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Research Article

EFFECT OF PECTIN AND ENZYME PREPARATION ON HEMATOLOGICAL VALUES, FOOD AND SANITARY AND HYGIENIC PROPERTIES OF BROILER MEAT

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Abstract:

When nitrates are reduced to nitrites, these xenobiotics increase the severity of the intoxication of the body of young and adult poultry, which has an extremely negative effect on the productivity, nutritional and sanitary and hygienic characteristics of poultry products. The goal of the research is to study the effect of citrus pectin and enzyme supplementation in feeds based on barley grain, soy and corn as denitrifying drugs on hematological parameters, meat productivity, nutritional and sanitary-hygienic properties of broiler chicken meat. The objects of the research were broiler chickens of the Smena-7 cross from one batch of hatch. In accordance with the scheme of the experiment, 4 groups of 100 animals each were formed from day-old chickens on the principle of group analogues. According to the results of the experiment, it was established that the process of denitrification under the influence of exogenous enzymes and pectin preparation had a stimulating effect on the morphological and biochemical composition of the blood of broiler chickens, which in group IV against their control analogues was expressed in a significant ($P < 0.05$) increase in erythrocytes, hemoglobin, total protein by 5.2g/l, albumins - by 4.1% and γ -globulin - by 2.5%, indicators of bactericidal and lysozyme activity by 12.93% and 4.32%, while reducing the proportion of α -globulins - by 6.9% ($P < 0.05$), nitrates - 1.63 times and nitrites - 2.47%. Joint feeding of the multi-enzyme complex and pectin preparation in chickens of group IV contributed to a significant ($P < 0.05$) increase in the weight of the half-dressed chicken by 10.9%, the slaughter yield - by 0.82%, the concentration of dry matter and protein in meat, protein quality index (PQI) of meat - by 18.5%, with a decrease in nitrates in the pectoral and femoral muscles - 1.80 and 1.69 times ($P < 0.05$) and nitrites - 2.26 and 2.23 times ($P < 0.05$).

Key words: broiler chickens, nitrates and nitrites, enzyme preparation, pectin, hematological parameters, slaughter indicators, nutritional and biological value of meat.

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INTRODUCTION:

Relevance of the topic. The Republic of North Ossetia-Alania (RNO-Alania), as well as other republics, territories and regions of the South of Russia belong to the zone of application of intensive technologies for the cultivation of forage crops, especially cereals and legumes. This factor of increasing the yield of these vegetable ingredients of complete feed forces local producers, in the conditions of widespread use of industrial grain cultivation technologies, to introduce mineral and nitrogen fertilizers for their crops in large quantities. However, with excessive use of nitrogen fertilizers to increase the yield of cereal and leguminous crops there is a risk of nitrate and nitrite poisoning of poultry (Kokaeva et al., 2015; Kokaeva et al., 2017; Tedtova et al., 2017).

Nitrates and nitrites, by oxidizing hemoglobin ferrous iron, contribute to the transformation of the latter into methemoglobin. Therefore, erythrocytes become incapable of binding oxygen in the lungs and its delivery to the cells of organs and tissues, resulting in impaired respiratory function of the chicken body, reducing the intensity of the digestive and intermediate metabolism. When nitrates are reduced to nitrites, these xenobiotics increase the severity of the form of intoxication of young and adult chickens, which has an extremely negative effect on the productivity and ecological and nutritional characteristics of poultry produce (Temiraev et al., 2017; Tsalieva et al., 2017; Baeva et al., 2013).

Long known about high adsorption properties of various types of pectic substances in relation to a variety of toxicants (heavy metals and radioactive elements, pesticides, etc.) due to the presence in their structure of D-galacturonic acid, which forms with them strong complex compounds that are not absorbed in the intestine of the poultry. But at the same time, this type of sparingly soluble polysaccharides belongs to enterosorbents with a certain polarity, which may be

the cause of a selective action in relation to a separate group of harmful and toxic compounds. Little information is available on the denitrifying properties of pectic substances (Tletseruk et al., 2013; Baeva et al., 2014).

On the other hand, a large proportion of locally produced cereal grain in the formulation of dry feed causes a higher concentration of starchy substances and partially fiber. Therefore, the inclusion in such rations of the multienzyme complex of amylosubtilin G3x, which is standardized by alpha-amylase activity, makes it possible to more actively destroy not only NFE in the digestive tract, but also crude protein, fiber, due to the presence of acid protease, β -glucanase, cellulase and xylanase in its composition. But this can lead to excessive formation of mono- and disaccharides in the gastrointestinal tract, which are easily fermented by intestinal microflora (Temiraev et al., 2017; Temiraev et al., 2017).

