The effect of feed additives from mountain pine and lichens on the young cattle productivity in Magadan Region

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Abstract. For the first time, in the conditions of the Magadan region, have been carried out studies on the use of a feed additive (FA) based on mountain pine in combination with lichens in the rations of young cattle (C) of Holstein breed and cross-bred young of Holstein and Aberdeen Angus breeds of the dairy and growing period. The use of FA positively affects the growth rate, daily average growth, blood counts, young growth resistance and digestibility of feed. The live-weight of the experimental gobies of Holstein breed at the age of 16 months, which additionally received the FA ration, exceeded the rate of the control group up to 2.15 kg (0.58%), the crossbreds of the Aberdeen-Angus breed exceeded the rate of a control group up to 9.55 kg (2.3%) (P≤0.05). The relative growth rate (according to S. Brody) of gobies at the age of 16 months, which got FA was higher than of gobies of the control groups. The growth rate of experimental gobies of Holstein breed is 0.12% higher, and of crossbred gobies is 2.57% higher respectively. A study of the hematological composition of the blood of experimental half-blood gobies of the Aberdeen-Angus breed showed that relative to the control group, the concentration of eosinophils increases by 0.4%, monocytes 0.8%, lymphocytes by 7.2%, the concentration of band neutrophil decreases by 1%, segmented neutrophils by 7.4%. The young of the experimental groups had better digestibility of dietary nutrients and feed costs per 1 kg of growth in comparison with the control groups.

1. Introduction

One of the conditions for the successful development of the constituent entities of the Russian Federation is the creation of food security, which in the condition of a reduction or stopping of food supplies will provide the food independence of the region and will not cause an emergency food situation. Today, the condition of agricultural production in Magadan region continues to be unstable, which negatively affects the development of the agri-food market and the level of supplying of the population with agricultural products.

Meat is an integral product, which is included in the list of socially significant goods and occupies an important place in the human diet and makes it harmonious due to its composition and nutritional properties. According to statistics in 2018 there was produced 6.3% less meat in the region than in 2017, the level of its consumption by the residents of the region was 81 kg, which is almost 11% higher than the recommended dietary norms. At the same time, the weight of imported meat products in the structure of the food market is 94.1%; so, the region can be classified as dependent on external supplies, i.e., the current level of consumption is provided mainly by the import of food [1].
In 2018, the potential capacity of the meat market in the region was 12,393 tons; the actual capacity was 5.8% lower than the potential. The coefficient of conjuncture of meat market products in the region is 0.93, which indicates a deficit. The saturation balance of the food market of the region shows that in general the necessity of meat is 95% provided including the import of 90%. At the same time, a large amount of incoming meat and vegetables to the region is imported, which does not guarantee the quality and safety of these products [2]. The above indicates the availability of reserves and the necessity of the increasing of the output of high-quality food products.

According to statistics in 2018, the number of cattle increased slightly and was 3800 heads, the volume of cattle meat production increased by 57.4%. On a per capita basis, beef production was 0.7 kg, which is 96.5% lower than the recommended medical norm. Beef self-sufficiency in the region was 3.7% [1]. This fact indicates the necessity to find new forms and methods to increase the production potential of the agricultural sector in the region with the aim of its sustainable development and the fullest supply of residents with high-quality food products of their own production.

Since 2018, research works to develop scientifically-based methods of organizing and crossbreeding cattle of dairy (Holstein) breed with producers of precocious beef breeds (Aberdeen-Angus) have been carried out for the first time in the conditions of the Magadan region.

Summarizing research data for more than 10 years, V.I. Levaquin, B.A. Sarkenov and M.M. Poberukhin claim that industrial crossbreeding can increase meat production by 20 kg or more per head [3].

The cross-bred young of black-and-white cattle and Aberdeen Angousses adapt better to their habitat. Because of the reduction of operational costs this allows to reduce the cost of production from these animals by 3.2-4.0% [3].

In the dairy period a significant functional restructuring of the digestive system occurs, the ability to absorb the nutrients of plant foods develops, grow protein and water metabolism. This period is characterized by both intensive growth of organs and tissues, the ability of animals to give high growths. Feeding conditions are an important point in growing young of beef breed direction.

