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The Influence of the Drug "Cercas" on the Intensity of Growing Broiler Chickens, Egg Production of Laying Hens and the Biophysical Properties of Eggs

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Abstract.

In the period of 2009-2014, LLC "Rudnichnoe" and LLC "Lipetsktptitsa" poultry farms had the studies conducted to consider the effect of various dosages of the "Cercas" silica-containing drug on the intensity of growth, the slaughter qualities of broiler chickens, the egg production of laying hens and the biophysical properties of eggs. It was found that this drug, when introduced into the diet, increased its usefulness and the digestibility of the main nutrients, resulting in the acceleration of live weight gain, improvement of the slaughter qualities of chickens, increase in the egg production and liveability of adult hens as well as in improvement of the biophysical properties of eggs.

The chickens of the experimental groups grew faster in comparison with the chickens of the control group: young chickens of the 1st test group – by 3.9%, of the 2nd test group – by 8.5% and of the 3rd test group – by 7.8%. With a slaughter yield of 72.6-72.9%, the yield of breast and thigh was higher by a reliable value in chickens of the 2nd and the 3rd test groups.

In laying hens that received a diet with silica-containing drug additives, in comparison with the hens of the control group, hen-housed and hen-day egg production was 1.6-4.6 and 1.6-3.9% higher, respectively. In the 3rd test group, in adult chickens that received the Cercas drug in addition to the main diet at a dose of 130 mg/kg of feed, the highest liveability (95.18%), hen-housed and hen-day egg production (312.17 and 327.98 eggs respectively), the average weight (65.71g) and the number of eggs of the highest and top categories (33.7%) were indicated. Feeding the "Cercas" drug contributed to an increase in the shell weight and density of eggs. In the 3rd test group, this figure was 1.089 g/cubic centimeter and was more than in the hens of the control group by 0.011 g/cubic centimeter ($P \geq 0.999$). The height of the egg white in the laying hens of the 2nd and the 3rd test groups was correspondingly higher than in the control group hens: in the 2nd test group it was 0.16 ($P \geq 0.95$), in the 3rd group – 0.37 mm ($P \geq 0.999$). The Haugh value in the 2nd and the 3rd test groups associated with the egg white height was also higher than in the control group by 0.6 and 0.8 units, respectively ($P \geq 0.99$). Studies have shown that when broilers were grown the most optimal dosage of Cercas was 110 mg/kg of feed, and 130 mg/kg of feed when feeding chickens.

Keywords: broiler chickens, laying hens, slaughtering qualities, egg production, egg density, Haugh units

INTRODUCTION.

The high genetic potential of modern crosses requires application of full-feed mixed fodders, balanced for all nutrients. This determines high productivity, effective use of feed, resistance to diseases when keeping poultry in industrial conditions. The actual task of improving the feeding technology in poultry farming is the development and introduction of functional feed additives into production.

Domestic poultry farming is offered a fairly extensive arsenal of biologically active substances, developed on the basis of silicon compounds, positively affecting the body of the bird, their digestive and immune systems. It is established that silicon is a part of all organs and tissues of animals and poultry. For example, the ashes of feathers contain it in an amount ranging from 40 to 70% depending on the age of the bird. This element takes an active part in calcification processes in the formation of bone tissue [1]. The relationship between the exchange of silicon, calcium and phosphorus has been established [2-3].

Experimental data obtained with the inclusion of biologically active additives containing silicon in the feed of broiler chickens and adult hens are rare, and therefore the study of the influence of the Cercas drug when fed in diets is relevant and of particular interest for science and production.

The biologically active additive 1-ethylsilatran-Cercas was developed and synthesized at the Laboratory of Biologically Active Substances of the Moscow State Research Institute of Chemistry and Technology of Organoelement Compounds and Flora-Si LLC [4-6]. The drug meets medical and biological requirements and sanitary standards for the quality of food raw materials and products: TU-6-05-02068737-001-94. The Cercas drug is registered in the State Committee of Standards of the Council of Ministers of the Russian Federation and is implemented on the basis of the Hygienic Certificate No. 19 NTs 03.970.t.15696.6 dated June 4, 1996.

