The Use of Feed Additives in the Diet of Cows and Young Cattle in Yakutia

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The implementation of the State Program of the Republic of Sakha (Yakutia) “Development of agriculture and regulation of markets for agricultural products, raw materials and food for 2012-2016” envisages ensuring the growth of livestock quantity and increase in its productivity, which so far is restrained by feed base limitations. The indispensable condition for achieving the desired level of livestock productivity is to develop effective ways to improve the biological value of their nutrition. The goal of the research – to study the effect of feed additives on the growth, development and milk productivity of cattle. Researches on use of feed additives have a positive effect on metabolic processes and helped to improve milk production, wherein the second test group, cows had a 22.2% higher productivity than the productivity in comparison with the control group and 4.7% higher than the first test group. Zeolite-hongurin additive to natural feed of the Kholmogory breed young stock provided the increase in average daily weight gain with the 1.3 g dose for 52.5 g, in comparison with the control group animals.

Key words: Cattle, molasses, brewer’s grain, hongurin, productivity.

In Yakutia, where the duration of the winter stabling period is 9 months, adequate animal nutrition is of particular importance. The existing system of feed production does not meet modern requirements for feeding dairy cattle in winter. Currently, at cooperative and peasant farms of dairy cows and young cattle diets of animals in winter are nutritionally unbalanced, especially with proteins and sugars, minerals and carotene. Often diets being used have deficit of vitamins and excess of protein, therefore deviations in metabolism occur. Prolonged feeding with low quality feed and nutritionally unbalanced diets hinder the implementation of genetic potential for milk production, decrease reproductive function and shorten the terms of animal economic use. In recent years, in order to normalize metabolic processes in farm animals a lot of attention is paid to the use of local feed additives with high biological activity and digestibility. Their environmental friendliness,
absence of any side effects and symptoms of addiction are quite relevant. Therefore, when organizing biologically full feeding of cows the main problem is finding additional feed, balancing additives that enhance nutrient utilization under the conditions of Yakutia.

One of the main conditions for achieving the objectives is the efficient use of feed resources on the basis of inclusion of industry wastes, various additives microbiological and chemical synthesis into the diet of animals, which also significantly reduces the dependence of livestock production on import purchases of protein components.

In order to normalize metabolic processes in farm animals a lot of attention is paid to the use of local feed additives with high biological activity and digestibility. In nature, as we know, there is no such feed that would satisfy all the versatile needs of the animals. Specific properties are inherent in each feed or group of feeds, that’s why in the practice of animal feed they is often used in combination, i.e. in the composition of diets. Nutrients missing in one feed type are replenished with food elements from the other.

One of the real alternatives to solve this problem is non-traditional feed additives, including brewer’s grain used as an additional source of protein and molasses – the only food of plant origin, which does not contain fat in its chemical composition.

In countries with developed milk cattle breeding, in order to expand the resource base of feed production and improve the quality of animal feed, dehydrated wastes of the processing industry (from 7 to 16% by weight), including dry brewer’s grains, are widely used. Data obtained during research have shown that in addition to fresh brewer’s grains it is possible to use dry brewer’s grains in the diets of livestock and poultry, the dry brewer’s grains consist of: %: water – 6.32; crude protein – 27.1; fat – 7.5; nitrogen-free extractive substances – 43.4; fiber – 11.7; ash – 4.0. According to the energy value, dry brewer’s grain is almost equivalent to corn grain, it contributes to urea utilization and serves as a preventive measure against rumen keratosis and liver abscesses.

At the same time, the development of systems for full feeding of livestock must be carried out taking into account the zonal characteristics of individual regions of our country. There are no diet structure developments for the conditions of Yakutia, the effect of the diet structure on cows productivity and the use of feed nutrients are not studied; there is almost no data on the digestibility of nutrients of diets, which mainly consist of mixed grass hay and haylage, concentrated feed and molasses. The problem of optimum doses for feeding cows with molasses during cow housing has not been studied in the republic either. In this regard, the study of all these issues is relevant.

