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PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.1048989>Available online at: <http://www.iajps.com>**Research Article****GENETIC FORMATION FACTORS OF DAIRY EFFICIENCY  
AND QUALITY OF CATTLE MILK****I. M. Donnik<sup>\*1</sup>, O. G. Loretts<sup>1</sup>, O. A. Bykova<sup>1</sup>, Shkuratova I. A.<sup>2</sup>, Isaeva A. G.<sup>2</sup>,  
Krivonogova A. S<sup>2</sup>**<sup>1</sup>Federal state-funded educational institution of the higher education "Ural state agricultural university" (FGBOOU WAUGH Ural GAU) Yekaterinburg, Karl Liebknecht St., 42, Russia<sup>2</sup>Federal public budgetary scientific institution "Ural Research Veterinary Institute" (FGBNU Ural NIVI), Yekaterinburg, Belinsky St., 112-a, Russia**Abstract:**

*Experimental results of studying the efficiency of cattle selection method use on a genotype are presented to technologies of industrial milk production. For carrying out researches three groups of cows of the Ural black-and-white breed type from lines Sovering Reflexion, Vis Back Ideal, Montwick Chiftain were created, up to 20 heads in every. The comparative analysis of dairy efficiency and quality of cow milk of different linear accessory is carried out. Impact of linear accessory of cows on a milk yield in 305 days of lactation, the content in milk of fat and protein, a ratio in milk protein of replaceable and irreplaceable amino acids is defined. It is revealed that the B-allele a kappa casein is characterized by the high content of protein in milk with the best abomasal coagulability. 14.3% of cows of the line Montwick Chiftain and 8% Sovering Reflexion had a desirable genotype on kappa casein - Centuries. Protein content in cow milk with a genotype of BB exceeded milk-protein indicators of cows of other genotypes by 0.14-0.18%. By amount of irreplaceable amino acids cow milk of the line Vis Back Ideal was the best that exceeded value of this indicator in cow milk of the line Montwick Chiftain and Sovering Reflexion by 9.5% and 4.5% respectively. It is established that in cow milk with AA genotype the share of irreplaceable amino acids exceeded their content as a part of the general protein in cow milk with a genotype of BB and AB for 8.9 and 39% respectively.*

**Keywords:** milk, kappa casein, milk fat and protein, selection, genotype, amino acids.**Corresponding author:****I. M. Donnik**

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**INTRODUCTION:**

One of the most important conditions of increase in milk production and increase in efficiency of dairy cattle breeding in the country is high-quality improvement of the existing breeds, increase in their genetic potential [4, 6, 10, 14, 15]. Now it is reached considerably due to wide use of the best domestic breeds and resources of a world gene pool, and first of all golshtinsky breed.

Effective reception of thoroughbred animal husbandry is developed in our country also the way of cultivation, widespread in many countries of the world, on lines and families. Cultivation on lines as reception of breeding work provides a complex of the zootechnical actions directed to improvement, fixing and further improvement of valuable qualities of animals. Cultivation of the dairy cattle on lines is directed to receiving the animals similar on the qualities to the ancestor. Now the main objective of selection of the dairy cattle is in increasing productive qualities of animals from generation to generation [7, 8, 9].

In recent years there were many works and interesting data on a question of improvement of milk quality by selection methods became known. The genotype exerts considerable impact on technological properties of milk. Now with development of molecular genetics and molecular biology, there is possible an identification of genes, directly or the animals who are indirectly connected with dairy efficiency. Identification of options of such genes, preferable from the point of view of selection, will allow in addition to traditional selection of animals to carry out selection at the level of DNA technologies, i.e. on a genotype. The attention of researchers is drawn recently by a locus of a gene of one of the main milk proteins - kappa casein (CSNZ). The genotype of a bull on kappa casein can serve as additional criterion at selection of animals. When completing the breeding enterprises manufacturing bulls it is necessary to consider their genotype on kappa casein. Use of manufacturing bulls without their genotypes leads to decrease in frequency of occurrence in herd of desirable genotypes and to decline in quality of combined milk

Practice shows that for the solution of this task it is necessary to rely on modern selection achievements and, first of all, on wide use of improvers [1, 2, 3]. For acceleration of selection progress it is necessary to study specific features of lines and efficiency of their combinations that will allow defining prospects of the applied methods of selection and to direct work to creation of animals of desirable type.

