TECHNOLOGICAL AND ECONOMIC ASPECTS OF
INDUSTRIAL PRODUCTION OF BROILER MEAT

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Abstract. The issues of development and implementation of resource-saving technologies in broiler poultry farming have a complex purposefulness and their solution must be scientifically substantiated and cost-effective. The productive qualities of meat chickens and broiler chickens of the productive crosses are significantly influenced by many factors that make up the conditions of keeping and feeding. The use of Apex and Emicidin preparations both separately and in combination with each other when rearing chickens of the broiler parent flock of the Ross 308 cross had a positive effect on their productivity and the quality of hatching eggs obtained at the end of the productive period, at the age of 52 weeks. Egg production per initial hen exceeded that in the control group by 2.6% in experimental group 1 (Emicidin), by 3.2% in experimental group 2 (Apex 3010), and by 5.8% in experimental group 3 (combined use of Emicidin and Apex 3010). The determined zootechnical indicators showed high efficiency of the use of the GerbaStor preparation for the floor rearing of broiler chickens of the Ross-308 cross in conditions of increased stocking density in winter. The difference in the productivity index was 18 units, and in meat yield from 1 m² of floor, it was 1.37 kg (3.8%) in favor of the broilers of the experimental group 2, who received GerbaStor. The profitability of the production and sale of meat of broilers grown under an increased stocking density using the GerbaStor preparation was 3.95% higher than that of broilers in the control group.

1. Introduction
Poultry farming is the most important component of the world and Russian agro-industrial complex. It provides the population with a wide range of dietary food products and its role can hardly be overestimated from the standpoint of contributing to food security. Despite the difficult economic situation around the world, the industry continues to develop dynamically. The development of the poultry industry is based on high-tech resource-saving technologies [1-3].

Our analysis showed that all categories of farms in the Russian Federation in 2020 produced 44.8 billion eggs, which is 0.22% less than in 2019. Consumption of eggs per capita was 290 eggs, which is 11.54% higher than the recommended rational rate, which, in accordance with the Order of the Ministry of Health of the Russian Federation of August 19, 2016, is 260 eggs per capita. The chicken egg is a product of animal origin, unique in its consumer qualities, without an alternative. Russia ranks 4th in the world in terms of the production of chicken eggs.

In 2020, in farms of all categories, the production of poultry meat (slaughter weight) amounted to 5.03 million tons, which is 0.40% more than in 2019. Poultry meat consumption per capita was 34.0 kg, which is 9.68% higher than the recommended rational norms. The share of poultry meat is 44% in
the Russian market for all types of meat. It should be noted that chicken eggs and poultry meat provide 33% of the population's need for the complete protein of animal origin. Russia ranks 6th in the world in terms of poultry meat production. The export of poultry meat to the countries of near and far abroad in 2020 reached 138.2 thousand tons, which is 62% of the export of meat of all types or 42% of the export of livestock products.

The main trend in the Russian poultry industry, which has been formed since 2017, is the production of eggs and meat without significant growth rates. This trend, according to Rosptitsesoyuz, will continue in the medium term. At the same time, poultry farming, as noted above, retains its leading positions, both in the domestic and foreign markets.

According to Rosstat, the industrial production of poultry in live weight in agricultural organizations in January-April 2021 amounted to 1965.5 thousand tons, which is 86.0 thousand tons (4.19%) below the same level in 2020. At the same time, in the Orel Region, poultry production in live weight in agricultural organizations in January-April 2021 increased from 8.6 thousand tons to 11.0 thousand tons, or by 27.91%. It should be noted that in the Orel region more than 90% of broiler meat is produced at the poultry farm of AO AIC "Orlovskaya Niva".

Nowadays, the poultry industry in Russia is faced with the following problems that hinder its further development:

- **Economic problems** - an increase in the cost of all resources used in the production of eggs and poultry meat (grain, compound feed, energy resources, etc.); high import dependence (feed additives, hatching eggs, breeding products, spare parts for equipment, veterinary preparations); the low purchasing power of the population (restrains the formation of manufacturer's selling prices at a level that covers production costs and the required level of profitability);
- **Technological problems** - violation of the delivery schedules of hatching eggs to poultry enterprises (dependence on import of parental and grandparent forms);
- **Veterinary problems** - contraction of low pathogenic and highly pathogenic avian influenza at some enterprises.

