Biotechnology in Animal Husbandry 27 (3), p 1059-1066 , 2011 ISSN 1450-9156
Publisher: Institute for Animal Husbandry, Belgrade-Zemun UDC 636.082.2
DOI: 10.2298/BAH1103059R

EVALUATION OF BREEDING VALUES OF BULLS FOR SOMATIC CELL COUNT IN MILK

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Original scientific paper

Abstract: The incidence of subclinical and clinical mastitis in the mammary gland produces variety of defensive factors were nuclear leukocytes, lymphocytes and macrophages play an important role and they are marked as somatic cells. Somatic cell count depends on the type of pathogen and stage of infection. Increased number of somatic cells in milk occurs as a result of lesions in the mammary gland. Studies have shown that the somatic cells count is genetically predisposed. Although the heritability of this trait is low, using modern methods and the proper selection of work it is possible to achieve some progress. Therefore it is necessary to the selection of bulls for somatic cells, on the basis of somatic cells in milk of daughters. Data on milk yield and somatic cell count in milk of 247 cows Holstein Friesian and Simmental breed from Vojvodina province, were used to analyze the evaluation of breeding values for somatic cells in milk Average values and variability of somatic cells, milk yield, milk fat yield and protein and content of milk fat and protein were determined. The average number of somatic cells was 317 000 per ml of milk, with high variability. Average milk yield of 7 634kg with an average content and yield of milk fat from 3.74% to 285.69 kg and the average protein content and yield of 3.15% and 237.15 kg were determined. Assessment of breeding values was calculated using BLUP model of father, high variability in the assessment of bulls was found. Getting more accurate breeding values is possible using the Animal Model.

Key words: somatic cell count, evaluation of breeding values, milk

Introduction

Selection of dairy cattle is reflected in the improvement of all economically important traits, which include, in addition to milk traits - yield of milk, fat and protein, conformation, longevity, calving ease, fertility of cows,

milking speed and temperament, also udder health traits which include the somatic cell count in cow milk and incidence of clinical mastitis.

Radinović (2008) in the study of the quantity of milk produced in standard lactation on farms included in the milk recording in Vojvodina, point out that production of milk in 305 days ranged from 5753 to 6533 kg. *Alberquerque et al. (1995)* established the average milk yield in lactation of Holstein-Friesian cows in the State of New York of 8712 kg, whereas in California it was even 10 295 kg. In the analysis of completed lactations of Holstein-Friesian cows in Vojvodina, the average milk yield in standard lactation of 5741 kg was established, with milk fat content and yield of 3.47 and 197 kg, respectively *(Trivunović, 2006)*. According to report by *Marković (1999),* the average milk yield of Holstein-Friesian cows in the first lactation was 5556 kg with 3.59% and 198.5 kg of milk fat, whereas for all lactations the average milk yield of 5957 kg was obtained with milk fat content and yield of 3.55% and 210.3 kg, respectively. As pointed out by *Gaidarska (2009),* the average milk yield of Black and White cows in Bulgaria in the first lactation, recorded in the period from 1996 to 2005, was 4357kg with 3.74% of milk fat.

Increased somatic cell count in milk leads to decrease of amount of milk coming from the udder as well as to changes of its composition. Somatic cell count in milk influences the price of raw milk in the sense that dairy plants which purchase milk from farmers want milk with somatic cell count of below 400.000 somatic cells in ml. One of the causes of increase of somatic cell count is mastitis. Mastitis is inflammation of the entire mammary gland, parts which produce, accumulate and secretion of milk *(Boboš, 2005)*. Symptoms of the inflammation can have subclinical form (subclinical mastitis) and clinical form (clinical mastitis). In case of subclinical and clinical mastitis, the mammary gland produces variety of defensive factors were nuclear leukocytes, lymphocytes and macrophages play an important role and they are regarded as somatic cells. Somatic cell count depends on the type and stage of infection causes. Increased somatic cell count in milk occurs as consequence of mammary gland lesions, and selection for the reduction of mastitis can be done indirectly, through selection for lower somatic cell count *(Haas et al., 2007)*. If somatic cell count in 1 ml of milk does not exceed 300000/ml and clinical condition of the udder is good, it must be considered that, nevertheless, 10-15% of quarters show signs of subclinical mastitis *(Boboš, 2005)*. As stated by *Radinović (2008)*, and pointed out by (1996), somatic cell count in collective milk sample from cows with all four quarters in good health should not exceed 100000/ml. In the study of somatic cell count in milk per dairy cow, *Radinović (2008)* established values which ranged from 392000 to 648000/ml. The similar results were obtained in studies carried out by *Wilson et al. (1971)* and *Lents et al. (2007)*.