The aim of the research was to study the intensity of growth and slaughter qualities of broiler chickens, the egg production and liveability of laying hens, as well as the biophysical properties of eggs.

In order to reach this goal, the following tasks were accomplished:

- when growing chickens from birth to 42-day old age, the intensity of growth, slaughter and meat qualities were studied;
- in studies on laying hens, the parameters of egg production and liveability, the biophysical properties of eggs and their distribution by categories were studied.
- optimal doses of feeding of the "Cercas" drug in the diets were determined for young and adult birds.

Table 1 – Experiment scheme

Groups	Number in group, chickens	Bird age on the beginning of test, days	Feeding peculiarities
Broiler chickens			
Control	50	1	Main diet (MD)
I-test	50	1	MD+100 mg Cercas/kg of feed
II-test	50	1	MD+110 mg Cercas/kg of feed
III–test	50	1	MD+120 mg Cercas/kg of feed
Laying hens			
Control	50	140	Main diet (MD)
I-test	50	140	MD+100 mg Cercas/kg of feed
II-test	50	140	MD+110 mg Cercas/kg of feed
III–test	50	140	MD+120 mg Cercas/kg of feed

CONDITIONS, MATERIAL AND METHODS

The research was carried out in production conditions of LLC Rudnichnoe and LLC Lipetskptitsa poultry farms of the Lipetsk Region in the period from 2009 to 2014 according to the following scheme (Table 1).

The experiment was carried out on clinically healthy birds by the method of groups. According to the principle of analogs and taking age and live weight into account, 4 groups of young and 4 groups of laying hens were formed with 50 heads in each group. In accordance with the age, the youngest of the control group received the main diet, the first experimental, the second, the third – 100, 110, 120 mg/kg of mixed "Cercas" fodder silicon supplements in addition to the basic diet. The adult poultry was fed 110,120 and 130 mg/kg of feed in the rations of experimental groups correspondingly.

Young hens were kept in cages. Poultry management conditions and microclimate indicators in all age periods for all groups were identical and corresponded to zootechnical norms. The hens were kept in BKN-3 cells. The temperature and light conditions were the same and corresponded to the cross standard. Hens were fed mixed fodders of domestic production in accordance with the norms of VNITIP [7].

In the course of the experiment, the following changes were taken into account: in young hens – changes in live weight depending on age, dynamics of gross, average daily and relative incremental gain, digestibility of essential nutrients in diets, usage of macro- and microelements. The optimal dosage of the drug used was also calculated. The liveability of the laying hens livestock and the reasons for their death were registered by a daily inspection of the birds; egg production was evaluated by daily counting of laid eggs in each group; the feed conversion ratio per the number of eggs was evaluated by daily counting during the period of the experiment; the category of eggs was evaluated in accordance with the requirements of GOST R 52121-2003 "Egg of brown crosses laying hens". Technical conditions.

Conventional techniques were used in order to determine the biophysical properties of eggs [8-9]. The quality of eggs was evaluated by the following indicators: the weight of eggs, of egg white, egg yolk and egg shell - by using electronic scales; index of the form - by the index meter; the ratio of white to yolk – by dividing the egg white weight by the egg yolk weight; the thickness of the shell - by a special sliding meter.

In order to determine the digestibility and usage of nutrient substances of mixed fodders and the degree of influence of the biologically active Cercas additive on them, balance experiments were carried out according to the VNITIP method and taking the mixed herd of birds into account [8].

The obtained digital material was processed by biometric methods [10] on a personal computer.

