

ANALYSIS OF UDDER QUARTERS MILKING PARAMETERS IN DAIRY COWS

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Abstract. Were analyzed data of 229 Lithuanian Black-and-White and Lithuanian red cows. The aim of our study was to analyze milking parameters (milk yield, milking duration, milk flow measures, electrical conductivity of milk) at udder quarters level by breed. In our study the data of milk yield (kg), milking time (min), milk electrical conductivity (mS/ cm), average milk flow (kg/ min) and peak milk flow (kg/ min) were analyzed. From Lithuanian Black-and-White cows' rear quarters were produced more milk, higher average milk flow rate was detected and therefore milking duration was shorter. Lithuanian Black-and-White cows left front quarter produced more milk but average milk flow rate fixed lower. The electrical conductivity in right side udder quarters was higher than in left side quarters in both breeds.

Key words: breed, cow, milk flow traits, milking robot, udder quarters.

Introduction. Milking robots have the opportunity to analyze the milking process. More efficient control systems require single quarter based milk flow data (Ipema and Hogewerf, 2002). The quarter milk flow parameters could be useful information for automated monitoring of health problems (Tančin *et al.*, 2006; Tančin *et al.*, 2002). Were described variations of quarter milk flow parameters and determined the factors that affect these parameters the most (Tančin *et al.*, 2003). Kuczaj *et al.* (2010) and Sorensen *et al.* (2008) concluded that milking frequency is one of the factors determining the milk yield of cows and the milk yield is greatly influenced by the milk flow rate (Bogucki *et al.*, 2017; Castro *et al.*, 2013; Castro *et al.*, 2012). Most flow characteristics were influenced by lactation number, days in milk, and peak flow but also strongly affected by premilking operations (Sandrucii *et al.*, 2007). Waśkiewicz *et al.* (2014) concluded that the highest milking rate depends on breed. Carlström *et al.* (2013) also reported that the cows' milkability is determined by milking duration and milk flow rate. Sitkowska *et al.* (2015) investigated cows milking systems in some European countries and concluded that the highest milking speed was observed in the cows from Italy (2.74 kg/min) and the lowest in the cows from the Czech Republic (2.35 kg/min). Electrical conductivity during milking characteristically show infected quarters (Nielen *et al.*, 1995). But Khatun *et al.* (2017) concluded that electrical conductivity alone cannot provide the accuracy required to detect infected quarters. Incorporating other information (e.g. milk yield, milk flow, number of incomplete milking) may increase accuracy of detection and ability to determine early onset of mastitis.

The aim of our study was to analyze milking parameters (milk yield, milking duration, milk flow measures, electrical conductivity of milk) at udder quarters level by breed.

Materials and methods

Were analyzed variations of milk yield, milking duration, electrical conductivity of milk, milk flow average and peak flow rates by breed in separate quarters of the udder. The analyzed parameters were determined during

milking process and stored at the DelPro herd management program.

Distribution of cows is shown in Table 1.

Table 1. **Distribution of cows by breed and lactation**

Breed	Lactation		
	1	2	3 th and older
Lithuanian Black-and-White	48	39	47
Lithuanian red	30	28	37

Were analyzed data of 229 Lithuanian Black-and-White and Lithuanian red cows.

In our study the data of milk yield (kg), milking time (min), milk electrical conductivity (mS/ cm), average milk flow (kg/ min) and peak milk flow (kg/ min) of two breed cows' were analyzed. For data analysis, averages, averaging errors, and statistical reliability of data (p) were calculated for each attribute assessed. The statistical analysis of the data was performed using the ANOVA using the statistical package R 2.15.2. The results are considered reliable when P<0.05.

Results and discussion

Fig. 1 shows the distribution of milk content in the separate quarters of Lithuanian Black-and-White and Lithuanian red cows. LR (left rear) and RR (right rear) quarters produced more milk than RF (right front) and LF (left front) quarters. Tančin *et al.* (2006) estimated the differences among quarters for yield per quarter and proportion per quarter. RF and LF quarters produced 22.04% and 22.23% of the total yield, whereas RR and left LR quarters produced 28.24% and 27.49%. Slyžius *et al.* (2013) and Weiss *et al.* (2004) found that front quarters produced about 40.0% and rear quarters about 60.0% of total milk yield (P<0.001). The higher milk yield was observed from Lithuanian red cows' rear quarters, while the milk yield from LF quarter was only 0.05 kg more compared with LR quarter.

The milking duration of investigated cows' udder quarters is given in Fig.2. Milking duration of all quarters in Lithuanian Black-and-White breed cows was longer

than in Lithuanian red cows. The biggest differences between analyzed breeds were determined in LF quarter. Milking time of LF quarter of Lithuanian Black-and-White cows was 0.15 min longer than in Lithuanian red cows.