**METHODS AND RESULTS:****Selection Work on Increase in Dairy Efficiency and Definition of Cow Milk Quality**

For increase in dairy efficiency in recent years in branch of dairy cattle breeding in our country the world gene pool, especially animal golshtinsky breed is actively used. Realization of genetic potential of cows of golshtinsky breed requires creation of comfortable conditions of keeping and ensuring the full feeding balanced on a complex of nutrients. In the Urals when using the golshtinsky cattle the new type of the Ural black-and-white breed is removed. Three lines of golshtinsky breed are most widespread in Sverdlovsk region: Sovering Reflexion, Vis Back Ideal, Montwick Chiftain. Therefore the comparative analysis of dairy efficiency and quality of cow milk of the Ural type of black-and-white breed of different linear accessory was carried out. For carrying out researches three groups of cows-analogs on the third lactation of lines Sovering Reflexion (1 group) were created, Vis Back Ideal (the 2nd group), Montwick Chiftain (the 3rd group) up to 20 heads in every.

For the analysis of dairy efficiency of cows used data of the information system "SELEKS". Dairy efficiency was estimated on a milk yield in 305 days of lactation, to milk coefficient, protein content and fat. Intensity of milk yield was considered according to the Dairymaster program. The structure and properties of cow milk studied on such indicators as a mass fraction of fat, protein, the dry fat-free dairy rest (DFFDR), density, acidity. Indicators of milk quality defined on the ultrasonic device "Clover 1-M" with use of the standard techniques. Determination of content of separate amino acids as a part of milk protein was carried out on the amino-acid T-339 analyzer by an ion-exchange chromatography. Assessment of polymorphism of genes kappa casein was carried out on the basis of the polymerase chain reaction (PCR).

**Dairy Efficiency of Cattle**

Dairy efficiency of cows is one of the main selection signs [5, 11, 13]. It is possible to estimate dairy efficiency on a number of indicators, the most important of which is the milk yield in 305 days of lactation [12]. Comparative assessment of dairy efficiency of cows depending on genealogical accessory showed that the highest dairy efficiency on average for lactation is received from cows of the line Sovering Reflexion that made 9183 kg. It exceeded the given indicator on group of cows of the line Montwick Chiftain on 420 kg and cows of the line Vis Back Ideal on 602 kg. The same tendency is traced also on an average daily milk yield. Advantage is established at animals of 1 group. Their milk yield on average was higher per day in comparison with cows 2 test groups on 15 and 3 test groups - for 20%.

**Table 1: Dairy efficiency of cows.**

Indicator	Group (Line of a bull)		
	Sovering Reflexion	Vis Back Ideal	Montwick Chiftain
Milk yield in 305 days	9183	8581	8763
Amount of milk fat, kg	350,7	351,8	330,6
Amount of milk protein, kg	285,6	267,5	264,2
The highest daily milk yield, kg	32,38	27,50	27,5
Live weight	623	620	652
Milk coefficient	1474	1384	1344

