The effect of unconventional mineral mixtures on the nutrient digestibility of broiler chicken feed

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Abstract. The article presents the results of the influence of the mineral mixture using local raw materials on the physiological parameters of broiler chickens of “Ross 308” cross. The studies were conducted on the basis of YeniseiAgroSoyuz LLC of the Sukhobuzim district of the Krasnoyarsk Territory, and the stock-raising farm of the Institute of Applied Biotechnology and Veterinary Medicine of FSBEI HE Krasnoyarsk State Agrarian University. The aim of the research was to study the effect of the mineral mixture using local raw materials in feeding broiler chickens. It has been found that a mineral mixture containing limestone, monocalcium phosphate, oxidized brown coal, belite sludge, peat, and vermiculite improves the nutrient digestibility of broiler chicken feed.

1. Introduction
Poultry meat production is dominated by products obtained from broiler chickens [1]. In this regard, the work of domestic and foreign scientists aimed at studying the influence of various factors on the quality of meat and the safety of broiler chickens is of great importance.

In order to ensure normal life activity and high productivity of modern poultry crosses, increased demands on the quality of their feeding are placed [2]. Of great importance in feeding farm animals are minerals and their standardized use to increase poultry productivity. The lack of mineral substances in the diet causes great damage to poultry farming, restrains the growth of livestock, reduces productivity, causes diseases and deaths, and worsens the quality of products. Fulfillment of these requirements can be ensured by using compound feeds balanced in all basic nutrients and biologically active substances (BAS), using highly effective special additives, such as zeolites, vermiculites, bentonites, kudurites, etc. [3, 4].

Low consumption of feed means. Krasnoyarsk Krai is one of the few subjects of the Russian Federation able to provide themselves with almost all types of mineral raw materials, and a number of them - and export. Its mineral resource base (SMB) includes more than 1300 deposits and promising manifestations of more than 80 types of minerals. The presence of deposits of various mineral sources in Krasnoyarsk Krai made it necessary to study the possibility of their use in animal feeding and to establish the efficiency of use against the background of traditional mineral additives.

Objects of research of the territory of Krasnoyarsk Krai, such as belite sludge, oxidized brown coal, peat and vermiculite rich in mineral composition, were chosen to determine the mineral raw material base of the feeding material.
Vermiculite is a natural mineral from the group of hydrosolids, the structure of which consists of interleaved mica sheets divided between each other by double layers of water. The composition of the vermiculite of the Tatar field of Motyginsky district is marked by a high number of such elements as magnesium, silicon, potassium, aluminium, sodium, calcium, carbon. As confirmed by the research of Pobedinsky AV were carried out in Krasnoyarsk Krai, and it has been proved that the sorption capacity of the natural mineral of expanded vermiculite, equal to 17.40%, subjected to additional treatment, is more effective for absorption and removal of mycotoxins from animals. These results show that the introduction of expanded vermiculite of the Tatar deposit in an amount of 3.5% of the total content; Concentrated fodders in the diet of cow feeding have a favorable effect on the physiological condition of animals, as well as contribute to normalization of morphological and biochemical indices of blood during the dry period. Introduction of adsorbent makes it possible to improve reproduction functions of animals, to increase safety of young man by 5.6%, to reduce duration of service period of animals by 12.5%. The use of expanded vermiculite in the feeding of cows resulted in an increase in the transportability rates of the main components of the diet by 2.7-13.7%, with the exception of carotene, whose transportability rate was 26.11% lower than the control one. Dairy productivity of animals, in the main diet of which expanded vermiculite of the Tatar deposit was added in amount of 3.5% of the total content of concentrates, was higher and differed from productivity of animals, which did not receive this mineral, by 351 kg of milk in 305 days of lactation per head. Introduction of expanded vermiculite of the Tatar deposit in the amount of 3.5% of the total content of concentrated fodders allowed to reduce fodder costs for production of a unit of production and increase the level of profitability by 10.77% [5].

