

Physical-chemical parameters of milk of Holstein cows, depending on the origin

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Abstract. In the Sverdlovsk region, dairy cattle of the Holstein breed is widely used, obtained as a result of long-term use of the global gene pool of Holstein servicing bulls. The assessment of the nutritional value of milk from cows-daughters of different servicing bulls of Holstein cattle genealogical lines and its quality from the point of view of raw materials for the dairy industry is relevant and has practical significance. As a result of the conducted research, it was found that the livestock of cattle in the farm belongs to five lines – these are Vis Back Ideal 1013485 (25.1%), Reflection Sovering 198998 (19.6%), Montwick Chieftain 95679 (18.2%), Pabst Governor 882933 (22.7%), and Annas Adema 30587 (14.4%). Several servicing bulls are used in each line. Milk obtained from cows-daughters of servicing bulls of the Annas Adema 30587 line has high nutritional values of milk and its caloric content is 76.15-77.50 kCal, which is higher than average. The milk of cows-daughters of all servicing bulls from all the studied lines, despite the difference in physical-chemical parameters, met the requirements of GOST 31449-2013 "Raw cow's milk. Technical specifications" of the highest grade. Thus, the farm breeds highly productive Holstein cattle with high milk quality indicators.

1 Introduction

The fulfillment of the task of ensuring the country's food security is directly related to the development of the country's agro-industrial complex. Dairy cattle breeding is the leading branch of animal husbandry, providing the production of raw milk as the main product and up to 83.4% of gross beef production as a by-product. It is difficult to overestimate the role of dairy cattle breeding in ensuring the country's food security. Currently, the widespread use of highly productive dairy cattle makes it possible to meet the needs for milk and dairy products by 90%, and no external factors can significantly shake the situation in the dairy market. As the events of recent years have shown, in the most unfavorable development of events, we can cover the deficit at the expense of domestic production, that is, Russians will never be left without milk, butter, and cheese [1-3]. Currently, the main dairy breed common throughout the Russian Federation is the Holstein breed, recognized as the most abundantly dairy breed in the world and created in North America in the USA and Canada [4]. Its distribution in almost all regions of the country is explained by the long-term use of

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the global gene pool of Holstein breeding bulls in improving the breeding stock of dairy and combined breeds bred in the country to increase the productive and technological qualities of animals. The value of milk as a food product obtained from these animals is determined by its chemical composition and the individual components that it contains, and as a raw material for processing into dairy products by the properties of individual components and complexes of all substances included in it [5-9]. Their variability is influenced by a large number of factors, including genetic ones.

In this regard, the assessment of the nutritional value of milk from cows-daughters of different servicing bulls of different genealogical lines of Holstein cattle and its quality from the point of view of raw materials for the dairy industry is relevant and has practical significance.

The purpose of the work is to evaluate the nutritional value and quality of milk from cows-daughters of different servicing bulls of genealogical lines of Holstein cattle.

2 Materials and Methods

The experimental part of the work was carried out in the period from 2022 to 2023 in a typical breeding reproducer for the Sverdlovsk region for Holstein cattle breeding. The material and data for comparison were the IAS "SELEX-Dairy Cattle" database, the results of their own research. The indicators of dairy productivity of cows of the herd were evaluated according to the last completed lactation. Milk productivity was assessed based on the results of control milking once a month. The physical-chemical and sanitary-hygienic parameters of cow's milk were evaluated using modern milk analyzers and according to generally accepted methods in accordance with GOST 31449-2013 "Raw cow's milk. Technical conditions" in the dairy laboratory of the Department of Biotechnology and Food Products of the Ural State Agrarian University.