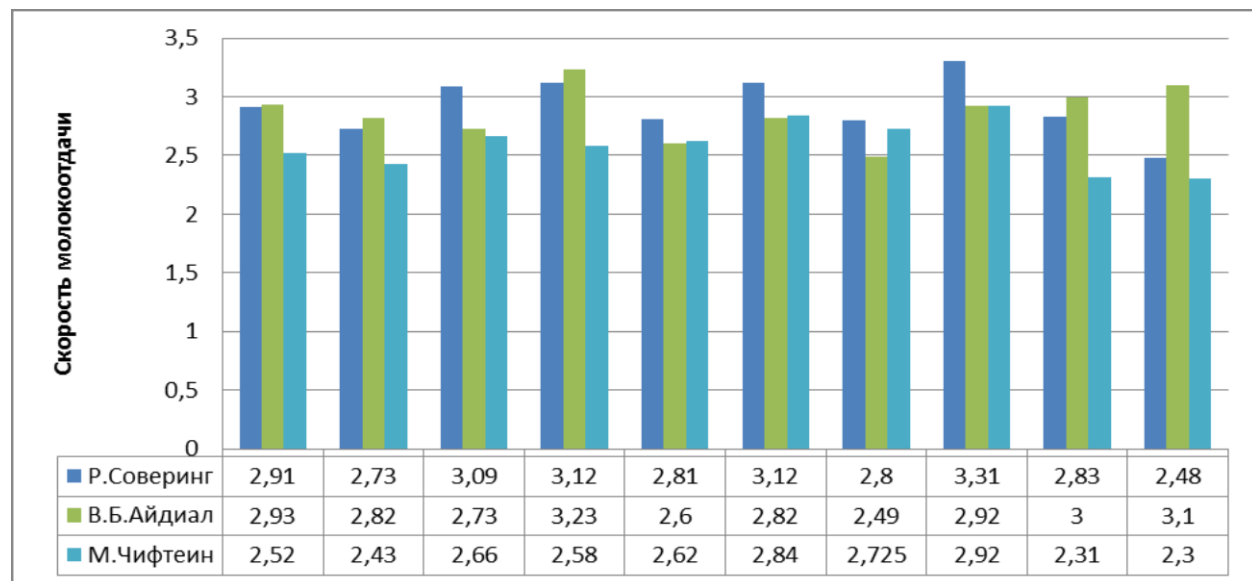
Assessment of milk quality on modern processing enterprises in the conditions of eco-production is carried out generally on the content in it of fat and protein. Fat and the milk-protein quality of cows is also one of the major selection signs. Results of researches demonstrate that the greatest number of milk protein is received with cow milk of the line Sovering Reflexion that was higher relatively than 2 and 3 groups on 18.1 - 21.4 kg. With cow milk of 1 and 2 groups approximately identical amount of milk fat with a difference in 1.1 kg is received that it was higher, than in the 3rd group on 20.1 - 21.2 kg.

Live weight is one of the most important signs of selection of cattle on dairy efficiency. Besides it adequately characterizes development of animals. Results of researches demonstrate that on the third lactation cows of the line Montwick Chiftain - 652 kg had the maximum live weight that Sovering

Reflexion is 50 kg more in comparison with animals of the line and 28 kg less in comparison with the line Vis Back Ideal.

The orientation of exchange processes in an organism of a cow shows Milk coefficient. The analysis of the obtained data showed that cows of the line had the greatest coefficient of a Milk Sovering Reflexion, and the smallest - at cows of the line Montwick Chiftain that made 1474 and 1344 kg respectively.

Speed of milk yield is a hereditary sign and depends on the level of dairy efficiency, elasticity of a mamillar sphincter, reactivity of nervous processes and other specific features of cows. Proceeding from it for the purpose of milking rationalization formation of groups for machine milking of cows was carried out taking into account duration of their milk yield and taking into account the milk yield speed.



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Milk yield speed  
Sovering Reflexion  
Vis Back Ideal  
Montwick Chiftain

**Fig. 1: Milk yield speed**

**Table 2: Physical and chemical indicators of cow milk**

Indicator	Group (Line of a bull)		
	Sovering Reflexion	Vis Back Ideal	Montwick Chiftain
Density, kg/m <sup>3</sup>	28,88	28,53	28,57
Acidity, °T	17	17	17
Mass fraction of fat, %	3,82	4,10	3,77
Mass fraction of protein, %	3,11	3,12	3,01
COMO, %	8,52	8,58	8,58

**Table 3: Distribution of lines of bulls of the studied livestock on genotypes, %.**

Line of a bull	Genotype on kappa casein		
	AA	AB	BB
Vis Back Ideal	67,2	31,3	1,7
Sovering Reflexion	56	36	8
Montwick Chiftain	57,1	28,6	14,3

Milk yield speed for cows of test groups made 2,3-3,31 kg/min. corresponds to requirements imposed to animals of the dairy direction of efficiency. In a section of linear accessory of a cow of the line Sovering Reflexion had higher speed of milk yield which averaged 2,92 kg/min., cows of the line Vis Back Ideal - 2,86 kg/min. and with the lowest speed return of milk took place at cows of the line Montwick Chiftain - 2,59 kg/min.

### STRUCTURE AND PROPERTIES OF COW MILK

The analysis of structure and properties of milk showed that on density of essential distinctions between groups it was not observed, this indicator conformed to requirements of the premium and made 1,028 g/cm<sup>3</sup>. Acidity of milk in all groups made 17 from that also conforms to requirements of normative documents.

