

## DEVELOPMENT OF COMPOUND FEED RECIPES FOR BROILER CHICKENS (13-28 DAYS) USING VERMICULITE

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*Recently, in the CIS countries and abroad, to compensate for the mineral deficiency of feed rations and reduce their cost, substances of natural origin have increasingly begun to be used: zeolites, travertines, sapropels, bentonites, etc. The prevalence of the widespread use of natural minerals in the diet of farm animals and poultry represents a pressing issue, given their distinctive properties, waste-free technology, environmental friendliness, and relatively low cost. One of these minerals suitable for use in poultry nutrition is vermiculite (hydromica, hydrous silicate of magnesium and iron of variable composition). The purpose of the study is to determine the physicochemical composition of vermiculite from the Kulantau deposit, and its use as a mineral in the production of animal feed and development of compound feed recipes for broiler chickens Cobb500. The physicochemical parameters of vermiculite, a natural mineral, have been determined. The research analyses were carried out in the research laboratory for assessing the quality and safety of food products of the Almaty Technological University. Feed recipes were developed at LLP «AGRO FIT KAPSHAGAY». The compound feed recipes for Cobb 500 broiler chickens of 13-28 days were tested at JSC «Alel agro», in poultry house No. 3.*

**Keywords:** mineral, vermiculite, formulation, broiler chickens, compound feed.

## РАЗРАБОТКА РЕЦЕПТОВ КОМБИКОРМОВ ДЛЯ ЦЫПЛЯТ-БРОЙЛЕРОВ (13-28 ДНЕЙ) С ИСПОЛЬЗОВАНИЕМ ВЕРМИКУЛИТА

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*В последнее время в странах СНГ и за рубежом для компенсации минеральной недостаточности кормовых рационов и их удешевления все чаще стали применять вещества природного происхождения: цеолиты, травертины, сапропели, бентониты и др. Проблема широкого использования природных минералов в составе рациона сельскохозяйственных животных и птицы представляет весьма актуальную задачу, связанную с их уникальными свойствами, безотходной технологией, экологической безвредностью, сравнительно низкой стоимостью. Одним из таких минералов, пригодных для использования в питании птицы является вермикулит (гидрослюда, водный силикат магния и железа переменного состава). Целью исследования является определение физико-химического состава вермикулита Кулантауского месторождения, использование в качестве минерала при производстве комбикормов и разработка рецептов комбикормов для цыплят-бройлеров Кобб 500. Определены физико-химические показатели природного минерала вермикулита. Анализы исследования выполнялись в научно – исследовательской лаборатории по оценке качества и безопасности продовольственных продуктов Алматинского Технологического Университета. Рецепты комбикормов были разработаны в ТОО «АГРО ФИТ КАПШАГАЙ». Апробация рецептов комбикормов для цыплят-бройлеров Кобб 500 13-28 дней проходит в АО «Алель агро», в птичнике №3.*

**Ключевые слова:** минерал, вермикулит, рецептура, цыплята-бройлеры, комбикорм.

## ВЕРМИКУЛИТТИ ҚОЛДАНА ОТЫРЫП, БРОЙЛЕР ТАУЫҚТАРЫНА (13-28 КҮН) АРНАЛҒАН ҚҰРАМА ЖЕМ РЕЦЕПТЕРІН ЖАСАУ

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*Соңғы уақытта ТМД елдерінде және шетелде жем рационында минералды заттардың жетіспеушілігін өтеу және оларды арзандату үшін табиғи тектес заттар: цеолиттер, травертиндер, сапропельдер, бентониттер және т.б. қолданады. Ауылшаруашылық жануарлары мен құстардың рационында табиғи минералдарды кеңінен қолдану олардың ерекше қасиеттеріне, қалдықсыз технологиясына, экологиялық зиянсыздығына және салыстырмалы түрде төмен құнына байланысты өте өзекті мәселе болып табылады. Құстардың тамақтануында қолдануға болатын осындай минералдардың бірі-вермикулит (сидрослюда, ауыспалы құрамдағы магний мен темірдің сулы силикаты). Зерттеудің мақсаты Қаратау кен орнының вермикулитінің физика-химиялық құрамын анықтау, құрама жем өндірісінде минерал ретінде пайдалану, Кобб 500 бройлер тауықтарына арналған құрама жем рецептерін әзірлеу болып табылады. Вермикулит табиғи минералының физика-химиялық көрсеткіштері анықталды. Зерттеу талдаулары Алматы технологиялық университетінің азық - түлік өнімдерінің сапасы мен қауіпсіздігін бағалау жөніндегі ғылыми-зерттеу зертханасында жүргізілді. Құрама жем рецептері "АГРО ФИТ Қапшағай" ЖШС бірлесіп жасалды. Кобб 500 13-28 күн бройлер тауықтарына арналған құрама жем рецептерін апробациялау «Алель агро» АҚ-да №3 құс үйінде жасалды.*