3 Results and Discussion

The cattle livestock in the farm belongs to five lines – these are Vis Back Ideal 1013485 (25.1%), Reflection Sovering 198998 (19.6%), Montwick Chieftain 95679 (18.2%), Pabst Governor 882933 (22.7%), and Annas Adema 30587 (14.4%). There are more than 52.3% of cows of the first two lines in the herd, but the first heifers among them are only 15.8% of the total number of cows and 30.3% of the first heifers in the herd. That is, the majority of animals of these lines are lactated at 2 and older lactations. 69.7% of the first heifers belong to the Montwick Chieftain 95679, Pabst Governor 882933, and Annas Adema 30587 lines (table 1).

Table 1. Genealogical structure of the breeding stock.

Line	Total livestock, heads of		Cows			
			in total		including 1 lac.	
	number of goals	%	number of goals	%	number of goals	%
Vis Back Id 1013485	517	25,1	280	30,3	78	16,2
Reflection Sovering 198998	403	19,6	203	22,0	68	14,1
Montwick Chieftain	375	18,2	175	19,0	132	27,4
Pabst Governer	468	22,7	168	18,2	136	28,2
Annas Adema 30587	296	14,4	96	10,5	68	14,1

total:	2058	100	922	100	482	100
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There are approximately the same number of animals belonging to one or another line in the herd, nevertheless, 2 main lines can be distinguished - Vis Back Ideal 1013485, Pabst Governor 882933, which occupy 47.8% of the specific weight of the breeding stock.

The cows of the Montwick Chieftain 95679, Pabst Governor 882933, and Annas Adema 30587 lines are of the greatest interest, since they have recently been used on the farm. We analyzed the results of the dairy productivity of cows of these lines.

The characteristics of relatively young lines in terms of cow productivity on average for completed lactation are presented in table 2.

Table 2. Dairy productivity of cows of Holstein lines.

Indicator	Annas Adema 30587	Montwick Chieftain 95679	Pabst Governer 882933
Number of heads	96	175	168
Milk yield, kg	8585±99,5	8947±109,7	8667±112,4
MJ, %	4,97±0,04	4,15±0,04	4,31±0,03
MDB, %	3,24±0,02	3,25±0,01	3,26±0,02
Live weight, kg	539±3,3	537±4,2	529±2,9

Several servicing bulls are used in each line. Thus, currently the farm uses 4 bulls from the Annas Adema 30587 line, 10 bulls from the Montwick Chieftain 95679 line, and 3 bulls from the Pabst Governor 882933 line.

The bulk of the cows of the Annas Adema 30587 line, lactating on the farm daughters of the servicing bulls: Statny 177, Dent 2244592261, Dancer 71088577, Marcellus 136057831. The best productivity indicators were found in the daughters of the servicing bull Dancer 71088577, who surpassed the daughters of other servicing bulls in milk yield by 489-1170 kg, the amount of milk fat - by 39-65 kg, milk protein - by 12-36 kg, and the coefficient of milk content by 59-227 kg/100 kg of live weight.

Of the Montwick Chieftain 95679 line, the largest number of daughters are from three servicing bulls: Deltar 1952, Emix-M 468186, and Maradonna-M 466685. This is a fairly young line in the farm, which is confirmed by the large number of cows for the first lactation, and the fact that the daughters of the estimated bull Maradonna-M 466685 are used for milk production for the first 2 lactation. The daughters of the servicing bull Deltar 1952 are used for a longer time. Nevertheless, they were inferior to the daughters of other bulls in milk yield by 639-622 kg or by 7.2-7.0%.

The Pabst Governor 882933 line is represented by the daughters of the servicing bulls Elsinore-M 1731, Ron-M 2671, and Nog-Raulio-M 490480. All of them had high productivity indicators.

To assess the value and quality of the products obtained, studies of the physico-chemical and sanitary-hygienic parameters of milk are used.

Table 3 presents data on the physical-chemical parameters of milk from cows of the Annas Adema 30587 line from different servicing bulls.

Table 3. Physico-chemical parameters of cow milk from bulls of producers of the Annas Adema line 30587.

