Acta Sci. Pol. Zootechnica 20(2) 2021, 19–26

www.asp.zut.edu.pl pISSN 1644-0714 eISSN 2300-6145 DOI:10.21005/asp.2021.20.2.02

ORIGINAL PAPER

Received: 20.06.2021
Accepted: 20.09.2021

THE EFFECT OF SIRE'S ORIGIN ON MILKING PERFORMANCE TRAITS OF COWS KEPT IN STANCHION BARNS

Jarosław Pytlewski, Ireneusz R. Antkowiak

Department of Animal Breeding and Product Quality Assessment, Poznan University of Life Sciences, Złotniki, Słoneczna 1, 62-002 Suchy Las, Poland

ABSTRACT

The aim of this study, conducted under identical environmental conditions and the stanchion barn housing system, was to compare milking performance traits and somatic cell count in milk of daughters sired by Holstein-Friesian Black-and-White bulls from various origin groups. Cows were divided into three groups depending on the region of sire's origin, i.e. Polish bulls, bulls from other European countries (the Czech Republic, France and Germany) and bulls from the USA. Analyses were conducted applying the following experimental conditions: the age group of cows (primiparous vs. multiparous), stage of lactation ($\leq$ 40 days, from 41 to 100 days, from 101 to 200 days and > 200 days) and season of the year (spring, summer, autumn and winter). Results of this study indicate that at the stanchion barn housing system of dairy cows in order to increase milk yields the use of semen from bulls of imported Holstein-Friesian Black-and-White bulls seems to be beneficial. However, daughters of US bulls may be prone to elevated somatic cell counts in milk. In turn, cows sired by Polish bulls can be characterised by favourable milk solids contents.

Key words: origin of cow's sire, milking performance, Polish Holstein-Friesian Black-and-White cows, stanchion housing

INTRODUCTION

Thanks to the operations of Interbull Polish cattle breeders when working on herd improvement may use genetic resources from all regions of the world. Thanks to that organisation bulls from around the world obtain genetic evaluation records referred to genetic data bases in many other countries. Productive longevity is a very important feature, which is determined by a combination of genotype factors in specific environments [Babik et al. 2017].

Milk yields produced by cows in 30% depend on hereditary factors and in 70% on non-hereditary factors, whereas milk fat or protein percentage contents are affected in as much as approx. 60% by hereditary factors and non-hereditary factors in approx. 40%. Animal perfection is achieved by selecting the best males and females for reproduction and individual selection [Gorelik et al. 2021]. According to Abramova et al. [2019], the value of animal husbandry is significantly influenced by the country of origin of the bulls. Greater degree of influence of paternal inheritance is explained both by the lowest (basic) level of intrabreed system hierarchy (the closest level of intragroup kinship) and (partially) by a much higher number of gradations of the organized factor [Polupan et al. 2021].

Depending on the assumed objective in the breeding programme realised in a given herd it is essential to select appropriate sires as fathers for the future generation of cows. In Polish conditions higher results of sort ratings concerning the overall appearance, body conformation, udder quality and frame size, efficiency of milk and its components were acquired after the imported bulls [Konsowicz et al. 2013].

The aim of this study is to compare – under identical environmental conditions at stanchion housing – daughters sired by Holstein-Friesian Black-and-White bulls from various groups of origin in terms of their milking performance traits and somatic cell counts in milk.

MATERIAL AND METHODS

Analyses were conducted in a herd of Holstein-Friesian Black-and-White cows kept in an agricultural cooperative in the Wielkopolska region (Poland). The experimental

jarek.pytlewski@up.poznan.pl

group consisted of 107 cows in their 1st to 6th lactations with an average milk production per lactation of approx. 8100 kg milk. Cows were divided into three groups depending on the region of the sire's origin: PL – sired by Polish bulls, EU – sired by bulls from other European countries (the Czech Republic, France and Germany) and US – sired by bulls from the USA. The numbers of cows in the experimental PL, EU and US groups were 45, 40 and 22 head, respectively. The number of daughters of one bull was at least 10. Their age structure in individual classes of sire's origin was comparable. Animals were kept in a stanchion barn in short tie-in litter stalls. Milkings were performed twice a day at 12-hour intervals using a pipeline milking machine. Feeds were prepared according to the INRA standards with the feed ration administered as TMR (Total Mixed Ration). Source data for the study were collected from milk recording records (the A4 method) using RW-2 performance records from the beginning of April 2016 to the end of December 2017. For each cow the recorded data included the actual daily milk yield, as well as milk contents of fat, protein, lactose, casein, milk solids-not-fat and somatic cell count. In total, 1409 records were collected. Daily milk yields were presented as Fat Corrected Milk (FCM) with standardised fat content (4%) according to Sjaunja et al. [1990]. In order to obtain a normal distribution the actual somatic cell count in milk was converted to the logarithmic number applying the transformation according to Ali and Shook [1980]. The calculations were made using the threshold levels for somatic cell counts in bulk milk collected from cows according to Hillerton [1999].

