

# Economic efficiency of the use of dwarf pine and lichen in the diets of young cattle in the conditions of the Magadan region

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**Abstract.** For the first time, in the conditions of the Magadan Region, studies were carried out on the use of a feed additive (FA) prepared from dwarf pine (*mountainpine*) in combination with lichens in feeding young cattle of the Holstein breed and crossbred young animals of the Golstein and Hereford breeds. Over the period of the experiment, the absolute increase of the experimental bulls exceeded the indicators of the control groups: young Holstein breed by 2.15 kg (0.58%), hybrids by 6.35 kg (1.51%). The relative growth rate of experimental bulls according to Brody was higher than that of bulls in the control groups: bulls of the Holstein breed by 0.12%, crossbreeds by 0.77%. The use of crossing low-productivity dairy cattle with bulls of meat breeds makes it possible to obtain interbred hybrid animals of the I and II generations. The production of beef from crossbred young stock is characterized by greater economic efficiency in comparison with the fattening of super-renovated young Holstein breed. In the experimental group of a hybrid of the Holstein and Hereford breeds of the 1st generation, this indicator was 7.2 energy feed units (EFU), which is 7.7% lower than in the control one, and 13.25% lower than in the experimental group of the Holstein breed.

## 1 Introduction

Since 2018, for the first time in the Magadan region, the development of scientifically based methods of organizing and maintaining the crossing of dairy (Holstein) cattle with producers of early maturing meat breeds (Hereford) has been carried out. The chosen direction of the research is especially important during the period of import substitution. Increasing the resistance of young animals to the extreme climatic conditions of the Far North-East of Russia is of scientific and practical interest.

Balanced feeding of crossbred young stock and the use of FA will allow realizing the level of productivity of the meat breed and will increase the efficiency of the industry.

There is no stable dynamics in the development of forage production in the Magadan Region; trends in the production of forage crops are stagnant. In 2019, the sown areas for

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all fodder crops amounted to 6086 ha, which is 20.8 and 1.4% more than in 2015 and 2019, respectively (Table 1).

**Table 1.** The main indicators of the state of forage production in the Magadan region in 2015–2019.

Index	2015	2016	2017	2018	2019
Sown areas (ha)					
fodder crops	5037	5658	6120	5983	6086
incl. for silage	4343	4635	1405	1230	5576
annual herbs	139	1022	4347	4699	425
perennial herbs	553	1	361	53	30
Yield (c/ha)					
hay of annual grasses	45,8	23	52,7	17,9	39,6
hay of perennial grasses	19,6	10,0	17,8	19,0	17,1

In the structure of sown areas, the main share falls on fodder crops for silage (91.6%), sown areas for annual grasses in 2019 decreased to 7% of the total area. The gross harvest of fodder crops has stable tendencies and amounts to 1.5 thousand tons. The yield of annual grasses in relation to the previous year increased 2 times, and of perennial grasses decreased [1].

The hay and silage used in the farm, made from wild plants and annuals (oats), are poor in vitamins, protein and microelements. This affects the physiological status of animals and their productivity. Balancing the ration with imported additives missing according to the norms is not economically profitable for agricultural producers, since long-term transportation affects the quality of additives. The study of the chemical composition of growing plants, the development of the preparation technology and the norms for feeding feed additives for feeding young animals is of great importance.

The FA developed by us from dwarf pine (*Pinuspumila*) and lichens - alpine cladonia (*Cladoniaalpestris*) and Icelandic cetraria (*Cetrariaislandica*) does not require significant costs for collection and preparation for feeding.

Dwarf pine needles are rich in vitamins and mineral composition, contain flavonoids, vitamin C, carotenoids. The list of its beneficial properties seems to be all-encompassing: it has a multivitamin, anti-cold, analgesic, embalming, antiseptic, healing effect. It is effective in the treatment of vitamin deficiencies, pulmonary, intestinal and respiratory diseases. The substances contained in the needles have antioxidant activity, remove free radicals, inhibit oxidative damage of DNA and body cells. According to the World Health Organization, it contributes to the regulation of blood circulation and the treatment of diseases of the circulatory system.

Lichens are eaten by wild animals, are rich in carbohydrates and vitamins A, C, D, B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> etc. [2], they produce unique lichen acids, known for their enzymatic properties [3]. Lichens have a positive effect on the microflora of the gastrointestinal tract, increasing the secretion of digestive enzymes. Usnic acid sodium salt is the first domestic antibiotic obtained from lichens.

The chemical composition of FA includes amino acids: lysine, methionine, threonine, tryptophan, arginine, valine, etc., minerals: sodium, phosphorus, iron, magnesium, etc., as well as vitamins of group B, E, C, H, carotenoids [ 4, 5].

Previously, we conducted studies on the use of FA from dwarf pine and lichens, in combination with trace elements in the rations of cows in the period of 4, 5 months of lactation. The use of FA contributes to an increase in daily milk yield by 6.07%, the content of milk fat by 10%, increases the fat content in milk by 0.18 percentage points, relative to control, which made it possible to increase the profitability of milk production by 14.3% in comparison with the control group. [6, 7, 8].

