Modernized system of phased broiler chicken rearing

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Abstract. The modernized domestic complex of LLC "Belgrankorm – Veliky Novgorod" is engaged in the production of embryos, eggs, meat, its processing and freezing and facilitates productivity of chickens, safety of a livestock, body weight gain, achieves the reduction of rearing terms by 5 days and the decrease of feed expenses on 1 kg of production. The duration of the incubation period of eggs in the cabinets of the incubation shop is 18 days. During the following incubation phase (from 18th to 21st days) toxic substances, gases and decay products accumulate in the cabinets. They also get into the body of embryos and hatched chickens, as well as maintenance personnel. Modernized poultry farm facilities enable embryos to be transported by mobile method for three days (from 18th to 21st day) directly to poultry houses (buildings) for hatching of chickens and their subsequent rearing. This can significantly reduce the amount of toxic substances, gases and decay products, energy and financial costs and improve environmental and biological safety. On the 18th or 19th day, egg embryos were exposed to ozonation for 5 min by the "Rios–20" apparatus with a capacity of 20 g/m3. With the current technology, hatching of chickens directly in the housing (poultry house) occurs on the 21st day, when they jump out of their lofty perches in special conveyor belts, quickly find their "working" places, identify their drinking bowls (nipple), feeders and litter (with grain). Broiler chickens of cross "Hubbard" were reared.

1. Problem Statement
Various phytopreparations, antioxidants and biocorrectors in the diets of broiler chickens are used to reduce or eliminate the toxicological effect on the body of poultry, improve metabolic processes and product quality, increase productivity and reduce feed costs [1-4].

Implementation of amino acids (glycine, methionine) and active components (Complivit, Selmevit, Biomax, and Undevit) for broiler chickens feeding is a relevant and promising research trend. The above mentioned substances were used in the form of granules (tablets) in a mixture with compound feed in certain phases of rearing: on the 11-20 days (1 time) and 21-33 days (1 time), that is, twice in 35 days of their feeding [5-8].

The composition of the Complivit includes vitamins, calcium, phosphorus, manganese, copper, zinc, magnesium, cobalt. This vitamin and mineral complex is necessary to fill the physiological need for vitamins and minerals and is balanced with the daily allowance for broiler chickens with the use of intensive rearing technology. In scientific research, a new purpose of its usage in ration along with a number of amino acids is stated.

The composition of Selmevit includes vitamins, methionine (100 mg per tablet), phosphorus, calcium, magnesium, iron, manganese, copper, zinc, cobalt, selenium. Selmevit increases the body's resistance to stressful situations, improves the growth and development of broiler chickens.
The Biomax contains vitamins (fat-and water-soluble), as well as iron, copper, cobalt, manganese, zinc, calcium, phosphorus, magnesium. Biomax strengthens the protective forces of the organism and contributes to the optimal functioning of the nervous system of the bird, increases resistance to overloads, provides development and differentiation of tissues, improves the condition of the skin, feathers, skeleton, blood vessels, protective forces of the body. Pharmacological action is determined by the complex of vitamins and mineral macro- and microelements included in the preparation. Biomax is necessary for intensive growth, development and production of high body weight of broilers under cage management.

The composition of Undevit includes water-and fat-soluble vitamins. Undevit enhances the strength of blood vessels and skeleton of broilers. All these properties of biocorrectors are used to improve metabolic processes in the body of broiler chickens.

In real conditions of broiler chickens growing amino acids (glycine and methionine) and complexes of active components (Complivit, Selmevit, Biomax and Undevit) were used to reduce or eliminate stressful situations in the body. Four phases of rearing were determined in the following terms (day): 1, 4, 15 and 35.

The change of compound feed (CF) was carried out four times according to recipes: the first CF-5-1 (grits) the prelaunch phase, age 0-10 days, the second – CF-2 (granules) the starting phase, age 11-20 days, the third CF-5-5 (granules) the growth phase, age 21-33 days, the fourth CF-6 (granules) the final fattening phase, age from 34 days to slaughter.

