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MILK PERFORMANCE ANALYSIS OF DAIRY COWS OF DIFFERENT COLOURS SIRED BY HOLSTEIN–FRIESIAN RED–FACTOR BULLS

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ABSTRACT

The analysis was carried out on 67 primiparous cows of different colour sired by black–white red–factor (RF) bulls, kept in a modern dairy farm in south–west Poland. The aim of this study was to confirm or reject the hypothesis that the daughters with different colours obtained from red–white mothers and black–white RF bulls may also differ in their milk yield during the first 305–day lactation corrected on age and calving season. The cows with different colour were statistically similar with regard to the investigated milk performance traits. Average corrected yield of RF bulls' daughters with black–white or red–white colour was respectively 10 300 and 10 112 kg of milk with 4.31 and 4.32% of fat, and 3.08 and 3.13% of protein. The observed relative differences in the range of the investigated milk traits of cows with different colour were not higher than 2%, except for the FPD index. The greatest relative difference between cows with different genotype (below 75.0 and above 75.1% HF genes) was found in milk yield (512 kg, which is 5.18%) in favour of one–sided milk type cows (above 75.1% HF). The colour of RF bulls' daughters, either black–white or red–white, does not show a significant link with their milk performance traits, regardless of their HF genes share in their genotypes, and therefore it would not be justified to favour the daughters with different colour in the process of selection. Insemination of the domestic population of cows with the semen of red–factor HF bulls will neither lead to a reduction in milk yield or deterioration of milk chemical composition of their either black–white or red–white daughters.

Key words: colour of cows and bulls, red factor, genotype, milk yield, milk composition

INTRODUCTION

Genetic improvement of country cattle herd has been carried out according to the programme of evaluation and selection of bulls, with its main objective to obtain the sires of the highest genetic value. The studies carried out over the last few years have demonstrated that, among others, milk yield and milk chemical composition of crossbred Black–and–White (BW), Red–and–White (RW), and Holstein–Friesian (HF) cows is strongly affected by both sire effect [2, 5, 6, 9] and the percentage (higher or lower) of HF genes in the cow's genotype [7, 8]. During the latter part of the 1990s, also the semen of so called red–factor (RF), black–white, Holstein–Friesian bulls was utilized for the reproduction of BW cows. The progeny of such bulls and cows have either black–white or red–white colour [5]. The effect results also from the fact that black–white RF bulls' genotype has both genes of black and red coat colour.

The aim of this study was to confirm or reject the hypothesis that the daughters with different colours obtained from red–white mothers and black–white RF bulls may also differ in their milk yield during the first 305–day lactation corrected on age and calving season.

MATERIALS AND METHODS

The studies were carried out on the cows held in a dairy cattle farm located in south–west Poland. The results of performance evaluation were used for the study, and the evaluation was for 67 cows – black–white (group I) and red–white (group II) primiparous heifers sired by 3 black–white HF Red Factors (RF): 16 daughters of bull Twen 90017–4–2 (born in Germany, 88% of HF genes), 15 daughters of Reid 90569–4–7 (born in the USA – 100% HF), and 35 heifers – daughters of Adonis 90722–4–2 (born in the USA – 100% HF). Their breeding values as measured with the BLUP Model (Animal Model / evaluation number) were as follows: Twen (AM/09) – 429 kg of milk, 26.8 kg of fat, 15.8 kg of protein, 0,24% of fat, 0.09% of protein, Reid (AM/05) – 692 kg of milk, 20.2 kg of fat, 21.5 kg of protein, –0.14% of fat, –0.01% of protein, Adonis (AM/03) – 221 kg of milk, 2.1 kg of fat, 4.8 kg of protein, –0.14% of fat, –0.09% of protein.

Most of the cows calved during 1998–1999 at the average age 25.7 months (groups: I – 25.3, II – 26.2 months). The cows remained on a dairy cattle farm of a high productivity level, under the same feeding and management conditions. The management system was described in the previous paper [5].

Milk performance evaluation included the breed factor (black–white colour or red–white colour, respectively in the group I and II) as well as the genotype (group 1 – less than 75.0% HF, group 2 – more than 75.1% HF genes). The following analyses were carried out: milk yield in the first 305–day lactation, corrected to age and season of calving (11), fat–corrected milk yield (FCM), fat content, protein content, and the relationships between these components (protein–fat ratio, PFR, and fat–protein difference, FPD).
Mean values () and standard deviations (s) were calculated. The results were statistically analysed using one–way ANOVA (10).

