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The Effect of Vilofoss Mineral Feed Additive on Productive and Wool Quality Characteristics in Fattening Hissar Lambs

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Abstract. *This article highlights the effect of using different doses (50 g and 100 g) of Vilofoss feed additive in a two-stage system for fattening Hissar lambs on nutrient digestibility, live weight gain, feed conversion ratio (FCR), and wool productivity. The experimental results indicated that the inclusion of Vilofoss additive significantly improved ration digestibility while concurrently increasing live weight gain by 18.4–26.3% and substantially enhancing wool quality parameters. Furthermore, the specific biological and physiological patterns regarding the optimal dose levels for both meat and wool productivity were scientifically substantiated.*

Keywords: *Hissar breed, Vilofoss, fattening, feed conversion, digestibility, wool yield, keratin, mineral balance*

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Kökəltmədə olan Hissar quzularında "Vilofoss" mineral yem əlavəsinin məhsuldarlıq və yun keyfiyyəti göstəricilərinə təsiri

Şoira Aminova

Xülasə. *Məqalədə Hisar cinsli quzuların kökəldilməsində iki mərhələli sistem üzrə müxtəlif dozalarda (50 q və 100 q) Vilofoss yem əlavəsindən istifadənin qida maddələrinin həzm olunmasına, canlı çəki artımına, yemin konversiya əmsalına (FCR) və yun məhsuldarlığına təsiri araşdırılmışdır. Təcrübə nəticələri göstərmişdir ki, rasiona Vilofoss əlavəsinin daxil edilməsi qida maddələrinin həzm olunmasını əhəmiyyətli dərəcədə yaxşılaşdırmaqla yanaşı, canlı çəki artımını 18,4–26,3% artırmış və yunun keyfiyyət göstəricilərini əhəmiyyətli dərəcədə yaxşılaşdırmışdır. Bundan əlavə, ət və yun məhsuldarlığı baxımından optimal doza səviyyələrinin müəyyənləşdirilməsinə dair spesifik bioloji və fizioloji qanunauyğunluqlar elmi cəhətdən əsaslandırılmışdır.*

Açar sözlər: *Hisar cinsi, Vilofoss, kökəltmə, yemin konversiyası, həzm olunma, yun məhsuldarlığı, keratin, mineral balans*

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Introduction

In the modern livestock sector, ensuring a sustainable supply of high-quality and safe animal products (meat, wool) to the population, increasing production efficiency, and reducing product costs represent paramount strategic objectives. The fundamental prerequisite for enhancing productivity lies in establishing a comprehensive and balanced nutrition system that fully aligns with the genetic potential and physiological requirements of animals.

In Uzbekistan and across the Central Asian region, Hissar sheep constitute the cornerstone of mutton-tallow (meat-fat) sheep farming. Representatives of this breed are distinguished by their exceptionally large body frame, rapid growth rates, high adaptability to extreme climates and pasture conditions, as well as an extensive genetic potential. However, in practice, the inherent hereditary (genetic) capacities of Hissar lambs are not being fully utilized. The primary reason for this is the inadequacy of the ration, particularly the deficiency of minerals and biologically active substances therein.

In the livestock industry, improving feed efficiency to boost meat and wool productivity, alongside formulating rations tailored to the physiological needs of animals, stands as a crucial task. In particular, enriching the diet of Hissar lambs with minerals and biologically active substances plays a vital role in unlocking their full hereditary potential. Enhancing the assimilation (absorption) of elements such as protein, calcium, and phosphorus in the ration not only optimizes primary meat productivity but also improves the quality of wool as a secondary product. This study investigated the effects of incorporating the Vilofoss feed additive on the productivity and physicochemical characteristics of Hissar lambs (Yuldashbayev et al., 2023).

Materials and Methods

The conducted experiment was carried out on Hissar breed lambs using a two-stage fattening system. The dietary nutritive value was formulated based on the age, live weight, and physiological requirements of the lambs. Three experimental groups were established for the study:

Control group – basal ration (BR);

Experimental group 1 – BR + 50 g of Vilofoss additive;

Experimental group 2 – BR + 100 g of Vilofoss additive.

