CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
http://doi.org/10.5281/zenodo.3248677

Available online at: http://www.iajps.com Research Article

SCIENCE-BASED USE OF MOUNTAIN FORAGE LANDS AND THEIR IMPACT ON THE PRODUCTIVE AND BIOLOGICAL PECULIARITIES OF FATTENING YOUNG CATTLE DURING THE SUMMER

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Article Received: April 2019 **Accepted:** May 2019 **Published:** June 2019

Abstract:

Development of the livestock industry is based on the creation of a stable fodder base. The mountainous part of RNO-Alania is one of the factors of natural livestock providing with mountain pastures. Feed produced in pastures is of low cost and increasing its share in animal diets will help to reduce the cost per unit of animal product. In this regard, experimental studies on science-based use of mountain forage lands and their impact on the productive and biological peculiarities of fattening young bull-calves were performed at the mountain station of the Dargavskaya hollow belonging to the seventh agro-climatic region [1]. Two groups of six calves each – control and experimental, which were used during scientific and economic and physiological studies were formed by the analogue scale for the stationary experiment including age, live weight and physiological state [14].

The control group used natural pasture grasses, experimental animals grazed in improved, fertilized with biologicals, agricultural ores and sheep manure pastures.

Studies found that the application of fertilizers and bio-additives contributed to a better use of pasture feed, extension of the grazing period to 180 days and increase in the load per 1 ha from 0,8 (in the control variant) to 3,86 animal units, while reducing the cost of 1 feed unit by 2,5 times (1,53 versus 0,60 roubles) and realizing additional profit on experimental bulls – 5.56 % per head that is 4460 roubles.

Keywords: *pastures, biological additives, fertilizers, bull-calves, blood, live weight.*

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Please cite this article in press Ugoretz Valentino Iosifovna et al., ***Science-Based Use Of Mountain Forage Lands And Their Impact On The Productive And Biological Peculiarities Of Fattening Young Cattle During The Summer.,*** *Indo Am. J. P. Sci, 2019; 06[06].*

INTRODUCTION:

Relevance. Nowadays issues of rational use of natural resources by farm animals in the mountains are an important natural-scientific and socio-economic problem, solution of which implies reclaiming the fertility of mountain forage lands with different degree of degradation, in modern conditions, and because of its environmental orientation becomes particularly relevant.

The research aim was to study the created target plant communities for different usage modes basing on improvement of the cereal-legume grass composition to increase efficiency of using biological nitrogen, soil fertility and environmental safety of plant products for farm animals.

Research methods. The research object was degraded mountain forage lands in eastern exposure of Dargavskaya hollow, North Ossetia-Alania. The characteristic feature of the climate in the research area is the drop in air temperature. The average annual air temperature was 5,9 °C, precipitation – 540-720 mm, and the hydrothermal coefficient – 1,1-2,8. The rate of precipitation during the growing season reached 80% of their annual amount. In general, meteorological conditions during the research period for the growth and development of meadow grasses were favorable.

Research was performed on the mountain-meadow subalpine soil, which contained humus – 4,71%; total nitrogen – 0,97%; P_2O_5 – 5,90 mg/100g soil; K_2O – 25,06 mg/100 g soil; pH_{salt} – 5,09. According to the mechanical composition, the soil belongs to heavy one [3].

To achieve the aim, the experiment was made, in the process of which were used according to the scheme of the experiment in variants:

1. Unfertilized control;
2. Agricultural ore – 0,5 t/ha;
3. Agricultural ore – 1 t/ha;
4. Agricultural ore – 2 t/ha;
5. Sheep manure (humus) 10 t/ha;
6. Agricultural ore – 0,5 t/ha + Extrasol 0,1 %;
7. Agricultural ore – 1,0 t/ha + Extrasol 0,1 %;
8. Agricultural ore – 2,0 t/ha + Extrasol 0,1 %;
9. Sheep manure (humus) 10 t/ha + Extrasol 0,1%.