The purpose of research is to study the effect of citrus pectin and enzyme supplementation in barley grain -based feeds, soy and corn as denitrifying preparations on hematological parameters, meat productivity, nutritional and sanitary-hygienic properties of broiler chicken meat.

MATERIAL AND RESEARCH METHODS:

The goal of the research was achieved during the research and production experience on meat chickens in the conditions of the poultry farm LLC "Iraf-Agro" of the Irafsky district of RNO-Alania. Broiler chickens of the Smena-7 cross from one batch of hatch were used as objects of the research. In accordance with the scheme of the experiment (Table 1), 4 groups of 100 heads each were formed according to the principle of group analogues from day old chicks (taking into account body weight at birth, origin and general condition). The duration of breeding chickens of these

groups in the course of research and production experiment was 42 days.

Table 1 - Design of scientific and business experiments n=100

| Group | Basal diet (BD) | Doses of supplements, g/t feed | | | |
|--------------------------------------|-----------------|--------------------------------|-------------------|---------------------|-------|
| | | sodium nitrate | amylosubtilin G3x | citrus pectin E 440 | toxin |
| I scientific and business experiment | | | | | |
| I - control | BD | 40 | - | - | - |
| II-experimental | BD | 40 | 300 | - | - |
| III-experimental | BD | 40 | - | 200 | - |
| IV-experimental | BD | 40 | 300 | 200 | - |

Conditions for keeping and feeding test chickens were the same. In the premises where the experimental population was kept, the feeding, watering, lighting and ventilation systems were automated, the temperature and humidity of the air in poultry houses met sanitary and hygiene requirements.

In the course of the experiment, the nutrition of the experimental meat poultry was two-phase, differentiated, taking into account the growing period: when the age period of fattening 1-28 days - with compound feed prepared according to the formula PK-5; when the age period of fattening 29-42 days - with feed prepared according to the formula PK-6.

The tested preparations of adsorbents and amylosubtilin G3x were introduced into the composition of these feeds in a three-step manner using typical dosers, which contributed to their more uniform mixing with other ingredients.

The chemical composition of the selected average samples of feed, residues of feed, dung excreta was studied according to the state standard GOST R 52337-2005.

In order to determine the effect of the tested adsorbent preparations on the intermediate metabolism processes in chickens of the compared groups, we studied the values of the morphological and biochemical composition of the blood. For this, in the course of the control slaughter, blood was taken from 5 chickens from each group, which was further stabilized with heparin. In the blood samples of experimental chickens, the morphological and biochemical composition of the blood was studied by standard methods.

During the experiment, the level of nitrates and nitrites in the average samples of feed, blood and muscles was determined colorimetrically according to the standard technique using Griess reagent.

The experiment ended with the control of slaughter of meat poultry at the age of 42 days, according to the state standard GOST R 52837-2007 "Poultry for slaughter". At the same time, from each compared group of broilers, 5 typical chickens were selected taking into account body weight and fatness.

According to the generally accepted method, studies of the chemical composition of the pectoral muscle samples were conducted.

The research results were processed by the method of variation statistics using the Microsoft Excel software package.

RESEARCH RESULTS AND DISCUSSION:

In accordance with the technology of broiler meat production used on the poultry farm of Iraf-Agro LLC, two-phase feeding was used with the commercial mixed feeds PK-5 and PK-6. At the same time, in the course of experiment 1, the grain ingredients of these feeds were represented by barley, corn and soybeans produced in the Mozdok District of North Ossetia - Alania. However, due to the introduction of large quantities of nitrogen fertilizers for these local feed crops in the course of research and production experiments, special attention was paid to the concentration of nitrates and nitrites in them.

The analysis of the content of nitrates and nitrites in the grain of barley, corn and soybeans used in feeding the poultry during the experiment showed that the content of these toxicants in them in no case exceeded the maximum permissible concentrations (MPC). Therefore, nitrates and nitrites do not have time to accumulate in the soil in excessive amounts, even with large amounts of nitrogen fertilizers for this cereal. With this in mind, during the experiment, sodium nitrate was additionally introduced into the rations of experimental chickens of all groups at the rate of 40 g

/ ton of feed, i.e. to a level not exceeding the subtoxic dose of nitrates in the compound feed [18].

Nitrates and nitrites are distinguished by the specificity of their effects on the respiratory function of the blood through the formed methemoglobin

during the oxidation of ferrous iron of hemoglobin. In this case, serious changes occur in the intermediate metabolism in broiler chickens, as evidenced by changes in the morphological values of their blood (Table 2).

