

Influence of the breed and country of origin on milk performance of primiparous cows

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Abstract: *Influence of the breed and country of origin on milk performance of primiparous cows.* The aim of the study was comparison of the milk performance of primiparous cows from six European countries with Polish Holstein-Friesians, as well as to demonstrate the differences within the different genetic groups. Material consisted of data contained in the dairy reports gathered from 26 farm “Healthy Cow” project. The analysis involved data including milk yield and its chemical composition, i.e.: fat, protein, lactose, solids, and urea somatic cells count in milk. On the basis of these results, it was found that the country of origin had significant impact on daily milk yield, percentage of fat, percentage of protein, percentage of lactose and also affected dry matter content, urea and somatic cells in the milk of lactating cows. Research revealed that there were not differences in milk performance between imported and native cows. However, the breed of cows had a strong impact on daily milk production, percentage of protein, percentage of lactose, percentage of dry weight, as well as urea content and somatic cells count.

Key words: primiparous cow, breed, milk components, country of origin

INTRODUCTION

Import of breeding material from western countries had a significant impact on the

genetic improvement on population of Polish Holstein-Friesian cows (Barański et al. 2008, Czubska et al. 2009). The main advantages of the import of breeding material to Poland were improvement of the milk production and chemical composition as well as correction of cow body conformation (e.g. udder and feet). However, analysis conducted by other authors haven't clearly confirmed if imported animals characterized by better milk performance than native ones (Barański et al. 2008, Czubska et al. 2009). This is due to genetic-environment interaction, as well as multi-environmental factors that have stronger than genetic effect on cow productivity (Sender et al. 1987, Dorynek and Kliks 1998, Litwińczuk et al. 2000, Matras et al. 2000, Sawa et al. 2000, Nałęcz-Tarwacka et al. 2002). As the main factor affecting the dairy performance of cows is the environment, to take full advantage of breeding value of cow in terms of production and health, genotype on the animal should be match with specific environmental conditions. On the other hand, the breed of cattle is known to have a huge impact on the composition of

milk. The most valuable breeds for cheese producing plants are: Polish Red, Simmental, Montbeliarde and Brown Swiss (Barłowska et al. 2014, Malchiodi et al. 2014). Those breeds do not impress with quantity of produced milk, but in terms of the milk composition outperformed other popular breeds in Poland. The raw material obtained from these breeds had significant higher protein content in milk, particularly kappa casein fractions, which is very valuable for cheese production. Despite the obvious advantages of such milk its production is marginal in Poland due to the relatively small population of these breeds (Choroszy 1997).

Many authors (Sablik et al. 2001, Czaplicka et al. 2002, Czaplicka et al. 2003, Puchajda et al. 2003, Bogucki et al. 2009, Cichołowicz et al. 2010) dealt with the comparison of milk performance of native and imported cows. However, those researches hasn't clearly confirmed that imported heifers performed better than Polish ones. So it seems advisable to compare the milk performance of imported cows, with native ones in similar environmental conditions.

The aim of the study was therefore confrontation milk recording data of cows originated from six European countries and Poland and demonstrate the differences within the different breeds.

MATERIAL AND METHODS

The study was conducted on 26 farms, involved in "Healthy Cow". This project was initiated by the Dairy Cooperative "Spomlek" located in Radzyn Podlaski in 2011. The main objective of the program is to improve the health of animals, upgrade breeders skill, introduce the

latest research results in the field of dairy farming and the economics into milk production. The "Healthy Cow" program cooperatives were: Veterinary Institute in Pulawy Polish Research Institute; Warsaw University of Life Sciences – SGGW, Department of Animal Sciences and the Polish Federation of Dairy Cattle Breeders and Producers.

Research material consisted of data contained in dairy reports (RW-2) prepared by the Polish Federation of Dairy Cattle Breeders and Producers. The reports were gathered from 26 farms and totally involved 12,357 observations. In the statistical analysis following variables were studied: milk yield and the content of the milk: fat, protein, lactose, solids, urea and somatic cells.

The analyzed factors were:

- the effect of the country of origin of animals on the results of milk performance as well the differences between particular countries;
- the effect of the country of origin of animals on the level of urea and somatic cell count in milk;
- the effect of the breed on the milk performance results;
- the effect of breed on the level of urea, and the number of somatic cells.

Statistical analysis was performed with IBM SPSS 21 (2013) software by the following GLM model (differences between means were estimated with the F test):

$$Y = \mu + KP_i + KPI_j + R_k + e_{ijk}$$

where:

- μ – average general;
- KP_i – country of origine (Austria, the Czech Republic, Denmark, Germany, France, the Netherlands, Poland);

- KPI_j – imported, native;
 R_k – breed: Brown Swiss (BS), Back and White variety of Holstein-Friesian (HO), Red and White variety of Holstein-Friesian (RW), Norwegian Red (NR), Simental (SM);
 e_{ijk} – random error.

