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Autonomic nervous system tone in poultry protein metabolism

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Abstract. The problem of the world market in the lack of one of the main components of all living organisms, namely protein, is more urgent than ever. Products from poultry farms are rapidly trying to fill this gap, which is ensured by the rapid growth in the number of livestock and its growth rate. The main material that ensures the growth of a given number of animals is protein. There is a direct relationship between protein metabolism and poultry productivity. The purpose

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of the study was to establish the influence of the autonomic nervous system on the indicators of protein metabolism in poultry blood serum. The study was conducted on COBB-500 chickens. The experimental groups were established according to the Baevsky method. The LabLine-010 spectrophotometer (Austria) was used to determine the content of total protein, globulins, and albumins. For the analysis of blood serum, a test system from Granum Laboratory LTD, Kharkiv, was used According to the results of the biochemical study, it was found that the total protein content in the experimental group of normotonics with a balanced effect of the sympathetic and parasympathetic nervous systems was higher in comparison with sympathotonics by 10.5% ($p < 0.001$) and vagotonics by 21.1% ($p < 0.001$). The albumin content in normotonics was 9% higher than in sympathotonics ($p < 0.001$) and vagotonics by 18.1% ($p < 0.001$). In the experimental group of normotonics, globulin values on day 35 were 11.4% higher in relation to sympathotonics ($p < 0.001$). The experimental group of vagotonics had the lowest globulin content compared to the experimental group of normotonics, which was 19.1% less compared to them ($p < 0.001$). According to the results of the study, it should be noted that poultry belonging to the experimental group of normotonics was characterised by more active processes of protein metabolism in the body, which introduced a new variable that should be considered when studying the processes of protein synthesis and resynthesis and used as an additional factor for the use of various feed additives

Keywords: broilers; protein; whey; amino acids; autonomous regulation

Introduction

According to J. Peinado-Izaguerri *et al.* (2023), due to the active growth of the world's population, the need for a protein source is growing more and more. Among the variations of products that can provide a lack of this organic element are meat products from poultry farms, which is justified by the fact that it takes less time to raise poultry compared to a cow or pig. These complexes can accommodate a large number of livestock on a small area, which provides a large volume of production. On the world market, the percentage of meat products obtained from poultry is gradually growing.

According to A. Geng *et al.* (2023), not everything is positive in the future development of this economy, there are quite a few different sharp corners of this issue. Without considering the technical support of this complex, it is necessary to focus on the processes of protein metabolism. This issue is quite important both from the economic and environmental sides. If it is possible to regulate protein metabolism with the use of less concentrated protein feeds, the development of poultry on rearing improves, and the financial costs of the farm for the purchase of mixed feeds with a high feed content are reduced, which solves the issues of the economic plan. S. Ma *et al.* (2023) and M. Kidd *et al.* (2021) note the significant role of protein metabolism in poultry rearing. According to their research, in addition to total protein, protein components, namely amino acids, also play a significant role in the development of animals. They note that a balanced diet should consider the content of essential amino acids. In addition to their specifics in the genetic coding of protein substrates, it is necessary to distinguish their secondary functions, which are reflected in immune functions, correction of metabolic processes as antioxidants, components of enzymes, hormones, structural role as the main component of muscle weight, etc. Therefore, an adjusted diet is quite an important component in raising poultry.

According to P. Selle *et al.* (2023) and K. Qiu *et al.* (2023), the active development of

poultry farming appears as an excess source of carbon in the form of carbon dioxide and methane and nitrogen in the form of nitrogen compounds. This is quite dangerous from the standpoint of ecology, because the accumulation of these compounds causes the development of global warming and the accumulation of carbon dioxide.

According to V. Stoyanovskyy *et al.* (2020) and A. Saleh *et al.* (2021), correction of protein metabolism is an important issue, and understanding aspects of factors that have a direct impact on these processes is currently relevant. The exchange of organic compounds is subject to a certain number of complex systems of the body. In the current case, the issue is considered from the standpoint of the role of the autonomic nervous system in the correction of protein metabolism. After all, this system is quite good with the participation of its own departments of the sympathetic and parasympathetic nervous systems is able to correct the constancy of the body's homeostasis quite well, being part of the neurohumoral regulation of metabolism in the body. This is a very relevant issue in the study of this area. The purpose of the study was to determine the influence of the autonomic nervous system on the indicators of protein metabolism in the blood serum of poultry.

