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ANALYSIS OF MILK PERFORMANCE AND FERTILITY INDICES OF POLISH HOLSTEIN-FRESIAN BLACK-AND-WHITE COWS (PHF CB)

ANALIZA UŻYTKOWOŚCI MLECZNEJ I ROZRODCZEJ KRÓW RASY POLSKIEJ HOLSZTYŃSKO-FRYZYJSKIEJ ODMIANY CZARNO-BIAŁEJ (PHF CB)

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Streszczenie. Analizą objęto użytkowość mleczną oraz wybrane parametry rozrodu (wiek pierwszego wycielenia – WPW, okres międzywycieleniowy – OMW, okres międzyciążowy – OMC) 258 krów rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej (phf cb). Porównano wydajność mleczną, zawartość tłuszczu i białka (kg) oraz zawartość tłuszczu i białka (%) w mleku krów rasy phf cb w czterech kolejnych laktacjach 305-dniowych. W celu przeprowadzenia dokładniejszej oceny produkcyjności krów rzeczywistą wydajność przeliczono na wydajność mleka FCM (wydajność mleka standaryzowanego na 4% tłuszczu). Dodatkowo w badanej populacji krów przeanalizowano przebieg porodów (w skali 6-stopniowej wg PFHBiPM) w dwóch sezonach wycielenia – wiosenno-letnim i jesienno-zimowym. Najwyższą wydajnością mleka (8332 kg), w przeliczeniu na wydajność mleka FCM (9131 kg), charakteryzowały się krowy w laktacji III – 305-dniowej, natomiast najwyższą wydajnością tłuszczu (396kg) i białka (287 kg) charakteryzowały się krowy w laktacji IV – 305-dniowej. Wykazane różnice były statystycznie istotne ($P \leq 0,05$ i $P \leq 0,01$). Największą zawartość tłuszczu (4,75%) i białka (3,39%) w mleku stwierdzono w laktacji II, zaś najmniejszą zawartość tłuszczu stwierdzono w laktacji I (4,52%), a najmniejszą zawartość białka – w laktacji IV (3,25%); różnice nie były istotne. Wiek pierwszego wycielenia (822 dni), długość okresu międzywycieleniowego (438 dni) i okresu międzyciążowego (136 dni) nie mieściły się w przedziałach wartości uznawanych za korzystne. W obu badanych sezonach w analizowanym gospodarstwie znacznie więcej było porodów łatwych (niż trudnych).

Słowa kluczowe: krowy, mleczność, płodność.
Key words: cows, fertility, milk field.

INTRODUCTION

Milk is an important component of the daily diet of man, that is why breeding work is still continuing and knowledge of dairy cattle is expanded. Producers of milk and meat seek to improve productivity and increase the effectiveness of their work, but achievement higher and higher milk yield of cows carries problems about breeding, metabolic and hoofs, which cause decrease in herds. The development of biotechnology and genomics opens up new opportunities for farmers. All aspects of animal husbandry, animal welfare, housing system, appropriate nutrition and herd management should be control.

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It is not surprising, that a lot of attention is focused on PHF cows, which represent 88,64% of the total number of cows in Poland (data for 2012 source: PFHBiPM).

The aim of the study was to analyze milk performance and selected fertility indices of Polish Holstein-Fresian Black-and-White cows on a farm in West Pomerania province. In the examined population of cows were also evaluated the course of cows' parturitions including birth season was evaluated (spring-summer and autumn-winter).

MATERIAL AND METHODS

Research were carried out on the farm in West Pomerania province, set at agriculture and cows and horse husbandry. Animals were fed and kept in the same environmental conditions, in the tie stall barn, used grazing in spring and summer time. Diet composition was as follows: grass-hay silage, beetpulp, high-protein concentrates, rape seed extracted and soya middlings extracted, straw, hay, grinding grain.

