

# Productivity and quality of broiler chicken meat with the use of preparations “Apex” and “Emicidin”

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**Abstract**–The article is devoted to solving a relevant problem - increasing the efficiency of industrial production of broiler chicken meat. The aim of the study was to study the effect of environmentally friendly products "Emicidin" and "Apex 3010" on the productivity of broiler chickens under the conditions of industrial technology of their farming. In the process of carrying out scientific and business experience modern zootechnical, biochemical and statistical research methods were used. In the experimental studies, the prospect of using natural growth supplements “Apex 3010” and the antioxidant “Emicidin” in the broiler poultry industry has been established, which make it possible to increase the productivity, preservation, meat quality of carcasses and broiler chicken meat. The inclusion of "Emicidin" and "Apex 3010" in the floor-growing technology of broiler chickens of the cross “Ross-308” contributed to a decrease in the fat content of poultry meat, which increased the dietary properties of the food product and its compliance with the biological requirements for dietary nutrition. The obtained new data expand the understanding of the role of antioxidants and natural food supplements in the technology of industrial production of broiler meat.

**Keywords** – broiler chickens, biologically active supplements, antioxidants, productivity, meat quality of carcasses, meat quality.

## I. INTRODUCTION

The priority task of the Federal Scientific and Technical Program for the Development of Agriculture for 2017–2025 is the creation and introduction of competitive technologies for the production of animal products, high-quality feed, food supplements for animals and poultry. A significant contribution to the solution of this problem is made by the poultry industry, especially specialized enterprises for the production of broiler meat [1].

Conditions and feeding are very important for the realization of the genetic potential of the poultry productivity, increase its livability, improvement of the meat quality, in particular, the use of various dietary supplements in the technology of rearing young animals (probiotics, prebiotics, synbiotics, phytobiotics, antioxidants, enzymes, natural growth supplements, adsorbents, etc.) [2, 3, 4, 5].

Currently, a lot of studies are being conducted on the development and widespread use of environmentally safe biologics in the industrial poultry farming, which will eventually replace antibiotics and chemicals. However, research results are often controversial and do not meet the

needs of practice. This predetermined the relevance of the research topic.

## II. LITERATURE REVIEW

At present one of the ways to solve the problem of biological protection of animals and providing population with high-quality food is the development, production and use of new ecobiotechnological preparations, which include probiotics, prebiotics, synbiotics, phytobiotics, antioxidants. They play a leading role in replacing feed antibiotics in poultry diets. Nowadays it is difficult to imagine modern technology of growing broiler chickens without the use of food supplements [6, 7, 8]. In this regard it is necessary to search for new types of food supplements instead of feed antibiotics, which increase livability and growth energy of young birds and productive and reproductive qualities of adult birds.

Scientific research and practical experience show that one of the real prospects for solving this problem is the rational use of natural food supplements (growth stimulants) and antioxidants at different stages of the broiler meat production process [7, 8, 9, 10]. The inclusion of environmentally friendly food supplements in the technology of growing broiler chickens is the most promising way to improve the productivity, livability of poultry, as well as meat quality.

Much attention and interest is paid now to the use of natural herbs, medicinal plants and spices as food supplements in the diets of chickens representing an alternative to antibiotics as growth stimulants to increase their potential productivity. Natural herbal supplements in poultry rations can be used to enhance antioxidant mechanisms and reduce the intensity of oxidative processes that affect negatively the quality of products — meat and eggs [4,10].

It was established that the inclusion of the composition of biologically active substances from oak bark extract (*Quercus cortex*) into the diet of broiler chickens of the cross “Smena-8” contributed to maintaining the productivity and strengthening of the immune modulating state of the body [11].

Allicin is believed to be the main biologically active compound found in the garlic extract or in the raw garlic homogenate. The body's response to these biologically active compounds manifests itself in the form of reducing the

occurrence of cardiovascular diseases, stimulating the immune system, protecting the liver, antimicrobial, anti-inflammatory and antioxidant activity [12].

