
TA	min	0.74	0.00	1.82	0.42	57.04
TP	min	2.50	0.09	6.81	1.48	59.12
TD	min	2.48	0.51	6.53	1.43	57.67

* DMY - daily milk yield; DFC - daily fat content; DPC - daily protein content; LAK – lactose; UREA - urea; MYM - total amount of milk from begin to the end of milking; MMF - maximum milk flow; AMF - average milk flow in the main milking phase; MMD - duration of main milking phase; MD - duration of total milking; TA - duration of the ascending phase; TP - duration of the plateau phase; TD - duration of the descending phase

Table 2. LS means of the milkability traits according to the parity

Traits	Units	Parity			
		1st	2nd	3rd	4th
DMY	kg	17.20a	24.57ab	17.65a	25.06b
MYM	kg	7.68a	10.09ab	7.96a	11.08b
MMF	kg/min	2.19a	2.46a	2.60a	2.54a
AMF	kg/min	1.49a	1.61a	1.67a	1.72a
MMD	min	5.01a	6.23a	4.38a	6.51a
MD	min	9.11ab	10.42ab	8.60a	10.67b
TA	min	0.67a	0.81a	0.95a	0.64a
TP	min	2.65a	2.38a	2.17a	2.21a
TD	min	3.19a	2.97a	2.33a	2.63a

*Values within the same row marked with different letter have a significant statistical difference (p<0.05); DMY - daily milk yield; MYM - total amount of milk from the beggining to the end of milking; MMF - highest milk flow within 22 second; AMF - average milk flow in the main milking phase; MMD - duration of main milking phase; MD - duration of milking; TA - duration of the ascending phase; TP - duration of the plateau phase; TD - duration of the descending phase

The similar trend for AMF among parities was determined, as follows: in the first and third parity's AMF were descending with days in lactation (Fig. 3; from 1.55 and 2.25 to 1.25 and 1.30 kg/min), in the second and forth parties it was shown that AMF had constant values from the beginning to the end of ~~the~~ lactation (1.70 to 1.75 kg/min). According to milk yield per milking through parties, it was found ascending trend of the plateau phase of the milk flow curve, its duration was longer with higher MYM in all four parties (Fig. 4; less than 1.0 to more than 6.0 minutes). As for descending phase, there was similar trend as for the plateau, with exception of the second parity (less than 1.0 to more than 5.0 minutes).

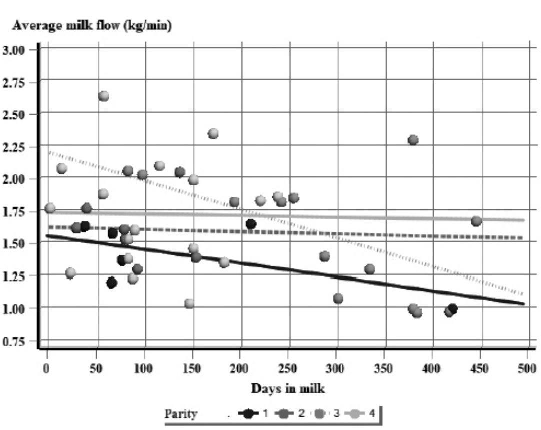

Figure 3. Average milk flow through parity according to days in milk

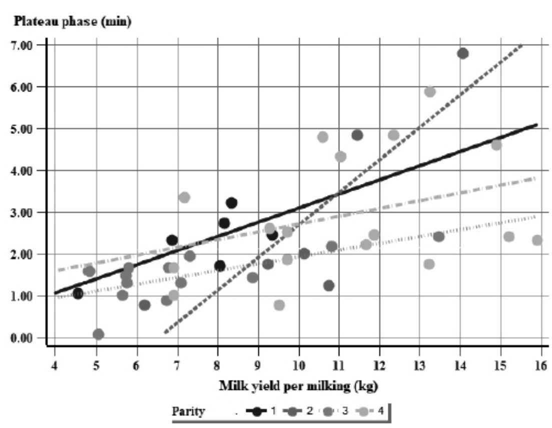

Figure 4. Duration of the plateau phase of the milk flow curve through parity according to milk yield per milking

