

EVALUATION OF SELECTED TRAITS OF LITHUANIAN DAIRY COWS BEFORE AND STARTING THE TRANSITION PROCESS AND BECOME AN ORGANIC FARM

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Abstract. The aim of this study was to compare production, somatic cell count (SCC) and milkability traits of Lithuanian dairy cows' in one farm during different periods of the change from conventional to organic farming: before and starting the transition process and then the farm became an organic farm. The research was carried out on Lithuanian dairy cows (n=100) from first to fifth lactation in one dairy farm in 2013-2018 years. The research was carried out with the same dairy cows during the whole study period. During lactation the highest milk, milk fat and protein yield were estimated in 2015, when the transitional period was started. The highest percent of milk protein was estimated in 2015-2016 and the highest percent of milk fat was estimated in 2014. The lowest productivity traits and the highest SCC were in 2018, when the farm was organic. The highest milk yield, milking speed, the highest milk flow and the lowest milking time were estimated in 2014, when the farm was conventionally managed. The lowest milk yield and high milk flow were in 2015, when transitional period was started, milking speed - in 2015-2016, when the farm was at transitional period and the highest milking time was estimated in 2016. The cows, which produced higher milk yield, had the faster milking speed. The performance of organically managed dairy cows differs from conventionally managed cows. Cows in organic herds have lower production and higher SCC than cows in conventional herds. However, the performance of cows in organic production depended to a large extent on the lower milk production level.

Key words: cows, milk yield, lactation, milkability, reproduction traits.

Introduction. Increased awareness about climate change and influence of animal husbandry on environment, needs for sustainable farming systems. Alternative production systems based on holistic views developed and became with time an integrated part of the agricultural sector, today known as organic farming. (Lund, 2002; Ahlman, 2010).

The "organic chain" implies that a healthy soil leads to healthy cattle feed, which in turn leads to healthy cows with healthy milk, which lead to healthy consumers (Blokma et al., 2008).

Organic milk production systems rely on ecologically based practices that virtually prohibit the use of antibiotics and hormones in the cow herd and the use of synthetic chemicals in the production of cattle feed. Organic milk production systems also attempt to accommodate the animals' natural nutritional and behavioural requirements, for example ensuring that dairy cows have access to pasture (Greene and Kremen, 2003). These requirements add production costs and create obstacles to widespread adoption, such as higher managerial costs and risks of shifting to a new way of farming, and significant time and costs associated with the transition to organic production (McBride and Greene, 2007).

The ideology of organic farming is based on ethical considerations regarding the environment and the health and welfare of humans and animals. Some traits, such as mastitis resistance, may have a higher economic value in organic herds than in conventional herds, due to the extra costs of prolonged withdrawal periods after medical treatment. Increased mastitis resistance would also

increase animal welfare, which should have a high value in organic production. Other traits that have been suggested to be highly important for dairy cows in organic production are: persistency of lactation and increased milk yield from first to third lactation (Bapst, 2001; Pryce et al., 2004).

The dairy cows are mainly selected for high production in an environment that differs from that of organic production, mainly regarding feeding regimes and medical treatments (Ahlman, 2010). There is an increasing debate about the use of conventional breeding animals in organic farming (Nauta, 2009). Many concerns are related to the ability of high producing breeds to adapt to organic environments, which often involve lower energy and protein intake and limited use of antibiotics (Nauta et al., 2006).

Dairy farmers place considerable emphasis on milkability, because slow milking cows hinder the milking process of the herd, especially in milking parlours (Krogmeier et al., 2006). The evaluation of milk flow traits is also important in connection with establishing the efficiency of milk ejection (Tančin and Bruckmaier, 2001). Moreover recent studies on milk flow traits showed an association with somatic cell count (Mijic et al., 2005; Tančin et al., 2007) and milk yield.

The aim of this study was to compare production, somatic cell count (SCC) and milkability traits of Lithuanian dairy cows' in one farm during different periods of the change from conventional to organic farming: before and starting the transition process and then the farm became an organic farm.

