

# The effect of biomineral composition on the biochemical parameters of animal blood

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**Abstract.** The article presents the results of scientific and experimental studies on the creation of a biomineral composition intended for the prevention of diseases and improve animal health. The possibility of creating biomineral compositions based on wormwood of bitter and siliceous rocks - flasks of Western Kazakhstan, taking into account their chemical, mineralogical and biological properties. Based on experimental studies, the choice of siliceous rock, flasks of the West Kazakhstan region, is scientifically justified by the criterion of a high content of amorphous and finely divided silica, which gives the following advantages: - highly dispersed silica, guarantees effective sorption of mycotoxins, salts of heavy metals, chemical toxins, radionuclides, gases and other metabolic products in the animal's body due to the huge sorbing surface. Wormwood as a biological active component enhances immunity and acts as an antifungal, antimicrobial, anti-inflammatory agent. As a result of scientific and experimental work, it was found that the proposed biomineral composition has high biological activity and significant pharmacological action, which is manifested by an improvement in the morphological and biochemical parameters of the blood of cows.

## 1 Introduction

The Republic of Kazakhstan has adopted the State Program for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2017 - 2021, where one of the main priority areas is the development of animal husbandry. However, there are objective threats associated with animal diseases for the successful development of animal husbandry. Infectious, non-infectious, invasive (parasitic) animal diseases cause great economic harm to the farms of the Republic of Kazakhstan. Among the common diseases of animals is mycotoxin poisoning as a result of eating contaminated herbs, plants, feeding animals rotted, moldy feed. These factors provoke digestive disorders, poisoning of varying severity, metabolic failures. Often during poisoning, refusal of feed is noted, which leads to the death of animals. Among the main factors contributing to the mass disease of animals is a poor-quality, unbalanced, meager diet, weakening of resistance and immunity.

An important direction in improving the technology of preventive measures is the introduction into production of new tools and methods for the prevention and treatment of animal diseases, including the use of drugs with bioactive properties that can have a

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regulatory effect on the intensity of metabolic processes, enhance functional activity organs and systems of the body, increase the level of natural resistance of animals [1-3]. Особенное место в этом направлении занимает обширный класс биоминеральных веществ, выполняющие важную роль в построении структурных частей и тканей животного организма [4-6].

It is well known that the inorganic part of bone tissue consists of calcium phosphate and magnesium, silicon, calcium carbonate, potassium and sodium, potassium, magnesium and sodium chlorides and other compounds. Other elements are part of similar organic compounds that perform various functions in physiological and biochemical transformations. Among the inorganic natural raw materials is an extensive group of aluminosilicate minerals that have valuable specific properties - sorption, ion exchange, binders, thixotropic. This group includes siliceous rocks and bentonite (montmorillonite) clays [7-9].

It should be noted that research in this area is actively being carried out abroad. The authors argue that bioactive supplements usually play a central role in animal diets in order to stimulate performance and improve well-being and health, especially during stressful periods of life [10].

The authors of the studies carried out detailed studies of clay minerals as sorbents for mycotoxins in the diets of lactating goats. The effects of bentonite and montmorillonite on consumption, digestibility, blood chemistry, rumen fermentation, milk yield and composition, as well as milk aflatoxin were revealed [11].

According to many scientists, montmorillonite clays contribute to the inactivation of mycotoxins, which may be present in dry animal feed [12-16].

They are especially important when using ruminant synthetic nitrogen-containing substances in feeding against the background of diets insufficiently supplied with sugar in the winter-stall period, and when feeding green protein-rich feeds in the summer in the summer [17].

There is a positive experience in the use of natural minerals in agriculture as bioactive additives that contribute to the normalization of metabolic processes, better absorption of nutrients, trace elements and vitamins. The properties of minerals, such as high adsorption, catalytic, and ion-exchange activity, are especially appreciated. Due to these properties, it adsorbs alkaloids, poisons, heavy metals, toxins of microorganisms, nitrates and nitrites, and other harmful substances [18-21].

