Рус.

UDC 637.4.04 **DOI: 10.18413/2313-8971-2016-2-2-107-112**

Buhanov V.D.[1]
Vesentsev A.I.[2]
Naumenko L.I.[3]
Sokolovsky P.V.[4]
Pankova O.N.[5]

INFLUENCE OF THE ENTEROSORBENT ON QUALITY OF EGGS

1) Candidate of veterinary sciences, associate professor of medical and biological bases of physical education National Research Belgorod State University. 85, Pobedy St., Belgorod, 308015, Russia. e-mail: valabu55@bk.ru.
2) Doctor of technical sciences, professor, head of the department of general chemistry, National Research Belgorod State University 85, Pobedy St., Belgorod, 308015, Russia. e-mail: vesentsev@bsu.edu.ru.
3) Candidate of technical sciences, assistant professor of medical and biological bases of physical education National Research Belgorod State University. 85, Pobedy St., Belgorod, 308015, Russia. e-mail: naumenko@bsu.edu.ru.
4) Graduate student, department of general chemistry, National Research Belgorod State University
85, Pobedy St., Belgorod, 308015, Russia. e-mail: levap90@list.ru
5) Researcher at the National Research Belgorod State University
85, Pobedy St., Belgorod, 308015, Russia. e-mail: valabu55@bk.ru.

Abstract. In this article research the influence of natural montmorillonite containing sorbent used as a mineral supplement in animal feed in an amount of 30 g per 1 kg of sorbent feed on commercial quality table eggs at his dacha hens-layers. Found that feeding hens' mineral feed additive reduces the toxic chemical elements in a chicken egg. It was found that the weight of the eggs in the experimental group compared to the control group, was significantly increased by 3,5% ($p < 0,05$) after the completion of feeding the mineral sorbent. Despite the fact that in the control group, egg weight did not change and remained virtually unchanged. There is a bright pigmentation and reduction of "marbling" of the egg shell in the experimental birds. Set reduction "marbling" of 4.9 % and a decrease in light-colored eggs by 48.3 %. It has been established that chicken's experimental group had a higher feed consumption and conversion (1.4 kg) as compared to control birds (1.3 kg). The best feed conversion per unit of egg products was observed in the experimental birds due to increased productivity. Proved that the marketability of the eggs is in direct proportion to the consumption of laying hens' natural montmorillonite containing sorbent. Found that despite the great variety of indicators that characterize the quality of table eggs, the main thing is the maximum permissible levels of pollutants in them. Concluded that when administered in feed for laying hens 3 wt. % Montmorillonite clay containing eggs can be obtained with low dietary content of harmful substances entering the body to feed the birds .
Keywords: montmorillonite containing sorbent, enterosorbent, pollutants, laying hens, diet eco-friendly edible egg.

Introduction.

Intensive development of the industry and urbanization of the population at the present stage of life correlate with the level of pollution of environments of an ekzotoksinama. The last, getting into an organism of animals in the inhalation or parenteral way, reduce resistance, lead to development of diseases, various on the etiology, and in certain cases – to death. Use by the person in food of substandard production of animal husbandry is the reason of development of a wide number of diseases.

In this regard search of the optimum methods capable to carry out the general detoxication of an organism of animals in order that is quite actual today: on the one hand to normalize the status of their health, with another – to organize a rupture of a

vicious chain of transition and a kumulyation of toxins in system "an animal - production of animal husbandry - the person".

Methods of efferent therapy (from Latin efferens – to remove) can be those. Among them the increasing application is found by the enterosorbtion method based on binding and removal from a digestive tract with the medical and preventive purpose, endogenous and exogenous substances, supramolecular structures and cages.

The essence of an enterosorbtion consists in oral introduction of a number of substances – enterosorbents which properties are directed to keeping on the surface the toksigennykh of components of a himus. Enterosorbtion is used in medicine and veterinary science for treatment of the sharp and chronic diseases which are followed by toxicoses, violations of digestion, the immune status, a metabolism of lipids and bilious acids, other types of an exchange.