Material and methods

The research was carried out on Lithuanian dairy cows (n=100) from first to fifth lactation in one dairy farm in 2013-2018 years. The research was carried out with the same dairy cows during the whole study period.

It was estimated:

- **The milk production traits:** milk yield during lactation (kg), percent of milk fat and protein, milk fat yield (kg) and milk protein yield (kg), daily milk yield (kg), somatic cell count (SCC, thousands/ml).

- **Milkability traits:** daily milk yield (kg), milk yield in morning and in evening (kg), average of milking speed (kg/min.), milking speed in morning and in evening (kg/min.), average of highest milk flow (kg/min.), highest milk flow in morning and in evening (kg, min.), average of milk time (s), milk time in morning and in evening (s).

The research was performed in groups of different years:

- In 2013 year the farm was not organic,
- In 2014 year the farm was not organic,
- In 2015 year when transitional period was started,
- In 2016 year was transitional period,
- In 2017 year the farm got status of organic farm,

- In 2018 year the farm was organic.

The milkability traits and milk yield of dairy cows were measured with DeLaval electronic milk meters that were installed on milking sites and data was processed with DeLaval "Apro Windows" software. Descriptive statistic (mean \pm standard error), reliability value (P) were calculated by using R 2.1.0" package (<http://www.r-project.org/>). Data analysis was conducted having performed the statistical significance by the method of variance analysis (ANOVA). The results considered to be reliable under $P \leq 0.05$.

Results

The results of the research have shown (Figure 1), that the highest milk yield during lactation was estimated in 2015, when transitional period was started and it was the highest value in the period of research. In this year milk yield was 9.28 percent higher than in 2016, 17.95 percent higher than in 2017 ($P < 0.005$) and 31.49 percent higher than in 2018. In 2014 milk yield of these cows was the lowest. In this year milk yield was 36.15 percent lower than in 2015 ($P < 0.001$) and 6.80 percent lower than in 2018 ($P < 0.001$).

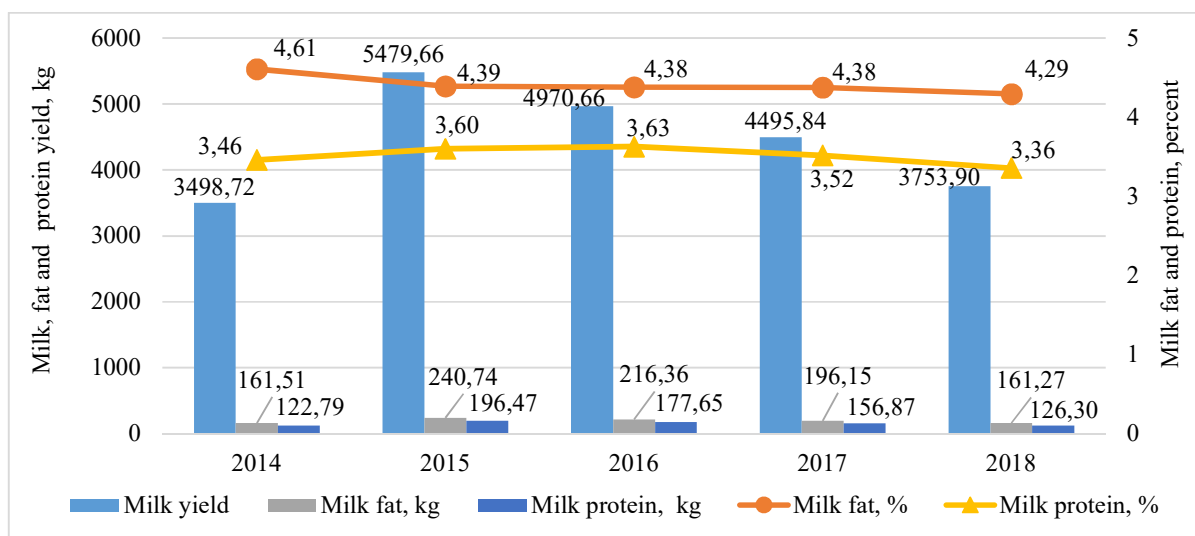


Figure 1. The average of milk production in different years

The highest percent of milk fat was estimated in 2014. In this year percent of milk fat was 0.22 percent higher than in 2015 and 0.32 percent higher than in 2018. The lowest percent of milk fat was noted in 2018 during the period of research.

