

## COMPARISON OF MILK PRODUCTION BETWEEN BLACK-AND-WHITE HOLSTEIN-FRIESIAN COWS IMPORTED FROM SWEDEN AND DOMESTIC PEERS

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**Abstract.** The aim of the study was to compare the milk performance, age of first calving and inter-calving interval in Holstein-Friesian black and whites imported from Sweden with domestic cows of the same breed. We also evaluated the process of birth of tested animals and body weight of newborn calves. Domestic cows were more productive and obtained better PFC (the difference between fat and protein content) and PFR values (protein to fat ratio) in both lactations. In the first lactation, animals from Poland were characterized by better average milk yield and average protein content whereas imported cows produced higher milk yields with higher fat content ( $P \leq 0.01$ ). In the second lactation Polish cattle achieved better results in terms of average yield of proteins and fat as well as protein and fat content when compared to Swedish cows ( $P \leq 0.01$  and  $P \leq 0.05$ , respectively). Heifers imported from Sweden were younger at first calving ( $P \leq 0.01$ ) and required longer inter-calving intervals. Regardless of country of origin, births were not problematic, without any complications, and calves were of similar weight.

**Key words:** calves, HF import, milk yield

### INTRODUCTION

In recent years, an increase in the production potential of dairy cattle has been observed. This results from the improvement of cattle farming conditions (ma-

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inly feeding), and genetic progress, which undoubtedly was influenced by import of semen and breeding material from countries such as France, Germany, the Netherlands and Denmark [Kuczaj 2004, Czerniawska-Piątkowska and Szewczuk 2006, Barański et al. 2008, Czerniawska-Piątkowska et al. 2009, Czubska et al. 2009, Chociłowicz et al. 2010].

In Poland, Holstein-Friesian breed has been used for many years to improve the national dairy cattle population. According to many authors, this is a long process, and the results are visible after few years [Kuczaj 2004, Pilarczyk et al. 2004, Skrzypek et al. 2005, Kamieniecki et al. 2008]. A quick way to improve the situation is to import Holstein-Friesian heifers with high genetic potential. This way, better cow performance can be achieved in shorter time, and slightly higher expenditures, but high quality feeding and maintaining conditions need to be ensured [Czerniawska-Piątkowska and Szewczuk, 2006, Gnyp et al. 2006, Skrzypek and Szukalski 2006, Chociłowicz et al. 2010]. Studies have shown that imported animals, kept in our conditions, demonstrate significantly higher milk yield than domestic cows with similar genotypes [Wroński et al. 2001, Czerniawska-Piątkowska and Szewczuk 2006, Skrzypek and Szukalski 2006].

Aim of this work was to compare the productivity of black and white Holstein-Friesian breed imported from Sweden to our domestic cows of the same breed. Selected breeding parameters, births and body weight of newborn calves were also assessed in the animals studied.

## MATERIAL AND METHODS

Experimental material consisted of two groups of animals: 144 Polish Holstein-Friesian cows, black and white domestic variety (PHF cb), and 74 Holstein-Friesian cows imported from Sweden (HF), held in one of the barns in Western Pomerania. Observations were carried out in 2009–2011. The study encompassed heifers and cows, and lasted two 305-day lactations.

Purchased pregnant heifers were transported from Sweden in double-decker trucks adapted for the cattle transport, in accordance with the Regulation of the Minister of Infrastructure dated 6 October 2003 (Journal of Laws of 2003. 185. 1809) on the detailed conditions and means of livestock transport. Heifers underwent quarantine, and subsequently were kept in an intensive system in free stalls on deep litter with access to the feed. A complete, year-round Total Mixed Ration (TMR) feeding system was used and cows had continuous access to water from automatic drinkers. Milking took place twice a day in the milking parlor, “side by side”, using the ALPRO system.

Data on milk yields and selected breeding parameters (first calving age, FCA, inter-calving interval, ICI) were obtained from the farm breeding documentation

(heifers – cows cards, tables – A4 assessment method). In order to describe the productivity of the two groups of cows evaluated in this study, a comparison of milk performance has been made in both 305-day lactations. We have evaluated milk, fat and protein yields (kg), the percentage of protein and fat, and FCM yield (milk yield with 4% fat content). We have also determined the relationship between these components (PFC% – the difference between the fat and protein content, PFR – the ratio of protein to fat).

Data were analyzed statistically using the StatSoft Inc. software package STATISTICA ver. 10.0 PL, the mean values and standard error (S) for each trait are provided. Statistical significance between mean values for the evaluated traits was calculated using Student's *t*-test.

## RESULTS AND DISCUSSION

Table 1 presents the values of the milk performance traits of phf and Swedish hf cows, in the first and second 305-day lactation.