## 2 Materials and methods

In order to study the effect of FA on the physiological state of young animals and determine the economic efficiency, a scientific and economic experiment was carried out on the basis of an agricultural enterprise (peasant farm holdings) «Komarova» in the Magadan region. During the research, classical research methods were used [9, 10]. Laboratory studies on the chemical composition of the fodder used in the farm were carried out on the basis of Federal state budgetary scientific institution Magadan Research Institute of Agriculture Russian Federation using the methods corresponding to the regulatory documents [11, 12].

The experiment was carried out on 40 bulls aged from 14 to 16 months, divided according to the principle of pairs-analogs into 4 equal groups. The first two groups (experimental and control) included Holstein gobies, and the other two (experimental and control) included hybrid Holstein and Hereford gobies of the 1st generation. The animals of the experimental and control groups were kept in the same conditions according to the technology adopted in the farm. The gobies of the experimental groups aged from 14 to 16 months, daily, in addition to the economic ration, received FA: dwarf pine with lichens. FA was fed in the following quantities: cedar flour - 120 g / head; lichen flour - 50 g / head. per day.

For the experiment, 150 kg of dry spring shoots of dwarf pine were prepared and 60 kg of lichens were collected. The technology of obtaining flour from elfin wood consists of drying raw materials in a specially equipped warehouse on mesh racks and preparing flour with a particle size of 0.5-1.5 mm. Lichens were dried and crumbled by hand. Flour was stored in kraft bags in warehouse-type premises.

Evaluation of the economic efficiency of raising crossbred bull calves of different genotypes was determined by calculating the difference between the costs of growing and proceeds from sales, as well as comparing meat productivity. The calculation of indicators of the economic efficiency of raising cross-breed bulls was carried out on the basis of the values of the absolute growth, costs and cost of EFU (energy fodder unit), as well as the actual selling price of livestock for meat.

## 3 Results

The data obtained in the experiment confirm the positive effect of introducing FA into the diet when growing young animals (table 2).

**Table 2.** Dynamics of live weight and average daily gain of bull calves, kg (M±m).

Age, months	Holstein breed		Hybrids of Holstein and Hereford breeds of the 1st generation	
	Control group	Experimental group	Control group	Experimental group
	Live weight at the end of the period, kg			
At birth	31,00±0,26	30,98±0,26	26,2±0,28	26,15±0,26
14	329,3±3,02	330,85±2,68	372,15±2,33	374,8±1,79
15	351,5±3,26	353,32±2,77	397,7±2,12	400,7±1,56
16	373,55±3,5	375,7±2,88	422±2,0	428,35±1,43
	Average daily gain, g			
from 14 to 16	729,39±9,82	736,7±8,09	837,7±14,17	849,14±9,38
from 15 to 16	722,84±13,72	733,7±8,64	796,66±16,06	904,84±9,14
	Absolute gain, kg			
from 14 to 16	44,25±0,63	44,85±0,45	49,85±0,83	53,55±1,53
	Relative growth rate, %			
from 14 to 16	12,59±0,12	12,71±0,13	12,56±0,24	13,33±0,16

Over the period of the experiment, the absolute increase in Holstein gobies, which received FA with the diet, exceeded the indicators of gobies in the control group by 2.15 kg (0.58%). The growth of the experimental bulls of the Holstein and Hereford breeds exceeded the indicators of the control group by 6.35 kg (1.51%). The relative growth rate of the Brodie bulls, which received FA, was higher than that of the control groups. In purebred bulls of the Holstein breed, it is slightly higher by 0.12%, in crossbred bulls of the Golstein and Hereford breeds by 0.77%. To establish the degree of influence of FA on the growth rate, a univariate analysis of variance was carried out. The studied variants in all samples is the absolute increase in the live weight of animals during the period of the experiment. In the groups of crossbred animals, the effect of FA in Holstein and Herefords was 45% of the absolute increase based on the influence of the factor under study, with  $P < 0.05$ .

A comparative assessment of the consumption of feed by animals of different genotypes revealed that the bulls of the experimental group of the Holstein breed, having an absolute increase in live weight over the period of the experiment by 0.6 kg more than the individuals of the control group, consumed more feed: extra 0.1 kg of digestible protein (DP) (+0,1%) and extra 69.1 MJ of exchangeable energy (EE) (+1,2%). At the same time, the indicators of payment for fodder by weight gain in the experimental group were lower than in the control group. (-1,2% DP; -0,2% EE) (Table 3). Among the genotypes, the experimental group of 1/2 Holstein × 1/2 Herefords achieved an absolute gain of 53.6 kg, which is 3 kg more than in the control group. In the experimental group, the food consumption was less than in the control one by 0.5 kg of DP and by 61 MJ of EE, and the feed consumption per 1 kg of weight gain was better by 6.2% for DP and 6.7% for EE.