This study presents analyses concerning the effect of the region of sire's origin on milking performance traits of the daughters and somatic cell count in milk.

Statistical analyses were conducted using the SAS [2015] statistical software package. In order to calculate the basic statistical parameters the MEANS procedure was applied. The significance of the effect of experimental factors (the year, season of the year, calving group, sire's region of origin, group of udder health status, milking day in lactation) was analysed using multivariate analysis of covariance with the GLM procedure in SAS [2015] according to the following linear model:

$$Y_{ijklmnop} = \mu + r_i + p_j + l_k + k_l + z_m + \\ + \beta 1 d_n + \beta 2 wm_o + e_{ijklmnop}$$

where:

$Y_{ijklmnop}$ – phenotypic value of analysed trait,
μ – population mean,
r_i – fixed effect of i-th year ($i = 1, 2$),
p_j – fixed effect of j-th season of the year ($j = 1, 2, 3, 4$),
l_k – fixed effect of k-th calving group ($k = 1, 2$),
k_l – fixed effect of l-th sire's region of origin ($l = 1, 2, 3$),
z_m – fixed effect of n-th group of udder health status ($n = 1, 2$),
$\beta 1, \beta 2$ – partial coefficients of first order linear regression,
d_n – milking day in lactation,
wm_o – daily milk yield in lactation,
$e_{ijklmnop}$ – random error.

Statistically non-significant effects in individual linear models were eliminated and calculations were repeated. The following factors were considered in the analyses: age group of cows (primiparous vs. multiparous), stage of lactation ($\leq$ 40 days, 41 to 100 days, from 101 to 200 days and > 200 days) and season of the year (spring, summer, autumn and winter).

In order to compare the means in details, a series of multiple comparisons were made applying the Duncan test.

RESULTS

The analysis showed several statistically significant differences (P $\leq$ 0.05) for the analysed traits between the groups of sire's origin both within the population of primiparous and multiparous cows, as well as between the age groups of cows sired by bulls of the same origin (Table 1). It was shown that primiparous cows sired by bulls from Poland and the USA were characterised by the greatest daily milk yield and FCM (fat corrected milk). Cows sired by bulls from Poland differed in terms of the above-mentioned traits from their analogues, which sires originated from other European countries. In turn, in the case of multiparous cows daughters of Polish bulls had the lowest daily milk yield in relation to cows sired by bulls from the USA and from other European countries. In terms of the daily yield of fat corrected milk with 4% fat content (FCM) no statistically significant differences were recorded between multiparous cows. The highest fat content in milk was found for primiparous cows – daughters of American sires, which differed in this parameter (at P $\leq$ 0.05) with the other two groups of animals. In the case of multiparous cows the highest fat percentage contents in milk was recorded for animals sired by bulls from Poland, which differed statistically from cows, which sires came from other European countries. The highest protein and casein contents in milk were recorded for primiparous cows, which sires originated from the USA and Poland. In the group of multiparous cows the highest values for these milking performance traits were found for daughters of bulls from Poland, while they were lowest in cows sired by other European bulls. It was shown that the highest milk solids content and the greatest natural logarithm with somatic

Table 1. The comparison of daily milk yields, milk composition and somatic cell counts for daughters sires by from different origin groups of Holstein-Friesian Black-and-White bulls depending on age groups of cows