During the trial, nutrient digestibility, live weight dynamics, feed conversion ratio (FCR), as well as quantitative and qualitative characteristics of wool were analyzed according to standard methodologies, and the statistical significance level (P) of the obtained results was evaluated (Shcheglov et al., 1989).

Results and Discussion

Nutrient digestibility and growth performance: The inclusion of the Vilofoss additive into the ration exerted a positive effect on the digestibility of dietary nutrients and the assimilation of nutritive substances. In the first stage of the experiment, dry matter digestibility increased by 4.6% in experimental group 2 compared to the control, crude protein digestibility rose by 4.3%, and energy utilization increased by 5.0%. Furthermore, calcium and phosphorus assimilation was higher by 5.5–6.0%. In the second stage of the trial, these parameters increased even further, demonstrating that the effect of the additive intensified over time (Ulyanov, 1982).

The improvement in feed digestibility was directly reflected in growth and development efficiency:

At the conclusion of the experiment, live weight gain reached 18.0 kg in experimental group 1 (18.4% higher than the control) and 19.2 kg in experimental group 2 (26.3% higher than the control) ($P > 0.99$). The average daily gain (ADG) fluctuated around 300–320 g, with the highest performance and the most optimal feed conversion ratio (FCR) being recorded in experimental group 2, which received the 100 g dose (Yuldashbayev et al., 2023).

Wool productivity and quality traits: The enhancement of mineral and protein metabolism throughout the fattening stage directly and favorably influenced the wool cover parameters of the animals (Table 1).

Table 1
Changes in wool characteristics relative to the control, %

Parameter	Control	Experimental 1 (50 g)	Experimental 2 (100 g)
Annual wool yield	-	+16.5	+13.2
Clean wool mass	-	+27.8	+23.7
Wool fiber length	-	+17.3	+15.3
Wool fiber strength	-	+15.2	+13.9
Proportion of breakable fibers	-	39.1	-34.4

In terms of physical parameters, wool fiber strength—which stood at 7.9 sN/tex in the control group—successfully reached 9.1 sN/tex in experimental group 1 and 9.0 sN/tex in experimental group 2, representing an increase of 15.2% and 13.9%, respectively ($P > 0.95$). Concurrently, the proportion of breakable fibers dropped significantly from a baseline of 6.4% in the control down to 3.9% in the 50 g group and 4.2% in the 100 g group, confirming a reduction of 39.1% and 34.4% at a high statistical significance level ($P > 0.99$) (Shcheglov et al., 1989).

The synthesis of these findings highlights an important biological pattern: while the maximum meat productivity and optimal feed conversion ratios (FCR) were yielded by the 100 g dietary dose (experimental group 2), the highest values for wool productivity and corresponding quality traits were distinctly achieved at the lower 50 g dose (experimental group 1). This difference is biologically justified by the fact that a moderate mineral equilibrium is highly optimal for active wool follicle function, whereas escalating the dose to 100 g provides no cumulative synergistic effect on the complex wool formation pathways (Yuldashbayev et al., 2023).

Crucially, the Vilofoss premix efficiently fulfilled the biological requirements for sulfur-containing amino acids and vital trace elements such as zinc (Zn) and copper (Cu), which serve as essential

components for the synthesis of the core keratin protein matrix in wool fibers. Furthermore, a general optimization of feed conversion was recorded across both treatment groups, resulting in a reduced feed intake per kilogram of live weight gain and confirming an overall rise in dietary utilization efficiency, which bears pronounced economic relevance, particularly within the 100 g treatment cohort (Ulyanov, 1982).

Furthermore, the incorporation of the Vilofoss additive exerted a distinctly positive effect on the wool cover characteristics of the lambs. Specifically, it led to an increase in annual wool yield, clean wool mass percentage, wool fiber length, and fiber strength, while simultaneously reducing the proportion of breakable fibers. This clearly demonstrates that the feed additive enhances not only primary meat productivity but also significantly improves both the quality and quantity of wool as a secondary product (Shcheglov et al., 1989).

