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Longevity and milk production efficiency of Latvian local breeds during last decades

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Abstract. The aim of the study was to analyse the longevity and the amount of energy-corrected milk (ECM) per day of local dairy cattle breeds Latvian Brown (LB) and Latvian Blue (LZ). The study was based on the data of LB genetic resources (LB) 1770 and LZ 921 cows, which were born from January 1st, 2000 till December 31st year 2015. Milk productivity and longevity of the LB and LZ cows were analysed by birth year periods: 2000–2005, 2006–2010 and 2011–2015. LZ culled cows lifespan was in average 2,762.8 ± 55.14 days, or 7.6 years and it was significantly higher than for LB. The average lifespan of LB culling cows was 6.7 years. There are cows which had closed 7–12 lactations. On average, cows' lifespan decreased during analysed period. In general, LZ cows are characterized by higher length of productive life and milking days. LZ cows produced more EC milk during their productive life; however, they had the lower milking day ECM productivity than LB cows.

Key words: local breed, longevity, milk production efficiency.

INTRODUCTION

Latvian Brown (LB) is mentioned as a local cattle breed and Latvian Blue (LZ) as a local native breed in the DAD-IS list of the FAO database (FAO, 2019).

LB breed was formed in mid-19th century from local cows and Angler, then later in 19th century was improved by Danish Red bulls. At the beginning of the 20th century pedigree breeding was planned and milk recording was started, and some years later in the 1920's the herd-book was published. The LB is a red cattle breed, which was selected on higher milk productivity, a strong body and good udder shape. The LB breed is used for milk and meat production and it is well suited to local conditions and can graze on the poor pasture (FAO, 2019). Since the 1960's genetics from Danish Red, Angler, Brown Swiss, Red Holstein, Swedish Red-and-White have been used. The conservation of Latvian Brown stock was started in 2013 with only 134 cows; however, there are – 41 bulls' semen stocks in store at the artificial insemination stations (Porter et al., 2016). The LB breed cows with percentage of local breed genes at least 50% and only the Angler and Danish red breeds genetics used for improving are considered for inclusion in the genetic resources conservation program (National conservation programme of Latvian Brown breed dairy cows, 2019).

LZ breed originated from local cows on the coast of the Baltic Sea (FAO, 2019). Their coat colour is from light to dark blue (grey) and around the eyes have blue 'glasses' (Grīslis, 2006). In the 1920's blue cows as well as LB were included in the Latvian cows herd book. In the 1930's, in Latvia, we had only one purebred LZ farm in which in 1935 was started to use crossbreeding (Grīslis, 2006; Griņevičs & Grosvalds, 2011; Smiltina et al., 2015). LZ was officially accepted in 1995 as a breed to be conserved (FAO, 2019) and in 2000 a breeders association was established orientated on the planning and conservation of the very small and endangered population (Grīslis, 2006). The breed is well adapted to maritime and harsh climate and can graze on the poor pasture. LZ is found mainly in the northern and north-western part - coastal area of Latvia, in Kurzeme (FAO, 2019). In 2001, in the Agricultural Data Center (LDC) 224 LZ cows were registered, including 185 females and 39 males, as the LZ cows' population (Grīslis, 2006) and in 2013 they numbered 349 (Porter et al., 2016). LZ breed is at risk (FAO, 2019).

During the last decade the number of Holstein cows in Latvia is increasing and at the same time the number of red breeds' cows and cows which are classified as local is decreasing, especially LB genetic resources (LB) cows. Local cattle breeds are not only important for the conservation of genetic diversity, but are also economically effective on small farms (10 to 30 cows), because of higher longevity. According to Strandberg (1996) research, if longevity increases from three to four lactations, then profit per year will increase by 11–13%.

The aim of the study: to analyse the longevity traits and the amount of energy-corrected milk per day of local dairy cow breeds.

MATERIALS AND METHODS

The study was based on the data of Latvian Brown genetic resources 1770 and LZ 921 cows. For study purposes, from Latvian Agricultural Data Centre were collected data about cows' milk productivity of cows which were born from January 1st, 2000 till December 31st, 2015. The main criterion for including LB genetic resources cows in the research is percentage of genes of a local breed which has to be at least 50%. For LZ cows, the percentage of genes of a local breed could be 37.5% or higher because the main requirement during the conservation process of the breed was blue-gray colour and breed-typical characteristics (darker legs, white horns with black tips, stature around 130–135 cm). The analysed cows are from different parts of Latvia and are located in small farms with the stall housing systems and grazing in pastures.

Data about cows' birth, culling and first calving dates, milk yield (kg), milk fat and milk protein content (%) in full lactation and in milking day were included in the dataset. For the analysis of longevity, age at first calving, lifespan, length of productive life and a number of days milking were calculated. For analysis the efficiency of milk production, energy corrected milk (ECM) in one life day, in one productive life day and in one milking day for culling and lactating cows were calculated. Life length and ECM yield for lactating cows were recorded from the birth till November 1st year 2018.

