Use of a mineral additive in cattle feeding

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Abstract. Mineral additives on the basis of domestic natural minerals, products of chemical and microbiological production are developed. At calculation of structure of additives the daily requirement of animals for mineral substances taking into account a direction of productivity, biological and physiological features of an animal in structure of the experimental mineral additive No. 1 includes forage salt, monoammonium phosphate, brusite, chalk and salts of microcells -100 g of this additive allows to provide completely an animal with microcells, and also to compensate lack of phosphorus, calcium, sodium and magnesium. Mineral additive No. 2 in the amount of 300 g provides the animal's need for trace elements. In addition, this additive includes a daily rate of feed salt and 60% of calcium, phosphorus and magnesium requirements. Therefore, the use of this additive makes it possible to almost fully meet the needs of animals in feed salt, macro- and microelements. Feeding experimental mineral additives to animals allowed increasing milk production during the break-up period by 3.9 and 6.6%, respectively. Balanced mineral nutrition reduced the duration of the service period by 10.2 and 15.8% in the pilot groups. The use of new mineral additives in the diet led to a decrease in production costs by 2.65 and 3.94%. In the end, all this led to an increase in the profitability of milk production: in the control group it was 21.02%, and in the experimental group it was by 3.79% and 5.85% more, respectively. Thus, thanks to the use of new types of mineral additives, animal productivity has increased, feed consumption per unit of production has decreased, milk quality has improved and profitability of production has increased.

1. Introduction
Livestock breeding in Russia, as well as in many other countries, is one of the leading branches of agriculture and the main branch of livestock breeding. High genetic potential of dairy productivity can be realized only in case of rational and complete feeding of animals. However, the increase in productivity is usually accompanied by a decrease in reproduction functions - low fertility, long service period, etc. These disorders are associated with a prolonged mismatch of the used diets to the needs of animals, which causes the borrowing of nutrients, minerals and bioactive substances from the reserves of the body. This, in turn, leads to impaired metabolism, deterioration of reproductive functions and depletion of animals. Therefore, the decisive factor providing high productivity of cows is not only the energy value of the diet, but also the provision of animal minerals.

Providing animals with the necessary nutrients and minerals is impossible without the use of complete feed and balancing mineral additives. Increase of the productive effect of mixed fodder, and in dairy cattle breeding and the diet as a whole, largely depends on the enrichment of their biologically active substances, including trace elements (copper, zinc, manganese, cobalt, iodine, selenium) [1-4].

In the light of the above, it seems promising to use in the diet of cattle mineral additives based on
feed salt enriched with trace elements. The aim of our research is to determine the effect of new mineral additives on the milk productivity of lactating cows during the break-up period.

2. Research methods
To achieve this goal, granular mineral additives based on domestic raw materials were developed. When calculating the composition of additives, the daily requirement of animals for mineral substances was taken into account, taking into account the direction of productivity, biological and physiological characteristics of the animal. The experimental mineral additive No. 1 includes fodder salt, monoammonium phosphate, brusite, chalk and microelement salts. Feeding 100 g of this additive allows you to fully provide the animal with microelements, as well as compensate for the lack of phosphorus, calcium, sodium and magnesium.

Feeding of 300 g of mineral additive No. 2 also provides the need of the animal in microelements. In addition, this additive includes a daily rate of feed salt and 60% of calcium, phosphorus and magnesium requirements. Therefore, the use of this additive makes it possible to almost fully meet the needs of animals in feed salt, macro- and microelements.

One of the best binder components used in pelleting feed was introduced into the experimental additives. This has improved the quality of the pellets (crumbleness, fine particle content) and reduced the energy consumption for pelleting the additive. Pelletizing of additives has improved their preservation by reducing the traceability and segregation during storage.

Scientific and economic experience was conducted on cows during milking period. For this purpose, three groups of 10 black-motley cows were formed using the balanced group method (Table 1).

| Group               | Number of animals, head. | Feeding conditions                                           |
|---------------------|--------------------------|-------------------------------------------------------------|
| control group       | 10                       | Full-age lactating cows                                      |
| 1 experimental      | 10                       | Basic diet + mineral supplements used in the farm            |
| 2 experimental      | 10                       | Basic diet + 100 g of mineral additive No. 1                 |

In the diet of the 1st experimental group was introduced 100 g per day of experimental granulated mineral additive № 1. Animals of the 2nd experimental group in composition of mixed fodder were fed 300 g of mineral additive No. 2 per day.