RESULTS AND DISCUSSION

Table 1 presents the values of milk performance traits for the cows of different colour, during the first 305–day lactation. The black–white heifers attained higher milk performance merits during a slightly shorter lactation (by 2.2 days) compared to those red–white, however, the significance of differences was not confirmed statistically. The observed lack of significant differences is a result of extensive variability of the traits in both groups of heifers, as they were heterozygous crosses. The milk yield of the black–white cows (10 300 kg) with 4.31% of fat and 3.08% of protein, compared to the red–white heifers, was higher by 188 kg (which constitutes 1.82% of relative difference), but of poorer chemical composition (fat – by 0.01% and protein – by 0.05%, which represents 0.23% and 1.62% respectively). The average milk yield of the studied black–white and red–white heifer–cows nearly twice exceeded the country average for all evaluated cows, which in 2000 was 5 379 kg of milk with 4.12% fat and 3.26% protein [4]. Maximum daily yields of the red–white (II) and black–white (I) cows were, respectively, 40.9 and 40.1 kg of milk. The difference in FCM between the red–white and black–white cows was 207.4 kg (or 1.93%) in favour of the black–white colour of coat. Fat and protein yield of the cows with black–white colour was higher by 8.8 kg (which is 1.99%) and by 0.5 kg (or 0.16%) respectively, compared to the red–white cows of the same age. The values of the parameters PFR (protein–fat ratio) and FPD (fat–protein difference) were slightly better for the milk of red–white (by 1.24% and 2.46% of the relative value). The chemical composition of milk and the relations between the components that were analysed in this study for the black–white cows were slightly worse than those reported by many domestic authors [2, 6]. An example of relation between quantitative and qualitative traits may be found in the observations by Comberg *et al.* [1]. It was demonstrated that the milk of Black–and–White Lowland cows and Holstein–Friesian cows, whose portion of pigmented skin is smaller, contains statistically significantly less fat. The coefficient of correlation between the pigmented skin area of sires and that of their daughters was 0.7; the value of this parameter demonstrates the efficiency of selection directed on this trait.

Table 1. Parameters of first 305–day lactation milk performance traits of black–white (group I) and red–white (group II) cows sired by RF bulls

Trait	Group I		Group II		Difference / n.s.	
	$\bar{x}$	s	$\bar{x}$	s	absolute [days kg %]	relative [%]
Number of cows	33	–	34	–	–	–
Days in milk	295.5	21.2	297.7	12.6	–2.2	0.74
Maximum daily milk yield [kg]	40.9	8.4	40.1	8.5	0.8	1.95
Milk yield [kg]	10300	2715.3	10112	2201.8	188	1.82
FCM [kg]	10763.4	2949.8	10556.0	2233.8	207.4	1.93
Fat yield [kg]	442.9	127.9	434.1	94.5	8.8	1.99
Protein yield [kg]	316.5	81.4	316.0	68.4	0.5	0.16
Fat content in milk [%]	4.31	0.49	4.32	0.48	–0.01	0.23
Protein content in milk [%]	3.08	0.16	3.13	0.14	–0.05	1.62
PFR	0.724	0.083	0.733	0.087	–0.009	1.24
FPD [%]	1.22	0.47	1.19	0.52	0.03	2.46

Table 2 presents the 305–day lactation milk performance values for of the primiparous cows of different colour, with respect to different HF genes share (below 75.0% and over 75.1%) in their genotypes. The effect of genotype in both studied groups appeared as a varied, however statistically insignificant yield of milk and its components and days in milk (by 4.7 days). Both black–white and red–white cows with higher proportion of HF genes (> 75.1%) produced more milk (by 512 kg, which is 5.15% of the relative difference), yet with lower fat content (by –0.02%, or 0.46%) and protein content (by –0.04%, that is 1.28%). The obtained results correspond to those reported my other authors (3, 6, 8), who state that one must take into account the decline in the content of important milk components in one–sided selection for milk yield. In the studied genetic groups, the differences between fat and protein yields were respectively 21.6 kg (or 5.08%) and 13.6 kg (or 4.42%) in favour of those primiparous cows that have higher HF genes share. The relations between the milk components were nearly identical between the studied genetic groups. In other studies (7), which took into account different genotypes of black–white and red–white crossbred cows — the effect of consecutive stages of superseding HF crossing — more favourable relations between the milk components were observed in both black–white primiparous cows with 76–99% HF genes (PFR = 0.780, FPD = 0.90%) and in their red–white age mates (PFR = 0.803, FPD = 0.78%).