Special interest for the poultry industry is raised by the drugs with a wide spectrum of actions, including natural growth stimulants and antioxidants, which could increase natural resistance, livability and productivity of broiler chickens and do not affect the quality of meat and meat products negatively. These drugs, in our opinion, include the antioxidant "Emicidin" and the natural growth stimulant "Apex 3010".

"Emicidin" is a water-soluble antioxidant of the new generation. "Emicidin" is a derivative of 3-hydroxypyridine and succinic acid. It possesses antioxidant and antihypoxic properties, has a therapeutic and prophylactic effect during hypoxia and increases the body's resistance to oxygen deficiency [7].

"Apex" is a natural herbal flavor food supplement, a natural growth stimulant, used as an alternative to antibiotics. The effect of the drug on the body of a bird is caused by the synergism of its constituent components. One of the ingredients is garlic allicin, isolated from special varieties of garlic. Plant extracts that are part of "Apex" have antioxidant properties, which leads to a decrease in the incidence of cardiovascular diseases, ascites, hepatosis, and problems associated with low reproductive ability [8].

Considering the importance of increasing productivity, livability of broiler chickens and obtaining full-value, ecologically safe food, it became necessary to study the effectiveness of using the antioxidant "Emicidin and the natural food supplement "Apex 3010" as food supplements.

### III. METHODOLOGY AND RESEARCH METHODS

The experimental and methodical part of the work was done at the Department of small animal science and farm animal breeding of the Orel state agrarian university, as well as under the production conditions of the JVC "Poultry Production Factory" of the JSC of the APC "Orel Niva". The experimental studies were carried out in accordance with the method of the All-Russian scientific research and technological institute of poultry farming (ARSRTIPF) [13].

Experimental groups of the non gender-segregated cross "Ross-308" of broiler chickens, selected according to the analogue group method, were grown from daily to 38-day-old on the deep litter, following the technological parameters

corresponding to the recommendations for growing broiler chickens of the cross "Ross-308". The broiler chickens of the control group, as well as the 1st, 2nd and 3rd experimental groups were fed with complete feed according to the norms of the Federal scientific center (FSC) of the ARSRTIPF of the Russian academy of science (RAS).

Broiler chickens of the 1st experimental group were fed with the preparation "Emicidin" with water in a dose of 2.5 mg per 1 kg of live weight once a day, starting from the daily age till 14 days.

Broiler chickens of the 2nd experimental group were given food supplement "Apex 3010" to their compound feed in a preventive dose of 150 g/t of feed all the time.

Broiler chickens of the 3rd experimental group were given "Apex 3010" as a food supplement with compound feed at a preventive dose of 150 g/t of feed constantly and the preparation "Emicidin" was given at a dose of 2.5 mg per 1 kg of live weight once a day, starting from the daily age till 14 days.

The experimental data obtained in the course of the research were processed with the method of variation statistics [14, 15] on a personal computer using Microsoft Excel (2003), including the calculation of the mean value (M), arithmetic mean error (m). The evaluation of the reliability of differences between the arithmetic mean value was carried out by Student t-test within the following levels of significance: \*  $P < 0.05$ ; \*\*  $P < 0.01$ ; \*\*\*  $P < 0.01$ .

### IV. RESULTS OF THE RESEARCH

The data on a comparative evaluation of the effectiveness of the use of the preparations "Apex 3010" and "Emicidin" individually and in the combination with the industrial broiler chickens farming of the cross "Ross-308" are presented in Table 1.

The results of the research showed that when using the studied preparations, the live weight of a bird increased in experimental group 1 by 4.1% ( $P < 0.05$ ) in experimental group 2 by 5.5% ( $P < 0.01$ ) and in experimental group 3 by 8.2% ( $P < 0.001$ ) compared with the control group. It should be noted that the live weight of broiler chickens from the experimental group 3 was higher by 3.9% ( $P < 0.05$ ) than in the experimental group 1, and also exceeded the live weight of the analogues from the experimental group 2 by 2.54%, but the difference was not statistically significant.