Literature Review

Poultry farming has made a huge step in development compared to previous years. An increasing number of methods are being applied to improve the growth and development of poultry, using both genetic and metabolic factors. For the rapid growth of these animals, considering their growing technologies, high-energy feed and the necessary amount of energy for the growth of the body are required to maintain it. However, organic components, such as proteins, should not be neglected as they are essential for building a rapidly developing organism. G. Wu (2022) notes the significant role of a balanced diet for raising animals, since if these conditions are provided, the energy consumption for growth will be successfully compensated with feed, which will improve weight gain. The main goal is to achieve a zero value between the nitrogenous compounds consumed and spent, because protein plays a key role in ensuring the sustainable development of the poultry body.

Groups of researchers including P. Maharjan *et al.* (2021) and G. Brugaletta *et al.* (2023), in their discussion of the importance of high-protein feedstuffs, draw attention to the problem of nitrogen leakage into the environment and the efficiency of their assimilation. The fact is that with a large amount of protein consumed, the leakage into the environment of a large number of end products of their metabolism, such as methane, nitrogen, and carbon dioxide, increases. This is taking into account the active growth of these enterprises, which contributes to the growth of the poultry population and, as a result, the leakage of these exchange products becomes an integral factor of an environmental catastrophe. Therefore, according to the researchers, it is necessary to take this factor into consideration and adjust the diet of animals to reduce crude protein and improve the assimilation of what is consumed, which is successfully implemented by introducing components such as carbohydrates and lipids.

Against the background of the development of environmental problems, the issue of technological stress arises. The main issue of which, which is more frequent at this time, is temperature adjustment in production. This factor should always be one of the priority issues to solve. The development of this problem is influenced by many factors, the main of which are the rapid change in climatic conditions, the number of poultry and conditions of keeping, which in most cases is characterised by a significant accumulation in a small space. As noted by M. Kumar *et al.* (2021), if this issue is ignored, the poultry farm will necessarily face heat stress, which will have a significant

negative impact on the growth and development. The question of heat stress and the overall impact factor on the animal is widely studied. After all, correcting the condition of the poultry in this situation is quite difficult. Direct impact on the stress of animals in the conditions of a huge farm is practically impossible and the occurrence of this variable for this enterprise can lead to significant economic losses. To avoid these problems, it is worth considering the following points, namely the causes of this problem and what consequences they will have for the animal's body, namely, how the bird will counteract external factors of influence.

To solve this problem, attention should be paid to systems that take an active part in responding to these variables. It is known that the constancy of any living organism is characterised by its homeostasis. The systems that control this condition consist of the nervous and endocrine systems, which provide a composite complex of neurohumoral regulation. Given this, the response to stress is complex (Hyun & Sohn, 2022). But what is the primary structure of the body has a primary role in responding to this factor of influence. When analysing the work of the neurohumoral system, the autonomous nervous system plays a special role in this issue. This system, through the well-coordinated work of its own departments of the sympathetic and parasympathetic nervous systems, can provide a primary response to the stress factor. This feature is still actively used in the analysis of the constancy of homeostasis of the body and more than once confirms the significant role of the autonomic nervous system in correcting the metabolism of organic substances (Adeniyi, 2022; LeBouef *et al.*, 2023).

Poultry farming is a promising area in the production of animal products against the background of the growth of the human population. To ensure a balanced development of poultry, especially meat, a balanced diet with a significant protein content is required. But significant protein intake poses a significant environmental threat in the form of the release of nitrogen and carbon dioxide into the environment. Methods of countering this environmental catastrophe are aimed at reducing crude protein in the diet, or replacing excess protein. Therefore, the study of protein metabolism and its correction factors is an urgent issue today.

