

## **Cow longevity in herds of different milk production levels and herd size**

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**Abstract:** *Cow longevity in herds of different milk production levels and herd size.* The effect of herd production level and herd size on cow longevity was studied using the SYMLEK system data on 12,045 Polish Holstein-Friesian cows (Black-and-White variety) from 1,371 herds. The cows, which belonged to the active population in Pomerania and Kujawy, first calved in 2008 and were used or disposed from the herds by the end of 2015. FREQ and GLM procedures from the SAS package were used in the statistical calculations. With increases in herd size (from less than or equal 20 to beyond 200 cows) and herd production level (from less than or equal 6,000 to 9,000 kg milk), the culling level increased ( $P \leq 0.01$ ) while the proportion of cows sold and alive decreased. Cow longevity was differentiated ( $P \leq 0.01$ ) by herd size. As the number of cows in the herd increased, the lifespan and the length of productive life, as well as number of calvings decreased. The effect of herd production level on cow longevity was not statistically confirmed.

*Key words:* cow, milk, longevity, production level

### **INTRODUCTION**

In view of the long-persisting tendency in Poland and the world to reduce the cows' lifespan and length of productive life, longevity is increasingly considered the most important functional trait that is crucial for breeding and production (Strapák et al. 2005, Brickell et al. 2010, Sawa 2011, Chabuz et al. 2016, Litwińczuk et al. 2016). Considering the economics of dairy cow production, the

possibility of increasing the length of productive life in cows is of particular interest for breeders. Róžańska-Zawieja et al. (2008) concluded that the lifespan of cows is highly significantly affected by breed, farm, cause of removal, maximum lactation number, maximum lactation length, and lifetime milk and milk constituents yield. Other determinants of cow longevity include milk production intensity (Jugowar et al. 2008) and herd size (Wroński et al. 2003, Jankowska et al. 2014).

Cattle and especially cow farming is characterized by differences in the scale of production. According to Zięta (2007), an increase in the profitability of dairy farms depends on the possibility of reducing unit production costs, their magnitude being determined to a considerable extent by herd size and milk yield of the cows.

The aim of the study is to analyse the effect of herd production level and herd size on the cows' lifespan and length of productive life.

### **MATERIAL AND METHODS**

Using data from the SYMLEK database on 12,045 Polish Holstein-Friesian cows (Black-and-White variety) from 1,371 herds, belonging to the active population

in Pomerania and Kujawy, which first calved in 2008 and were used or disposed from the herds by the end of 2015. Procedures of FREQ and GLM from the SAS (2014) package were used in the statistical calculations. The following longevity indicators were calculated:

- lifespan = culling date – birth date;
- length of productive life = culling date – date of first calving;
- number of calvings.

Chi square test of independence (SAS 2014) was used to analyse the effect of herd production level and herd size on percentage of cows removed (sold or culled) or surviving until the end of 2015.

The longevity ( $Y$ ) of culled cows (lifespan, length of productive life, number of calvings) was analysed as the effect of herd production level and herd size, using the following linear model (SAS 2014):

$$Y = \mu + a_i + b_j + e_{ij}$$

$\mu$  – overall mean;

$a_i$  – effect of  $i$ -th herd production level ( $\leq 6,000$ , 6,001–7,000, 7,001–8,000, 8,001–9,000, >9,000 kg milk);

$b_j$  – effect of  $j$ -th herd size ( $\leq 20$ , 20–50, 51–200, >200 cows);

$e_{ij}$  – random error of observation.

Significant differences were analysed with the Scheffé test.

## RESULTS AND DISCUSSION

The average lifespan of the cows was 5.36 years (3.12 years for length of productive life). These results fall within the range reported by other authors (Sawa 2011, Chabuz et al. 2016). Comparison of chi square values (Tables 1 and 2)

shows that differences in the proportion of the cows sold, culled and alive were influenced more by herd size than by herd production level. The relatively high (over 13%) proportion of cows sold from lowest producing herds and from herds that had the lowest stocking rate may be indicative of appropriate breeding work, but could also be due to insufficient profitability of milk production in these herds. According to Hadley et al. (2002) and Wolf (2003), milk production costs are lower in large herds. McDonalds et al. (2013) believe that with the abolition of EU milk quotas, the best strategy is to expand the farms and to increase the number of cows in the herd.

