Biotechnology

Application of Methionine-Containing Complexes and their Composites with Clinoptilolite in Poultry Nutrition

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ABSTRACT. A premix and its composite with clinoptilolite were prepared to study physiological activity of chelate compounds and natural zeolite -clinoptilolite, which was used to balance formula feed for poultry layers. Experiment lasted 60 days on three groups: control group was given a feed used generally at the factory, I experimental group was given a feed balanced by premix prepared on the base of biometals (Mn, Zn, Fe, Co, Ca, Mg, Cu) and chelate compounds of sulfur-containing amino acid, methionine, while that of the II experimental group - by clinoptilolite and the same formulation premix composite. Observations were made over poultry development, egg-laying intensity and physical properties of eggs (egg yolk, white, shell mass et al). The role of amino acids, namely methionine, on the one hand, and that of biometals, on the other hand, is known in poultry and animal nutrition. Therefore, simultaneous presence of methionine and biometals in chelate form should provide sharp increase of their biological activity, decrease of toxicity and high grade of assimilation. It was proved by analysis of the obtained data. In particular, researches showed that live mass increase in the I group reached 6.7% , in the II group – 7.33%, while in the control one – 5.13%. Poultry preservation index in the I group equaled to 93.75%, in the II group – 95.06, while in the control -81.3%. Productivity of layers, egg-laying capacity and egg quality and physical characteristics (egg mass, egg length, width, white mass, yolk mass, shell mess and others) were increased. The obtained results are conditioned by biometals in chelate form (I exp. group) and simultaneous presence of these chelate forms and clinoptilolite (II exp. group), which provided better assimilation of biometals and improvement of metabolism in experimental poultry. *© 2015 Bull. Georg. Natl. Acad. Sci.*

Key words: *chelate compounds, zeolite-clinoptilolite, premix, biometals, layers, poultry, animal, formula feed.*

Introduction

It is known that biometals play significant role in physiological and biological processes going on in poultry and animal bodies. Up to 75 chemical elements are found in their organism. This is why the so-called "vital metals" attract the attention of wide sphere of researchers. One of the main causes conditioning low quantitative and qualitative indices of

food products is deficiency of biometals in plants, soil, as well as agricultural animal and poultry. Decisive role in a matter of resolution of this problem is attributed to the provision of live organism by optimal quantity and ratio of biometals. Biometals fulfill their functions in live organism in the form of chelate compounds. Therefore filling of deficiency in biometals in such a form sharply increases biological activity of animal and poultry. This is explained by the fact that biometals, when they are in chelate forms, are characterized by low toxicity and high capacity of assimilation. Their application in small doses provides increased rate of efficiency and ecological safety. As to inorganic salts, they are characterized by high toxicity, low grade of assimilation and low efficiency which is conditioned by formation of hardly soluble and hardly digestible compounds in animal and poultry intestinal tract [1-4].

Data of special literature prove the significance of the focused application of natural minerals, zeolites for development of cattle growing and poultry rearing. Application of natural zeolites in feed ration provides: high nutritive properties of formula feed, improvement of physiological state of animals and poultry, elevation of immune system stability, normalization of metabolism, slowing down passing of feed mass through intestinal tract (prolongation effect), as a result of which effect of digestive juice on feed mass increases. Thus, conditions are created for more thorough absorption/assimilation and digestion of nutrients [5-8].

Materials and Methods

During experiments we studied:

· Poultry live mass at the beginning and end of experiments, by individual weighing of poultry on electronic scales.

· Poultry preservation, by recording of fallen and discarded poultry, by sectioning of the fallen poultry and determination of cause of fall.

· Egg-laying capacity, by recording daily obtained egg in each group, and then by division of egg number obtained during the whole length of experiment into average number of poultry.

· Egg mass – at the beginning, in the middle and at the end of the experiment we studied by weighing total egg obtained in 3 successive days and by computation of a mean;

· In the process of egg weighing we studied/measured egg length, width and circumference by the use of a ruler. Mathematical formulas were used to determine form index (ratio of a big diameter and small diameter).

· Morphological analysis of egg was carried out at recommendations of poultry and technology institutes (white and yolk diameter, white and yolk mass, shell mass, yolk color according to Rosche's scale) [16].

