Assessment of influence of biostimulating medicines on the cow milk cheeseability

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Abstract. The article shows the research results of qualitative composition and technological characteristics of milk in case the food ration of cows is added by biostimulant belonging to the category of synthetic phytohormone “Irkutin”. To hold the experiment 5 groups of first-calf heifers of black and motley breed, up to 10 heads in each have been created. The division was based on the principle of analogs. The selection of animals was made according to the following criteria: live mass, dairy efficiency level, month of calving and their physiological state. The 1st group (control group) as was bred on the main diet of the farm. “Irkutin” was introduced in different doses into the main diet of cow experiment groups II, III and IV. Medicine was given to animals in the morning, once every 3 days. “Irkutin” represents a biostimulant from the category of synthetic phytohormones (growth substance). As an analog, for comparison of impact of “Irkutin” on milk structure and milk properties, extract of eleuterococcus spiny, natural biostimulant. Eleuterococcus was introduced into the diet of group V of cows in a dose 40 ml per head. Research shows that the introduction of “Irkutin” and extract of spiny eleutherococcus into the ration influenced fat and protein content of milk given by fresh cows. It was proved that the best characteristics of cheeseability were shown by the animals of the fourth experimental group. It coagulated more quickly under the influence of rennet shaping dense and elastic clot.

1. Introduction
Today scientists use their accumulated experience in processing of high-quality milk production and concentrate on perfection of technical methods of production and optimization of component structure of milk aimed at increasing their food and biological value. Great attention is paid to problems of development of the qualitative products capable to fully satisfy physiological needs of people for energy and nutrients [1–3].

Increase in demand of people for milk and milk products forces producers to intensify rates and production outputs, at the same time they try to preserve and improve the quality of production. This aspect contributes to the development in cattle breeding practice of use of various biologically active
agents which are capable to exert beneficial influence on milk quality and, as a result, products of milk processing [4–6].

The purpose of researches is to study qualitative structure and technical characteristics of milk of cows if case producers introduce “Irkutin” in the ration of cows.

2. Experimental research
Scientific and economic experiment was carried out in 2014 in the conditions of the dairy and commodity farm of LLC “Demetra” located in Uvelsky district of the Chelyabinsk region. To hold the experiment 5 groups of first-calf heifers of black and motley breed, up to 10 heads in each have been created. The division was based on the principle of analogs. The selection of animals was made according to the following criteria: live mass, dairy efficiency level, month of calving and their physiological state.

The 1st group (control group) as was bred on the main diet of the farm. “Irkutin” was introduced in different doses into the main diet of cow experiment groups II, III and IV. Medicine was given to animals in the morning, once every 3 days. “Irkutin” represents a biostimulant from the category of synthetic phytohormones (growth substance). Medicine accelerates biosynthesis of proteins and nucleinic acids, increases activity of enzymes and immune resistance and, as a result, it increases natural efficiency of animals.

As an analog, for comparison of impact of “Irkutin” on milk structure and milk properties, extract of eleuterococcus spiny, natural biostimulant, has been used and it increases efficiency of animals. Eleuterococcus was introduced into the diet of group V of cows in a dose 40 ml per head.

The experiment lasted during the period of milking animals from January to April, duration of the experiment was 90 days.

The quality of milk was analyzed based on standard universal methods of physical and chemical analyses. The tests were carried out at the department of merchandizing of food products and veterinary and sanitary examination and in the laboratory of the Ural State Academy of Veterinary Medicine.

The degree of bacterial content (State Standard P 53430-2009) was established by the method based on duration of coloring change of resazurin under the influence of oxidation-reduction enzymes of microorganisms of raw milk.

The determination of the quantity of somatic cells in samples was carried out on the “Somatos-Mini” viscometer.

The calculation of the quantity of fatty balls and measuring of their average diameter was realized by a microscopy method, by means of Goryaev's camera and a micrometer ruler, according to P.V. Kugenev and N.V. Barabanschikov’s technique [7].

The rennet clotting and fermenting test (State Standard P 53430-2009) characterizes the quality of milk and its suitability for cheese production. The method is based on ability of raw milk, to coagulate under the influence of labs and own microorganisms.

The duration of rennet coagulability of milk (after preliminary pasteurization) was estimated, by time measurement of coagulation of casein under the influence of labs (State Standard 53430-2009).

The index of heat stability (State Standard 25228-82) was established by the method based on ability of milk proteins to resist to denaturation, under the influence of ethyl alcohol of certain concentration.

