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LACTATION EXTENSION WITH REGARD TO MILK, FAT AND PROTEIN YIELD IN POLISH HOLSTEIN-FRIESIAN COWS OF BLACK-AND-WHITE VARIETY

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Abstract. In the paper the influence of daily milk yield in peak lactation, milk yield during 305 days after calving and number of cows' calving on frequency of lactations longer than 305-day standard were analyzed. It was also estimated the influence of extended lactation on milk yield and milk composition. The research were carried out in a herd including 220 Polish Holstein-Friesian cows of Black-And-White variety. The animals were housed in a loose barn and were fed a balanced TMR. The research included 384 lactations, which were longer at least 1 day than 305-day standard, and were selected out from 488 complete lactations. It was found that frequency of extended lactations was 78.7%, and moreover the most frequently (25.0%) the period of extension lasted up to 30 days. During extension period milk production was higher by 2.5–43.0% in compare to milk yield in standard lactation. Lactation extending was slightly connected with milk yield per 1 day of complete lactation. Values of this trait were highest in the case of lactation extended maximally by 60 days.

Keywords: cows, extended lactation, productivity, standard lactation

INTRODUCTION

The constantly increasing unit yield of dairy cows and shortening of their lifetime and productive life have given rise to the discussion on the appropriateness of maintaining a 12 month calving interval. According to Sawa and Bogucki [2009], the planned extension of calving intervals affected the increase in annual and lactational milk yield and the improvement of reproductive parameters. Numerous studies have shown advantages resulting from extended productive and reproductive cycles [Dymnicki et al. 2003, Krzyżewski and Reklewski 2003, Guliński et al. 2004, Guliński and Salamończyk 2007, Miciński 2008]. Although extended lactations are associated with a decreased number of calvings (and of calves born) in cows during their lifetime and productive life, their positive effect is a smaller number of diseases occurring during the periparturient period and

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at the beginning of lactation and, consequently, reduced costs of veterinary treatment [Pösö and Mäntysaari 1996, Szarek 1998, Larsson and Berglund 2000, Knight 2005]. In the studies cited by Krzyżewski and Reklewski [2003], it has been found that milk yield per day of calving interval in cows with extended lactation was approx. 1 liter lower in comparison with the control group. Economic effects were more favorable due to the improvement in the indices of fertility, health and herd replacement.

The aim of this study was to estimate an effect of selected factors on the extension of lactations and to analyze yield and composition of milk obtained during the extended lactation period.

MATERIAL AND METHODS

The data used in the study consisted of the results of milk recording performed on the farm, where 220 Polish Holstein-Friesian cows of Black-and-White variety were kept in a loose barn on deep litter. The animals were fed a balanced TMR and the average milk yield per cow exceeded 8000 kg. Three hundred eighty-four lactations, selected out of 488 ones and being at least one day longer than the 305-day standard, were analyzed. According to extension length, lactations were divided into four groups: 1–30, 31–60, 61–90, 91–150 and over 150 days. The frequency of extended lactations was analyzed depending on:

– daily milk yield at peak lactation (≤30.0 kg; 30.1–40.0; 40.1–50.0 and >50.0 kg);
– 305-day milk yield (≤7000 kg; 7001–8000; 8001–9000; 9001–10 000 and >10 000 kg);
– lactation number (1, 2, 3 and >3).

In addition, the following was determined for each lactation:

– complete lactation milk yield and its fat and protein content;
– number of days by which lactation was extended beyond the standard;
– milk yield during extension period (in kg and per cent in relation to the standard lactation);
– milk yield per day of lactation and per day of its extension, kg.

One-way analysis of variance was used for statistical calculations and the significance of differences between the means was estimated with Duncan's test. The effect of individual factors on the extension length was determined using the χ^2 test of independence.

RESULTS AND DISCUSSION

Among 488 lactations that were completed during the examined period, 384 (78.7%) ones lasted over 305 days (Table 1). VanRaden et al. [2006] showed that lactations extended beyond the standard occurred in more than 50% of cows. In the study by Winnicki and Głowicka-Wołoszyn [2007], percentage of cows with extended lactation was 77.2% and in the work by Czaplicka et al. [1994] it was 70%. Salamończyk and Guliński [2007 a] found that lactations longer than standard ones amounted to 55% and that their highest percentage was characteristic of pure-bred Holstein-Friesians (67.2%), animals with calving in-

terval longer than 470 days (64.7%) and primiparous cows (58.4%). These figures indicate that extended lactations are observed mainly in high-yielding cows and those most persistent during lactation.