Traits	Region of origin bull	Age group of cows			
		Primiparous		Multiparous	
		x̄	sd	x̄	sd
Milk, kg	PL	20.2^{AX}	4.4	22.6^{AY}	6.3
	EU	18.5^{BX}	4.9	23.8^{BY}	7.2
	US	19.1^{ABX}	5.6	23.8^{BY}	6.0
FCM, kg	PL	20.1^{AX}	4.1	23.3^{Y}	6.3
	EU	18.5^{BX}	4.4	23.8^{Y}	6.8
	US	19.6^{ABX}	5.1	24.2^{Y}	5.4
Fat, %	PL	4.02^{AX}	0.61	4.27^{AY}	0.65
	EU	4.05^{A}	0.77	4.10^{B}	0.68
	US	4.32^{B}	0.71	4.19^{AB}	0.69
Protein, %	PL	3.46^{A}	0.43	3.40^{A}	0.45
	EU	3.28^{BX}	0.42	3.37^{ABY}	0.41
	US	3.52^{AX}	0.46	3.31^{BY}	0.47
Casein, %	PL	2.73^{A}	0.36	2.67^{A}	0.37
	EU	2.59^{B}	0.35	2.63^{AB}	0.33
	US	2.79^{AX}	0.39	2.60^{BY}	0.38
Lactose, %	PL	4.84^{X}	0.18	4.69^{Y}	0.19
	EU	4.82^{X}	0.19	4.72^{Y}	0.21
	US	4.81^{X}	0.13	4.70^{Y}	0.22
Dry matter, %	PL	13.12^{A}	0.92	13.15^{B}	0.94
	EU	12.88^{A}	1.11	12.99^{A}	0.94
	US	13.40^{BX}	1.09	12.99^{AY}	1.06
SCC, $10^3 \cdot ml^{-1}$	PL	136	92	158	98
	EU	111^{AX}	73	161^{Y}	102
	US	185^{B}	106	169	103
Ln SCC	PL	11.55^{AX}	0.80	11.73^{Y}	0.76
	EU	11.40^{AX}	0.68	11.74^{Y}	0.76
	US	11.91^{B}	0.73	11.79	0.80

The means marked with different letters differ statistically significantly ($P \leq 0.05$). A, B – comparison of daughters of different bull origin groups within the age group of cows. X, Y – comparison of age groups of cows within one bull origin group.

cell count (ln SCC) in milk were found for primiparous cows sired by bulls from the USA. In terms of the relationships between milking performance traits of primiparous and multiparous cows within the same sire groups several statistically significant dependencies ($P \leq 0.05$) were observed. These include an increase in fat content in milk in multiparous cows when compared to primiparous cows in the group of cows sired by bulls from Poland, a decrease in protein and casein contents in milk of multiparous cows related to primiparous cows in the group of cows sired by bulls from the USA and a lack of differences between ln SCC in milk of primiparous and multiparous cows within the same sire group.

It was shown (Table 2) that in the first period of lactation up to day 40 after calving, significantly the lowest solids content (at $P \leq 0.05$) in milk in relation to the other sire groups was recorded for cows sired by bulls from the USA. For this group of cows in the second stage of lactation (41–100 days) a similar relationship was observed, while additionally identical dependencies were found for protein and casein contents in milk. In turn, in the third stage of lactation (101–200 days) milk produced by cows sired by bulls from the USA was characterised by the highest fat percentage content and the lowest lactose content, differing significantly (at $P \leq 0.05$) from the levels of these components recorded in milk of cows sired by other European bulls. After day 200 of lactation cows sired by other European bulls were characterised by significantly lower solids contents when compared to the mean calculated for the group of cows after sires from Poland and the USA. In turn, in individual periods of lactation daughters of bulls from Poland were characterised by the highest level of this milk parameter. In the last period of lactation (> 200 days of lactation) sired by bulls US sires had the highest ln SCC, significantly differing (at $P \leq 0.05$) from the value of this trait recorded for daughters of bulls from Poland. With progress in lactation the level of ln SCC increased to the greatest extent in milk of cows sired by bulls from the USA.

Table 2. The comparison of daily milk yields, milk composition and somatic cell counts for daughters origin of bulls from different origin groups of Holstein-Friesian Black-and-White bulls depending on the stage of phases lactation