The milk production efficiency in the paper is characterized with the amount of ECM per one life day, productive life day and per milking day.

Energy corrected milk (ECM) was calculated by formula:

$$ECM = milk\ yield, kg \times \frac{[(fat, \% \ \times \ 0.383) + (protein, \% \ \times 0.242) + 0.7832)]}{3.14}$$

Milk productivity and longevity of the LB and LZ cows were analyzed based on birth year periods. Data set was divided into three birth year periods: 2000–2005, 2006–2010 and 2011–2015.

Data in tables are presented as mean ± standard error of mean. A two-way analysis of variance (ANOVA) was used to determine the effect of factors – breed and period on cows' longevity and productivity traits. Pairwise comparisons were performed by Bonferroni test. Significant differences at α = 0.05 in the tables were marked with different letters of the alphabet (a, b, and A, B). The data analysis was done by SPSS 23 program package.

RESULTS AND DISCUSSION

The number of LB and LZ cows used in the analysis is shown in Fig. 1. Analyzed cows were born from year 2000 to 2015 and calved from year 2001 to 2017. The number of LB continued to decrease through year 2000 to 2015. The number of LB and LZ breeds' cow's is decreasing since 2006 and it is relatively constant and similar during time period from year 2008 to 2015. Number of LB cows' in 2008 was noticeably lower than in earlier years.

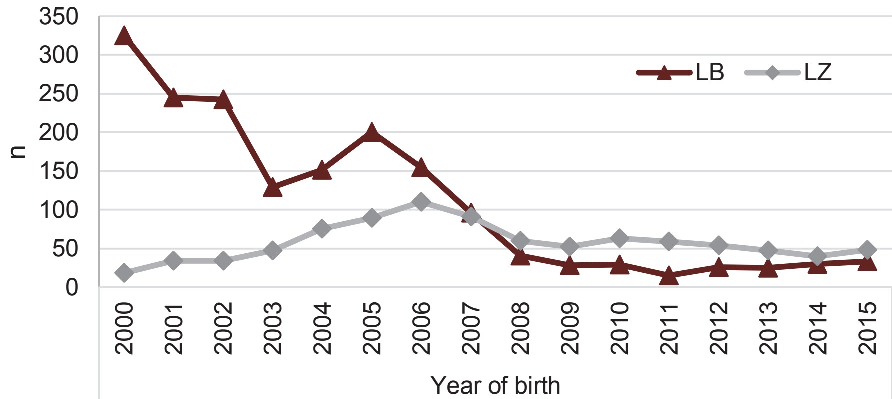

Figure 1. Number of LB and LZ cows by birth year.

Usually, local breeds have the small population size and breeding organizations need to control the rate of inbreeding. However, as study results in 2006 show (Grislis et al., 2005) the inbreeding level in LZ population was 1% and the average inbreeding of the inbred cows was 12.3%, the effective population size for LZ was Ne = 18 (Zutere et al., 2006). In the later investigation (Grīslis & Simkevica, 2018), 40% or 225 cows of the LZ population had the coefficient of inbreeding higher than 3%.

The local breeds have lower milk productivity; however, they are characterized by higher longevity. In total 0.7% of the LB and 2.4% of LZ breed cows, which were born between years 2000 to 2005, are still lactating and had closed 7–12 lactations at the end of 2018. From the first study period (2000–2005) 9 LB and 7 LZ cows had on average 8.9 ± 0.42 lactations. The proportion of LB and LZ cows which were born from 2006–2010 and are still lactating was more than 11%, and the proportion in 2011–2015 was around 70% (Fig. 2).

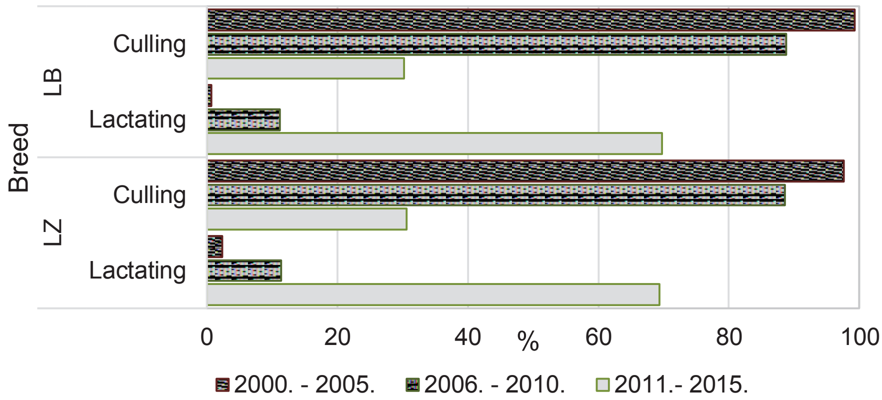

Figure 2. The distribution of lactating and culling LB and LZ cows by birth year periods.