3. Results of the research
During the milking period the diets of all groups met the norms of feeding cows with live weight of 600 kg and daily milk yield of 22-28 kg. Feeding rations for cows of all groups included bromegrass hay, corn silage, haylage, molasses and mixed fodder in the same amount. The structure of the diets of lactating cows was as follows (% nutritive): coarse fodder – 11.5-12.4, juicy fodder – 53.5-56.5, mixed fodder – 31.1-34.8. Premix, feed salt, chalk and precipitate were used as mineral supplements in the diet of the control group. In experimental groups, due to the introduction of experimental additives, the animals were fully provided with all macro- and microelements. Of all the environmental factors, the greatest impact on the milk productivity of cows has the level and nature of feeding, as only with abundant and complete feeding the most fully realized hereditary abilities of animals. Cow milk yield is the main criterion by which to judge the effectiveness of the use of different feeds and additives (Table 2).
Feeding experimental mineral supplements had a positive effect on milk yield in the first month of lactation. Thus, in 1 experimental group more milk was received by 0.6%, and in the second group - by 1.9%. Balanced feeding of experimental groups' cows allowed increasing the gross milk yield and the second month of lactation: in 1 experimental group by 2.7%, and in 2 experimental groups - by 4.6% compared to the control.

**Table 2. Dairy cow productivity**

| Index                   | control group | 1 experimental | 2 experimental |
|-------------------------|---------------|----------------|----------------|
| 1 month of lactation:   |               |                |                |
| average daily milk yield, kg | 22.49±1.86   | 22.63±2.06     | 22.92±2.99     |
| mass fraction of fat, % | 3.77±0.06    | 3.75±0.05      | 3.74±0.05      |
| milk yield, kg          | 705.93       | 707.97         | 714.56         |
| 2 months of lactation:  |               |                |                |
| average daily milk yield, kg | 24.51±1.31   | 25.07±1.60     | 25.48±2.27     |
| mass fraction of fat, % | 3.78±0.05    | 3.79±0.05      | 3.80±0.04      |
| Milk yield, kg          | 771.99       | 792.56         | 807.11         |
| 3 month of lactation:   |               |                |                |
| average daily milk yield, kg | 26.88±0.80   | 27.95±0.95     | 28.64±1.33     |
| mass fraction of fat, % | 3.82±0.05    | 3.85±0.05      | 3.87±0.05      |
| milk yield, kg          | 855.01       | 897.25         | 924.69         |
| During milking period   |               |                |                |
| average daily milk yield, kg | 25.24±1.14   | 26.00±1.34     | 26.56±1.92     |
| mass fraction of fat, % | 3.80±0.05    | 3.82±0.05      | 3.83±0.05      |
| milk yield, kg          | 2861.49      | 2974.25        | 3050.28        |

The peak of milk productivity in the experimental animals was observed by the end of the third month of lactation. Gross milk production with fat content of 3.6% for the third month of lactation in 1 pilot group was 4.9% higher, and in 2 pilot groups - 8.2% higher, compared to the control.

Over the period of milking, the productivity of cows of experimental groups was higher by 3.0% in 1 experimental group and by 5.2% - in 2 experimental groups, compared to the control group. Taking into account the fat content in milk, the difference was 3.9 and 6.6%, respectively. Thus, the use of experimental mineral additives in feeding lactating cows can increase their milk productivity.

The problem of persistent increase of fat, protein and other components in milk should be solved using the laws of genetics in breeding work against the background of complete feeding and normal maintenance of animals. The most important task of zoo technical science and practice is to create optimal conditions for the synthesis of milk and its individual components in the organism of lactating animals. Table 3 shows the chemical composition of milk over the milking period.

Table 3. Chemical composition and nutritional value of milk, %

| Index                  | control group | 1 experimental | 2 experimental |
|------------------------|---------------|----------------|---------------|
| Milk fat               | 3.80±0.05     | 3.83±0.05      | 3.84±0.06     |
| Milk protein           | 3.09±0.03     | 3.11±0.03      | 3.12±0.03     |
| Milk sugar (lactose)   | 4.72±0.03     | 4.75±0.03      | 4.76±0.02     |
| Minerals               | 0.83±0.01     | 0.84±0.02      | 0.85±0.02     |
| Dry matter             | 12.45±0.08    | 12.53±0.09     | 12.58±0.07    |
| Caloric value 100 g, kcal | 67.95±0.54   | 68.40±0.54     | 68.64±0.55    |
Feeding new mineral supplements to animals stimulated milk biosynthesis. On average, the fat content in the milk of the experimental groups was higher by 0.03 and 0.04% compared to the control. The same dynamics was observed for other components of milk. The mass fraction of protein in milk of experimental groups was higher by 0.02 and 0.03%, respectively; lactose - by 0.03 and 0.04% and mineral substances - by 0.01 and 0.02% compared to the control. The increase of nutrient content in milk allowed increasing the energy value of the product in experimental groups by 0.6 and 1.0%, respectively.

