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Investigation Of Vibrational Technology Of Shungite Processing As The Basis Of A Promising Mineral Fodder Additive For Poultry Farming.

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ABSTRACT

In industrial conditions, the animal's organism experiences significant functional loads, its adaptive responses to external stimuli change, which often become stressful and weaken the natural defenses, which negatively affects health and growth intensity. In order to increase the efficiency of production of eggs and poultry meat, it is necessary to develop new technologies for keeping and feeding, to search for new types of feeds and feed additives of various origins containing a wide range of biologically active compounds, macro-microelements, the use of which can stimulate growth, development, reproductive functions and, in general, the functional state of the young and adult livestock. In this connection, shungite has a great interest.
Keywords: shungit, poultry, eggs, biologically active compounds, macro-microelements, crushing.

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INTRODUCTION

Under the industrial conditions of reproduction, the animal organism experiences significant functional loads, its adaptive responses to external stimuli change, which often become stressful and weaken the natural defenses, which negatively affects health and growth intensity. In order to increase the efficiency of production of eggs and poultry meat, it is necessary to develop new technologies for keeping and feeding, to search for new types of feeds and feed additives of various origins containing a wide range of biologically active compounds, macro-microelements, the use of which can stimulate growth, development, reproductive functions and, in general, the functional state of the young and adult livestock. In this connection, the shungite breed is of great interest.

The schungite rock is an ancient Precambrian carbonaceous formation with a specific structure and properties. Shungite carbon, which is part of rocks, possesses a fulleron-like structure, is characterized by high chemical and physical-chemical activity. It was found that fullerene is the most powerful and long-acting antioxidant. Due to this, fullerene-based drugs help to treat a variety of inflammatory, viral, allergic and other diseases: asthma, influenza, infertility, burns, ulcers, which are often difficult to treat standard therapy.

Shungit preparations accelerate cell renewal and epithelization, enrich cells with essential nutrients, stimulate blood circulation and regenerate skin cells, have a bactericidal and antiseptic effect, relieve itching, and have an analgesic effect.

These properties open new possibilities for the use of schungite in medical practice [1].

Shungite as a sorbent is characterized by a number of positive characteristics:
-high mechanical strength and low abrasion;
-High filtering ability (ie has low resistance to pressure);
-absorbability to sorption of many substances as organic (oil products, benzene, phenol, pesticides, etc.), and mineral (iron, manganese, phosphorus, arsenic) [1].

Modern crosses of agricultural poultry are distinguished by high productivity indicators. The main task of the technological process of growing chickens is to maximize the full realization of the genetic potential of the cross in order to obtain the maximum yield of poultry products (meat, eggs) from the unit of the poultry house at a minimum cost.

One of the factors that negatively affects the productivity of a bird is stress [2]. Stress can be caused by fodder contaminated with mycotoxins - secondary metabolites of mold fungi (*Aspergillus, Penicillium, Fusarium, Alternaria*, etc.).

Currently, over 400 species of mycotoxins produced by various species of fungi are known. Mycotoxins are detected both in different crops at different technological stages of growing in the field, and during storage, at the stage of processing grains in feed (Diaz, 2006).

Therefore, the development of promising fodder additives, neutralizers of mycotoxins, primarily non-polar, is topical.

It seems that the most promising technology for processing grinding of raw materials for the production of high-quality components of feed and feed additives is the vibrational method of disintegration and coupled vibration classification developed by Research and Production Corporation "Mekhanobr-technika" [3]. The essence of this method consists in compulsory self-grinding of the material inside its own layer under the action of vibroimpulse compression with simultaneous shift. In this case, the level of force action on the material layer is regulated in the range of the strength limit of the defective surfaces of its structure.

It should be noted that vibrational disintegration is a universal technology and has practically no limitations on the ultimate strength of the material to be destroyed, ensures high opening of the phase-forming phases and ensures the production of the finished product with a specified dispersion and particle shape [4].

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To conduct research to reduce the size of the lumpy rock mass in order to obtain the desired fractions, a cone inertial crusher with a crushing cone diameter of 300 mm was used (Fig. 1).