In the current production and economic conditions, the most important task is to increase the production efficiency and the competitiveness of products based on cost optimization, finding internal reserves that ensure a rhythmic production and technological cycle and the possibility to produce uninterruptedly in significant volumes, in a short time and regardless of territorial distribution. It is necessary to develop a quality management system and traceability of the production to guarantee its quality and livability at all stages. The key to success consists in the competent management of resources within enterprises, in reducing the cost of production, primarily through the introduction of resource-saving technologies at all stages of the production of eggs and poultry meat [4].

The issues of development and implementation of resource-saving technologies in broiler poultry farming have a complex purposefulness and their solution must be scientifically substantiated and cost-effective. The productive qualities of meat chickens and broiler chickens of the productive crosses are significantly influenced by many factors that make up the conditions of keeping and feeding. To optimize the operation of a poultry enterprise, and increase the profitability of poultry meat production, an integrated approach is required, taking into account the influence of all technological and economic parameters. Measures to improve the efficiency of industrial production of broiler meat can be divided into two groups - current and strategic. Current activities include the introduction of modern technological methods of poultry rearing; improvement of the program of medical and preventive measures at the poultry farm; the use of promising chicken crosses; experimental research on the use of energy-saving lighting modes, new feed additives, biologically active additives, etc. [5-7]. Strategic activities include strategic planning of all production technology, forecasting, and budgeting.

In 2018 - 2020 the average level of profitability from the sale of broiler meat was at the level of 7-10%. In the structure of the cost of eggs and poultry meat, feed accounts for up to 70% of all costs. In
2021, due to the rise in the price of compound feed, the cost of poultry products increased by an average of 15%.

A promising direction for increasing the efficiency of broiler meat production and improving its quality is the use of probiotics, prebiotics, phytobiotics, synbiotics, antioxidants, and other preparations in poultry feeding, including in stressful situations (changing the compound feed formulation, using coccidiostatics and other veterinary preparations, impaired ventilation, increased stocking density, vaccination, poor water quality, etc.), which are often manifested in industrial poultry farming. The actual problem is the production of organic poultry products [8 - 15].

The technological parameters of keeping, including the stocking density of poultry, are of great economic importance. When choosing the stocking density, first of all, considered is the maximum meat yield from 1 m² of the floor area of the poultry house without reducing the genetically determined live weight of broilers. The optimum stocking density for chickens should be set taking into account the required average live weight of broilers to be slaughtered. Poultry of different crosses reacts unequally to a compacted keeping, so there is a need for a differentiated approach, that is, the stocking density and growing time should be determined depending on the method of rearing [16].

This work aims to study the effectiveness of the use of various biologically active additives in the technology of keeping chickens of the broiler parent flock, as well as in the floor rearing of broiler chickens in winter under conditions of increased stocking density.

2. Materials and methods
Experimental studies were carried out at AO AIC "Orlovskaya Niva", Subdivision “Factory for the production of poultry meat”. Chickens of the parent flock and broiler chickens of the Ross-308 cross were used as the object of study. During the study, 2 scientific and economic experiments were carried out.

The task of the first scientific and economic experiment was to study the effect of Emicidin and Apex 3010 on the productivity and quality of hatching eggs of hens of the parent flock of broilers of the Ross-308 cross.

The scientific and economic experiment was carried out in a typical poultry house. The parent flock of meat chickens was kept on bedding at a sex ratio of 1:10 and 1:9. The chickens were divided into four groups of 70 heads each according to the principle of analogous pair. There was one control group and three experimental. The scheme of the first experiment is presented in Table 1. The conditions of keeping, feeding, and all technological parameters of rearing were the same for all experimental groups and corresponded to the recommendations of the Federal Research Center "VNITIP" RAS and the company "Aviagen" for the keeping and feeding of hens of the broiler parent flock.

Emicidin is a new-generation water-soluble antioxidant. Emicidin is a derivative of 3-hydroxyxypyrine and succinic acid (structural analog of vitamin B6).