Overall, the experimental results scientifically substantiate that supplementing the ration of Hissar lambs with the Vilofoss mineral feed additive markedly increases livestock efficiency by improving nutrient digestibility, accelerating live weight gain, optimizing feed conversion, and boosting wool productivity. Consequently, the practical application of this additive is highly recommended and considered expedient for livestock farms.

Conclusion

In conclusion, Hissar lambs are characterized by their rapid growth rates and large carcass conformation, with their growth performance being directly dependent on the efficiency of the digestive system and overall metabolism. Regarding nutrient and energy digestibility, the Vilofoss feed additive stimulates the gastrointestinal tract microbiota, particularly within the rumen. This stimulation enhances the breakdown and absorption rate of crude fiber, protein, and carbohydrates. As a result, metabolic energy from the feed is efficiently directed toward the biological processes of body growth and development, rather than being wasted.

In terms of calcium (Ca) and phosphorus (P) metabolism, these minerals serve as essential building blocks for bone tissue formation, muscular contraction, and enzymatic reactions. The ideal ratio and highly bioavailable form of minerals in Vilofoss substantially improve their absorption through the intestinal walls into the bloodstream, ensuring the rapid and robust development of the skeletal framework while effectively preventing calcium-phosphorus deficiency disorders such as rickets and osteomalacia.

Furthermore, meat productivity and feed conversion metrics represent the most critical economic indicators in meat-oriented sheep farming, specifically regarding daily live weight gain and the feed units consumed per kilogram of growth. The lambs receiving the Vilofoss-supplemented ration exhibited a significantly accelerated growth rate compared to the control group, achieving an 18.4%–26.3% increase in live weight gain.

Due to the enhanced digestibility of the diet, the amount of feed required per kilogram of live weight gain was reduced, optimizing the feed conversion ratio (FCR). This reduction effectively conserves feed expenditures, which constitute the largest expense during the fattening period, thereby lowering the overall production cost of mutton.

Optimal dose for meat productivity (100 g/day): In meat-oriented sheep farming, administering a dietary dose of 100 grams induces intensive muscle tissue development, maximizing both the carcass yield (dressing percentage) and qualitative meat characteristics such as juiciness and marbling.

Wool productivity and its physical properties: Although the Hissar breed is predominantly utilized for mutton-tallow (meat-fat) production, the wool harvested from these animals serves as an important source of secondary economic income for livestock operations. The overall improvement in wool quality traits is biologically driven by the adequate supply of dietary mineral substances, which actively stimulates the physiological functions of the skin and wool follicles.

Consequently, this nutritional enrichment leads to a significant increase in annual wool yield and clean wool mass, while concurrently expanding wool fiber length and tensile strength (resistance to breaking). Furthermore, the inclusion of these minerals effectively reduces the proportion of brittle, dry, and breakable fibers, thereby enhancing the overall uniformity of the fleece.

Optimal dose for wool productivity (50 g/day): In terms of enhancing wool productivity and its core physical characteristics, the 50-gram dose (Experimental Group 1) yields the highest biological and economic efficiency. Because the 100 g dose is primarily partitioned toward muscle tissue deposition and metabolic pathways related to meat accretion, the 50 g daily dose remains highly optimal for satisfying the specific physiological requirements of wool quality and development.

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Growth, Development and Biological Characteristics of Medicinal Marshmallow (*Althaea officinalis* L.) and Quality Indicators of Raw Materials

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Abstract. *The results of the conducted studies showed that the biochemical and physiological processes occurring in the medicinal marshmallow (Althaea officinalis L.) plant are directly related to the availability of mineral elements. The obtained data indicate that each macronutrient performs a specific function in the vital activity of the plant, while their combined action forms an integrated system regulating plant growth and development. This article presents information on the relationship between mineral elements and biochemical processes in medicinal marshmallow, as well as the quality indicators of medicinal plant raw materials.*

Keywords: *medicinal marshmallow, biologically active substances, plant raw materials, Mucaltin, herbal preparations, pharmacognosy*

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Dərman gülxətmisinin (Althaea officinalis L.) böyüməsi, inkişafı və bioloji xüsusiyyətləri, həmçinin xammalın keyfiyyət göstəriciləri

