Evaluation of the combined and separate action of the Quercus cortex extract and an antibiotic on the amino acid composition of broilers’ muscle tissue

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Abstract. The industrial technology of broiler bird production broadens requirements for supplying birds with various biologically active substances. One of the most important elements of the intensive technology of producing poultry meat is organization for full and balanced feeding, which is the basis of the most complete manifestation of the productivity genetic potential, the efficient use of nutrients from the ration, the high natural resistance of the organism, and the product quality. Preventive measures in the context of modern poultry production should organically fit the process. In this aspect, the most promising technique is group prophylaxis with plant extracts or phytobiotics and traditional antibiotics capable to improve the quality of meat products. The study revealed the primary increase of the content of essential and nonessential amino acids in the pectoral muscles of the broilers that additionally received the oak bark extract as part of the ration compared to the control. The femoral muscles did not discover any clearly traced decline or increase of the content of nonessential and essential amino acids. The use of the oak bark extract without the antibiotic stimulated the accumulation of nonessential and essential amino acids mainly in the pectoral muscles of broilers, which has great economic value.

1 Introduction

Nowadays, the industrial technology of broiler bird production broadens requirements for supplying birds with various biologically active substances [1-3]. One of the most important elements of the intensive technology of producing eggs and poultry meat is organization for full and balanced feeding, which is the basis of the most complete manifestation of the productivity genetic potential, the efficient use of nutrients from the ration, the high natural resistance of the organism, and the product quality [4, 5]. Preventive measures in the context of modern poultry production should organically fit the process. In this aspect, the most promising technique is group prophylaxis with plant extracts or phytobiotics, for example oak bark, and traditional antibiotics capable to improve the quality of meat products [6-8].

Poultry meat is one of the most important elements of a healthy diet. It is a source of digestible protein, fatty acids, and vitamins. Poultry meat contains more protein than any other meat while comprising a low content of fat, which provides a full balance of protein in the body.

The search for and the practical application of new techniques to improve the quality of poultry meat and to increase contents of nonessential and essential amino acids in it look promising.

2 Materials and Methods

Experimental studies were carried out at the Center for collective use of scientific equipment of the Federal State Scientific Institution “Federal Research Center of Biological Systems and Agro-technologies of the Russian Academy of Sciences” (FSSI FRC BST RAS), the experiments were held in vivo (Gallus gallus). 120 heads of 7-day-old broiler chickens were selected for experiments (“Smena-8”), four groups, n = 30. The control group received the main ration (MR), experimental group I – MR + the extract from Quercus cortex; experimental group II – MR + an antibiotic based on 20% chlorotetracycline (dosed in accordance with recommendations of the manufacturer); experimental group III – MR + the antibiotic + the extract from Quercus cortex.

Bird treating and experimental procedures met the requirements and recommendations of Russian rules (order of the Ministry of the health of the USSR № 755 of 12.08.1977) and “The Guide for the Care and Use of Laboratory Animals” (National Academy Press Washington, D.C. 1996). Watering was not regulated.

Before the slaughter, the birds were kept on a starvation diet (except drinking) for 12 hours. Observed after the slaughter pectoral and femoral muscles of

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The analysis of the content of nonessential amino acids in the pectoral muscles of the studied birds gave us a similar picture as essential amino acids in the first experimental group did, namely – a significant increase (p ≤ 0.05) of all nonessential amino acids: arginine – by 14.8%, leucine-isoleucine – by 25.5% (p ≤ 0.05) in the first experimental group in comparison with the control: lysine – by 27.4% (p ≤ 0.01) phenylalanine – by 24.4%, tyrosine – by 27.1%, histidine – by 27.6%, proline – by 25.9%, serine – by 32.1%, alanine – by 28.7%, and glycine – by 28.1% compared to the control group. Regarding other nonessential amino acids, threonine showed a significant increase for all essential amino acids compared to the control group. Regarding other nonessential amino acids, threonine showed a significant increase for all essential amino acids compared to the control group.