Apex 3010 is a natural feed additive with a herbal flavor, a natural growth stimulant, used as an alternative to antibiotics. It is a blend of specific, specially selected herbal extracts that exhibit antioxidant properties and are designed to increase feed intake, productivity, and reproductive capacity of poultry. The preparation was developed by BFI Innovations (Great Britain).

The task of the second scientific and economic experiment was to determine the effectiveness of the use of the dietary supplement GerbaStor during the floor rearing of broilers of the Ross-308 cross in conditions of increased stocking density in winter.
Table 1.

| Group       | Number of chickens | The used preparation       | Dozage and administration route                      | Treatment period                                |
|-------------|--------------------|----------------------------|-----------------------------------------------------|-------------------------------------------------|
| Control     | 70                 | Complete feed (CF)         | -                                                   | Once a day in two courses of 14 days each: at the age of 246-259 days and 351-364 days |
| 1 - Experimental | 70    | Emicidin                   | 2.5 mg per 1 kg of live weight once a day, feeding with drinking water |                                                |
| 2 - Experimental | 70    | Apex 3010                  | CF + 150 g per 1 ton of compound feed                | Constantly, during the entire technological cycle of the parent flock operation, from 23 weeks (161 days) to 62 weeks (434 days) |
| 3 - Experimental | 70    | Emicidin and Apex 3010    | Complex use of preparations according to the schemes of experimental groups 1 and 2: Emicidin - 2.5 mg per 1 kg of live weight once a day, feeding with drinking water; Apex 3010 - CF + 150 g per 1 ton of compound feed | Emicidin: once a day in two courses of 14 days each: at the age of 246-259 days and 351-364 days; Apex 3010: constantly, during the entire technological cycle of operation of the parent flock, from 23 weeks (161 days) to 62 weeks (434 days) |

The experimental chickens were raised in a standard poultry house measuring 96x18 m for 30 thousand poultry places using modern technological equipment (Big Dutchman) for the floor keeping of broilers. The technological parameters of growing and feeding broilers corresponded to the recommendations of the Federal Scientific Center “All-Russian Research and Technological Institute of Poultry” of the Russian Academy of Sciences and the recommendations of the Aviagen company for rearing broilers of the Ross-308 cross. The scheme of the second experiment is presented in Table 2.

Table 2. The scheme of the second experiment.

| Group       | Age, days | Number of heads | Stocking density, head/m² | Features of chicken feeding | The scheme of preparation use | The preparation was not used |
|-------------|-----------|-----------------|---------------------------|----------------------------|-----------------------------|-----------------------------|
| 1 - Control | 1 - 40    | 150             | 21.5                      | Complete feed (CF)         | The preparation was not used |                             |
| 2 - Experimental | 1 - 40 | 150             | 21.5                      | CF + 0.4 kg of GerbaStor per 1 ton of compound feed | From the 5th to the 40th day of rearing |                             |

GerbaStor is a dietary supplement containing live spore-forming bacteria of the genus Bacillus and lactic acid microorganisms, products of their metabolism (enzymes, organic acids, vitamins), fermented beet pulp, yeast autolysates, mineral salts, carbohydrates, phyto-additives (oregano herb, plantain leaf, chamomile flowers, St. John's wort, echinacea, milk thistle). The additive is produced by microbiological synthesis (LLC STC BIO, Russia, Belgorod region, Schebekino).

During the period of scientific and economic experiments, studied were zootechnical, morphological indicators of the quality of hatching eggs; economic indicators of the effectiveness of
the use of biologically active additives in broiler poultry farming. These indicators were determined at AO AIC "Orlovskaya Niva", an innovative research and testing center for collective use of the Orel State Agrarian University. Statistical processing of the digital material of the experimental data was performed using the Microsoft Excel program.

3. Results and discussion

The first scientific and economic experiment. The peak of oviposition in meat chickens of modern crosses with good flock uniformity (more than 85%) and correct rearing is reached at the age of 29-30 weeks. Within 6-9 weeks after the peak of egg production, the yield of the egg weight remains practically at the same level (the level of egg production decreases slightly, and the weight of eggs increases). After the age of 35-36 weeks, the meat chickens show a gradual decline in productivity (the egg production rate is below 80%). Therefore, to maintain egg production and the viability of chickens, we consider it expedient to use biologically active additives not only at the beginning of oviposition (at 22-23 weeks of age) and at its peak, but also at the age period of 35-52 weeks (from 245 to 364 days). It should also be noted that after 245 days, the feeding program of the chickens is adjusted, and often the chickens develop symptoms of stress. The scheme of experiments was drawn up and research was carried out [17].