RESULTS AND DISCUSSION

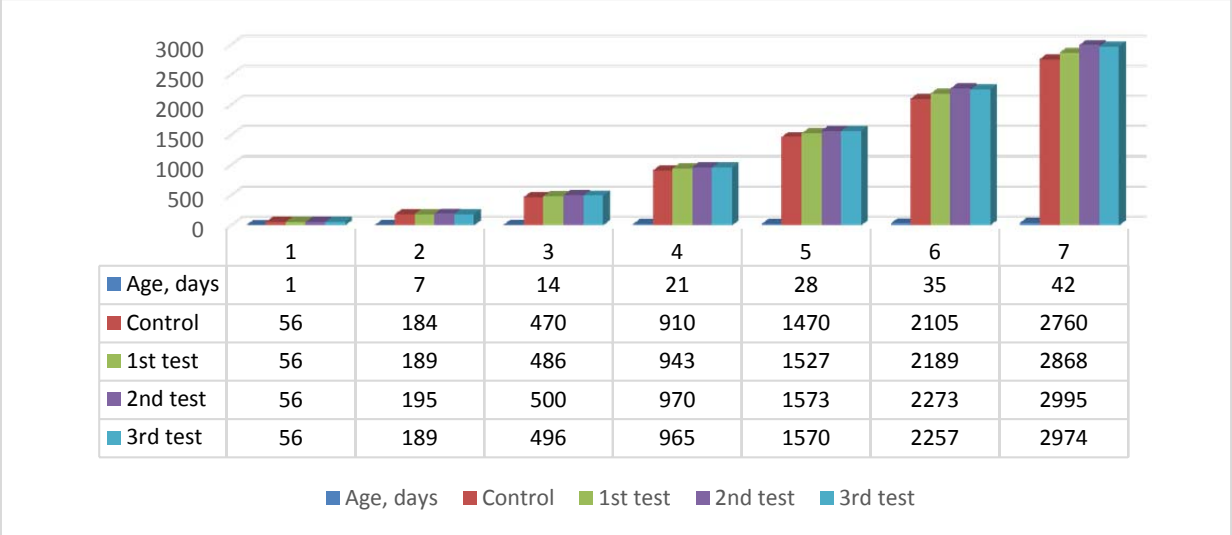
The data obtained in the experiment showed that different doses of Cercas did not affect the dynamics of the live weight and the gains of chickens. Changes in the live weight of chickens are presented in Fig. 1.

In the experimental groups, the average live weight at the end of the rearing was higher than in the control group analogs. The greatest increase in live weight was in the 2nd test group. Chickens surpassed their peers from other groups in this indicator: the control group chickens – by 8.5%; the 1st test group chickens – by 4.4% and 3rd test group – by 0.7%.

The chickens of the test groups who were treated with the Cercas drug used the feed better than their counterparts in the control group.

It can be seen in Fig. 2 that the feed consumption increases with age and, accordingly, the feed conversion per 1 kg of live weight gain increases as well. A significant advantage of using feed by chickens of test groups in comparison with those of the control group was found. From the age of fourteen days, the offspring of the test groups used their food more economically. The chickens of the 2nd test group were the most efficient consumers receiving the "Cercas" supplement in the dose of 110 mg/kg of feed in addition to the main diet.

The control slaughter data (Table 2) showed that the offspring of the test groups had a higher live weight before slaughter in comparison with the birds of the control group, and in the 2nd test group the advantage reached 233 g ($P \geq 0.99$). The same tendency was noted for the weight of gutted carcass and slaughter yield.



	1	2	3	4	5	6	7
Age, days	1	7	14	21	28	35	42
Control	56	184	470	910	1470	2105	2760
1st test	56	189	486	943	1527	2189	2868
2nd test	56	195	500	970	1573	2273	2995
3rd test	56	189	496	965	1570	2257	2974