In feeding young of beef breed direction scientists use various FA. Murashkin D.E. developed recipes of protein, vitamin-mineral, and enzymatic probiotic FA. There were studied the adaptation deviations and the influence of FA on the growth, development, hematological parameters of young animals of various ecological groups [4].

A detailed study of feed and biologically active additives in cattle ration, which have a significant impact on animal productivity, is a perspective direction. In the conditions of the Far North, some attention is paid to the practical use of local wild plants, which do not require significant costs for their harvesting and preparation for feeding.

Earlier studies of plant materials showed that non-traditional phytogenic dietary components have antimicrobial, antioxidant and anti-inflammatory features [5,6]. In addition, they have a stimulating effect on the digestive system by increasing the production of digestive enzymes and increasing the efficiency of food use as a result of improved liver function [7,8,9].

Cetraria islandica (Icelandic moss) has been used for centuries in traditional medicine in many countries against a number of conditions, including inflammatory conditions, mainly in the form of an aqueous extract. C. islandica contains many compounds, such as polysaccharides and secondary metabolites, some of which have biological activity. However, very little is known about their effect on the immune system [10].

The first Russian antibiotic - sodium salt of usnic acid, which under the name "binan" is recommended for use in veterinary medicine, was obtained from lichens. Its bacteriostatic effect is manifested in relation to Staphylococcus aureus, streptococci, anaerobes, pneumococci and tubercle bacillus [10,11].

Lichens are a rich source of vitamins B12 and C, which are necessary for the life of the animal. It was found that because of a lack of vitamin B12, anemia can develop, and productivity decreases.

Some polysaccharides contained in lichens enhance nitric oxide production by macrophages and change production levels of anti-inflammatory cytokines by macrophages and dendritic cells. They
can induce immunomodulatory reactions in macrophages and dendritic cells, due to the antioxidant, antimicrobial and antitumor activity of some main metabolites. Due to the high level of various biological substances, lichens have practical applications in medicine, also as sources of medicinal substances [12,13].

The needles have effective and safe antibacterial components, which makes it suitable for processing into antiseptic medicine for the disinfection of food and feed products and for medical purposes. The needles show antioxidant activity, the ability to remove free radicals and inhibit oxidative damage of DNA and body cells.

The proteins of plant components of the studied mountain pine have the wide spectrum of amino acids, including all irreplaceable ones [14].

Amino acids have an active influence on all the vital functions of the cattle: the formation of structural and protective tissues, regulation of metabolism. They play the role of predecessor of many important non-protein components of the body, and also affect the productive and reproductive functions of the body [15,16].

The goal of the planned studies is to develop a FA for young dairy and meat direction during the housing period using unconventional feed resources of the region based on mountain pine combined with lichens: Alpine cladonia (Cladonia alpestris) and Icelandic cetraria (Cetraria islandica) and study its influence on the growth, development, physiological condition and digestibility of food during young dairy period and growing period.

2. Material and methods

To enrich the ration of young cattle with biologically active substance, fiber, enzymes, vitamins and to study the effect of FA on the physiological condition of young animals scientific and economic experiments were carried out on the basis of “Komarova” agricultural enterprise in Magadan Region. The experiment was conducted on 40 gobies aged from 3 to 6 and from 14 to 16 months during the housing period. According to the principle of analogue pairs they were divided into four equal groups. The first two groups (experimental and control) were included gobies of Holstein breed, and the remaining two (experimental and control) were included cross-breed gobies of Holstein and Aberdeen-Angus breeds of the 1st generation (table 1).

During the research, classical research methods were used [17]. Hematological blood tests of young animals were carried out according to the methods of veterinary clinical laboratory diagnostics of Kondrakhina I.P. [18].

The chemical composition of feed laboratory researches, which is used in the farming were carried out on the basis of FSBRI Magadan ARI using the methods of the relevant normative documents [190].

To study the effect of FA on the digestibility of nutrients in the ration, a physiological balance experiment was conducted on young animals at the age of 16 months. The ration in the balance experiment was the same as in the scientific and economic one, so the duration of the preliminary period was 2 days, the accounting period was 3 days. Eating ability in groups was the same. Consumption by young animals of dry and organic stuff, protein, fiber, fat, nitrogen free extract (NFE) and ash was about the same. For the calculation of digestible substances, the average daily amount of feces of calves and its chemical composition were taken into account.