TABLE I. ZOOTECHNICAL INDICATORS OF BROILER CHICKENS (AGE - 38 DAYS;  $M \pm m$ ;  $N = 70$ )

Indicator	Group			
	control	1 - experiment	2 - experiment	3-experiment
Initial poultry population, heads	70	70	70	70
Duration of broiler farming, days	38	38	38	38
Average live weight of a daily chicken, g	41,1±0,10	41,2±0,13	41,0±0,11	41,3±0,09
Average live weight of 1 broiler at the age of 38 days old (average), g	2142,5±27,10	2230,0±25,61*	2260,2±24,20**	2317,5±23,92***
incl.. cockerel chicks (average)	2297,6±21,51	2379,1±22,72*	2398,9±20,93**	2446,4±19,66***
female chickens (average)	1987,4±28,12	2085,3±25,78*	2125,6±31,63**	2188,6±24,94***
Live weight of 1 head at the end of farming (arithmetical mean), g	2142,5	2232,2	2262,3	2317,5
Livability of broilers, %	94,3	95,7	95,7	97,1
Population at the end of the experiment	66	67	67	68
incl.. cockerel chicks (average)	33	33	33	34
female chickens (average)	33	34	34	34
Daily live weight gain, g	55,3	57,6	58,4	59,9
Feed expenses per 1 kg of live weight gain, kg	1,76	1,74	1,72	1,70
European productivity index, un..	302	323	331	348

<sup>a</sup> \*  $P < 0,05$ ; \*\* $P < 0,01$ ; \*\*\* $P < 0,001$

At the end of the experiment, at the age of 38 days old, when chickens were divided depending on their gender, an increase in body weight was observed when the preparations were given both to the cockerel chicks and female chickens. It should be noted that the use of the preparation "Apex 3010" and "Emicidin" separately and in the combination with each other, had a greater impact on the live weight of the female chickens than of the cockerels. The highest live weight of the chickens was in the experimental group 3 - 2188.6 g, which was 10.1% ( $P < 0.001$ ) higher than in the control group. The live weight of the males in the experimental group 3 at the end of the farming reached 2446.4 g, which was 6.5% ( $P < 0.001$ ) higher compared to the control group.

The average daily increase in live weight of broilers in the experimental groups 1, 2 and 3 was higher than in the control group by 4.2%, 5.5% and 8.3%, respectively. Throughout the experimental period, the livability of chickens in the experimental groups was high. At the end of the farming, this indicator in the experimental groups 1 and 2 was 95.7%, it was 97.1% in the experimental group 3, and it was 94.3% in the control group. The lowest feed costs per unit of production were in the experimental group 3, that was 1.70 kg, which was less than the control group by 0.06

kg or 3.4%. For a comprehensive assessment of the productive qualities of broiler chickens, the European productivity index was calculated, which was the highest in experimental group 3 and amounted 348 units, which was 46 units. (15.2%) higher than in control group.

Thus, we can note the positive impact of the preparations "Emicidin" and "Apex 3010" on the zootechnical indicators of floor farming of broiler chickens of the cross "Ross-308". At the same time, the best results on the main indicators of the productivity of broiler chickens were achieved in experimental group 3, where a complex scheme of using these food supplements was used.

To determine the meat quality of broilers, anatomical cutting (boning) of dressed chickens was carried out using the methodology developed by the specialists of the ARSTIPF [13].

When evaluating the meat qualities of carcasses, a statistically significant difference was found in favor of the broilers of experimental groups 1, 2, 3, which surpassed their herdmates from the control group in the eviscerated carcass weight by 4.6% ( $P < 0.05$ ), 6.1% ( $P < 0.01$ ) and 9.2% ( $P < 0.001$ ), respectively (Table 2).