Belite sludge is a waste of Achin alumina mill contains such elements as phosphorus, zinc, calcium, aluminium, cobalt, manganese, iron, selenium, sulphur, chromium, magnesium, potassium, copper, sodium.

150 peat deposits have been explored in Krasnoyarsk Krai. Technological properties of peat deposits of the edge have been studied only to the extent necessary to determine the possibility of their use in agriculture. Peat, Nazar district, the constituent part of which is humic acids (having therapeutic and preventive effect) contains manganese, zinc, copper, sodium. Krasnoyarsk Krai belongs to the most coal-saturated territories of Russia. Within it are such large coal basins as Kansko-Achinskiy, Tungussky, Taimyrsky, North Taimyrsky and western part of Lensky. More than 45% of all conditioned resources and 26% of the country’s explored coal reserves are concentrated here.

Oxidized brown coal of Balakhtin deposit is rich in humic acids, macro and trace elements: manganese, copper, sodium, zinc, iron, potassium. In addition to the rich mineral composition vermiculite and peat have good sorption, ion exchange and catalytic properties, they are able to absorb radioactive and carcinogenic substances from food products, green mass of plants and other biological objects, which increases their efficiency in poultry feeding.

Therefore, the main purpose of our research was to study the effect on the body of mineral mixture based on local raw materials in the feeding of broiler chickens.

2. Materials and methods

Prior to the experiment, the chemical composition and energy nutrition of the fodder were studied. Based on the obtained data, fodder mixtures were developed, which were manufactured in the feed preparation shop of the stock-raising farm of the Institute of Applied Biotechnology and Veterinary Medicine of the Krasnoyarsk State Agrarian University.

As a result of the studies, the influence of the developed mineral mixture on the digestibility of the nutrients of the experimental poultry feed was studied. The experimental groups were formed on the basis of the YeniseiAgroSoyuz LLC of the Sukhobuzim district of the Krasnoyarsk Territory, on the basis of analogues (cross, age, live weight) of ten-day-old Ross 308 cross broilers, 20 heads in each. Housing conditions, poultry density, field of feeding and watering, microclimate parameters in all the groups were the same in accordance with the methodological recommendations for working with the Ross 308 cross poultry. Feeding was carried out 2 times a day by hand, plenty of watering from nipple drinkers.
The chickens of the control group received a balanced basic diet (BD), prepared according to the standards of the Russian National Research Veterinary Institute of Poultry, and in the diets of the experimental groups, partial or complete replacement of limestone and monocalcium phosphate with oxidized brown coal, belite sludge, vermiculite and peat was carried out, the grain part remained unchanged. The studies were conducted for 32 days according to the experimental scheme presented in table 1.

Table 1. Experiment table chart of feeding mineral mixture to chickens broiler.

| Group          | Diet                                           | Number of chickens |
|----------------|------------------------------------------------|--------------------|
| Control        | BD (Basic Diet)                                | 20                 |
| Experiment 1   | BD + mineral mixture №1 (limestone (0.4 %), oxidized brown coal (0.4 %), belite sludge (0.4 %), vermiculite (0.4 %), monocalcium phosphate (0.3 %)) | 20                 |
| Experiment 2   | BD + mineral mixture №2 (limestone (0.4 %), oxidized brown coal (0.4 %), belite sludge (0.4 %), vermiculite (0.4 %), peat (0.3 %)) | 20                 |

Feed consumption was determined by taking into account the given fodder and its residues. The safety of the broiler stock was monitored daily, taking into account the death loss and culling. The live weight of broiler chickens was monitored by the method of individual (by wing numbers) weekly weighing. The reliability of the obtained data was estimated by the method of variation statistics using the Student t-test. Arithmetic means (x) and their errors (Sx) were calculated. The difference in indicators was considered reliable at $P \geq 0.95$. Statistical data processing was performed using Microsoft Office Excel 2013 applications.