Figure 1 – Change in live weight of broiler chickens

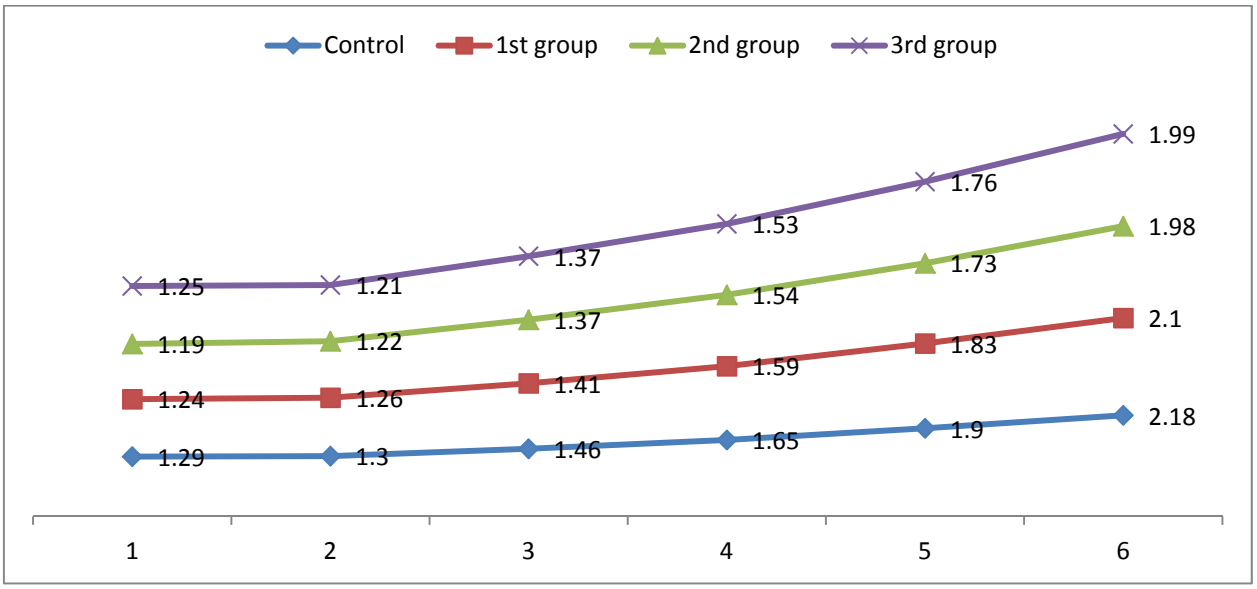


Figure 2 – Feed conversion rate per 1 kg of live weight gain, kg

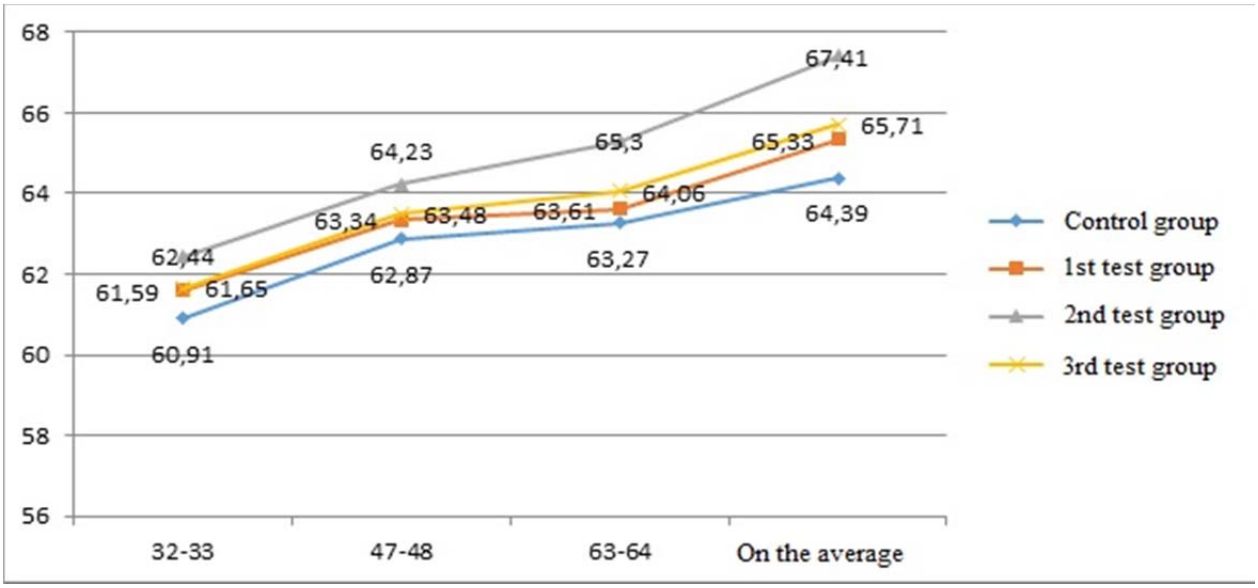


Fig. 3 – Average weight of eggs in laying hens depending on age

Table 2 – Slaughter qualities of broiler chickens

Indicators	Sex	Groups			
		control	1st test	2nd test	3rd test
Live weight, g	Males	2,910.1±15.98	3,018.6±11.24	3,145.7±17.5	3,124.8±17.5
	Females	2,610.3±14.4	2,718.4±11.93	2,845.5±18.1	2,824.6±18.0
	Average	2,760.2±67.7	2,868.5±67.5	2,995.6±68.1	2,974.7±68.0
Live weight before slaughter, g	Males	2,881.03±15.82	2,988.4±11.13	3,114.24±17.3	3,093.55±17.32
	Females	2,584.2±14.2	2,691.2±11.81	2,817.04±17.9	2,796.36±17.86
	Average	2,732.6±67.05	2,839.8±66.86	2,965.64±67.38	2,945.0±67.37
Drawn carcass weight, g	Males	2,100.4±11.75	2,179.57±8.69	2,277.67±16.67	2,257.57±13.4
	Females	1,866.1±11.8	1,944.33±6.33	2,047.63±14.5	2,023.65±14.4
	Average	1,983.25±52.92	2,061.95 ±52.94	2,162.65**±52.19	2,140.61*±53.04
Slaughter yield, %	Males	72.9±0.048	72.93±0.05	73.14±0.049	72.98±0.049
	Females	72.21±0.058	72.25±0.055	72.69±0.055	72.37±0.055
	Average	72.56±0.16	72.59±0.16	72.91±0.11	72.67±0.14

* – P≥0.95; ** – P≥0.99

Table 3 – Results of broiler chicken carcasses cutting

Groups	Sex	Broiler chicken carcasses cutting					
		Breast		thighs		drumsticks	
		g	%	g	%	g	%
Control	Males	635.0±4.42	21.82±0.032	378.62±3.01	13.01±0.032	295.39±2.7	10.15±0.038