TABLE II. MEAT QUALITY BROILER CARCASSES (AGE - 38 DAYS OLD;  $M \pm M$ ;  $N = 6: 3 \text{ ♀}$  AND  $3 \text{ ♂}$ )

Indicator	Group			
	<i>control</i>	<i>1 – experimen-tal</i>	<i>2 – experimen-tal</i>	<i>3-experimen-tal</i>
Eviscerated carcass weight, g	1552,80±16,84	1623,50±15,69*	1648,10±14,13**	1696,30±11,98***
Edible part of carcass, g	1219,88±15,16	1286,30±14,87*	1309,42±13,94**	1357,21±10,15***
Inedible part of carcass, g	332,92±4,12	337,20±3,56	338,68±3,19	339,09±2,99
Yield of edible parts to the eviscerated carcass weight, %	78,56	79,23	79,45	80,01
Yield of inedible parts to the eviscerated carcass weight, %	21,44	20,77	20,55	19,99
Correlation of edible parts to inedible ones	3,66	3,81	3,87	4,00
Muscles weight, g	981,99±13,72	1040,83±12,85*	1065,99±12,18**	1114,81±9,79***
incl. pectoral	421,36±6,23	443,37±5,89*	450,41±5,32**	467,12±4,65***
Yield of muscles to eviscerated carcass weight, %	63,24	64,11	64,68	65,72
Yield of pectorals to eviscerated carcass weight	27,14	27,31	27,33	27,54
Bone weight, g	313,78±3,28	318,42±2,97	320,23±2,86	322,81±2,58
Yield of bones to eviscerated carcass weight, %	20,21	19,61	19,43	19,03
Correlation of muscles weight to bones weight	3,13	3,27	3,33	3,45
Weight of skin with basting fat, g	214,99±3,01	223,62±2,76	222,45±2,44	222,76±2,13
Yield of skin to eviscerated carcass weight, %	13,85	13,77	13,50	13,13
Internal fat weight, g	22,90±0,71	21,85±0,58	20,98±0,63	19,64±0,85*
Yield of basting fat to eviscerated carcass weight, %	1,47	1,35	1,27	1,16

b. \*  $P < 0,05$ ; \*\* $P < 0,01$ ; \*\*\* $P < 0,001$

A significant increase in muscle weight was observed in the experimental groups compared to the control: by 6.3% ( $P < 0.05$ ) in the experimental group 1; by 8.6% ( $P < 0.01$ ) in the experimental group 2 and by 13.5% ( $P < 0.001$ ) in the experimental group 3, respectively. The yield of all muscles in broiler carcasses was the highest 65.72% in group 3, and according to this indicator it was 2.48% higher than the control group and other experimental groups by 1.04-1.61%.

What concerns the most valuable part of the carcass - the pectoral muscles- a similar tendency was observed; the highest indicator was obtained in the experimental group 3 and amounted to 467.12 g, which was 10.6% higher than the control group ( $P < 0.001$ ).

The yield of edible parts in broiler carcasses in the control group was 78.56%, in the experimental group 1 it was 79.23%, in the experimental group 2 it was 79.45%, and the highest one was 80.01% in the experimental group 3. Consequently, the yield of edible parts in broiler carcasses in the experimental groups was 0.67 - 1.45% higher than in the control group.

The highest ratio of the weight of edible and inedible parts of the carcass was observed in experimental group 3 and amounted to 4.0.

The yield of skin with basting fat was 13.85% in the broiler carcasses of the control group, , and in the

experimental groups 1, 2 and 3, it was equal to 13.77%, 13.50% and 13.13%. It should be noted that too high content of skin with basting fat in the carcasses of broiler chickens affects negatively the meat qualities.