One of the promising raw materials of Kazakhstan for using them as a mineral component in the creation of biomineral active substances is carbonate-siliceous rocks with high sorption properties and useful minerals for animals. These siliceous rocks are sedimentary deposits and are distinguished by the presence of well-preserved remains of fauna and flora, consisting of biogenic silica (radiolarians and diatoms) [22-23]. The author of the work has established a close relationship between mineral, protein, carbohydrate, lipid and vitamin exchanges. In this paper, it is noted that ensuring the productivity of cows with a sufficient number of macro- and microelements helps to increase their productivity, improve reproductive ability and maintain the health of animals. This is possible only through the additional use of mineral dietary supplements. It should be noted at present that the main feeds cannot satisfy the increased demand of highly productive animals for inorganic substances [24].

## **2. The main idea and hypothesis of research**

Creation of domestic active biomineral substances for animals based on the composition of natural mineral raw materials and local plant bioactive components of the Republic of Kazakhstan.

Carrying out scientific and experimental work in this direction is also dictated by the fact that at present, due to the lack of domestic producers of effective bioactive feed additives, the Republic of Kazakhstan is completely dependent on imported manufacturers.

For the successful implementation of this idea and hypothesis, the unique biological and mineralogical properties of wormwood and siliceous rocks of Kazakhstan are of particular scientific and practical interest.

However, in order to use the siliceous rock of Kazakhstan of a particular deposit and wormwood, it is necessary to carry out scientific and experimental work taking into account the biological and chemical-mineralogical characteristics of each type of investigated raw materials.

### **3. The purpose and objectives of research**

Development of biomineral composition compositions based on natural, safe and readily available raw materials of Western Kazakhstan and assessment of their impact on the morphological and biochemical parameters of cattle blood.

To achieve this goal, it was necessary to solve the following tasks:

- selection of raw materials for the development of biomineral compositions;
- to study the basic biological and chemical-mineralogical characteristics of the selected raw materials;
- development of biomineral composition compositions;
- conducting studies on their effect on morphological and biochemical parameters of animal blood.

### **4. Research methods and materials**

The chemical and mineralogical composition of the studied raw materials was determined using a JSM-6390LV scanning electron microscope with an energy-dispersive microanalysis system, an X'Pert PRO MPD X-ray diffractometer, and an ICP-MS Agilent 7500cx inductively coupled plasma mass spectrometer (JEOL, Japan).

X-ray phase analysis (XRD) was carried out on a DRON-3 diffractometer with radiation in the range of angles 80-640. The sensitivity of the method is from 1 to 2%. Silica rock powders — flasks passing through a 0.315 sieve — were subjected to X-ray analysis.

The sorption activity of the flask was carried out with respect to methylene blue by the photocolometric method. The method was based on the ability of the flask to adsorb various substances in aqueous solutions. As a test indicator from dyes, a 1% solution of methylene blue in purified water was selected and used.

The sorption capacity was judged by the change in the optical density of the solution after its contact with the flask.

Blood biochemical parameters were determined using the CHEM WELL analyzer, which has the following features: it performs the whole range of biochemical and immunochemical analyzes, is fully automatic, Russified, and equipped with a quality control program.

A hemotological analysis of blood was performed on a Mindray BC-2800 Vet veterinary automatic hematology analyzer designed to determine 18 parameters with differentiation of leukocytes into 3 subpopulations and plotting distribution histograms. The analyzer uses two independent measurement principles: the Coulter method and the colorimetric method. During each measurement cycle, the sample is automatically aspirated, diluted and mixed before each parameter is determined. These research methods

were carried out on the basis of M. Auezov South Kazakhstan State University and Zhangir Khan West Kazakhstan Agrarian Technical University.

As a mineral raw material, siliceous rock was chosen - a flask of the Taskalinskoye deposit of the West Kazakhstan region.