Conventional methods of prevention and treatment with chemicals in many cases do not give the expected result [9-11]. In this regard, in the last 15–20 years, there has been a significant increase of interest in the use of medical feed products, various complexes having the properties of biocorrectors to reduce or eliminate the toxicological effect on the body in order to improve the quality of poultry meat [12, 13]. As part of the diet of poultry, these substances and complexes are of certain interest for science and practical activities.

2. Research methods
The research was conducted on the base of LLC "Belgrankorm-Veliky Novgorod" (Patio №3) in Krestzy district of Novgorod region. The domestic technology of broiler chicken rearing under the conditions of large-group cage management has been developed. Poultry houses are equipped with devices that regulate the light mode and microclimate. The poultry house (housing) is equipped with broiler batteries and is designed for 125 thousand broiler chickens. Cross "Hubbard" is used. The scheme of experiments is presented in Table 1.

| Group of broiler chickens | Livestock, heads | Rearing conditions |
|---------------------------|------------------|--------------------|
| First Experiment          |                  |                    |
| General Control Group     | 140              | The basic diet (BD; water) |
| Test Group I              | 140              | BD + glycine (100% by weight) |
| Test Group II             | 140              | BD + glycine + Complivit (1:1) by weight |
| Test Group III            | 140              | BD + glycine + Selmevit (1:1) by weight |
| Test Group IV             | 140              | BD + glycine + Biomax (1:1) by weight |
| Second Experiment         |                  |                    |
| Test Group I              | 140              | BD + methionine + Complivit (1:1) by weight |
| Test Group II             | 140              | BD + methionine + Selmevit (1:1) by weight |
| Test Group III            | 140              | BD + methionine + Biomax (1:1) by weight |
| Third Experiment          |                  |                    |
| Test Group I              | 140              | BD + methionine (100% by weight) |
| Test Group II             | 140              | BD + methionine + glycine (1:1) by weight |
| Test Group III            | 140              | BD + glycine + Undevit (1:1) by weight |

Table 1. The scheme of experiments
Selection of clinically healthy broiler chickens of the age of 1 day was carried out on the principle of analogue, taking into account the origin and body weight. 140 broiler chickens were included in each group. Their growth and development were studied in terms of body weight, the absolute average daily body weight gain, the amount of feed and water used in diets. In scientific and economic experiments, the conventional method was used, while for physiological experiments 3 heads from each group were selected.

The body weight of broiler chickens during the study was measured by the method of individual blind weighing. The content of minerals and heavy metals in the samples was determined in the Central Chemical Laboratory of PJSC "Akron", located in the Novgorod region.

Chemical analysis of bioassays of compound feed and manure was carried out according to the following methods: dry substance – by drying in a drying cabinet to a constant mass at a temperature of 100-105 °C, total nitrogen – by Kjeldal, nitrogen of broiler manure by M. I. Dyakov – by the release of uric acid and its salts, crude fat – by Soxlet, fiber – by Kirchner and Ganek, calcium - by volumetric method, phosphorus – colorimetrically. Broiler chickens for slaughter were selected in the morning at 6 o'clock, slaughter was carried out in the slaughter-processing shop.

3. Findings and Discussion

Recipes of compound feed are used to improve growth rate and final fattening, nutrients efficiency and metabolic energy of the body. The content of crude fat in 100 g of complete compound feed is directly proportional to the increase in the age and body weight of broiler chickens of cross "Hubbard", which accounted for from 2.36 % in the first decade to 7.56 % by weight in the last day of fattening phase.

A similar trend was observed in the ratio of the concentration of metabolic energy in it, which can be explained by the increase in the content of crude fat in diets due to the inclusion of sunflower oil from 2.70 to 3.90 % and poultry fat before slaughter (1.0 % by weight). With the concentration of crude fat within these limits, the content of crude fiber in compound feed varied from 2.92 to 4.02 % by weight, which corresponds to the generally accepted norms of feeding broiler chickens.