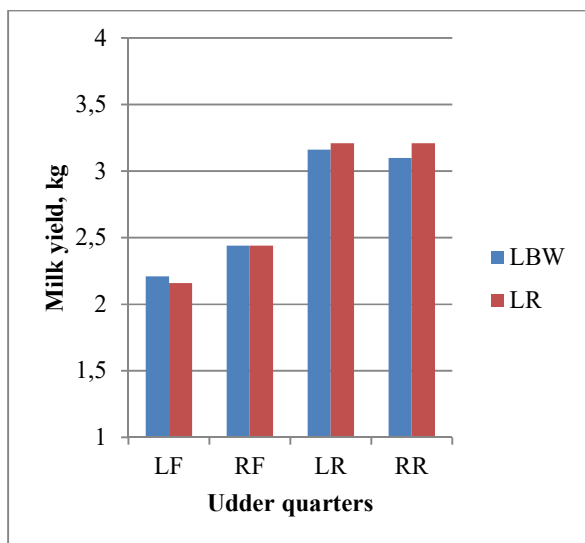


Fig. 1. Total milk yield

A differences of milking duration between left and right sides of udder were estimated. Milking duration of LR quarter was 0.47 min longer ($P < 0.05$) compare with LF quarter of Lithuanian Black-and-White and 0.51 min. longer ($P < 0.05$) than in Lithuanian red breed. The milking length in first breed cows' rear quarters differed to 0.10 min. ($P < 0.05$) and in front quarters of second breed cows - 0.12 min. ($P < 0.05$).

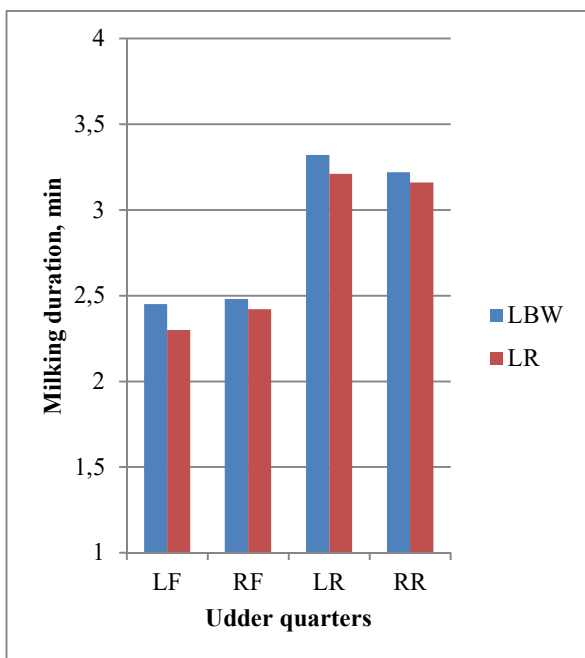


Fig. 2. Milking duration of cows

As shown in Fig. 3 the lowest milk flow rates determined in LF udder quarter. Results in RF were similar. The upper flow rate was established in RR udder quarters (respectively 0.99 kg/min and 1.01 kg/min). The average milk flow rate of Lithuanian Black-and-White breed cows in LF udder quarter was 0.07 kg/min lower than in RF quarter, 0.09 kg/min lower in LR quarter and 0.12 kg/min. lower compared with RR quarter ($P < 0.05$). Our results agreed with results other researchers (Juozaityene *et al.*, 2007; Tančin *et al.*, 2006) who reported that rear quarters had longer time of milking, higher peak and higher average flow rates than front quarters. The average milk flow rate of Lithuanian red cows in LR udder quarter was also 0.12 kg/min lower compared with RR quarter ($P < 0.05$).