Characteristics of unconventional fertilizers used in the pasture: “Extrasol” – a microbiological preparation, rhizosphere bacteria Bacillus subtilis 4-13 strain that has a complex of useful properties – improves nutrients supply to plants, increases seeds germination, reduces their invasion by phytopathogenic microorganisms, increasing the grasses productivity [5]. The preparation was introduced as 0,1% water solution at the rate of 200 l/ha area.

Zeolite-containing agricultural ore is a natural environmentally friendly product belonging to the category of marine clays formed from fine-dispersed suspensions with high adsorption properties. Chemical analysis of agricultural ore found the following elements: SiO_2 – 37,8%; N – 8,82 mg/100 g dry weight; P_2O_5 – 4,92; K – 11,72; CaO – 21,21; Cd – 0,333; Ni – 2,72; Cu – 2,22; Zn – 3,94; Co – 0,93; Mo – 3,84; Mg – 2,08 mg/100; Fe – 321,19 mg/CI; Mn – 420,27; Pb – 564 mg/kg; when pH – 9,11 [12, 18].

Sheep manure (humus) – enriches the soil with nutrients, keeping it from drying, promotes the reproduction of earthworms, strengthening the microbiological activity, improves its physical and biological properties. It contains: total nitrogen – 0,56%; ammonia – 0,14; phosphorus – 0,47; potassium – 0,88; organic matter – 28%; ash – 23% when humidity is 49,0% and pH – 7,9; C:N – 17.
For the further grass development, previously tested biologized system of fertilizers comprising pre-sowing seeds treatment with biologically active preparation “Extrasol” was used and then the grass was resprayed in the period of tillering; the mixture of zeolite-containing agricultural ore and humus – sheep manure was introduced in the soil surface.

Yield control in the earing phase of the dominant was performed by mowing method that details its chemical composition and is used during cattle fattening [8-10, 15]. Phenological phases onset, growth and development were observed according to the method of experiments in hayfields and pastures of the All-Russia Williams Fodder Research Institute [11] and other standard methods: energy estimation of meadow agro-systems [6], training and methodological guidelines for research in agronomy [2] and animal husbandry [10], as well as computer programs for processing experimental data [15-32].

RESEARCH RESULTS:

The results of studying the grass yield of two alpine pastures with detailed elaboration of its chemical composition, used during cattle fattening found that the application of fertilizers and biological additives not only increased the yield of green mass of pasture grasses but also contributed to the earlier grass vegetation (15-20 days) in spring and later wilt in autumn that allowed to lengthen the grazing period up to 180 days (until mid-October).

Application of fertilizers and biological additives on the experimental pasture plots leads to an increase in their productivity and faster recovery of consumed nutrients that usually takes 3-6 weeks.

The interval duration causes an increase in the nec-

essary amount of green mass for the next pasturing, which depends on the pasture rest period, grazing and grasses nutrient supply.

For the rational pastures use it is necessary to determine the correct load on them. The cattle load on the pasture varies according to the pasture grass productive capacity depending on the specific conditions of the year.

Physiological observations of changes in the grass under the influence of grazing revealed that, on average, during the period of pastures use by animals, the yield of unfertilized pastures was 59 cwt/ha, while of fertilized pastures – 298,8 cwt/ha (table 1).

Table 1. Productivity of alpine pastures

Indicators	Green mass productivity in timing of pastures use cwt/ha						Pasture productivity per season cwt/ha
	30.V	10.VI	30.VI	25.VII	15.VIII	15.XI	
Unfertilized control	8,1	10,2	11,5	12,6	9,1	7.5	59,0
Fertilized pasture + biological additives	27,8	43,0	65,6	69,8	53,5	39,1	298,8

As can be seen from the above data, the application of fertilizers and biological additives contributes to a threefold increase in the grazing capacity. By autumn, the plants in natural pastures dry out, the feed quality decreases. Closer to the fall pasture forage cannot completely meet the needs of animals, and this seems to be due to changes in the chemical composition of pasture grass (table 2).