As a result of the studies, it was found that the flasks of the Taskalinskoye deposit are light, dense microporous rocks composed mainly of the smallest (<0.005 mm) particles of opal - cristobalite silica. Table 1 shows the mineralogical composition of the investigated raw materials.

**Table 1.** Mineralogical composition of siliceous rock - flasks of the Taskala deposit of the West Kazakhstan region, %

Name of species	Opal	Clay minerals	Calcite	Quartz	Mica	Glauconite	Organogene residues
Siliceous rock - flask	54-78	15-22	until 6	4-7	2-4	2-3	until 12

In addition, it was found that the flask of the Taskalinskoye field has a relatively low average density in the range of 1200 - 1350 kg / m<sup>3</sup>, and is characterized by good moisture capacity, high hydraulic and adsorption activity.

As a plant biological stimulant, wormwood (*Artemisia absinthium*) was chosen.

The choice of this plant is justified by the fact that wormwood is included in the list of medicinal herbs and is growing everywhere in almost all regions of Kazakhstan.

For further studies, bitter wormwood collected after full maturation, i.e. with a completed growing season.

The complete completed vegetative period of wormwood (mature wormwood) occurs after the first frost.

After the first frosts, wormwood dries up in natural conditions. At the same time, it was proved that useful substances in wormwood with a full vegetative period are higher than 1.5 - 2 times than in wormwood with an incomplete vegetative period.

In addition, the use of dried bitter wormwood excludes the process of special drying in the process of preparing a biomineral composition.

Essential oils are the main biological substance in wormwood, and contain organic acids, fatty acids, tannins as accompanying substances.

The herb and leaves of wormwood contain 0.5-2% of essential oil, the components of which are cineol (1), thujol alcohol, thujone (14.15) (about 10%), tuyol (5) (10-25%) cadinene (16), fellandren (17.18), pinene (19.20), b-caryophyllene (21), y-sepinen, bisabolen (22),, chamazulenogen.

As the complex chemical and biological composition of wormwood is shown, they can be classified as biologically active substances that increase appetite, improve digestion, and as antifungal, antimicrobial, anticonvulsant, diuretic, anti-inflammatory, wound healing, carminative, sedative.

## 5. Results and discussions

To prepare a biomineral composition, the collected stalks of wormwood are crushed using a grinder to form a loose fraction with sizes of 0.5 - 2.5 cm. In parallel, siliceous rock - flask is prepared by preliminary high-speed drying in a rotary kiln at a temperature of 100 - 110 ° C to a residual humidity 7 - 8%. This heat treatment provides thermal sanitation of the used mineral raw materials. The dried siliceous flask rock is ground in a porcelain ball mill

before passing through a 0.14 mm sieve. Finished powders of wormwood and siliceous rock-flask breed are weighed on an electronic balance and the mixture is prepared in the following ratios wt%: wormwood 60–70, siliceous rock — flask 30–40. Then, loose mixtures of wormwood are mixed with ground flask using a mixer. The thoroughly mixed mixture is further co-milled using grinding equipment. Thus obtained biomineral composition has a particle size of 0.1 to 3.0 mm The studied compositions of the biomineral composition are presented in table 2.

**Table 2.** The investigated composition of the bio-mineral composition

Composition №	Wormwood, wt. %	Siliceous rock - flask, wt. %
1	60	40
2	65	35
3	70	30

As the optimal composition, composition No. 1 was chosen, since it is in these ratios that the adsorption properties of the siliceous flask are maximally manifested. According to the results of preliminary studies, we found that a decrease in the content of siliceous rock - flask due to an increase in the content of wormwood with a slide significantly reduces the adsorption capacity of the biomineral composition. Moreover, the content of wormwood in the amount of 60% by weight of dry matter is quite sufficient for the manifestation of biological activity. In the composition, it dominates in mass and volume due to the low average density in a loose state.

Scientific and experimental studies on the influence of the developed compositions of the biomineral composition on the cattle in the conditions of the peasant farm “Kazyna” in the Shieli district of the Kyzylorda region (Kazakhstan).

