Reserves for increasing the productivity of broilers with a large-cage method of keeping

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Abstract. The paper describes the features of growing broiler chickens in conditions of large-group cage keeping at workshop No. 3 Patio of OOO Belgrankorm-Veliky Novgorod, Krestetsky District, Novgorod Region. The study used 2-start (11-20 days, granules), 3-growth (21-33 days, granules) and 4-finishing (34 days before slaughter). Broiler diets in the first period contained 1.26 MJ of metabolic energy (EE), the second – 1.28, the third – 1.30 and the fourth – 1.31 MJ (EE), crude protein, respectively (%) 22.42, 21, 49, 20.04 and 18.65. To increase the usefulness of diets and the use of nutrients and EE, the studied amino acids methionine and glycine, both individually and together in a 1:1 ratio, as well as Undevit vitamins, both individually and together with methionine in a 1:1 ratio (% by weight) were exposed to laser radiation of Hubbard broilers in the chest area through the laser beam of the spatial modulator (PM). Ozonation of air in the halls of the building and the poultry was carried out using a domestic ozonizer Rios of Dekont series (mode 3, productivity 20 g/m³). The feed conversion is quite high in 39 days of growing. The lowest consumption of feed (1.33 g/g) by production was observed in broilers of the third experimental group of the fourth scientific inhouse experiment against 1.85 g/g in the analogs of the control group.

1. Introduction

The quality of life of broiler chickens is largely determined by the growing and feeding conditions. In order to produce domestic tasty, healthy, economically beneficial, environmentally friendly products, it is necessary to be able to improve an integrated system that includes favorable conditions for keeping, growing and using high-grade, most effective feed products, feed additives, equipping poultry enterprises with modern devices and technologies [1, 2, 3, 7, 10, 11].

To improve the quality of nutrition and growing broiler chickens, to more fully realize their genetic potential, to increase the productivity and use of nutrients in rations and to normalize metabolic processes in the body [3, 8, 9], the tasks of increasing safety, health, stimulation digestion, growth energy [4, 5, 6], immune, hormonal functions [4, 5], providing favorable conditions for protein, lipid and carbohydrate metabolism and the activity of biomembranes of the central and autonomic nervous systems [6, 9, 11] in poultry are analyzed.

With the same compound feed, but with the additional use of the biotechnical method of influencing the body, there is a real opportunity to significantly increase the body weight, growth energy, payment for feed with products and training of the intestinal tract [7, 10, 12].
There are very few experimental materials on growing meat chickens in conditions of large-cage keeping, which prompted the development of a regional system for the production of poultry meat. The purpose of the study is to analyze the reserves for increasing meat productivity of broiler chickens with a large-cage method of keeping. To achieve this purpose, the following objectives shall be met:

- to evaluate the broiler chicken cultivation system in the large-cage method of keeping;
- to determine the effect of low-level laser radiation (LLLR) of the infrared (IR) range and ozonation \( \text{O}_3 \) of air in the room (building) on exchange processes, dynamics of the body weight, growth energy, feed efficiency.

2. Materials and methods.
To fulfill the above objectives, 4 scientific in-house and physiological experiments were carried out. The study was carried out in the workshop No. 3 Patio of OOO Belgrankorm-Veliky Novgorod, Krestetsky District, Novgorod Region.