Research material consisted 258 Polish Holstein-Fresian Black-and-White cows. Data relating to milk performance and selected fertility indices (age at first calving, intercalving period, calving-to-conception interval) was obtained on the basis of breeding documentation of the farm.

Milk, fat and protein yield (kg) and fat and protein content (%) in milk of PHF cows including 305-days lactation were compared based on collected data. In order to compare obtained results fat corrected milk (FCM, kg) – milk yield adjusted for 4% fat content was calculated according to the following formula (Januś and Borkowska, 2006):

$$FCM = (\%\ fat \cdot 0.15 + 0{,}4) \cdot milk\ yield\ (kg)$$

The significance of differences between mean values of milk traits were determined by Duncan's test. The material analyzed statistically using Statistica® 9 PL (StatSoft, Inc 2010). The course of cows' parturitions in analyzed farm was also tested with regard to the birth season by 6-point scale according to PFHBiPM.

Type of labour codes:

1 – independent,

2 – easy,

3 – difficult – considerably stronger assistance needed than normal,

4 – serious (surgical intervention, damage to cow or calf, embryotomy),

5 – miscarriage,

6 – cesarean.

RESULTS AND DISCUSSION

Table 1 shows performance of cows and their milk usability for four consecutive 305-days lactations. Milk yield in the analyzed farm increased until the third lactation and in the fourth lactation recorded downward trend. The lowest milk yield was observed in the first lactation (7689 kg) and the highest in the third lactation (8332 kg). Similary, FCM milk yield was the lowest in the first lactation (8267 kg) and the highest in the third (9131 kg). Significant differences ($P \leq 0{,}05$) were showed between lactations: first and third, second and third.

Table 1. Milk usability of cows in each 305-day lactation
Tabela 1. Użytkowość mleczna krów w poszczególnych 305-dniowych laktacjach

Lactation Laktacja	Number Liczebność	Statistical parameters Parametry statystyczne	Milk Mleko (kg)	FCM milk Mleko FCM (kg)	Fat Tłuszcz (kg)	Protein Białko (kg)	Fat Tłuszcz (%)	Protein Białko (%)
I	131	$\bar{x}$	7689^{a}	8267^{a}	344^{Ab}	257^{aB}	4.52	3.32
		SD	978.31	1 040.48	55.25	36.45	0.48	0.20
II	67	$\bar{x}$	8118^{b}	9017^{b}	377	274^{cd}	4.75	3.39
		SD	1218.80	1382.31	75.92	36.86	0.48	0.25
III	37	$\bar{x}$	8372^{ab}	9131^{ab}	387^{A}	282^{ac}	4.68	3.37
		SD	1489.42	1489.31	64.14	45.39	0.51	0.31
IV	23	$\bar{x}$	7977	9008	396^{b}	287^{Bd}	4.74	3.25
		SD	2246.16	2553.65	75.38	65.54	0.41	0.28
Average for all lactation Średnie dla wszystkich laktacji		$\bar{x}$	8039	8855.75	376	275	4.67	3.33

Statistically significiant difference at $P \leq 0.05$ – a,b …; $P \leq 0.01$ – A,B.
Różnice istotne przy $P \leq 0,05$ – a,b …; $P \leq 0,01$ – A,B.

According to Dorynek et al. (2002) Holstein-Fresian cattle occupies the leading position among the dairy cattle population in the world. In Borkowska's opinion the best milk performance is achieved by cows in the third and fourth lactation (Borkowska 2005). Dorynek et al. (2002) emphasized, that the condition of the mammary gland in cows next to breeding disorders are the main cause of reduction in quality of milk and its technological usefulness and has negative influence on animal performance.

