EFFECT OF FARM SIZE ON THE PRODUCTIVITY AND LONGEVITY OF LATVIAN BROWN COWS

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Abstract
One of most important traits in dairy farming is cow (*Bos primigenius taurus*) longevity. In last few years the length of productive life in Latvian dairy cow population significantly decreased. Cow longevity depends on a large amount of genetic and non-genetic factors. Data from 1037 excluded Latvian brown (LB) breed cows were included in the analysis. Cows were born in the period from the year 2002 to 2006 and a farm size was 9 – 163 cows per farm. Farms were dislocated in all main regions of Latvia. Average life length of cows excluded from the herd was 2463.0 days in small farms, 2234.6 days in medium size farms and 2089.5 days in large farms. Cows' productivity in one life day in small farms was 5.9 kg energy corrected milk (ECM), in medium size farms 6.2 kg ECM and in large farms 6.5 kg ECM. Large farm cows had longer life length in days (p<0.05), but higher productivity in one productive day (p<0.05) and productivity in one life day.
Key words: cows; lifetime productivity; lifespan.

Introduction

The term 'longevity' refers to duration of life that ends in natural death. Most farm animals have no opportunity to achieve longevity, because they are slaughtered long time before their natural death. Longevity in cows (*Bos primigenius taurus*) can be measured by their lifespan (time from birth to culling from herd) and length of productive life (time from first calving to culling from herd) (Arthur et al., 1992).

Dairy cattle have the potential to live up to the age of 20; however, most modern farm cows are culled even before reaching the sixth lactation. The fact that cows are removed from the herd prematurely is affected by various global factors. One of them is milk or beef purchase price rapid increase, but mostly cow culling happens due to low fertility, mastitis and udder problems as well as milk productivity loss and great age. In the UK an average cow on a farm was kept about 3 lactations until problems with fertility, health and milk quality (Ojangoa et al., 2005; Brickell and Wathes, 2011) occurred. The reasons for culling in farms are different. In farms by first two lactations average are culled 47.9 cows (in different farms from 20.0 – 67.9%). In farms there are culled not only lactating cows, but also heifers in rearing process. In farms with biggest herds most common culling reasons was low fertility, insemination problems, but the third most common reason was increased somatic cell count in milk (Brickell and Wath, 2011). Culling decisions are the result of cow factors such as health, milk production, and reproductive status, but also of factors such as the availability of replacement heifers, parlour capacity or land availability, and prices. With a good availability of heifers farmers might not be able to see the opportunities that lie in keeping healthy cows in the herd, to avoid the hidden costs behind the culling.

Milk production depends on various factors – the main of them are housing and feeding conditions, farm management system, region and season. Cows with low productivity level are culled from herds earlier, because of low productivity level, which is not profitable, but high-yielding cows are often culled because of problems with udder health, metabolism and other (Kalantari et al., 2010).

European farm income from culled cows constitutes an average of 10 - 15% of the total farm budget. Studies in Romania showed that a cow comes profitable reaching 5.85 years of age (Bognar et al., 2009), by increasing cow age, farmers can get more profit from one cow, avoiding costs of rearing new heifer. Housing and feeding conditions are the main factors that affect cow health and productivity. Housing and keeping conditions vary not only in different regions and countries, but in different farms as well. The aim of the study was to evaluate productivity and longevity traits of Latvian brown cows in small, medium and large size farms.

Materials and Methods

In the study data on 1037 Latvian Brown breed cows that started at least first lactation and were culled from the herd in the period from the year 2000 – 2013 were analysed. The farms were located in every Latvian region (Kurzeme, Zemgale, Latgale and Vidzeme). All farms were characterized with different housing, feeding and breeding systems.

Data used in this study were obtained from Latvian Agricultural data centre. Information about cow productivity, the date of cows' birth, date of first calving and date of culling were obtained from the data base. The previously mentioned traits were used to calculate cows' lifespan, length of productive

life, lifetime productivity, and productivity in one productive day.

To characterize milk productivity used energy corrected milk (ECM), which is calculated by the following formula:

$$ECM = milk\ yield \times$$

$$\times \frac{[(0.383 \times fat, \%) + (0.242 \times protein, \%)]}{3.14}$$

Cows were selected from fifteen different farms of which five are added to the group of small farms (<25 cows), five to the average farm groups (25 - 100 cows) and five farms at large farm group (over 100 cows). Cows distribution in farms and farm groups are shown in Table 1.

