

CORRELATIONS BETWEEN THE NUMBER OF SOMATIC CELLS AND QUALITATIVE AND QUANTITATIVE PARAMETERS OF MILK DEPENDING ON THE STAGE OF LACTATION OF COWS FROM THE BULGARIAN BLACK AND WHITE BREED

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Original scientific paper

Abstract: The study was conducted to establish correlations between the number of somatic cells and quantitative and qualitative parameters in the milk of cows from the Bulgarian Black and White breed. 819 numbers of individual milk samples were tested. The controls were conducted in spring-summer period (April - September) of 2009. The controlled parameters were milk fat (%), total protein (%), somatic cell count (number / ml), milk fat (kg) and milk protein (kg). Distribution in groups: depending on the stage of lactation – up to the 120th day of the lactation (n = 292) and after the 120th day (n = 527) and according to the level of somatic cells in milk- up to 400000 somatic cells / ml, from 400000 to 500000 somatic cells/ml and more than 500000 somatic cells/ml. Relationship between the studied parameters is represented by the values of linear correlation. The results show that there are from moderate to high positive correlations between the amount of milk yield per day of quantitative parameters milk fat and milk protein per day for the three levels of somatic cells. Correlation coefficients between the amount of milk yield per day and quality parameters - % milk fat and % of total protein per day for the three levels of somatic cells were negative and moderate. The relationship between the number of somatic cells in milk and quantitative and qualitative parameters is low.

Key words: cows, milk yield, somatic cells, correlation

Introduction

The number of somatic cells is an indicator of udder health. Their appearance in milk is an indicator of udder infection. Milk from healthy cows normally contains from 50 000 to 200 000 somatic cells in 1 ml of milk. Higher

values indicate a venerable infection. (*Heeschen and Reichmuth, 1995; Heeschen et al., 1996; Auldist et al., 1996*). In our country (*Regulation 30 of 01.01.2001*) the requirement about the somatic cells in cow's milk is up to 400 000 somatic cells/ml for the extra quality, less than 500 000 somatic cells/ml for first quality and under 1 million somatic cells/ml for the second quality. In recent years the interest of many authors is aimed at clarifying the dependence of various quantitative and qualitative parameters of the number of somatic cells in milk (*Todorova and Petrova, 1995; Filippov, 1996, Petrova et al., 1998; Fenerova et al., 2008; Borkowska et al., 2003; Fernandes et al., 2004*). The purpose of this study was to establish correlations between the number of somatic cells with quantitative and qualitative parameters in the milk of cows from the Bulgarian Black and White breed.

Materials and Methods

The total data included 819 individual milk samples obtained from healthy cows from the Bulgarian Black and White breed were tested. The cows were kept and fed under identical conditions in a herd of company "Katle" P. Penev in town Varna. Controls were conducted in spring-summer period (April - September) of 2009. The next daily average quantitative parameters were determined: milk from the control day (kg), milk fat (kg), milk protein (kg). The qualitative parameters were milk fat (%), total protein (%) and number of somatic cells (n / ml) in milk. Depending on the stage of lactation, animals were divided into two groups – up to the 120th day of the lactation (n = 292) and after the 120th day (n = 527). According to the level of somatic cells in milk, the individual samples in each subgroup were divided into three sub-groups – with the content of somatic cells up to 400 000 somatic cells / ml, from 400 000 to 500 000 somatic cells / ml and more than 500 000 somatic cells / ml. The criteria for the number of somatic cells were complying with the parameters for milk quality (*Directive 92/46 EEC and Regulation 30/01.01.2001*) of European Union. Relationship between the studied parameters is represented by the values of linear correlation.

Results and Discussion

The results from the correlations between quantitative and qualitative parameters of milk and number of somatic cells at different stages of lactation / up to the 120th and after the 120th day / are shown in Tables 1, 2 and 3. Data from the tables show that the three groups have high positive correlation between the amount of milk from the control day (kg) and milk protein (kg). The values of the correlation coefficient between the amount of milk and milk protein are 0.884, 0.902 and 0.951 in the group up to the 120th days of lactation, and in the group after the 120th day these values are respectively 0.944, 0.987 and 0.939. For the group up to 400 000 somatic cells / ml the correlation coefficient between the quantity of

milk and milk fat is 0.447 up to the 120th day and respectively 0.483 after the 120th day.