**Негізгі сөздер:** минерал, вермикулит, рецепттер, бройлер-тауықтары, құрама жем.

### **Introduction**

Minerals play a crucial role in poultry nutrition and their standardized use can significantly increase productivity. The lack of mineral substances in the diet can cause severe harm to poultry farming, restrain the growth of livestock, reduce productivity, cause diseases and deaths, and worsen the quality of products. Fulfillment of these requirements can be ensured by using compound feeds balanced in all basic nutrients and biologically active substances, as well as using highly effective special additives, such as vermiculites [1, 2].

Vermiculite is a promising natural mineral for use in agriculture [3]. It is a silty mineral that is a product of weathering or hydrothermal decomposition of biotite, phlogopite, some chlorites, and other silicates rich in magnesium [4]. In the CIS, explored reserves of vermiculite are concentrated in Russia, Ukraine, Kazakhstan and Uzbekistan. Russia ranks third in the world in terms of vermiculite reserves. Currently, more than 25 deposits located in the European and Asian regions of the country have been explored. The most famous industrial deposits of vermiculite are Kovdor and Potanin. In Kazakhstan the following vermiculite deposits are known: Altyntas, Karatas, Sholak-Kairakty - in the Aktobe region; Barchin - in the North Kazakhstan region; Neozhidannoe - in the Karaganda region, Kulantau - in the Chimkent region [5].

Vermiculite does not burn or disintegrate and is chemically inert and biostable. It is also environmentally friendly since vermiculite does not contain impurities that are carcinogenic or harmful to human and animal health [6]. The presence of macro - and micro-elements in the composition of vermiculite in a sufficiently large amount distinguishes it from other natural minerals [7]. Vermiculite provides animals with the necessary microand macroelements, while also aiding in the excretion of endo- and exotoxins from the body. This prepares the digestive tract for better assimilation of essential substances [8]. Vermiculite improves digestive processes by increasing the surface area of biochemical reactions in the intestine and the absorption of low-molecular-weight metabolites [9]. Large vermiculite deposits have been identified in 40 countries (the United States, Japan, Italy, Canada, Bulgaria, Hungary, etc.). Although vermiculite has been found in many parts of the world, only a few sources have undergone industrial development [10]. In Central Asian countries, large vermiculite deposits have been discovered in Kazakhstan, Kyrgyzstan, and Uzbekistan [11]. Vermiculite is highly absorbent and is used as a carrier for liquid nutrients, vitamins, molasses, choline chloride, and other liquid-based medicinal substances [12]. The production technology, experimental studies, and introduction of biologically active feed addi-

tives for livestock utilizing vermiculites are relevant and contribute to the sustainable development of the agro-industrial sector.

According to the studies by B. Lozowicka, N. Sarsembaeva, T. Abdigalieva and others, vermiculite has been found to be non-toxic to laboratory animals in veterinary-toxicological assessments [13]. Broiler chickens raised on a diet containing 5% vermiculite exhibit an average daily gain of 51 g, compared to the control group's average of 46.6 g. When expanded vermiculite is used in conjunction with fishmeal at a rate of 5% of the dry matter of the diet, the gain increases by 9.1%. The addition of 3 and 5% vermiculite in the diet of broiler chickens contributed to an increase in hematological parameters, in particular hemoglobin levels, by 4,1%. When determining the content of vitamins in the eggs of the experimental groups of chickens, it was found that the percentage of vitamin E is higher by 17,2 %, and vitamin B 6 is higher by 14,7 % compared to the control group. The experimental groups showed an increase in calcium content by 0.02% and phosphorus content by 0.4%.

In broiler duckling's liver normalization of the structural and functional state was detected, due to the optimization of mineral nutrition and the sorbent properties of the mineral diet which had vermiculite in an amount of 3% [14]. This suggests that vermiculite and vermiculite-based feed additives are highly valuable in nutrition due to their provision of high-quality minerals.

Thus, in Kazakhstan, there are large reserves of vermiculites, but they are not used enough in the production of animal feed. It is economically expedient to incorporate these mineral feeds in the production of animal feed.

The scientific development of new, more effective ways to prevent and improve the health of birds is an urgent task of science and practice.

Numerous studies have established that these sorbents are non-toxic to animals, do not pose any teratogenic, mutagenic and organotropic hazards, and are not chemical stressors. The introduction of these sorbents into the diet can decrease the level of toxic substances in the body, which has a positive effect on the physiological state and metabolism.

