Meat qualities of cross cobb-500 broilers grown with the use of the antioxidant dihydroquercetin

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Abstract. The Research is devoted to the study of the effect of the biologically active additive "Dihydroquercetin" in the compound feed on the indicators of meat productivity of broiler chickens. The results show that the increase in live weight of chickens that received dihydroquercetin in addition to the main ration was ahead of their control peers by 11.91-32.78%. During the 40-day period of growing broilers, in the experimental groups with the addition of dihydroquercetin, they had a live weight of 15.22-50.51% more. From the beginning of fattening to the age of 40 days, the absolute and average daily growth rates showed a steady upward trend, then there was a decrease in the growth rate of chickens. The greatest effectiveness of the drug was noted at the beginning of the experiment, which indicates a positive corrective effect of the antioxidant on metabolism and an increase in the level of assimilation processes in the body of broilers. Up to 10 days of age, the chickens of the experimental groups receiving dihydroquercetin had higher relative growth rates, which obviously characterizes their better adaptation to the conditions of the experiment. The magnitude and nature of changes in the relative increase in live weight of broilers with longer cultivation up to 60 days of age indicate its inexpediency—even when using the drug dihydroquercetin, due to the unprofitability of its further use, and the lack of recoupment of costs for the purchase. In general, the higher studied indicators during the experiment were observed in broiler chickens of the III-IV experimental groups, the best result was shown in the group of birds receiving dihydroquercetin Supplement at the level of 1 g/100 g of feed, which allows us to consider it optimal.

1. Introduction
One of the most urgent tasks facing the agro-industrial complex of the Russian Federation is to increase production and improve the quality of livestock products. In the context of a shortage of raw materials in the domestic market of the EAEU, one of the priority areas in solving the tasks set is the development of poultry farming. In the global structure of poultry meat production, it still occupies a leading position [1].

Low feed quality, presence of infectious agents, mismatch of microclimate and maintenance conditions (increased planting density), use of antibiotics and disinfection, stressful situations (vaccinations, transportation) are limiting factors for the realization of the genetic potential of poultry productivity [2].

To reduce the negative impact of adverse factors, various biological preparations are used, the use of which can be an environmentally safe method in the prevention of negative effects on the bird's organism [3].
During intensive selection for meat, the body changes the metabolism and technological parameters of meat (structure, color, moisture retention, consistency, chemical composition, fat distribution, taste and aroma properties, losses during heat treatment). Therefore, there is an objective need to develop and implement methods to reduce the qualitative and quantitative losses of meat products [4, 5].

Modern technologies in poultry farming are based on the production of competitive, environmentally safe products with maximum use of biological reserves of poultry. The world experience of countries with developed poultry farming shows that the formation of the quality of meat products begins with cultivation and is controlled at all sections of the trophological chain «from farm to counter» [6].

Modern centers of biotechnology make it possible to obtain various biologically active drugs that are available for use, and the use of means of natural origin is of the greatest interest.

One of them is a natural antioxidant of plant origin – dihydroquercetin. The possibility of its widespread use in the food industry is confirmed by research conducted at the I. M. Sechenov Moscow Medical Academy. It is established that this antioxidant is non-toxic, physiologically harmless to human health, does not give the products a foreign taste and smell, does not change their color when used. The substance is resistant to temperature (from minus 50 to plus 180 °C), mechanical influences, and processes occurring in the manufacture of products, that is, it meets all the requirements for all food additives in General and, in particular, for antioxidants. This is an important aspect for the consumer, and the manufacturer, at the same time, gets the opportunity to produce products of guaranteed quality, taking into account unforeseen technological situations [7, 8].

In this connection, research on the effect of the natural biologically active antioxidant Supplement dihydroquercetin on the growth and meat productivity of poultry is very relevant.

The studies were performed on broiler chickens of the COBB-500 cross in the production conditions of OOO «Zverozkhozyaistvo Kiznerskoye». For the farm-scale trial, 40 chickens of day-old broiler chickens of the COBB-500 cross with an average live weight of 39.8±0.13 g were selected, and from them, according to the principle of analogues, four groups of 10 birds each were formed. All chickens, according to the trial periods, received the main diet, which consisted of starter, growth, and finishing compound animal feedstuffs used at the poultry farm.