| Table 1. Scheme of scientific in-house experiments |
|-----------------|----------------|-------------------|---------------------|
| **Experiment**  | **Group of broiler chickens** | **Breeding and feeding conditions** | **Influencing factors** |
|                 |                               |                                 | **LLLR** | **Ozonation, 5 min.** |
|                 |                               |                                 | **Pulse frequency, Hz** | **Pulse strength, W** | **Exposure, sec** |
| 1               | Control (general)             | BD (basic diet), water          | -         | -                    | -                |
|                 | I experimental                | BD, water (LLLR)                | 8         | 3                    | 8                |
|                 | II experimental               | BD, water (LLLR), methionine (100%) | 80       | 3                    | 8                |
|                 | III experimental              | BD, water (LLLR), methionine+glycine 1:1 | 80       | 3                    | 8                |
| 2               | I experimental                | BD, water (LLLR), Undevit       | 80       | 3                    | 8                |
|                 | II experimental               | BD, water (LLLR), Undevit       | 80       | 3                    | 15               |
|                 | III experimental              | BD, water (LLLR), methionine+Undevit 1:1 | 80       | 3                    | 8                |
| 3               | I experimental                | BD, water (LLLR), ozonation 3 mode | 80       | 3                    | 8                |
|                 | II experimental               | BD, water (LLLR), ozonation 3 mode, methionine | 80       | 3                    | 8                |
|                 | III experimental              | BD, water (LLLR), methionine+glycine 1:1, ozonation 3 mode | 80       | 3                    | 8                |
| 4               | I experimental                | BD, water (LLLR), Undevit, ozonation 3 mode | 80       | 3                    | 8                |
|                 | II experimental               | BD, water (LLLR), Undevit, ozonation 3 mode | 80       | 3                    | 15               |
|                 | III experimental              | BD, water (LLLR), methionine+Undevit 1:1, ozonation 3 mode | 80       | 3                    | 8                |
Selection of clinically healthy Hubbard cross broiler chickens of a day age was carried out according to the principle of the pairs of analogues taking into account the origin and body weight. Each group included 140 chickens, which were kept in cages, the body weight was determined by individual blind weighing (i.e. without sampling) – four times over the entire growing period in the following periods (days): 1, 12, 22 and 39.

Broiler chickens were kept in six-row two-fold large-group cages (i.e. from the wall to the wall of the cage). For scientific in-house and physiological experiments inside the workshop, plastic partitions with holes were built in to pass the air flow and comply with the corresponding microclimate and optimal consumption, accounting for feed and drinking water. Amino acids (methionine and glycine) and Undevit vitamins included a spatial modulator (SM) in the form of a 30x30 mm container of porous white paper weighing 2.0 g attached to two emitters (simultaneously) of Uzor 2K-Super laser. Amino acids and vitamins were purchased from pharmacies in Veliky Novgorod.

The experiments were carried out according to conventional procedures in accordance with the study scheme (Table 1).

Digestibility and nutrient use were studied for each group in the control group.

Physiological experiments were carried out to determine the digestibility and use of nutrients, as well as the balance of nitrogen, calcium and phosphorus in the body four days before slaughter (3 heads from each group).

Access to feed and water is free for chickens. The change of feed was carried out four times during the entire growing period.

Meat chickens for slaughter were taken in the morning at 6 o’clock, slaughter was carried out in a slaughter and processing workshop. The studies were carried out using domestic semiconductor lasers Uzor2K-Super with minimum laser operation parameters (wavelength – 0.89 μm, pulse power – 3 W, pulse frequency – 80 Hz) and mobile ozonator Rios-20 (mode 3, capacity 20 g/m³; Penza). After slaughter, biochemical studies of blood serum were carried out in the veterinary laboratory of the poultry farm and the Novgorod Regional Oncology Center.

3. Results and discussion

During 39 days of growing Hubbard broiler chickens, the crude fat content (in diets) increased from 5.84 to 8.75%, raw fiber – from 2.69 to 4.14%, and, conversely, the concentration of crude protein decreased from 22.42 to 18.65%. Over all age periods of growing and feeding, the chickens consumed (ate) only 3,593 g of compound feed and drank 6,472 g of water. The weight of the diet (feed plus drinking water) was 10,065 g, i.e. more than 10 kg. The juiciness of the diet was 1.8:1, which corresponds to one of the most important indicators of its fullness when growing broilers in the conditions of a large-group cage method.

The ratio of crude protein to crude fat in diets ranged from 3.84:1 to 2.43:1, i.e. there was a tendency towards a decrease with increasing age and body weight. A similar trend was observed in the consumption of crude protein and raw fiber in diets, the ratio of which ranged from 8.33:1 to 4.54:1. Minimum indicators in both cases were observed when feeding feed to broilers aged 11-20 days before slaughter. The need to reduce the proportion of a number of components in diets is caused by an increase in their concentration of crude fat and exchange energy.