Traits	Region of origin bull	Phase of lactation, days							
		≤ 40		41–100		101–200		>200	
		$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Milk, kg	PL	28.4^{X}	6.3	26.6^{Y}	4.8	23.7^{Z}	4.9	18.9^{Q}	4.8
	EU	28.3^{X}	6.2	28.8^{X}	6.8	23.8^{Y}	5.7	19.0^{Z}	5.6
	US	27.8^{X}	4.5	28.9^{X}	5.3	23.2^{Y}	4.6	19.4^{Z}	5.5
FCM, kg	PL	30.1^{X}	6.9	26.1^{Y}	5.3	23.8^{Z}	5.0	19.8^{Q}	4.7
	EU	29.2^{X}	6.9	27.8^{X}	6.8	23.3^{Y}	5.3	19.3^{Z}	5.3
	US	28.2^{X}	5.3	28.0^{X}	4.6	23.4^{Y}	3.8	20.3^{Z}	5.2
Fat, %	PL	4.42^{X}	0.68	3.88^{Y}	0.52	4.04^{ABY}	0.53	4.37^{X}	0.68
	EU	4.22^{X}	0.77	3.78^{Y}	0.56	3.90^{AY}	0.57	4.25^{X}	0.74
	US	4.11^{X}	0.67	3.84^{X}	0.61	4.10^{BX}	0.60	4.41^{Y}	0.71
Protein, %	PL	3.13^{X}	0.32	2.98^{AY}	0.32	3.26^{AZ}	0.29	3.66^{Q}	0.40
	EU	3.05^{X}	0.38	2.95^{AX}	0.24	3.23^{AY}	0.29	3.58^{Z}	0.36
	US	2.97^{X}	0.25	2.83^{BX}	0.23	3.20^{BX}	0.32	3.66^{Z}	0.40
Casein, %	PL	2.43^{X}	0.25	2.34^{AX}	0.24	2.55^{Y}	0.24	2.89^{AZ}	0.33
	EU	2.39^{X}	0.29	2.32^{AX}	0.18	2.51^{Y}	0.24	2.63^{BZ}	0.30
	US	2.30^{X}	0.18	2.23^{BX}	0.16	2.51^{Y}	0.26	2.90^{AZ}	0.33
Lactose, %	PL	4.75	0.15	4.78	0.23	4.74^{AB}	0.15	4.69	0.20
	EU	4.74	0.27	4.83	0.14	4.77^{A}	0.19	4.73	0.21
	US	4.78	0.13	4.81	0.12	4.71^{B}	0.28	4.72	0.18
Dry matter, %	PL	13.03^{AX}	0.77	12.44^{AY}	0.68	12.79^{Z}	0.67	13.56^{AZ}	0.93
	EU	12.84^{AX}	0.86	12.27^{BZ}	0.65	12.65^{X}	0.76	13.36^{BY}	1.01
	US	12.59^{BX}	0.80	12.18^{CZ}	0.71	12.77^{X}	0.86	13.50^{AY}	1.04
SCC, $10^3 \cdot ml^{-1}$	PL	137^{X}	94	129^{XZ}	93	141^{X}	99	170^{AY}	96
	EU	134^{X}	98	99^{Y}	82	138^{X}	95	174^{AZ}	96
	US	153^{X}	99	136^{X}	96	161^{X}	98	199^{BY}	102
Ln SCC	PL	11.44^{X}	0.83	11.40^{X}	0.76	11.57^{AX}	0.82	11.85^{AY}	0.69
	EU	11.55^{X}	0.83	11.48^{X}	0.83	11.58^{AX}	0.82	11.89^{AZ}	0.63
	US	11.45^{X}	0.95	11.41^{X}	0.91	11.78^{BY}	0.70	12.02^{BY}	0.80

The means marked with different letters differ statistically significantly (P ≤ 0.05). A, B, C – comparison of daughters of different bull origin groups within the lactation phase. X, Y, Z, Q – comparison of daughters of one bull origin group within the lactation phase.

In terms of the effect of the sire group on milking performance parameters and somatic cell count in milk of cows in individual seasons of the year (Table 3) in the spring, autumn and winter statistically significant ($P \leq 0.05$) differences were found for selected traits between the analysed groups of cows. In all the seasons of the year milk of daughters from bulls from the USA had the highest ln SCC. In turn, the greatest amounts of lactose were found in milk collected from cows daughters of other European bulls. In the autumn milk of daughters sired by US bulls contained the highest levels of fat. The same group of animals, this time in the winter, was characterised by the lowest daily yields of milk and FCM. In that season of the year the worst values of milk solids, fat, protein and casein were recorded for cows sired by other European bulls. Analyses of milking performance traits and somatic cell counts in milk in individual groups of cows showed several dependencies within individual seasons of the year. In the winter daily yields of milk and FCM increased in cows from the group sired by other European bulls. In the autumn and winter an increase was recorded for the percentage fat content in milk of cows of US bulls. For the same group of cows in the winter the concentrations of protein and casein in milk also increased. In turn, in the summer a decrease in milk casein content was recorded for cows sired by Polish bulls. In the autumn milk produced by cows sired by other European bulls contained the lowest lactose percentage content. In the winter and autumn a significant increase in milk solids content was found for cows sired by US bulls, while in the case of daughters of Polish bulls such a dependence was recorded in the winter. Milk produced in individual seasons of the years by cows sired by bulls from Poland contained relatively high solids contents. In turn, cows sired by US bulls in all the seasons of the years were characterised by the highest somatic cell counts in milk. In the summer and autumn or only in the autumn an increase in ln SCC was observed in milk of cows sired by bulls from other European countries and bulls from Poland, respectively.