The formation of groups of animals for the experiments was carried out according to the principle of analogues, which took into account age, breed, body weight, physiological state, productivity, health status. The number of animals in the groups was determined by the appropriateness of an objective assessment of the results obtained and their statistical reliability.

The control groups of animals received the main diet, envisaged by the feeding technology and designed to obtain high productivity.

The animals used in the experiment were divided into two groups of 10 animals each, taking into account body weight, age and productivity. All experimental cows were clinically healthy.

Cows of the control group received feed of the main diet, the experimental group of animals was additionally fed with a biomineral composition at the rate of 3% of the dry matter of the diet.

For three months, the physiological state of the animals was evaluated by morphological and biochemical studies of animal blood. dynamics was monitored Changes in the metabolic processes of the cows were monitored by the following indicators: the number of red blood cells and the level of hemoglobin, total protein and protein fractions, glucose, urea, the level of aminotransferases (AST, ALT), total calcium and inorganic phosphorus, as well as some trace elements (Mg, Zn, Fe, Cu) and carotene.

According to the results of the data obtained using the analyzer, a significant ( $P < 0.05$ ) increase in erythrocytes and hemoglobin is observed. At the same time, the hemoglobin level in the first month of the experiment increased by 6.2% relative to background values, and after 60 and 90 days its concentration increased to 8.3% and 12.2%, respectively. The indices of these increases were  $104.1 \pm 41.2$  g / l and  $105.6 \pm 38.5$  g / l against  $93.1 \pm 29.7$  g / l of background indicators.

The increase in the number of red blood cells in experimental animals over the entire period of research varied in the range of 5.3–8.4%.

In the control group, an increase in the level of hemoglobin is not observed while maintaining the initial (background) number of red blood cells ( $6.21 \pm 0.9 \times 10$ ).

The results of studies on the effect of biomineral composition on biochemical blood parameters of cows are presented in table 3.

**Table 3.** The effect of biomineral composition on biochemical blood parameters of cows

Indicators	Background	Control		Experimental	
		after 60 days.	after 90 days.	after 60 days.	after 90 days.
Total protein, g / l	87.2±10.4	85.3±11.4	89.2±10.7	88.9±12.9	95.2±16.2
Protein fractions:% albumin	40.1±6.7	41.2±4.3	39.1±5.1.0	42.9±4.8	45.6±5.9
a-globulins	13.4±0.9	12.9±1.1	11.4±0.7	13.9±2.6	16.4±2.4
Glucose, mmol / L	1.41±0.3	1.44±0.50	1.72±0.4	2.17±0.5	2.3±0.8
Urea, mmol / L	4.7±0.9	6.4±0.7	5.2±0.3	4.9±0.66	5.5±0.5
AST, U / ml	26.5±3.2	36.1±3.6	37.1±5.7	35.5±2.9	38.7±3.6
ALT, U / ml	15.7±2.0	14.6±3.4	22.3±5.1	15.6±3.8	23.1±2.7
Total calcium, mmoy/l	1.57±0.2	1.58±0.3	1.8±0.32	1.76±0.54	1.98±0.6
Phosphorus inorganic-nich., mmol / l	2.4±0.25	2.5±0.3	2.6±0.28	2.7 ±0.42	2.84±0.45
Iron, mmol / L	20.58±3.1	21.3±3.4	22.0±1.9	26.5±3.8	27.3±3.3
Zinc, micromol / l	13.9±1.8	12.9±0.8	14.4±2.0	15.2±2.3	15.1±2.9
Copper, mmol / L	13.4±2.2	13.5±3.4	13.7±4.5	13.9±3.4	14.1±2.4
Manganese, mmol	1.06±0.5	1.07±0.32	1.08 ±0.24	1.08±0.8	1.09±0.2
Carotene, mM / L	0.47±0.02	0.49±0.03	0.48±0.03	0.49±0.05	0.5±0.01

Note: \* - confidence level  $P < 0.05$

As the results of the study show, the use of the biomineral composition had a positive effect on the biochemical homeostasis of experimental animals.