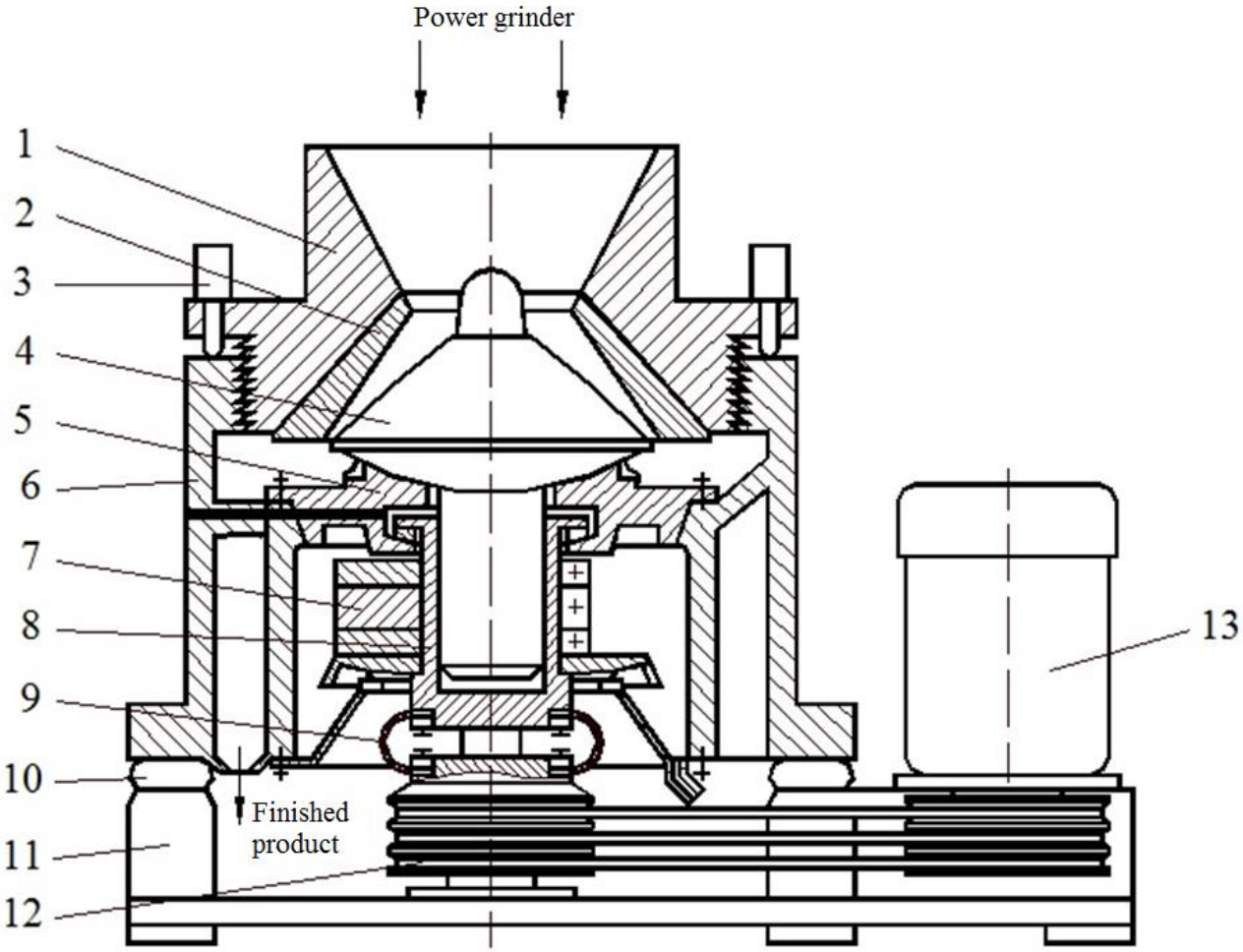

Figure 1: Cone inertial crusher

1 - the outer cone, 2 - the armor of the outer cone, 3 - the hydraulic jack, 4 - the inner cone, 5 - the spherical bearing, 6 - the body, 7 - the unbalanced rotor-vibrator, 8 - the rotor-vibrator bearing, 9 - the elastic clutch, 10 - rubber shock absorbers, 11 - metal support, 12 - V-belt drive, 13 - electric motor

The purpose of the study was to test the technology of shungite processing to obtain the basis of the fodder additive-mycotoxin neutralizer for the needs of poultry farming.