The concentration of metabolic energy in 100 g of feed ranged from 1.23 to 1.34 MJ depending on age and body weight. Feeding rations were balanced in calcium and phosphorus content and the ratio varied from 2.0:1 to 2.3:1, crude protein content ranged from 22.15 to 18.17 %. Diets are balanced in terms of nutrients and biologically active substances, and metabolic energy in accordance with the generally accepted norms of farm animal feeding.

Control weighing was carried out on the 1st day, 4th day and 15th day, and before the slaughter on the 35th day, broilers were weighed again. The body weight dynamics of broiler chickens in certain phases of rearing is presented in Table 2. Their body weight at the age of 1 day varied from 39.0±0.70 g to 41.0±1.22 g versus 39.6±1.49 g in the control group (P<0.05). At the age of 24 hours, the body of the chickens adapted to the new keeping and feeding conditions.

Body weight monitoring of broiler chickens in different phases of rearing was carried out along with the analysis of corresponding absolute average daily weight gain, which is presented in the Table 3. It was found that the absolute average daily body weight gain during the age period of 1-4 days ranged from 18.7±0.57 g to 19.6±0.55 g in the control group (P<0.05). Thus, during the age period of 11 days, absolute average daily body weight gain of broiler chickens varied from 66.0±0.16 g to 75.1±1.06 g, while in the control group of their peers it was 66.7±4.4 g (P<0.05).

When using glycine with Complivit in a ratio of 1:1 (by weight), the absolute body weight gain (on average) increased to 68.8±0.50 g, or by 3.1 % (P<0.05). During the same period (5-15 days) there was a decrease in the value of this indicator to 62.8±0.19 g (P<0.05) when glycine combined with Biomax (1:1) was used.

When methionine with Complivit in a ratio of 1:1 (by weight) was used, more effective processes of digestion, assimilation of nutrients and biologically active substances of diets and of the above mentioned complex of active components were measured, which led to an increase in the absolute average daily body weight gain, namely 75.1±1.06 g, which is 12.5 % higher than that of the peer control group (P<0.05).
Table 2. Body weight dynamics of broiler chickens of cross "Hubbard» in certain phases of rearing

| Broiler Chickens Group, Impact Factor | Body Weight, g | 1<sup>st</sup> Day | 4<sup>th</sup> Day | 15<sup>th</sup> Day | 35<sup>th</sup> Day |
|--------------------------------------|----------------|-------------------|------------------|-------------------|------------------|
| First Physiological Experiment       |                |                   |                  |                   |                  |
| Control Group, common                |                |                   |                  |                   |                  |
| (Basic Diet - BD; water);            |                |                   |                  |                   |                  |
| Test group I. BD + glycine (100% by weight) |   | 39.6±1.49         | 118.0±0.70       | 852.0±47.7        | 1991.0±0.50      |
| Test group II. BD + glycine          |                | 39.3±1.08         | 117.7±1.08       | 872.0±17.8        | 2048.0±54.2      |
| +Complivit (1:1) by weight           |                | 39.3±1.08         | 117.3±1.65       | 874.1±3.90        | 2159.0±52.1      |
| Test group III. BD + glycine +Selmevit (1:1) by weight |   | 39.7±1.47         | 116.0±0.70       | 843.0±1.0         | 2235.0±57.8      |
| Test group IV. BD + glycine +Biomax (1:1) by weight |   | 39.0±0.70         | 117.0±0.70       | 807.6±1.47        | 2203.0±17.1      |
| Second Physiological Experiment      |                |                   |                  |                   |                  |
| Test group I. BD + methionine        |                | 39.0±0.70         | 116.1±1.06       | 942.0±10.6        | 2246.7±47.6      |
| +Complivit (1:1) by weight           |                | 39.0±0.70         | 116.3±0.49       | 794.0±1.09        | 2299.0±48.7      |
| Test group II. BD + methionine +Selmevit (1:1) by weight |   | 39.0±0.70         | 117.0±0.70       | 843.1±1.09        | 2363.3±0.50      |
| Test group III. BD + methionine +Biomax (1:1) by weight |   | 40.0±0.71         | 117.0±0.70       | 843.1±1.09        | 2363.3±0.50      |
| Third Physiological Experiment       |                |                   |                  |                   |                  |
| Test group I. BD + methionine (100% by weight) |   | 39.7±1.08         | 118.3±1.08       | 863.1±14.5        | 2322.6±0.50      |
| Test group II. BD + methionine +glycine (1:1) by weight |   | 40.3±1.49         | 117.7±1.07       | 847.0±0.70        | 2147.3±5.73      |
| Test group III. BD + glycine +Undevit (1:1) by weight |   | 41.0±1.22         | 116.0±1.08       | 898.0±1.00        | 2191.3±48.3      |