Enterosorbents are the pharmacological preparations of various structure which are carrying out binding ekzo-and endogenous substances in a digestive tract by adsorption, ion exchange, a complex formation [1].

Almost total absence of adverse effects is peculiar to enterosorbents that allows to appoint these preparations an animal of various age groups, including birds.

Free from decay egg of chicken has a high biological and dietetic value.

Various nutritional components which contain in it are balanced and easily absorbed in the body.

In conditions of market economy and rivalry, with the excuse of reduction of cost price of eggs, entrepreneurs have to enter into hens' ration more cheap ingredients of low quality, which, undoubtedly, affect for the maximum permissible levels of pollutants (earwax, nitrogen, heavy metals, persistent organic compounds and others) containing in eggs. Among the pollutants one of the first take place heavy metals, i.e. a group of chemical elements with the relative atomic mass of over 40 [2].

The main reason of contamination of feeds with different xenobiotics considers technology-related and anthropogenic influence to the natural environment. At present, the extent kerkovich indicators of environmental pollution by chemical elements have achieved significant quantities. In many regions of the Russian [2-6]. According to modern concepts of the density of metals, it is conditionally divided into two large groups: light metals, the density of which not more than 5 g/cm^3, and heavy metals the rest.

Getting involved in agrocoenosis cycles, heavy metals through the lithosphere, the hydrosphere and the atmosphere come in plants, animals and man, providing for them a negative effect [7]. That's why, the problem of getting dietetic eggs with low content of harmful substances, regularly coming into the body of birds with feed, as rule, solved by introduction in a ration of laying hens of different enterosorbents. However, to reduce the concentration of heavy metals, affecting to the ecological-biochemical exponents of nutritional value of eggs, it is advisable to use scientific alternative options for the application of inorganic sorbent additives in complete balanced mixed fodders. Sorption active inorganic substances represent clay natural materials such as zeolites, montmorillonite (smectites) and other [8].

Montmorillonite is a clay mineral belonging to the group of layered silicates structural type 2:1 with a swelling crystal lattice. It can find in nature in the form of small, often nanoplenki and nano-crystals. The structure of the crystal lattice of montmorillonite presents a three-layer package of type 2:1: two layers of oxygen silica tetrahedra $[SiO_4]^{4-}$, with genesis of reticle in composition $[Si_2O_5]^{2-}$, facing peaks to each other, on both sides of the covering layer of the composition $Al_4(OH)_8$ which was built from alyumosilikatnykh octahedra $[Al(O,OH)_6]^{3-}$. The conjunction between packages is weak, packet distance is large and it can be injected molecules of water or other polar molecules, and also exchange cations and anions. The mineral is not toxic for animals, have not cumulative properties, embryo toxicity, and teratogenicity, irritating effect wasn't experimentally established on the mucous membranes. It binds and removes from the body toxic substances, improves the metabolism of proteins, lipids, vital minerals, promotes absorption of vitamins digestive system, normalizes the function of the intestines, increases heterospecific resistance of organism, have a positive effect on productivity and reproductive function for animals. It improves biological value and ecological purity of the animals' products.

Sorption-adhesive and ion-selective ability of montmorillonite clays determine their porous layered structure and presence on the surface of negative charge, i.e. electro kinetic from EQ potential. These kind of adsorbents usually have high specific surface up to several hundred m^2/g. The distance between the layers of thickness are about 1 nm, components of the structural basis of clay, as well as the tenth fractions of nanometer. If it increases this distance and electro kinetic potential, it can be significantly increase

specific surface of montmorillonite, and thus its adsorption properties [7, 8, 9, 10].

The aim of this research was to study the influence of montmorillonite containing clay in the ration of laying hens to eggs quality.