Cows in second parity had almost unchanged duration of the descending phase with higher milk yield per milking (Fig. 5; from 2.0 to 3.0 minutes). The bimodal milk flow curve was present in 18%, and the unspecified in 16% of cows. The more desirable milk flow curves, rectangular and descending, were present in 40 and 26% (Fig. 6). Regarding the effect of milk flow curve, the significant (p<0.05) difference between unspecified and rectangular milk flow curve was found for the following traits: AMF and TD (Fig. 7).

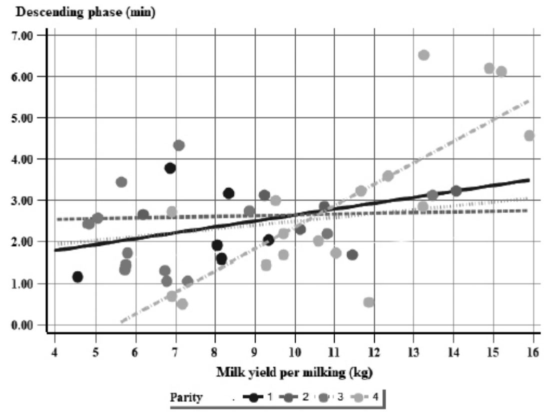

Figure 5. Duration of the descending phase of the milk flow curve through parity according to milk yield per milking

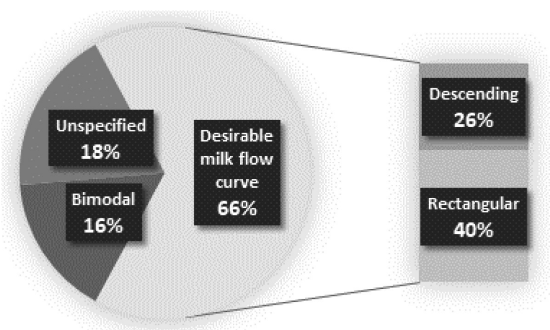

Figure 6. Percentage representation of the milk flow curve types of the Jersey cows

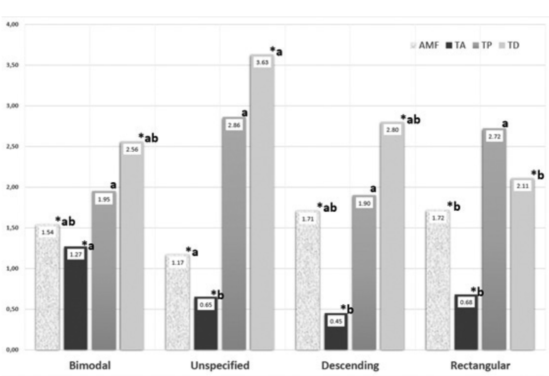

Figure 7. Milkability traits according to milk flow curve types. *Values with different letter differ statistically significant ($p<0.05$); AMF - average milk flow; TA - duration of the ascending phase; TP - duration of the plateau phase; TD - duration of the descending phase

Cows with unspecified milk flow curve had significantly lower AMF and longer TD compared to cows with rectangular curve (1.17:1.72; 3.63:2.11). Cows with bimodal milk flow curve had significantly ($p<0.05$) longer duration of the ascending phase compering to: unspecified, descending and rectangular (1.27; 0.65; 0.45; 0.68). For the plateau phase of the milk flow curve no significant difference was found.