In both the first and the second lactation, domestic cows had higher milk yields than the imported Swedish cows of the same age (7946.1 kg and 7726.0 kg, 9345.9 kg, and 8199.3 kg, respectively). However, the differences were statistically significant only in the second lactation ( $P \leq 0.01$ ).

In first lactation, domestic cows surpassed imported cows in terms of the average milk (about 220.1 kg) and protein yield (9.76 kg), and the average protein content (0.02%). The FCM milk yield was also favorable for domestic cows (39.7 kg) when compared with imported ones.

Kamieniecki et al. [2008], when comparing the milk productivity of imported heifers from the Netherlands and Sweden, have found that cows coming from Sweden produced a lower milk yield, FCM, protein yield and protein content in milk. In addition, imported cows from Sweden showed a lower milk yield by 198.94 kg, lower protein yield by 12.86 kg, and lower protein content by 0.08% as compared to the imported heifers analyzed in this study (Table 1).

In a study conducted by Czerniawska-Piątkowska et al. [2008], a higher milk yield was found in domestic cows in the first 305-day lactation when compared to cows imported from Germany. Milk yield (8463 kg), protein yield (283 kg) and protein content (3.37%) in Polish cows from the latter study were higher by 516.92 kg, 20.78 kg and 0.07%, respectively, than the values achieved by the local cows in our study (Table 1).

A comparison of the productivity of HF cows imported from Sweden and Germany by Chociłowicz et al. [2010] indicated a higher average milk yield of Swedish cows compared to German cows of the same age. German cows productivity results were significantly better ( $P \leq 0.01$  and  $P \leq 0.05$ ) in terms of average

fat yield, and protein and fat content in milk. In the studies of above-mentioned authors, cows imported from Sweden were characterized by greater efficiency of milk yield (7822.5 kg) in the first lactation compared to the productivity of heifers of the same origin analyzed in this study (7725.4 kg).

Table 1. The milk performance in the first and second lactation of cows imported from Sweden

Tabela 1. Użytkowość mleczna w I i II laktacji krów krajowych z importowanymi ze Szwecji

Trait – Cecha	Polish cows Krowy polskie n = 144		Imported cows Krowy importowane n = 74		Difference Różnica $\bar{x}_S - \bar{x}_N$
	$\bar{x}_S$	SD	$\bar{x}_N$	SD	
Lactation I – Laktacja I					
Milk, kg – Mleko, kg	7946.10	111.21	7726.00	93.42	220.10
Fat, kg – Tłuszcz, kg	298.71	4.31	300.99	3.99	-2.28
Protein, kg – Białko, kg	262.22 <sup>A</sup>	3.70	252.46 <sup>A</sup>	2.93	9.76
Fat, % – Tłuszcz, %	3.77 <sup>A</sup>	0.03	3.92 <sup>A</sup>	0.04	-0.15
Protein, % – Białko, %	3.30	0.02	3.28	0.02	0.02
FCM, kg – FCM, kg	7659.11	105.82	7619.41	90.18	39.70
PFC, % – RTB, %	0.47 <sup>A</sup>	0.02	0.64 <sup>A</sup>	0.04	-0.17
PFR – SBT	0.88 <sup>A</sup>	0.01	0.84 <sup>A</sup>	0.02	0.04
Lactation II – Laktacja II					
Milk, kg – Mleko, kg	93445.90 <sup>A</sup>	136.01	8199 <sup>A</sup>	107.90	1146.60
Fat, kg – Tłuszcz, kg	350.05 <sup>A</sup>	6.03	328.41 <sup>A</sup>	5.70	21.64
Protein, kg – Białko, kg	308.44	4.39	265.11	4.20	43.33
Fat, % – Tłuszcz, %	3.99 <sup>a</sup>	0.04	3.87 <sup>a</sup>	0.04	0.12
Protein, % – Białko, %	3.31 <sup>A</sup>	0.01	3.23 <sup>A</sup>	0.03	0.08
FCM, kg – FCM, kg	9146.73 <sup>A</sup>	136.34	8180.57 <sup>A</sup>	115.21	966.16
PFC, % – RTB, %	0.56 <sup>A</sup>	0.034	0.76 <sup>A</sup>	0.03	-0.2
PFR – SBT	0.87 <sup>A</sup>	0.01	0.81 <sup>A</sup>	0.06	0.06

A, B – statistically significant differences at  $P \leq 0.01$ ; A, B – różnica istotna na poziomie  $P \leq 0,01$ .

a, b – statistically significant differences at  $P \leq 0.05$ ; a, b – różnica istotna na poziomie  $P \leq 0,05$ .