On average, the analysed culling cows had a lifespan from 1,486.2 ± 150.4 to 2,762.8 ± 55.14 days and it is decreasing during the time (Table 1).

Table 1. The average longevity of culling LB and LZ breeds' cows by birth year periods

Period	Breed	n	Longevity traits: age at first calving, days	lifespan, days	length of productive life, days	milking days
2000-2005	LB	1,283	843.0 ± 4.35 ^{aA}	2,446.7 ± 26.22 ^{A}	1,603.7 ± 26.43 ^{A}	1,257.0 ± 21.52 ^{A}
	LZ	290	830.4 ± 9.15 ^{aA}	2,762.8 ± 55.14 ^{B}	1,932.4 ± 55.59 ^{B}	1,552.2 ± 45.25 ^{B}
2006-2010	LB	310	853.8 ± 8.85 ^{aA}	2,369.7 ± 53.33 ^{A}	1,515.9 ± 53.76 ^{A}	1,125.5 ± 43.77 ^{A}
	LZ	333	859.2 ± 8.54 ^{bA}	2,349.8 ± 51.46 ^{A}	1,490.6 ± 51.87 ^{A}	1,181.1 ± 42.23 ^{A}
2011-2015	LB	39	814.6 ± 24.95 ^{bA}	1,486.2 ± 150.4 ^{A}	671.6 ± 151.58 ^{A}	564.4 ± 123.40 ^{A}
	LZ	76	841.9 ± 17.87 ^{abA}	1,575.8 ± 107.7 ^{B}	733.9 ± 108.58 ^{A}	636.2 ± 88.40 ^{B}

$^{A; B}$ – significant differences between breeds in one period; $^{a;b}$ – age at first calving differs significantly between birth year periods for one breed.

2000–2005 birth year period cows had the lifespan an around 2,500 days. LZ cows' lifespan was 2,762.8 ± 55.14 days, or 7.6 years and significantly higher than for LB. The average lifespan of LB culling cows was 6.7 years. 2011–2015 birth year period LZ cows had the higher lifespan (1,575.8 days) than LB cows (1,486.2 days) ($P < 0.05$). In the investigation about Polish local breed cows' longevity, authors pointed out that the cows most frequently culled at the age of 8-9 years and the lowest lifespan was observed for Polish Red cows and it was 7.8 years (Adamczyk et. al., 2017). The LZ and LB cows had the lower lifespan compared to the Polish Red cows. LZ 2000–2005 birth year period cows are characterized by the higher length of productive life ($P < 0.05$) and milking days ($P < 0.05$) compared to the LB cows.

Age at first calving is an important factor in reducing production costs and economic return in the dairy sector (Eastham et al., 2018). The LB breed cows that were born between 2011–2015 had lower age at first calving (814.6 ± 24.95 days) compared to the cows born from the 2006 and 2010 birth year period ($P < 0.05$). The lowest age at first calving (830.4 ± 9.15 days) was observed for LZ breed cows, which were born in 2000–2005 analysed birth year period ($P < 0.05$).

As our previous investigation shows (Jonkus et al., 2018), the optimal age at first calving for the higher milk productivity was smaller than 25 months in LB breed group and 27–30 months in LZ breed group. Sawa et al. (2019) obtained that the optimal age at first calving in Black-and-White Polish Holstein-Friesian dairy cows' population was 22.1–26.0 months. The age at fist calving after 28 months is associated with decreases in lifetime milk production and increases in culling rate in the first production year due to low milk yield and udder diseases (Sawa et al., 2019).

For the milk production efficiency evaluation milk productivity during the lifetime, productive life time and milking day were evaluated (Table 2).

Table 2. The average lifetime ECM productivity of culling LB and LZ breed cows by birth year periods

Period	Breed	Milk productivity traits, kg			
		Lifetime ECM productivity	Life day ECM productivity	Productive life day ECM productivity	Milking day ECM productivity
2000-2005	LB	19,634.7 ± 388.23 ^{A}	7.3 ± 0.09 ^{A}	12.3 ± 0.11 ^{A}	15.1 ± 0.12 ^{A}
	LZ	24,179.9 ± 816.59 ^{B}	8.0 ±0.20 ^{A}	12.2 ± 0.23 ^{A}	14.8 ± 0.25 ^{A}
2006-2010	LB	19,144.9 ± 789.80 ^{A}	7.4 ± 0.19 ^{A}	13.0 ± 0.22 ^{A}	16.5 ± 0.24 ^{A}
	LZ	18,830.0 ± 762.04 ^{A}	7.3 ± 0.18 ^{A}	12.6 ± 0.21 ^{A}	15.2 ± 0.23 ^{B}
2011-2015	LB	9,537.9 ± 1,226.73 ^{A}	5.5 ± 0.53 ^{A}	14.5 ± 0.63 ^{A}	16.7 ± 0.66 ^{A}
	LZ	9,937.1 ± 1,595.12 ^{A}	5.7 ± 0.38 ^{A}	13.9 ± 0.45 ^{A}	15.5 ± 0.48 ^{B}

$^{A; B}$ – significant differences between breeds in one birth year period.