Studies have shown that the somatic cell count in cow milk and milk traits are genetically predisposed. Heritability value for this trait is approx. 0.09 *(Keown*

and Kononoff, 2007). Considering that the genetic value of bulls cannot be directly determined, the assessment is carried out based on production of their daughters which can be directly measured *(Panić and Vidović, 2006)*. *Vidović et al. (1993)*, used BLUP and CC method in the evaluation of the bulls' breeding value, and obtained results had similar scores and rank.

Objective and task of this study was to determine the average value of milk performance traits and assess the breeding value of bulls for somatic cell count in milk.

Materials and Methods

In order to obtain data on milk performance traits and somatic cell count, milk from cows was samples on individual agricultural holdings/farms. The study included 247 cows of Holstein-Friesian breed, Simmental breed and cows of Red Holstein breed.

Prior to sampling, data on cows was collected, as follows: CS cow number, date of birth, parity date of last calving and HB number of the bull sire of female breeding animal.

The average value and variability of studied milk performance traits according to breeds were calculated using the software package STATISTIKA 10. Genetic parameters were calculated using the software package LSMLMW (*Harvey, 1990*) by method of intra-class correlation. Mathematical-statistical model used for calculation of genetic parameters was:

$$Y_{ijklmno} = \mu + O_i + F_j + Gt_k + S_l + Gr_m + L_n + R_o + e_{ijklmnop}$$

where:

Y – phenotypic value of observed traits
μ - general mean value
O_i – random effect of the bull sire
F_j – fixed effect of the farm
Gt_k – fixed effect of the calving year
S_l – fixed effect of the calving season
Gr_m – fixed effect of the year of birth
L_n – fixed effect of the lactation
R_o – fixed effect of the breed
e – other uncontrollable effects (random error).

Results and Discussion

According to the data presented in Table 1., average somatic cell count in milk produced by daughters of studied animals, in both breeds, was 317000/ml,

with standard deviation of 322.32 and minimum of 8000 and maximum of 999 000. In the study of the somatic cell count in milk per dairy animal, the mean value per ml of collective milk in the range from 392000 to 648000 was established *(Radinović, 2008)*.

Established average milk yield, for all three breeds, was 7634 kg, with average milk fat content of 3.74% and average milk protein content of 3.15%.

Table 1. Average values and variability of studied traits

Trait	$\bar{x}$	$S\bar{x}$	SD	min	max
SSC	317000	20.51	322.32	8000	999000
MY	7 634	137.49	2160.91	3304	15577
MFC	3.74	0.04	0.66	1.88	4.87
PC	3.15	0.02	0.24	2.58	3.77
MFY	285.69	6.30	99.01	111.573	602.8299
PY	237.15	3.56	55.98	105.728	425.2521

SCC – somatic cell count; MY – milk yield; MFC – milk fat content; PC – protein content; MFY – milk fat yield; PY – protein yield

Lower average milk yield in standard lactation, content and yield of milk fat in Holstein-Friesian cows were reported by *Trivunović (2006)* and *Radinović (2008)*.

Significantly higher average milk yield in Holstein-Friesian cows was recorded by *Alberquerque et al. (1995)*. Value reported for the State of New York was 8 712 kg, and for California even 10 295 kg.

Data presented in Table 2 shows that the average somatic cell count per studied bull sire was 308000, whereas the maximum somatic cell count was 708000, and minimum 31000.

Approximately the same average somatic cell count in cow milk of 308 200/ml is reported in the study by *Lents et al. (2007)*.

Significantly higher average somatic cell count in milk from F1 generation of angus-Holstein is reported by *Wilson et al. (1971)* and in cows in the first lactation the reported value was 761 000/ml.

The bulls' breeding value for somatic cell count was calculated/evaluated, because this trait is becoming increasingly important in conditions of contemporary milk production. In evaluation of the breeding value of bulls BLUP sire model was used, starting from the assumption that all cows were of the same genetic value and that there was only one relationship between half-sisters after their father.

