Biological Characteristics of the Cattle Fed with Organomineral Fodder Additives in the Conditions of Yakutia

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Abstract. The evidence-based analysis has revealed that feed stresses are one of the main reasons of a low cattle's productivity. Scientists justify the need for the study the reason and nature of feed stresses, which is the primary source of animal metabolic disorder. The article presents the results of the studies on the effect of organomineral fodder additives from local natural resources on behavioral reaction and changes of hair-covering hair, which reflect the degree of cattle adaptation to the extreme continental climate. 3 young cattle groups have been formed and divided into equal subgroups for the experiments. The organomineral fodder additives have had a positive effect on feeding behavior, increased the cattle’s appetite and formed a better heat exchange thanks to the hair-covering hair.

1. Introduction

Simmental cattle breed is widespread in the Russian Federation and abroad and kept all over the world. This breed known on the territory of Russia since the 19th century [1], and has been used for productivization with other aboriginal breeds. There has been established a simmentalized cattle rearing business in Yakutia [2]. This breed was imported to improve production performance in 1920 [3]. The Simmental cattle is characterized by its hardiness, good adaptiveness to new natural and climatic conditions, easy-going about food, high milk and meat productivity, and beef with good taste.

The studies on the intensification of livestock production using the gene pool of the Simmental cattle breed is of great research and practice value for the country stock raising [4, 5, 6].

The use of additional organomineral and mineral feed supplies in feeding agricultural animals makes it possible to correct feed stress, replete the organism with major and minor elements, and thereby break new ground for productivization of livestock [13, 14, 15, 16].
There is an association between feeding stresses and adaptation, between adaptation and resistance of the organism. However, the adaptation of animals depends on many factors: genetics, phenotype, physiology and distinction of the organism, and other factors [10, 11, 12].

The use of fodder additives in animal feeding contributes to the improvement of physiological processes in the organism [17, 18, 19].

In this case, a natural adsorbent has approved itself as one of the best stimulator of metabolism, increasing the intensity of digestibility and nutrient availability of the ration. One of the main advantages of adsorbents is their mineral composition. Moreover, zeolites have high ion-exchange properties capable of absorbing harmful substances, including various toxins, microbes, heavy metals, gases, etc. [20, 21, 22].

On the territory of Yakutia, there is a large zeolitic natural occurrence Khonguruu, located in the Suntarsky ulus, managed by Suntarzeolit LLC [23].

Sapropels is a valuable feed resource is widely used along with zeolites in livestock raising. It contains minerals and micronutrients such as carbohydrates, oils, vitamins, carotenoids, amino acids, humic substances, various enzymes, and antibiotics. Their composition and level depends on the specific freshwater body. Sapropels help to increase the productivity and reproductive ability of cattle. The humic acids that are the part of the sapropels act on pathogenic germ and toxins. The relevance of the practical use of this resource as an organomineral fodder additive is due to the presence of a large amount of lakes in the Russian Far East Federal district, where there are a significant quantity of sapropels [24, 25].

The co-use of zeolites and sapropels in animal feeding is of profound research interest. Scientific studies carried out on a group of lactating mares of Megezhek breed in the conditions of Central Yakutia have showed that the organomineral zeolite-sapropel fodder additive has a positive effect on the animals’ metabolism and milk productivity [26].

The research has been carried out to determine the effectiveness and the necessity of adding the zeolite-sapropel fodder additives with a natural mineral salt into the ration of the Simmental breed cattle.

2. Objectives
The research objective is to study the behavioral reactions, the elaboration of Simmental cattle hair and the physiological maker of the experimental groups after adding the organomineral fodder additives into their ration in the conditions of Yakutia.

3. Methods
The research has been carried out in Central Yakutia, the Churapchinsky district. 3 groups of Simmental calf bulls have been formed. The difference from the mean values did not exceed the limit ± 10% within the experimental groups.

To find out the adaptive capacity and the animals’ resistance to the conditions of Yakutia, the cattle hair and behavioral reactions have been studied. The cattle hair was studied in the winter and summer seasons. Hair samples have been taken with an area of 1 cm² from the middle of the last rib from each group. Weight, length and density of the hair-covering hair and fraction proportion (fur, guard and transitional) of the experimental animals have been taken into account.