3. Results

To determine the digestibility of mixed feed substances in broiler chickens, a balance experiment was conducted, during which the digestibility coefficients of the main nutrients of the diet were calculated on the basis of the chemical composition of the feed samples and poultry manure. The results of the study on the digestibility of nutrients in the diet of experimental broiler chickens are presented in table 2.

Table 2. The digestibility of nutrients, % (n=20).

| Indicator                      | Control            | Group                  | Experiment 1 | Experiment 2 |
|-------------------------------|--------------------|------------------------|--------------|--------------|
| Protein, %                    | 79.3±1.06          | 82.6±1.12              | 80.2±1.06    |
| Fat, %                        | 67.5±0.81          | 73.8±1.02**            | 67.5±0.88    |
| Fibre, %                      | 11.8±0.52          | 13.7±0.28**            | 11.5±0.42    |
| Nitrogen-free extractive substance, % | 83.2±0.78       | 87.1±0.32***           | 82.5±0.77    |

* $P \geq 0.95$; ** $P \geq 0.99$; *** $P \geq 0.999$ in comparison with the control group.

The highest digestibility ratios were observed in the experimental groups. So the digestibility of crude protein in the second experimental group amounted to 80.2%, which is higher than the control group by 0.9%, in the first experimental group reached 82.6%; which is higher than the control group by 3.3%; the digestibility of crude fibre in the second experimental group was lower than the control values by 0.3%, and in the first experimental group it was higher by 1.9% ($P \geq 0.99$); the digestibility of raw fat in the first experimental group is higher by 6.3% ($P \geq 0.99$), and in the second experimental group, it did not practically differ from the control indicators. The digestibility of nitrogen-free extractive substances
exceeded the control values in the first and second experimental groups by 3.9 (P≥0.999) and 0.7%, respectively.

When determining the use of nutrients of compound feeds, as well as nitrogen, calcium and phosphorus by broiler chickens against the background of scientific and economic experience, a balance experiment was conducted to study the effect of mineral mixtures introduced into the compound feed.

The level of balance and use of nitrogen, calcium and phosphorus in the body of poultry is very important when conducting scientific research. Since it is the main productive quality of broilers - the liveweight gain - that depends on the nitrogen balance. The results of studying the balance and use of nitrogen by experimental broiler chickens are presented in table 3.

**Table 3.** The level of balance and use of nitrogen by experimental broiler chickens, % (n=20).

| Indicator                  | Control | Experiment 1 | Experiment 2 |
|---------------------------|---------|--------------|--------------|
| Ingested with feed, g     | 3.08±0.19 | 3.75±0.09** | 3.12±0.06    |
| Excreted with manure, g   | 1.31±0.07 | 1.30±0.01    | 1.36±0.01*** |
| Digested, g               | 1.77±0.08 | 2.45±0.15*** | 1.76±0.05**  |
| Feed conversion rate, %   | 57.6±0.88 | 65.33±0.95** | 56.41±0.85*  |

* P≥0.95; ** P≥0.99; *** P≥0.999 in comparison with the control group.

Improving metabolic processes, in particular protein metabolism in the body of broilers that received compound feed, enriched with the tested mineral mixtures, contributed to an increase in the use of nitrogen from the ingested and digested. The highest nitrogen use from the ingested one was in the first experimental group – 3.75 g., which is higher than in the control group by 21.75% (P≥0.99), in the second experimental group – 47.18, which is higher than in the control group by 0.8%.

Our results of physiological studies obtained when feeding broiler chickens with a mineral mixture consisting of 0.4% limestone, 0.4% oxidized brown coal, 0.4% belite sludge, 0.4% vermiculite, 0.3% monocalcium phosphate indicate an increase in the digestibility of nutrients in the diet, the use of nitrogen by the poultry, which is consistent with the data of a number of authors [6, 7, 8].

**4. Conclusion**

Thus, the inclusion in the diet of young poultry of a mineral mixture based on local raw materials (0.4% limestone, 0.4% oxidized brown coal, 0.4% belite sludge, 0.4% vermiculite, 0.3% monocalcium phosphate), contributed to increased digestibility of feed nutrients.

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