The highest percent of milk protein was estimated in 2016. In this year a percent of milk protein was 0.17 percent higher than in 2014 ($P < 0.001$) and 0.27 percent higher than in 2018. The lowest percent of milk protein was noted in 2018.

The highest milk fat and protein yield was estimated in 2015. In this year milk fat yield was 32.91 percent higher than in 2014 ($P < 0.001$) and 33.12 percent higher than in 2018. In 2018 milk fat yield was the lowest.

In 2015 milk protein yield was 37.50 percent higher than in 2014 ($P < 0.001$) and 17.92 percent higher than in 2018. The lowest milk protein yield was noted in 2018. The results of the research have shown (Figure 2), that the highest daily milk yield and lower SCC was estimated in 2015. In this year daily milk yield was 9.87 percent higher compared to 2014, 36.22 percent higher than in 2017 ($P < 0.001$) and 29.45 percent higher than in 2018. In 2017 daily milk yield of these cows was the lowest during the period of research.

The highest SCC was estimated in 2018. In this year daily milk yield was 53.72 percent higher than in 2014, 18.57 percent higher than in 2016 and 24.36 percent higher than in 2017. In 2014 SCC in milk of these cows was the lowest.

The results of the research show (table 1), that the highest daily milk yield was estimated in 2014. In this year daily milk yield was 5.11 percent higher than 2013 and 17.34 percent higher than 2015, when transitional period was started and it was the lowest daily milk yield in the period of research.

The highest average of milking speed was estimated in 2014. In this year the average of milking speed was 4.98 percent higher compared to 2013 and 12.22 percent higher

than in 2015. The lowest average of milking speed was estimated in 2016 and it was the lowest value in the all period of research. In this year average of milking speed was 17.20 percent lower compared to 2014. In 2017 average of milking speed was 8.60 percent lower than in 2014, but 9.41 percent higher than in 2016. The same tendencies were found with the average of milking speed in the morning and the evening. The cows, which produced higher milk yield, had the faster milking speed.