RESULTS AND DISCUSSION

Table 1 presents the effect of country of origin of the heifers on the milk performance. Heifers originated from six European countries including: Austria, the Czech Republic, Denmark, Germany, France, the Netherlands and Poland. As a result of analysis highly significant ($p \leq 0.01$) the influence of heifers origin on their milk yield, and the percentage content of fat, protein and lactose was observed. The highest performance characterized by animals from France, which produced an average of 27.03 kg of milk a day. The lowest yield was reported in heifers originating from the Netherlands, which produced 18.29 kg milk daily. Moreover, results revealed that imported animals generally produced more milk than native, except for heifers brought from the Netherlands (Table 1). Different results were obtained by Gnyp et al. (2006), who in his study found the highest dairy performance in animals imported from the Netherlands, and the lowest in French ones. Other results reported by Skrzypek and Szukalski (2006), confirmed the superiority of cows imported from Germany in terms of milk yield (21.25 kg/day) compared with Polish ones (21 kg/day) at the same age. In the study of Czaplicka et al. (2013) yield of cows imported from France was

at 14.43 kg of milk a day, in contrast to Polish Holstein-Friesian which produced only 12.92 kg of milk a day. On the other hand, according to Czarniawska-Piątkowska (2009), imported cows had lower milk yields than Polish cows domestic (native – 27.75 kg/day, imported – 27.54 kg/day). Similarly, in the study of Kuczaj (2004) heifers imported from the Netherlands, characterized by a lower productivity of milk (9.10 kg/day) than Polish HO and RW (12.02 and 11.7 kg/day, respectively). Also Gnyp et al. (2001) found higher milk yield (18.77 kg/day) of native cows compared with cows imported from Germany (14.54 kg milk yield). Similar results were reported by Antkowiak and Kliks (1998) and Zdziarski et al. (2002).

Milk with the highest fat content derived from animals imported from the Netherlands (average 4.36%). Similar to Gnyp (2012), the obtained results confirmed the highest content of fat in heifer originated from the Netherlands. However, the highest protein content was found in milk of German cows (an average of 3.66%), and the highest content of lactose in milk of animals from France (an average of 4.95%). There was a significant influence on the country of origin of heifers on dry matter content in milk (Table 1). The dry matter content was the highest in milk of cows imported from France, and was 12.94% on average.

The average fat content of milk from imported cows in the study was 4.09%. Comparing it with the average fat content of Polish population of HO reported by Polish Federation of Dairy Cattle Breeder and Producer in 2013, it was found that native cows have a higher fat content in milk (4.16%) compared to the

TABLE 1. The influence of country origin of primiparous cows on milk components

Specification	N	Milk (kg)		Fat (%)		Protein (%)		Lactose (%)		Dry matter (%)		Urea content (mg/l)		Somatic cells count (10 ³ /l)	
		LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE
Austria	128	23.61	0.84	4.13	0.10	3.52	0.05	4.94	0.027	13.31	0.139	126.58	74.18	214.33	9.37
Czech Republic	224	24.09	0.47	3.95	0.06	3.29	0.03	4.83	0.015	12.77	0.077	315.83	70.24	200.43	5.20
Denmark	2112	24.06	0.34	3.96	0.04	3.40	0.02	4.89	0.011	12.94	0.056	237.57	51.09	211.26	3.78
Germany	71	25.49	0.75	4.18	0.09	3.67	0.05	4.77	0.024	13.40	0.123	373.08	112.54	206.04	8.33
France	231	27.03	0.47	3.92	0.06	3.43	0.03	4.95	0.015	12.94	0.078	116.79	71.36	172.58	5.28
Netherlands	72	18.29	0.87	4.36	0.11	3.49	0.06	4.79	0.028	13.30	0.143	654.37	130.522	195.92	9.66
Poland	9099	19.88	0.22	4.15	0.02	3.44	0.01	4.84	0.007	13.12	0.037	310.14	34.11	177.91	2.52
Average value		21.72	0.16	4.09	0.02	3.44	0.01	4.86	0.005	13.09	0.028	283.13	25.10	191.01	1.85
Significance of the effect		P ≤ 0.01		P ≤ 0.01		P ≤ 0.01		P ≤ 0.01		P ≤ 0.05		P ≤ 0.01		P ≤ 0.01	