In the group up to 500 000 somatic cells / ml up to the 120th day of the lactation the value of the coefficient is very low +0.072, and after the 120th day of the lactation this value is very high +0.792. In the third group with more than 500 000 somatic cells / ml up to the 120th day was observed inverse relation – the coefficient is very high +0.702, and after the 120th day that value is moderate +0.539.

The relationship between the quantity of milk and quality parameters is negative. The values of the correlations are from low to moderate. In the group with a somatic cell up to 400 000 somatic cells / ml and more than 500 000 somatic cells / ml the correlation coefficient between the quantity of milk yield and total protein (%) is low (-0.072 and -0.112) in the group up to the 120th day and the quantity of milk yield and fat (%) is moderate (-0.390 and -0.434). The tendency is the same in the group up to 400 000 somatic cells / ml after the 120th day (-0.442 and -0.512), and in the group with more than 500,000 somatic cells / ml these values are high (-0.710 and -0.609). When the number of somatic cells is from 400,000 to 500,000 somatic cells / ml the correlation coefficients ranged from -0.415 (between milk yield and % fat content) and -0.734 (between milk yield and protein %) in cows up to the 120th day, and in animals after the 120th day, respectively -0.438 and -0.792.

The values of the correlations between the number of somatic cells and quantitative parameters in the group up to the 120th day of the lactation were low and negative. An exception occurred in the group up to 500 000 somatic cells / ml where the correlation coefficient between the quantity of milk yield and somatic cells is also negative, but moderate (-0.247) and the coefficient of correlation between the amount of milk fat and somatic cells which is also low, but positive (0.054). In the group with up to 400 000 somatic cells / ml the relationship between the somatic cells and milk fat and milk protein is also positive (0.084 and 0.101). An exception is observed in the group up to 500 000 somatic cells / ml where the correlation coefficient between the quantity of milk yield and somatic cells is also negative, but moderate (-0.247). The values of the correlations between the number of somatic cells and quantitative parameters in the group after the 120th day of the lactation were low and negative. An exception occurred in the group up to 500 000 somatic cells/ ml and more than 500 000 somatic cells / ml where the coefficients of correlation between somatic cells and the amount of milk yield and milk protein are also low, but they are positive. They ranged from 0.046 to 0.136.

In the three 3 subgroups with different number of somatic cells in the group up to the 120th days of the lactation, the correlations between quantitative and qualitative parameters are positive and their values are from low to moderate. An exception was observed in correlations between the percentage of milk fat and the amount of protein (-0.251 in the group with a level of somatic cells up to 400 000 somatic cells / ml), between the percentage of milk fat and the amount of protein and between the total protein % and amount of protein (-0.042 and -0.374 in the

group with a level of somatic cells up to 500 000 somatic cells / ml) and between the percentage of total protein and milk fat, between the milk fat % and the amount of protein and between milk fat % and somatic cells (-0.022, -0.404 and -0.028 in the group with a level of somatic cells more than 500,000 somatic cells / ml), where the values change their sign. In the group after the 120th day of the lactation in all three levels of somatic cell, the correlations between quantitative and qualitative parameters are positive in sign and from low to moderate values. An exception was observed in correlations between the percentage of milk fat and the amount of protein, % of total protein and the amount of milk fat and between the % of total protein and the amount of protein per day, where they change their sign and take negative values. Negative and with very low values are the correlations between the number of somatic cells and % milk fat (-0.041) in the group with the level of somatic cells up to 500 000 somatic cells / ml and between the somatic cell and % milk fat (-0.177) and the number of somatic cells and % of total protein (-0.097) in the group with the level of somatic cells more than 500,000 somatic cells / ml.