MATERIAL AND METHODS

Mineral additive "Mustala" based on schungite was crushed with the use of innovative technologies of crushing and classification to fractions of various sizes. The size of the fractions was determined by the regulatory requirements for fodder for agricultural poultry.

The studies were carried out in a poultry farm on broilers of the Kobb 500 cross-country in Big Dutchman cell batteries, with 30 heads in each group, from daily to 42 days of growth [5].

Norms of planting, light, temperature, wet conditions, feeding and drinking front in all age periods corresponded to recommendations [5] and for the two experiments were identical.

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Poultry were fed with placer mixed fodder with nutrition according to the norms [5], 2015. In the period of 1-14 days fed mixed fodder under the brand name "Starter"; 15-21 days - mixed feed "Grouer"; 22-36 day - mixed fodder "Finisher".

From the daily conditioned chicks by random sampling four groups were formed in the feeding experiment (Table 1).

It did not exceed the MPC, and was at the level of 0.9-1.0 and 3.0-4.0 mg / kg, respectively.

Table 1: Scheme of experience in broiler chickens (experiment 1)

Group	Features of feeding
1 control	Fodder balanced for all nutrients in accordance with the guidelines for feeding poultry (2015) - BR-1
2 experimental	BR -1 + 0,2% of mineral additive "Mustala" on the basis of schungite in the form of grits with Ø particles of 0,5-1,5 mm
3 experimental	BR -1 + 0.2% of mineral additive "Mustala" on the basis of shungite in powder form with Ø particles of 10-20 microns
4 experimental	up to 14 days BR -1 + 0.1% mineral additive "Mustala" on the basis of shungite in the form of grits with Ø particles 0.5-1.5 mm, after 14 days BR -1 + 0.1% mineral additive "Mustala" on based schungite in the form of grits with Ø particles of 0.5-1.5 mm and 0.1% shungite crushed stone 2-3 mm instead of gravel.

Recipes of mixed fodders and premix composition are given in Tables 2 and 3.

Table 2: Feed recipes,%

Index	Growing period		
	1-14 days	15-21 days	from 22 to slaughter
Corn	7,00	7,00	7,00
Soy fatty ekst.	24,55	24,00	21,50
Wheat	51,00	53,24	54,61
Sunflower oil	1,84	2,95	4,12
Fish flour	5,00	3,00	2,00
Sunflower cake	7,00	7,00	7,00
Monocalcium phosphate	0,69	1,00	1,00
Limestone	1,56	1,47	1,50
Salt	0,32	0,32	0,32
Lysine	0,44	0,45	0,41
Methionine	0,30	0,29	0,26
Threonine	0,17	0,15	0,15
Blend mineral 0.08%	0,10	0,10	0,10
Blend vitamin 0.02%	0,03	0,03	0,03
Total:	100	100	100

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In 100 g of feed contains:			
exchange energy, Kcal / 100g	310,24	315,29	320,25
MJ	12,96	13,18	13,38
raw protein	23,23	21,25	20,30
raw fat	9,10	9,92	10,63
raw cellulose	4,20	4,23	4,13
raw ash	4,17	4,07	3,99
calcium	1,00	0,90	0,90
common phosphorus	0,68	0,68	0,67
phosphorus available	0,40	0,40	0,40
sodium	0,19	0,16	0,16
chlorine	0,35	0,33	0,32
lysine	1,40	1,25	1,17
methionine	0,66	0,59	0,55
methionine + cystine	0,98	0,90	0,85
threonine	0,94	0,83	0,80
tryptophan	0,25	0,23	0,22
arginine	1,38	1,26	1,20
amino acids digestible:			
lysine	1,24	1,11	1,03
methionine	0,61	0,55	0,51
methionine + cystine	0,86	0,78	0,74
threonine	0,64	0,56	0,54
tryptophan	0,21	0,19	0,18
arginine	1,15	1,04	1,00