Broiler chickens were fed with compound feed, following the originator’s recommendations for this cross. In terms of energy nutrition and nutrient content, they were the same and differed between groups in the amount of supplement added. The chickens of the control group received only compound feed (the main diet), the second experimental group received the additional antioxidant supplement Dihydroquercetin (DHQ) in an amount of 0.5 g per 100 g of compound feed, the third group - 0.75 g per 100 g of compound feed, and the IV - 1 g per 100 g of compound feed (table 1).

| Groups | Number of birds | Trial scheme |
|--------|----------------|--------------|
| I – K  | 10             | Full diet compound feed (FDCP) |
| II– O  | 10             | (FDCP) + 0.50 g DHQ \ 100 g of compound feed |
| III– O | 10             | (FDCP) + 0.75 g DHQ \ 100 g of compound feed |
| IV– O  | 10             | (FDCP) + 1.00 g DHQ \ 100 g of compound feed |

The duration of the experiment was 40 days, and to clarify the efficiency of prolonging the duration of the feeding period, it was extended to 60 days. Broiler chickens were raised floor standing, temperature and light conditions, air humidity, feeding, and watering areas of the poultry during the experiment corresponded to the recommended standards of VNITIP [7, 8].

To study the impact of dihydroquercetin on the growth and meat productivity of broiler chickens, during the trial, the changes in their live weight, absolute and average daily gains, and safety were assessed. Every ten days, the entire livestock was weighed using electronic scales, in the morning before feeding; absolute and relative growth was determined by calculation; safety - by daily counting of dieoff.
Upon completion of the scientific and economic experiment was carried out the slaughter of all livestock of broiler chickens. The pre-slaughter mass, the mass of devastated carcasses, the slaughter yield and the mass of all slaughter products were taken into account.

2. Research results
At the beginning of the trial, the chickens practically did not differ in live weight, this indicates the uniformity of the formed groups (table 2).

| Age, days     | I – K         | II – O         | III – O        | IV – O         |
|---------------|---------------|----------------|----------------|----------------|
| day old       | 40.00±0.22    | 39.70±0.22     | 39.70±0.22     | 40.10±0.19     |
| 10 days old   | 104.00±2.08   | 126.20±4.64    | 145.80±9.53    | 228.60±5.78    |
| 20 days old   | 372.00±15.96  | 415.30±11.63   | 450.40±12.19   | 537.70±8.37    |
| 30 days old   | 749.43±22.01  | 848.50±10.95   | 900.90±10.06   | 1192.50±18.84  |
| 40 days old   | 1561.14±12.18 | 1798.78±19.64  | 1869.90±23.97  | 2349.70±34.67  |
| 50 days old   | 2562.14±16.03 | 2899.00±46.00  | 2985.30±43.79  | 3468.10±30.17  |
| 60 days old   | 3638.57±44.51 | 4072.00±56.83  | 4181.20±58.82  | 4831.40±54.94  |

The results of weekly weighing of broiler chickens from the control and experimental groups objectively indicate that the addition of antioxidants has a significant effect on the increase in live weight, but its effectiveness manifests itself in different ways - depending on the growing period and the dosage of dihydroquercetin.

The most significant expression of the stimulating effect of the preparation on the change in the weight of broilers has been already noted in the first decade of rearing chickens in the experimental groups. Relative to the control peers, they showed superiority in live weight: at the level of dihydroquercetin 0.5 kg/100 kg of compound feed, it was 1.21 times (P<0.001), 0.75 kg/100 kg – 1.4 times (P<0.001), and at the level of 1 kg/100 kg – 2.2 times (P<0.001). In the subsequent periods of rearing broiler chickens up to 40 days of age, the effect of the drug remained with the same pattern, but had a less effect. The increase in the live weight of chickens in the experimental groups that received the addition of dihydroquercetin was significantly greater than in the control. In general, for 40 days of broilers growth in groups with different content of dihydroquercetin additive in the feed, they had a live weight by 15.22% (P<0.001) - in group II (0.5% of the drug), by 19.72% (P<0.001) - in group III (0.75% of the drug) and by 50.51% (P<0.001) - in group IV (1% of the drug) greater, respectively. Further broiler rearing, up to 60 days of age, showed a less significant, but positive impact of the antioxidant supplement on the difference (P<0.001) in live weight compared to the control – 1.1, 1.2 and 1.3 times, respectively, and indicates the inexpediency of increasing the duration of poultry feeding.

The dynamics of the absolute gain in broiler chickens had a steady tendency to increase the value of this indicator during their rearing. If at the beginning of fattening the increase in their live weight was at the level of 64.29-188.5 g (period 1-10 days), in the second decade it amounted to 268-309.1 g. Further, the weight of poultry increased in 21-30 days by 1.4-2.13 times, then by 1.7-2.2 times (period 31-40 days), and subsequently, a decrease in the growth rate of chickens is observed.