Szarek (2010) has found that cows are used only for 3–4 lactations in barns in Polish breeding, which gives the culling rate of 25–30%. In the present study FCM milk yield was 8267 kg in the first lactation (Table 1) and then the systematic increase up to third lactation was observed (9131 kg). In the fourth lactation compared to third the decrease in milk yield was found. The highest fat yield in milk was observed in the fourth lactation (396 kg) and the lowest in the first lactation (344 kg). It has been shown significant differences in fat yield between first and third lactation ($P \leq 0.01$) and first and fourth ($P \leq 0.05$). The highest fat content in milk was found in second lactation (4.75%) and the lowest in first lactation (4.52%). Sitkowska et al. (2009) have obtained the highest fat content in milk of cows which age at the first calving was 26–28 months. Fat content in the third lactation was 5.09%.

Analyzing protein yield in milk the highest values was found in fourth lactation (287 kg) and the lowest in the first lactation (257 kg) (Table 1). Significant differences in protein yield occured $P \leq 0.05$ and $P \leq 0.01$. The highest protein content was found in second lactation (3.39%) and the lowest in fourth (3.25%). Sobotka et al. (1999) have received the highest protein content in milk in the third lactation (3.33%) and the lowest in the first (3.10%).

Table 2. Selected parameters of breeding in examined cows' population
Tabela 2. Wybrane parametry rozrodu w badanej populacji krów

Breeding parameters Parametry rozrodu	Liczebność Number	Statistical parameters Parametry statystyczne	Values Wartości
Age at first calving (days/months) Wiek przy pierwszym wycieleniu (dni/mies.)		$\bar{x}$	822 /27.4
		SD	79.87
CCI (days) OMC (dni)		$\bar{x}$	136
		SD	78.61
CI (days) OMW (dni)		$\bar{x}$	438
		SD	80.76

CCI – calving-to-conception interval – OMC – okres międzyciążowy.
CI – intercalving period – OMW – okres międzywycieleniowy.

Age at the first calving was 822 days (about 27 months) in the examined farm. According to Guliński et al. (2003) cows calving about 26 months of age characterized highest milk yield in the first lactation compared to cows calving above 30 months of age. Sitkowska et al. (2009) have found that the highest mil, fat and protein yield in the first lactation was characteristic for the cows calving between 26 and 30 months of age, whereas in the second and third lactations – for the cows calving between 24 and 26 months of age. Bilik (2001) on the basis of his study indicated that age at the first calving affects the first lactation but its influence on the following lactations is less important. The author has given 85 days as the optimal calving-to-conception interval. In present study (Table 2) was recorded longer calving-to-conception interval (136 days) than in Bilik's study. According to Weller et al. (1985) optimal calving-to-conception interval should be 110–130 days. Kamieniecki et al. (1994) found a significantly loger calving-to-conception interval in young cows after first calving, which shortened after fifth and sixth calving. Jankowska (2002) believes that age of cows does not matter with the lenght of calving-to-conception interval, but affects significantly on insemination index. Bogucki et al. (2006) emphasize that with a yield of cows also calving-to--conception interval is prolonged from 105 (yield up to 5000kg) to 146 days (at the highest yield exceeding 8000 kg). On the other hand, Krzyżewski et al. (2004) in cows gives more than 8000 kg of milk, which were properly fed and kept in good environmental conditions, they have received the average lenght of calving-to-conception interval about 111 days. A prolongation of calving-to-conception interval up to 160 days did not affect negatively nor the milk yield or the content of milk.

In present study (Table 2) the intercalving period in the analyzed herd was 438 days, which could proved the poor fertility of cows on that farm. Bogucki et al. (2006) were identifying the lenght of intercalving period depending on milk yield and found that it had extended from 388 days (milk yield up to 5000 kg) to 421 days (milk yield 7001–8000 kg). In the other study by Bogucki et al. (2007) the lenght of intercalving period was extended with increasing milk yield – from 369 days (milk yield up to 6000 kg) to 540 days (milk yield up to 14 000 kg). Juszczak and Hibner (2000) reported that the correct intercalving period should be within the range of 360–400 days. Its extention indicated on disturbances occurrence

in cows' fertility while its shortening reduced the effecitveness of services per conception and milk yield in current and next lactation. However, in high-yielding cows the lenght of intercalving period within the range of 360–400 days may cause difficulties in dry and appropriate preparation of cows to the next lactation (Hibner et al. 1999).