Results and Discussion

At the Laboratory of Agrarian Chemistry Problems researches are continued in the sphere of creation of new generation premixes and their testing in experiments [9-14]. With this in view we synthesized methionine-containing chelate citrates of the following formula: $M_2 \cdot Mt_2 \cdot L \cdot nH_2O$, (where M = Mn, Zn, Fe, Co; n=2-6. Mt-neutral molecule of methionine, L-citrate ion); $M \cdot (Mt)_2 \cdot nH_2O$, (where M = Ca, Mg, Cu; Mt^{-2}-methionine anion, n=2-4). A series of their physical and chemical properties were studied [15]. Proceeding from the above stated the goal of the research was to balance formula feed of egg-layer poultry by premixes made on the base of chelate compounds, in combination with zeolite as well as without it. On the base of computations carried out (according to the detailed norms of nutrition) we prepared the recipes for feed necessary for 3 groups: control, I exp. group, II exp.group (each group contained 16 layers, experiment duration was 2 months).

Control	I exp. group	II exp.group
Conc.of Netherland origine –5%	premix – 0.5%	premix – 0.5%
Feed – 95%	feed – 99.5%	feed – 96.5%
		zeolite (KL)– 3%
16 chickens 60 day	16 chickens 60 day	16 chickens 60 day

Table 1. The main zoo-technical indices of poultry

#	Indices	measure unit	Groups		
			I-group	II-group	Control
1	Poultry number at the beginning of experiment	pcs	16	16	16
2	Length of experiment	day	60	60	60
3	Poultry live mass at the beginning of experiment	g	1393.00	1389.50	1380.00
4	Poultry live mass by the end of experiment	g	1486.80	1491.40	1450.80
5	Number of fallen chicken during experiment	pcs	1	1	3
6	Poultry preservation during experiment	%	93.75	93.75	81.30
7	Age of starting egg laying	day	137	137	144
8	Number of eggs obtained during experiment	pcs	840	845	745
9	Average poultry number during experiment	pcs	15.50	15.50	14.50
10	Number of eggs given by one chick	pcs	54.20	54.50	51.40
11	Laying intensity from the beginning of egg-laying:				
	• in the first week	%	25.00	31.30	19.00
	• in the second week	%	73.50	73.80	68.20
	• in the fourth week	%	93.80	93.80	87.50
	• in the sixth week	%	93.20	93.40	87.30
	• in the eighth week	%	91.20	90.80	86.10

Formula feed for control group consisted of: 4.8 kg concentrate and 91,2 kg feed (to a feed for control group we added 5% concentrate of Netherland origin). Feed for the I exp. group consisted 0.48 kg premix and 95.52 kg feed, while that for the II exp. group – 0.48 premix, 2.88 kg zeolite (KL) and 92.64 kg feed. Sample weights were taken according to the computed masses of components of three groups, then on their base the mixes were prepared by stage-wise mixing/addition according to the following succession: 1. chelate component mixtures; 2.vitamin mixtures; 3. amino acid mixtures; 4. mixtures of other compounds; 5. zeolite (KL) (only for the II exp. group).

For all groups batches of formula feed sufficient for 14 days were prepared. Experiments were conducted on layers at the poultry factory. Physical-chemical analysis of water to be given to poultry was carried out, in particular, analysis of smell, taste, color, transparency, acidification, mineralization, hardness; besides, iron, calcium and magnesium norms were defined. Chemical composition of soil and fodder was studied. Chickens of similar age and live masses (48 pcs) were selected for experiments, for three groups (control, I exp. group and II exp. group), 16 pcs in each group. Permanent observation was carried out on their growth development and egg-laying intensity. Simultaneously, observation over physical properties of eggs was carried out. Results are given in Table 2.

Discussion

According to the results of experiments carried out on egg-layers within two months, the increase of live mass in the I group was 6.67%, in the II group -7.33%, in the control group – 5.13% in the same period (Table 1).

In our experiments we studied preservation of poultry which amounted to 93.75% in the I group, in the II group - 93.75%, while in the control group – 81.30%. Study of egg-laying capacity showed that in the I and II groups egg laying started 7 days earlier than in the control group. In two weeks from starting egg-laying, the intensity was 73.5% in the I group, in the II group – 73.8%, while in the control group it was 68.2%.