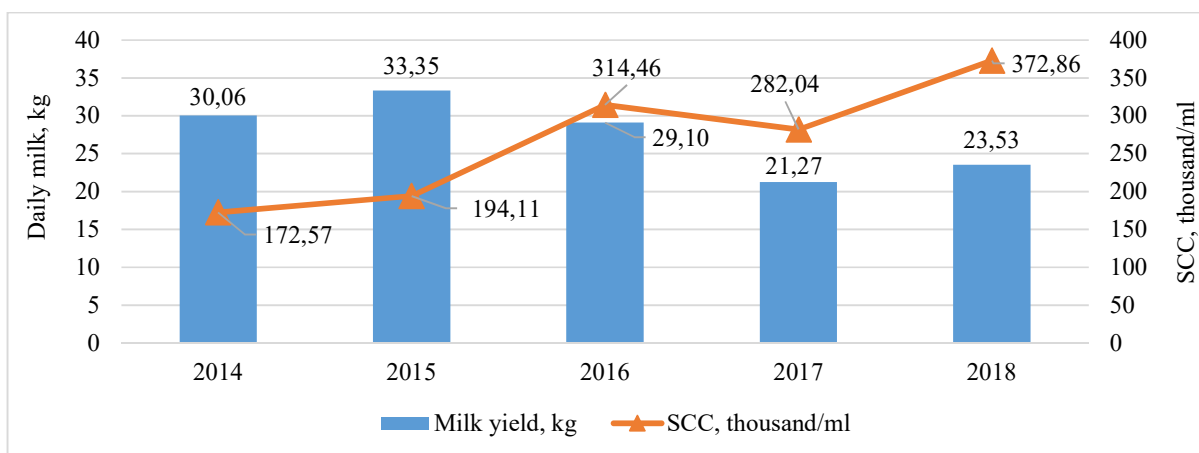


Figure 2. The average of milk yield and SCC in different years

Table 1. The average of daily milk yield and milking speed in different years

Year	Lactation		Daily milk yield, kg	Milk yield in morning, kg	Milk yield in evening, kg	Average of milking speed, kg/min.	Milking speed in morning, kg/min.	Milking speed in evening, kg/min.
2013 ^a	I	n	100	100	100	100	100	100
		x	23.97	12.70 ^{***}	11.91	2.10	2.16 [*]	2.04
		mx	1.727	0.868	0.846	0.155	0.172	0.139
2014 ^b	II	n	100	100	100	100	100	100
		x	25.26	11.97	13.30 ^{**}	2.21	2.14 ^{**}	2.28
		mx	2.045	1.030	1.072	0.163	0.137	0.190
2015 ^c	III	n	100	100	100	100	100	100
		x	20.88	10.99 ^{***}	9.88 ^{b**}	1.94	2.02	1.86
		mx	2.085	1.126	1.005	0.199	0.212	0.185
2016 ^d	IV	n	100	100	100	100	100	100
		x	25.21	12.57 ^{***}	12.63	1.83	1.77 ^{b**}	1.89
		mx	1.649	0.866	0.819	0.116	0.081	0.150
2017 ^e	V	n	100	100	100	100	100	100
		x	22.13	10.47 ^{a,c,d***}	12.26	2.02	2.05	2.00
		mx	2.146	0.899	1.427	0.225	0.209	0.241

*P<0.05; **P<0.025; ***P<0.001

The results of the research have shown (table 2), that the highest average of high milk flow was estimated in 2014. In this year the average of highest milk flow was 11.08 percent higher than in 2013 and it was the lowest value in the all period of research. In 2015 the average of highest milk flow was 6.22 percent lower compared to 2014, but 5.19 percent higher than in 2013. In 2017 the average of highest milk flow was 5.14 percent lower than in 2014, but

2.23 percent higher than in 2016. The same tendencies were found with a highest milk flow in the morning and in the evening.

The lowest average of milking time was estimated in 2015. In this year the average of milking time was 7.66 percent lower compared to 2013 and 3.61 percent lower than 2014. The highest average of milking time was estimated in 2016 and it was the highest value in the all

period of research. In this year average of milking time was 20.47 percent higher than in 2015. In 2017 average of milking time was 9.41 percent higher than in 2015 and

12.21 percent lower than in 2016. The same tendencies were found with the average of milking time in the morning and in the evening.

Table 2. The average of highest milk flow and milking time in different years

Year	Lactation		Average of high milk flow, kg/min.	Highest milk flow in the morning, kg/min.	Highest milk flow in the evening, kg/min.	Average of milking time, s.	Milking time in the morning, s.	Milking time in the evening, s.
2013 ^a	I	n	100	100	100	100	100	100
		x	3.29	3.49	3.09	369.46	362.58	376.33
		mx	0.248	0.254	0.241	27.838	24.654	31.023
2014 ^b	II	n	100	100	100	100	100	100
		x	3.70	3.65	3.75	353.93	344.65 ^{d*}	363.20
		mx	0.275	0.260	0.290	24.499	27.177	21.821
2015 ^c	III	n	100	100	100	100	100	100
		x	3.47	3.53	3.42	341.15	341.90 ^{d*}	340.40
		mx	0.296	0.299	0.292	27.582	25.545	29.619
2016 ^d	IV	n	100	100	100	100	100	100
		x	3.51	3.46	3.57	428.95	444.15 ^{b,c,e*}	413.75
		mx	0.243	0.199	0.287	37.463	39.606	35.319
2017 ^e	V	n	100	100	100	100	100	100
		x	3.59	3.64	3.54	376.58	352.50 ^{d*}	400.67
		mx	0.350	0.326	0.375	34.505	25.018	43.992