For farm privacy reasons we gave them group and consecutive code where – S – small, M – medium and L – large.

Data in tables are represented as mean ± standard error. The factor of farm impact on cow longevity and productivity traits was determined by analysis of variance. Pairwise comparisons between farms occurred by using Bonferroni test. Significant differences in the tables were marked with different superscripted letters of the alphabet (A, B, C, etc.). The mathematical processing was performed using the SPSS program package (Næs et al., 2011).

Results and Discussion

On average, there wre no significant differences between the lactation count in small, medium and large farms, but cows stayed longer on small farms - on average 3.8 lactations. In different conditions cows show different productivity and lifetime results. High rates of dairy cows culling are due to all kinds of diseases and injuries (25.7% of cases), sudden death (23.9% of cases), udder problems and mastitis (16.8% of cases), problems with reproductive traits (16.0% of cases) and low productivity (8.3% of cases) (Dechow et al., 2012; Novaković et al., 2010).

In M size farms some of cows (4.45% or 15 cows) had the maximum 11 lactations if compared with small farms, the maximum lactations were only 7 (Table 2).

There is a significantly longer lifespan in S farms (2463.0 days) than in M farms (2234.6 days) as well as there is a significantly shorter lifespan in L farms (2089.5 days) (p<0.05). All cow life length traits are in large amplitude with coefficient of variation from 23.6

Table 1

The number of milk cows in research farms

Farm	Region*	Cows in farm	Farm	Region*	Cows in farm	Farm	Region*	Cows in farm
1S	V	21	1M	K	64	1L	Z	120
2S	V	10	2M	L	76	2L	L	163
3S	Z	9	3M	Z	85	3L	V	113
4S	L	9	4M	K	60	4L	K	100
5S	K	16	5M	V	52	5L	K	139
Count		65	Count		337	Count		635

*K – Kurzeme, Z – Zemgale, V – Vidzeme, L – Latgale

Table 2

Longevity traits depending on farm size

Farm group	Traits		Min	Max	V%
S	Lactation	3.8 ± 0.17	1	7	37
	Lifespan, days	2463.0 ± 72.34[A]	1271	4203	23
	Length of productive life, days	1584.5 ± 74.78[A]	25	1584	38
M	Lactation	3.7 ± 0.09	1	11	48
	Lifespan, days	2234.6 ± 37.15[B]	983	4879	28
	Length of productive life, days	1387.9 ± 38.28[B]	244	4022	50
L	Lactation	3.5 ± 0.07	1	10	36
	Lifespan, days	2089.5 ± 30.10[C]	779	4403	36
	Length of productive life, days	1248.5 ± 29.25[C]	6	3538	59

[ABC]-traits with different superscriptions are significantly different (p<0.05)

Table 3

Longevity traits in different farms

Farm code	Lactation	Lifespan, days	Length of productive life, days
1S	3.2 ± 0.29[A]	2365.2 ± 123.87[A]	1459.7 ± 145.20[B]
2S	4.6 ± 0.37[B]	2564.8 ± 153.30[B]	1766.8 ± 155.15[C]
3S	4.9 ± 0.51[B]	2548.9 ± 263.94[B]	1719.3 ± 208.29[C]
4S	3.4 ± 0.34[A]	2319.0 ± 168.27[A]	1380.4 ± 171.02[AB]
5S	3.8 ± 0.34[AB]	2587.8 ± 79.74[B]	1673.3 ± 153.98[B]
1M	4.5 ± 0.22[B]	2584.8 ± 74.91[B]	1699.5 ± 80.84[B]
2M	3.1 ± 0.20[A]	2112.0 ± 81.83[A]	1150.3 ± 84.83[A]
3M	3.3 ± 0.17[A]	2001.7 ± 69.48[A]	1241.0 ± 69.59[A]
4M	3.4 ± 0.20[A]	2125.2 ± 71.75[A]	1313.6 ± 79.97[B]
5M	4.4 ± 0.27[B]	2488.8 ± 101.28[BC]	1677.7 ± 101.99[B]
1L	3.8 ± 0.60[AB]	2651.6 ± 60.31[C]	1558.5 ± 63.44[B]
2L	2.9 ± 0.12[A]	1759.0 ± 49.68[A]	1020.9 ± 50.9[A]
3L	2.6 ± 0.13[A]	1707.0 ± 48.91[A]	909.5 ± 49.13[A]
4L	5.3 ± 0.23[C]	2639.8 ± 88.45[C]	1884.8 ± 88.57[C]
5L	3.1 ± 0.11[A]	1906.1 ± 41.35[A]	1065.7 ± 40.97[A]