Material and methods of research. The experiment was carried out in vivarium conditions of Belgorod branch of VIEW. In the capacity of objects of research were used two groups of laying hens of the cross «Rhodonite». In each group was selected 20 hens of 30 weeks of age with a live body with weight 1800-2010 grams. The birds of first, experienced group additionally received with the main ration (feed - GOST R 51851-2001) granulated montmorillonite containing clay in concentrations of 30 g/kg of a feed-stuff. Diameter previously made by us granules was in the range of 1-3 mm. The hens of second, control group utilized the feed without sorption supplements. The conditions of keeping and feeding birds accorded with regulatory requirements for this cross. The experiment lasted 17 days, in which the adaptation period lasted for 7 days. After referred to term of experiment in both groups was collected eggs laid during the day to study the influence of natural mineralogist on their commodity and food quality.

Quantitative indicators of the presence of chemical elements in feed-stuff and eggs of experimental hens were established with the help of emission spectrometer parallel steps with inductively coupled plasma Shimadzu ICPE-9000. During the experience revealed the presence in eggs of chemical elements relating to non-metals and metals, only those that are important or dangerous for health, even in insignificant quantities exceeding MPC. From the 22 non-metals of the periodic system of Mendeleyev's elements identified three of them: iodine, selenium and arsenic.

At determining of metal content in eggs of laying hens took into account the concentration of light (manganese, beryllium, strontium) and heavy (vanadium, zinc, chromium, manganese, tin, cobalt, Nickel, copper, bismuth, lead, mercury) metals. Analysis of availability of materials of chemical elements produced in each egg after thorough mixing of albumen and yolk until a homogeneous mass (mélange).

In the mélange also determined the carotenoids. To determine the total content of carotenoids used spectrophotometric method.

Received on assay balance hinges (with the accuracy of 0.0001 g) in the range from 2,3191 to 3,6649 g filled with 10 ml of acetone and was kept for a few minutes during a constant mixing. Then the manufactured mixture was filtered through a filter of SCHOTT. Completeness of extraction estimated on a full visual discoloration of the solid residue on the filter. Received filtrate scanned photo metrically relatively the solvent in quartz cuvettes (l = 1 cm) with lmax = 440 - 445 nm. The total content of carotenoids (in terms of lutein) was determined using such way $E^{1\%}_{1см} = 2550$. The content of carotenoids in the extract was calculated by the formula (1):

$$\alpha^* = \frac{A_{max}}{E^{1\%}_{1см}} \cdot \frac{V \cdot P \cdot 1000}{100 \cdot m \cdot l}, \text{ mg/g} \quad (1)$$

where the Amax is an optical density of the solution in the maximum of absorption, $E^{1\%}_{1см}$ is a coefficient of extinction, V is a volume of the extract, ml, R is a measure of attenuating extract before the spectrophotometric using, m is a weight of hinge, g, l is length of the optical path, cm.

Received material was statistically manufactured (Lakin, 1980). At determining significant differences between the control and experimental groups was used criterion of Stjudent. The results were considered as significant at $p < 0.05$.

Results and discussion. In feed-stuff for laying hens the content of experimental, chemical elements was not exceed the maximum allowable concentration (table.).

It's common knowledge that the main indicator of commercial quality of the egg is its mass, but the absence in the scientific literature sufficient information of the effects of montmorillonite containing clay on the body of laying hens and consequently on their productive significatives prompted us to pay attention to this issue during the experiment. After finishing of feeding the sorbent, the weight of eggs in the experimental group, as compared to control group, significantly increased 3,5 % ($p < 0.05$). In control group the mass of eggs not changed and remained virtually at the same level.

Also, it ought to be noted the fact of strengthening of pigmentation and reduction of «marbling» of shard of eggs in the experimental birds. Comparing the changed appearance shard of eggs experienced and control hens, we established a fall «marbling» by 4.9 % and the reduction of light-colored eggs by 48.3 %. At the same time, the index of the form of eggs in both groups did not change significantly and complied the requirements, set for the quality of food, incubation and commodity eggs.