It was found that the use of Apex and Emicidin preparations, both separately and in combination with each other when rearing broiler parent flock chickens, had a positive effect on their productive and reproductive qualities and, as a result, economic efficiency (Table 3).

Table 3. The effectiveness of the use of Apex and Emicidin when rearing chickens of parent flock (in prices of 2015).

| Characteristics                          | Group          |
|------------------------------------------|----------------|
|                                          | Control | 1-Experimental | 2-Experimental | 3-Experimental |
| The number of chickens at the beginning of the experiment, head | 70      | 70              | 70              | 70              |
| The livability of chickens during the laying period (23-62 weeks),% | 87.1    | 88.6            | 88.6            | 90.0            |
| Productive period, days                  | 273     | 273             | 273             | 273             |
| Egg production per the initial hen, pcs. | 171.1   | 175.6           | 176.5           | 181             |
| Gross production of eggs, pcs.           | 11977   | 12292           | 12355           | 12670           |
| The output of hatching eggs per the initial laying hen,% | 89.4    | 91.0            | 92.1            | 92.9            |
| Gross production of hatching eggs, pcs.  | 10707   | 11186           | 11379           | 11770           |
| The hatching of day-old chickens,%       | 78.7    | 79.8            | 80.4            | 81.6            |
| The hatching of day-old chickens, head   | 8425    | 8926            | 9145            | 9602            |
| Total costs, rub.                        | 154009.00| 159330.33       | 154495.89       | 160897.22       |
| Including the cost of the preparation, rub. | -      | 5321.33         | 486.89          | 5808.22         |
| Cost of 1 head of a day-old chicken, rub. | 18.28  | 17.85           | 16.89           | 16.76           |

The cost of 1 head of a day-old chicken in experimental group 3 was 1.09 rub. and 0.13 rub. lower than in experimental groups 1 and 2, respectively. The difference in the cost of 1 head of a day-old chicken in experimental group 3 and the control group was 1.52 rub. (8.32%).

Thus, the highest production and economic performance in rearing chickens of parent flock broilers was achieved in experimental group 3 with the combined use of Apex and Emicidin.

The most important condition for high incubation results is the quality of the hatching eggs. To determine the morphological indicators of the quality of hatching eggs of hens of parent flock broilers at the end of the productive period, at the age of 52 weeks (364 days), 50 eggs were selected from each experimental group.
The determined main morphological parameters of hatching eggs of Ross-308 meat cross chickens are presented in Table 4.

Table 4. Morphological indicators of the quality of hatching eggs of hens of the parent flock of the Ross - 308 cross (M ± m; n=50; age of 52 weeks).