Indicator	The bull is a producer			
	Stately 177	Dent 2244592261	Dancer 71088577	Marcellus 136057831
Dry matter, %	13,58±0,24	13,53±0,31	13,70±0,27	13,50±0,43
SOMO, %	8,72±0,12	8,76±0,09	8,76±0,13	8,69±0,14
Fat, %	4,86±0,02	4,77±0,01	4,94±0,02	4,81±0,02
Protein, %	3,19±0,002	3,19±0,002	3,16±0,04	3,14±0,003

Milk sugar, %	4,67±0,003	4,72±0,002	4,73±0,004	4,69±0,003
Ash, %	0,73±0,002	0,72±0,002	0,74±0,001	0,73±0,002
Density, °A	30,8±0,028	30,3±0,032	30,6±0,019	30,3±0,034
Acidity, °T	16,0±0,001	16,3±0,002	16,5±0,003	16,2±0,004
Calorie content, kCal	76,64	76,00	77,50	76,15

It was found that milk obtained from cows-daughters of servicing bulls of the Annas Adema 30587 line has high nutritional values of milk and its caloric content is 76.15 – 77.50 kCal, which is higher than average. This is due to the high FMF values in milk. The difference in its content in the milk of the daughters of different bulls had an impact on calorie content. The remaining indicators did not have significant differences, they provide the biological value of milk and did not have a big impact on its nutritional value.

Milk is accepted to dairy plants in accordance with GOST 31449-2013 "Raw cow's milk. Technical specifications" (table 4).

Table 4. Quality indicators and milk grade.

Indicator	The bull is a producer			
	Stately 177	Dent 2244592261	Dancer 71088577	Marcellus 136057831
Fat, %	4,86±0,02	4,77±0,01	4,94±0,02	4,81±0,02
Protein, %	3,19±0,002	3,19±0,002	3,16±0,04	3,14±0,003
Density, °A	30,8±0,028	30,3±0,032	30,6±0,019	30,3±0,034
Acidity, °T	16,0±0,001	16,3±0,002	16,5±0,003	16,2±0,004
Freezing point, °C	-0,531±0,001	-0,538±0,002	-0,544±0,023	-0,546±0,003
Mechanical contamination, group	1	1	1	1
Bacterial contamination of milk, thousand/ cm3	168±10,8	106±7,3	143 ±9,5	98 ±7,2
The presence of somatic cells, thousand/ cm3	187 ±9,9	128±10,6	163 ±12,9	130±17,1
Variety	upper	upper	upper	upper

It can be seen from the table that all milk has high quality indicators, which allows it to be delivered in the highest grade.

Table 5 presents data on the physical-chemical parameters of milk from cows-daughters of bulls from the Montwick Chieftain 95679 line.

Table 5. Physico-chemical parameters of milk of cows-daughters of bulls-producers from the Montwick Chieftain line 95679.

Indicator	The bull is a producer		
	Deltar 1952	Emix-M 468186	Maradonna-M 466685
Dry matter, %	13,18±0,28	13,08±0,14	13,12±0,21
SOMO, %	8,95±0,11	8,95±0,09	8,93±0,16
Fat, %	4,23±0,03	4,13±0,03	4,19±0,05
Protein, %	3,26±0,02	3,27±0,02	3,26±0,02
Milk sugar, %	4,78±0,004	4,77±0,003	4,78±0,003
Ash, %	0,78±0,009	0,78±0,003	0,76±0,003
Density, °A	30,1±0,019	29,9±0,029	30,3±0,017
Acidity, °T	16,4±0,002	16,1±0,003	16,3±0,002
Calorie content, kCal	71,50	70,57	71,13

The milk of cows-daughters of all servicing bulls of the Montvik Chieftain 95679 line is characterized by high nutritional qualities, full-fledged composition, it is natural, which is confirmed by density and fresh, as evidenced by the acidity, which corresponds to fresh milk indicators.

Table 6 presents data on the sanitary and hygienic indicators of cow's milk.

Table 6. Quality indicators and milk grade.