Table 3. The comparison of daily milk yield, milk composition and somatic cell counts for daughters bull origin from different origin groups of Holstein-Friesian Black-and-White bulls depending on the season of the year

Traits	Region of origin bull	Season of the year							
		Spring		Summer		Autumn		Winter	
		x̄	sd	x̄	sd	x̄	sd	x̄	sd
Milk, kg	PL	21.9	6.5	21.9	6.2	22.0	5.7	22.7^{AB}	5.9
	EU	22.5^{X}	7.5	21.6^{X}	6.6	22.0^{X}	6.8	24.1^{AY}	7.2
	US	22.6	6.8	22.9	6.0	22.1	6.5	22.0^{B}	5.5
FCM, kg	PL	22.2	6.3	22.2	6.3	22.6	5.8	23.3^{AB}	5.7
	EU	22.3^{X}	7.0	21.4^{X}	6.3	22.3^{X}	6.5	24.4^{AY}	7.0
	US	22.5	6.3	22.9	5.1	23.0	6.0	22.9^{B}	5.0
Fat, %	PL	4.16^{X}	0.58	4.14^{X}	0.74	4.24^{ABY}	0.67	4.31^{BY}	0.63
	EU	4.03	0.69	3.98	0.74	4.15^{A}	0.70	4.17^{A}	0.68
	US	4.02^{X}	0.59	4.08^{X}	0.66	4.39^{BY}	0.69	4.40^{BY}	0.80
Protein, %	PL	3.44	0.46	3.36	0.41	3.39	0.47	3.45^{A}	0.44
	EU	3.37	0.44	3.32	0.40	3.34	0.42	3.34^{B}	0.40
	US	3.34^{X}	0.47	3.31^{X}	0.44	3.34^{X}	0.47	3.51^{AY}	0.51
Casein, %	PL	2.71^{X}	0.37	2.62^{Y}	0.33	2.67^{X}	0.39	2.73^{AX}	0.36
	EU	2.65	0.35	2.61	0.32	2.60	0.35	2.62^{B}	0.32
	US	2.64^{X}	0.37	2.60^{X}	0.39	2.64^{X}	0.39	2.79^{AY}	0.42
Lactose, %	PL	4.71^{A}	0.22	4.75	0.19	4.72	0.19	4.71^{A}	0.17
	EU	4.79^{B}	0.17	4.78	0.20	4.70	0.26	4.76^{A}	0.17
	US	4.76^{AB}	0.17	4.71	0.33	4.72	0.16	4.73^{A}	0.18
Dry matter, %	PL	13.10	0.91	13.00	0.92	13.27	0.96	13.28^{AB}	0.92
	EU	12.94	1.01	12.87	0.96	12.99	1.04	13.05^{A}	0.90
	US	12.88^{X}	0.95	12.88^{X}	1.05	13.40^{Y}	1.09	13.44^{BY}	1.19
SCC, $10^3 \cdot ml^{-1}$	PL	138^{AX}	87	162^{X}	96	178^{AY}	104	137^{AX}	96
	EU	133^{AX}	104	156^{XZ}	97	164^{AZ}	96	147^{AX}	92
	US	168^{BX}	101	190^{Y}	104	187^{BY}	95	182^{BY}	106
Ln SCC	PL	11.60^{AX}	0.76	11.79^{XY}	0.69	11.81^{AY}	0.76	11.54^{AX}	0.82
	EU	11.49^{AX}	0.81	11.74^{Y}	0.70	11.79^{AY}	0.71	11.66^{ABXY}	0.77
	US	11.78^{B}	0.81	11.95	0.75	11.98^{B}	0.75	11.84^{B}	0.80

The means marked with different letters differ statistically significantly ($P \leq 0.05$). A, B – comparison of daughters of various bull origin groups within the season of year. X, Y, Z – comparison of daughters of one breeding group of bulls within the seasons of year.