| Characteristics | Group                     |
|-----------------|---------------------------|
|                 | Control | 1-Experimental | 2-Experimental | 3 - Experimental |
| Egg weight, g   | 66.52 ± 0.50 | 67.43 ± 0.43 | 68.01 ± 0.37* | 68.53 ± 0.58** |
| Egg density, g/cm³ | 1.075 ± 0.002 | 1.079 ± 0.002 | 1.080 ± 0.001 | 1.081 ± 0.002** |
| Shape index, %  | 76.20 ± 0.53 | 76.89 ± 0.60 | 77.43 ± 0.58 | 78.08 ± 0.49* |
| Egg white:      |          |               |               |                  |
| Weight, g       | 39.85 ± 0.48 | 40.45 ± 0.50 | 40.94 ± 0.53 | 41.50 ± 0.57*    |
| Index, %        | 6.08 ± 0.16 | 6.21 ± 0.19 | 6.33 ± 0.21 | 6.51 ± 0.23      |
| Haugh unit      | 68.50 ± 1.82 | 68.92 ± 1.93 | 70.01 ± 1.72 | 72.41 ± 1.98     |
| Yolk:           |          |               |               |                  |
| Weight, g       | 19.63 ± 0.20 | 20.13 ± 0.23 | 20.28 ± 0.26 | 20.39 ± 0.23*    |
| Index, %        | 40.52 ± 0.66 | 41.03 ± 0.50 | 42.51 ± 0.49* | 43.07 ± 0.41**   |
| Eggshell:       |          |               |               |                  |
| Weight, g       | 7.04 ± 0.17 | 6.85 ± 0.14 | 6.79 ± 0.11 | 6.64 ± 0.13      |
| Thickness, mm   | 0.340 ± 0.005 | 0.352 ± 0.008 | 0.358 ± 0.007 | 0.364 ± 0.007    |
| Relative weight, %: |      |               |               |                  |
| Egg white       | 59.91 ± 0.41 | 59.99 ± 0.61 | 60.20 ± 0.56 | 60.56 ± 0.65     |
| Yolk            | 29.51 ± 0.42 | 29.85 ± 0.49 | 29.82 ± 0.54 | 29.75 ± 0.36     |
| Eggshell        | 10.58 ± 0.18 | 10.16 ± 0.19 | 9.98 ± 0.17* | 9.69 ± 0.15***   |
| The weight ratio of egg white to yolk | 2.03 ± 0.02 | 2.01 ± 0.04 | 2.02 ± 0.05 | 2.04 ± 0.06 |

Note: * P<0.05; ** P<0.01; *** P<0.001

It was found that hens of the experimental group 2 (received Apex) and the experimental group 3 (received Apex and Emicidin in combination) showed a statistically significant increase in the egg weight by 2.2% (P <0.05) and 3.0% (P <0.01), respectively compared to control. The increase in the weight of eggs was due to an increase in the absolute weight of its constituent parts – egg white and yolk. Thus, in experimental group 2, the egg white weight was 2.7% higher than in the control, and in experimental group 3, the significant excess in comparison with the control was 4.1% (P <0.05). The increase in yolk weight in these experimental groups compared to the control was 3.3% and 3.9% (P <0.05), respectively. At the same time, the ratio of the weight of egg white to the weight of yolk in all groups corresponded to the requirements for the quality of hatching eggs for chickens of meat crosses. There were no significant differences in eggshell weight in the experimental groups. The relative weight of egg white and yolk in all experimental groups tended to increase compared to the control. The relative eggshell weight, on the contrary, in experimental groups 2 and 3 decreased by 5.7% (P <0.05) and 8.4% (P <0.001) compared with the control group. The increase in yolk weight in these experimental groups compared to the control was 3.3% and 3.9% (P <0.05), respectively. At the same time, the ratio of the weight of egg white to the weight of yolk in all groups corresponded to the requirements for the quality of hatching eggs for chickens of meat crosses. There were no significant differences in eggshell weight in the experimental groups. The relative weight of egg white and yolk in all experimental groups tended to increase compared to the control. The relative eggshell weight, on the contrary, in experimental groups 2 and 3 decreased by 5.7% (P <0.05) and 8.4% (P <0.001) compared with the control group.

The egg shape is of great importance when characterizing the morphological indicators of the quality of hatching eggs of chickens. The shape index is the ratio of small to large diameter, expressed as a percentage (the norm of the shape index is 70-82%). The shape of the eggs affects the position of the embryo during its development. Eggs that are too elongated or round have reduced hatchability. In our studies, the hatching eggs had the correct shape, while there was a tendency to an increase in the
egg shape index in experimental groups 1 and 2, and in experimental group 3, the difference with the control for this indicator was 1.88% (P < 0.05).

The most important indicator of the quality of the eggshell of chicken eggs is its thickness, which determines the strength of the eggshell. The eggshell thickness in all groups was within the normal range (not less than 0.33 mm). This indicator in experimental groups 1, 2, and 3 was 3.5%, 5.3%, and 7.1% higher than in the control group, but the difference was statistically insignificant.

To a certain extent, the quality of the eggshell can be assessed by the indicator of their density, which, in accordance with the requirements for the quality of hatching eggs for chickens of meat crosses, should be at least 1.075 g/cm³. The density of eggs in experimental groups 1 and 2 tended to increase, and in experimental group 3 this indicator differed from the control by 0.6% (P < 0.01).