Heifers imported as calves from many European countries not always achieved satisfactory productivity results in the first lactation. Often they were inferior in terms of performance and milk composition when compared to domestic cows [Gnyp et al. 2006, Czerniawska-Piątkowska 2008, Kamieniecki et al. 2008].

In other studies in this area, Pilarczyk [2004], Skrzypek and Szukalski [2006] found that the import of Danish Holstein cows is justified when the animals are provided with optimal environmental conditions. We believe that genotype in conjunction with environment can have a significant impact on the productivity of imported animals.

In our study (Table 1), the analyzed group of cows imported from Sweden was characterized by greater milk fat yield (by 2.28 kg), and the average fat content (by

15%) in the first lactation than domestic cows. These differences were confirmed statistically ( $P \leq 0.01$ ).

In the first lactation protein-fat ratio (PFR) was 0.88 and was better in domestic cows (by 0.04), while the percentage difference between the fat and protein content (PFC) was 0.47% and was higher in imported cows (by 0.17%). Similar results favoring domestic cows (by 0.06) were reported for protein-fat ratio (PFR) in the second lactation. Imported cows demonstrated slightly higher percentage of the difference between fat and protein content (0.76% PFC) in milk. In both of these characteristics, statistically significant differences were recorded ( $P \leq 0.01$ ).

Similar results were also obtained by Czerniawska-Piątkowska et al. [2009]. These authors observed more favorable protein-fat ratio (PFR) in domestic cattle (0.90) in comparison to imported cows (0.87). However, the percentage difference between the fat and the protein (PFC) was greater in imported cows (0.54%) when compared with domestic ones (0.48%).

In the second lactation, the highest milk yield (9345.9 kg), with the highest fat (350.05 kg) and protein content (308.44 kg) was reached by PHF cb cows. Milk of Polish cows compared to imported animals also had a higher fat (328.41 kg) and protein yield 43.33 kg. Within these analyzed traits, the differences were statistically significant.

A comparison of the heifers in the first 305-day lactation and cows in the second lactation revealed that the first group produced lower yields of milk, fat and protein, and protein-fat content in relation to the other group of animals. Similar opinions were presented by Sawa et al. [2004] who found that heifers had worse parameters of protein and fat content in milk than cows in later lactation. According to Barłowska et al. [2005], the longer lactation lasts, regardless of breed, the higher fat concentration in milk.

The primary factor affecting the economics of milk production in dairy herds is fertility. In the large groups of animals with high milk production it is important to obtain good results in the reproduction, which is not straightforward and depends on many factors [Bogucki et al. 2007]. There were numerous studies carried out in Poland on the relationship between increasing milk productivity and declining fertility of cows [Nogalski 2006, Bogucki et al. 2007, Nałęcz-Tarwacka et al. 2011]. The influence of the level of cows' productivity on fertility parameters were also analyzed, taking into account the maintenance system. The study by Nogalski [2006] showed a significant interaction between the maintenance system and productivity in relation to characteristics that determine fertility. In tie stall barns, with increasing productivity, fertility parameters deteriorated, and the cows kept in the free stall system showed no significant relationship between productivity and fertility.

In many cases it was found that the main cause of culling cows from the herd is sterility and disturbances in the function of reproductive system [Sawa and Maciejewski 2000, Bogucki et al. 2007, Czerniawska-Piątkowska 2008].

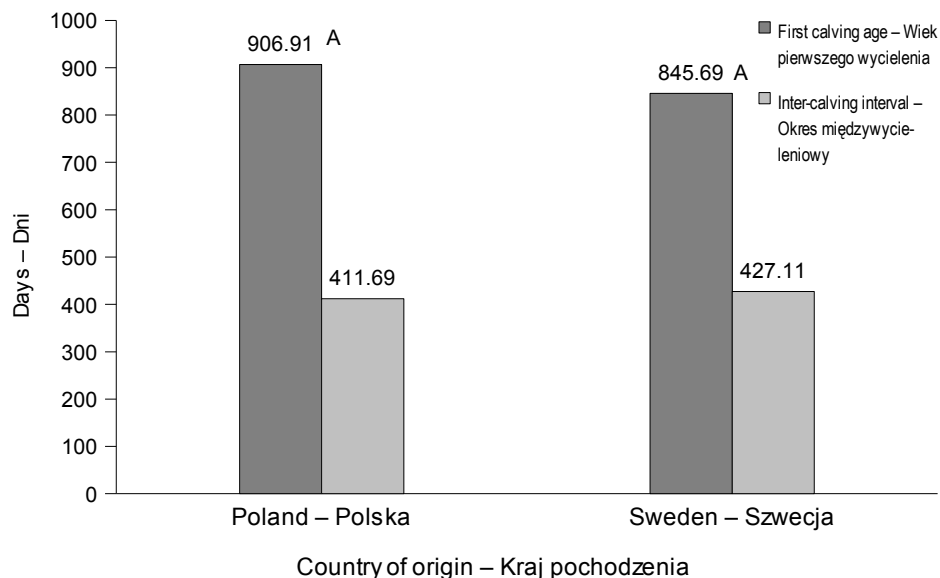


Fig.1. Some fertility parameters of domestic cows and imported from Sweden (A, B – statistically significant differences at  $P \leq 0.01$ )