An important indicator characterizing the meat quality of a carcass is the content of internal (abdominal) fat, since its presence on the internal organs leads to losses during cooking and decrease in consumer demand. In our studies, the content of internal fat in carcasses was low (1.16 - 1.43%), and when "Emitsidin" and "Apex 3010" were used in the experimental groups, it tended to decrease.

In general, the best meat qualities of carcasses were noted in the experimental group 3, where the mode of combined application of the antioxidant "Emicidin" and the food supplement "Apex 3010" were used for broiler farming.

One of the factors determining the effect of "Emicidin" and "Apex 3010" on the functional state of the body of broiler chickens is to control the development of their internal organs. For this purpose separate internals and gastric cecum after anatomical boning of carcasses were taken and weighed in each experimental group (3 heads of females and 3 of males, 6 heads all in all) (Table 3).

TABLE III. WEIGHT OF INTERNALS OF BROILER CHICKENS, G (AGE - 38 DAYS OLD; M ± M; N = 6: 3 ♀ AND 3 ♂)

Indica-tor	Group			
	control	1- experimen-tal	2 -experimen-tal	3 - experimental
Live weight, t	2143,8±34,91	2233,1±35,88	2262,9±37,12*	2320,1±36,98**
Heart, t	10,73±0,44	11,44±0,39	11,57±0,50	12,06±0,51
% of live weight	0,50	0,51	0,51	0,52
Liver, t	41,13±0,76	43,63±0,69*	44,08±0,59*	45,75±0,74**
% of live weight	1,92	1,95	1,95	1,97
Lungse	12,49±0,57	13,52±0,62	13,95±0,59	14,08±0,67
% of live weight	0,58	0,61	0,62	0,61
Kidneys	8,91±0,63	9,51±0,67	9,78±0,71	10,13±0,59
% of live weight	0,42	0,43	0,43	0,44
Gizzard stomach (without content and lining) g	31,83±0,75	33,27±0,69	34,53±0,71*	35,69±0,68**
% of live weight	1,48	1,49	1,53	1,54
Gastric cecum	9,77±0,59	10,44±0,77	11,12±0,42	12,01±0,53*
% of live weight	0,46	0,47	0,49	0,52

c. \* P < 0,05; \*\*P<0,01; \*\*\*P<0,001

It was established that the use of preparation "Emicidin" and food supplement "Apex 3010" did not have a statistically significant effect on the weight of a heart, although it tended to increase in the experimental groups of chickens. The intensity of metabolic processes in the body of broilers can be judged to a certain extent by the development of the liver. The liver weight of the chickens in the experimental groups 1, 2 and 3 was higher than in control group by 6.1% ( $P < 0.05$ ), 7.2% ( $P < 0.05$ ) and 11.2%

( $P < 0.01$ ) respectively. There were no significant differences in the absolute and relative weight of the lungs and kidneys between the studied groups of chickens. The use of "Apex 3010" both separately and in combination with "Emicidin" contributed to an increase in the weight of the gizzard stomach and gastric cecum of broilers in experimental groups 2 and 3 by 8.5% ( $P < 0.05$ ); 13.8% and 12.1% ( $P < 0.01$ ); 22.9% ( $P < 0.05$ ) respectively compared to the control group.

It should be noted that the weight of the internals in relation to the body weight (relative weight) varied slightly in all experimental groups. The weight of the gastric cecum of chickens in experimental group 3 had a visible increase compared to the control group. This is important, since the gastric cecum by birds are the only place where the fiber is digested plant components of feed for broilers.

The higher the relative mass of the internals, provided a healthy bird is used, the more intensive the physiological processes in its body proceed. In our research, the studied preparations did not have a side effect on the poultry organism. The changes of the physiological indicators of growth and development of broiler chickens of the cross "Ross-308" and their internal organs were within the limits of the norms corresponding to the age and cross of the bird. The analysis of the location of organs, their size, color and consistency indicates the absence of pathological changes.