Table 1. Values of the phenotypic correlation between investigated milk parameters with a level of somatic cells up to 400000 somatic cells/ml

Parameters	Milk from the control day (kg)	Milk fat %	Total protein %	Milk fat per day (kg)	Milk protein per day (kg)	Number of somatic cells x 1000
Milk from the control day (kg)		-0.390	-0.072	0.447	0.884	-0.009
Milk fat %	-0.442		0.217	0.611	-0.251	0.138
Total protein %	-0.512	0.434		0.187	0.392	0.220
Milk fat per day (kg)	0.483	0.527	-0.088		0.503	0.084
Milk protein per day (kg)	0.944	-0.348	-0.221	0.526		0.101
Number of somatic cells x 1000	-0.079	0.057	0.065	-0.021	-0.065	

Table 2. Values of the phenotypic correlation between investigated milk parameters with a level /of somatic cells from 400000 to 500 000 somatic cells/ml

Parameters	Milk from the control day (kg)	Milk fat %	Total protein %	Milk fat per day (kg)	Milk protein per day (kg)	Number of somatic cells x 1000
Milk from the control day (kg)		-0.415	-0.734	0.072	0.902	-0.247
Milk fat %	-0.438		0.814	0.864	-0.042	0.286
Total protein %	-0.792	0.582		0.447	-0.374	0.553
Milk fat per day (kg)	0.792	0.169	-0.542		0.402	0.054
Milk protein per day (kg)	0.987	-0.391	-0.706	0.796		-0.001
Number of somatic cells x 1000	0.046	-0.041	0.278	-0.009	0.123	

Table 3. Values of the phenotypic correlation between investigated milk parameters with a level of somatic cells more than 500 000 somatic cells/ml

Parameters	Milk from the control day (kg)	Milk fat %	Total protein %	Milk fat per day (kg)	Milk protein per day (kg)	Number of somatic cells x 1000
Milk from the control day (kg)		-0.434	-0.112	0.702	0.951	-0.024
Milk fat %	-0.710		0.058	0.268	-0.404	-0.028
Total protein %	-0.609	0.453		-0.022	0.188	0.057
Milk fat per day (kg)	0.539	0.151	-0.263		0.692	-0.095
Milk protein per day (kg)	0.939	-0.664	-0.331	0.561		-0.001
Number of somatic cells x 1000	0.136	-0.177	-0.097	-0.107	0.114	

Note to Table. 1, 2 and 3: above the diagonal - for the group up to the 120th day of the lactation, under the diagonal-the group after the 120th day of the lactation

Conclusion

There were from moderate to high positive correlation between the amount of milk yield per day and the next quantitative parameters: milk fat and milk protein per day for the three levels of somatic cells. The values of the correlation between the amount of milk yield per day and qualitative signs: % milk fat and % total protein per day for the three levels of somatic cells were negative and with moderate values. The relationship between the number of somatic cells in milk and quantitative and qualitative parameters is low.

Korelacija broja somatskih ćelija i kvantitativnih i kvalitativnih parametara mleka u zavisnosti od faze laktacije krava bugarske crno bele rase

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Rezime

Istraživanja su postavljena da bi se utvrdile korelacije između broja somatskih ćelija i kvantitativnih i kvalitativnih parametara u mleku bugarske crno bele rase krava. Ispitivano je 819 uzoraka mleka. Kontrola je sprovedena u periodu proleće-leto 2009. godine. Kontrolni parametri su bili: mlečna mast (%), ukupni protein (%), broj somatskih ćelija (broj/ml), mlečna mast (kg) i mlečni protein (kg). Raspored u grupi: zavisi od faze laktacije- do 120-tog dana (n=292) i nakon 120-tog dana (n=527) i od broja somatskih ćelija u mleku – do 400 000 ćelija/ml, od

400 000 do 500 000 somatskih ćelija/ml i više od 500 000 somatskih ćelija/ml. Veza između ispitivanih parametara prikazana je vrednostima linearne korelacije. Rezultati pokazuju da postoji umerena do visoka korelacija između količine mleka proizvedenog po danu i kvantitativnih parametara mlečne masti i mlečnih proteina za tri nivoa somatskih ćelija. Korelacioni koeficijenti između količine mleka proizvedene po danu i kvalitativnih parametara- procenta mlečne masti i ukupnih proteina, za tri nivoa somatskih ćelija bili su negativni i umereni. Veza između broja somatskih ćelija u mleku i kvantitativnih i kvalitativnih parametara je slaba.

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