The effective utilization of feed by bird has the fundamental importance for the economy of egg's production. Judging by the cost of fodder per 10 eggs, hens of experimental group had higher rate of consumption and feed of conversion (1.4 kg) in comparison with the control bird (1.3 kg). The best

feed's conversion efficiency per unit of egg's production was observed in the experimental birds by means of increased productivity.

Received affirmative materials give us to suggest that commercial quality of eggs are in direct dependence from the use of hens-layers natural montmorillonite containing sorbent.

In spite of the variety of indicators characterizing the quality of the food-grade eggs, the principal is the maximum permissible levels of pollutants in them.

In our opinion, introduction to feed-stuff for laying hens 3 of the masses. % montmorillonite containing clay was the prerequisite of obtaining of dietetic eggs with low content of harmful substances entering in organism of birds with feed.

Table 1

The changes of biochemical indicators of egg of laying hens at startup in the ration of montmorillonite containing sorbent

№ p/p	Chemical element	Concentration of the experimental in the egg, mg/kg			Significance
		feed-stuff	experiment	control	
			M ± m	M ± m	
Non-metals					
1.	I mg/kg	2,15	0,186±0,07	0,136±0,08	p > 0,05
2.	Se mg/kg	12,40	0,832±0,44	0,791±0,44	p > 0,05
3.	As mg/kg	0,072	-	-	-
Light metals					
1.	Mg mg/kg	318,00	69,76±3,52	58,80±3,26	p > 0,05
2.	Be mg/kg	0,09	– 0,003±0,00	– 0,005±0,00	p > 0,05
3.	Sr mg/kg	51,50	2,005±0,13	1,251±0,15	p < 0,01
	Heavy metals				
1.	V mg/kg	0,302	0,016±0,01	0,031±0,02	p > 0,05
2.	Zn mg/kg	62,3	10,50±1,57	8,22±0,80	p > 0,05
3.	Cr mg/kg	2,45	0,359±0,04	0,532±0,04	p < 0,05
4.	Mn mg/kg	91,1	0,604±0,06	0,865±0,09	p < 0,05
5.	Sn mg/kg	0,164	0,028±0,00	0,035±0,00	p < 0,05
6.	Cd mg/kg	0,024	0,0008±0,00	0,0007±,00	p > 0,05
7.	Co mg/kg	1,00	0,150±0,02	0,257±0,05	p > 0,05
8.	Ni mg/kg	2,97	0,560±0,06	0,994±0,20	p > 0,05
9.	Cu mg/kg	2,34	0,316±0,05	0,651±0,08	p < 0,01
10.	Bi	1,06	0,142±0,01	0,227±0,04	p > 0,05
11.	Pb mg/kg	1,85	0,211±0,06	0,381±0,04	p < 0,05
12.	Hg mg/kg	0,005	-	-	-

Confirmation of aforesaid presented in table of numerical characteristics, showing the reduction of level of contact control chemical elements under the influence of the sorbent. In all eggs from the experimental group were much less, than in control, except magnesium, zinc and cadmium, but at the statistical processing of the obtained factors was noted insignificant increase in their content. Revealed experimentally in the eggs of both groups as indicators of levels of non-metals, light and heavy metals were not exceeding MPC.

From the category of the most dangerous and toxic chemical elements arsenic and mercury were absent in eggs of experimental birds. In turn looked up manganese, tin, copper and lead, also belonging to this group, and low-toxic metals strontium and chrome was no significant difference relative to control. Moreover, their concentration was low, except strontium. Identified the lack of strontium's ion sorption of natural montmorillonite sorbent contain with the same as the previously conducted us research [11].