Thus, the productivity, meat quality of carcasses and the development of the internal organs indicate a more intensive metabolism and mobilization of the body's internal reserves in broiler chickens from the experimental groups that received preparations "Emicidin" and "Apex 3010" additionally to their diet.

The meat productivity of broiler chickens and the quality of the products obtained depend to a great extent on the feeding and stockkeeping. In this regard, for a comprehensive assessment of the impact of "Emicidin" and "Apex 3010" on broiler meat productivity, an analysis of the chemical composition of muscle tissue was carried out. The results of the analysis are presented in Table 4.

It was defined that when using "Emicidin" and "Apex 3010" in the technology of broiler chickens farming, there was a tendency to increase the level of protein in the pectoral and femoral muscles in all the experimental groups. The highest protein content in the pectoral and femoral muscles of broilers was observed in the experimental group 3, it was 22.35% and 19.04% respectively. However, the difference in this indicator between the groups was not statistically significant.

TABLE IV. THE CHEMICAL COMPOSITION OF THE MUSCLES OF BROILER CHICKENS, % (AGE - 38 DAYS OLD; M ± M; N = 6: 3 ♀ AND 3 ♂)

Indicator	Group			
	control	1- experimental	2 - experimental	3 - experimental
Pectoral muscles				
Moisture	75,38±0,64	75,30±0,61	75,12±0,71	74,97±0,68
Protein	21,70±0,36	21,90±0,32	22,09±0,41	22,35±0,39
Fat	1,28±0,06	1,20±0,11	1,11±0,08	1,06±0,07*
Leach	1,14±0,03	1,10±0,05	1,09±0,06	1,12±0,04
Femoral muscles				
Moisture	76,59±0,47	76,46±0,65	76,50±0,54	75,96±0,56
Protein	18,11±0,34	18,36±0,42	18,41±0,38	19,04±0,49
Fat	3,98±0,09	3,87±0,10	3,79±0,12	3,71±0,08*
Leach	1,02±0,06	1,01±0,08	1,00±0,09	0,99±0,08

d. \* P < 0,05; \*\*P<0,01; \*\*\*P<0,001

The fat content in the pectoral and femoral muscles of broilers in all experimental groups was low and amounted to 1.06 - 1.28% and 3.71 - 3.98%, respectively. In the pectoral muscles of the broilers of experimental group 3, the fat content was 0.22% (P<0.05) lower than in the control. The fat content in the femoral muscles of broilers of the experimental group 3 was less by 0.27% (P<0.05) compared with the control group. Consequently, the inclusion of "Emicidin" and "Apex 3010" in the floor-growing technology of broiler chickens of the cross "Ross-308" contributed to a decrease in the fat content of poultry meat, which, in our opinion, provided some improvement in the dietary properties of the food product and its compliance with the biological requirements for dietary nutrition.

Thus, on the basis of the conducted research, it was established that the meat of broiler chickens from the experimental groups and, especially, experimental group 3, which received the antioxidant "Emicidin" and the food supplement "Apex 3010" for growing had higher quality indicators of their biochemical characteristics compared to the control group .

**CONCLUSION**

Thus, the multicenter studies have shown that the use of the antioxidant "Emicidin" and the natural food supplement "Apex 3010" has a positive effect on zootechnical indicators, the livability of broiler chickens, and reduces the cost of feed per 1 kg and increases live weight. In general, the best meat qualities of carcasses and the quality of meat were noted in experimental group 3, where the mode of combined use of the antioxidant "Emicidin" and the food supplement "Apex 3010" were used for growing broilers. From this point of view, they should be considered as the most important component of the optimization of poultry meat production technology, a rational way of maintaining its health and obtaining safe high quality products. It is recommended to add the food supplement "Apex 3010" in a prophylactic dose of 150 g / t of feed and the preparation "Emicidin" in water in a dose 2.5 mg per 1 kg of body weight to the diet once a day, starting from the daily age for 14 days to stimulate growth and development of chicken broilers, improve their livability and meat qualities of carcasses. The feeding is carried out through vacuum drinkers from the 1st to the 4th day of chickens' life. From the 5th day of life and up to the 14th day, the preparation is drunk through a nipple watering system and the use of medicators (dispensers).