Table 1. Number and percentage share of lactations longer than the 305-day standard
Tabela 1. Liczba i procent laktacji przedłużonych ponad 305-dniowy standard

Specification Wyszczególnienie	Number of lactations Liczba laktacji	% of lactations (number of extended lactations = 100%) % laktacji (liczba laktacji przedłużonych = 100%)
Total – Ogółem	488	100.0
Number of lactations longer than the standard by at least 1 day, in this: Liczba laktacji dłuższych od standardowych o co najmniej 1 dzień, w tym:	384	78.7
lactation extended beyond the standard, days przedłużenie laktacji ponad standard, dni		
– 1–30	96	25.0
– 31–60	69	18.0
– 61–90	59	15.4
– 91–150	83	21.6
– >150	77	20.0

The length of extension period most frequently (25.0%) amounted to 1–30 days. Lactations extended by 91–150 days and over 150 days occurred slightly less often (21.6% and 20.0%, respectively). Lactations lasting 366–395 days (61–90 days of extension) accounted for the lowest percentage (15.4%). In the study by Guliński et al. [2004], it was shown that 76% of cows had at least 30-day longer standard lactations and almost 37% had at least 90-day longer lactations in relation to all the cows that completed the 305-day lactation.

The 305-day milk yield of cows had the most influence on the length of extension period beyond the standard (Table 2) and this effect was significant ($P \leq 0.05$). However, no significant effect of the daily milk yield at peak lactation or the calving number on the extension of lactation was found. Cows with the lowest milk yield during the standard period (up to 7000 kg and 7000–8000 kg of milk) most frequently (33.3 and 29.0%) had lactations extended by 1–30 days. In the remaining groups, the proportion of lactations lasting 306–335 days ranged between 18.2 and 27.7%. The animals with the lowest 305-day milk yield had over 150-day longer lactations only in 8.3% of cases. Cows with the milk yield of 8000–10 000 kg most often (23.5 and 28.7%) had lactations extended by 91–150 days. The frequencies of the longest lactations (>150 days) for these cows were 21.2% and 19.2%, respectively. In the case of cows with the highest 305-day milk yield, the frequency of the longest lactations was the highest (29.5%). Such long lactations of high yielding cows may indicate declined reproductive performance or the planned delay of the moment of conception for these animals.

Table 2. The influence of selected factors on the length of extension period beyond 305-day standard
Tabela 2. Wpływ wybranych czynników na długość okresu przedłużenia laktacji ponad 305-dniowy standard

Specification Wyszczególnienie	Lactation extended beyond the standard, days Przedłużenie laktacji ponad standard, dni										χ^2
	1–30		31–60		61–90		91–150		>150		
	n	%	n	%	n	%	n	%	n	%	
Peak daily milk yield, kg Dobowa wydajność w szczycie laktacji, kg											
– ≤30.0	10	27.1	7	18.9	4	10.8	8	21.6	8	21.6	117.3
– 30.1–40.0	44	25.1	31	17.7	36	20.6	36	20.6	28	16.0	
– 40.1–50.0	34	26.5	28	21.9	11	8.6	26	20.3	29	22.7	
– >50.0	8	18.2	3	6.8	8	18.2	13	29.5	12	27.3	
Milk yield in standard lactation, kg Wydajność w laktacji standardowej, kg											
– ≤7000	16	33.3	9	18.8	8	16.7	11	22.9	4	8.3	330.1*
– 7001–8000	20	29.0	13	18.8	19	27.7	6	8.7	11	15.9	
– 8001–9000	18	21.2	18	21.2	11	12.9	20	23.5	18	21.2	
– 9001–10000	26	27.7	13	13.8	10	10.6	27	28.7	18	19.2	
– >10000	16	18.2	16	18.2	11	12.5	19	21.6	26	29.5	
Lactation number – Kolejna laktacja											
– I	25	21.8	15	13.0	26	22.6	23	20.0	26	22.6	117.8
– II	26	27.4	16	16.8	15	15.8	21	22.1	17	17.9	
– III	19	31.7	11	18.3	4	6.7	10	16.7	16	26.6	
– >III	26	22.8	27	23.7	14	12.3	29	25.4	18	15.8	
Total – Ogółem	96	25.0	69	18.0	59	15.4	83	21.6	77	20.0	–

* test value significant at P≤0,05 – * wartość testu istotna przy P≤0,05.

The daily milk yield at peak lactation did not affect significantly the frequency of extended lactations of different length. However, the lowest daily milk yield at peak lactation (up to 30 kg of milk) was accompanied by the highest proportion (27.1%) of lactations extended by 1–30 days. In the case of peak yield above 50 kg of milk, the highest frequency (27.3%) was found for lactations extended beyond 150 days. The extension of the complete lactations with an increasing yield at peak lactation was observed in the study by Salamończyk and Guliński [2007 a]. These authors also found that the complete lactation length decreased as the number of lactation increased. The oldest age group, i.e. cows in fourth and higher lactations, milked, on average, for 25 days less compared to primiparous ones.