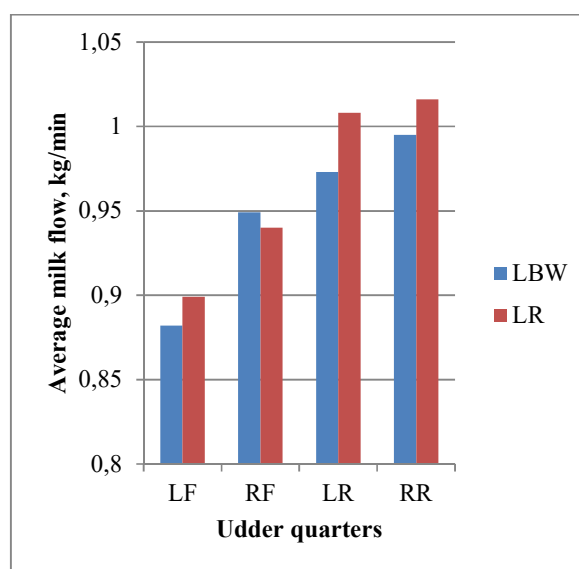


Fig. 3. Average milk flow rate

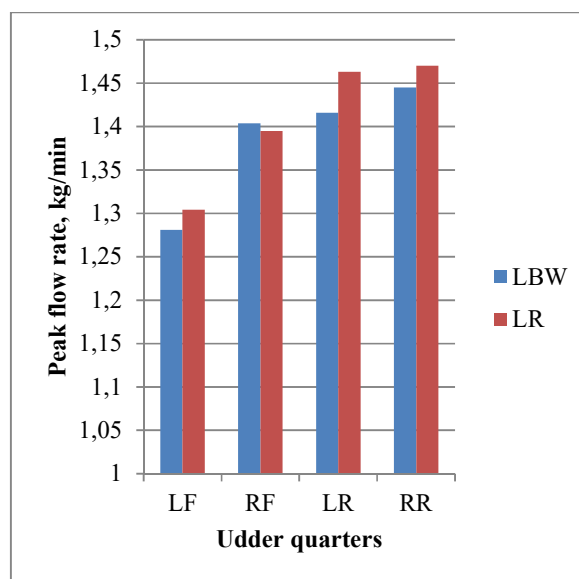


Fig. 4. Peak flow rate

The highest milk flow has been distributed very unevenly between udder quarters (Fig. 4). The biggest differences were founded between LF and RF quarters. Compared peak milk flow rate between front quarters of Lithuanian Black-and-White breed cows, we can see that the peak milk flow rate of LF quarter was 0.12 min/min lower than in RF quarter. The research has shown the highest milk flow of LR cows between front quarters was 0.09 kg/min and between rear udder quarters only 0.01 kg/min. Our results confirm with Wellnitz *et al.* (1999) who demonstrated the difference between front and rear quarters in peak flow rate.

Electrical conductivity of both breed cows' milk is presented in Fig. 5. The electrical conductivity of investigated breeds' cow milk was different in left and right side quarters. The biggest difference in milk electrical conductivity was found in the RF udder quarter. The electrical conductivity of Lithuanian Black-and-White milk in this quarter was 0.22 mS/cm higher than that of Lithuanian red breed. The electrical conductivity of milk in this breed was 0.02 - 0.12 mS/cm lower than in Lithuanian Black-and-White cows each quarter. The electrical conductivity in all Lithuanian red cows udder quarters was 0.02 - 0.12 mS/cm lower than in Lithuanian Black-and-White breed.

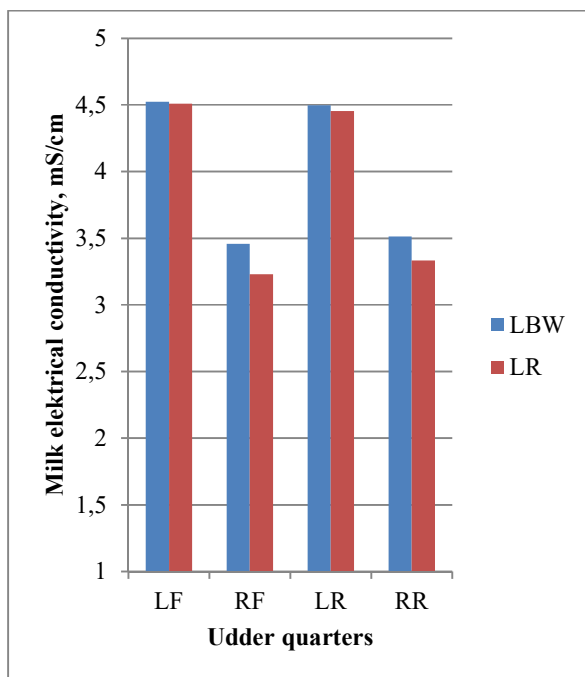


Fig. 5. Electrical conductivity of milk

Conclusions

From Lithuanian Black-and-White cows' each rear quarter was produced 0.08 kg more milk, average milk flow was 0.07 kg/min higher and therefore milking duration was 0.08 min shorter than in LBW cows.

Lithuanian Black-and-White cows' left front quarter produced 0.05 kg more milk but average milk flow rate was fixed 0.01 kg/min lower.

The electrical conductivity in left side udder quarters in both breeds was 1.12 mS/cm higher than in right side quarters ($P < 0.05$).

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