Analysis of the results given in Table 1 shows that the herd production level (which, as an outcome of many factors, mainly environmental ones, often serves as a measure of the quality of rearing conditions) has a statistically significant effect on the proportion of cows sold, culled and alive. As the herd production level increased to 9,000 kg milk, so did the proportion of culled cows, from 78.73 to 95.79%. Pytlewski et al. (2014), when summarizing the findings of other authors, concluded that the increase in milk yield may be accompanied by increased herd culling, and by higher herd replacement and veterinary costs due to greater morbidity rates and reduced fertility.

In our study, we found the proportion of the cows sold and alive to decrease (from 13.05 to 1.96% and from 8.22 to 2.25%, respectively) as the herd production level increased to 9,000 kg milk. In the highest yielding herds (beyond 9,000 kg milk), the proportion of cows sold and alive each exceeded 3%.

TABLE 1. Proportion of the cows sold, culled and alive in herds with different production levels

Herd production level (kg milk)	Number of herds	<i>n</i>	%	Proportion (%) cows ( $\chi^2 = 411.93^*$ )		
				sold	culled	alive
≤6 000	492	2 214	18.39	13.05	78.73	8.22
6 001–7 000	410	2 719	22.57	6.07	88.67	5.26
7 001–8 000	285	2 913	24.18	6.04	90.59	3.36
8 001–9 000	112	2 044	16.97	1.96	95.79	2.25
>9000	72	2 155	17.89	3.11	93.32	3.57

$P \leq 0.01$ .

TABLE 2. Proportion of the cows sold, culled and alive depending on herd size

Number of cows in herd	Number of herds	<i>n</i>	%	Proportion (%) cows ( $\chi^2 = 532.11^*$ )		
				sold	culled	alive
≤20	608	2255	18.72	13.61	79.03	7.36
20.1–50	623	4225	35.08	7.53	87.14	5.33
50.1–200	107	2748	22.81	3.42	93.20	3.38
>200	33	2817	23.39	0.64	97.16	2.20

$P \leq 0.01$ .

The results presented in Table 2 show that the proportion of the cows sold, culled and alive varied ( $P \leq 0.01$ ) according to herd size. The lowest proportion of culled cows (79.03%) was observed in herds with less than 20 cows. These herds were also characterized by the highest proportion of the cows sold (13.61%) and alive (7.36%). The herds with more than 200 cows had the lowest proportion of the cows sold (0.64%) and alive (2.20%), and the highest proportion of the cows culled (97.16%). Production in large herds can be mechanized and automated, which enables increasing the number of cows being managed per person. However, limited contact with the cows may make the attendants unaware of their individual characteristics and first signs of disease, leading to prolonged treatment and even early culling.

Table 3 shows the results for the effect of herd productivity and number of cows in the herd on longevity. The herd production level had no appreciable effect on the lifespan, length of productive life and number of calvings. The length of productive life was almost the same for all the cows. However, the number of calvings was higher for cows that yielded more than 7,000 kg milk per lactation, but the difference was not significant. The effect of the number of cows per herd on their longevity was confirmed statistically. Cows from the herds with up to 50 animals had the longest lifespan, the greatest length of productive life and the greatest number of calvings. Differences between the herds with less than 20 and 20–50 cows were not significant. Significant differences were observed between the herds of less than 50 and more than

TABLE 3. Effect of herd production level and number of cows in herd on cow longevity