After 2 weeks from starting egg-laying, the egg-

Table 2. Physical analysis of egg yolk

#	Indices	May			June		
		Control	I-group	II-group	Control	I-group	II-group
1	Egg mass, g	55.31 ± 0.125	56.02 ± 0.52	56.50 ± 0.45	59.41 ± 0.125	61.57 ± 0.15	61.9 ± 0.65
2	Egg length, cm	5.91 ± 0.30	5.95 ±0.45	5.95 ± 0.45	5.95 ± 0.45	6.08 ± 0.425	6.20 ± 0.60
3	Egg width, cm	4.10 ± 0.30	4.30 ± 0.20	4.30 ± 0.20	4.38 ± 0.50	4.61 ± 0.55	4.68 ± 0.52
4	Egg sircumference, cm	13.54 ± 0.06	13.56 ± 0.04	13.92 ± 0.31	13.96 ± 0.20	14.28 ± 0.48	14.66 ± 0.04
5	Small diameter of thin white, cm	7.50 ± 0.50	7.74 ± 0.35	7.75 ± 0.25	7.92 ± 0.55	8.59 ± 0.50	9.67 ± 0.20
6	Big diameter of thin white, cm	13.22 ± 0.105	13.40 ± 0.16	13.93 ± 0.27	13.42 ± 0.16	14.21 ± 0.245	14.40 ± 0.07
7	Small diameter of thick white, cm	4.92 ± 0.49	4.94 ± 0.46	4.97 ± 0.64	5.02 ± 0.35	5.06 ± 0.26	5.48 ± 0.47
8	Big diameter of thick white, cm	8.50 ± 0.59	9.16 ± 0.59	9.17 ± 0.32	8.99 ± 0.29	9.50 ± 0.47	9.73 ± 0.50
9	Small diameter of yolk , cm	3.37 ± 0.33	3.47 ± 0.29	3.61 ±0.42	3.84 ±0.31	3.89 ± 0.30	3.93 ± 0.40
10	Big diameter of yolk, cm	3.98 ± 0.53	4.04 ± 0.80	4.15 ± 0.88	4.02 ± 0.93	4.80 ± 0.16	5.00 ± 0.15
11	White mass, g	29.37 ±0.71	29.50 ±0.63	29.54 ±0.51	32.54 ±0.57	33.40 ± 0.19	33.49 ± 0.11
12	Yolk mass, g	14.41 ± 0.19	15.25 ±0.42	15.35 ±0.36	16.14 ±0.49	16.89 ± 0.32	16.94 ± 0.26
13	Shell mass, g	7.56 ± 0.40	7.66 ± 0.325	8.73 ± 0.55	9.64 ± 0.35	10.18 ± 0.80	10.25 ± 0.375
14	Yolk (points)	10.60 ± 0.275	10.70 ± 0.30	10.80 ± 0.40	12.40 ± 0.475	13.30 ± 0.375	13.50 ± 0.675

laying capacity in the I and II groups almost reached the peak – 93.8% and 93.8%, correspondingly, while in the control group this index was 87.5%. In all, in the period under study in the I group 54.2 eggs were obtained per hen, in the II group – 54.5, while in the control one – 51.4.

Analysis of physical indices of eggs showed (Table 2) that in the first month of egg-laying in the I group of layers, egg mass equaled to 56.02 g, in the II group – 56.5 g, while in the control – 55.31 g. After 4 weeks in the I group alongside with the increase of egg laying- intensity, egg mass also increased reaching 61.57 g (3.64% higher compared to the control group); in the II group egg mass reached 61.9 g (4.19% higher than in control) , while in the control group it was 59.41 g.

At the initial stage of egg-laying an egg had an oblong form which was proved by the form index. In the I group the form index was 1.44 in the beginning of egg-laying period, while after 4 weeks eggs had a form of ellipsis and the index was 1.32. Analogical changes were observed in the II and control groups.

Index of white and yolk ratio was almost similar at the beginning of egg-laying and after 4 weeks varying within 1.97-2.04. As to the shell mass it was increased in the second period of egg-laying and equaled to: in the I group 7.66 – 10.18 (5.6% higher than in control), in the II group – 8.73 – 10.25 (6.33% higher than in the control), while in the control group - from 7.56 to 9.64. Grade of egg-laying along the whole accounting period in the I group exceeded by 5.2% compared with the control group while in the II group exceeded by 6.6%.

In the second period of egg-laying only color of yolk changed,significantly; in the I experimental group it increased up to 10.7 -13.3 points, in the II

group from 10.8 to 13.5 points, while in the control – from 10.6 to 12.4 points.