[ABCD]-traits with different superscriptions are significantly different (p<0.05)

Table 4

Lifetime productivity traits depending on farm size

Farm group	Traits		Min	Max	V%
S	Lifetime productivity, kg ECM	15278.6 ± 843.20	386.0	28218.6	44
	Productivity in one life day, kg ECM	5.9 ± 0.23	0.3	9.0	32
	Productivity in one productive day, kg ECM	9.6 ± 0.26[A]	3.1	15.4	20
M	Lifetime productivity, kg ECM	15226.4 ± 577.51	1593.0	67845.2	69
	Productivity in one life day, kg ECM	6.2 ± 0.16	1.0	14.7	49
	Productivity in one productive day, kg ECM	10.3 ± 0.20[A]	1.5	20.8	35
L	Lifetime productivity, kg ECM	15034.2 ± 411.48	54	50616.8	68
	Productivity in one life day, kg ECM	6.5 ± 0.11	0.1	11.4	44
	Productivity in one productive day, kg ECM	11.9 ± 0.15[B]	2.3	25.3	32

[ABC]-traits with different superscriptions are significantly different; p<0.05

to 59.0%. The same tendency occurred in the length of productive life, where it was significantly longer in S farms (1584.5 days), but in L farms it was only 1248.5 days (p<0.05). In S farm group the first calving was at the age of 879 days, M farm group – 847 days and in L farm group – 841 day, which makes approximately 29.3 months in S farms 28.3 months in M farms and 28.0 months in L farms.

On different farms there are different conditions and different solutions to farming problems. Also, there is a difference between smaller farms and farms with larger number of cows in them. According to our investigation, there are significant differences between lifespan and productive life length as well as in the count of closed lactations (Table 3).

Lifespan was significantly lower for cows in L size farms (1707.0 and 1759.0 days). Longer lifespan occurred on 2L and 3L farms, but it was significantly higher on 1L and 4L farms (2651.6 and 2639.8 days; p<0.05). In S farm group there are overall similar lifespan readings that vary from 2319.0 (4S farm) to 2587.8 (5S farm) days. In M farm group there is a significant difference between 2M, 3M, 4M farms and 1M and 5M farms, respectively, between the lowest and highest lifespan readings (p<0.05). Length of productive life keeps on the same tendencies – significantly longest length of productive life was on 4L farm (1884.8 days), but on L farms there are the lowest productive life performances too (in 2L, 3L and 5L farms). As well as

Table 5

Lifetime productivity traits in different farms

Farm code	Lifetime productivity, kg ECM	Productivity in one life day, kg ECM	Productivity in one productive day, kg ECM
1S	13975.9 ± 1462.68[AB]	5.6 ± 0.47[B]	9.9 ± 0.53[C]
2S	17117.8 ± 1716.26[BC]	6.6 ± 0.35[B]	9.6 ± 0.29[C]
3S	15736.1 ± 2028.44[B]	6.0 ± 0.46[B]	9.1 ± 0.37[BC]
4S	10975.9 ± 1920.57[A]	4.6 ± 0.58[AB]	7.9 ± 0.75[B]
5S	18001.5 ± 1910.01[BC]	6.7 ± 0.48[BC]	10.6 ± 0.44[C]
1M	26306.5 ± 1459.60[C]	9.8 ± 0.34[D]	15.1 ± 0.36[D]
2M	8966.5 ± 853.11[A]	3.8 ± 0.22[A]	7.3 ± 0.26[A]
3M	15437.4 ± 1173.18[B]	6.8 ± 0.38[BC]	11.4 ± 0.45[CD]
4M	15437.4 ± 1173.18[B]	6.8 ± 0.38[BC]	11.4 ± 0.46[CD]
5M	14943.7 ± 1221.33[AB]	5.6 ± 0.26[B]	8.5 ± 0.29[AB]
1L	24223.9 ± 1171.65[C]	8.5 ± 0.29[C]	15.1 ± 0.34
2L	9732.7 ± 529.24[A]	4.9 ± 0.16[AB]	9.5 ± 0.16[B]
3L	13523.8 ± 837.05[AB]	7.1 ± 0.28[C]	14.4 ± 0.24
4L	15304.6 ± 873.91[B]	5.3 ± 0.19[B]	7.6 ± 0.19[A]
5L	14350.7 ± 710.87[ABC]	6.9 ± 0.22[BC]	12.9 ± 0.25