Animals of the experimental and control groups were kept in the same conditions and had the same ration. In addition to the ration, the experimental groups received FA: mountain pine with lichens daily during two periods (dairy and growing). The amount of FA was adjusted as the live weight of experimental gobies increased.

| Age, month | Gobies of the Holstein breed | Cross-breed gobies of Holstein and Aberdeen-Angus breeds of the 1st generation |
|------------|-----------------------------|--------------------------------------------------------------------------------|
|            | control                     | control                                                                      |
|            | experimental group          | experimental group                                                            |

Table 1. Scheme of scientific and economic experiments.
breed by 4.33 kg (2.84%), and gobies, which also got FA with their main ration, exceed during the growing of young cattle (Table 2). At the age of 6 months, the live weight of experimental crossbreeds by 2.54 kg (1.62%).

### Table 2. Live weight dynamics and daily average growth of gobies, kg (M±m).

| Age, month | Holstein breed | Cross-breed gobies of Holstein and Aberdeen-Angus breeds of the 1st generation |
|------------|----------------|--------------------------------------------------------------------------------|
|            | Control group  | Experimental group                                                              |
| From 3 to 6 months | 732.79±6.91 | 757.29±3.03 | 783.6±6.43 | 802±8.59 |
| From 0 to 6 months | 664.42±2.28 | 688.24±1.60 | 714.2±8.25 | 728.4±3.73 |
| From 14 to 16 | 729.39±9.82 | 736.7±8.09 | 797.54±13.99 | 965.33±7.09 |
| From 15 to 16 | 722.84±13.72 | 733.7±8.64 | 7725.13±27.26 | 1018.03±5.16 |
| From 3 to 6 months | 67.07±0.62 | 69.29±0.28 | 71.7±0.58 | 73.39±0.79 |
| From 0 to 6 months | 121.6±0.42 | 125.95±0.29 | 130.7±1.51 | 133.29±0.67 |
| From 14 to 16 | 44.25±0.63 | 44.85±0.45 | 48.65±0.85 | 58.95±0.42 |
| From 3 to 6 months | 56.30±0.43 | 56.35±0.14 | 84.19±1.24 | 85.43±1.62 |

*SD – staple diet

#### 3. Results and its discussion

The results of the first experiment confirm the positive effect of the addition of FA into the ration during the growing of young cattle (Table 2). At the age of 6 months, the live weight of experimental crossbreeds, which also got FA with their main ration, exceeded the control group rates of young Holstein breed by 4.33 kg (2.84%), and Aberdeen-Angus crossbreeds by 2.54 kg (1.62%).
Dispersive analysis of one-factor complexes showed that out of all the factors involved, that determine the increase in live weight of young Holstein breed at the age of 6 months, 3.2% are due to FA.

The relative growth rate (calculated according to the formula of S. Brodie) of experimental gobies from 3 to 6 months is higher than of gobies of control groups. The growth rate of gobies of Holstein breed is slightly higher, and of crossbred gobies by 1.24%.

By the end of the 2nd experiment, the live weight of experimental gobies at the age of 16 months exceeded the rate of the control groups: of young Holstein breed by 2.15 kg (0.58%), of crossbreeds by 9.55 kg (2.3%).

Dispersive analysis of one-factor complexes of the effect of FA on the weight of crossbred young animals showed that out of all the factors involved which influence the growth of weight, 68.0% is due to the effect of FA (P > 0.999).

At the age of 16 months, the relative growth rate of the experimental gobies was higher than that of the gobies of the control groups. The growth rate of gobies of Holstein breed is higher by 0.12%, of crossbred gobies by 2.57%. The average daily growth was 167.75 g higher for the experimental gobies of the crossbred young, compared to the young of the control group.