Rys. 1. Wybrane wskaźniki płodności krów krajowych i importowanych ze Szwecji (A, B – różnica istotna na poziomie  $P \leq 0,01$ )

According to Guliński et al. [2003], age at first calving is one of the main indicators of reproductive performance of cows. In the present study, it was observed that the imported cows from Sweden calved earlier (by 61.22 days, in total 845.69 days) compared with the same age domestic animals (906.91 days) (Fig. 1). In both of these characteristics, statistically significant differences were noted ( $P \leq 0.01$ ). According to Ettema and Santos [2004] and Ruiz-Sánchez et al. [2007] the best age for first calving for HF breed is at 23-24 months, due to the positive effect on milk yield in the first lactation. In the study by Guliński et al. [2003] cows with high proportion of hf blood, calving till the 26 months of age, during the first lactation produced higher milk yields compared to cows that calved after 30 months of age. Most favorable in economic terms, according to Nałęcz-Tarwacka and others [2011] is mating heifers for calving to occur till 27 months of age because best milk, fat and protein production is achieved from such animals, calculated per one day of life. Pérez-Cabal and Alenda [2002] reported first calving in heifers of hf breed to be 28 months (approximately 850 days). The

results obtained by these authors were similar to those obtained in our study in the cows imported from Sweden. In other studies Czerniawska-Piątkowska and Szewczuk [2006], stated that the first calving age (FCA) for cows of domestic origin was 912 days and was extended by 5.09 days compared to FCA of Polish cows in our study (Fig. 1).

A comparison of the average inter-calving intervals (ICI) of domestic cows and animals imported from Sweden showed that local cows had shorter ICI by 15.42 days. However, no significant statistical differences were found in these traits (Fig. 1).

According to Wierzbowski and Żukowski [2007], ICI in cattle should last about 365 days while Juszcak and Hibnera [2000], and Sawa et al. [2007] claim that ICI in HF breed should be in the range from 360 to 400 days. In our study, we found that both domestic animals and cows imported from Sweden (Fig. 1) deviated from this model as local cows' ICI was 411.69 days while in imported cows it lasted 427.11 days. Similar ICI values of imported cows were found in Januś and Borkowska study [2006] (ICI – 424 days) and Dymnicki et al. [2003], in which the average length of ICI in heifers was 417 days and 423 days in older cows, with productivity of more than 7000 kg of milk during lactation.

Since the milk yield of cows in many countries (USA, UK) has increased significantly to the point where serious and frequent problems with animal health and the effective fertilization began to occur, 12 or 13-month ICI was started to be withdrawn. Extension of this parameter according to Wierzbowski and Żukowski [2007] helps to reduce the physiological competition between milk yield, fertility, as well as to increase the longevity of the best animals. Hibner et al. claim that extending the cows ICI enables [1999] better use of the production capacity over extended periods of lactation in high-performing cows. Whereas, research carried out by Sawa et al. [2007] demonstrated that the cows, which first ICI is longer than 490 days showed reduced fertility, and highest culling rate because of sterility.

Both domestic and imported cows calved without any problems, births were easy without the intervention of a veterinarian (100%), which indicate high welfare of cows, proper structure of the genital tracts, and well-functioning hormonal mechanisms that stimulate the independent birth [Przysucha and Grodzki 2007]. In the study by Chociłowicz et al. [2010] in the group of cows imported from Germany and Sweden only easy births (without human assistance or with a little help from one person) were reported. Czerniawska-Piątkowska et al. [2009] observed that the number of easy births with the help of one person, and difficult ones where more than one person was assisting was similar in animals imported from Germany and in domestic cows. An ease of the birth is influenced by many factors, including weight of calves being born [Wójcik 2006].

There were no significant differences noted in the body weight of newborn calves (Fig. 2). Calves of cows imported from Sweden (37.96 kg) were heavier by 0.32 kg than domestic cows (37.64 kg).