***p <0.001

During the rearing phase from 16 to 35 days, i.e., for 20 days, the absolute body weight gain ranged from 56.0±3.43 g to 72.4±0.75 g (P<0.001) versus 54.2±2.29 g in the control group.

Based on the experimental studies, it was found that with the intensive broiler chicken rearing under the conditions of a large-group cage management (in a modern complex for the poultry meat production), the body weight could be increased through the use of amino acids (glycine and methionine separately) in combination with complexes of active components – Complivit, Selmevit, Biomax and Undevit.

Body weight gain of poultry was achieved with the use of the same recipes of complete compound feed and excluding any additional amount of feed for 35 days of rearing.

Glycine with Complivit (in a ratio of 1:1 by weight) contributed to the production of broilers with a body weight of 2159.0±52.1 g, which is 8.4 % higher than that of the control group of their peers (P<0.001). Applying the same amino acid in combination with Selmevit, body weight increased to 2235.0±57.8 g, or by 12.2 % (P<0.05). And in the case of using glycine with Biomax (in a ratio of 1:1 by weight), this figure was 2203.0±17.1 g, which is 10.6 % higher than the control level (P<0.001).

It is evident that the use of the methionine amino acid with different complexes of active components increases the body weight of broilers at this age. Thus, methionine with Complivit in a ratio of 1:1 (by weight) contributed to the body weight of 2246.7±47.6 g (P<0.001), and with Selmevit (1:1) – 2299.0±48.7 g (P<0.001) and, finally, with Biomax (1:1) – 2363.3±0.50 g (P<0.001). The use of methionine with the studied complexes of active components stimulated an increase in the body weight of broiler chickens compared to the control group by 12.8 %, 15.5 % and 18.7 %, respectively.
Table 3. Absolute average daily body weight gain of broiler chickens of cross "Hubbard", g

| Broiler Chickens Group, Impact Factor | Age phase, days | On average in 35 days |
|--------------------------------------|-----------------|-----------------------|
| **First Physiological Experiment**    |                 |                       |
| Control Group, common (Basic Diet - BD; water); | 1-4 | 54.2±2.29 | 56.9±1.62 |
| Test group I. BD + glycine (100% by weight) | 5-15 | 56.0±3.43 | 58.5±1.67 |
| Test group II. BD + glycine +Complivit (1:1) by weight | 16-35 | 61.1±2.67 | 61.7±1.76 |
| Test group III. BD + glycine +Selmevit (1:1) by weight | | 66.3±2.80 | 63.8±1.82 |
| Test group IV. BD + glycine +Biomax (1:1) by weight | | 66.4±0.88 | 62.9±1.79 |
| **Second Physiological Experiment** |                 |                       |
| Test group I. BD + methionine +Complivit (1:1) by weight | 1-4 | * | ** |
| Test group II. BD + methionine +Selmevit (1:1) by weight | 5-15 | *** | ** |
| Test group III. BD + methionine +Biomax (1:1) by weight | 16-35 | 71.7±2.37 | 65.7±1.87 |
| Test group IV. BD + methionine (100% by weight) | | 72.4±0.75 | 67.5±1.93 |
| **Third Physiological Experiment** |                 |                       |
| Test group I. BD + methionine +glicine (1:1) by weight | 1-4 | *** | *** |
| Test group II. BD + methionine +Undevit (1:1) by weight | 5-15 | *** | |
| Test group III. BD + glycine +Biomax (1:1) by weight | 16-35 | 61.9±0.31 | 61.3±1.75 |
| **4. Feed consumption and conversion into meat production at different phases of broiler chickens rearing** |     |                       |