The analysis of the results of blood tests revealed that giving the experimental young animals FA had an impact on indicators characterizing the biochemical and morphological composition of the blood (Table 3).

| Rate                        | Control group | Experimental group |
|-----------------------------|---------------|--------------------|
| Erythrocytes, ml/µL        | 6.3±0.03      | 7.84±0.02          |
| Hb, g/µL                   | 12.9±0.04     | 12.86±0.15         |
| ESR, mm/h                  | 1.00±0.00     | 1.00±0.00          |
| Leukocytes, thou/µL        | 8.1±0.1       | 9.42±0.74          |
| % Neutrophils              | 2.2±0.2       | 2.0±0.32           |
| % Segmented neutrophils    | 42.4±2.27     | 29.0±0.71          |
| % Juice neutrophils        | 0.0±0.0       | 0.0±0.0            |
| Eosinophils, %             | 1.0±0.32      | 0.6±0.24           |
| Basophils, %               | 0.0±0.0       | 0.0±0.0            |
| Monocytes, %               | 7±0.32        | 5.6±0.24           |
| Lymphocytes, %             | 47.4±2.27     | 62.8±0.86          |
| Protein, g/l               | 61.0±0.32     | 61.2±0.37          |
| Calcium, mmol/l            | 2.38±0.08     | 2.08±0.03          |
| Phosphorus, mmol/l         | 3.58±0.03     | 2.49±0.01          |

a P ≤ 0.01.
b P ≤ 0.001.
The minimum concentration of total protein in the blood was detected at the beginning of the experiment in both groups of crossbred gobies 61.0-61.4 g/l, respectively. By the end of the experiment, after taking FA, the concentration of total protein in the blood of experimental bulls increases by 0.98% relative to the control group. An increase in the protein concentration in the blood of gobies promotes the growth and development of the body.

The research of the hematological composition of the blood of experimental half-blood gobies of the Aberdeen-Angus breed showed that relative to the control group, the concentration of eosinophils increases by 0.4%, monocytes 0.8%, lymphocytes by 7.2%, the concentration of stab neutrophils decreases by 1%, segmented neutrophils by 7.4%.

The effect of giving experimental young FA on indicators which characterize the biochemical and morphological composition of the blood can have a positive effect on the overall resistance of calves.

Digestibility of nutrients in rations was higher in young experimental groups relative to the control. The digestibility coefficients of cross-bred young animals were slightly higher than that of purebred peers: dry stuff by 0.43, organic stuff by 1.15, fiber by 1.24, NFE by 2.47% (table 4).

| Rate          | Holstein breed young | Young animals with ½ genotype of Aberdeen-Angus breed |
|---------------|----------------------|-------------------------------------------------------|
|               | Control | Experimental | ± % to the control | Control | Experimental | ± % to the control |
| Dry stuff     | 56.47   | 64.27        | +7.81              | 53.69   | 61.92        | +8.24              |
| Organic stuff | 60.24   | 66.89        | +6.65              | 57.30   | 65.10        | +7.80              |
| Protein       | 74.66   | 78.85        | +4.19              | 75.14   | 77.61        | +2.48              |
| Fat           | 64.31   | 68.17        | +3.86              | 74.86   | 72.97        | -1.89              |
| Fiber         | 56.76   | 63.28        | +6.51              | 50.92   | 58.67        | +7.75              |
| NFE           | 55.17   | 62.97        | +7.80              | 51.07   | 61.34        | +10.27             |
| Ash           | 23.76   | 43.20        | +19.44             | 16.16   | 35.27        | +19.11             |
| Ca            | 37.50   | 53.11        | +15.61             | 33.06   | 46.55        | +13.49             |
| P             | 22.67   | 39.97        | +17.30             | 20.96   | 24.25        | +3.29              |
| K             | 54.79   | 62.51        | +7.72              | 62.09   | 69.59        | +7.47              |
| Na            | 45.74   | 47.66        | +1.92              | 51.72   | 45.93        | -5.78              |

4. Conclusion
The article presents the results of studies on the entry of an unconventional feed additive of plant origin: mountain pine needles and lichens, in various doses, in the rations of young dairy and meat directions. The results confirm the feasibility of using the developed FA to enrich the ration of young cattle with enzymes, antimicrobial substances and vitamins in order to increase the growth rate, development and general resistance of the body in the conditions of Magadan region.

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