Materials and Methods

The study was conducted on COBB-500 chicken cross with 5 animals in each experimental group. When performing the experimental studies presented in the paper, all manipulations with the bird involved in the research were carried out considering the basic principles of bioethics, in accordance with the European Convention for the Protection of Vertebrate Animals Used for Research and Other Scientific Purposes (1986) and Procedure for Conducting Research and Experiments on Animals by Scientific Institutions (2012). The tone of the autonomic nervous system was determined according to the Baevsky method. An electrocardiographic study was performed with recording of the electrical potentials of the bird's heart for at least 100 cardiac intervals. The cardiograph electrodes were placed at the humerus and tibia. Blood sampling was performed at the age of 60 days from the saphenous vein of the shoulder, after a starvation diet.

To obtain the serum, the obtained samples were placed in a thermostat at a temperature of 37°C. Total protein was determined using a LabLine-010 spectrophotometer (Austria). Determination of total protein was carried out using a test system from Granum Laboratory LTD, Kharkiv. Measurement conditions: 540 (530-650) nm wavelength cuvette with an optical layer thickness of 1 cm, temperature 15-25°C. Before using the reagents, they were kept at room temperature for 30 minutes. Next, the following samples were prepared for analysis.

The samples were mixed and placed in a thermostat at 37°C for 5 min. Measurements were made on a photocolourimeter in cuvettes

with an optical layer thickness of 10 mm relative to the blank sample at a wavelength of 540 (530-650) nm.

The results obtained were calculated using the equation:

$$C_{exp} = \frac{E_{exp}}{E_{st}} \times C_{st}, \quad (1)$$

where C_{exp} – total protein concentration in the experimental sample, g/l, E_{exp} – optical density of the experimental sample, optical density units, E_{st} – optical density standard, optical density units, C_{st} – total protein content in the standard, 70.0 g/l.

Determination of albumin was carried out using a test system from Granum Laboratory LTD, Kharkiv. Measurement conditions: 630 (600-650) nm wavelength cuvette with an optical layer thickness of 1 cm, temperature 15-25°C. Before using the reagents, they were kept at room temperature for 30 minutes. Next, the samples were prepared for analysis.

The samples were mixed and placed in a thermostat at 37°C for 5 min. Next, measurements were made on a photocolorimeter in cuvettes with an optical layer thickness of 10 mm relative to the blank sample at a wavelength of 630 (600-650) nm.

The albumin concentration was calculated using the equation:

$$C_{exp} = \frac{E_{exp}}{E_{st}} \times C_{st}, \quad (2)$$

where C_{exp} – albumin concentration in the experimental sample, g/l; E_{exp} – optical density of the experimental sample, optical density units; E_{st} – optical density standard, optical density units; C_{st} – albumin concentration in the standard, 50 g/l.

Determination of globulins was carried out using a test system from Granum Laboratory LTD, Kharkiv. Measurement conditions: 640 (620-670) nm wavelength cuvette with an optical layer thickness of 1 cm, temperature 15-25°C. Before using the reagents, they were kept at room temperature for 30 minutes.

The samples were mixed and placed in a thermostat at 37°C for 5 min. Next, measurements were made on a photocolourimeter in cuvettes with an optical layer thickness of 10 mm relative to the blank sample at a wavelength of 640 (620-670) nm.

The concentration of globulins is calculated using the equation:

$$C_{exp} = \frac{E_{exp}}{E_{st}} \times C_{st}, \quad (3)$$

where C_{exp} – globulin concentration in the experimental sample, g/l; E_{exp} – optical density of the experimental sample, optical density units; E_{st} – optical density standard, optical density units; C_{st} – globulin concentration in the standard, 50 g/l.

Statistical analysis of the results obtained was calculated using Microsoft Excel software suite. The probability of the difference between the obtained indicators was calculated according to the Student's t-test. Differences between the compared indicators were considered probable at the significance level $p < 0.05$, $p < 0.01$, and $p < 0.001$.

Results and Discussion

During a biochemical analysis of the blood plasma of poultry at the age of 35 days, the following indicators were established for the experimental group of normotonics (Table 1).