Indicator	The bull is a producer		
	Deltar 1952	Emix-M 468186	Maradonna-M 466685
Fat, %	4,23±0,03	4,13±0,03	4,19±0,05
Protein, %	3,26±0,02	3,27±0,02	3,26±0,02
Density, °A	30,1±0,019	29,9±0,029	30,3±0,017
Acidity, °T	16,4±0,002	16,1±0,003	16,3±0,002
Freezing point, °C	-0,536±0,003	-0,533±0,002	-0,534±0,002
Mechanical contamination, group	1	1	1
Bacterial contamination of milk, thousand/ cm3	165±12,41	158±10,13	196±9,37
The presence of somatic cells, thousand/ cm3	89±3,24	92±4,21	108±2,98
Variety	upper	upper	upper

In accordance with GOST 31449-2013 "Raw cow's milk. Technical conditions" milk obtained from the daughters of servicing bulls of the Montvik Chieftain 95679 line meets the requirements of the highest grade.

Milk obtained from cows-daughters of servicing bulls of the Pabst Governor 882933 line differed in average indicators of the nutritional value of milk compared with other lines (table 7).

Table 7. Physico-chemical parameters of milk of cows-daughters of bulls-producers from the Pabst Governor 882933 line.

Indicator	The bull is a producer		
	Elsinore-M 1731	Ron-M 2671	Nog-Raulio-M 490480
Dry matter, %	13,19±0,23	13,10±0,24	13,21±0,20
SOMO, %	8,80±0,14	8,74±0,11	8,85±0,09
Fat, %	4,39±0,03	4,36±0,02	4,36±0,02
Protein, %	3,24±0,01	3,24±0,01	3,25±0,01
Milk sugar, %	4,67±0,003	4,62±0,005	4,71±0,002
Ash, %	0,76±0,002	0,75±0,003	0,76±0,003
Density, °A	30,4±0,019	30,1±0,009	30,3±0,007
Acidity, °T	16,1 ±0,002	16,1±0,003	16,3±0,002
Calorie content, kCal	72,47	71,99	72,39

The milk of cows-daughters of all servicing bulls is characterized by high nutritional qualities, full-fledged composition, it is natural, which is confirmed by density and fresh, as evidenced by the acidity, which corresponds to fresh milk. Compared with the milk of cows from other lines, the daughters of bulls of the line have intermediate fat content and the highest PMF values in milk, which indicates that from the point of view of biological usefulness, this milk is better.

Table 8 presents data on the sanitary and hygienic indicators of cow's milk.

Table 8. Quality indicators and milk grade.

Indicator	The bull is a producer		
	Elsinore-M 1731	Ron-M 2671	Nog-Raulio-M 490480
Fat, %	4,39±0,03	4,36±0,02	4,36±0,02
Protein, %	3,24±0,01	3,24±0,01	3,25±0,01
Density, °A	30,4±0,019	30,1±0,009	30,3±0,007
Acidity, °T	16,1 ±0,002	16,1±0,003	16,3±0,002
Freezing point, °C	-0,543±0,002	-0,537±0,003	-0,541±0,003
Mechanical contamination, group	1	1	1
Bacterial contamination of milk, thousand/ cm3	182±12,41	179±10,13	186±9,37
The presence of somatic cells, thousand/ cm3	102±3,24	106±4,21	98±2,98
Variety	upper	upper	upper

In accordance with GOST 31449-2013 "Raw cow's milk. Technical conditions" milk obtained from the daughters of servicing bulls of the Pabst Governor 882933 line meets the requirements of the highest grade.

4 Conclusion

Thus, it is possible to draw a general conclusion that the farm breeds highly productive Holstein cattle with high milk quality indicators. The origin influences the physical-chemical parameters of milk with its constant high quality when sold to dairy processing enterprises. Similar data were obtained in the studies of A.S. Gorelik, M.B. Rebezova, O.V. Gorelik [6]; O.V. Gorelik, A.S. Gorelik, N.A. Fedoseeva, M.V. Temerbayeva [7] and others.

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