	Females	587.41±3.91	22.5±0.027	347.3±2.66	13.3±0.029	245.12±2.33	9.39±0.038
	Average	611.21±10.96	22.16±0.15	362.94±7.24	13.16±0.07	270.26±11.35	9.77±0.17
1st test	Males	663±3.52	21.96±0.035	394.44±2.54	13.07±0.037	307.30±2.1	10.18±0.032
	Females	614.37±3.73	22.6±0.04	362.46±2.53	13.33±0.035	258.46±1.48	9.41±0.043
	Average	638.68±11.10	22.28±0.14	378.45±7.3	13.2±0.064	282.88±11.0	9.80±0.17
2nd test	Males	694.37±5.04	22.07±0.04	413.05±3.62	13.13±0.045	320.57±2.86	10.19±0.035
	Females	643.38±4.88	22.61±0.035	379.70±3.34	13.34±0.035	268.06±2.82	9.42±0.04
	Average	668.88±11.83**	22.34±0.12	396.37±7.78*	13.24±0.054	294.32±11.88	9.81±0.17
3rd test	Males	688.82±4.85	22.04±0.032	409.67±3.43	13.11±0.04	318.12±2.68	10.18±0.029
	Females	638.37±4.69	22.60±0.03	374.29±3.75	13.33±0.035	265.81±2.64	9.41±0.035
	Average	663.59±11.67*	22.32±0.2	391.98±8.23*	13.22±0.055	291.96±11.82	9.8±0.17

* – P≥0.95; ** – P≥0.99

Table 4 – Egg productivity of laying hens for the entire experiment period

Indicators	Groups			
	control	1st test	2nd test	3rd test
Actual number of feed days	17,265	17,268	17,290	17,370
Liveability, %	94.60	94.62	94.74	95.18
Gross collection of eggs, pieces	14,929	15,167	15,315	15,609
On the initial laying hen, pieces	298.57	303.34	306.29	312.17
On the average laying hen, pieces	315.61	320.59	323.30	327.98
Intensity of egg production, %	86.46±1.96	87.83±1.95	88.57 ± 1.93	89.86±1.86