A promising direction in improvement of full feeding is inclusion of residues of food production, particularly grain syrup in the diet composition. Molasses is considered to be a good carbohydrate supplement to the diet of milk cows and calves, it’s also a good tool for flavouring coarse and concentrated feed (especially it is useful when flavouring hard feed in winter). Molasses has a high nutritional value, improves the palatability of feed, increases its eatability, animals easily digest it, it covers the body needs of high yielding cows in sugars.

To solve the problem of increasing the biological value and efficiency of farm animals feed, premixes and balancing supplements, the studies aimed at finding new feed products, including non-traditional ones and biologically active substances of the new generation, are very relevant and practically important.

An interesting trend in livestock production is the use of zeolite hongurin as a feed additive that stimulates digestion and nutrient utilization of diets, as well as absorbent supplement binding afla- and mycotoxins (poor feed), sorbing and taking out exo- and endotoxins, heavy metals, radionuclides. Hongurin comprises up to 40 macro- and micro elements, each of which is vitally important for farm animals, and as a rule, there is a lack of it in feed. The use of hongurin as a mineral additive improves the average daily weight gain in body weight, reduces the feeding cost per unit of output, reduces the wastes of young stock. All this has been possible due to sorption and cation exchange properties, consisting in the withdrawal of heavy metals, ammonia nitrogen, toxins, and...
absorption of necessary elements by the body\textsuperscript{15}.

Hongurin field was discovered in 1978 by the employees of the Institute of Geological Sciences, Russian Academy of Sciences, the field is located in the Suntarsky region of Yakutia 22 km east from the village of Kempendyay\textsuperscript{12}. This field is of the volcanic-sedimentary type. There are 4 layers of zeolitized tuffs total with capacity from 3 m to 24 m with the zeolite content greater than 55%, the field reserves are approximately 11.4 million tonnes\textsuperscript{13}. The composition of hongurin zeolite chemical elements is presented in Table 1. The data of the Central Research Institute for Geology of Industrial Minerals\textsuperscript{14}.

Zeolite hongurin, acting as an adsorbent of metabolism products, mycotoxins, heavy metal salts, radionuclides and other harmful substances, contributes to the prevention of feed diseases (cleanses the digestive tract)\textsuperscript{11}. Hongurin also participates in several biochemical reactions in the digestive process as an ion exchanger, including: transportation, activation and prolongation of the enzymes and hormones action; maintenance of favourable ionic equilibrium of sodium, potassium and calcium; stabilizing the acid-base balance in the digestive tract; as a catalyst promotes better assimilation of macro- and micro-elements, coming with food, by the body.

To regulate carbohydrate exchange, feeding Simmental breed milk cows with grain molasses and brewers’ grain provided the nutritious diet amounting to 10.8 EFU, 982.1 g of digestible protein per capita. The concentration of EFU in 1 kg of dry matter made up to 0.90 digestible protein per 1 EFU 91.0 g. When recalculating for 4% milk, 426.3 kg more milk was milked from the cows of the second test group cows, 157.3 kg more milk – from the first test group, in comparison with their herdmates from the control group. Enrichment of diets with grain molasses and brewer’s grain allowed us to increase the milk production of the second test group cows 22.2% more than in the control group and 4.7% more than in the first test group.

Inclusion of hongurin in the diet of heifer calves of the first test group in the amount of 1.0 g per 1 kg of live weight contributed to the increase in the absolute weight gain by 10.13 kg and average daily gain by 90 g.

The goal and objectives of the research

To study the effect of feed additives on the growth, development and milk productivity of cattle.

To achieve the goal, the following objectives were set:

a) To study the effect of feed additives (grain syrup and brewer’s grain) on milk production of the Simmental breed cows;

b) To study the effect of hongurin zeolite on the growth and development of young cattle of the Holmogorsky breed.

MATERIALS AND METHODS

Research on the use of feed additives was carried out according to the thematic plan of research work of the SSI Yakutsk Research Institute of Agriculture by the laboratory of cattle and birds feeding on dairy milk cows of the Simmental breed in the Federal State Unitary Enterprise “Krasnaya Zvezda” of the Megino-Kangalassky District (Ulus) of the Republic of Sakha (Yakutia).