Daughters of bulls of the line Vis Back Ideal had high rates of milk quality. The mass fraction of fat and protein in it made 4.10% and 3.12% respectively that exceeded these indicators on other groups on average on fat for 0.3% and a squirrel - for 0.01-0.11%. Therefore an exit of milk fat and protein at lower milk yield was higher, than the group of cows has lines Montwick Chiftain. Concentration of SOMO at cows of lines Vis Back Ideal and Montwick Chiftain was at one level and made 8.58%. Cows of the line Sovering Reflexion conceded to them on the maintenance of the dry fat-free dairy rest for 0.06%.

One of the main indicators of milk quality is protein content. Casein concerns to the main group of proteins and is subdivided into 4 fractions ( $\alpha^s 1$ ,  $\alpha^s 2$ ,  $\beta$  and  $\chi$ -casein). Milk contains 13% kappa casein. Shortage of fraction a kappa casein leads to deterioration in coagulability of milk, formation of a flabby clot, decrease in its quality and volume. A kappa casein it is possible to consider as the gene connected with technological properties and milk quality. It is revealed that the B-allele a kappa casein is characterized by the high content of protein in milk with the best abomasal coagulability.

Blood test of cows by DNA diagnostics method taking into account linear accessory showed that 63.4% of the heads had AA genotype; 32.2% of the heads - a genotype of AB and only 4.3% of the heads - a genotype of Centuries. On the basis of results of the analysis of genotypes a kappa casein of cows divided into three AA, AB and BB groups, taking into account a genotype a kappa casein and on lines of bulls - Sovering Reflexion, Vis Back Ideal, Montwick Chiftain. Researches in a section of lines showed that 14.3% of cows of the line Montwick Chiftain and 8% Sovering Reflexion had a desirable genotype on a kappa casein - BB, animal lines had the lowest interest of a genotype of BB Vis Back Ideal (Table. 3). The best results are noted at daughters of bulls of the line Sovering Reflexion whose milk yield in 305 days of a lactation made 9183 kg of milk. An exit of milk fat in this group made 351.8kg. Lower dairy efficiency was observed

at cows of the line Montwick Chiftain and Vis Back Ideal which milk yield made 8763 - 8581 kg, and an exit of milk fat made - 330.6 - 351.8 kg respectively.

The amount of the general protein in milk in practice is used as cheese making capacity indicator as it is proportional to the content of casein. As showed researches, the content of the general protein in cow milk of all groups was above standard value of 3.0%. The highest value of this indicator is established in cow milk of the line Vis Back Ideal, the smallest - in cow milk of the line Montwick Chiftain of 3.01%. The difference in concentration of lactose in cow milk of all test groups was insignificant. Fluctuations made from 4.45-4.65% and were in limits of standard sizes.

Solid of milk includes all components defining its technological and nutritious properties. Higher content of solid is noted in cow milk of the line Vis Back Ideal and made 12.37%. However, the intergroup difference on solid was insignificant. On the content of calcium and phosphorus in cow milk of all groups of essential distinctions it is not established (Sa - 0,145 mg/kg; P - 0.09 - 0.10 mg/kg).

Technological properties of cow milk with various genotypes kappa casein (AA, AB, BB) studied when processing it in cottage cheese and cheese. Abomasal coagulability of milk belongs to the factors defining its suitability for production of cheese. Duration of abomasal coagulation of proteins and density of a clot depend on concentration of ions of hydrogen in milk. In process of decrease pH milk reaction proceeds quicker and density of the received clot is more that, generally is explained by increase in activity of abomasal enzyme.

Minor change of concentration of ions of calcium in milk significantly affects duration of folding of

proteins and density of an abomasal clot. The best coagulation of proteins was observed at concentration of chloride of calcium in milk, equal 0.142%. Researches of technological properties of cow milk are presented in Table 4.

Results of a research showed that the content of fat, were higher than protein in combined milk in group of cows with a genotype of Centuries. Content of fat in cow milk with a genotype of BB exceeded milk fat indicator of cows with AA genotype for 0,21%, cows with AB genotype - for 0,04%. Researches of fat acids composition of milk showed that the greatest mass fraction of polynonsaturated fatty acids (23.4%) was in cow milk of the line Montwick Chiftain, at the same time the mass fraction of linoleic acid made 0.76%. The highest share of linoleic acid was established as a part of milk fat at cows with genotype AB kappa casein. The mass fraction of saturated fatty acids on this group was lower, than in group with a genotype of BB and AA for 1.4 and 0.8%.