DISCUSSION

Results recorded in this study for daily milk yields of primiparous daughters sired by bulls from various origin groups indicate an advantageous productivity of progeny sired by Polish and US bulls. In turn, earlier studies conducted by Niedziałek et al. [2002] and Antkowiak et al. [2009] showed the highest milk yield and protein content in lactation for primiparous cows sired by bulls from the USA and Canada. In this study multiparous cows sired by Polish bulls were characterised by the lowest daily milk yield when compared to daughters of the two other groups of bulls, although milk solids content in that group of cows was highest. According to Guliński [2017], age of cows has a significant effect on milk protein content. In the opinion of that author milk produced by of cows older than three years has much lower protein contents than milk of young cows. Many studies compared milking performance traits of Polish Black-and-White cows with a high share of genes of Polish Holstein-Friesian cattle with those having genes of cattle imported mainly from Germany, France, Holland and the USA. Results of those studies indicate a dominance of imported cattle. Gnyp [2012] reported that Holstein-Friesian Black-and-White cows imported from Holland, Germany and France compared to Polish cows exceeded them in terms of milk yields (by 25–30%) and were characterised by smaller differences between fat and protein contents in milk as well as a more advantageous protein: fat ratio in three successive lactations. In a study by Bogucki et al. [2009] it was shown that cows of from France had the highest daily milk yields compared to their peers from Germany and Poland. Similar results in relation to milk solids were reported by Puchajda et al. [1999a]. In the opinion of Dymnicki and Reklewski [1999], cows imported from Holland have higher milk yields and contents of milk constituents compared to German cows, while fat content in their milk was lower at a comparable protein percentage content. In turn, animals imported from France were characterised by higher milking performance parameters compared to German cows and comparable to Dutch cows. In turn, Czerniawska-Piątkowska et al. [2009] in their study showed that animals from Germany exceeded Polish cows in terms of milk yields expressed in FCM and milk fat contents. Inflammations of the udder are a significant problem in herds of dairy cows. However, thanks to the common access to electronic meters quantitative cytological analyses of milk may be performed directly on the farm [Dudko and Zawadzki 2015]. Puchajda et al. [1999b] stated that in Poland in the indoor keeping system cows imported from Germany were more resistant to udder disease (by 2.57%) than their peers coming from France. Comparable results concerning somatic cell counts in milk of Polish and imported cows were reported by Bogucki et al. [2009]. In turn, Gnyp et al. [2006] when analysing family farms stated that the highest somatic cell counts were detected in milk produced by cows coming from Holland. According to Skrzypek and Szukalski [2006], import of cows from Holland is justified in the case of large cattle farms, while import of animals from Germany does not guarantee any competitive advantage when compared to animals bred in Poland. In this study the highest somatic cell count in milk was recorded for daughters sired by US bulls. Such a result was probably caused by the fact that daughters sired by US bulls were also characterised by high milk yields, which may lead to elevated SCC levels. This thesis may be confirmed by the suggestion by Sharma et al. [2011], who stated that high-producing breeds are characterised by greater SCC in milk. Significant environmental factors affecting somatic cell counts in milk include e.g. the season of the year and the housing system of cows. This study confirmed results presented by Dorynek and Kliks [1998] concerning an increase in somatic cell counts in milk in the summer and autumn. This phenomenon may be explained by the relatively high air temperature, promoting the development of mastitis. It is believed that in July, August and in the first half of September the so-called summer mastitis may develop in cows (not only those kept on the pasture). In a study by Pytlewski et al. [2002] it was shown that milk produced in each of the seasons of the year by cows kept in the loose housing system compared to milk of animals from the stanchion barn housing system contained lower somatic cell counts.

CONCLUSIONS

The highest milk yields among the three analysed groups of animals were recorded for primiparous cows bulls from Poland of the USA, although in milk of the latter group the highest somatic cell counts were recorded, which may suggest their greater susceptibility to mastitis. In the case of multiparous cows the highest levels of fat, protein and casein were found in milk of cows sired by bulls from Poland.

In individual stages of lactation milk of daughters sired by Polish bulls contained the most advantageous contents of milk solids compared to milk produced by cows and from the other groups.

The strongest effect of the sire's group of origin on milking performance traits of their daughters was observed in the winter. In that season of the year cows sired by other European bulls showed the greatest daily milk yields and the lowest contents of milk solids, fat, protein and casein.

Results of this study suggest that in the stanchion barn housing system of dairy cows in terms of daily milk yield it is preferred to use semen of Holstein-Friesian Black-and-White bulls from the USA and other European countries. However, daughters of bulls from the USA may be more prone to exhibit elevated somatic cell counts in milk. In turn, in terms of milk solids content it is recommended to use Polish bulls in reproduction.

ACKNOWLEDGEMENT

This study was financed by the funds of the Ministry of Science and Higher Education of Poland (statutory research).