Non-radioactive strontium (^{88}Sr) is low toxicity and moreover, widely used for the treatment of osteoporosis. Being the analog of calcium, strontium with great speed accumulates in the organism of children up to 4 years of age, especially when there is an active formation of bone tissue. Based on the results of experiments it should indicate the effective assimilation from the feed-stuff of natural stable isotope of strontium (^{88}Sr) by organism of laying hens from the experimental group, and this contributed to significant increase of its concentration in eggs.

The content in eggs the rest chemical elements of montmorillonite containing clay did not absorbing action and didn't contribute to the removal of the intestinal lumen of hens. At the same time, in eggs of experimental hens was visible a clear tendency to a slight reduction in the content of beryllium,

vanadium, cobalt, Nickel and bismuth. Giving with feed of montmorillonite sorbent containing sorbent to the birds of the experimental group have not prompted to significant decrease of carotenoids in their eggs (4.50±0.31 mg/g) in comparison with eggs derived from control hens (6.39±0.61 mg/g) [11]. Nonetheless, the diagnosed difference in the number of carotenoids in the eggs of laboratory hens, points at a manifested tendency of lowering the intake of provitamin A, from the bowels of experimental birds under the action of a sorbent (Fig. 1).

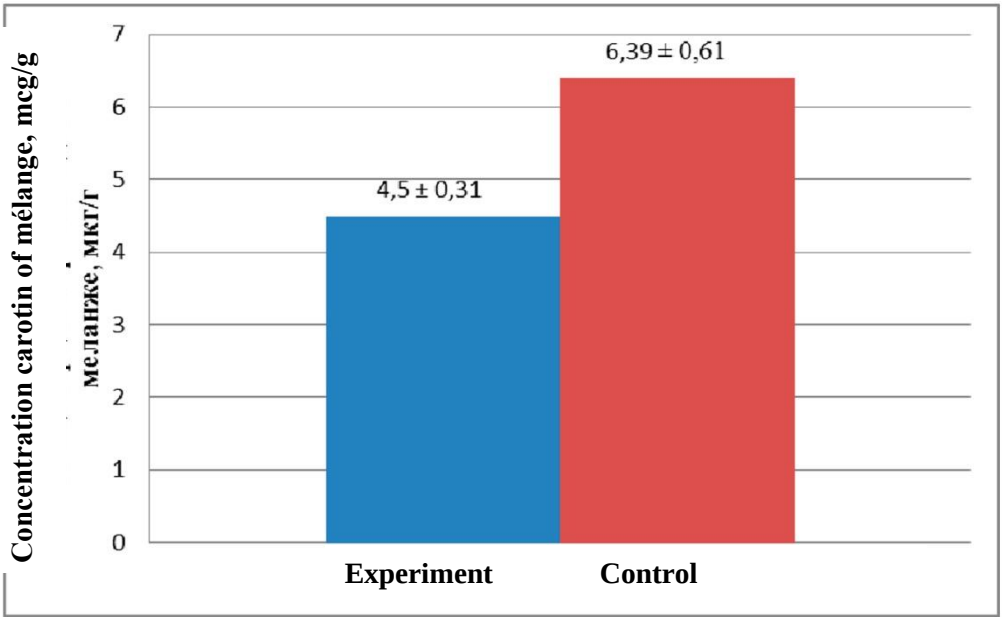

Figure 1. Concentration of carotenoids in eggs of experimental hens.

In connection with this, the introduction to feed-stuff to laying hens of montmorillonite containing sorbent with the aim to reduce the level of pollutants in the eggs should not exceed 3 of the masses. %.

Conclusion. Addition in a diet of laying hens of 3 masses. the % of a natural clay mineral as an enterosorbent increases the mass of egg by 3,5%, lowers shell "mramornost" for 4,9% and reduces amount of the light-painted eggs by 48,3% in comparison with control. The composition of chemical elements of melange of egg considerably reflects the level of mineral security of compound feed. Entering into a diet of laying hens montmorillonite the containing clay, it is possible to receive dietary organic food egg with concentration within admissible norm macro - and minerals, especially toxic and rather widespread.