Table 2. Chemical composition (in % for absolutely dry matter) of mountain pastures grass (on average for the summer period)

Indicator	Mountain pasture	
	Unfertilized control	Fertilized pasture
Dry matter	25,30	24,70
ME of 1 kg dry matter, MJ	10,33	10,19
GE of 1 kg dry matter, MJ	17,91	18,10
Crude protein	9,10	16,60
Crude fat	3,70	2,60
Crude fiber	25,10	23,50
Ash	9,30	9,30
Nitrogen-free extractives	52,80	48,00

Data in table 2 show that the chemical composition of the grass varied depending on the application of fertilizers and biological additives throughout the grazing season. Thus, according to the dry matter level, grass of the fertilized pasture was characterized by slightly increased water content and was 24,7% versus 25,3% of the unfertilized pasture.

Grass of the fertilized pasture during grazing is characterized by a decrease in fat content from 3,7 to 2,6% and, as studies showed, in the content of nitrogen-free extractives, which is associated with the duration of pastures use – 52,8% versus 48% or less by 4,8%.

The results of our research are confirmed by the data of other scientists [4; 7; 10; 13; 16; 17; 18; 19]. Fiber is of great importance among the nutrients in the feeding of farm animals. Its level in the diet has influence on the digestibility of other feed elements. The amount of fiber ranged from 25,1 to 23,5% for absolutely dry matter.

With increasing the content of crude protein and decreasing fiber in the pasture grasses, under the influence of fertilizers and biological additives, the feed nutritional value increased and was per 1 kg pasture DM in the unfertilized control – 0,92 feed units, 72 g of digestible protein versus 0,92 feed units and 135 g of digestible protein in fertilized

pastures at 1 food unit cost – 1,53 roubles in control and 0,60 roubles in fertilized pastures. The use of mineral and biological preparations on natural mountain pastures is economically efficient.

One of the indicators of forage zootechnical evaluation is their productive effect on animals.

As studies have shown, the indicator of animals' growth and development is their live weight (table 3).

Table 3. Live weight of bull-calves by age periods, kg (n=6)

Age of an animal	Group of bull-calves	
	control	experimental
Experimentation at 8 months	126,80±0,77	124,80±0,45
at 9 months	142,92±1,37	144,60±1,30
at 12 months	200,32±3,46	213,47±2,83
at 15 months	239,40±1,94	252,70±2,36

The use of fertilized pastures provided the highest live weight when stopping to fatten up the experimental group at 15 months. So, this superiority of 9 month old animals in the control group was 1,2%, 12 month old – 6,65% and 15 month old – 5,5%. Consequently, the increase in the biological value of animal feeding suggests that the high content of macro-and microelements in the pasture forage affected positively the live weight gain of animals in the experimental group. During the experimental period, the average daily gain in their live weight was 693 g, which is more compared to the control group of animals by 92 g or 15,3%.

Evaluation of the exterior and body tympanum completely characterizes the productive qualities of animals due to the fact that the animals' productivity is related to the large physiological stress of all body systems, so they must be constitutionally strong (table 4).

Table 4. Comparative characteristics of linear growth of experimental bull-calves at different age periods (n=6)