The lifetime ECM productivity of 2000–2005 birth year period cows was 19,634.7 kg for LB and 24,179.9 kg for LZ breed cows; however, cows which were born in 2011–2015 did not exceed an average lifetime milk yield – 10,000 kg ECM. LZ cows born in 2000–2005 period ($P < 0.05$) and 2011–2015 period produced more EC milk during their productive life than LB cows, although, the LZ cows had lower milking day ECM productivity. The lowest milk production 5.5 ± 0.53 kg ECM/life day was observed for LB cows and the highest one 8.0 ± 0.20 kg ECM life day for LB cows.

In general, LZ culling cows had longer lifetime and higher lifetime productivity, but lower productive life day and milking day ECM productivity. This can be explained by the fact that LZ cows had significantly higher average milking days (1,275.8 ± 30.0) at all periods than LB cows (1,215.4 ± 19.60) ($P < 0.05$).

In our previous research, there was found out, that Latvian brown cows' lifetime productivity and life day productivity was around 15,000 kg and milking day ECM productivity were in average 9.6 kg in small and 11.9 kg in large size farms therefore farm size is showing effect on dairy cow efficiency (Cielava et al., 2014). In our further investigation the life day milk productivity of Latvian brown cows was lower in the stall housing than it was in loose housing (accordingly 8.2 kg and 9.9 kg ECM per one life day) (Cielava et al., 2017). During the last decade the lifetime and life day productivity have been decreasing due to the shorter lifespan and length of productive life.

The milk production intensity of lactating cows was analysed and significantly higher life day ECM productivity (11.7 ± 1.08 kg) was obtained from 9 still producing LB cows which were born in 2000–2005 (Fig. 3).

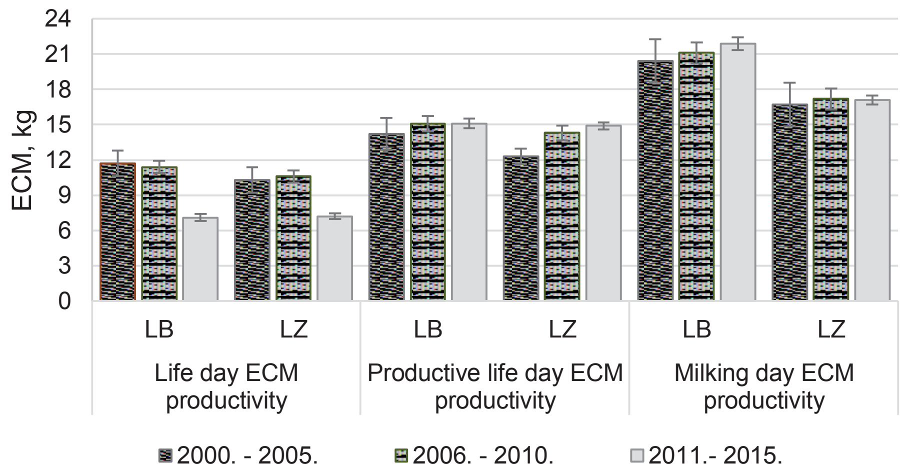

Figure 3. The average lifetime ECM productivity of lactating LB and LZ breed cows depending on their birth year periods.

ECM productivity in one productive life day and one milking day did not differ significantly between study periods, but it significantly differed between breeds ($P < 0.05$). From the LB breed cows in one milking day 3.7–4.8 ECM kg more than from LZ breed cows were obtained in all study periods.

In comparison with lactating LB and LZ cows, a significantly higher daily ECM yield was obtained in all study periods than with culling cows (Table 2, Fig. 3).

Taking into account the small number of local cows population in Latvia and their keeping purpose, low milk productivity is not a reason for the culling of these cows. The main goal is to get as many non-inbred calves as possible to preserve genetic diversity.

CONCLUSIONS

LZ breed was associated with higher longevity (lifespan, length of productive life, milking days) traits than LB in Latvian dairy herds. From culling and now lactating LB breed cows significantly higher daily ECM yield were obtained in all study periods than it was LZ cows.

The present study shows the number of local LB and LZ breeds cows' with percentage of genes of a local breed through 2000 to 2015 was decreased. This indicates that local breeds have a small population number and breeding organizations need to control the rate of inbreeding.

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