Table 5 – Main biophysical properties of 63-64-week-old laying hens' eggs

Indicators	Control	1st test	2nd test	3rd test
Egg weight, g	62.14±0.52	63.92±0.55	65.18±0.59**	67.28±0.62***
Egg white height, mm	7.09±0.040	7.18±0.031	7.25±0.039*	7.46±0.041***
Haugh unit	84.2±0.29	84.4±0.35	84.6±0.34	85.0±0.24*
Egg density,g/cubic centimeter	1.078±0.0014	1.079±0.0016	1.082±0.0019	1.089±0.0015***
Form index, %	74.4±0.42	75.6±0.43	75.9±0.44	76.2±0.43
Shell weight, g	6.65±0.12	7.13±0.13*	7.13±0.14*	7.30±0.12**
% of the egg weight	10.70	11.15	10.94	10.85
Egg yolk weight, g	19.41± 0.39	19.86 ± 0.33	20.52± 0.40	21.11± 0.48*
% of the egg weight	31.24	31.07	31.48	31.38
Egg white weight, g	36.08±0.31	36.93 ±0.41	37.53±0.4*	38.87±0.47**
% of the egg weight	58.06	57.78	57.58	57.77
Egg white to egg yolk proportion	1.859	1.860	1.829	1.841
Shell thickness, mm	0.352±0.0022	0.359±0.0032	0.368±0.0025*	0.375±0.0032***

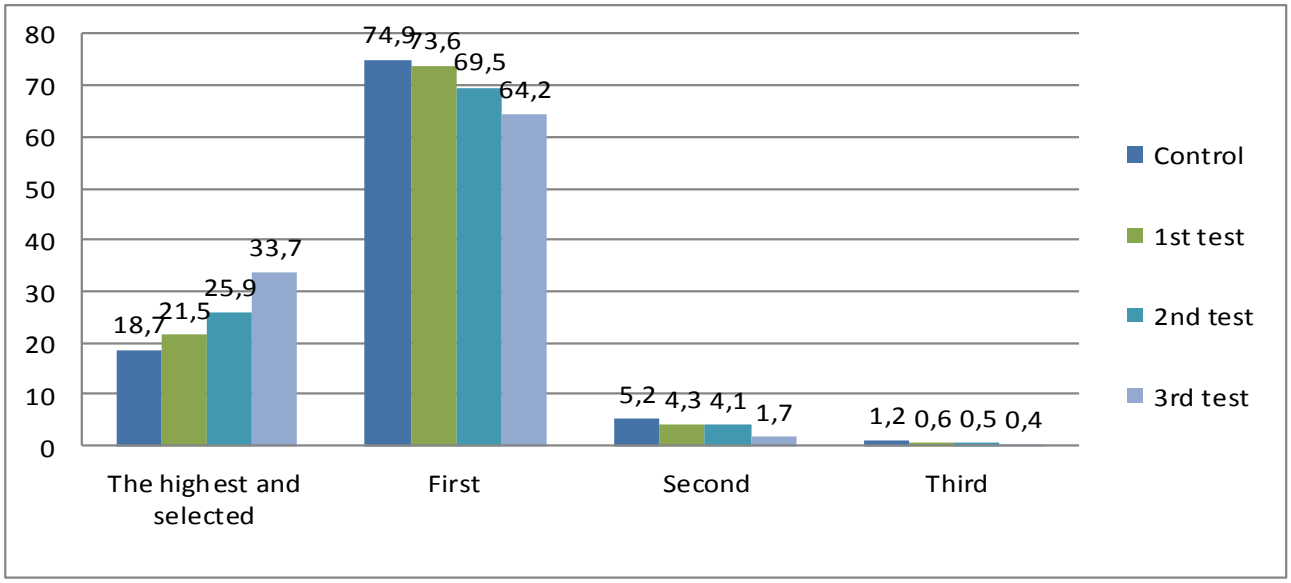
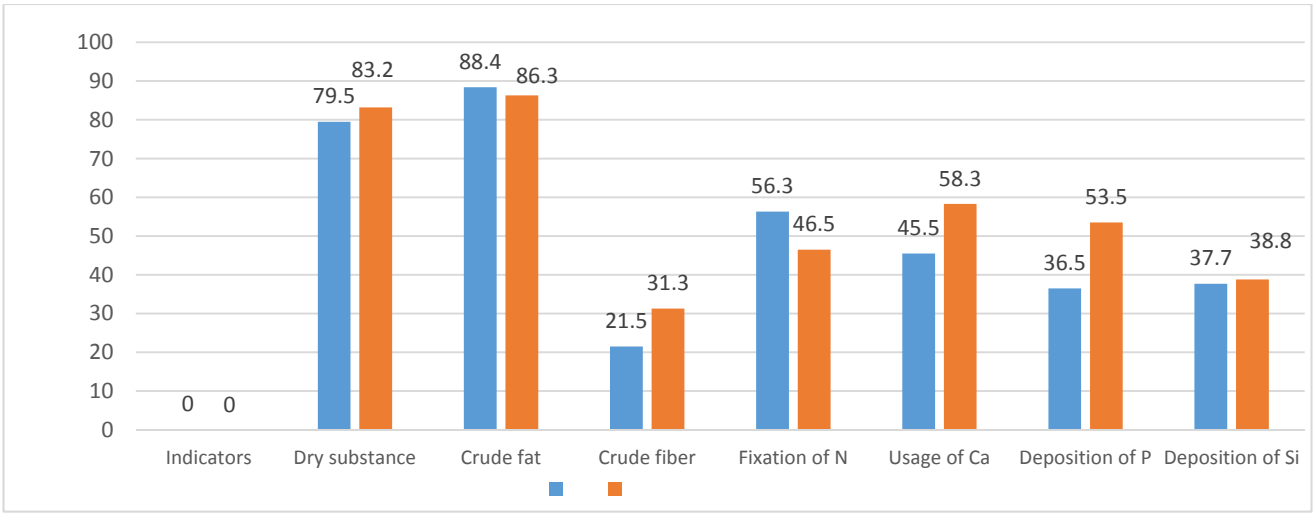