Table 1. *Indicators of the protein fraction content in the blood serum of poultry of the experimental normotonic group at 35 days (n = 10)*

Indicators	NVO	SE	M	SD	A	Min	Max
Total protein	10	0.04	43.87	0.13	-0.83	43.56	44.00

Table 1. Continued

Indicators	NVO	SE	M	SD	A	Min	Max
Albumins	10	0.06	19.99	0.15	-0.85	19.85	20.04
Globulins	10	0.08	23.88	0.11	-0.82	23.72	23.95

Note: NVO – number of valid observations, SE – standard error, M – median, SD – standard deviation, A – asymmetry, Min – minimum value, Max – maximum value
Source: developed by the author

The biochemical study of poultry blood plasma found that the total protein content of normotonics on day 35 ranged from 43.56-44.00 g/l with an average value of this indicator of 43.87 ± 0.13 g/l. Total protein in the experimental group of poultry with a balanced effect of the sympathetic and parasympathetic nervous systems among five animals had discrepancies of 0.44 g/l, which indicates a small discrepancy in the initial results of a biochemical analysis of blood serum. The albumin content ranged from 19.85-20.04 g/l and had an average value of 19.99 ± 0.15 g/l. Albumins in the experimental group of poultry with a balanced effect of the sympathetic and parasympathetic nervous systems among five animals had discrepancies of 0.19 g/l, which indicates a small discrepancy in the initial results of a biochemical analysis of blood serum. The globulin content in the experimental group of normotonics ranged from 23.72-23.95 g/l with an average baseline value of 23.88 ± 0.11 g/l. Globulins in the experimental group of poultry with a balanced effect of the sympathetic and parasympathetic nervous systems among five animals had discrepancies of 0.23 g/l, which indicates a small discrepancy in the initial results of a biochemical analysis of blood serum.

The experimental group of sympathotonics according to the results of biochemical analysis of blood plasma had differences in the content of total protein and albumins with globulins, in contrast to other experimental groups (Table 2).

Table 2. *Indicators of the protein fraction content in the blood serum of poultry of the experimental sympathotonic group at 35 days (n = 10)*

Indicators	NVO	SE	M	SD	A	Min	Max
Total protein	10	0.27	39.69	0.21	-1.14	39.21	39.92
Albumins	10	0.13	18.30	0.19	-1.16	18.08	18.41
Globulins	10	0.18	21.44	0.11	-1.17	21.18	21.56

Note: NVO – number of valid observations, SE – standard error, M – median, SD – standard deviation, A – asymmetry, Min – minimum value, Max – maximum value
Source: developed by the author

It was established based on a biochemical study of blood plasma of the experimental group of sympathotonics that the total protein ranged from 39.21 to 39.92 g/l with an average value of 39.69 ± 0.21 g/l. Total protein in the experimental group of poultry with a predominance of sympathetic over parasympathetic nervous system among five animals had discrepancies

of 0.71 g/l, which indicates a slight discrepancy in the initial results of a biochemical analysis of blood serum. The albumin content in this group ranged from 18.08 to 18.41 g/l and averaged 18.30 ± 0.19 g/l. Albumins in the experimental group of birds with a predominance of the sympathetic over parasympathetic nervous system among five animals had discrepancies of 0.33 g/l, which indicates a slight discrepancy in the initial results of a biochemical analysis of blood serum. In this experimental group of sympathotonics, the plasma globulin content was in the range of 21.18-21.56 g/l with an average value of 21.44 ± 0.11 g/l. Globulins in the experimental group with a predominance of the influence of the sympathetic over parasympathetic nervous system among five animals had discrepancies of 0.38 g/l, which indicates a slight discrepancy in the initial results of a biochemical analysis of blood serum.

The experimental group of vagotonics according to the results of a biochemical study had differences in the content of total protein, albumins, and globulins in blood plasma (Table 3).

Table 3. *Indicators of the protein fraction content in the blood serum of poultry of the experimental vagotonic group at 35 days (n = 10)*

Indicators	NVO	SE	M	SD	A	Min	Max
Total protein	10	0.24	36.24	0.19	1.03	36.11	36.52
Albumins	10	0.21	16.92	0.15	1.13	16.86	17.04
Globulins	10	0.16	19.33	0.18	1.06	19.26	19.47

Note: NVO – number of valid observations, SE – standard error, M – median, SD – standard deviation, A – asymmetry, Min – minimum value, Max – maximum value