To carry out the scientific and economic experiment we formed 3 groups of 10 cows taking into account age, live weight, productivity and physiological state (Table 2).

According to the experiment scheme, diets had nutritional values of feed and energy level and content of other essential nutrients within norms of the All-Russian Research Institute of Animal Husbandry (ARRIAH) (1969) (1). The difference in feeding consisted in the fact that the control group of animals received general diet, the first test group cows – 6 kg of oat haylage, 1 kg of local feed, 1.5 kg of grain molasses and 3.0 kg of brewer’s grains, animals of the second test group – 6 kg of oat haylage, 1 kg of local feed, 3.0 kg of grain molasses and 1.5 kg of brewer’s grains.

Milk productivity was taken into account by means of monthly milking control and determination of % fat and protein in milk on the milk analyser “Laktan-M” with the preparation of the lactation curve and diagrams.

Scientific and economic experiment on the use of zeolite in the diet of young Holmogorsky breed cattle was held in the spring and summer (May-August) period at the collective...
enterprise “Hatasskoe” according to the scheme of the experiment (Table 3).

To perform this test on the basis of pairs-analogues 75 heads of young cattle were chosen (heifers of the Holmogorsky breed) and then divided into 3 groups: one control, two test ones with 25 heads in each. Within 120 days the first test group received 1.0 g of hongurin a day per 1 kg of live weight, the second test one – 1.3 g per 1 kg of live weight.

The influence of Hongurin on the physiological state of the test animals was determined by eatability of feed, appetite, fatness of animals. Growth and development of young cattle were taken into account by monthly weighing, we studied the chemical composition of feed, clinical indicators of the test animals. Selection of young cattle was conducted by the conventional zootechnical method of ARRIAH (1985)4. Statistical data processed by the biometric method of Plohinskoy N.A. (1969)7.

RESULTS AND DISCUSSION

Influence of the additives on milk production was determined by the yield of milk per day for 245 days of lactation, as well as by fat and protein content in the milk and the lactation curve and charting (Table 4).

Analysing the data in Table 3 we need to point out that the basic fat milk yield of cows of the second test group was significantly higher than the analogues of the control and first test groups – by 392.0 kg or 22.2% (P>0.99) and 98.0 kg, or 4.7% (P>0.95) respectively. When recalculating for 4% milk, 426.3 kg more milk was milked from the cows of the second test group, 157.3 kg more from the first test group than from the cows of the control group (Figure 1).

Chemical composition of milk is not constant; it changes during lactation, as well as under the influence of external and internal factors. We observed a tendency of increasing milk protein content in the milk of cows of the second test group. In this regard, the yield of milk protein during lactation was significantly higher than in the control group by 18.1 kg and 12.25 kg, than in the second test group. On average extra 67.0…84.08 kg of milk fat was obtained from each cow.

### Table 1. Composition of chemical elements of the Suntarsky zeolite (hongurin)

<table>
<thead>
<tr>
<th>The field of Hongurin</th>
<th>SiO₂</th>
<th>TiO₂</th>
<th>Aℓ₂O₃</th>
<th>Fe₂O₃</th>
<th>FeO</th>
<th>CaO</th>
<th>MgO</th>
<th>H₂O</th>
<th>Si/Al (Ca+Mg)</th>
<th>Cation exchange capacity, meq/100 g of rock</th>
</tr>
</thead>
<tbody>
<tr>
<td>[layer I]</td>
<td>88</td>
<td>0.12</td>
<td>12.11</td>
<td>1.11</td>
<td>0.44</td>
<td>1.31</td>
<td>1.19</td>
<td>1.74</td>
<td>12.5</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td>67.28</td>
<td>0.14</td>
<td>12.01</td>
<td>1.25</td>
<td>0.40</td>
<td>1.19</td>
<td>1.74</td>
<td>1.74</td>
<td>12.6</td>
<td>12.6</td>
</tr>
</tbody>
</table>