The analysis of the experiment results shows that the addition of dihydroquercetin to the diets of broilers of the II-IV experimental groups contributes to a positive difference in this indicator, relative to the control, during all periods of growth. So, if in the first decade of feeding the experimental chickens, their weight exceeded the control mates by almost 1.4-2.9 times, then by 40-days-old age already by 1.2-1.7 times. Longer rearing of broilers also confirmed its ineffectiveness, since in terms of absolute gain in live weight they exceeded control chickens only by 9.91-11.73% - in the period 41-50 days of age and by 8.97-26.65% - in the period 51-60 days of age. Consequently, the broiler feeding period can be considered optimal if it does not exceed 40 days.
Average daily gains of broiler chickens, during the experiment, predictably reflected the pattern traced by the dynamics of the absolute weight gain. It was found that the value of the studied parameter increases in chickens throughout the entire period of the trial (table 3).

Table 3. Dynamics of average daily growth, %.

| Age, days. | I− K | II− O | III− O | IV− O |
|------------|------|-------|--------|-------|
| 1-10       | 7.14±0.25 | 9.61±0.53 c | 11.79±1.08 c | 20.94±0.66 c |
| 10-20      | 26.80±1.43 | 28.91±1.08 a | 30.46±0.47 a | 30.91±0.38 a |
| 20-30      | 37.74±2.69 | 43.32±2.17 | 45.05±2.21 | 65.48±2.64 c |
| 30-40      | 81.17±1.71 | 95.51±0.97 c | 96.90±1.57 c | 108.82±2.32 c |
| 40-50      | 100.10±1.15 | 110.02±2.81 b | 111.54±2.31 c | 111.84±2.21 c |
| 50-60      | 107.64±2.95 | 117.30±1.62 a | 119.59±2.45 b | 136.33±2.90 c |
| 1-60       | 61.00±0.75 | 68.35±0.96 c | 70.19±0.99 c | 81.21±0.93 c |

Broilers of the II-IV experimental groups received dihydroquercetin as an additive to the diet, showed higher average daily gains in live weight, compared with chickens in the control. The greatest efficiency of the preparation is manifested from a period of 31-40 days. Birds up to 10 days of age outpaced the control mates in average daily gain by 6.97 g (P<0.001). By the age of 40 days, the experimental chickens were superior in this indicator to the control ones, respectively by 14.34 g (P<0.001) in group II, by 15.73 g (P<0.001) in group III, and 27.65 g (P<0.001) in group IV. It is noted that the productive effect of dihydroquercetin reflects a similar trend in the absolute increase in live weight (table 3). This probably indicates that by the age of 40 days the chickens practically reach the maximum meat condition and their ability for intensive growth reduces.

In general, over the trial, the number of poultry groups that received the preparation had a higher average daily gain, compared to the control, exceeding by 12.05%; 15.07%, and 33.13% (P<0.001), respectively, and describes the positive corrective effect of the antioxidant on metabolism and an increase in the level of assimilation processes in the body of broilers.

The analysis of the obtained results demonstrates that the relative growth of broilers is in an inverse relationship with the absolute weight gain, which indicates a reduction in the growth energy of chickens with age. The addition of dihydroquercetin provided higher relative growth rates of chickens in the experimental groups up to 10 days of age.

Table 4. Dynamics of relative growth, %.

| Age, days | I− K | II− O | III− O | IV− O |
|-----------|------|-------|--------|-------|
| 1-10      | 89.33±1.91 | 103.66±2.86 c | 112.70±4.20 c | 140.06±1.44 c |
| 10-20     | 112.29±1.84 | 106.75±2.41 | 102.91±2.72 a | 80.79±1.04 c |
| 20-30     | 67.32±4.62 | 68.58±3.45 | 66.72±3.36 | 75.57±2.59 |
| 30-40     | 70.39±2.19 | 72.30±0.35 | 69.92±0.55 | 60.60±2.22 b |
| 40-50     | 48.56±0.54 | 46.79±0.60 a | 45.92±0.52 b | 38.49±0.90 c |
| 50-60     | 34.69±0.64 | 33.67±0.38 | 33.38±0.53 | 32.83±0.45 a |
| 1-60      | 195.68±0.04 | 196.15±0.04 c | 196.22±0.03 c | 196.71±0.03 c |

This is noticeably manifested in the value of the indicator, depending on the level of antioxidants in poultry diets. So, the broilers of the second experimental group added more intensively to the mass by 16.04% (P<0.001), relative to the control group, the third - by 26.16% (P<0.001), and the fourth - by 56.79% (P<0.001). In subsequent periods, the impact of dihydroquercetin on the growth energy of chickens is leveled. Consequently, the addition of the drug to the composition of poultry compound feed does not have an obvious effect on the value of the relative increase, but it certainly contributes to better adaptation of the chickens of the experimental groups to the experimental conditions in the initial period.
The data on the productivity of birds, in connection with the use of the Dihydroquercetin during their rearing, allowed us to analyze the main zootechnical indicators of the effectiveness of rearing broiler chickens.