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Xülasə. *Aparılmış tədqiqatların nəticələri göstərdi ki, dərman gülxətmi (Althaea officinalis) bitkisində baş verən biokimyəvi və fizioloji proseslər mineral elementlərlə birbaşa bağlıdır. Əldə edilmiş məlumatlardan məlum olduğu kimi, hər bir makroelement bitkinin həyatında özünəməxsus funksiyanı yerinə yetirir və onlar birlikdə bitkinin inkişafını idarə edən vahid sistem təşkil edir. Bu məqalədə dərman gülxətmi bitkisinin mineral elementlər və biokimyəvi proseslər arasındakı qarşılıqlı əlaqəsi, həmçinin xammalın keyfiyyət göstəriciləri haqqında məlumatlar təqdim olunur.*

Açar sözlər: *dərman gülxətmi, bioloji fəal maddələr, xammal, mukaltin, bitki preparatları, farmakoqnoziya*

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1. Introduction

Nitrogen is a major “building material” for plants, being a component of proteins, amino acids, and enzymes, and it accelerates biochemical reactions occurring in cells. Therefore, under conditions of sufficient nitrogen supply, plant growth is accelerated, leaves become larger and dark green, and photosynthetic processes proceed actively. The participation of nitrogen in chlorophyll further increases its importance (Meyghan & Moradi, 2018).

Phosphorus plays an important role in energy metabolism in plants. As a component of ATP, it ensures the accumulation and transfer of energy. Therefore, when phosphorus is supplied adequately, the root system develops well, the plant enters the generative stage earlier, and flowering and seed formation proceed effectively (Meyghan & Moradi, 2018).

Potassium regulates the synthesis, transport, and accumulation of carbohydrates. Its role is particularly important in the formation of mucilage and polysaccharides, which are important for medicinal marshmallow. In addition, potassium maintains water balance in cells and increases the plant’s resistance to various stress factors. Research on marshmallow cultivation also examines mineral nutrition under irrigation (Pryvedeniuk et al., 2021).

2. Materials and methods

The results were analyzed using mathematical and statistical methods, and the differences between treatments were found to be statistically significant ($p < .05$). This indicates that the effect of mineral nutrition on the quality of medicinal raw materials is scientifically substantiated and follows a regular pattern.

3. Results

The results of our studies showed that the highest efficiency is achieved when these elements are maintained in balance. In particular, in the N90P60K60 treatment, the main biochemical processes in the plant were observed to be activated to the highest level. This was manifested in enhanced photosynthesis, increased enzyme activity, and accelerated synthesis of carbohydrates and secondary metabolites.

At the same time, it was found that when mineral elements were applied in excessive amounts, the expected effect was not fully achieved. For example, a decrease in some indicators was observed in the N120P80K80 treatment. This can be explained by disruption of the balance among elements, reduced nutrient uptake, and decreased efficiency of metabolic processes.

Comparative analysis of the results obtained in the experimental fields showed that the effect of mineral elements on plants follows general regularities; however, its degree may vary depending to some extent on soil and climatic conditions, moisture regime, and agrotechnical practices. This further increases the reliability of the obtained results and the possibility of their wide practical application (Ahmedov et al., 2018).

The data in Table 1 show that the level of biochemical activity in medicinal marshmallow (*Althaea officinalis* L.) is directly dependent on mineral nutrition conditions.

Table 1
Efficiency of mineral nutrition treatments in medicinal marshmallow (Althaea officinalis L.)

№	Treatment	Biochemical activity	Note
1	Control	Low	Natural conditions
2	N40P40K40	Lower	Partial activation
3	N60P40K40	Medium	Partial activation
4	N60P60K60	Above medium	Activation
5	N90P60K60	Highest	All processes balanced
6	N90P80K80	Decrease	Beginning of imbalance
7	N120P80K80	Decrease	Imbalance

In the control treatment, biochemical activity was low, reflecting the growth of the plant under natural agro-background conditions. Under these conditions, the synthesis of biologically active substances was observed to proceed in a limited manner.