High milk productivity is often not a direct cause of lower cow fertility. In accordance with modern notions the disturbance of reproductive functions is caused by genetic factors only on 10% and on 90% - by environmental factors. For normal reproduction of animals, easily digestible food with a high content of biologically active substances is needed. Providing the body with minerals, especially microelements, has a positive effect on the reproductive functions of animals.

The new mineral supplements began to be fed to the cows immediately after calving. Therefore, the long-term use of these additives in the diet has reduced the service period in 1 pilot group by 14.1 days, or 10.2%, and in the 2nd pilot group by 21.7 days, or 15.8% (P≤0.01), compared to the control group.

The processes taking place in an organ, influence morphological structure of blood, its physical and chemical properties on which it is possible to judge about intensity of oxidative processes and the energy value of the product in experimental groups by 0.6 and 1.0%, respectively.

### Table 4. Cow hematology at the beginning of the experiment

| Index               | control group | 1-experimental | 2-experimental |
|---------------------|---------------|----------------|----------------|
| Erythrocytes, 10¹²/l| 5.13±0.33     | 5.55±0.14      | 5.48±0.33      |
| Hemoglobin, g/l     | 70.67±3.18    | 73.33±3.48     | 73.33±4.18     |
| Leukocytes, 10⁹/l   | 7.65±0.62     | 7.67±0.66      | 7.87±0.84      |
| Morphological indicators at the end of the experience |
| Erythrocytes, 10¹²/l| 5.63±0.10     | 5.66±0.20      | 5.80±0.08      |
| Hemoglobin, g/l     | 120.33±4.10   | 104.33±4.48    | 107.33±2.91    |
| Leukocytes, 10⁹/l   | 7.63±0.47     | 7.71±0.62      | 7.52±0.51      |
| Total protein, g/l  | 85.30±2.06    | 84.57±1.79     | 85.46±1.27     |
| Albumin fraction, g/l| 36.20±2.46    | 31.40±1.42     | 35.20±2.72     |
| Globulin fraction, g/l| 49.10±3.27    | 53.17±2.61     | 50.26±1.46     |
| Calcium, mmole/l    | 2.83±0.07     | 2.53±0.07      | 2.70±0.25      |
| Phosphorus, mmole/l | 1.93±0.09     | 1.60±0.17      | 1.80±0.21      |
| Biochemical indicators at the end of the experience |
| Total protein, g/l  | 81.60±0.89    | 84.07±1.30     | 85.09±0.86     |
| Albumin fraction, g/l| 36.70±1.38    | 38.57±0.67     | 39.10±0.92     |
| Globulin fraction, g/l| 44.90±0.72    | 45.50±0.85     | 45.99±1.46     |
| Calcium, mmole/l    | 2.77±0.09     | 2.76±0.06      | 2.87±0.15      |
| Phosphorus, mmole/l | 1.80±0.06     | 1.83±0.15      | 1.90±0.15      |
Correspondence of protein nutrition level to biological needs of cows is carried out by concentration of total protein and its fractions in blood serum. To identify a lack of protein in the diet, the concentration of albumins is determined, and they are considered an amino acid reserve of the body. The increase in total protein and albumins is observed at the beginning of lactation, and by the end of lactation the content of globulins increases. At the beginning of the experiment the protein content in the blood serum of the experimental animals corresponded to the physiological norms.

Most blood parameters at the end of the experiment did not change significantly and corresponded to the physiological norm. Thanks to balanced feeding in the blood of animals normalized protein metabolism. The total protein content in milk in all groups was within normal limits, but the share of albumins in the experimental groups increased, while the content of the globulin fraction decreased. Complete mineral nutrition of animals provided a stable content of minerals in the blood during the experiment. Thus, the feeding of new mineral supplements had a positive effect on the health of animals.

4. Conclusion
Mineral feed additives are the most important components of the daily diet of animals. In our researches sources of mineral substances were domestic natural minerals, production of chemical and microbiological manufactures. Feeding experimental mineral additives to animals allowed increasing milk production during the break-up period by 3.9 and 6.6%, respectively. Balanced mineral nutrition reduced the duration of the service period by 10.2 and 15.8% in the pilot groups.

The use of new mineral additives in the diet led to a decrease in production costs by 2.65 and 3.94%. In the end, all this led to an increase in the profitability of milk production: in the control group it was 21.02%, and in the experimental group it was by 3.79% and 5.85% more, respectively.

Thus, thanks to the use of new types of mineral additives, animal productivity has increased, feed consumption per unit of production has decreased, milk quality has improved and profitability of production has increased.

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