The total protein content in blood serum when prescribing biomineral increased and amounted to  $95.2 \pm 16.2$  against  $87.2 \pm 10.4$  g / l of background indicators and  $89.2 \pm 10.7$  indicators of control animals by the end of the experiment . Moreover, the largest difference in protein content by groups was noted from the second month of research. The amount of albumin in serum before the experiment, on average in groups, was 40.1%. With the introduction of the biomineral composition, an increase in the level of this fraction in experimental cows was noted after 60 days — by 4.1%, and after 90 days — by 16.6%. Moreover, the reliability of the results on the level of albumin was already evident from the second month of application of the proposed biomineral composition ( $P < 0.05$ ).

The main indicator of carbohydrate metabolism is glucose, in the experimental group it increased during the research period by 1.3 times relative to control animals by 1.6 times relative to background studies.

The results of the experiment showed that the use of biomineral composition in the diet of cows influenced the absorption of mineral elements. Prior to the experiment, the

phosphorus level in the blood serum of cows was at the upper limits of the physiological norm ( $2.4 \pm 0.25$  mmol / L).

However, after 60 days of applying the biomineral composition, the calcium content in the blood of experimental cows increased from  $1.58 \pm 0.3$  to  $1.76 \pm 0.54$ , and by the end of the experiment to  $1.98 \pm 0.6$ , reaching physiological limits.

Analysis of the obtained data on the effect of the proposed biomineral composition on the morphological and biochemical parameters of the blood of cows showed positive dynamics in terms of hemoglobin, red blood cells, carbohydrate metabolism, protein content, albumin, phosphorus and calcium.

Thus, one can note the activation of the processes of biological protein synthesis and, first of all, its albumin fraction under conditions of using a biomineral composition, the metabolic activity of which is stipulated by the content of a wide range of macro- and microelements, physicochemical and biological structural features. This determines the further stage of protein biosynthesis. In this case, Mg, Zn, and Cu ions can be included. The concentration of these elements within small limits is quite sufficient for the manifestation of the biological activity of siliceous rocks - flasks.

## 6. Practical recommendations

The proposed biomineral composition is recommended to be used as a feed additive for therapeutic and prophylactic action in case of gastrointestinal diseases of non-infectious etiology, anemia, correction of mineral metabolism, mixed mycotoxicosis, normalization and optimization of immuno-biochemical status, intensification of metabolic processes, stress loads, and as a means of increasing animal productivity.

## 7 Conclusion

1. The possibility of creating Biomineral compositions based on wormwood and siliceous rock - flask of Western Kazakhstan with regard to their chemical-mineralogical and biological properties.

2. When choosing wormwood, its chemical and biological composition was taken into account as a criterion of biological activity that contribute to increased immunity, appetite, improves digestion, and as an antifungal, antimicrobial, anti-inflammatory, wound healing, carminative, sedative.

3. Based on experimental studies, the selection of siliceous rock - flask of the West Kazakhstan region on the criterion of a high content of amorphous and finely divided silica is scientifically substantiated, which gives the following advantages:

- highly dispersed silica, guarantees the effective sorption of mycotoxins, salts of heavy metals, chemical toxins, radionuclides, gases and other metabolic products in the animal body due to the huge sorbing surface;

- the presence of amorphous silicon in the composition of the siliceous rock - flask contributes to the growth and hardening of tissues during the development and formation of the skeleton and is involved in bone mineralization.

4. Developed the most optimal compositions and method for preparing compositions in the system biomineral wormwood - siliceous rocks - flask differing therapeutic and prophylactic action;

5. As a result of scientific and experimental work, it was found that the proposed biomineral composition has high biological activity and significant pharmacological action, which is manifested by the improvement of morphological and biochemical parameters of blood of cows.

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