*P<0.05

Discussion

Ahlman (2010) results of research shows that cows in organic herds had lower production and higher SCC than cows in conventional herds. The production of cows in organic farm depended on the lower milk production level. The main reason for culling in organic production was poor udder health followed by low fertility. The results indicate that in organic farms are more problems with udder health than in conventional farms. Genetic correlations for production, fertility, SCC and longevity, estimated in organic and conventional dairy farms were in general close to unity (Ahlman, 2010).

Milk, fat and protein yield were lower in organic production compared with conventional production, and the percentage of fat and protein was slightly lower in organic herds. In organic production the means for milk yield were 6725 kg, 7702 kg and 8083 kg for lactations 1-3, respectively. Corresponding means in conventional production were approximately 700 kg higher. The increase in milk production from the first to the second lactation was higher in organic herds when expressed in kg milk, whereas no significant difference was found when expressed as a percentage, calculated at individual cow basis. (Ahlman, 2010)

The results of researches of Sato et al. (2005) and Valle et al. (2007) show the similar tendencies. The lower production levels are probably due to a lower energy intake by cows in organic production, because organically produced feed tend to contain less energy than conventionally produced feed (Reksen et al., 1999).

The low milk yield in first lactation is caused by a lower amount of energy available for production, because energy

still has to be allocated for growth during first lactation. The cows in organic farms are able to adapt their production level to the available energy. The same conclusion has been drawn from studies of metabolic variables in organically and conventionally managed cows (Roesch et al. 2005; Fall et al., 2008a).

Other studies of udder health in organic and conventional production in Sweden have shown no difference (Fall et al. 2008b) or better udder health in organic herds (Hamilton et al., 2006).

Together, the results indicate small differences in udder health between organic and conventional production in Sweden. The large proportion of cows culled due to poor udder health in Swedish organic herds was therefore not expected. This indicates that in organic farms are more concerned about the udder health than in conventional farms, and in organic farms are also known to consider mastitis to be the dominant disease problem. (Vaarst et al., 2003; Ahlman, 2010)

One explanation for the poor udder health in organic herds, despite the similar level of udder health as in conventional herds, could be that organic farms also have to consider the organic standards when evaluating cows. The standards prescribe limited use of antibiotics and twice as long withdrawal periods after medical treatment. (Nielsen et al., 2010) H. Larroque with co-authors (2005) estimated a negative correlation between a milking speed and SCC. This negative correlation indicates, that SCC increases then milking time is shorter and milking speed is higher (Mijić et al., 2002). Very quick milking has an impact on SCC (Samoré and Groen, 2003). Our results indicate that the milking traits varies according to the

stages of lactation due to change in milk production with advancing lactation (Gurmessa and Melaku, 2012). Similar results were reported by Strapak et al. (2011) and Sandrucci et al. (2007) in Holstein dairy cows (Fahim et al., 2017).

Conclusions

1. The highest milk, milk fat and protein yield during lactation were estimated in 2015, when the transitional period was started. The best milkability traits were estimated in 2014, when the farm was conventionally managed. The cows, which produced higher milk yield, had the faster milking speed. The poorest milkability traits were in 2015-2016, during transitional period.

2. The performance of organically managed dairy cows differs from conventionally managed cows'. The lowest productivity traits and the highest SCC were in 2018, when the farm was organic. Cows in organic herds have lower production and higher SCC than cows in conventional herds. However, the performance of cows in organic production depended to on a large extent of the lower milk production level.

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