Milk protein content was the lowest at cows with AA genotype, the highest - at cows with a genotype of Centuries. At cows with AB genotype protein content had intermediate value. Protein content in cow milk with a genotype of BB exceeded milk-protein indicators of cows of other genotypes for 0.14-0.18%. Value of an indicator of density had no distinctions, cow milk of all genotypes corresponded to a premium indicator. Cow milk of all genotypes concerned on heat stability to 1 group. Under the influence of abomasal enzyme cow milk with BB genotype had the shortest period of coagulability that made 24 min. and there was less rather abomasal coagulability of cow milk with genotypes of AB and AA for 10 and 14 min.

**Table 4: Technological properties of milk.**

Indicators	Genotype		
	AA	AB	BB
Mass fraction of fat, %	3,80	3,96	4,02
Mass fraction of protein, %	3,08	3,12	3,26
Density, g/cm <sup>3</sup>	1,028	1,028	1,028
Abomasal coagulability, min.	38	34	24
Heat stability, group	1	1	1

Thus, milk of the cows containing the B-allele kappa casein had the best technological properties, contained more protein and turned for shorter time that gives the chance to receive more cheese of the best quality. Shortage of fraction a kappa casein leads to deterioration in coagulability of milk, formation of a flabby clot, decline in quality and the volume of the developed product.

Indicator of biological value is the amino-acid composition of milk. By amount of irreplaceable amino acids cow milk of the line was the best Vis Back Ideal that exceeded value of this indicator in cow milk of the line Montwick Chiftain and Sovering Reflexion for 9.5% and 4.5% respectively. Content of replaceable amino acids in cow milk of the line Sovering Reflexion was higher, than in cow milk of lines Montwick Chiftain for 31.5% also Vis Back Ideal - for 23.7%. In cow milk with AA genotype the share of irreplaceable amino acids exceeded their content as a part of the general protein in cow milk with a genotype of BB and AB for 8.9 and 39% respectively. The greatest mass fraction of replaceable amino acids was in cow milk with genotype kappa casein of Centuries.

#### SUMMARY:

1. Use of cows of the line Reflexion Sovering in dairy cattle breeding allowed receiving in addition 420-602 kg of milk, 18.1 - 21.4 kg of protein concerning cows of lines Vis Back Ideal and Montwick Chiftain.
2. With cow milk of lines Vis Back Ideal and Sovering Reflexion approximately identical amount of milk fat with a difference in 1,1 kg is received that it was higher, than from cows of the line Montwick Chiftain on 20.1 - 21.2 kg.
3. It is revealed that the B-allele kappa casein is characterized by the high content of protein in milk with the best abomasal coagulability. 14.3% of cows of the line Montwick Chiftain and 8% Sovering Reflexion had a desirable genotype on a kappa casein - BB, animal lines had the lowest interest of a genotype of BB Vis Back Ideal.
4. Protein content in cow milk with a genotype of BB exceeded milk-protein indicators of cows of other genotypes for 0.14-0.18%.
5. Under the influence of abomasal enzyme cow milk with BB genotype had the shortest period of coagulability that made 24 min. and there was less rather abomasal coagulability of cow milk with genotypes of AB and AA for 10 and 14 min.
6. By amount of irreplaceable amino acids cow milk of the line was the best Vis Back Ideal that exceeded value of this indicator in cow milk of the line Montwick Chiftain and Sovering Reflexion for 9.5%

and 4.5% respectively. Content of replaceable amino acids in cow milk of the line Sovering Reflexion was higher, than in cow milk of lines Montwick Chiftain for 31.5% also Vis Back Ideal - for 23.7%.

7. In cow milk with AA genotype the share of irreplaceable amino acids exceeded their content as a part of the general protein in cow milk with a genotype of BB and AB for 8.9 and 39% respectively. The greatest mass fraction of replaceable amino acids was in cow milk with genotype kappa casein of Centuries.

#### CONCLUSION:

Thus use of selection on a genotype is represented perspective for industrial maintaining dairy cattle breeding as provides the expressed effect of increase in dairy efficiency, increase in a mass fraction of fat and protein in milk, increases in a share of irreplaceable amino acids as a part of milk protein.

The advantage of the used method of increase in dairy efficiency and quality of cow milk is improvement by chemical composition of milk, as well as its technological properties necessary for highly effective processing of milk in cheese. Also use of selection on a genotype of small cattle is obviously possible.

#### CONFLICT OF INTERESTS

Authors confirm that the submitted data do not contain the conflict of interests.

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