REFERENCES

Abramova, N.I., Khromova, O.L., Vlasowa, G.S., Bogoradova, L.N., Burgomistrova, O.N. (2019). Breeding value of bulls of Black-and-White breed of different origin. Zootekhniva, 8, 2–7.

Ali, A.K.A., Shook, C.E. (1980). An optimum transformation for somatic cell concentration in milk. J. Dairy Sci., 63, 487–490. DOI: 10.3168/jds.S0022-0302(80)82959-6.

Antkowiak, I., Pytlewski, J., Skrzypek, R., Jakubowska, M. (2009). Wpływ pochodzenia buhajów na użytkowość mleczną ich córek [The influence of provenance of bulls on milking performance of their daughters]. Rocz. Nauk. PTZ, 5(4), 11–19 [in Polish].

Babik, N.P., Fedorovych, Y.I., Fedorovych, V.V. (2017). Duration and effectiveness of lifetime use of dairy cows depending on their father's country origin. Anim. Breed. Genet., 54, 19–29. DOI: 10.31073/abg.54.03.

Bogucki, M., Sawa, A., Neja, W., Bembnista, M. (2009). Użytkowość mleczna krów rasy holsztyńsko-fryzyjskiej pochodzenia krajowego i zagranicznego [Milk performance of Holstein-Friesian cows of domestic and foreign origin]. Rocz. Nauk. PTZ, 5(4), 21–31 [in Polish].

Czerniawska-Piątkowska, E., Szewczuk, M., Sowa, A., Żychlińska-Buczek, J. (2009). Porównanie poziomu cech produkcyjnych krów rasy hf importowanych z niemiec z rówieśnicami krajowymi [A comparison of the level of production traits of Holstein-Friesian cows imported from Germany to their native age mates]. Acta Sci. Pol., Zootechnica, 8(3), 3–10 [in Polish].

Dorynek, Z., Kliks, R. (1998). Wpływ wybranych czynników na kształtowanie się liczby komórek somatycznych w mleku krów [Influence of selected factors on the somatic cell count in cow milk]. Rocz. AR Poznań 302, Zootech., 50, 91–95 [in Polish].

Dudko, P., Zawadzki, W. (2015). Badania nad efektywnością preparatu Biomast w zwalczaniu mastitis u krów [The study on effectiveness the immune-modulation of res in bovine udders by Bomast]. Acta Sci. Pol., Medicina Veterinaria, 14(4), 5–18 [in Polish].

Dymnicki, E., Reklewski, Z. (1999). Użytkowość mleczna córek buhajów z niektórych krajów europejskich i krów importowanych z Niemiec i Holandii [Milk performance of doughters of top bulls from some countries and imported cows from Germany and Holland]. Zesz. Nauk. PTZ, 44, 101–108 [in Polish].

Gnyp, J., Kowalski, P., Tietze, M. (2006). Wpływ genotypu oraz kraju pochodzenia krów na ich wydajność dobową mleka, jego skład i jakość cytologiczną [The influence of genotype and country of origin on 24-hour milk efficiency, milk composition and cytological quality in cows]. Annales Universitatis Mariae Curie-Skłodowska Sectio EE: Zootechnica, 24, 1–8 [in Polish].

Gnyp, J. (2012). Wpływ kraju pochodzenia na produkcyjność krów i relacje pomiędzy zawartością tłuszczu i białka w mleku [Effect of country of origin on productivity of cows and relations between fat and protein content in milk]. Rocz. Nauk. PTZ, 8(4), 19–26 [in Polish].

Gorelik, O.V., Yu Brianzey, A., Safronov, S.L., Gritsenko, S.A., Shakirov, D.R. (2021). Comparative assessment of cows by daughters from different breeding bulls in terms of milk production. IOP Conf. Ser.: Earth Environ. Sci., 677, 022101. DOI: 10.1088/1755-1315/677/2/022101.

Guliński, P. (2017). Bydło domowe hodowla i użytkowanie [Domestic cattle: breeding and management]. Wydaw. Nauk. PWN Warszawa [in Polish].

Hillerton, J.E. (1999). Redefining mastitis based on somatic cell count. IDF Bulletin, 345, 4–6.

Konsowicz, K., Pogorzelska, J., Miciński, J., Sobotka, W., Zwierzchowski, G. (2013). Relationships between sire effect, milk production in young cows and their productive longevity. Med. Weter., 69(10), 606–611.