The quality of the egg yolk in all experimental groups was high, as evidenced by the yolk index, which is 40.52% in the control group and 43.07% in the experimental group 3, which corresponds to the normative indicators (40-50%). It should be noted that the yolk index of chicken eggs in experimental groups 2 and 3 was 2.0% and 2.6% higher than in the control.

The quality of egg white in our studies was assessed by the egg white index, the norm of which is 5.0-9.0%, and Haugh units, the optimal values of which for different meat crosses of chickens are in the range of 65-87. It was found that both indicators tended to increase in all experimental groups. Thus, the egg white index in experimental groups 1, 2, and 3 was higher compared to the control by 0.13%, 0.25%, and 0.43%, and the Haugh units exceeded by 0.6%, 2.2%, and 5.7%, but the difference with the control group was not reliable.

Studies have shown that Emicidin and Apex preparations, used both separately and in combination with each other, in general, positively affect the quality of hatching eggs obtained from experimental groups of Ross-308 meat cross hens at the end of the productive period, at the age of 52 weeks.

The second scientific and economic experiment. Table 5 shows the results of the use of the GerbaStor preparation in the floor rearing of chickens - broilers of the Ross-308 cross in conditions of increased stocking density in winter. It was found that the average live weight of broiler chickens in experimental group 2 was 3.3% (P < 0.05) higher than in the control group 1. The average daily gain for the entire period of rearing broilers in experimental group 2 was 3.3% higher than in the control. The livability of poultry in experimental group 2 was 95.3% versus 94.7% in the control. Feed consumption per 1 kg of live weight gain in broilers in experimental group 2 was 1.7% lower than in control group 1. The difference in the productivity index was 18 units, and in terms of the meat yield from 1 m² of floor, it was 1.37 kg (3.8%) in favor of the broilers of the experimental group 2.

The profitability of the production and sale of meat of Ross-308 broilers grown under an increased stocking density using the GerbaStor preparation is 3.95% higher than that of broilers in the control group.
### Table 5. Production and economic indicators for broiler chickens rearing using the GerbaStor preparation.

| Characteristics                                | 1 - Control | 2 - Experimental |
|------------------------------------------------|-------------|------------------|
| Stocking density, meads/m²                     | 21.5        | 21.5             |
| Feeding time, days                             | 40          | 40               |
| Livestock, heads                               | 150         | 150              |
| Livability, %                                  | 94.7        | 95.3             |
| Poultry production in live weight, kg          | 346.03      | 359.55           |
| Average daily gain, g                          | 59.90       | 61.88            |
| Average live weight of one head, g             | 2436.00±25.3| 2515.20± 28.1*   |
| Feed consumption per 1 kg of live weight gain, kg | 1.76      | 1.73             |
| Productivity index, units                      | 328         | 346              |
| Slaughter yield, %                             | 73.4        | 73.4             |
| Produced meat in slaughter weight, kg          | 253.99      | 263.91           |
| Meat output of gutted carcasses from 1 m² of floor, kg | 36.41    | 37.78            |
| The cost of the preparation, rub.              | -           | 88.56            |
| Total prime cost of meat, rub.                 | 22493.25    | 22570.89         |
| Proceeds from the sale of meat, rub.           | 25033.14    | 26010.78         |
| Profit, rub.                                   | 2539.89     | 3439.89          |
| Profitability, %                               | 11.29       | 15.24            |

* P < 0.05

### 4. Conclusion

The issues of development and implementation of resource-saving technologies in broiler poultry farming have a complex purposefulness and their solution must be scientifically substantiated and cost-effective. The productive qualities of meat hens and broiler chickens of industrial crosses are significantly influenced by many factors that make up the conditions of keeping and feeding.

It was found that Apex and Emicidin preparations used separately and in combination when keeping chickens of the Ross-308 meat cross, had a positive effect on their productivity and the quality of incubation eggs obtained at the end of the productive period, at the age of 52 weeks.

As a result of studies using a complex of zootechnical indicators, high efficiency of the application of the GerbaStor preparation was established for floor rearing of chickens - broilers of the Ross-308 cross in conditions of increased stocking density. The profitability of the production and sale of meat of broilers grown at an increased stocking density using the GerbaStor preparation was 3.95% higher than that of broilers in the control group.