Conclusion

Proceeding from the results of the experiment carried out on egg-laying poultry we can state the following: a) in both experimental groups we observe growth of productivity of egg-layers and increase of physical indices, compared with those of the control group, which is conditioned by inclusion of chelate compounds of biometals into premix composition of formula feed given to the I experimental group; b) in the second experimental group we observe increase of productivity of egg-layers and physical characteristics of eggs by still higher grade, which is a result of simultaneous presence of chelate compounds and natural zeolite (clinoptilolite) in the premix that provided better assimilation of biometals by experimental poultry and improvement of metabolism.

Thus, on the base of the results of our researches we can conclude that synthesis and study of chelate type compounds is interesting with both the scientific and practical point of view, since composites made on the base of chelate compounds and zeolite (clinoptilolite) can be successfully used in premixes and on their base industrial designation admixes can be created for formula feeds for poultry and animals.

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ი. ბეშკენაძე*, ს. უროტაძე*, ვ. ციციშვილი, ნ. ჟორჟოლიანი*, მ. გოგალაძე*, გ. ბელელური§**

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ხელატური ნაერთების და ბუნებრივი ცეოლით-კლინოპტილოლითის ფიზიოლოგიური აქტივობის შესწავლის მიზნით მომზადებულ იქნა პრემიქსი და მისი კომპოზიცია კლინოპტილოლითთან ერთად, რომელიც გამოყენებული იყო კვერცხმდებელი ფრინველის კომბინირებული საკვების დასაბალანსებლად. ექსპერიმენტი მიმდინარეობდა 60 დღე სამ ჯგუფზე: საკონტროლო ჯგუფს ეძლეოდა ფაბრიკაში არსებული საკვები, I საცდელი ჯგუფის საკვები დაბალანსდა ბიოლითონების

(Mn, Zn, Fe, Co, Ca, Mg, Cu) და გოგირდშემცველი ამინომჟავას - მეთიონინის ხელატური ნაერთების საფუძველზე მომზადებული პრემიქსით, ხოლო II საცდელი ჯგუფის - კლინოპტილოლითის და იმავე შემადგენლობის პრემიქსის კომპოზიციით. დაკვირვება მიმდინარეობდა ფრინველის განვითარებაზე, კვერცხდების ინტენსივობასა და კვერცხის ფიზიკურ თვისებებზე (ყვითრის, ცილის, ნაჭუჭის მასა და ა.შ.). ცნობილია, ერთი მხრივ, ამინომჟავების, კერძოდ, მეთიონინის, ხოლო მეორე მხრივ, ბიოლითონების როლი ფრინველთა და ცხოველთა კვებაში. ცხადია მეთიონინის და ბიოლითონების ერთდროულმა შემცველობამ ხელატურ ფორმაში უნდა განაპირობოს მათი ბიოლოგიური აქტივობის მკვეთრი ზრდა, ტოქსიკურობის შემცირება და შეთვისების მაღალი ხარისხი, რაც დადასტურდა ექსპერიმენტის შედეგად მიღებული მონაცემების ანალიზით. კერძოდ, დადგენილია, რომ I საცდელ ჯგუფში ცოცხალი მასის მატება 6,67%-ია, II საცდელ ჯგუფში - 7,33%-ია ხოლო საკონტროლოში - 5,13%. ფრინველის შენარჩუნებამ I სადელ ჯგუფში 93,75% შეადგინა, II საცდელ ჯგუფში - 93,75%, ხოლო საკონტროლო ჯგუფში - 81,30%. საკონტროლოსთან შედარებით ადგილი აქვს კვერცხმდებელი ფრინველის პროდუქტიულობის, კვერცხის დებადობის, ხარისხისა და ფიზიკური მაჩვენებლების (კვერცხის მასა, სიგრძე, სიგანე, ცილის მასა, ყვითრის მასა, ნაჭუჭის მასა და ა.შ.) ზრდას. მიღებული შედეგები განპირობებულია ბიოლითონების ხელატური ფორმით (I საცდელ ჯგუფი), მათი და კლინოპტილოლითის ერთდროული შემცველობით (II საცდელი ჯგუფი), რამაც უზრუნველყო ბიოლითონების უკეთ ათვისება და საცდელ ფრინველში ნივთიერებათა ცვლის გაუმჯობესება.

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