Table 2 - Morphological picture of blood of broilers during the experiment n=5

| Value | Group | | | |
|---------------------------|-----------|-----------|-----------|-----------|
| | I | II | III | IV |
| Erythrocytes, $10^{12}/l$ | 3.22±0.28 | 3.64±0.18 | 3.67±0.22 | 3.78±0.25 |
| Hemoglobin, g/l | 76.5±0.62 | 80.9±0.69 | 81.9±0.59 | 83.5±0.56 |
| Methemoglobin, % | 4.07±0.24 | 3.21±0.30 | 3.14±0.37 | 2.67±0.47 |
| Leucocytes, $10^9/l$ | 8.85±0.38 | 8.79±0.50 | 8.95±0.51 | 8.90±0.48 |

Feeding the pectin preparation and exogenous enzymes stimulated the blood formation processes. But during denitrification, the more favorable effect on the morphological parameters of the liquid internal environment had the joint inclusion of the preparation of the adsorbent and the multienzyme complex in barley-corn-soybean rations of chickens. This made it possible to increase the number of erythrocytes in the blood of broilers of group IV by $0.56 \times 10^{12} / l$ ($P < 0.05$) than in the control.

It has been found that the optimization of erythropoiesis in meat chickens of group IV in comparison with the control was facilitated by the addition to diets of a subtoxic dose of nitrates of the multienzyme complex and an adsorbent preparation, which stimulated the respiratory function of the blood due to a significant ($P < 0.05$) increase in hemoglobin concentration by 7.0 g/l. At the same time, there was a reduction in the level of methemoglobin by 1.40% ($P < 0.05$). This, in our opinion, was promoted by the adsorption of xenobiotics in the alimentary canal with the help of pectin substances, as well as the improvement of protein metabolism under the action

of an acidic proteinase of the multienzyme complex.

At the same time, joint feeding of tested preparations for detoxification of nitrates did not have any significant effect on the level of leucocytes in the blood of chickens of the compared groups, which indicates a greater resistance of white blood cells to various external factors, including environmental ones.

However, it is known that nitrates and nitrites inhibit protein metabolism to a greater extent, since nitrates, being reduced under the action of nitrate reductases of the intestinal microflora into nitrites, block the synthesis of exogenous proteinases in the body of young birds.

Taking into account the above, during the experiment we studied the changes in the concentration of total protein and its fractions, metabolites of nitrogen metabolism in the blood of chickens of the compared groups under the effect of the tested adsorbent preparation and multienzyme complex (Table 3).

Table 3 - The level of protein metabolism in the blood and indicators of natural resistance of the organism of experimental chickens n=5

| Value | Group | | | |
|--------------------------|------------|------------|------------|------------|
| | I | II | III | IV |
| Total protein, g/l | 61.5±2.3 | 65.5±2.9 | 65.9±3.2 | 66.7±2.7 |
| Albumines, % | 46.3±1.2 | 48.8±1.0 | 49.1±1.1 | 50.4±1.3 |
| α-globulins, % | 21.9±0.5 | 18.4±0.6 | 17.9±0.5 | 15.0±0.7 |
| β-globulins, % | 13.9±0.3 | 14.0±0.8 | 13.7±0.7 | 14.2±0.5 |
| γ-globulins, % | 17.9±0.4 | 18.8±0.5 | 19.3±0.3 | 20.4±0.5 |
| A/G index | 0.86 | 0.95 | 0.96 | 1.02 |
| Lysozyme activity, % | 17.41±0.27 | 19.54±0.29 | 19.77±0.33 | 21.73±0.31 |
| Bactericidal activity, % | 38.84±0.42 | 47.52±0.44 | 48.04±0.50 | 51.77±0.38 |
| Uric acid, mmol / l | 4.34±0.26 | 5.89±0.28 | 5.92±0.19 | 6.51±0.29 |
| Nitrates, mg / kg | 11.45±0.30 | 9.11±0.24 | 8.95±0.28 | 6.99±0.33 |
| Nitrites, mg / kg | 3.14±0.004 | 2.26±0.003 | 2.19±0.006 | 1.27±0.005 |

In the course of our research, it was shown that the process of denitrification under the influence of exogenous enzymes and pectin preparation had a stimulating effect on the protein metabolism in the liquid internal environment of broiler chickens. This was expressed in a significant ($P < 0.05$) increase in the total protein content by 5.2 g / l, albumin - by 4.1% and γ -globulins - by 2.5 % and a simultaneous reduction of the proportion of α -globulins - by 6.9% ($P < 0.05$) in the serum of meat poultry of group IV against their control analogues. Due to the similar ratio of albumin and globulin, the value of the A / G index in broilers of group IV was the highest, being ahead of the control group in this indicator by 0.16 units, which indicates an increase in the protective functions of their organism.