In the present study no simple relationship between the parity and the length of extension period was found. In heifers, the longest lactations (>150 days) and lactations extended by 61–90 days occurred most frequently (22.6% each). Cows in the second and third production season, most frequently (27.4 and 31.7%) had their lactations extended by 1–30 days. In these two groups, lactations lasting 365–395 days occurred least frequently (15.8 and 6.7%). The smallest number of such lactations (12.3%) was also found in the oldest cows. In heifers, 1–30 and 31–60-day longer lactations occurred least frequently (21.8 and 13.0%). Their proportion increased as lactation number increased. However, this relationship for animals in the fourth or later lactation existed only for 31–60-day extension of the milk production period (23.7%).

The mean number of days by which the lactations were extended was 97 days and ranged from 15 to 240 days (Table 3). Over the above-standard period of lactation, the cows produced, on average, 1579 kg of milk, which accounted for 17.3% in relation to the standard lactation. The amount of milk per day of extension was 15.9 kg. In the study by Salamończyk and Guliński [2007 a], the mean length of the extension of lactation was shorter and amounted to 82 days. At that time, cows produced 1222 kg of milk, which accounted for 19.9% in relation to the standard lactation [Salamończyk and Guliński 2007 b]. Vargas et al. [2000] reported that, during the extension of lactation beyond the standard, cows produced, on average, 2200 kg of milk, i.e. 26% of the total 305-day production.

Table 3. Milk production during extension beyond 305-day standard in relation to different length of this period
Tabela 3. Produkcja mleka w okresie przedłużenia laktacji ponad 305-dniowy standard przy różnej długości tego okresu

Lactation extension, days Przedłużenie laktacji, dni	Number of lactations Liczba laktacji	Average length of lactation extension Przeciętna liczba dni wydłużenia laktacji	Milk yield during period of lactation extension Wydajność w okresie przedłużenia laktacji		Milk yield per day of lactation extension, kg Wydajność na dzień przedłużenia laktacji, kg
			kg of milk kg mleka	% in relation to the standard lactation % w stosunku do laktacji standardowej	
1–30	96	15 [A]	219 [A]	2.5 [A]	15.1
31–60	69	43 [B]	703 [B]	8.0 [B]	16.4
61–90	59	76 [C]	1216 [C]	13.9 [C]	16.2
91–150	83	121 [D]	1869 [D]	20.6 [D]	15.5
>150	77	240 [E]	4025 [E]	43.0 [E]	16.7
Total Ogółem	384	97	1579	17.3	15.9

Means in columns marked with different letters differ significantly at $P \leq 0.01$.
Średnie w kolumnach, oznaczone różnymi literami, różnią się istotnie przy $P \leq 0,01$.

The length of the extension of milk production beyond 305-days significantly ($P \leq 0.01$) affected milk yield. Over the period extended by 1–30 days, 219 kg of milk was obtained on average, which was 2.5% in relation to the standard lactation. Extending lactation by another 30 days resulted in the 484 kg (8.0%) increase in milk production. When extending lactation by 61–90, 91–150 and >150 days, the amount of milk obtained amounted to 1216 (13.9%), 1869 (20.6%) and 4025 kg (43.0%), respectively. The similar relationships between the extension of lactation and the amount of milk obtained were indicated by Salamończyk and Guliński [2007 b]. They showed that the FCM production in five groups with lactations extended by another 60 days amounted to: 356; 1181; 2072; 2941 and 4703 kg, which accounted for 5.4–64.5%.

In the present study, no significant differences in the milk yield per day of extension between the individual groups were found. These values ranged from 15.1 kg (1–30 days) to 16.7 kg of milk for the lactation extended by more than 150 days. Winnicki and Głowicka-Wołoszyn [2007] found that the extension length did not affect the mean daily milk yield (amounting to 15.3 kg) during the above-standard period.

The milk, fat and protein yields in complete lactations were significantly affected by the length of their extension beyond the standard (Table 4). The extension of lactation exerted less influence on the milk fat and protein yields and the milk yield per day of complete lactation. As the extension of lactation increased, the amount of milk produced during the lactation and the yield of its basic constituents (fat and protein) also increased (8759 to 13 638 kg, 347 to 559 kg and 280 to 453 kg, respectively). For these traits, most differences were significant at $P \leq 0.01$. The study by Miciński [2009] showed that the unplanned extension of lactation resulted in the 50% increase in the milk yield and even 58% increase in the yield of its constituents. The negative relationship between the length of lactation and annual yield of milk and its constituents was indicated by Auldist et al. [2007]. According to these authors, the cows with 10-month lactations produced, on average, 6454 kg of milk per year. The value of this trait decreased from 6280 kg (16-month lactations) to 5775 kg (22-month lactations), and the combined fat and protein yield decreased from 497 to 495 to 463 kg, respectively.