Fig. 4 – Distribution of eggs of laying hens by categories, %



Note: the 1st column – broilers (daily supply of the drug – 110 mg/feed); the 2nd column – laying hens (daily supply of the drug – 130 mg/kg of feed)

Fig. 5 – Digestibility of nutrients and the use of mineral substances in rations by a bird

By the weight of gutted carcass, the chickens of test groups exceeded their peers of the control group. The differences between the broilers of the 2nd test and control group were also significant (P≥0.99). The slaughter yield was higher in the experimental groups, mainly due to their better growth intensity. It should also be noted that the studied indicators were higher in males. The 2nd test group of chickens receiving the "Cercas" biopreparation in the amount of 110 mg/kg of feed also stood out.

When cutting broiler chicken carcasses, it was established (Table 3) that on average by weight of the batch portions (breasts, thighs and drumsticks) the test group chicks outscored their control group analogs. The differences in the weight of the breast compared to the control were as follows: in chickens of the 1st test group – 27.47 g; 2nd test – 57.67 g (P≥0.99); 3rd test – 52.38 g (P≥0.95); the weight of the thigh was higher by 15.51 g; 33.43 g (P≥0.99); 29.04 g (P≥0.99), respectively.

The average intensity of egg production was higher in the test groups compared to the control group birds over 12 months: in the 1st test group, by 1.37%; in the 2nd test – by 2.11%, and 3rd test group – by 3.4% (Table 4).

The gross egg productivity in groups was determined by the liveability of birds, i.e. the number of fodder days and egg production. The largest total collection of eggs was observed in laying hens of the 3rd test group – 15,609 pieces, or, respectively, 105 units higher than in the control group, 102 pieces higher than in the 1st test and 120 pieces higher than in the 2nd test group. In this group, the bird liveability was 95.18% higher than that of the control, the 1st and the 2nd test groups. Due to better liveability of the test groups birds and better egg collection, both hen-housed and hen-day egg production was also higher. So, in comparison with the control, these indicators were higher: in the 1st test group, respectively, by 4.77 and 4.98 pieces;

in the 2nd test group – by 7.72 and 7.69 pieces; in the 3rd test group – by 13.6 and 12.37 pieces. A similar trend was observed in the egg production average intensity, which increased from the control to the 3rd test group.