In the second experimental group, we observed a similar pattern of declining levels of nonessential amino acids, the sectional cut was slightly moist, the meat juice was transparent; the femoral muscle was of pale pink color, the consistency of the samples was dense and elastic. The smell on the surface and in section was peculiar, typical for fresh poultry meat. When boiling meat, the broth was transparent with no flakes, foreign smells were absent.

Poultry meat is the most full value and dietary product in comparison with meat of other agricultural animals as poultry meat contains more full value and less hard digestible proteins (collagen and elastin), which makes its high nutritional value. The nutritional value of meat is determined by its amino acid composition.

The studies on the amino acid composition of the pectoral and femoral muscles in chicken broilers of the experimental and control groups revealed 13 amino acids, 6 of which are essential and directly affect the value of muscle protein (Tables 1 to 4).

Among essential amino acids in the pectoral muscle of broiler-chickens, we found the following amino acids: lysine, phenylalanine, methionine, valine, and threonine. Accounting the fact that the isoleucine deficiency gets compensated by leucine, the amino acids were combined together in leucine-isoleucine (table 1).

### Table 1. Content of essential amino acids in the pectoral muscles of broiler chickens, %

| Content of amino acid, % | Control I experimental | II experimental | III experimental |
|-------------------------|-----------------------|----------------|-----------------|
| Lysine                  | 9.37±0.26             | 12.9±0.22**    | 10.3±0.22       | 11.0±0.25*      |
| Phenylalanine           | 3.78±0.18             | 4.72±0.24*     | 3.84±0.30       | 4.01±0.25       |
| Leucine-isoleucine      | 11.7±0.28             | 15.7±0.20*     | 12.6±0.16       | 13.5±0.24*      |
| Methionine              | 2.81±0.24             | 4.44±0.28*     | 2.30±0.17       | 2.45±0.21       |
| Valine                  | 3.86±0.27             | 5.41±0.28*     | 4.10±0.27       | 4.43±0.20       |
| Threonine               | 4.17±0.22             | 5.79±0.26*     | 4.63±0.19       | 4.69±0.77       |

* - p≤0.05; ** - p≤0.01 – significant differences to the control group

Studies on the content of essential amino acids showed a significant increase for all essential amino acids in the first experimental group that additionally received the oak bark extract in comparison with the control: lysine – by 27.4% (p ≤ 0.01) phenylalanine – by 27.1% (p ≤ 0.05), leucine-isoleucine – by 25.5% (p ≤ 0.05), methionine – by 36.7% (p ≤ 0.05), valine – by 28.7% (p ≤ 0.05), and threonine – by 27.9% (p ≤ 0.05).
In the third experimental group, the picture was the opposite, namely we recorded increases of such amino acids as arginine, tyrosine, proline, alanine, and glycine by 3.02%, 1.95%, 6.06%, 6.78%, and 1.18% respectively compared to the control group, but there were not observed significant changes.

**Table 2. Content of nonessential amino acids in the pectoral muscles of broiler chickens, %**

| Content of amino acid, % | Control | I experimental | II experimental | III experimental |
|--------------------------|---------|----------------|----------------|-----------------|
| Arginine                 | 5.60±0.21 | 7.41±0.57*     | 6.72±0.44      | 7.18±0.27*      |
| Tyrosine                 | 4.5±0.24  | 6.17±0.15      | 5.8±0.26       | 5.78±0.26       |
| Histidine                | 2.67±0.21 | 3.68±0.16*     | 2.98±0.27      | 2.9±0.3         |
| Proline                  | 2.78±0.23 | 3.75±0.17*     | 3.12±0.19      | 3.19±0.24       |
| Serine                   | 3.56±0.27 | 5.24±0.24*     | 4.02±0.26      | 4.07±0.2        |
| Alanine                  | 6.9±0.29  | 9.68±0.27*     | 7.86±0.15*     | 8.10±0.26*      |
| Glycine                  | 4.10±0.18 | 5.70±0.22*     | 4.67±0.21      | 4.75±0.23       |