Factor	Value	Longevity indicator					
		lifespan (years)		length of productive life (years)		number of calvings	
		<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>
Herd production level (kg milk)	≤6 000	5.52	0.05	3.21	0.05	2.87	0.04
	6 001–7 000	5.36	0.04	3.08	0.04	2.79	0.03
	7 001–8 000	5.33	0.04	3.13	0.04	2.86	0.03
	8 001–9 000	5.25	0.04	3.08	0.04	2.83	0.04
Number of cows in herd	>9 000	5.36	0.04	3.17	0.04	2.93	0.04
	≤20	5.58 <sup>AB</sup>	0.05	3.43 <sup>AB</sup>	0.05	3.10 <sup>AB</sup>	0.04
	20.1–50	5.54 <sup>CD</sup>	0.03	3.34 <sup>CD</sup>	0.03	3.04 <sup>CD</sup>	0.03
	50.1–200	5.25 <sup>ACa</sup>	0.04	2.95 <sup>ACa</sup>	0.04	2.70 <sup>ACa</sup>	0.03
	>200	5.08 <sup>BDa</sup>	0.04	2.81 <sup>BDa</sup>	0.04	2.58 <sup>BDa</sup>	0.03

A, B, C, D – means within columns followed by the same letters differ significantly at  $P \leq 0.01$ ;

a – means within columns followed by the same letters differ significantly at  $P \leq 0.05$ .

50 cows. As the number of cows per herd increased, their longevity, as assessed by all the indicators used in the study, was found to deteriorate. The decreasing number of calvings with the increasing stocking rate is considered unfavourable because this causes the cows to remain for less time in the herd, thus having a direct impact on the profitability of milk production (Forabosco et al. 2004, Sewalem et al. 2008). In the loose housing system, Sawa et al. (2008) showed that increasing the number of cows per herd (from less than or equal 50 to beyond 200) had a negative effect on the length of productive life, which decreased from 3.68 to 2.64 years. In the tie-stall system, the productive life was longest for cows from herds with less than or equal 50 animals and shortest for herds with 50.1–200 cows. Jankowska et al. (2014) reported the longer lifespan (5.91 years) for cows from herds of less than or equal 50 animals, while in larger herds, the lifespan decreased to 4.99 years (herds of

51–100 cows) and 4.81 years (herds with beyond 100 cows). The same authors observed a similar trend for the length of productive life and the number of calvings. Also other researchers (Sawa et al. 2000, Wroński et al. 2003) found that cows in smaller herds are characterized by better longevity, which they attribute to the individual approach to every animal and better care in small compared to more mechanized, larger herds.

## CONCLUSIONS

In summary, it is concluded that with the increasing herd size and herd production level to 9,000 kg milk, the culling rate increased ( $P \leq 0.01$ ) while the number of cows sold and alive decreased. It was also found that cow longevity was differentiated ( $P \leq 0.01$ ) by the herd size. As the number of cows per herd increased, the lifespan and the length of productive life as well as number of calvings

decreased. The effect of herd production level on cow longevity was not confirmed statistically.

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**Streszczenie:** *Długowieczność krów w stadach o zróżnicowanym poziomie wydajności i wielkości.* W pracy wykorzystano dane z bazy SY-MLEK o 12 045 krowach z 1317 stad. Badane krowy były rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej i należały do populacji aktywnej Pomorza i Kujaw. Krowy wycieliły się po raz pierwszy w 2008 roku i były użytkowane lub usuwane ze stad do końca 2015 roku. Analizowano wpływ poziomu wydajności stada i jego wielkości na długowieczność. W obliczeniach statystycznych zastosowano procedury *FREQ* i *GLM* z pakietu *SAS*. Stwierdzono, że wraz ze wzrostem liczebności stada z równo lub poniżej 20 do powyżej 200 krów oraz poziomu wydajności stada

z równo lub poniżej 6000 do 9000 kg mleka zwiększał się ( $P \leq 0,01$ ) stopień brakowania, zmniejszał się natomiast udział krów sprzedanych oraz żyjących. Wykazano, że wielkość stada różnicowała ( $P \leq 0,01$ ) długowieczność krów. Wraz ze wzrostem liczby krów w stadzie skracala się długość życia i użytkowania krów, zmniejszała się liczba ich wycieleń. Wpływ poziomu wydajności stada na długowieczność krów nie został potwierdzony statystycznie.

*Słowa kluczowe:* krowy, mleko, długowieczność, poziom produkcyjny

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