The presence of inhibiting substances in milk (State Standard 23454-79) was determined by the method based on the restoration of rezazurin in case of development of microorganisms (Streptococcus thermophilus).

3. Results and considerations
The term “cheeseability” is characterized by a complex of parameters that milk should contain for the production of cottage cheese and cheese. It includes the characteristics of component structure
(mainly, protein content), fat and DFFMR (the dry fat-free milk rest); level of a bacterial content of raw milk; physical and chemical parameters.

The carried-out analysis of experimental groups of animals showed that processes of protein synthesis were more active in comparison with analogs from control experimental group (table 1).

Thus, the content of the crude protein in all experimental groups exceeded control indicators for 0.01÷0.04%, and the content of casein in milk of cows of the III-V groups was 0.02% higher in comparison with animals of the I group. Essential differences in the mass fraction of serum proteins and the amount of DFFMR (the dry fat-free milk rest) were not observed.

**Table 1. Amount of Milk Protein and its Fractions.**

| Index                                   | Group          |
|-----------------------------------------|----------------|
|                                          | I (control)    |
|                                          | II             |
|                                          | III            |
|                                          | IV             |
|                                          | V              |
| Protein Mass Fraction, %                 | 3.13±0.02      |
|                                         | 3.14±0.01      |
|                                         | 3.17±0.03      |
|                                         | 3.17±0.02      |
|                                         | 3.16±0.02      |
| Casein Mass Fraction of, %               | 2.54±0.02      |
|                                         | 2.53±0.03      |
|                                         | 2.56±0.02      |
|                                         | 2.56±0.01      |
|                                         | 2.56±0.01      |
| Albumine and Globulin Mass fraction of, %| 0.59±0.02      |
|                                         | 0.61±0.01      |
|                                         | 0.61±0.03      |
|                                         | 0.61±0.02      |
|                                         | 0.60±0.02      |
| DFFMR (the dry fat-free milk rest), %    | 8.61±0.22      |
|                                         | 8.55±0.08      |
|                                         | 8.58±0.12      |
|                                         | 8.56±0.19      |
|                                         | 8.44±0.07      |

The most poor-dispersion phase of all milk components is fat presented in the form of firm balls. Milk of cows of experimental groups contained more fat than in the control group (0.18÷0.49%) (table 2).

On average, 1 ml of the whole cow’s milk contains about 3 billion fatty balls. While producing cottage cheese and cheese (during sinerezis) considerable loss of fat is observed when milk contains small fatty balls (from 0.1 to 1.5 microns). These factors are widely used for the characteristic of quality and technological properties of milk [8].

**Table 2. Amount of Fat and Characteristics of its Structure.**

| Index                                   | Average Data |
|-----------------------------------------|--------------|
|                                          | Group        |
|                                          | I            |
|                                          | II           |
|                                          | III          |
|                                          | IV           |
|                                          | V            |
| Fat Mass Fraction, %                     | 3.4          |
|                                         | 3.97±0.10    |
|                                         | 4.15±0.25    |
|                                         | 4.17±0.20    |
|                                         | 4.46±0.07    |
|                                         | 4.20±0.09    |
| Quantity of Fatty Balls, 1.5÷7.5 billion/cm³ | 4.31±0.06    |
|                                         | 4.29±0.17    |
|                                         | 5.21±0.10    |
|                                         | 5.28±0.14    |
|                                         | 4.36±0.15    |
| Average Diameter of Fatty Balls, Micron | 2.0÷4.0      |
|                                         | 3.32±0.06    |
|                                         | 3.48±0.05    |
|                                         | 3.54±0.06    |
|                                         | 3.62±0.05    |
|                                         | 3.42±0.06    |

The experiment showed that the quantity of fatty balls in milk of cows III and IV groups was more that in the control group by 0.90 and 0.97 billion/cm³ (20.88÷22.50%).

The IV group surpassed indicators of I in the average diameter of fatty balls for 9.04%. In II, III and V groups the average level of this indicator was above control for 3.01÷6.63%.

An important indicator of milk cheeseability is the degree of its bacterial content which is determined by the presence of reductase in the product (table 3).

Milk, during the certain period after milking, has the bactericidal and bacteriostatic properties united by the general term “bactericidal phase”. It is happens as antibacterial substances are produced by the organism of an animal and coming to a mammary gland with blood.

The bactericidal phase is influenced by time from the beginning of milking until milk cooling, extent of cooling and also bacterial content [9].