The highest milk yield per day of complete lactation (27.4 and 27.2 kg) accompanied the lactations extended by 1–30 and 31–60 days. These values decreased with an increase in lactation length from 26.0 kg (61–90 days) to 25.7 kg (91–150 days) to 25.2 kg per day (over 150-day extension beyond the standard).

Table 4. Milk, fat and protein yield and content of basic milk constituents in complete lactations in relation to period of lactation extension beyond 305-day standard

Tabela 4. Wydajność mleka, tłuszczu i białka oraz zawartość tych składników w laktacjach pełnych w zależności od długości okresu przedłużenia laktacji ponad 305-dniowy standard

Lactation extension, days Przedłużenie laktacji, dni	Length of complete lactation, days Długość laktacji pełnej, dni	Yield, kg Wydajność, kg			Milk yield per day of lactation, kg Wydajność mleka na dzień laktacji, kg	Content in milk, % Zawartość w mleku, %	
		milk mleka	fat tłuszczu	protein białka		fat tłuszczu	protein białka
1–30	320^{A}	$8\,759^{Aa}$	347^{A}	280^{A}	27.4^{a}	3.97	3.22^{a}
31–60	348^{B}	$9\,464^{ABb}$	379^{AB}	306^{ABa}	27.2^{a}	4.03	3.24
31–90	381^{C}	$9\,912^{B}$	398^{BCa}	323^{BCb}	26.0	4.02	3.28
91–150	426^{D}	$10\,962^{C}$	442^{Cb}	350^{Cb}	25.7	4.06	3.27
>150	545^{E}	$13\,638^{D}$	559^{Dc}	453^{Dc}	25.2^{b}	4.11	3.32^{b}
Total Ogółem	402	10 517	424	341	26.3	4.04	3.27

Means in columns with different letters differ significant: capital letters at P≤0.01; small letters at P≤0.05.

Średnie w kolumnach, oznaczone różnymi literami, różnią się istotnie: małe litery przy P≤0,05; wielkie litery przy P≤0,01.

CONCLUSIONS

Summarizing the obtained results, it should be emphasized that the lactations extended beyond the 305-day standard were observed in 78.7% of the analyzed cases and the extension of up to 30 days was the most frequent (25.0%). During the period of extension beyond the 305-day standard, the cows produced 2.5–43.0% more milk compared with the standard lactation. The extension of lactation was most influenced by the milk yield during the standard lactation. It was found, however, that the extension of lactation was related to the milk yield per day of complete lactation to a little extent. The values of these traits were the highest when lactation was extended by up to 60 days.

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PRZEDŁUŻANIE LAKTACJI A WYDAJNOŚĆ MLEKA, TŁUSZCZU I BIAŁKA U KRÓW PHF ODMIANY CB

Streszczenie. W pracy analizowano wpływ dobowej wydajności mleka w szczycie laktacji, produkcyjności za 305 dni od porodu oraz kolejności wycieleń krów na częstotliwość występowania laktacji przedłużonych ponad standard. Oceniono także wpływ przedłużenia laktacji na wydajność mleka i jego skład chemiczny. Badania przeprowadzono w stadzie liczącym 220 krów phf cb. Zwierzęta utrzymywano w oborach wolnostanowiskowych i żywiono mieszankami pełnoporcjowymi TMR. Badaniami objęto 384 laktacje, wybrane spośród 488, dłuższe przynajmniej o 1 dzień od 305-dniowego standardu. Stwierdzono, że przedłużanie laktacji

ponad standard dotyczyło 78,7% analizowanych przypadków, przy czym najczęściej (25,0%) okres wydłużenia wynosił do 30 dni. Na wydłużenie laktacji w największym stopniu wpływała wydajność krów w laktacji standardowej. W okresie przedłużonych laktacji krowy produkowały o 2,5–43,0% mleka więcej w stosunku do laktacji standardowej. Wydłużenie laktacji w nieznacznym stopniu związane było z wydajnością mleka przeliczoną na 1 dzień pełnej laktacji. Wartości tej cechy najwyższe były przy przedłużaniu laktacji maksymalnie o 60 dni.

Słowa kluczowe: krowy, laktacja standardowa, produkcyjność, przedłużenie laktacji

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