Therefore, it was necessary to note a new indicator of dietary compliance for this cross, which, unlike the energy-protein ratio, characterizes the energy-fat ratio, and tended to decrease from 51.79 to 35.96.

Diets are balanced in terms of calcium and phosphorus content. Given their balance, the ratio of Ca:P (available) in diets ranged from 1.75:1 to 1.98:1. The ratio of vitamin A:vitamin D₃ in diets ranged from 2.9:1 (for start) to 3.3:1 (for finish) is closely associated with the strengthening of ligaments, joints, skeleton and wings when transporting broilers to the slaughter shop.

The balancing of diets according to the concentration of fat (lipid) fodder products led to optimal ratios, for example, crude fat: linoleic acid – from 2.08:1 (for growth) to 2.34:1 (for fattening), crude fat: exchange energy – from 4.6:1 (for prestart) to 6.7:1 (for growth).
Such indicator as the ratio of vitamin E:Se in the diets of broilers was 500:1, it is constant and serves the preventive norm for the need for vitamin E and selenium to increase the body weight at the age of 36-39 days.

In addition to controlling the completeness of diets, ventilation modes, temperature, humidity and illumination of broiler chickens, it was necessary to identify metabolic processes using the biotechnical method of exposure.

**Nutrient digestibility of diets.** When exposed to low-level laser radiation (LLLR) of the infrared (IR) range, which has the main biological and physiological effects on the body, the state of the central and autonomic nervous system is improved through respiratory organs and skin due to an increase in enzymatic, hormonal and immune status, redox potential, functional state, activity of the digestive system of broiler chickens.

**Table 2. Nutrient digestibility of diets, %**

| Group of broiler chickens and method of treatment | Dry matter | Organic matter | Crude protein | Raw fiber | Crude fat |
|-------------------------------------------------|------------|----------------|--------------|-----------|-----------|
| 1                                               | 2          | 3              | 4            | 5         | 6         |
| First experiment                                |            |                |              |           |           |
| Control (general), BD (basic diet), water       | 77.4±0.24  | 80.9±0.24      | 81.2±0.13    | 23.1±0.26 | 69.9±0.32 |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz)    | 78.6±0.18*** | 81.7±0.28*    | 83.7±0.34*** | 25.6±0.15*** | 71.2±0.18*** |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine (100%) | 78.9±0.29*** | 81.5±0.31 | 84.2±0.27*** | 24.7±0.29*** | 76.4±0.35*** |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+glycine | 81.6±0.12*** | 82.0±0.43* | 85.6±0.28*** | 25.9±0.43*** | 76.4±0.47*** |
| Second experiment                               |            |                |              |           |           |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit | 83.7±0.37*** | 84.7±0.47*** | 87.2±0.35*** | 27.4±0.51*** | 77.6±0.27*** |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit | 82.1±0.15*** | 84.9±0.15*** | 88.4±0.43*** | 26.8±0.38*** | 78.7±0.31*** |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+Undevit 1:1 | 82.6±0.24*** | 83.6±0.33*** | 87.6±0.49*** | 28.1±0.28*** | 79.1±0.28*** |
| Third experiment                                |            |                |              |           |           |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz), ozonation 3 mode 5 min | 78.1±0.23* | 81.8±0.28* | 85.7±0.28*** | 27.3±0.26*** | 76.2±0.27*** |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine 100%, ozonation 3 mode 5 min | 79.1±0.44*** | 82.4±0.29*** | 84.3±0.11*** | 27.9±0.21*** | 76.7±0.42*** |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+глицин 1:1, ozonation 3 mode 5 min | 82.3±0.33*** | 82.7±0.14*** | 85.2±0.37*** | 28.0±0.28*** | 77.4±0.27*** |
| Forth experiment                                |            |                |              |           |           |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit, ozonation 3 mode 5 min | 79.8±0.14*** | 82.7±0.34*** | 87.7±0.23*** | 29.3±0.34*** | 78.0±0.29*** |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit, ozonation 3 mode 5 min | 81.6±0.62*** | 83.4±0.18*** | 88.3±0.41*** | 28.3±0.14*** | 78.2±0.63*** |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+Undevit 1:1, ozonation 3 mode 5 min | 82.4±0.29*** | 84.9±0.28*** | 88.2±0.12*** | 29.5±0.71*** | 77.6±0.47*** |

*P <0.05, **P <0.01, ***P <0.001
The action of LLLR is based on the enhancement of the production of free radicals: at the first stage: lipid radicals during photoperoxidation, the second stage – superoxide and NO. More intense NO release is accompanied by dilation of blood vessels and improved blood circulation.