imported ones. Similar observations was made by Gnyp et al. (2001). Mentioned above authors also confirmed higher fat content (4.16%) in Polish HO cows compared with cows imported from Germany (4.02%). Nevertheless, the papers published by Dymnicki and Reklewski (1999) and Czerniawska-Piątkowska (2009) revealed different results. These authors of these publications stated that imported cows were characterized by higher content of fat than cow native ones (4 vs. 3.82%, respectively). Our study revealed that, cows imported from Austria, Germany, Denmark and the Netherlands had an average fat content of the milk in the range of 4.0–4.9% of fat and cows from the Czech Republic and France range of 3.0–3.9% of fat. It is worth mentioning, that German cows characterized by the highest maximum level of fat in milk at range of 5.0–5.9% all analyzed cows. The studies presented by Dymnicki and Reklewski (1999) and Czerniawska-Piątkowska (2009) indicated a similar to our study percentage of fat in milk of German cows. The results of Czaplicka et al. (2013) observed comparable to those obtained in the study percentage fat content in milk of cows imported from France (4.28%).

The average concentration of protein in milk in our study was 3.44%. Other authors (Dymnicki and Reklewski 1999, Czaplicka et al. 2013) observed a similar protein content in milk of cows imported from France and Germany, the Polish HO cows and the same age in (3.38, 3.19%, respectively). However, different results were obtained by Czerniawska-Piątkowska (2009) in her research on comparison of production traits of Holstein-Friesian cows imported from

Germany and their Polish contemporaries. Mentioned author observed a higher protein content in milk of Polish cows (3.34%) compared to imported ones (3.37%). Dymnicki and Reklewski (1999) and Czaplicka et al. (2013) found that cows imported from France and Germany, produced similar to observed in the study, concentration of milk protein. In studies of Cichołowicz et al. (2010) Holstein-Friesian cows imported from Germany were superior for protein content (3.37%) if compared to cows originated from Sweden (3.28% protein).

Our study also revealed that the country of cow origin, had significant effect ($p \leq 0.01$) on the content of urea and somatic cells in milk (Table 1). The highest average content of urea in milk characterized by animals from the Netherlands (654.37 mg/l) and the lowest, the heifers imported from France (116.79 mg/l). Animals carried from Austria were characterized by the highest average milk somatic cell count, which amounted to $214.33 \cdot 10^3/l$, while the lowest average somatic cell count was observed in animal from France – $172.58 \cdot 10^3/l$. In studies of Czaplicka et al. (2013) found that the heifers imported from France had higher levels of SCC in milk ($248 \cdot 10^3/l$) than their contemporaries from Poland.

Table 2 presents the comparison of the milk performance of imported and native cows. There was no statistically significant differences between those two groups. However, it is worth noting, that the imported animals clearly characterized by higher daily milk production (23.89 kg) if compared to the Polish contemporaries (19.88 kg). The chemical composition of milk in both groups is similar. Nevertheless, imported animals

TABLE 2. The influence of primiparous cows breed on milk components

Specification	N	Milk (kg)		Fat (%)		Protein (%)		Lactose (%)		Dry matter (%)		Urea content (mg/l)		Somatic cells count (10 ³ /l)	
		LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE
Brown Swiss	73	24.48	1.09	4.04	0.13	3.57	0.07	4.97	0.03	13.30	0.17	163.39	66.15	226.04	12.10
Black and White Holstein-Friesian	10786	23.77	0.18	4.05	0.02	3.43	0.01	4.84	0.01	13.02	0.03	338.44	26.98	192.42	1.99
Red and White Holstein-Friesian	431	21.25	0.44	4.15	0.05	3.38	0.03	4.91	0.01	13.12	0.07	188.63	66.45	196.21	4.92
Norwegian Red	517	20.41	0.48	4.11	0.06	3.50	0.03	4.79	0.01	13.12	0.07	233.34	72.35	185.23	5.35
Simmental	130	18.02	0.60	4.31	0.07	3.51	0.04	4.99	0.02	13.45	0.10	112.91	90.78	202.78	6.72
Average value		21.72	0.16	4.09	0.02	3.44	0.01	4.86	0.01	13.09	0.02	283.13	25.10	191.01	1.85
Significance of the effect		P ≤ 0.01		NS		P ≤ 0.01		P ≤ 0.01		P ≤ 0.05		P ≤ 0.01		P ≤ 0.05	

NS – non-significant.