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#### REFERENCES

- [1] V.I. Fisinin, "Strategic trends in the development of world and domestic poultry farming: state, challenges, prospects," World and Russian trends in the development of poultry farming: realities and challenges of the future: materials of the XIX International Conference VNAP (May 15-17, 2018), Sergiev Posad, Federal Research Center "VNITIP" RAS, pp. 9-48, 2018.
- [2] I.A. Egorov, and V.S. Buyarov, "The development of new directions in the field of breeding, feeding and technology of broiler poultry," Vestnik Orel GAU, № 6, pp. 17-23, 2011.
- [3] I.V. Pavlenko, E.E. Shkolnikov, L.A. Nemushchaya, T.A. Skotnikova, V.I. Yeremets, I.P. Saleeva, and A.V. Ivanov, "New environmentally friendly products for broiler poultry," Poultry and poultry products. № 1, pp. 55-57, 2015.
- [4] Yu.A. Selivanova, "A wide range of phytoncides - the maximum functionality of phytobiotics," Poultry, № 1, pp. 37-40, 2018.
- [5] E.V. Shatskikh, O.V. Zelenskaya, and I.A. Yarullina, "The effect of carbitox feed additive on the productivity of broiler chickens," Agrarian Bulletin of the Urals, №.6 (85), pp. 33-34, 2011.
- [6] N. Sadovnikova, "Ecological products are increasingly in demand," Livestock of Russia, special edition, pp. 24-25, 2016.
- [7] T.V. Kurmakaeva, Yu.V. Petrova, and A.V. Avdeenko, "Morphological characteristics of broiler chicken meat with the introduction of succinic acid and emicidine into the diet," Agrarian Scientific Journal, № 12, pp. 19-22, 2014.
- [8] A. Pavlenko, "Apex - a natural growth stimulator", Poultry farming, № 12, p.16, 2007.
- [9] V.I. Fisinin, A.V. Miftahutdinov, and E.M. Amineeva, "Invasive and non-invasive diagnostics of adaptive reactions of meat poultry when using a stress-protective antioxidant," Agricultural biology, Vol. 52, № 6, pp. 1244 – 1250, 2017.
- [10] R.U. Khan, S. Naz, Z. Nikousefat, and V. Tufarelli, "Thymus vulgaris: alternative to antibiotics in poultry feed," World's Poultry Science Journal, Vol. 68, № 3, pp. 401-408, 2012.
- [11] V.I. Fisinin, A.S. Ushakov, G.K. Duskayev, N.M. Kazachkova, B.S. Nurzhanov, Sh.G. Rakhmatullin, and G.I. Levakhin, "Changes in immunological and productive indicators in broiler chickens under the influence of biological active substances from oak bark extract," Agricultural Biology, Vol. 53, №. 2, pp. 385 – 392, 2018.
- [12] N. Puvaca, D. Ljubojevic, Lj Kostadinovic., D. Lukac, J. Levic, S. Popovic, and O. Duragic, "Allies sativum L. on broiler chicken production," World's Poultry Science Journal, Vol. 71, № 3, pp. 533-539, 2015.
- [13] V.S. Lukashenko, A.Sh. Kavtarashvili, and I.P. Saleeva, "Methods of research on the technology of production of eggs and poultry meat," ed. V.S. Lukashenko and A.Sh. Kavtarashvili. Sergiev Posad, p. 103, 2015.
- [14] G.F. Lakin, "Biometrics: a textbook for biol. specialist. universities," 4th ed., Pererab. and ad. Moscow, High School, p. 352, 1990.
- [15] N.A. Plokhinsky, "Biometrics," Moscow, Publishing House of Moscow State University, 2 ed., p. 367, 1970.