Table 3: Addition of vitamins and microelements per 1 ton of mixed feed

Component	Levels of input of vitamins and microelements (per ton of mixed fodder)		
	"Starter"	"Rostovii"	"Finisher"
Vitamin A million IU	13,0	11	10,0
Vitamin D_3 million IU	5,0	5,0	5,0
Vitamin E, g	80,0	60	50,0
Vitamin K, g	4,0	3,0	3,0
Vitamin C, g	50,0	50,0	50,0
Vitamin B_1, g	4,0	2,0	2,0
Vitamin B_2, g	8,0	8,0	8,0
Vitamin B_6, g	4,0	4,0	3,0
Vitamin B_{12}, mg	20,0	15	15,0
Biotin, mg	150	120	120
Choline, g	400	200	350
Folic acid, g	2,0	2,0	1,5
Nicotinic acid, g	60	50	50
Pantothenic acid, g	15	12	12
Manganese, g	100	100	100
Zinc, g	100	100	100
Iron, g	40	40	40
Copper, g	15	15	15
Iodine, g	1,0	1,0	1,0
Selenium, g	0,3	0,3	0,3

Considered indicators:

1. Preservation of livestock by taking into account waste and establishing its causes, %;

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2. Live weight of broilers at the age of: days, 14, 21, and 42 days, by individual weighing of the entire population by groups. At the age of 42 days, live weight was recorded for male chicks and female chicks separately, and the average live weight of chickens was calculated as the average weight of male chicks plus the average mass of female chicks and this amount was divided by 2. The period from weighing to weighing corresponds to one period and the feeding phase (1-14, 15-21, 22-42 days);

3. Average daily gain of live weight, g;

4. Feed costs per 1 kg of live weight gain at the end of the experiment, kg;

5. Feed intake, for the entire period of cultivation, kg per head;

6. Digestibility and use of the basic nutrients of mixed fodder by the bird according to the results of physiological experience at the age of 32-38 days;

7. Chemical composition of shungite.

The chemical composition of the mineral additive "Mustala" based on schungite, is presented in Table 4.

Inclusion of the mineral additive "Mustala" on the basis of schungite in poultry mixed fodders can substantially fill the bird's need for macro- and microelements.

In general, the content of macro- and microelements, although it can not fully meet the need for limited elements of food for broilers, is a significant addition to the diet. According to the literature, shungite, depending on the mineral base (aluminosilicate, siliceous, carbonate) has adsorption, absorbing, highly reactive, catalytic and other properties. Mainly all these properties are due to a combination of basic macroelements: silicon and fullerene-like carbon.

The chemical composition of the mineral additive "Mustala" based on schungite is presented in Table 4.

Table 4: Chemical composition of the mineral additive "Mustala" on the basis of schungite,% (on absolutely dry matter)

The main component	Content,% wt.	The basic microelement	Content,% wt.
SiO_2	54,89	Si	23,07
Zn	0,008	Zn	0,008
Al_2O_3	3,67	Al	6
Fe_2O_3	2,43	Fe	3,5
MnO	<0,02	Mn	0,022
CaO	0,19	Ca	1,2
MgO	1,07	Mg	1,8
Na_2O	<0,3	Na	0,25
K_2O	1,05	K	1,01
P_2O_5	0,06	P	0,08
SO_3 sulf / S**C**	0,72/0,49	S	1,2
$C_{gen.}$	34,8	$C_{gen.}$	34,8
Cu	0,0058	Cu	0,0058
Other components	8 - 10	Other microelements	6 - 8

RESULTS AND DISCUSSION

The main zootechnical indicators obtained on broilers in the first experiment are presented in Table 5.