Data of pharmacological researches have also shown expediency of use of an enterosorbent in veterinary and agricultural practice as an additive and a filler of compound feeds. The indisputable advantage of a preparation is good tolerance, absence of undesirable effects and ability to deletion of metals.

Work is performed at the expense of means of a grant of the Russian Federal Property Fund № 14-43-08021 «Research of processes fazo-and the structurizations proceeding at joint pyrolysis of vegetable waste of agro-industrial complex of the Belgorod region with local montmorillonite the containing clays and studying of influence of physical and chemical parameters of process of synthesis of effective composite sorbents on absorption of heavy metals, pathogenic and opportunistic bacteria from water solutions and cleaning of fertile soils of pesticides», 2015 - 2016.

References

1. Belyakov N.A. Alternative medicine: Non-drug methods of treatment. Arkhangelsk: Sowing. - Zap. publishing house, 1994. 462 p. [LIBEX][Abstract]

2. Onishchenko G.G. Chemical safety as an interdepartmental problem. The role of the State Sanitary and Epidemiological Russia in chemical safety population. Poison Gazette, № 1 (2002): P. 2-7. [eLIBRARY][Full text]

3. Davydova S.L., Tagasov V.I. Heavy metals as supertoxicants XXI century: a training manual. People's Friendship University, 2002. 140 p. [Abstract].

4. Ilyin V.B. Heavy metals in soil-plant system. Novosibirsk: Science, 1991. 151 p. [Abstract].

5. Afonina I.A. Effect of copper and zinc on the productive and biological indicators of laying hens cross «Rhodonite»: Dis ... Candidate. biol. Science. Novosibirsk

State Agrarian University Institute of Veterinary Genetics and Breeding. Novosibirsk, 2006. 208 p. [eLIBRARY].

6. Buhanov V.D., Vesentsev A.I., Naumenko L.I., Myachikova N.I. Modern problems of food quality and production of ecologically pure products of animal origin. Progressivni Technique that tehnologiï nutritive virobnitstv, restaurant gospodarstva i torgovli: ST. Science. Pr. №1(9) (2009): P. 474-479. [cyberleninka][Full text]

7. Shaposhnikov A.A. The use of natural hydroaluminosilicates in animal husbandry and veterinary medicine: Guidelines. Comp. Shaposhnikov A.A. and others, ed. Ushakov L.A. – Belgorod State Agricultural Academy, Belgorod State University, 2003. 21 p.

8. Buhanov V.D., Vesentsev A.I., Safonov N.A., Kozubova L.A., Volovicheva N.A. Anti-adhesive effect on Escherichia coli form a lithium-containing montmorillonite sorbent. Proceedings of the conference (23-26 May 2011), «The problems of agricultural production at present and the ways to solve them». Belgorod State Agricultural Academy Publishing House (2011): P. 67. [cyberleninka][Full text]

9. Buhanov V.D., Skvortsov V.N., Vesentsev A.I., Kozubova L.A., Korol'kova S.V., Volovicheva N.A. Chemical composition and sorption properties of the drugs, «Ecos» and «Ecos-O». Actual problems of metabolic diseases in farm animals in modern conditions. International scientific-practical conference dedicated to the 40th anniversary (2010): P. 64-68. [Full text]

10. Buhanov V.D., Skvortsov V.N., Vesentsev A.I., Shaposhnikov A.A., Kozubova L.A., Frolov G.V. Sorption of cesium-137 and strontium-90 preparation «Ecos». Scientific Statement BSU. Series of natural sciences. Issue 13. №21(92) (2010): P. 131-134. [Full text]

11. C. Hartmann, M. Wilhelmson The hen's egg yolk: a source of biologically active substances. World's Poultry Sci. J. №1 (57) (2001): P. 14-28. [Abstract]