

## **Length of life, length of productive life, and productivity of dairy cows in herds in the Lublin Voivodeship**

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**Life expectancy, length of productive life, lifetime productivity and indicators of lifetime dairy performance efficiency were compared in 8,223 cows of the Black-and-White breed which were culled from 334 herds in the Lublin Voivodeship in the years 1980-2002 and 2003-2014. No significant differences were found between the cows culled in these two periods in age at first calving, length of life and production life, or number of births. The cows culled in 2003-2014 were characterized by poorer fertility (significantly longer calving intervals) than the cows culled in the years 1980-2002, but had significantly higher lifetime yield of milk and its components, as well as better milk composition (significantly higher protein content and a significantly better protein-to-fat ratio). These cows achieved significantly higher values for indicators of lifetime dairy performance efficiency (milk yield per day of life, per day of productive life, per day of milking, per day of rearing, per year of life and per year of productive life).**

**KEY WORDS:** cows/ length of life / length of productive life / yield of life/ efficiency of use

The length of life and length of productive life of dairy cows significantly influence their lifetime performance parameters [2, 3, 12, 15]. Longer use reduces the cost of milk production by decreasing expenditures on replacing culled cows [6]. Animals used longer achieve higher lifetime milk production and produce more calves, which reduces the cost of rebuilding the stock and increases the profitability of dairy farming [13]. Research by many authors [2, 5, 15] has shown a persistent downward trend in the length of life and productive life of dairy cows in Poland for many years. Observations by Pokorska et al. [11] indicate that the main reasons for culling of cows have been sterility and udder disease. According to many authors [8, 12, 13, 15], for economic reasons dairy cows should be used for 6-7 lactations. When they are used for a longer period, an additional source of income, apart from milk production, may be the sale of calves and heifers that are not used

to rebuild the owners' herd [6, 14]. The length of the productive life of the cow is also a determinant of its lifetime yield. Animals culled too early do not reach peak production, which occurs at 3-5 lactations [3, 6, 12]. Hence the lifetime yield of cows is currently considered their most important production feature and is included in the latest selection indices developed in many countries [5, 7]. It is one of the main factors influencing the profitability of dairy cattle breeding and farming.

The aim of the study was to compare the length of life and productive life and the values of lifetime dairy performance parameters of cows culled in dairy cattle herds in the Lublin Voivodeship between 1980-2002 and 2003-2014.

### **Material and methods**

The study was conducted in 334 dairy cattle herds in the Lublin Voivodeship. The data used in the study were obtained from herd breeding documentation (heifer/cow records, insemination certificates, cow pedigrees, and RW-1 and RW-2 evaluation reports) and the Regional Animal Breeding Station in Parzniew – Lublin Division, Polish Federation of Cattle Breeders and Dairy Farmers. The analysis included 8,223 black and white cows (since 2004 the Black-and-White variety of the Polish Holstein-Friesian breed) divided into two groups: culled in 1980-2002 and culled in 2003-2014. Cows that had had at least one lactation (not less than 200 days in milk) were included in the study.

The following were calculated for each cow:

- age at first calving
- length of life and productive life (from the day of birth and the day of first calving, respectively, to the day of culling)
- lifetime number of days in milk
- lifetime yield of milk, fat and protein and the content of these components in the milk (lifetime milk yield was calculated as the sum of milk yields in each full lactation)
- lifetime yield of VCM (value-corrected milk, corrected for fat and protein content) according to the formula given by Arbel et al. [1]
- mean length of calving intervals
- ratio of length of productive life to length of life and rearing
- milk yield per day of life, day of productive life, day in milk, day of rearing, year of life and year of productive life

Also determined were the percentage of cows that were productive for a period shorter than their rearing and the number of births during the cow's entire productive life. The numerical data were analysed by Student's t-test, using Statistica 9.1.

### **Results and discussion**

The results shown in Table 1 indicate that cows culled in the years 1980-2002 and 2003-2014 in herds in the Lublin Voivodeship had a similar age at first calving and a similar mean lifespan, length of productive life, and number of births. More favourable

**Table 1**

Length of life and productive life, number of births, age at first calving and fertility of cows culled in the years 1980-2002 and 2003-2014

Specification		Years of culling	
		1980-2002	2003-2014
Number of cows (head)		4134	4089
Length of life (days) (years)	$\bar{x}$	2125	2099
	Sd	804.51 (5.82)	753.70 (5.75)
Length of productive life (days) (years)	$\bar{x}$	1275	1251
	Sd	809.20 (3.49)	748.56 (3.43)
Number of births	$\bar{x}$	3.44	3.36
	Sd	2.00	1.77
Age at first calving (days) (months)	$\bar{x}$	851	848
	Sd	125.55 27.98	123.71 27.89
Average calving interval (days)	$\bar{x}$	419 <sup>xx</sup>	427 <sup>xx</sup>
	Sd	79.17	75.43

xx – differences significant at  $P \leq 0.01$

results were obtained by Sawa and Bogucki [14] who found a significant improvement in length of life and productive life in a very large population of cows (over 25,000) in the Pomerania and Kujawy region, which first calved in 2000, as compared to cows that began producing milk in 1998.

Cows raised in herds in the Lublin Voivodeship and culled in the years 2003-2014 were found to have inferior fertility (highly significantly longer mean calving interval) to those culled in 1980-2002 (Table 1).

Regarding the lifetime performance parameters of dairy cows (Table 2), animals culled between 2003 and 2014 achieved highly significantly higher lifetime yields of milk, fat, protein and VCM than those culled in 1980-2002.