The ethological researches have been conducted according to the method [27] using continuous visual observation within 24 hours and recording the behavior of individual animals every 5 and 15 minutes.

In previous experiments, the optimal rates for the use of Hongurin’s zeolite and sapropel in the ration of agricultural animals in Yakutia have been set. According to the feeding conditions, an optimal dose has been set, taking into account the bodily need of the calf bulls. The norm of Hongurin’s zeolite has been 0.7 g per kg of body weight of the animal, sapropel – 0.6 and 0.7 g / kg. 33 g of Kempendyai salt have been added to the main ration in accordance with the research program.
The observation results have been processed using standard methods of mathematical statistics. The data have been handled according to the methods [28, 29].

4. Results and discussion
The climate of Central Yakutia is extremely continental like the rest part of the republic. Climate and permafrost have a significant affect to the physiographic shell, soil and phytocenosis. The occurrence of specific surface configurations directly relates to permafrost. Meadow vegetation is in gramineous and sedgy plants. Soil has an essential potential, as it is the main foundation in the agrocenosis system.

As to the mineralogy, the soil in Central Yakutia has a quartzo-feldspathic composition. Whereby, the level of mineral content is significantly lower in the surface soil to the subsurface of the parent rock. This is due to the slight attachment of the solodization and podzolization processes [30]. Analysis of the main biogenic elements (N, P, K, Ca, Mg) in different soil formations and vegetation has indicated that the accumulation and occurrence of these elements is associated with slow biological processes in cryogenic soil.

In the conditions of Yakutia, where there is a deficiency of minerals in soil and feeders, the use of zeolites, sapropels and mineral salts to prevent feed stresses in breeding is proved scientifically and practically.

Thermoregulation is one of the most important criteria for adaptation and a main component of animal adaptability. The assessment of the cattle hair has a special role. The analysis of the animals’ hair fraction has showed that the data vary according to the year season and feeding conditions (Table 1).

| Groups          | Summer time | Winter time |
|-----------------|-------------|-------------|
| I - control     | 14.33±0.36  | 37.58±0.48  |
| II - experimental| 14.08±0.26  | 37.92±0.50  |
| III - experimental| 13.75±0.28  | 38.25±0.54  |

The weight of the calf bulls’ hair of the control group has averaged 23.8 mg, which is 1.28% and 3.93% more than the 2nd and 3rd experimental groups in summer. The index of hair length of calf bulls in these groups has averaged 13.75-14.33 mm.

The change of the cattle hair mass depends on a season. The quantity of its hair has been larger, and the hair has been longer and comparatively thicker in cold season. The animals from the experimental groups have exceeded the rest ones in winter. According to the results, the hair mass of the control group has been inferior to the 2nd experimental group by 2.56% and the 3rd experimental group by 5.12%, respectively. The length of the fur hair of the 3rd experimental group has been longer than the control group by 6.25% and the 2nd experimental group by 5.88%, respectively.

The highest indicators of the mass and density of the calf bulls’ hair from the 3rd experimental group and the lowest ones in the control group have been found out. The calf bulls of the experimental groups fed by the local organomineral fodder additives have showed better adaptability to the change of a season in comparison with the animals from the control group.

The structure of the hair and the proportion of its fractions varied with the year season and feeding conditions as well (Figures 1 and 2).
Figure 1. The structure of the cattle’ hair (summer time) in %.

The animals of all groups have had a lot of guard and transitional hairs in the structure of fraction of their hair in summer period. The calf bulls form the 3rd experimental group have had the most quantity of guard hair and the animals from the control group have had the fewest one by 7.0%.

The calf bulls of the 3rd experimental and control groups have had the largest proportion of the fraction of the transitional hair with a not-critical lag behind the II experimental group by 1.0%. The calf bulls of the control group have had the highest volume of fur hair in summer time and have exceeded the 2nd experimental group by 1.0% and the 3rd experimental group by 2.0%, respectively.