In all periods of the experiment, the laying hens of the test groups exceeded their analogues of the control group in the weight of eggs (Fig. 3). At the beginning of the experiment, the laying hens of the 1st test group showed an increase by 1.96 g in comparison with the control; of the 2nd test group – by 2.36 g (P≥0.99); of the 3rd test group – by 3.48 g (P≥0.999). The weight of eggs in laying hens increased with age and reached a maximum at 63-64 weeks of age, with an increase in the control group reaching 2.51%; in the 1st test group - 2.2%; in the 2nd test group – 3.2%, and in the 3rd test group – 4.69%. On average, the highest eggs' weight was recorded in chickens of the 3rd test group – 65.71 g.

The quality of eggs was examined in chickens at 63-64 weeks of age (Table 5). It was found that the height of the egg white in eggs in the laying hens of the 2nd test and the 3rd test groups was correspondingly higher than in the hens of the control group: in the 2nd test group it was 0.16 mm higher (P ≥0.95), in the 3rd test group – 0.37 mm (P≥0.999) higher. Hence, the Haugh value in the 2nd test and the 3rd test groups associated with the height of the egg white was also higher than in the control group by 0.6 and 0.8 units (P≥0.99), respectively. This indicator is important, because when the egg white density increases, the content of essential amino acids increases in it and taste qualities are improved.

It should be emphasized that the feeding of the "Cercas" drug contributed to an increase in the weight of the shell in the test groups: by 0.48 g (P≥0.95) in the 1st test and the 2nd test groups and by 0.65 g (P ≥0.99) in the 3rd test group. This pattern was also noted in the density of eggs. In the 3rd test group, this figure was 1.089 g/cubic centimeter and was greater than in the birds of the control group by 0.011 g/cubic centimeter (P≥0.999). The density of eggs was interrelated with the thickness of the shell, which was higher by 0.016 mm (P≥0.95) and 0.023 mm (P≥ 0.999) than in the control group in poultry eggs of the 2nd test and the 3rd test groups, respectively.

The inclusion of "Cercas" into the diets contributed to a better ratio of eggs by categories in the test groups (Fig. 4).

Thus, there were more eggs of higher and selected categories in comparison with the chickens of the control group: by 2.8% in the 1st test group; by 7.2% in the 2nd test group and by 15% in the 3rd test group. The decrease in the number of eggs of the remaining categories was the following: for the first category – from 74.9% to 64.2%; for the second category – from 5.2% to 1.7%; for the third category – from 1.2% to 0.4%.

Such results of the intensive gain of live and slaughter weight, high conversion of broiler feed, increase in egg production and improvement of the quality of laying hens production had been confirmed by higher digestibility of the main nutrients and the usage of mineral substances in diets. The analysis of balance experiments showed that upon adding the "Cercas" drug into the diet more effective digestion of dry matter, raw fat, crude fiber, assimilation of nitrogen, usage of calcium, deposition of phosphorus and silicon took place (Fig. 5)

CONCLUSION

Thus, the best results on the energy of gaining live and slaughter weight and the yield of the most valuable cuts in carcasses for broilers were obtained in the 2nd test group, where the Cercas drug was administered in a basic diet in a dose of 110 mg/kg of feed. 100% liveability was noted in all groups of chickens. In the experimental groups of laying hens that received this drug in addition to the main diet, the hen-day egg production was higher than in the control group by 1.57-3.92%, the yield of egg weight was 5.13-11.64% higher than in the control group, the intensity of egg production was 1.3-3.4% higher as well as the stock liveability. The feed conversion ratio per 10 eggs was the lowest in the test groups (1.37-1.34 kg vs. 1.39 kg in the control group). The greatest advantage in these indicators was in the 3rd test group, where the "Cercas" drug in a dose of 130 mg/kg of feed was included into the laying hens' diet.

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