* - р≤0.05

**Table 3. Content of nonessential amino acids in the femoral muscles of broiler chickens, %**

| Content of amino acid, % | Control | I experimental | II experimental | III experimental |
|--------------------------|---------|----------------|----------------|-----------------|
| Arginine                 | 5.78±0.22 | 3.65±0.18**     | 4.43±0.24      | 5.96±0.28       |
| Tyrosine                 | 3.02±0.25 | 2.77±0.25       | 2.69±0.21      | 3.08±0.28       |
| Histidine                | 2.10±0.20 | 1.84±0.16       | 2.05±0.27      | 2.03±0.22       |
| Proline                  | 2.79±0.24 | 2.29±0.14        | 2.53±0.26      | 2.97±0.22       |
| Serine                   | 3.55±0.23 | 2.87±0.22        | 3.19±0.23      | 3.5±0.26        |
| Alanine                  | 5.91±0.23 | 4.85±0.24        | 5.38±0.24      | 6.34±0.28       |
| Glycine                  | 4.19±0.27 | 3.54±0.20        | 3.83±0.21      | 4.24±0.26       |

** - р≤0.01

**Table 4. Content of essential amino acids in the femoral muscles of broiler chickens, %**

| Content of amino acid, % | Control | I experimental | II experimental | III experimental |
|--------------------------|---------|----------------|----------------|-----------------|
| Lysine                   | 8.81±0.24 | 6.97±0.20*     | 7.84±0.23      | 9.41±0.27       |
| Phenylalanine            | 3.16±0.18 | 2.58±0.16       | 2.82±0.23      | 3.33±0.26       |
| Leucine-isoleucine       | 10.9±0.25 | 8.69±0.21*      | 9.80±0.23      | 11.2±0.29       |
| Methionine               | 2.05±0.22 | 2.37±0.21       | 3.71±0.29*     | 1.90±0.24       |
| Valine                   | 3.26±0.21 | 2.60±0.19        | 3.00±0.23      | 3.45±0.27       |
| Threonine                | 3.96±0.26 | 3.11±0.20        | 3.52±0.22      | 4.06±0.30       |

** - р≤0.01

Speaking of essential amino acids in the femoral muscles, we recorded a significant decline of lysine by 20.9% and leucine-isoleucine by 20.3% (p ≤ 0.05) in the first experimental group compared to the control, all changes in the remaining experimental groups were not of a significant nature (table 4).

The ratio of the number of essential amino acids to nonessential ones in the pectoral muscles of broiler chickens in the first experimental group amounted to 1.18, in group 2 – 1.07, and in group 3 – 1.11. The femoral muscles showed the following ratio: for the first experimental group – 1.21, for group 2 – 1.27, for group 3 – 1.19, the control groups had this ratio amounted to 1.19 and 1.18 for the pectoral and femoral muscles, respectively. For the amino acid composition, it indicates positive changes that increase the biological value of the meat, because the amount of essential amino acids increases and the number of nonessential ones decreases.

The study revealed the primary increase of the content of essential and nonessential amino acids in the pectoral muscles of the broilers additionally receiving the oak bark extract as part of the ration compared to the control. The femoral muscles did not discover any clearly traced decline or increase of the content of nonessential and essential amino acids. Thus, the use of the oak bark extract without the antibiotic stimulated the accumulation of nonessential and essential amino acids.
mainly in the pectoral muscles of broilers, which has great economic value.

As it is known, phytobiotics are natural stimulants of growth and may become a promising substitute for antibiotic growth stimulants in the modern animal husbandry [6]. Also, the overall impact of phytobiotics on agricultural animals and birds is associated not only with the antimicrobial effect but also with their positive effects on digestion. Phytobiotics stimulate the production of endogenous enzymes improving digestibility and assimilation of nutrients. Many of them serve as natural flavors that stimulate feed intake, which has a positive effect on the productivity of animals [9-10].

Conclusions

1. The main reasons why phytogenic feed additives are used in animal husbandry are the improvement of feed digestibility, the stimulation of growth, leverage of the feed conversion ratio and increased feed intake by animals.

2. It should be noted that the combined use of the oak bark extract with the antibiotic chlortetracycline is promising in its application with traditional grain products (wheat, rice, corn, oats, barley, etc.), which are deficient in essential amino acids, primarily in lysine.

   It will help receive a nutritious product optimally balanced on the contents of essential amino acids.

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