**Table 3.** The amount of consumed fodder and its payment by the increase in live weight.

Breed, genotype	Groups	Absolute gain over the period of the experiment, kg	Fodder consumed during the experimental period (on average for 1 head)		Feed costs per 1 kg of weight gain	
			digestible protein, kg	exchangeable energy, MJ	digestible protein, kg	exchangeable energy, MJ
Holstein	control	44,3	87,0	5797,0	1,964	130,86
	experimental	44,9	87,1	5866,2	1,940	130,65
	± to the control	0,6	0,1	69,1	-0,02	-0,21
1/2 Holstein × 1/2 hereford	control	50,6	74,7	5103,7	1,476	100,9
	experimental	53,6	74,2	5042,7	1,385	94,1
	± to the control	3	-0,5	-61,0	-0,09	-6,78

The calculation of economic efficiency for the experimental period is based on production costs and livestock productivity. The prime cost of FA includes the costs of collecting and preparing them and amounts to 3251.9 rubles for the period of experiment, including the costs for a feed additive from dwarf wood 2205.45 rubles and for the addition of lichen 1,046.43 rubles. FA consumption for the trial is 321 rubles per 1 head of cattle. The economic effect of using FA is to reduce feed consumption per 1 kg of gain. The economic effect as a result of the use of FA in the experimental group of hybrid Holstein and Hereford breeds of the 1st generation was 7.2 energy fodder units (EFU), which is 7.7% lower than in the control group, and 13.25% lower than in the experimental group of the Holstein breed (table 4).

**Table 4.** Economic efficiency of the use of a feed additive in the diet of young animals for the period of experiment.

Index	Holstein breed		Hybrids of Holstein and Hereford breeds of the 1st generation	
	Control	Experimental	Control	Experimental
Average daily gain, g	729,39	736,70	837,7	849,14
Absolute gain, kg	44,25	44,85	49,85	53,55
Quantity of fodder per 1 head., EFU	372	372	387	387
Price of 1 EFU, rub.	22,50	22,50	22,45	22,45
Feed costs per 1 head, rub.	8370	8370	8688	8688
The cost of growing of 1 head, rub.	12877	13198	13366	13687
Feed consumption per 1 kg of gain, EFU	8,4	8,3	7,8	7,2
Cost price per 1 kg of gain, rub.	291	294	268	256

The absolute gain per head in the experimental group of Holstein and Hereford hybrids of the 1st generation is more than in the control one by 3.7 kg, and in the control and experimental groups of Holstein breed - by 9.3 and 8.7 kg, respectively. The cost price of 1 kg of production gain due to the largest increase was lower than in the control by 4.69%, which creates the preconditions for an increase in profit from production activities.

## 4 Conclusion

According to the research results, obtained experimental data allow us to believe that from crossing purebred Holstein cattle with Hereford bulls in the conditions of the Magadan region, you can get young growth of the first generation, which differs from young Holstein breed in a high growth and development rate. The production of beef from crossbred young stock is characterized by better economic efficiency, compared to fattening of super-replacement young Holstein breed. The positive effect of the introduction of FA from dwarf pine and lichens into the diet on the absolute gain and growth rate of young growth of meat direction has been proven.

## References

1. *Agriculture of the Magadan region: statistical compilation*, 52 (Khabarovskstat. Magadan, 2020)
2. E.N. Moiseeva, *Biochemical properties of lichens and their practical significance*, 82 (Moscow, Akademii nauk SSSR, 1961)
3. A.R. Waldman, *The role of vitamin B12 in the nutrition of farm animals*, Vitamin B12 and its use in animal husbandry: collection of articles, Akademii nauk SSSR.. Scientific Council on the problems of chemicalization of animal husbandry, 157-169 (Moscow, Nauka, 1971)
4. V.N. Bazhenov, *Conifers – healers*, 96 (Moscow, LADA, 2006)
5. N.P. Starikova, *Dietary supplements: condition and problems*, 123 (Khabarovsk: Khabarovsk State University of Economics and Law, 2005)
6. I.Yu. Kuzmina, *Dairy and beef cattle breeding* **6**, 23-28 (2017)

7. I Yu Kuzmina, E V Ginter and A M Kuzmin, IOP Conf. Ser.: Earth Environ. Sci. **547** 012020 (2020) doi:10.1088/1755-1315/547/1/012020.
8. L.S. Ignatovich, E.V. Ginter, A.S. Lykov, I.Yu. Kuzmina, S.B. Kustova, Periodico Tchc Quimica **16** (32) 668-687 (2019) <https://elibrary.ru/item.asp?id=41635849>
9. *Guidelines for organizing and conducting research on feeding cows on industrial farms and complexes*, 55 (Dubrovitsy, 1983)
10. A.M. Gataulin, *System of applied statistical and mathematical methods for processing experimental data in agriculture*, 192 (Moscow, Moscow Agricultural Academy, 1992)
11. State Standard 2011 <http://gost.ruscable.ru/cgi-bin/catalog>.
12. *Enterprise standards. Methods for the analysis of forage plants and feed. STP 3102.1-83 – STP 3102.14-83*, 33 (All-Russian Williams Fodder Research Institute, Moscow, 1984)