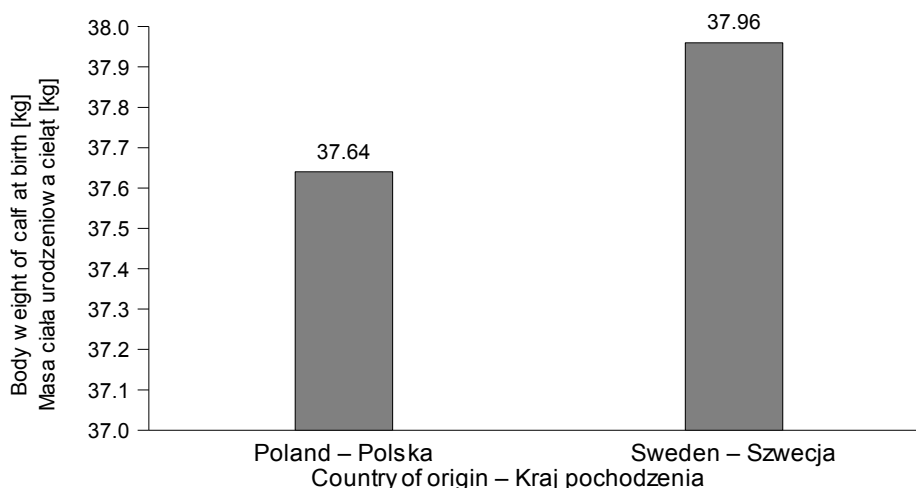


Fig.2. Body weight of calf at birth

Rys. 2. Masa ciała urodzeniowa cieląt

Body weight of calves depends also on gender and type of birth. Most newborn bulls are heavier than female calves as are the single calves than twins. Wójcik [2006] found a large range in body weight of calves being born from the cows of PHF breed black and white variety, in the range of 22–62 kg for a single calf and 24–35 kg for twins.

## CONCLUSIONS

Domestic cows showed greater milk yield and obtained better PFC (%) and PFR values in both lactations compared to the cows of the same age, imported from Sweden. In the first lactation, domestic animals were characterized by better average milk yield and average protein content whereas imported cows produced higher milk yields with higher fat content ( $P \leq 0.01$ ). In the second lactation Polish cattle achieved better results in terms of average yield of protein and fat as well as protein and fat content in comparison to Swedish cows ( $P \leq 0.01$  and  $P \leq 0.05$ , respectively). Heifers imported from Sweden were younger at first calving ( $P \leq 0.01$ ) and required longer inter-calving interval when compared to Polish heifers. Regardless of country of origin, births were not problematic, without any complications, and calves were of similar weight. In summary, the im-



port of animals from the European Union is desirable, provided that the animals will have the optimal maintenance conditions, balanced feed, which would give the opportunity to reveal a full genetic potential of these imported animals.

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### **PORÓWNANIE UŻYTKOWOŚCI MLECZNEJ KRÓW RASY HOLSZTYŃSKO-FRYZYJSKIEJ ODMIANY CZARNO-BIAŁEJ IMPORTOWANYCH ZE SZWECJI Z RÓWIEŚNICAMI KRAJOWYMI**

**Streszczenie.** Celem badań było porównanie użytkowości mlecznej oraz wieku pierwszego wycielenia i długości okresu międzywycieleniowego krów rasy holsztyńsko-fryzyjskiej odmiany czarno-białej importowanych ze Szwecji z rówieśnicami krajowymi. Ocenie poddano także przebieg porodu badanych zwierząt i masę ciała nowo narodzonych cieląt. Krowy krajowe osiągnęły większą wydajność mleka i uzyskały korzystniejsze wartości RTB (różnica między zawartością tłuszczu i białka) i SBT (stosunek zawartości białka do tłuszczu) w obu laktacjach. W I laktacji zwierzęta z Polski cechowały się lepszymi wynikami pod względem średniej wydajności i zawartości białka, natomiast korzystniejszą wydajnością i zawartością tłuszczu w mleku odznaczały się krowy importowane ( $P \leq 0,01$ ). W II laktacji krowy polskie osiągnęły lepsze wyniki pod względem średniej wydajności białka i tłuszczu oraz zawartości białka i tłuszczu od krów szwedzkich ( $P \leq 0,01$  i  $P \leq 0,05$ ). Pierwiastki importowane ze Szwecji charakteryzowały się wcześniejszym wiekiem I wycielenia ( $P \leq 0,01$ ) i dłuższym okresem międzywycieleniowym. Niezależnie od kraju pochodzenia porody były łatwe, bez komplikacji, a masy ciała cieląt zbliżone.

**Słowa kluczowe:** cielęta, hf import, wydajność mleczna

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