At the beginning of the experiment, the live weight at the day-old age of broiler chickens of all groups did not differ. The results obtained indicate that the inclusion of the drug "Dihydroquercetin" in their diet significantly affected the difference in the live weight of chickens in the experimental groups. So, at the age of 40 days, this indicator in the third experimental group was 16.51% more, and in the fourth by 33.56%, relative to the control.

Throughout the trial period of rearing, the preservation of broiler chickens of the III and IV groups was not recorded, while in the control group it was 70%, which allows us to indirectly judge the effect of the antioxidant on increasing resistance in poultry.

The analysis of the slaughter indicators of the experimental broiler breeding stock strongly indicates the effective effect of the biologically active substance (table 5).

| Parameters                                | I - K     | II – O     | III – O    | IV – O    |
|-------------------------------------------|-----------|------------|------------|-----------|
| Live weight before slaughter, g          | 3638.57±5.51 | 4072.00±56.83 | 4181.20±58.82 | 4831.40±54.94 |
| Weight of gutted carcass, g               | 2340.51±100.83 | 2701.10±69.46 | 2811.30±53.49 | 3231.20±56.80 |
| Including weight of lungs and kidneys, g | 28.74±3.63 | 31.35±3.58 | 33.87±3.72 | 38.17±3.91 |
| Slaughter-out-percentage, %              | 64.32±0.64 | 66.33±1.38 | 67.24±1.05 | 66.88±1.77 |
| Weight of a set of offal with a neck, g   | 303.75±5.98 | 342.15±5.42 | 347.50±5.57 | 425.16±5.73 |
| Including: liver, g                      | 79.86±2.02 | 77.37±6.99 | 80.00±2.03 | 91.31±3.05 |
| heart, g                                 | 23.00±0.75 | 24.43±0.92 | 25.09±0.81 | 28.51±1.84 |
| gizzard, g                               | 97.42±1.79 | 97.88±1.56 | 99.13±0.78 | 131.41±2.37 |
| neck, g                                  | 103.17±3.29 | 142.93±1.88 | 143.42±1.63 | 173.93±10.82 |
| The mass of the head without neck, g     | 142.11±1.91 | 142.73±4.05 | 143.57±2.90 | 171.03±3.02 |
| The mass of the legs, g                  | 200.28±2.93 | 204.12±3.40 | 216.63±2.94 | 232.01±2.42 |
| Feather-down raw materials, g            | 203.40±2.04 | 206.52±2.89 | 208.08±2.68 | 229.95±2.97 |
| Technical waste, g                       | 448.51±2.06 | 475.39±2.12 | 454.15±2.35 | 542.01±2.40 |

The weight of the gutted carcass of chickens of groups II, III and IV exceeded the control by 15.41; 20.11 and 38.06%, respectively, and this contributed to an increase in the Slaughter-out-percentage by 2.01; 2.91 and 2.55 %.

The results obtained indicate that there is no significant effect of the studied drug on the mass of byproducts'. However, the mass of internal organs tends to increase due to an increase in the dosage of the biologically active substance. This was most significantly reflected in the weight of internal organs of group IV chickens that received the drug at the rate of 1.0 kg per 100 kg of feed, this indicator was 1.4 times (P<0.01) more than in the control group.

A similar pattern is observed in the effect of an antioxidant on the yield of heads, legs, and feather-down raw materials, which reliably reflects the unconditional effect of a biologically active Supplement on the increase in live weight and the efficiency of fattening broilers.

Therefore, it is possible to note a positive effect of the antioxidant drug "Dihydroquercetin" on zootechnical indicators of growing and meat quality of broiler chickens. At the same time, it was objectively established that the best results were obtained when using the biologically active substance "Dihydroquercetin" at a dose of 1.00 g per 100 g of compound feed in broiler chickens of group IV.
3. Conclusions
Thus, the conducted studies allow us to assert that the most effective was the raising of broiler chickens of III-IV groups, and the best result was in the poultry group that received 1 g of dihydroquercetin per 100 g of feed, which gives grounds to consider this level to be optimal. It was found that a longer raising (up to 60 days of age) indicates its inexpediency and even with the use of the dihydroquercetin, due to the unprofitability of its further application, and the low return on costs for the purchase of the additive.

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