Measurements (cm)	Age groups					
	1 – control			2 – experimental		
	6 months	9 months	12 months	6 months	9 months	12 months
Withers height	77,82±1,50	86,20±0,37	103,60±0,70	85,40±2,13	87,40±0,19	110,56±0,35
Chest depth	24,74±0,65	29,50±0,27	40,10±0,37	31,06±0,57	31,50±0,29	44,20±0,12
Chest width	22,32±0,73	22,50±0,19	30,40±0,32	22,70±0,38	23,80±0,25	33,20±0,21
Chest girth	89,24±0,33	98,60±0,57	111,40±0,33	91,64±0,47	101,50±1,53	118,50±0,26
Oblique body length	87,50±0,63	92,80±0,10	113,50±0,27	89,8±0,59	93,60±0,26	118,60±0,30
Hook bone width	18,30±0,15	19,00±0,10	24,90±0,13	18,34±0,14	19,36±0,14	27,00±0,20
Metacarpus girth	8,16±0,12	9,24±0,40	10,80±0,17	8,46±0,15	9,46±0,25	11,90±0,15
Hip joint width	18,80±0,38	20,50±0,21	23,50±0,47	18,88±0,10	21,50±0,29	25,40±0,23
Shoulder joint width	18,60±0,10	20,66±0,30	22,90±0,13	19,1±0,12	21,16±0,21	24,20±0,28

The analysis of the data (table 4) showed that better feeding conditions of the second group contributed to a greater linear growth compared to the control group in all measurements at all ages, however, there was insignificant difference between them.

Results of biochemical blood tests were retrospectively analyzed. The research results found that all morphological and biochemical blood parameters were within the physiological range (table 5).

Table 5. Blood biological parameters in experimental bull-calves (n=6)

Parameters	Group	
	1 – control	2 – experimental
6 months		
Hemoglobin, g/l	106,04±0,31	110,40±0,29
Erythrocytes 10^{12}/l	5,75±0,02	6,22±0,03
Leukocytes 10^{9}/l	7,56±0,07	7,44±0,04
Total protein, % g/%	7,08±0,04	7,83±0,02
9 months		
Hemoglobin, g/l	105,90±0,98	110,00±0,34
Erythrocytes 10^{12}/l	5,42±0,04	5,94±0,05
Leukocytes 10^{9}/l	7,42±0,06	7,61±0,09
Total protein, % g/%	7,26±0,07	7,90±0,04
12 months		
Hemoglobin, g/l	107,50±0,27	115,70±0,25
Erythrocytes 10^{12}/l	5,64±0,04	6,12±0,06
Leukocytes 10^{9}/l	7,50±0,10	7,65±0,10
Total protein, % g/%	7,41±0,15	8,14±0,09

However, during the experiment the content of formed blood elements in animals of the experimental group compared to the control was higher at all ages, within the physiological range, animal health in both groups was good.
This may be explained by the fact that grazing animals of the experimental group in biologized pastures affected positively their body and better activated the hematopoietic system than when grazing bull-calves in primitive pastures.

Thus, considering the indicators of blood hemoglobin concentration, one may conclude that there was a tendency to increase hemoglobin with the bull-calves age but in the experimental group of animals there was a significant increase in hemoglobin concentration (P>0,001) compared to the control (table 5). As for the number of red blood cells indices there was their significant increase in the experimental group (P>0,001). The results of the studies to determine the total blood protein found an increase of this index in the experimental group compared to the control one (table 5).

When analyzing data in table 5, one can conclude on the increase in total protein in all age periods. When comparing this indicator to the control group, it significantly increased in the blood of the experimental bull-calves (P>0,001). There is a correlation between the content of total serum protein with nitrogen metabolism and animal productivity, which indicates an increase in the intensity of protein metabolism and thus significant gain in the total body weight of animals.

Thus, it can be concluded that biological preparations and agricultural ore had a stimulating effect on hematopoietic functions in the bull-calves body, as well as on the level of intermediate metabolism. Based on the above, we can conclude that one of the conditions for the using mountain pastures is their biologization, as it contributes to the increase in the forage use, animal productivity and is one of the problems in the formation and improvement of effective management of natural resources and environmental protection.

CONCLUSIONS:

The studies allowed us to establish differences in the extreme natural climatic conditions of the high-mountain Dargavaskaya hollow between fattening in groups of bull-calves, pattern of mountain pastures use, growth and development of their live weight and the average daily gain, meat productivity and animals metabolism of using biological preparations and manure, which will contribute to the ecological integrity of mountain landscapes not only in our Republic, but also in other mountain regions of the Russian Federation.

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