Source: developed by the author

It was determined that in the experimental group of vagotonics, total protein values ranged from 36.11 to 36.52 g/l, which overall averaged 36.24 ± 0.19 g/l. Globulins in the experimental group with a predominance of the sympathetic over parasympathetic nervous system among five animals had discrepancies of 0.41 g/l, which indicates a slight discrepancy in the initial results of a biochemical analysis of blood serum. The albumin content according to the results of biochemical analysis ranged from 16.86 to 17.04 g/l and had an average value of 16.92 ± 0.15 g/l. Globulins in the experimental group with a predominance of the sympathetic over parasympathetic nervous system among five animals had discrepancies of 0.41 g/l, which indicates a slight discrepancy in the initial results of a biochemical analysis of blood serum. In the experimental group of vagotonics, the obtained globulin values ranged from 19.26 to 19.47 g/l and had an average value of 19.33 ± 0.18 g/l. Globulins in the experimental group of birds with a predominance of parasympathetic over sympathetic nervous system among five animals had discrepancies of 0.21 g/l, which indicates a slight discrepancy in the initial results of a biochemical analysis of blood serum.

When analysing the total protein content, differences in indicators were found among experimental groups of poultry with different tones of autonomic nervous regulation. Thus, in the experimental group with balanced influence of the sympathetic and parasympathetic nervous systems, the total protein values on day 35 (43.87 ± 0.13) were 10.5% higher in relation to animals with a predominance of the influence of the sympathetic over the parasympathetic nervous system (39.69 ± 0.21) ($p < 0.001$). The experimental group with a predominance

of parasympathetic over sympathetic nervous system had the lowest total protein content (36.24 ± 0.19) compared to the experimental group of normotonics, which was 17.4% less compared to them ($p < 0.001$). As a conclusion, a bird with a balanced influence of the sympathetic and parasympathetic nervous systems had the highest total protein content, which may indicate a better exchange of protein compounds compared to other groups (Fig. 1).

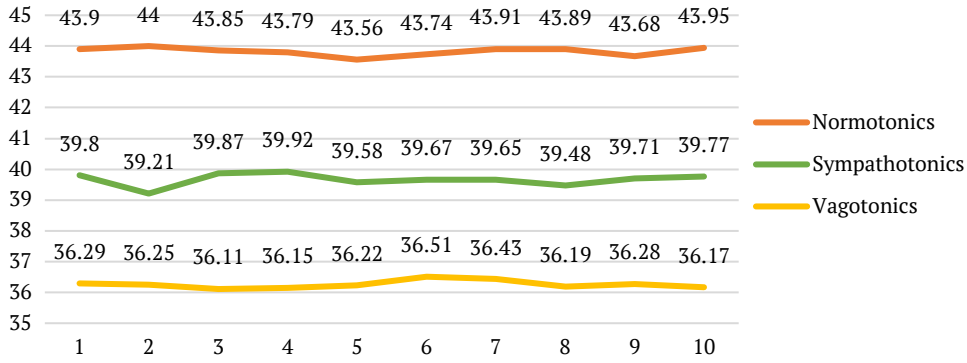

Figure 1. Total protein content in blood plasma of experimental poultry groups
Note: the colours show different tones of the autonomic nervous system, respectively
Source: developed by the author

According to statistical analysis of the results of biochemical analysis of the content of albumins in the blood plasma of poultry, a high content was determined in the experimental group, with a balanced sympatho-vagal balance. Thus, the experimental group with balanced influence of the sympathetic and parasympathetic nervous systems had a higher albumin content (19.99 ± 0.15) by 9% compared to the experimental group with a preference for the influence of the sympathetic over the parasympathetic nervous system (18.30 ± 0.19) ($p < 0.001$), a bird that had a preference for the influence of the sympathetic nervous system. It was established that the experimental group of vagotonic animals with the predominance of the influence of the parasympathetic nervous system had the lowest albumin content (16.92 ± 0.15) in blood plasma, which is 15.4% less than in the experimental group of normotonic animals ($p < 0.001$). The experimental group with a balanced sympatho-vagal balance had the highest albumin content, which indicates intensive protein metabolism processes, especially in poultry during the active growth period (Fig. 2).