Niedziałek, G., Litwińczuk, Z., Guliński, P. (2002). Wartość użytkowa pierwiastek, utrzymywanych w gospodarstwach indywidualnych regionu Podlasia, pochodzących po buhajach krajowych, europejskich i amerykańskich [Performance value of primiparous cows, kept in the individual farms of the Podlasie region, derived from national, European and American bulls]. Zesz. Nauk. PTZ, 62, 121–126 [in Polish].

Polupan, Y.P., Stavetska, R.V., Siriak, V.A. (2021). The influence of genotypic factors on longevity and lifetime production of dairy cows. Anim. Breed. Genet., 61, 90–106. DOI: 10.31073/abg.61.11.

Puchajda, Z., Szymańska, A.M., Czaplicka, M., Czudy, W. (1999a). Ocena wartości użytkowej krów pierwiastek francuskiej odmiany prim Holstein w północno-wschodnim regionie Polski [The assessment of production value of primiparous cows of the french variety Prim Holstein in the region of north-eastern Poland]. Zesz. Nauk. PTZ, 44, 207–213 [in Polish].

Puchajda, Z., Czaplicka, M., Radzka, E., Szatkowski, R. (1999b). Wpływ stanu zdrowotnego wymienia pierwiastek holsztyńsko-fryzyjskich importowanych z Francji i Niemiec na wydajność, skład i niektóre właściwości fizyko-chemiczne mleka [The effect of the sanitary condition of udder of Holstein-Friesian primiparas imported from France and Germany on yield, composition and some physico-chemical properties of milk]. Zesz. Nauk. PTZ 44, 201–206 [in Polish].

Pytlewski, J., Dorynek, Z., Antkowiak, I., Burkiewicz, E. (2002). Wpływ systemu utrzymania i wybranych czynników na zawartość komórek somatycznych w mleku krów czarno-białych [The influence of the housing system and selected factors on somatic cell counts in milk of Black-and-White cows]. Rocz. AR Pozn. CCCL, Zootech. 54, 35–45 [in Polish].

SAS (2015). SAS® user's guide. Statistics version 9.4 edition. Cary, NC, SAS Institute.

Sharma, N., Singh N.K., Bhadwal, M.S. (2011). Relationship of somatic cell count and mastitis an: overview. Asian-Aust. J. Anim. Sci., 24(3), 429–438. DOI: 10.5713/ajas.2011.10233.

Sjaunja, L.O., Baevre, B., Junkkarienen, L., Pedersen, J., Setala, J. (1990). A Nordic proposal for an energy-corrected milk (ECM) formula. 27th Session International Committee for Recording and Productivity of Milk Animals, 2–6 July 1990, Paris, France, 156–157.

Skrzypek, R., Szukalski, L. (2006). Użytkowość krów rasy czarno-białej importowanych z Holandii i Niemiec oraz krów wyhodowanych w Polsce [Utility of Black-and-White cows imported from the Netherlands and Germany and cows raised in Poland]. Med. Weter. 62(2): 197-200 [in Polish].

WPŁYW POCHODZENIA OJCA NA CECHY UŻYTKOWOŚCI MLECZNEJ KRÓW UTRZYMYWANYCH UWIĘZIOWO

STRESZCZENIE

Celem pracy było porównanie, w jednolitych warunkach środowiskowych przy utrzymaniu uwięziowym, cech użytkowości mlecznej oraz liczby komórek somatycznych w mleku córek po buhajach rasy holsztyńsko-fryzyjskiej odmiany czarno-białej reprezentujących różne grupy pochodzeniowe. Krowy podzielono na trzy grupy w zależności od regionu pochodzenia ojca: po buhajach krajowych, po rozpłodnikach z innych krajów europejskich i po buhajach z USA. Przy analizach uwzględniono następujące czynniki: grupę wiekową krów, fazę laktacji oraz porę roku. Wyniki przeprowadzonych badań wskazują, że przy utrzymaniu krów mlecznych systemem uwięziowym dla wzrostu wydajności mleka korzystne wydaje się stosowanie nasienia buhajów holsztyńsko-fryzyjskich odmiany czarno-białej pochodzących z zagranicy. Jednakże u córek reproduktorów z USA może wystąpić tendencja do podwyższonej ilości elementów komórkowych w mleku. Z kolei krowy urodzone po buhajach krajowych mogą charakteryzować się korzystną zawartością suchej masy w mleku.

Słowa kluczowe: pochodzenie ojca krów, użytkowość mleczna, krowy rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej, utrzymanie uwięziowe

Jarosław Pytlewski https://orcid.org/0000-0002-5552-7649
Ireneusz R. Antkowiak https://orcid.org/k000-0001-9819-7750