It was found that the feed conversion of chickens at the age of 1 day ranged from 0.29 to 0.31 g per 1 g of body weight. At this age, they drank water from 0.54 to 0.56 g, that is, 1.8 - 1.9 times more than the consumption of dry feed. At the age of 4 days, feed conversion varied from 0.53 to 0.54 g per 1 gram of body weight. During the same age period, water consumption ranged from 0.95 to 0.97 g.

On the fourth day of consumption of feed and drinking water by broiler chickens both control and test groups did not go beyond a significant difference. It should be emphasized that since the 15th day of rearing, individual fattening qualities of this cross became noticeable: a sense of perception of a particular recipe of complete compound feed, filling of feeders and the smell of freshly prepared feed, so from this age period, the conversion of feed varies from 0.62 to 0.75 g per 1 gram of body weight, while for broiler chickens of the control group it was 0.70 g/g. On the 15th day of rearing, the test group broiler chickens drank from 1.13 to 1.37 g/g of water versus 1.25 g/g in the control group. 593 g of compound feed is consumed and 1067 g of water is drunk during this age period.

Feed conversion of broiler chickens increased to 0.62 g/g when using methionine with Complivit (1:1 by weight), in particular by 12.9% in control group. The increase in feed conversion means lower feed consumption. Increased feed conversion with the use glycine combined with Biomax (1:1 by weight), which amounted to 0.73 g/g, which is 4.3 % higher than the control level (P<0.05). A similar trend was observed when using methionine with Selmevit (II scientific and economic experiment), the
consumption of which had increased to 0.75 g/g, i.e. by 7.1% (P<0.05). During the broiler chicken rearing from 16 to 35 days (i.e. within 20 days), 2257 g of feed per head was consumed and 4063 g of water was drunk. For all periods of intensive rearing of broiler chickens of this cross the expenditure of complete compound feed and drinking water was only 2850 g and 5130 g respectively.

Due to the improvement of feed conversion, consumption of the same feed decreased. The highest feed conversion is 1.19 g/g, that was obtained using methionine with Biomax (1:1 by weight), while in the control group it was 1.43 g/g (P<0.05).

5. Conclusion
The use of biocorrectors in the diet contributed to the increase in the intensity of growth and development, especially in the period of rearing of broiler chickens from 16 to 35 days: absolute gains in body weight ranged from 56.0±3.43 g to 72.4±0.75 g (P<0.001) versus 54.2±2.29 g in the control group. The maximum weight gain rate was observed in the case of the use of methionine in combination with Biomax (1:1 by weight).

The inclusion of amino acids in the feed - methionine in particular - (dose - 1 tablet) led to the production of heavy broilers with a body weight of 2322.6±0.50 g (P<0.001) versus 2158.3±2.68 g (P<0.05) in the control group. The maximum weight gain rate was observed in the case of addition of methionine combined with Biomax to the diet, the body weight was 2363.3±0.50 (P<0.001), or 18.7 % more than in the control group.

To increase the intensity of broiler chicken rearing, it is recommended to include biocorrectors (Complivit, Selmevit, Biomax, and Undevit) and amino acids (glycine and methionine) in the feed, in a 1:1 ratio by weight two times during the growing period, in terms: 11-20 days (one time), and 21-33 days (one time). The dose of one particular amino acid in the feed (mixed with the compound feed) – 1 tablet per head, the dose of a biocorrector – 1 tablet per head.

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