The purpose of the study is to develop recipes for feed recipes for broiler chickens using the mineral vermiculite.

To achieve this goal, the following tasks were set:

- To study the physical and technical properties of the Kulantau vermiculite mineral mines;

- Study the chemical composition of the mineral vermiculite;

- Develop feed recipes for broiler chickens 13-28 days old using vermiculite.

Due to a deficiency in mineral elements, poultry may utilize their body's reserves, including those in bones and tissues, to maintain homeostasis of mineral substances. However, this can result in mineral starvation, leading to various diseases and metabolic disorders: a decrease in productivity and reproductive abilities, the birth of an unviable young animals, and increased feed cost for product formation. This means that all minerals should be considered indispensable factors in poultry nutrition. The significance of the work lies primarily in the study of the mineral vermiculite from the Kulantau deposit as a component of feed for broiler chickens aged 13-28 days. As well as the development of compound feed recipes for broiler chickens using the mineral vermiculite.

#### ***Materials and research methods***

The development of recipes was carried out at the feed mill of LLP "AGRO FIT KAP-SHAGAY", located in the city of Konaev.

The object of the study was the vermiculite of the Kulantau deposit of the Republic of Kazakhstan, purchased from AVENUE LLP.

The subjects of the study are feed recipes for 13-28 days old broiler chickens. And also, the use of vermiculite from the Kulantau deposit as a component in the development of compound feed recipes for broiler chickens aged 13-28 days.

Research methods:

Physical and technological properties of vermiculite were determined by:

- Moisture content of compound feed components according to State Standard-13496.3-92 [15];

- Volumetric mass and angle of natural slope of compound feed components according to State Standard-28254-89 [16];

- Modulus of vermiculite fineness according to State Standard-13496.8-72 [17];

- Spectral analysis of mineral raw materials according to Instruction No. 246 [18].

#### ***Results and discussion***

Studies have been carried out on the utilization of vermiculite from the Kulantau deposit in the production of feed for broilers.

Veterinary and sanitary studies conducted on vermiculite from the Kulantau deposit and a plant located in the South Kazakhstan region allow us to conclude that vermiculite of the M150 brand with a particle size of 3 mm, is suitable for veterinary and feed purposes. Vermiculite has a

stable chemical composition containing 17% silicon, 2,3% calcium, 20,6% iron, 6,3% aluminum, 6,4% magnesium, and 8,1% potassium. Veterinary-toxicological assessment of vermiculite on

laboratory animals has shown that this mineral does not have toxicity.

The chemical composition of vermiculites from various deposits is shown in Table 1.

Table 1 – Chemical composition of vermiculites from various deposits

Mines	Content of oxides in %										
	SiO <sub>2</sub>	TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	FeO	CaO	MgO	MnO	Na <sub>2</sub> O <sub>3</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>
Kovdor (Russia)	38,62	0,8	12,15	6,29	0,62	1,82	27,76	-	-	0,44	-
Barchin (Kazakhstan)	39,77	1,55	15,54	8,01	0,29	1,89	20,87	-	3,74	0,96	-
Kulantau (Kazakhstan)	44,8	2,4	12,6	9,2	2,0	10,2	7,7	0,2	0,2	4,5	1,5
Bear Hill, Baltimore (USA)	36,13	0,24	13,9	4,24	0,68	0,18	24,84	-	-	-	-

From the data in Table 1, it is evident that the chemical composition of vermiculites varies among different deposits. Determination of the chemical composition of the vermiculite of the Kulantau deposit showed the presence of many important macro- and microelements: Fe<sub>2</sub>O<sub>3</sub> – 9,2 %, MgO – 7,7 %, Na<sub>2</sub>O<sub>3</sub> – 0,2 %, K<sub>2</sub>O – 4,5 %, CaO – 10,2 %, SiO<sub>2</sub> – 44,8 %, Al<sub>2</sub>O<sub>3</sub> – 12,6 %, MnO – 0,2 %, etc. The

vermiculites of Kazakhstan deposits contain the necessary macro- and microelements for enrichment of diets of farm birds.

To incorporate vermiculite into compound feed for broilers, the levels of toxic elements and radionuclides were assessed in vermiculite obtained from the Kulantau deposit (Table 2).