Ozonation (O₃) of air oxygen with an exposure of 5 minutes was taken for the sanitization of buildings and poultry.

It was possible to detect the difference in nutrient digestibility of diets in the broilers of the control (general) and all experimental groups (Table 2).

It was found that crude fat is better digested in the body of broilers when irradiating methionine (74.9±0.35%, P<0.001; by 7.1%), methionine+glycine (76.4±0.47%, P<0.001; by 9.3%). The maximum indicator was revealed when irradiating methionine with Undevit (1:1 by weight), which is equal to 79.1±0.28% (P<0.001) versus 69.9±0.32% in the control group.

Digestibility of diet protein increased from 87.7±0.23% (P<0.001) to 88.3±0.41% (when irradiating Undevit with exposure 8 sec and 15 sec, respectively, in combination with ozonation of indoor air and poultry).

The laser beam passing through the Undevit complex of water-soluble vitamins with an exposure of 8 sec and 15 sec stimulated an increase in protein digestibility, which was 87.2±0.35% (P<0.001) and 88.4±0.43% (P<0.001), respectively.

Digestibility of dietary fiber increased from 24.7±0.29% (P<0.001) to 29.5±0.71% (P<0.001) depending on the nutritional effect on the body against 23.1±0.26% in the control group. The laser beam (IR) in contact with methionine, both alone and in combination with glycine (1:1 by weight), as well as with air ozonation, changes functional, biological and physiological characteristics of the body associated with metabolism.

When irradiating Undevit and amino acids of methionine with a laser, both separately and together with the use of an ozone-air mixture for poultry, it became possible to increase the digestibility of nitrogen by the body against the background of the basic diet. The balance of nitrogen in the body of broiler chickens of control and experimental groups is positive. Nitrogen retention in the body using ozone-air mixture with exposure of 5 minutes was 18.2% above the control level.

To increase the size of calcium retention in the body and its digestibility, the studied biological active substances (amino acids – methionine and glycine, and the Undevit complex of water-soluble vitamins) were passed through a laser beam. With the help of an ozonator it becomes possible to improve the quality of the air ozone mixture in the shops of the poultry farm.

LLLR exposure on the chest area of broilers using ozone (without amino acids) led to an increase in the body ratio of Ca:P to 1.67:1. When introducing a laser beam through amino acid, methionine, both separately and in combination with glycine when ozonizing air, the Ca:P ratio in the body was 1.63:1 and 1.59:1, respectively. The retention of phosphorus in the body of broilers tended to grow from 0.296±0.02 g when irradiated with Undevit to 8 sec and 0.301±0.03 g of the same vitamins with exposure to 15 sec. The digestibility of phosphorus in the body with a difference in laser radiation from 8 to 15 sec was 47.7±0.64% and 48.5±0.85%, respectively.

The optimal Sa:P ratio was revealed in the body of broilers, which corresponds to the norms for feeding agricultural poultry (Moscow, RAS, recommendations of the All-Russian Research and Technological Institute of Poultry Farming).

The functional activation of the digestive system increased with an improvement in the quality of feeding when using nutrient and biologically active substances of diets, as well as the metabolic processes alongside with an increase in enzyme, immune and hormonal systems, detoxification function of liver and at the organizational level.

Therefore, in case of improved state of lipid-nitrogen-white-carbohydrate metabolism in broilers under the influence of laser radiation of amino acids (methionine, glycine) and Undevit led not only to an increase in the level of digestibility of organic substances of diets, but also to the degree of retention (accumulation) of total nitrogen, calcium and phosphorus in the body depending on age and body weight.