When analysing the total protein content, differences in indicators were found among experimental groups of poultry with different tones of autonomic nervous regulation. Thus, in the experimental group with balanced influence of the sympathetic and parasympathetic nervous systems, globulin values on day 35 (23.88 ± 0.11) were 11.4% higher in relation to animals with a predominance of the influence of the sympathetic over the parasympathetic nervous system (21.44 ± 0.11) ($p < 0.001$). The experimental group with a predominance of parasympathetic over sympathetic nervous system had the lowest globulin content (19.33 ± 0.18) compared to the experimental group of normotonics, which was 19.1% less compared to them ($p < 0.001$). Poultry with a balanced influence of the sympathetic and parasympathetic nervous systems had the highest globulin content, which may indicate a better metabolism of protein compounds compared to other experimental groups (Fig. 3).

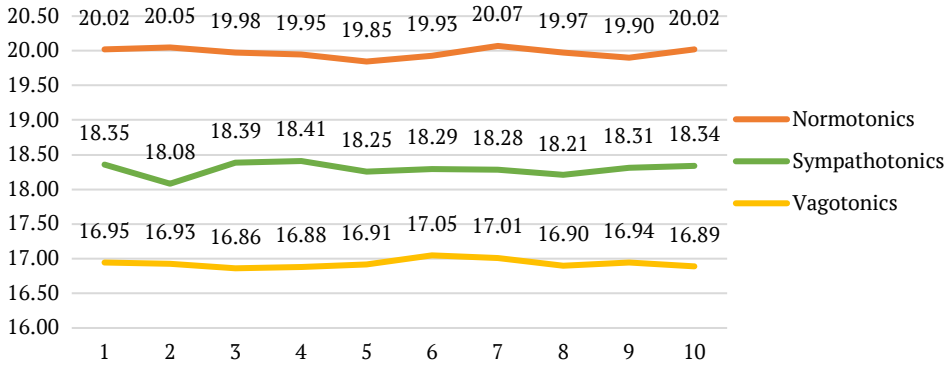

Figure 2. Albumin content in blood plasma of experimental poultry groups
Note: the colours show different tones of the autonomic nervous system, respectively
Source: developed by the author

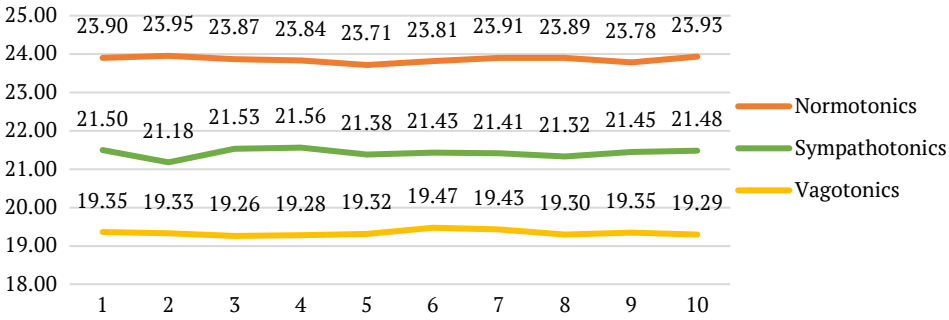

Figure 3. Albumin content in blood plasma of experimental poultry groups
Note: the colours show different tones of the autonomic nervous system, respectively
Source: developed by the author

The content of protein fractions in blood growth plays an important role in understanding the issues of metabolic processes in the bird's body. When the body is actively developing during this period, it is quite important to balance the concentration of nutrients in the diet of broiler chickens. According to S. Harlap *et al.* (2021), protein is one of the most important components among blood parameters. The most common method for assessing the protein spectrum in poultry is to assess the biochemical parameters of total protein, albumins, and globulins. They provide the researcher with an idea of the anabolic or catabolic processes in the body, which further helps to predict the poultry's productivity. The results obtained confirm that considering the tone of the autonomic nervous system, it is possible to record differences in the protein fractions.