TABLE 3. Milk performance of imported and native primiparous cows

Specification	N	Milk (kg)		Fat (%)		Protein (%)		Lactose (%)		Dry matter (%)		Urea content (mg/l)		Somatic cells count ($10^3/l$)	
		LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE
Imported primiparous cows	2838	23.89	0.24	4.03	0.03	3.44	0.01	4.88	0.01	13.04	0.04	251.13	37.08	206.53	2.74
Native primiparous cows	9099	19.88	0.22	4.15	0.02	3.44	0.01	4.84	0.01	13.12	0.03	310.14	34.11	177.91	2.52
Average value		21.72	0.16	4.09	0.02	3.44	0.01	4.86	0.01	13.09	0.02	283.13	25.10	191.01	1.85
Significance of the effect		NS		NS		NS		NS		NS		NS		NS	

NS – non-significant.

were characterized by a slightly higher level of somatic cells count. The average content of somatic cells in milk of imported animals was $206.53 \cdot 10^3/l$ and native $177.91 \cdot 10^3/l$ (Table 3).

Analyzing the results in Table 3 it can be seen that the breed of cattle has a highly significant effect ($p \leq 0.01$) on average daily milk yield. Among the breeds studied, the highest daily performance elements characterized by Brown Swiss race that produced 24.48 kg of milk per day, whereas marked by Simmental cows from which the daily obtained averaged just over 18 kg.

Table 3 presents the effect of breed on the of milk performance results. The largest group of animals was represented by Black and White variety of Holstein-Friesian (10,786 cows), while the smallest was the Brown Swiss breed (presented by only 73 cows). The study also showed a highly significant ($p \leq 0.01$) the impact of the breed of cattle on the protein and lactose concentration in milk (Table 3). The highest average protein content was reported in Brown Swiss milk. The milk obtained from Simmental and Norwegian Red and Polish cows contained 3.57, 3.51 and 3.50% protein respectively. Simmentals' milk, as indicated by Neja et al. (2013), was characterized by the most preferred ratio of protein to fat content. According to Litwińczuk et al. (2006), milk obtained from Simmentals had the high content of the casein fraction, and had the most preferable technological value.

The highest average lactose content was observed in Simmental milk (4.99%). Slightly lower, but also a high content of lactose was noticed in milk of Brown Swiss and Holstein-Friesian of Black and White variety.

In our study, there was no significant differences between the breeds in the milk fat content.

Analyzing Table 3, can also be observed that the breed of animals had a significant influence on the dry matter content in the milk. The highest content of dry matter was observed in milk of Simmentals with the average of 13.45%.

Study also revealed significant impact of cattle breed on the amount of urea in milk ($p \leq 0.01$). The highest content of urea in milk was stated in milk of Black and White variety of Holstein-Friesian cows. Animals of this breed characterized by an average content of milk urea at 338.44 mg/l.

There was significant effect of cow breed on the somatic cell count in milk. The lowest recorded number of somatic cells was observed in Norwegian Red milk, which contained on average only $185.23 \cdot 10^3/l$. However, the least favorable in terms of SCC were Brown Swiss cows (Table 3).

CONCLUSIONS

Obtained results revealed that, the country of cow origin had significant impact on daily milk yield, percentage of fat, percentage of protein, percentage of lactose and also on the dry matter content, urea and somatic cells in the milk of lactating cows.

Comparing the results of milk performance between native and imported cows there were no statistically significant differences between the two groups.

The breed of cows had strong influence on daily milk production, percentage of protein, lactose, dry matter, and also the content of urea and somatic cell count in milk.

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Streszczenie: *Wpływ rasy i pochodzenia pierwiastek na wyniki ich użytkowości mlecznej.* Celem badań było porównanie parametrów użytkowości mlecznej i składu mleka pierwiastek pochodzących z sześciu krajów europejskich z rówieśnikami utrzymywanymi w Polsce oraz wykazanie różnic między rasami. Materiał do badań stanowiły dane zawarte w raportach wynikowych z 26 gospodarstw. Analizowano takie dane, jak: wydajność mleka oraz zawartości tłuszczu, białka, laktozy, suchej masy, komórek somatycznych i mocznika w mleku. Na podstawie uzyskanych wyników stwierdzono, że kraj pochodzenia pierwiastek okazał się istotnym czynnikiem wpływającym na dobową wydajność mleka, procentową zawartość tłuszczu, procentową zawartość białka, procentową zawartość laktozy. Wpływ ten wykazano również na zawartość: suchej masy, mocznika i komórek somatycznych w mleku. Analizując

wyniki użytkowości mlecznej pierwiastek importowanych z krajowymi, nie wykazano statystycznie istotnych różnic między obiema grupami. Rasa krów miała wpływ na dobową produkcję mleka, procentowe zawartości białka, laktozy i suchej masy, a także na zawartości mocznika oraz komórek somatycznych w uzyskiwanym surowcu.

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