Table 3 shows the dynamics of the body weight of broiler chickens. At the age of 12 days, the minimum body weight in meat chickens was detected in the control group equal to 403.3±25.1 g, while in poultry of experimental groups this indicator ranged widely depending on the influencing factor.
Under the same growing and feeding conditions during this age period, the body weight increased to 420.0±0.90 g, or 4.1% in case of LLLR exposure to the chest area, and when the methionine amino acids were irradiated with a laser beam, it increased to 6.6%.

Complex irradiation of methionine+glycine in the ratio 1:1 (by weight) led to an increase in the body weight to 433.3±7.4 g or by 7.4%. Complex irradiation (simultaneously) of two amino acids with a laser was carried out before ozonation of the workshop, poultry house. A higher body weight of broilers was established when irradiating Undevit vitamins with a laser (436.7±8.9 g with an exposure of 8 sec and 440.0±7.1 g with an exposure of 15 sec). The maximum body weight equal to 445±9.5 g was revealed when using methionine with Undevit (1:1 by weight) with 8 sec exposure of in case of using air and bird ozonation.

Table 3. Body weight dynamics of Hubbard cross broiler chickens

| Group of broiler chickens and method of treatment | Body weight, g | 1st day | 12th day | 22nd day | 39th day |
|-------------------------------------------------|---------------|---------|----------|----------|----------|
| I scientific in-house experiment                |               |         |          |          |          |
| Control (general) BD (basic diet), water         | 50.3±5.5      | 403.3±25.1 | 993.3±22.9 | 1940.0±33.0 |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz)     | 50.7±7.0      | 420.0±0.9  | 1076.7±21.5* | 2206.7±31.6 |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine (100%) | 50.5±6.0 | 430.0±14.3 | 1051.7±23.8 | 2216.7±34.6* |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+glycine | 50.1±4.2 | 413.3±10.9 | 1176.7±35.2** | 2366.7±39.8* |
| II scientific in-house experiment                |               |         |          |          |          |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit | 50.5±7.5 | 411.7±12.5 | 1060.0±42.9 | 2385.0±25.0* |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit | 50.2±7.5 | 428.3±5.5  | 1036.7±38.2 | 2580.0±25.8** |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+Undevit 1:1 | 50.3±5.2 | 433.3±10.9 | 1105.0±32.1* | 2476.7±26.6* |
| III scientific in-house experiment               |               |         |          |          |          |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz), ozonation 3 mode 5 min | 502.±6.5 | 416.7±10.9 | 1100.0±28.6* | 2246.7±26.8 |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine 100%, ozonation 3 mode 5 min | 50.3±5.2 | 431.7±5.5  | 1103.3±39.9 | 2100.0±24.5 |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+glycine 1:1, ozonation 3 mode 5 min | 50.2±7.5 | 433.3±7.4  | 1126.7±23.0** | 2461.7±25.7* |
| IV scientific in-house experiment                |               |         |          |          |          |
| I experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit, ozonation 3 mode 5 min | 50.4±7.0 | 436.7±8.9  | 1103.3±34.8 | 2448.3±26.8* |
| II experimental, BD, LLLR (8 sec, 3 W, 80 Hz), Undevit, ozonation 3 mode 5 min | 50.3±5.5 | 440.0±7.1  | 1096.7±17.9* | 2528.3±29.1* |
| III experimental, BD, LLLR (8 sec, 3 W, 80 Hz), methionine+Undevit 1:1, ozonation 3 mode 5 min | 50.1±4.2 | 445.0±9.5  | 1073.3±21.8* | 2708.3±10.3*** |

*P <0.05, **P <0.01, ***P <0.001
The use of Undevit with subsequent irradiation simultaneously led to an increase in body weight, namely, up to 2580.2±25.8 g (P<0.01), which is 32.9% higher than the control level. In case of using these vitamins in combination with methionine (1:1) with 8 sec exposure during air ozonation during 5 min, the body weight was 2708.3±10.3 g (P<0.001).