### Table 2. Scheme of experiment

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of animals</th>
<th>Features of feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>10</td>
<td>MD* 6 kg of mixed grass hay, 6 kg of oat haylage, 2 kg of local feed, 3 kg of grain molasses, 1.5 kg of Brewer's grains</td>
</tr>
<tr>
<td>First test group</td>
<td>10</td>
<td>6 kg of mixed grass hay, 6 kg of oat haylage, 2 kg of local feed, 4 kg of grain molasses, 1.5 kg of Brewer's grains</td>
</tr>
<tr>
<td>Second test group</td>
<td>10</td>
<td>6 kg of mixed grass hay, 6 kg of oat haylage, 2 kg of local feed, 3 kg of grain molasses, 1.5 kg of Brewer's grains</td>
</tr>
</tbody>
</table>

Note: MD*-- the main diet consisted of mixed grass hay, 6 kg. of oat haylage, 2 kg. locally produced feed.

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Consequently, enrichment of diets with grain molasses and brewer’s grain in the diets of the Simmental breed cows allowed us to increase the milk production of the second test group cows 22.2% more than in the control group and 4.7% more than in the first test group.

Along with the level of milk production it is equally important to know the quality indicators of milk depending on the feed used in the diet. Accordingly, we studied the chemical composition of milk (Figure 2).

During the analysis of the milk quality we identified a trend of significant increase in the basic indicators, characterizing its biological value, of the test group’s cows.

During the research period the dry matter content in the milk of the first test group cows was 14.06%, which is 0.32% higher than in the milk of the second test group cows and 0.59% higher than in the milk of the control group cows. Mass fraction of lactose in the milk of the second test group cows exceeded this indicator in the milk of the control and the first test group cows and amounted to 4.61%.

Thus, the diets of milk cows enriched with grain molasses and brewer’s grains resulted in a significant increase in the milk chemical composition indicators and corresponded to the indicators of natural milk quality.
Table 6. Changes in heifer calves’ live weight with various doses of hongurin

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control group</td>
</tr>
<tr>
<td>Live weight, kg in the beginning</td>
<td>50.25±1.33</td>
</tr>
<tr>
<td>of the experiment in the end</td>
<td>140.85±6.31</td>
</tr>
<tr>
<td>of the experiment</td>
<td>90.60</td>
</tr>
<tr>
<td>Absolute gain, kg</td>
<td>750</td>
</tr>
<tr>
<td>Average daily gain, g</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1. The milk yield of cows, kg

Fig. 2. Chemical composition of the cows' milk, %

The daily diet with zeolite of young cattle of the Holmogorsky breed is shown in Table 5. Terms of feeding and maintenance of all test animals were identical and corresponded to the technology adopted in this sector.

Changes in live weight of the experimental heifer calves when different doses of hongurin were included in their diets are presented in Table 6. Inclusion of hongurin in the diet of heifer calves of the first test group in the amount of 1.0 g per 1 kg of live weight contributed to the increase in the absolute weight gain by 10.13 kg and average daily gain by 90 g ( >0.99). Inclusion of zeolite in the diet with the 1.3 g dose per 1 kg of live weight, daily gain increased by 52.5 g with respect to the animals of the control group (P>0.95), however it was lower than with the 1.0 g dose per 1 kg of live weight.

**CONCLUSION**

On the basis of the material presented above, we can conclude that the use of feed additives in feeding milk cows is a prerequisite for obtaining high yields, fully meeting the needs of animals in energy and nutrients, maintaining the sugar-protein ratio in the normal range. Research on the use of feed additives didn’t have a negative effect on metabolic processes and helped to improve milk production, wherein the second test group of cows had a 22.2% higher productivity than the productivity in comparison with the control group and 4.7% higher than in the first test group.

Inclusion of natural zeolite in the natural food diet provided increase in average daily gain of the young cattle of the Holmogorsky breed with the 1.3 g dose by 52.5 g with respect to the animals of the control group (P>0.95), however it was lower than with the 1.0 g dose per 1 kg of live weight.

Hongurin can also be used not only as a supplement in the diet of animals, but also as a therapeutic and prophylactic agent that cleanses the body (gastrointestinal tract).

Thus, the results of our scientific and economic studies show feasibility and potential of the practical use of local feed ingredients – grain molasses, brewer’s grain and hongurin zeolite of the Honguruu deposit of the Suntarsky Ulus in the animal farming of Yakutia.
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