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Table 5: Zootechnical indicators on broiler chickens

	Group			
	1 c	2	3	4
Goals in experience	30	30	30	30
Preservation,%	100	100	100	100
Live weight, aged, g: 1 day	44,32 ±0,14	44,48 ±0,15	44,46 ±0,17	44,51 ±0,14
14 days	357 ±4,95	363 ±4,46	361 ±4,21	364 ±4,31
% to control	100	101,7	101,1	102,0
21 days	1121 ±19,31	1140 ±15,64	1123 ±19,10	1135 ±19,85
% to control	100	101,7	100,2	101,2
42 days, on average, r	2218	2256	2230	2244
% to control	100	101,7	100,5	101,2
male chicks	2371 ±34,23	2417 ±20,80	23,93 ±19,87	2404 ±20,31
% to control	100	101,9	100,9	101,4
female chicks	2065 ±26,23	2094 ±25,02	2067 ±27,86	2084 ±21,94
% to control	100	101,4	100	100,9
Feed consumption per head for the whole period, kg	3,718	3,714	3,694	3,716
% to control	100	99,92	99,38	99,97
Feed consumption per 1 kg of live weight gain, kg	1,710	1,679	1,690	1,690
% to control	100	98,18	98,83	98,83
The average daily gain of live weight, g	51,75	52,66	52,04	52,37
% to control	100	101,7	100,6	101,2
Weight of liver of broilers, g	57,10	57,3 ±0,07	57,37 ±0,09	58,03 ±0,27
Slaughter carcass yield,%	71,21	71,42	71,22	71,24

From the data of Table 5, it can be seen that the safety of birds in all groups was high and was at the level of 100%.

The best live weights were obtained in experimental groups 2 and 4, where the chickens received a mineral supplement "Mustala" on the basis of schungite, in the form of grits and shungite crushed stone. Thus, the live weight of the experienced broilers at the ages of 14 and 21 was 363 and 364, 1134 and 1144 g, 4244 at 2244 and 2256 g, which is 1.7 and 2.0 higher than the control chicks, 1.2 and 2, 1, 1.2 and 1.7%, respectively, the growth periods.

At 42 days of age, the live weight of female chicks in test groups 2 and 4 was higher by 0.9 and 1.4%, and in male chicks, by 1.4-1.9%, respectively, in the control group.

Feeding the chicken feeds of the mineral additive Mustala on the basis of shungite, in the form of grits and shungite crushed stone, contributed to the average daily growth of young animals for 42 days of experiment (52.37 and 52.66g), which exceeds the growth of control broilers by 1.2 and 1.7 %.

Broiler chickens that received mixed feeds with the mineral additive "Mustala" on the basis of schungite, in the form of powder (group 3) had a living mass at the level of the control group during all growth periods.

With the inclusion of the mineral additive "Mustala" on the basis of schungite, in the form of mixed feed powder had a dark color, but this did not affect the level of their consumption.

During the whole period of cultivation, broilers of experimental groups 2, 3 and 4 consumed 3,694 feed; 3,714 and 3,716kg. At the same time, the consumption of mixed fodder for 1 kg of growth of live weight was 1.679-1.690 kg and were below the control group by 1.17-1.82%.

Thus, the use of various disintegration technologies has made it possible to improve the properties of the mineral fodder additive.

The use of innovative technologies for crushing a mineral additive based on schungite allowed to increase the productive indicators in broiler chickens.

When using benign fodders with the inclusion of a mineral additive "Mustala" in their composition on the basis of schungite in the form of grits and rubble with Ø particles of 2-3 mm and in replacement of gravel there is an increase in zootechnical indicators of broiler farming. Thus, the live weight of broilers that received the mineral supplement "Mustala" on the basis of shungite, in the form of grains and crushed stone at the age of 42 days exceeded the bird of the control group by 1.2 and 1.7%, with a decrease in feed conversion by 1.75 and 1 , 17% due to improved digestibility and the use of nutrients feed. The slaughter yield of broiler carcasses increased by 0.03 and 0.21%.

Prophylactic use of the mineral additive "Mustala" allows to neutralize the negative effect of mycotoxins on the broiler organism and keep their productivity at the calculated level.

The feed additive "Mustala"® was tested for lack of binding ability in relation to vitamins, microelements and amino acids during balance experiments.

CONCLUSION

Thus, feed additive "Mustala"® when used in poultry feeding, increases productivity, has the potential to improve feed conversion, practically does not affect the metabolism of vitamins, amino acids and trace elements.

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