When exposed to LLLR using the minimum laser operating parameters, the absolute body weight increased (compared to the control group) to 65.7±12.3 g, or by 11.3% (Table 3).

The 8 sec exposure of Undevit vitamins led to an increase of up to 64.8±21.4 g, or by 9.8%, while when the exposure increased to 15 sec, this indicator decreased to 60.8±13.40 g, i.e. by 3.0%. The irradiation of vitamins together with methionine (1:1 by weight) caused an increase in gains to 69.2±19.1 g, which is 17.2% to the control.

Due to the increase in the age period from 23 to 39 days, broiler chickens showed relatively high increases in body weight, namely 90.8±34.5 g in case of irradiation of Undevit – 96.1±13.9 g with complex irradiation of methionine amino acid and Undevit at a ratio (1:1) in combination with air ozonation.

Taking into account the peculiarities of growing and fattening of this cross poultry, it should be emphasized that for individual age periods the following was consumed per head: 1-12 days – 393 g of compound feed and 706 ml of water, 13-22 days, respectively, 852 g and 1540 ml, 23-39 days, respectively, 2348 g and 4226 ml. Thus, for all periods of growing and feeding broilers, only 3593 g of feed and 6472 ml of drinking water were consumed (per head).

Feed efficiency of 1-day old chickens was 0.24 g per 1 gram of the body weight. At this age a chicken drinks an average of 0.44 ml of water, i.e. twice as much as it consumes food. Feed conversion in broiler chickens at the age of 12 days ranged from 0.88 to 0.95 g/g depending on the effect factor on the body, while in meat chickens of the control group it was 0.97 g/g. During this age period, they drank from 1.59 to 1.71 g of water versus 1.75 g in the control group.

When growing at the age of 13-22 days, they consumed 0.72 to 0.81 g of compound feed against 0.85 g per 1 g of gain in chickens in the control version. The broilers of the experimental groups consumed 1.3 to 1.46 g of water versus 1.55 g in the control. There was a high conversion of feed in broilers of the third experimental group of the first experience, in particular when exposed to LLLR on the breast area (0.72 g/g).

High feed efficiency was also found in broilers when exposed to LLLR using the studied amino acids both separately and in combination with Undevit vitamins.

Therefore, it was necessary to determine the influence of the biotechnical method on training the intestinal tract in broiler chickens with this method of management. With an increase in the length of the intestine it becomes possible to progress the moisturized feed mass more slowly in the gastrointestinal tract, efficiently process it into the muscular and glandular parts of the stomach, improve digestibility and use of dietary nutrients. With such an indicator as the ratio of water (separately) in the diet (g): the length of the entire intestine (cm), it should be taken into account that by 1 kg (l) of drunk water, the size (length) of the entire intestine increases from 27.9 to 33.6 cm.

When improving the broiler growing system it is necessary to take into account both the size and weight of the intestine, especially when using laser radiation in the production of environmentally friendly meat. It was found that in terms of the weight of the diet (feed plus water for the entire period of cultivation before slaughter) there were from 43.3 to 52.3 cm of the entire length of the intestine. The ratio of the diet weight (g) without taking into account drinking water: the weight of the entire intestine (g) ranged from 17.5 to 27.9, which means when consuming the entire diet feed, the weight of the intestine falls from 17.5 to 27.9 g.

The anatomical and zootechnical assessment of the carcasses of broiler chickens revealed that with the characteristic ratio of the body weight (g): intestinal length (cm), the following should be taken into account – for each centimeter of the entire intestine length there are from 10.3 to 14.0 g of body weight of birds.

4. Conclusion
With the same quantities and qualities of compound feed and drinking water, the broiler chickens of the Hubbard cross at different age periods and with the use of optimized dietary and management modes, low-level laser radiation (LLLR) and ozone-air mixture, biologically active substances (methionine, glycine, Undevit vitamins) in particular, show an increase in metabolic processes, accumulation of nutrient and biologically active substances, exchange energy, an increase in body weight, growth energy, feed conversion and high anatomical and zootechnical assessment of broiler carcasses.

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