[ABC]-traits with different superscripts are significantly different (p<0.05)

in lifespan traits, the highest length of productive life was in S farm group.

In comparison, on farms where longer lifespan and length of productive life occurred, higher milk yield not only in one lifespan day, but also in one productive life day occurred, too (1L and 1M farms). On 4L farm there was the longest lifespan, but one of the lowest lifetime productivities, which led to lower productivity in one lifespan day and productive life day.

The average cows lifetime productivity on S farm was 15278.6 kg, on M farm 15226.4 kg and on L farm 15034.2 kg. All cow lifetime productivity traits are in a large amplitude with coefficient of variation from 20.8 to 69.6%. The L farms cows had significantly higher productivity in one productive day (p<0.05), the differences between S and L are 2.3 ECM kg per one productive day, but productivity in one life day does not significantly differ between different size farms. Productivity in one life day and productivity in one productive day increase with farm size and it means that in M and L farms the average cows' age at first calving is smaller.

As lifetime productivity and productivity in one life day in every farm group is not significantly different, but there are significant differences between productivity in one productive life day, we can assume that on S farms there are main problems with heifer rearing. In studies it was found out that optimal first calving age for dairy heifers is 23 – 27 months, if the first calving age is under 23 months, then the length of productive life decreases by 12%. A similar tendency

was observed when first calving age comes over 27 months. (Ajili and Rekik, 2010) The results of our paper shows that for cows with shorter lifespan and length of productive life productivity in one productive day is significantly higher than for cows with longer lifespan and productive life.

The lifetime productivity traits on different farms can be different, mainly because of significant difference in cow lifespan and productive life length. The cow lifetime productivity is shown in Table 5.

Higher lifetime productivity (26306.5 kg ECM) was observed on 1M farm in which there were 64 dairy cows. It was noticed that farm cows had the highest productivity in one life and one productivity day, but the lowest average lifetime productivity occurred on 2M farm (8966 kg ECM). In one life day significantly largest amount of productivity – 9.8 kg ECM – was on 1M farm as well as on 1L farm (8.5 kg ECM) (p<0.05). The smallest amount of productivity in one life day was on 2M farm – 3.8 kg ECM in one lifespan day. In one productive life day the largest amount of productivity was on 1M and 1L farms (15.1 kg ECM), but significantly lower productivity in one productive life day (7.3 – 7.9 kg ECM in one day) was on 2M, 4L and 4S farms. As shown in different studies, on farms with cow count form 20 – 100 productive life is significantly higher than on farms with cow count <20 or >100. In farms with cow count 20 – 100 lifespan was 5.7 years and length of productive life was 3.34 years, but within smaller farms it was respectively 6.14 and 3.24 years but in larger farms 5.48 and 3.15 years (Sawa and Bogucki, 2010; Gandini et al., 2012).

Conclusions

1. The largest lifetime milk productivity (15278.6 kg in lifetime) occurred on S (Small) farm group, so productive life (2463.0 days) was the largest, but there wasn't significant difference between other groups.

2. Higher lifetime productivity 26306.5 kg ECM was observed on 1M farm in which there were 64 dairy cows and on this farm cows had the highest productivity in one life (9.8 kg ECM) as well as in one productive day (15.1 kg ECM).

3. On the 4L farm cows were kept on average 5.3 lactations and the number of lactations is significantly higher than on other farms. 20% of investigated farms kept cows over 4 lactations.

4. There is no significant difference between lifetime productivity on different size farms, but there is difference between productivity in one productive day. L farms cows have higher productivity in one productive day ($p < 0.05$) and productivity in one life day.

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