In Table 3 was showed the course of cows' parturitions depending on birth season. In spring-summer season was noted 64 births of which 59 (92%) were easy and 5 (8%) were difficult – considerably stronger assistance needed than normal. In autumn-winter season was recorded 80 births of which 2 (3%) were independent, 74 (92%) were easy and 4 (5%) were difficult – considerably stronger assistance needed than normal.

Table 3. The course of cows' parturitions including birth season
Tabela 3. Przebieg porodów krów rasy phf cb z uwzględnieniem sezonu wycielenia

Type of labour codes Kody porodów	Birth season Sezon wycielenia			
	spring-summer wiosenno-letni		autumn-winter jesienno-zimowy	
	n	%	n	%
1	–	–	2	3
2	59	92	74	92
3	5	8	4	5
4	–	–	–	–
5	–	–	–	–
6	–	–	–	–

Przysucha and Grodzki (2007) believed that the course of cows' parturitions is a complex trait conditioned by different groups of factors. Cows predisposition for easy parturition are connected with its weight and body composition and hormonal mechanisms which are responsible for among others the ability of cow to make an effort during parturition.

According to Wójcik (2003) body weight of newborn calves may have affected on easy of parutritions. Chociłowicz et al. (2010) were analyzing the course of cows' parturitions depending on the sex and body weight of calf after birth. The authors found that both groups of cows imported from Germany and Sweden were only easy parturitions (forces of nature, without the intervention of veterinarian) – 100%. Czerniawska-Piątkowska (2008) was conducting research on PHF cows and found that easy parturitions represented 83% of all parturitons and the majority of cows were calving without human help 49%.

On the grounds of this paper (Table 3) was found that 100% of parturitions were independent, easy or difficult – considerably stronger assistance needed than normal in both birth season. Cows' parturitions have taken place without the intervention of veterinarian, which is confirmed in the research of cited authors.

CONCLUSIONS

The highest milk yield (8332 kg) and FCM milk (9131 kg) were characterized by cows in third 305-day lactation and the highest fat (396 kg) and protein (287 kg) yield were obtained in fourth 305-day lactation. The differences were significant ($P \leq 0.05$, $P \leq 0.01$). The highest

fat (4.75%) and protein (3.39%) content were found in the second lactation, and the lowest in the first for fat (4.52%) and in the fourth for protein (3.25%). Age at first calving (822 days), intercalving period (438 days) and calving-to-conception interval (136 days) did not within the range considered to be beneficial. In both analyzed births season cows characterized siginificant advantage of easy parturitions over difficult.

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Abstract. The analysis included milk performance and selected fertility indices of 258 Polish Holstein-Fresian Black-and-White cows were analyzed (age at first calving, intercalving period – CI, calving-to-conception interval – CCI). Milk yield, fat and protein (kg) and fat and protein content (%) in milk of PHF cows including four consecutive 305-days lactation were compared. In order to compare obtained results fat corrected milk (FCM, kg) was calculated. The course of cows' parturitions in analyzed farm was also tested with regard to the birth season (6-point scale according to PFHBiPM). The highest milk yield (8332 kg), calculated as FCM milk (9131 kg) were characterized by cows in third 305-day lactation and the highest fat (396kg) and protein (287kg) yield were obtained in fourth 305-day lactation. The differences were significant ($P \leq 0.05$; $P \leq 0.01$). The highest fat (4.75%) and protein (3.39%) content were found in the second lactation, and the lowest in the first for fat (4.52%) and in the fourth for protein (3.25%), the differences were not significant. Age at first calving (822 days), intercalving period (438 days) and calving-to-conception interval (136 days) did not within the range considered to be beneficial. In both analyzed births season cows characterized siginificant advantage of easy parturitions over difficult.