### References

[1] Bobyleva G A 2021 The situation on the poultry and egg market in 2021 and the prospects for its development (Poultry and poultry products vol 2) pp 4–8

[2] Buyarov V S and Buyarov A V 2020 Poultry subcomplex of the Russian Federation: Functioning and development in modern economic conditions (Bulletin of Agrarian Science vol 6 (87)) pp 84–91

[3] Mottet A and Tempio G 2017 Global poultry production: current state and future outlook and, World's Poultry (Science Journal vol 73 (2)) pp 245–256

[4] Valdokhina S I and Roiter L M 2020 Traceability as a tool for managing the economic viability of a poultry enterprise (IOP Conf Ser: Earth Environ Sci vol 548) p 022032

[5] Andrianova E N, Egorov I A, Prisyazhnaya L M, Akhmetova L T, Sibgatullin Zh Zh, Slesarenko N A, Kondratov G V, Nikonov I N and Laptev G Yu 2016 Feed additive Vinivet of apicultural products as an alternative for antibiotic growth promoters in broiler chick diets – bactericidal and biostimulating effect (Agricultural Biology vol 51 (2)) pp 213–222
[6] Buyarov V S, Chervonova I V, Buyarov A V and Aldobaeva N A 2018 Modern meat and egg crosses of chickens: zootechnical and economic aspects (Bulletin of the Voronezh State Agrarian University vol 2 (57)) pp 88–99

[7] Kavtarashvili A Sh, Fisinin V I, Buyarov V S and Kolokolnikova T N 2019 The effects of lighting regimes on the oviposition time and egg quality in laying hens (Review) (Agricultural Biology vol 54 (6)) pp 1095–1109

[8] Bagno O A, Prokhorov O N, Shevchenko S A, Shevchenko A I and Dyadichkina T V 2018 Use of phytobiotics in farm animal feeding (review) (Agricultural Biology vol 53 (4)) pp 687–697

[9] Buyarov V S and Metasova S Yu 2019 The effectiveness of the use of the symbiotic "ProStor" in poultry farming (Scientific notes of Kazan University: Series: Natural Sciences vol 161 (3)) pp 408–421

[10] Feoktistova N V, Mordanova A M, Khadieva G F and Sharipova M R 2017 Probiotics based on bacteria of the genus bacillus in poultry farming (Scientific Notes of Kazan University: Series: Natural Sciences vol 159 (1)) pp 85–107

[11] Fisinin V I, Miftakhutdinov A V and Amineva E M 2017 Invasive and noninvasive detection of adaptive response in meat poultry after preventive application of a stress-protective antioxidant composition (Agricultural Biology vol 52 (6)) pp 1244–1250

[12] Fisinin V I, Ushakov A S, Duskaev G K, Kazachkova N M, Nurzhanov B S, Rakhmatullin Sh G and Levakhin G I 2018 Mixtures of biologically active substances of oak bark extracts change immunological and productive indicators of broilers (Agricultural Biology vol 53 (2)) pp 385–392

[13] Emecheta A O, Ike A C, Onu C J, Eze C D and Olovo C V 2018 The benefits of supplementation with antibiotic alternatives on Newcastle desiaise virus titres in poultry (World's Poultry Science Journal vol 74 (4)) pp 665–674

[14] Lenkova T, Nikonov I, Kuznetsov Y, Karpenko L and Balykina A 2019 Development of the probiotic feed supplement based on Lactobacillus Plantarum to increase the broiler productivity (International Journal of Innovative Technology and Exploring Engineering vol 9 (1)) pp 2452–2454

[15] Vilà B, Esteve-garcia E and Brufau J 2010 Probiotic micro-organisms: 100 years of innovation and efficacy; modes of action (World's Poultry Science Journal vol 66 (3)) pp 369–380

[16] Lukashenko V S and Ovsiechik E A 2021 Stocking density of broiler chickens in cage rearing (Poultry and Poultry Products vol 2) pp 43–45

[17] Andreeva O N 2020 Mineral components of blood serum, eggshell structure and productivity of meat chickens with background of "Apex" and "Emicidine" preparations application (Bulletin of Agrarian Science vol 2 (83)) pp 147–156