The analysis of milking results of each group of animals showed that all samples belonged to the first class of bacterial content. It demonstrated good organization of technological process of milking of cows.
The indirect indicator of normal structure of milk is contents of somatic cells which should not exceed 500 thousand in 1 ml. The increase in their concentration from 500 thousand to 1 million, is the reason of decrease in content of casein in a product for 10-20% that results in impossibility of its coagulation [10].

**Table 3. Technical Characteristics of Milk Raw Materials.**

| Indices                        | Milk indices according to the specifications and technical documentation | Groups of Cows |
|--------------------------------|------------------------------------------------------------------------|----------------|
| Milk Class of Reductase Test   | 1 (up to 500 thousand. bacteria/cm3)                                   | I  | II | III | IV | V  |
|                                | 2 (more than 500 thousand. bacteria/cm3)                               | 1  | 1  | 1   | 1  | 1  |
| Number of Somatic Cells        | no more than 500 thousand/cm3                                          | 235—268       |
| Class and Assessment of Milk   | 1 (good)                                                               | 2  | 1 (good) | 1 | 1 | 2 |
| Based on the Rennet Clotting   | 2 (satisfactory)                                                      | (satisfactory) |
| and Fermenting Test            | 3 (bad)                                                                | (good) | (good) | (bad) |
| The Duration of Rennet Coagulability of Milk | from 10 to 40 minutes                                                | 35.2 | 34.5 | 31.4 | 32.0 | 37.4 |
| The Group of Heat Stability    | I — V                                                                  | III | II | I   | I  | II |
| Inhibitory Substances          | aren’t allowed                                                         | aren’t found   |

The research showed that concentration of somatic cells in all groups did not exceed 268 thousand in 1 ml of milk. It demonstrates that the biostimulators applied during the experiment have not exerted negative impact on animals’ health.

The assessment of raw milk on the rennet clotting and fermenting test is carried out for the purpose of determination of its fermentation ability of lactic bacteria.

The results prove that milk of all experimental groups corresponded to the required characteristics, but unlike I and V groups, milk of the cows consuming “Irkutin” belonged to the first class.

All factors mentioned above have some impact on the ability of pasteurized milk to form dense clots under the influence of labs. In practice such ability is checked by the rennet test.

Rennet coagulability is one of the main factors defining milk cheeseability. According to the criteria - duration of milk coagulability, milk is divided into three types. The coagulability is considered good (the I type) if its duration is less than 15 minutes, normal (the II type) — from 15 to 40, and weak (the III type) — if coagulation of casein lasts more than 40 minutes or it is not observed at all. During the research of this parameter it was established that milk from all groups of cows corresponded to the II type which is the most optimum for production of cottage cheese and cheese.

However, it is necessary to consider that time of rennet coagulation in the studied tests was not the same. Milk of the animals consuming “Irkutin” coagulated 0.7-3.8 minutes quicker than in the I group, and milk of cows who were given eleuterococcus extract for 2.2 minutes longer than in the control group.

Data received from the V experimental group confirm slower course of coagulation process of milk protein in comparison with groups II-IV in which this reaction lasted for 2.9-6.0 minutes less. It is the positive moment as reduction of duration of this operation is important from the point of view of the production technology and also has certain economic effect.
The criterion of possible use of milk raw materials for production of the products subjected to high heat processing (sterilized milk, the condensed canned food, etc.), is its heat resistance, that is the ability to maintain the influence of high temperatures without visible coagulation of proteins.

The researches revealed that the most thermally resistant milk is received from cows III and IV groups as it withstood the influence of the solution of ethyl alcohol with concentration of 80%. Milk of II and V of groups was slightly less resistant as the denaturation of protein was not revealed while adding 75% spirit solution. Milk of control animals which belonged to the III group had the lowest heat stability, what follows from that it can be used only for processing pasteurized drinking milk or fermented milk products which manufacturing techniques exclude high-temperature processing of initial raw materials.

One of the major criteria for milk assessment of cheeseability is presence of the inhibiting substances availability of which leads to production of substandard products. The inhibiting substances include antibiotics, formalin, peroxide of hydrogenium and others the washing, disinfectant and preserving agents. No sample contained any substances mentioned above.

4. Conclusion
Having analysed obtained data it is possible to draw a conclusion that all samples of the milk received from cows during scientific and economic experiment conformed to requirements for the indicators characterizing its cheeseability properties.

Introduction to the diet of “Irkutin” (biostimulator) and extract of an eleuterococcus spiny has exerted positive impact on the content of fat and protein in milk of firstcalf heifers. Milk of animals of the IV experimental showed the best cheeseability qualities. It coagulated under the influence of lab quicker, forming a dense and elastic clot. Time for its processing was reduced.

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