Analysis of the milk composition of cows culled in the years 1980-2002 and 2003-2014 revealed no significant difference in fat content. On the other hand, a large and highly statistically significant difference was found in the protein content of milk. The milk of cows culled in 2003-2014 had highly significantly higher (by 0.13 pp) content of protein as compared to those culled in 1980-2002. This indicates that the breeding work carried out for many years in herds in the Lublin Voivodeship, aimed at increasing the protein content of cow milk while lowering the fat percentage, has been effective. This is also confirmed by the relationship between fat content and protein content in the milk. A highly significantly smaller difference between fat and protein content (by 0.11 pp) and a more favourable protein-to-fat ratio (by 0.025) was noted in the milk of cows culled between 2003 and 2014

**Table 2**  
Lifetime yield of cows culled in the years 1980-2002 and 2003-2014

Specification		Years of culling	
		1980-2002	2003-2014
Number of cows (head)		4134	4089
Lifetime number of days milked	$\bar{x}$ Sd	1100 675.74	1093 633.27
Lifetime yield (kg):			
milk	$\bar{x}$	17 378 <sup>xx</sup>	24 397 <sup>xx</sup>
	Sd	12 309	14 641
fat	$\bar{x}$	704.62 <sup>xx</sup>	989.70 <sup>xx</sup>
	Sd	500.89	607.44
protein	$\bar{x}$	562.23 <sup>xx</sup>	820.11 <sup>xx</sup>
	Sd	395.92	488.53
Content of milk components			
fat (%)	$\bar{x}$	4.05	4.07
	Sd	0.35	0.55
protein (%)	$\bar{x}$	3.24 <sup>xx</sup>	3.37 <sup>xx</sup>
	Sd	0.18	0.21
DFP (pp)	$\bar{x}$	0.81 <sup>xx</sup>	0.70 <sup>xx</sup>
	Sd	0.31	0.50
PFR	$\bar{x}$	0.803 <sup>xx</sup>	0.828 <sup>xx</sup>
	Sd	0.061	0.104
VCM <sup>1</sup> (kg)	$\bar{x}$	13 738 <sup>xx</sup>	20 087 <sup>xx</sup>
	Sd	13 990	17 128

<sup>xx</sup> – differences significant at  $P \leq 0.01$ .

<sup>1</sup>VCM – value-corrected milk (fat and protein corrected)

DFP – difference between content of fat and protein

PFR – protein-to-fat ratio

as compared to cows culled in 1980-2002. These results find confirmation in studies by other authors [4, 9], who showed a favourable increase in protein in the milk of cows of the active domestic population and an improvement in the protein-to-fat ratio. Pogorzelska et al. [10] found that the protein-to-fat ratio increased with the yield of the herd and was most favourable in case of the youngest cows.

According to Sawa and Bogucki [14] and other authors [4, 10, 16], the efficiency of milk production by cows is determined not only by the absolute yield obtained for a specified period of life or productive life, but also by the amount of milk and its components per day of life, day productive life and day of rearing, or per year of life and productive life. Also important is the ratio of the length of the cows' productive life to the length of its life and rearing period. These values should be as high as possible, because then the share of the cow's rearing period in its entire life decreases accordingly.

**Table 3**  
Efficiency indicators of dairy performance of cows culled in the years 1980-2002 and 2003-2014

Specification	Years of culling	
	1980-2002	2003-2014
Number of cows (head)	4134	4089
Length of productive life to:		
length of life (%)	$\bar{x}$ 60.00 Sd 16.91	59.60 15.73
length of rearing (%)	$\bar{x}$ 149.82 Sd 102.91	147.52 94.06
VCM <sup>1</sup> (kg) per day:		
lifetime	$\bar{x}$ 6.47 <sup>xx</sup> Sd 3.55	9.57 <sup>xx</sup> 4.49
productive life	$\bar{x}$ 10.77 <sup>xx</sup> Sd 4.11	16.06 <sup>xx</sup> 6.02
milking	$\bar{x}$ 12.50 <sup>xx</sup> Sd 4.43	18.38 <sup>xx</sup> 6.53
rearing	$\bar{x}$ 16.14 <sup>xx</sup> Sd 17.94 <sup>xx</sup>	23.69 <sup>xx</sup> 21.45 <sup>xx</sup>
VCM <sup>1</sup> (kg) per years:		
life	$\bar{x}$ 2361 <sup>xx</sup> Sd 1296	3493 <sup>xx</sup> 1640
productive life	$\bar{x}$ 3936 <sup>xx</sup> Sd 1500	5856 <sup>xx</sup> 2197
Cows with productive life shorter than their rearing period (%)	38.10	36.36

xx – differences significant at  $P \leq 0.01$

<sup>1</sup>VCM – value-corrected milk (fat and protein corrected)

The data presented in Table 3 indicate that the dairy cows culled in the years 2003-2014 had markedly better lifetime parameters of dairy performance. These cows, as compared to those culled in 1980-2002, achieved higher VCM yields per day of life, day of productive life, day in milk and day of rearing, as well as per year of life and year of productive life. The differences were very large and highly statistically significant.

In conclusion, cows culled from herds in the Lublin Voivodeship in the years 2003-2014, were less fertile (longer calving interval) but achieved higher lifetime yield of milk and its components, produced milk with a better composition (smaller difference between fat and protein content and a more favourable protein-to fat-ratio) and higher lifetime performance parameters (milk yield per day of life, day of productive life, day in milk and day of rearing, as well as per year of life and productive life) in comparison with those culled in 1980-2002.

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