Of the whey proteins, in the first place, γ -globulins play a more significant role in the regulation of the nonspecific humoral immunity of meat chickens, since they do not allow them to penetrate the mucous barriers of various antigens into the body and have a depressive effect on the epithelial surface colonization by various microorganism species. Taking into account the above, a significant ($P < 0.05$) by 12.93% and 4.32% increase in bactericidal and lysozyme activity was observed in a liquid internal environment of broilers of group IV against control. This indicates the enhancement of non-specific immunity of broiler chickens with the addition of MEC of amylosubtilin G3x and citrus pectin preparation to diets with a subtoxic dose of nitrates, due to their denitrification properties.

Our studies have shown that there was an inverse relationship between the concentration of uric acid and the level of the studied toxicants (nitrates and nitrites) in the blood serum of the chickens of the compared groups. This is due to the fact that nitrates, reducing to nitrites, nitrites - to ammonia under the action of nitrate- and nitrite reductases of the intestinal microflora and xanthioxidase of organs and tissues, with the addition of a multienzyme complex and pectin preparation, promote the excretion of these xenobiotics with feces, as well as uric acid with urine in the composition of the litter. Therefore, in the blood of broilers of the IV group against the control group, there was a significant ($P < 0.05$) decrease - 1.63 times in the content of nitrates and nitrites - 2.47 times, and the concentration of uric acid, on the contrary, increased 1.50 times ($P < 0.05$).

Consequently, under the conditions of nitrate loads on the body, it is advisable to jointly introduce a test enzyme preparation and pectic substances in the rations of broilers based on barley grain, corn and soybeans to optimize intermediate metabolism.

When the compared poultry group reached 42 days of age, in the course of the first experiment, a control slaughter was conducted, for which 5 chickens of typical fatness and live weight were selected from each group.

The slaughter parameters of the experimental chickens that received joint additives of the multienzyme complex and pectin preparation for denitrification turned out to be higher than those of the other groups, which is confirmed by the data given in table 4.

Table 4 - Slaughter indices of experimental chickens in the course of I experiment n=5

| Index | Group | | | |
|-----------------------------------|------------|------------|------------|------------|
| | I | II | III | IV |
| Pre-slaughter weight of 1 head, g | 2110.8±5.1 | 2242.3±5.6 | 2250.3±4.9 | 2325.1±5.6 |
| Weight of half-dressed carcass, g | 1754.3±5.0 | 1872.3±5.2 | 1895.0±4.6 | 1946.3±4.8 |
| In % to live weight | 83.11 | 83.50 | 84.21 | 83.71 |
| Weight of dressed carcass, g | 1367.8±4.4 | 1462.6±4.7 | 1471.9±4.1 | 1525.7±4.3 |
| Slaughter yield, % | 64.80 | 65.23 | 65.41 | 65.62 |
| Weight of edible parts, g | 1078.2 | 1175.5 | 1194.7 | 1233.5 |
| Weight of inedible parts, g | 676.1 | 696.8 | 700.3 | 712.8 |
| Ratio of edible to inedible parts | 1.59 | 1.68 | 1.70 | 1.73 |
| Carcass (%): 1 category | 73 | 79 | 80 | 84 |
| 2 category | 27 | 21 | 20 | 16 |

It was found that in the course of the experiment, a more significant growth-promoting effect during denitrification had joint additions of tested preparations, which directly had a positive effect on the slaughter indicators of chickens in group IV. Therefore, against control in meat poultry of this group, there was a reliable ($P < 0.05$) higher indices of a half-dressed carcass by 10.9%, dressed - by 11.5% and a slaughter yield - by 0.82%.

According to the results of the control slaughter in the course of this experiment, it was found that the morphological parameters of the carcasses of experimental broilers were in direct proportion to the growth rate and their slaughter indices. Moreover, it was shown that with an increase in these studied parameters in chickens of group IV, there was an increase in the weight of edible parts by 14.4%, as well as the ratio of the weight of edible to inedible weight - by 8.8%. In addition, in group IV, the output rate of

carcasses of category I was higher by 11% than in the control.

It was established that during the research and production experiment, joint additions of the pectin preparation and the multi-enzyme complex had a beneficial effect on the chemical composition of red meat of broilers of group IV, which was expressed in a significant ($P < 0.05$) increase in the level of dry matter in the femoral muscles by 1.05 % and protein - by 1.09% than in the control. In addition, in chickens of group IV, against the control analogues, in the femoral muscle, there was a significant ($P < 0.05$) decrease in the content of nitrates by 40.8% and nitrites - by 55.1%.