Based on the results of the study by S. Liu *et al.* (2021) and T. Nikravesh-Masouleh *et al.* (2021), blood protein levels are very important for obtaining better live weight gain, especially in the initial stages of poultry fattening. The high content of protein fractions in the blood becomes a good reflection of the metabolic processes of metabolism and growth of the body. But there are a number of specific challenges in consuming and conquering protein. It is noted that the excessive protein

content in the bird's body causes a decrease in feed intake and a deterioration in live weight gain. This is because protein intake should be balanced with high-energy compounds. Since for the development and growth of muscle mass of fattening animals, a sufficient amount of carbohydrates and lipids is required. Without considering this variable, there will be an imbalance in the body, without a sufficient amount of energy, protein synthesis and the formation of protein structures are impossible, and it is also worth remembering about the deamination reactions, which are also highly dependent on energy-rich compounds.

The issue of correcting protein metabolism is actively developing. The most popular area is the use of feed additives with a lower level of crude protein. According to T. Woyengo *et al.* (2023), the use of these feeds will have a positive impact on animal health indicators. This is evidenced by the results of growing broilers with a low content of crude protein, the lack was compensated by the introduction of crystalline amino acids into the feeding diet, which equalised the lack of proteins and did not negatively affect the weight gain, which was 200-220 g/kg. Notably, due to the reduced content of crude protein, the economic costs of purchasing feed have decreased. N. Dankevych *et al.* (2020) argue that it is necessary to consider the features of protein metabolism and the rapid growth of the poultry body on fattening, the use of a diet with a lower percentage of crude protein will help prevent nitrogen imbalance, which is reflected in their work and supported by research.

It is also worth noting the importance of switching the poultry diet to a diet with a lower crude protein content according to Z. Goluch *et al.* (2023) and A. Dal Bosco *et al.* (2021), as this solution not only improves the growing technology but also solves the environmental issue. According to the conclusions of P. Maharjan *et al.* (2021), excessive protein nutrition of animals in poultry farms may become an environmental disaster in the future. Since, as a result of raising poultry under such conditions, it contributes to the accumulation of a significant amount of gases that negatively affect the ecological state of the planet.

According to M. Yakubu Abare *et al.* (2023), poultry farming suffers quite a lot from changing climatic conditions. The primary problem that has a negative impact on protein metabolism is heat stress. This indicator is quite actively studied; this is argued by the fact that the bird is located in a much smaller space of existence with a significant accumulation of livestock. The appearance of minor changes in the climatic state of isolated poultry can lead to significant economic losses. Diagnostics of the health status of broilers in this case plays a key role. To counteract the influence of the stress factor, C. Brown *et al.* (2023) used corticosterone hormone preparations to study changes in metabolic processes in the body under artificially simulated production stressors. G. Brugaletta *et al.* (2023) used arginine supplements to counteract cyclic heat stress, which had minor changes in metabolism when exposed to a stress factor. When evaluating these results, it is worth noting that the use of hormonal drugs or protein supplements in the form of amino acids is ineffective compared to the results of this study, and it is also worth noting that diagnosing poultry stress is a time-consuming process. To improve the initial results based on the data obtained in this study, it is worth noting the need to consider the tone of the autonomic nervous system, which will improve the effectiveness of scientific research.

Summing up, poultry farming is gaining more and more momentum over time to ensure the protein nutrition of humanity. More and more methods are being developed to help stabilise and improve the growth and development of poultry, taking into consideration the metabolic processes in their body. The problem is growing not only in providing livestock products, but also in gradually increasing the consequences of such successful production,

which is characterised by an environmental catastrophe. After analysing the work of other researchers, it should be noted that the correction of protein metabolism is taken into account by external feed input, there is also consideration of internal metabolic issues, which primarily concerns balancing the energy integrity of the body. Few questions relate specifically to the analysis of factors controlling protein synthesis and resynthesis. Therefore, it is worth noting that the omission of the body's systems that correct homeostasis in general can worsen the initial results. This is based on the results of a study that analysed the effect of the autonomic nervous system on protein metabolism. According to the results of biochemical analysis, depending on the activity of the sympathetic or parasympathetic nervous system, the results of protein content differ in experimental groups of animals. Thus, it is possible to assert the dependence of protein metabolism processes on the tone of the autonomic nervous system. This leads to the conclusion that it is worth considering this variable as an additional factor in the analysis of protein metabolism, as protein content is quite well correlated with poultry performance.