Table 2. Evaluation of the bulls' breeding value, LS mean values (000) and standard errors of the mean values for somatic cell count

Bull sire	BLUP	LSM	LSE	Bull sire	BLUP	LSM	LSE
1	-168	140	250	26	106	414	246
2	-235	73	304	27	-130	178	299
3	9	317	280	28	394	702	366
4	-191	117	288	29	-174	134	289
5	-247	61	332	30	-112	196	274
6	300	608	309	31	131	439	300
7	205	513	331	32	-142	166	310
8	34	342	279	33	-70	238	254
9	-216	92	337	34	-91	217	283
10	189	497	356	35	-157	151	298
11	476	784	371	36	228	536	356
12	-255	53	343	37	43	351	393
13	-136	172	301	38	281	589	332
14	-242	66	331	39	236	544	380
15	-2	306	279	40	-40	268	393
16	123	431	271	41	-104	204	273
17	109	417	463	42	480	788	379
18	-156	152	332	43	-86	222	369
19	64	372	278	44	182	490	327
20	301	609	285	45	-207	100	332
21	-63	245	337	46	-256	52	417
22	89	397	256	47	-222	86	287
23	-18	290	337	48	-151	157	318
24	-212	96	332	49	-227	31	324
25	317	625	269	50	60	368	289

Results showed that some breeding males had very high scores for breeding value. Also, high variability in the evaluation of the breeding value of bulls was established. By applying any of the animal models (single trait AM, AM for repeated lactations, multiple traits AM) more precise evaluation of breeding value is obtained. Increase in the accuracy of the evaluation of the breeding value of low heritability traits is achieved by applying the multiple trait animal model, and the level of increase depends on the heritability of traits included in the model.

Conclusion

Research results have shown that the average milk fat and protein contents are adequate and correspond to the requirements of the market.

In the present study, somatic cell count was established which meets the standards required not only in Serbia, but also in EU. However, high phenotypic variability indicates the necessity for further work on optimization of the

environmental factors. On one hand, this is inevitable in order to eliminate the incidence of high somatic cell count in all dairy animals. On the other hand, decrease of the phenotypic variability would contribute to increase of heritability and increase of selection efficiency for this trait.

Obtained results indicate high variability in the evaluation of bulls' breeding values for somatic cell count, which further indicates the possibility of selection of bulls in order to reduce the somatic cell count. Considering that this is trait with low level of heritability, application of the Animal Model in the evaluation of the breeding values would result in more precise values.

Acknowledgment

Research was financed by the Ministry of Education and Science, Republic of Serbia, project TR-31086.

Ocena oplemenjivačke vrednosti bikova za broj somatskih ćelija u mleku

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Rezime

Kod pojave subkliničkog i kliničkog mastitisa mlečna žlezda produkuje mnoštvo odbrambenih faktora od kojih značajnu ulogu imaju polimorfo nuklearni leukociti, limfociti i makrofage koje označavamo kao somatske ćelije. Broj somatskih ćelija zavisi od vrste uzročnika i stadijuma infekcije. Povećan broj somatskih ćelija u mleku javlja se kao posledica lezija na mlečnoj žlezdi. Istraživanja su pokazala da je broj somatskih ćelija genetski predisponiran. Iako je heritabilnost za ovu osobinu niska, uz pomoć savremenih metoda i pravilnog selekcijskog rada moguće je postići određeni genetski napredak. Zbog toga je potrebno vršiti selekciju bikova za broj somatskih ćelija i to na osnovu broja somatskih ćelija u mleku ćerki. Podaci o mlečnosti i broju somatskih ćelija u mleku kod 247 krava holštajn-frizijske i simentalske rase sa teritorije Vojvodine, korišćeni su za analizu ocene oplemenjivačke vrednosti za broj somatskih ćelija u mleku krava. Izračunate su prosečne vrednosti i varijabilnost broja somatskih ćelija, prinosa mleka, prinosa mlečne masti i proteina i sadržaja mlečne masti i proteina. Prosečan broj somatskih ćelija u ml iznosio je 317 000, sa velikom varijabilnošću. Utvrđen je prosečan prinos mleka od 7634 kg uz prosečan sadržaj i prinos mlečne masti od 3,74% i 285,69kg i prosečan sadržaj i prinos proteina od 3,15% i 237,15 kg. Ocena oplemenjivačke vrednosti je izračunata primenom BLUP

modela oca, utvrđena je velika varijabilnost u oceni priplodnjaka. Dobijanje preciznije oplemenjivačke vrednosti moguće je primenom Animal Modela.

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Received 30 June 2011; accepted for publication 15 August 2011