Table 2 – The content of toxic elements and radionuclides maximum permissible concentration in the vermiculite of the Kulantau deposit

Toxic elements	Maximum permissible concentration, mg / kg	Vermiculite, mg
Mercury (Hg)	0,1	-
Cadmium (Cd)	0,4	-
Lead (Pb)	30,0	0,0002 _
Fluorine (F)	2000,0	-
Arsenic (As)	15,0	0,001
Chrome (Cr )	3,0	0,015 _
Content of radionuclides, Bq/kg		
Cesium	200	-
Strontium	100	-

Table 2 shows that the content of toxic elements in vermiculite does not exceed the maximum permissible concentration, and there are no radionuclides, which indicates the environmental

friendliness of the natural mineral vermiculite of the Kazakhstan deposit.

The physical and technological properties of the minerals used in the production of compound feed were determined (Table 3).

Table 3 – Physical and technological properties of the minerals used in the production of compound feed

Mineral raw materials	Physical and technological properties					
	Moisture, %	Average particle size, mm	Bulk density, kg / m <sup>3</sup>	Flowability, kg / cm <sup>2</sup> sec	Angle of repose, hail	Density, g / cm <sup>3</sup>
Limestone flour	7,2	0,55	1380,0	0,023	46,0	2,85
Zeolite	3,8	0-0,5	1482,0	0,071	40,0	2,94
Shungite	0,5	0-0,5	1370,0	0,077	39,0	2,8
Vermiculit	2,9	0,5-0,75	287	0,064	36	1,25

Table 3 shows that vermiculite has good flowability, moisture 2.9% particle size up to 0,75

mm. Accordingly, vermiculite can be used as a filler in premixes for broilers.

A recipe for complete feed for broiler chickens of the Cobb500 cross at the age of 13-28 days was developed.

Table 4 – Calculated recipe for complete feed for broiler chickens aged 13-28 days with the inclusion of vermiculite.

Compound	Amount
Wheat	38,33 %
Corn	17,71 %
Corn germ	8 %
Soybean meal (protein, 44%)	27,04 %
Flaxseed cake	3,5 %
Lysine hydrochloride, 98%	0,35 %
DL-Methionine, 98.5%	0,32 %
L-Threonine, 98%	0,18 %
Table salt	0,15 %
Monocalcium phosphate	1,3 %
Limestone flour	1,2 %
Baking soda	0,17 %
Sodium sulfate anhydrous	0,25 %
Vermiculite	0,5 %
Premix	1 %

To study the effects of the natural mineral, 0.5% vermiculite was added to the recipe. The recipe was developed in collaboration with the director and technologists of LLP “AGRO FIT KAPSHAGAY”, which produced 1000 kg of complete feed for experimental 500 broilers

This recipe is currently being tested by JSC “Alel agro”, in poultry house No. 3.

The study of vermiculite's physical and technological properties, as well as its chemical composition, revealed that it possesses favorable physical and technological properties and a rich macro- and microelement composition. Due to the sterility of natural vermiculites, vermiculite can be used in the production of animal feed.

#### Conclusion

To increase productivity and normalize metabolic processes in poultry, great importance should be attributed to the use of economically accessible natural mineral resources, which include vermiculite. In Kazakhstan, there are large reserves of vermiculites, but they are not used enough in the production of animal feed. Kazakhstan has vermiculite deposits, which are estimated by good infrastructure conditions, which implies the possibility of their effective development for subsequent use for agricultural purposes.

Determination of the chemical composition of the vermiculite of the Kulantau deposit showed the presence in the studied samples of vermiculite of many important macro- and microelements: Fe<sub>2</sub>O<sub>3</sub> – 9,2%, MgO – 7,7%, Na<sub>2</sub>O<sub>3</sub> – 0,2%, K<sub>2</sub>O – 4,5%, CaO – 10,2%, SiO<sub>2</sub> – 44,8%, Al<sub>2</sub>O<sub>3</sub> – 12,6%, MnO – 0,2%, etc. The vermiculites of Kazakhstan depos-

its contain the necessary macro- and microelements for the enrichment of broiler rations of. Therefore, the use of environmentally friendly natural minerals in the production of compound feed, in the feeding of farm birds is an important direction in the Republic of Kazakhstan.

A recipe for complete feed for broiler chickens of the Cobb500 cross aged 13-28 days has been developed.

Testing of recipes for broiler chickens Cobb500, 13-28 days takes place at JSC “Alel agro”, in poultry house No. 3.

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## DEVELOPMENT OF BIOPOLYMER BASED COLORIMETRIC INDICATOR FOR MONITORING OF MEAT AND FISH FRESHNESS

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*The need to extend food products' shelf lives is growing as a result of efforts to cut expenses and minimize food waste. The food industry is interested in solutions that would make it easy to keep food fresh and safe for as long as the product is on sale. The purpose of the study is to develop a biopolymer-based colorimetric indicator for monitoring of meat and fish freshness. The significance of the research is to provide food safety via control of the freshness*