Conclusions

The influence of the tone of the autonomic nervous system on the indicators of protein metabolism in the blood serum of poultry was established. Differences in protein metabolism indicators in the animal body depending on the tone of the autonomic nervous system were determined: normotonics, vagotonics, and sympathotonics. In particular, differences were found in the blood serum of poultry regarding the content of total protein, globulins, albumins with different tones of the autonomic nervous system

It was found that the total protein content in poultry with a balanced effect of the sympathetic and parasympathetic nervous systems was 10.5% higher in relation to the experimental group of poultry with a preference for the influence of the sympathetic nervous system ($p < 0.001$). The experimental group of poultry that had a 17.4% lower total protein content compared to the experimental group that had a balanced sympatho-vagal balance ($p < 0.001$). It was found that the albumin content in the experimental group of animals with balanced influence of the sympathetic and parasympathetic nervous systems was higher by 9% compared to the experimental group of animals with an advantage of the influence of the sympathetic nervous system ($p < 0.001$). The experimental group of poultry with a predominance of vagotonia had a 15.4% lower content compared to the experimental groups of animals with a predominance of normotonia ($p < 0.001$). It was found that the total protein content in poultry with a balanced effect of the sympathetic and parasympathetic nervous systems was 10.5% higher in relation to the experimental group of poultry with a preference for the influence of the sympathetic nervous system ($p < 0.001$). The experimental group of poultry that had a 17.4% lower total protein content compared to the experimental group that had a balanced sympatho-vagal balance ($p < 0.001$).

Depending on the individual characteristics of the tone of the autonomic nervous system, differences in protein metabolism were determined in experimental groups of poultry that have the predominance of sympathotonia, vagotonia, and normotonia.

The prospect of further research is the use of biologically active additives of nanopreparations to improve protein metabolism and poultry productivity, considering individual characteristics, which are represented by the tone of the autonomic nervous system.

Acknowledgements

None.

Conflict of Interest

None.

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Роль тонусу автономної нервової системи у білковому обміні птиці

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Анотація. Проблема світового ринку у нестачі одного із головних компонентів всіх живих організмів а саме білку є як ніколи актуальною. Продукція від птахофабрик стрімкими темпами намагається заповнити дану ношу, що забезпечується швидким зростанням кількості поголів'я та темпом його росту. Основним будівельним матеріалом, що забезпечує ріст даної кількості тварин займає саме протеїн. Оскільки є пряма залежність білкового обміну і продуктивності птиці. Мета дослідження полягає у встановленні впливу автономної нервової системи на показники білкового обміну сироватки крові птиці. Дослідження проводили на курях кросу Кобб-500. Формування дослідних груп виконувалося за методикою Баєвського. Для визначення вмісту загального білку, глобулінів та альбумінів застосовували спектрофотометр LabLine-010 (Австрія). Для аналізу сироватки крові використовували тест системи від ТОВ «Лабораторія Гранум» м. Харків. За результатами біохімічного дослідження було встановлено, що вміст загального білку у дослідної групи нормотоніків із збалансованим впливом симпатичної і парасимпатичної нервової системи був більший в порівнянні з симпатотоніками на 10,5 % ($P < 0,001$) та ваготоніками на 21,1 % ($P < 0,001$). Вміст альбумінів у нормотоніків більший відносно симпатотоніків на 9 % ($P < 0,001$) та ваготоніків на 18,1 % ($P < 0,001$). У дослідної групи нормотоніків показники глобулінів на 35 день були на 11,4 % більше по відношенню до симпатотоніків) ($P < 0,001$). Дослідна група ваготоніки

мала найменший вміст глобулінів відносно дослідної групи нормотоніків, що було на 19,1 % менше порівнюючи з ними ($P < 0,001$). За результатами дослідження варто відмітити, що птиця яка відноситься до дослідної групи нормотоніків характеризується більш активними процесами обміну білків у організмі, що вносить нову змінну котру варто враховувати при вивченні процесів синтезу і ресинтезу протеїнів та використовувати як додатковий фактор за використання різних кормових добавок

Ключові слова: бройлери; білок; сироватка; амінокислоти; автономна регуляція