Partial activation of biochemical processes was recorded in the N40P40K40 and N60P40K40 treatments with mineral fertilizers. This can be explained by an increase in metabolic processes as a result of improved plant supply with nutrients (Berdiyev et al., 2016).

In the N60P60K60 treatment, an intensification of biochemical processes was recorded.

The highest biochemical activity was observed in the N90P60K60 treatment, where all physiological and biochemical processes in the plant proceeded in a balanced manner. The optimal ratio of mineral elements increased enzymatic activity and maximally stimulated the synthesis of carbohydrates and secondary metabolites.

However, a certain decrease in biochemical activity was observed in the N90P80K80 and N120P80K80 treatments, where mineral fertilizers were applied in excessive amounts. This can be explained by disruption of physiological and metabolic balance in the plant due to excessive nutrition and suppression of certain enzymatic processes.

Thus, the analysis results show that the correct selection of optimal rates and ratios in mineral nutrition is crucial for ensuring maximum biochemical activity in medicinal marshmallow. In particular, the N90P60K60 treatment was assessed as the most effective.

Quality indicators of medicinal marshmallow (*Althaea officinalis* L.) raw materials. The results of the conducted studies demonstrated that mineral nutrition has a significant effect on the main quality indicators of medicinal marshmallow (*Althaea officinalis*) raw materials. The experimental data were

consistent with one another, and a stable improvement in quality indicators was observed under conditions where mineral fertilizers were applied.

The results obtained for dry matter and extractive substances clearly confirm this trend. The increase in dry matter content under the influence of mineral nutrition indicates greater accumulation of organic substances in plant tissues. An increase in extractive substances is an important indicator determining the pharmacological value of medicinal plant raw materials, and a higher level indicates improved product quality.

The specific numerical results also confirm this regularity. In the first year of the study, 2023, the dry matter content in the control treatment was 22%, while extractive substances accounted for 18%; in the treatments with mineral fertilizers, these indicators increased gradually. In the N40P40K40 treatment, dry matter was 24% and extractive substances were 19.5%; in N60P40K40, dry matter was 25% and extractive substances 21%; in N60P60K60, dry matter was 26.5% and extractive substances 22.5%; and in N90P80K80, dry matter reached 27.5% and extractive substances 22.5%. The highest results were recorded in the N90P60K60 treatment, at 28% and 24%, respectively. This indicates that a balanced ratio of mineral elements most effectively promotes the accumulation of dry matter and biologically active compounds in plant tissues (Ahmedov et al., 2018).

At the same time, a certain decrease in the expected effect was observed when mineral fertilizers were applied in excessive amounts. In particular, in the N120P80K80 treatment, dry matter was 27% and extractive substances were 23%, but these indicators were lower than in the optimal treatment. This can be explained by disruption of metabolic balance in the plant as a result of excessive mineral nutrition and limitation of the synthesis of some biologically active compounds (Table 2).

In 2024, dry matter in the control treatment was 22.5% and extractive substances were 18%, while these indicators increased gradually in the treatments with mineral fertilizers. In N40P40K40, dry matter was 24% and extractive substances 19%; in N60P40K40, dry matter 25% and extractive substances 21%; in N60P60K60, dry matter 26% and extractive substances 23%; in N90P80K80, dry matter 27.5% and extractive substances 22%; and in N120P80K80, dry matter 26.5% and extractive substances 23%. These indicators were lower than those of the optimal treatment. The highest results were recorded in N90P60K60, reaching 28% and 24%, respectively.

In the third year of the study, 2025, dry matter in the control treatment was 22.5% and extractive substances were 18.5%, while these indicators increased gradually in the treatments with mineral fertilizers. In N40P40K40, dry matter was 24% and extractive substances 19%; in N60P40K40, dry matter 26% and extractive substances 21%; in N60P60K60, dry matter 26.5% and extractive substances 22%; in N90P80K80, dry matter 27.5% and extractive substances 22.5%; and in N120P80K80, dry matter 26% and extractive substances 23%. The highest results were recorded in N90P60K60, where dry matter reached 28.5% and extractive substances 24%.