Table 2. Parameters of milk performance traits of the RF bulls' daughters with les than 75% (group 1) and more than 75.1% (group 2) of HF genes

Trait	Group 1 (< 75.0%)		Group 2 (> 75.1%)		Difference / n.s.	
	$\bar{x}$	s	$\bar{x}$	s	absolute [days kg %]	Relative [%]
Number of cows	25	–	42	–	–	–
Days in milk	299.6	12.8	294.9	19.4	–4.7	1.57
Maximum daily milk yield [kg]	39.4	8.8	41.2	8.2	1.8	4.57
Milk yield [kg]	9883.0	2817.7	10395.0	2418.8	512.0	5.18
FCM [kg]	10327	2933.2	10855	2383.6	528.0	5.11
Fat yield [kg]	424.9	122.9	446.5	104.7	21.6	5.08
Protein yield [kg]	307.7	83.7	321.3	69.0	13.6	4.42
Fat content in milk [%]	4.33	0.44	4.31	0.51	–0.02	0.46
Protein content in milk [%]	3.13	0.14	3.09	0.16	–0.04	1.28
PFR	0.729	0.070	0.728	0.093	–0.01	1.37
FPD [%]	1.20	0.42	1.21	0.53	0.01	0.83

CONCLUSIONS

1. The colour (black–white and red–white) of red–factor bulls' daughters does not show a significant link with their milk performance traits regardless of their HF genes share in their genotypes, and therefore it would not be justified to favour the daughters of a particular colour in the process of selection.
2. Insemination of the domestic population of cows with the semen of red–factor HF bulls will not lead to a decrease in yield and chemical composition of their daughters' milk, either of black–white or red–white colour.

REFERENCES

1. Comberg G., Sponer G., Feder H., Aschermann A., Plischke R., Wegner W., 1972. Einige qualitative and quantitative Eigenschaften und ihre Beziehungen zueinander in Populationen Deutscher Schwarzbunter Rinder. I. Exterieur und Leistung [Some qualitative and quantitative characteristics and their interrelations in populations of German–Friesian cattle. I. Conformation and achievements]. Zschr. Tieär. Züchtungsbiologie 89, 109–122 [in German].
2. Gnyp J., Małyska T., Kowalski P., 1997. Ocena relacji między zawartością tłuszczu i białka w mleku pierwiastek czarno–białych pochodzących po różnych buhajach [Evaluation of relations between fat protein content in milk of primiparous Black–and–White cows, derived from different bulls]. Zesz. Nauk. Prz. Hod., 47, 69–77 [in Polish].
3. Kaczmarek A., Rosochowicz Ł., Kliks R., Antkowiak I., 1997. Możliwości poprawy zawartości białka w mleku krów [Possibilities of improvement of protein content in milk of cows]. Rocz. AR Pozn. Zootech., 299, 49–66 [in Polish].
4. Krencik D., Dobrowolski J., 2001. Ocena wartości użytkowej krów oraz ocena i selekcja buhajów. Wyniki za 2000 rok [Performance evaluation of dairy cows and evaluation and selection of sires. Year 2000 results]. KCHZ, Warszawa [in Polish].
5. Kuczaj M., 2001. Analiza zmienności cech mlecznych krów – córek buhajów rasy holsztyńsko–fryzyjskich RF [Analysis of dairy performance traits variability of cows – red–factor HF bulls' daughters]. Med. Weter., 57, 764–767 [in Polish].
6. Kuczaj M., Blicharski P., 2001. Zawartość białka i tłuszczu w mleku krów rasy czarno–białej importowanych do Polski oraz ich matek utrzymywanych w Holandii [Fat and protein content in milk of Black–and–White cows imported to Poland and their dams kept in Holland]. Med. Weter., 57, 518–521 [in Polish].
7. Kuczaj M., 2001. Ocena wydajności i składu mleka krów pierwiastek czarno– i czerwono–białych w Polsce [Evaluation of milk composition and yield in active populations of Black–White and Red–White primiparous cows in Poland]. Med. Weter., 57, 649–652 [in Polish].
8. Litwińczuk Z., Gnyp J., 1993. Powtarzalność składu chemicznego mleka w trzech laktacjach u krów czarno–białych i mieszańców F1 (hf x cb) [Recurrence of the chemical composition of milk in three lactations in BW cows and F_1 crossbreeds (HF x BW)]. Ann. UMCS, Sect. EE, 11, 61–66 [in Polish].
9. Pogorzelska J., Wielgosz–Grosz Z., Kijak Z., 1998. Wpływ buhajów rasy holsztyńsko–fryzyjskiej na użytkowość mleczną krów mieszańców F1 w stadzie wysokoprodukcyjnym [Influence of HF sires on milk production performance of F1 hybrid cows in high yielding herd]. Zesz. Nauk. AR Wroc. Konf., 17, 331, 165–173 [in Polish].
10. Ruszczyc Z., 1981. Metodyka doświadczeń zootechnicznych [Methods of Experiments in Zootechnics]. PWRiL, Warszawa [In Polish].
11. Żuk B., Szyszkowski L., Filistowicz A., 1980. Poprawki na wiek i sezon ocielenia dla korygowania cech mleczności krów rasy czerwono–białej i czarno–białej w Polsce południowo–zachodniej [Correction for age and calving season to rectify milking traits of cows of the Red–and–White and Black–and–White breed in south–west Poland]. Rocz. Nauk Rol. Ser. Zootech., 100, 3, 53–66 [in Polish].

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