Figure 2. The structure of the cattle hair (winter time), in %.

As the cold weather sets in, there has been a change in the structure of the cattle hair in the opposite direction. The calf bulls from the experimental groups fed by the organomineral fodder additives have had a prevailing proportion of fur hair. The 3rd experimental group has had more fur fiber in comparison with the indicators of the control group (5.0%) and the 2nd experimental group (1.0%). The proportion of the animals’ transitional hair in the control group averaged 34%, in the 2nd and the 3rd experimental groups - 30% and 27%, respectively.

The research works confirm the best adaptability of cattle [31, 32, 33, 34]. They reveal the adaptive and acclimatization abilities of cattle to freezing temperature. The local cattle has notable variations in constitution than other cattle breeds have. The Yakut cattle hair is thicker in winter in comparison with other stud breeds of cattle in the republic. The responses of the quantitative and qualitative composition of the hair-covering hair fraction depend on a year season and have an adaptive character. The local cattle hair is thicker in comparison with its crossbreeds as well. The biochemistry,
anatomical composition of the blood and the body metabolism indicate it. This is due to the adaptive changes of the hair-covering hair, which is capable of optimizing body heat loss from winter to summer and vice versa.

The study of the calf bulls’ behavioral reactions of all experimental groups has been carried out taking into account the technology of animal housing and the animals’ reactions to other factors. The adding of the organomineral fodder additives to the main ration is good for the animals’ appetite and, accordingly, food consumption. In the age of 9 months, the calf bulls of the 2nd and 3rd experimental groups have spent more time on feeding in comparison with the control group by 11.5% and 12.2%; upon reaching the age of 15 months – by 12.3% and 12.9%, respectively.

There has been also a difference in the time spent on the movement of animals. The bulls from the experimental groups spent more time on movement than the control group of animals, so at 9 months of age by 3.0-3.1%, and upon reaching 15 months of age, the indicator has been comparatively higher by 4.0-4.4% respectively. Changes in feeding behavior have also influenced on the animals’ rest. The resting time of calf bulls from the experimental groups at 9 months of age has decreased by 18.1-20.2%, and upon reaching 15 months of age – 12.9-14.0%. The difference in watering time of all groups has also been insignificant and vary from 3.9 to 16.1 minutes. The daily defecation and urination time of experimental animals in all groups has averaged 11.8-15.9 minutes and 13.8-15.7 minutes, respectively. Changes in the daily ethogram of animals from the experimental groups are explained by increased eating time and movement of animals, which are thanks to their good appetite caused by the positive effect of the organomineral fodder additives from local natural raw materials.

5. Conclusion

During comparison the findings of the hair-covering hair of the groups, the following common factors have been found out: the calf bulls from the 3rd experimental group have had comparatively thick and long hair, with a large excess of the fur hair fraction in the cold season. This has protected well the young stock from freezing. The animals from the experimental groups have had short with minimum percentage of hair-covering hair, which has contributed to a more rational heat exchange.

The ethological studies have indicated the difference between groups of animals. Animals from the experimental groups fed with the organomineral fodder additives have had the best feeding behavior. Thus, at the age of 9 months, the 3rd experimental group exceeded the control group by 12.2% and the 2nd experimental one by 0.7%, respectively. Upon reaching the age of 15 months, calf bulls from the 2nd experimental group have increased this indicator in comparison with the control group by 12.9%, and the 3rd experimental group by 0.6%.

The feeding behavior of the calf bulls fed with the organomineral fodder additives has been characterized by the fact that animals eat food more actively, have a good appetite and are less sensitive to changes of foodstuff conditions.

The activity of food consumption in the control group has been noticeably jaded than in the experimental groups. The watering time in all groups has taken virtually the same time. There were no notable variation in this indicator.

The adding of the organomineral fodder additives (zeolite hongurin, sapropel and mineral salt) has increased the time for feeding and movement and has reduced the time for rest.

Thus, the use of organomineral fodder additives from local natural raw materials in feeding cattle improves the feeding behavior of animals.

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