DISCUSSION

From all milkability traits, the greatest importance has average and maximum milk flow and duration of milking (9). According to Göft et al. (27) the preferred value of the MMF is from 3.0 to 4.5 kg/min, and the duration of the MMD up to 6 minutes. This supports the research of the Mijić et al. (28), who concluded that the least number of SCC observed in the cows with MMF from 3.5 to 4 kg/min, indicating the correlation between milk flow and udder health. In this research, Jersey cows had lower values of the milk flow, for example MMF was in average 2.49 kg/min, and through all four parities animals did not have more than 2.60 kg/min, which is lower than the preferred value (3.0 to 4.5 kg/min). In addition, the AMF was very persistent regarding the parities, and it was around 1.60 kg/min. Those values were similar to the results of the different dairy breeds of cows (Holstein, Ayrshire, Brown Swiss, Guernsey, Jersey) obtained by Edwards et al. (29), but lower than the values of milk flow of the Simmental and Holstein cows (11, 24, 30). Simmental cows had almost the same values of the AMF and MMF, but a little shorter DM comparing to those traits of the Jersey cows from this research (1.65:1.66; 2.56: 2.49; 7.96: 9.94, respectively) (31). According to these authors, the Holstein cows had much higher values of the average and maximum milk flow and shorter duration of the milking (2.40:1.66; 2.49: 3.60; 7.26: 9.94, respectively) compared to cows from this research.

In many previous studies, the significant influence of the parity has been established on the milk yield and that the amount of milk increases with the parity (22, 26, 32, 33, 34, 35). The results of this research confirm the above-mentioned results, and show the significant influence of the parity on the DMY and consequently on the MYM. A significant ($p<0.01$) influence of parity on duration of plateau phase and average milk flow was determined (7). Strapák et al. (24) also determined a significant (p<0.05) influence of parity on plateau phase in Holstein cows. These results differ from those obtained in this research, where the significant effect of parity on those milkability traits in Jersey cows was not confirmed. Furthermore, Antali and Strapak (23) have determined the influence of parity on the maximum and average milk flow. Opposite of that, Tančin et al. (34) did not found significant influence of the parity on the milk flow, which comply with the results of this research.

Previous research of the Lee and Chougharya (14) showed high positive correlation coefficients between milk yield and AMF an MMF (r^2 = 0.30 and 0.41), and between the MMF and the AMF is very high (r^2 = 0.85). Furthermore, these results were confirmed by other authors (16, 23, 35) who established the correlation between those traits in range from r^2= 0.18 to 0.54 in Holstein and Simmental cows. Guler et al. (7) noticed the high negative genetic and phenotypic correlation between stage of lactation and duration of milking (r^2= -0.49 and -0.63). There was a negative link between duration of milking and MMF and AMF (r^2= -0.86 and -0.90) and positive link between milk yield and duration of milking and plateau phases (r^2= 0.35 and 0.31), which were presented in the research on Brown Swiss cows (10). The Jersey cows analysed in this research had similar trend for milk yield and milk flow, both traits were increasing a bit to the second parity, then both traits dropped in third, after that in fourth parity traits continued to growth. The duration of MMD and the MD had the same trend, which comply with the above-mentioned results aforementioned (7, 15, 17, 24, 36). Furthermore, we showed a visible link between milk yield and plateau phases for all four parities, which confirm their positive correlation established earlier (10).

The Jersey cows had a much more preferably milk curve (66% of the rectangular and descending) compared to undesirable (34% of the unspecified and bimodal). That is crucial for udder health and longevity of the cows, for example cows with bimodal curve has a negative effect on milking efficiency, causing increase of the duration of milking and modified milk flow which can affect teat conditions (12,20, 31, 37). Furthermore, Mijić et al. (37), Sandrucci et al. (20), Tamburini et al. (18) and Strapák et al. (24) associated undesirably milk flow curve, shorter plateau and longer ascending and decreasing phase of milk flow curve with higher SCC and increased mastitis risk.

CONCLUSION

The results of this study showed the basic characteristics of milkability traits of Jersey cows. Also, is was found that Jersey cows have lower production and milk flow compared to other dairy cattle breeds. Nonetheless, they have uniform milkability traits, and a large representation of desirable milk flow curves which are associated with a beneficial effect on the udder health.

CONFLICT OF INTEREST

The authors declared that they have no potential conflict of interest with respect to the authorship and/or publication of this article.

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