Considering the three years of the study as a whole, the control treatment had 22.2% dry matter and 18.2% extractive substances, while these indicators varied in the treatments with mineral fertilizers. In N40P40K40, dry matter was 24% and extractive substances 19.2%; in N60P40K40, dry matter 25.3% and extractive substances 21%; in N60P60K60, dry matter 26.3% and extractive substances 22.5%; in N90P80K80, dry matter 27.5% and extractive substances 22.2%; and in N120P80K80, dry matter 26.5% and extractive substances 23%. The highest results were recorded in N90P60K60, with dry matter reaching 28.2% and extractive substances 24%.

Overall, in the N90P60K60 treatment of medicinal marshmallow (*Althaea officinalis* L.), the contents of dry matter and extractive substances increased more markedly than in the other treatments during all three years.

This indicates that a balanced ratio of mineral elements brings the accumulation of dry matter and biologically active compounds in plant tissues to the most effective level.

The obtained results once again confirmed that the application of mineral nutrition at scientifically justified rates is crucial for increasing the quality indicators of medicinal raw materials.

Table 2

Quality indicators of raw materials under mineral nutrition of medicinal marshmallow (Althaea officinalis L.), 2023–2025

No	Treatment	2023 Dry matter (%)	2023 Extractive substances (%)	2024 Dry matter (%)	2024 Extractive substances (%)	2025 Dry matter (%)	2025 Extractive substances (%)	Mean Dry matter (%)	Mean Extractive substances (%)
1	Control	22	18	22.5	18	22	18.5	22.2	18.2
2	N40P40K40	24	19.5	24	19	24	19	24	19.2
3	N60P40K40	25	21	25	21	26	21	25.3	21
4	N60P60K60	26.5	22.5	26	23	26.5	22	26.3	22.5
5	N90P60K60	28	24	28	24	28.5	24	28.2	24
6	N90P80K80	27.5	22.5	27.5	22	27.5	22.5	27.5	22.2
7	N120P80K80	27	23	26.5	23	26	23	26.5	23

4. Discussion

Related work has examined the accumulation of polysaccharides under different cultivation practices (Pryvedeniuk et al., 2026), the structural and rheological properties of root polysaccharides (Karimi et al., 2021), and leaf mucilage composition (Tomoda et al., 1981). These studies provide background for interpreting raw-material characteristics; they do not independently validate the measurements reported here. Good agricultural practices and raw-material testing are addressed in World Health Organization guidelines (World Health Organization, 2003, 2011).

According to the observations, the contents of dry matter and extractive substances in the treatments with mineral fertilizers were consistently higher than in the control treatment. This can be explained by the accumulation of organic substances and activation of the synthesis of biologically active compounds in the plant under the influence of mineral elements.

At the same time, the occurrence of certain differences is considered natural. These differences are associated with the soil composition, moisture availability, climatic characteristics, and agrotechnical practices of the study areas. In particular, differences in soil humus content or irrigation regime may directly affect the accumulation of dry matter and extractive compounds in plants.

It was also noted that a general regularity was maintained in both study areas: the application of mineral elements at balanced and scientifically justified rates improves the quality indicators of the plant. This indicates the reliability of the obtained results and the possibility of implementing them in practice under different soil and climatic conditions.

Comparative analysis of the obtained results showed that in both study areas, mineral nutrition was a significant factor in increasing the quality indicators of medicinal marshmallow (*Althaea officinalis*) raw materials. When mineral elements were applied in sufficient and balanced amounts, the accumulation of organic substances in plant tissues increased, resulting in a stable increase in dry matter and extractive substances.

At the same time, some differences recorded between the study areas were associated with natural and agroecological factors, which further demonstrates the correspondence of the results to real conditions and increases their practical significance. In other words, the observation of the same general pattern under different conditions supports the reliability of the study results.

5. Conclusion

In conclusion, the highest quality indicators of medicinal marshmallow (*Althaea officinalis*) raw materials were recorded in the N90P60K60 treatment. In this treatment, the contents of dry matter and extractive substances reached their maximum levels, and it may be considered the most effective mineral nutrition rate for practical application.

Thus, the application of mineral elements in an optimal ratio is an important agrotechnical factor for improving the quality of medicinal raw materials, and its wider implementation is appropriate.

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