But in assessing the nutritional and biological value, consumers prefer white meat, so we investigated the chemical composition of the pectoral muscle (Table 5).

Table 5 - Chemical composition of pectoral muscle (%) and biological value of the meat of experimental chickens n=5

| Index | Group | | | |
|--------------------|------------|------------|------------|------------|
| | I | II | III | IV |
| Dry matter | 25.51±0.11 | 26.10±0.12 | 26.43±0.16 | 26.72±0.14 |
| Fat | 2.11±0.03 | 1.87±0.04 | 1.94±0.05 | 1.94±0.06 |
| Protein | 21.96±0.10 | 22.74±0.11 | 22.79±0.16 | 22.98±0.14 |
| Tryptophan, % | 1.46±0.003 | 1.63±0.004 | 1.65±0.006 | 1.73±0.005 |
| Oxyproline, % | 0.35±0.001 | 0.35±0.002 | 0.36±0.003 | 0.35±0.002 |
| PQI | 4.17±0.09 | 4.66±0.12 | 4.58±0.14 | 4.94±0.15 |
| Nitrates, mg / kg | 4.42±0.17 | 3.51±0.13 | 3.42±0.12 | 2.45±0.14 |
| Nitrites, mg / kg, | 0.43±0.001 | 0.30±0.003 | 0.27±0.003 | 0.19±0.002 |

It was established that with a subtoxic dose of nitrates, the best denitrification effect was provided by the joint addition of amylosubtilin G3x and pectin preparation. Due to this, in the pectoral muscle of meat chickens of the IV group as compared to the control analogues, there was significantly ($P < 0.05$) more dry matter by 1.21% and protein - by 1.02%. We believe that this was a consequence of the optimization of protein metabolism due to the synergism of the denitrifying effect of the tested feed additives.

The main factor reducing the biological value of poultry meat in fattening broilers on feed with a high proportion of cereal grains (barley, corn, wheat, etc.) is the low availability of vitamin B₅ (nicotinic acid) of these crops and their deficiency in essential amino acid tryptophan. As it is shown by the data of our studies, under the influence of exogenous enzymes and pectin substances during denitrification in the pectoral muscles, a significant ($P < 0.05$) tryptophan concentration increase by 0.27% was in the chickens of the fourth group, which ensured an increase in protein quality index (PQI) of meat - by 18.5%.

One of the criteria for ecological well-being of broiler meat is the absence or presence of a small amount of various xenobiotics, including nitrates and nitrites. In the course of the experiment, it was found that with nitrate loads, the joint additives MEC of amylosubtilin G3x at a rate of 300 g / t and citrus pectin E 440 at a rate of 200 g / t feed had a more significant denitrifying effect. This allowed the chickens of group IV to have in samples of pectoral muscle significantly ($P < 0.05$) less nitrates - 1.80 times and nitrites - 2.26 times than in the control.

We believe that the best denitrifying effect when incorporating a mixture of tested drugs into the rations with a subtoxic nitrate dose was facilitated by the fact that, as part of the MEC of amylosubtilin G3x, there is an acidic proteinase that activated protein metabolism, and the pectic substances, at the same time, adsorbed part of the xenobiotics in the digestive tract of chickens and took them out with their droppings.

CONCLUSION:

1. With the joint inclusion of the multienzyme complex and pectin preparation in the rations with a subtoxic nitrate level, in broilers of group IV in relation to the control, an increase in the physiological and biochemical status of the organism was observed to the greatest extent; ($P < 0.05$), hemoglobin - by 7.0 g / l, total protein - by

5.2 g / l, albumin - by 4.1% and γ -globulins - by 2.5%, bactericidal activity - by 12.93%, lysozyme activity - by 4.32% while reducing the level of methemoglobin - by 1.40% ($P < 0.05$), nitrates - 1.63 times ($P < 0.05$) and nitrites - 2.47 times ($P < 0.05$);

2. Joint feeding of the multi-enzyme complex and pectin preparation in chickens of group IV contributed to a significant ($P < 0.05$) increase in the weight of the half-dressed carcass by 10.9%, the slaughter yield - by 0.82%, the concentration of dry matter and protein in meat, PQI of meat - by 18.5% with nitrates decrease in the pectoral and femoral muscles - 1.80 and 1.69 times ($P < 0.05$) and nitrites - 2.26 and 2.23 times ($P < 0.05$).

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