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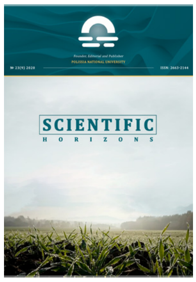

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Triazoline compounds influence on the meat productivity of turkey carcasses

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Abstract. The need to find effective means to improve the quality and production of meat products from poultry farming determines the relevance of the study. The introduction of drugs into the diet can increase the safety of livestock and improve the quality characteristics of poultry meat. The research aims to evaluate the impact of new 1,2,4-triazole derivatives on some blood parameters, as well as meat and slaughter qualities of poultry. The study was conducted between 2022 and 2023 at Odesa State Agrarian University. The trial was conducted to study the effect of new triazoline derivatives GKPF-109 at a dose of

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0.5 ml/bird per day on turkey performance and meat quality. The experiment was conducted on Big-6 turkeys aged 1-105 days. The following research methods were used: morphological and biochemical, organoleptic, physicochemical, and statistical. The effects of triazoline derivatives GKPF-109 on organoleptic (appearance, smell, consistency, fat condition, broth quality during meat cooking) and physicochemical studies of turkey meat for microbiological parameters were analysed and investigated following DSTU 3143:2013. The results showed that there was an increase in average daily weight by 13.1%, slaughter yield of gutted carcasses by 12.4%, semi-gutted carcasses by 12.3% and livestock preservation by 4%. An increase in the nutritional value of meat was noted due to an increase in muscle tissue protein by 7.5%, fat by 8.3%, and energy value by 4.8%. The organoleptic, bacteriological, and physicochemical parameters of turkey meat when using triazoline derivatives GKPF-109 in the diet met the requirements of DSTU 3143:2013. It was concluded that the addition of triazoline GKPF-109 derivatives to drinking water enhances haemopoiesis and has anti-inflammatory and hepatoprotective effects. The assessment of the quality of broiler turkey meat and broth at the end of the experiment does not allow to assert a decrease in their aroma and taste, which indicates the absence of a negative effect of triazoline derivatives GKPF-109 and methods of their application on the organoleptic characteristics of meat, which should be considered when keeping turkeys

Keywords: 1,2,4-triazole derivatives; turkeys; weight gain; red blood cells; haemoglobin; leukocytes

INTRODUCTION

A special place in biological science is given to the natural resistance of the organism, which is a component of immunology. A decrease in immunity and adaptation mechanisms in young animals and poultry may lead to an increase in mortality at an early age with a subsequent decrease in productive qualities in the future. Based on the above, the immunobiological state of poultry at an early age is of great interest at present. The study of changes in the body's immune response will allow for the effective use of new drugs to reduce the impact of stress in poultry. The problem of immunoprotection of disturbed homeostasis is to find and create effective immunoprotective agents and develop effective methods of immunodiagnostics. The relevance of pharmacocorrection is due to a significant increase in immunodeficiency states in animals, which cause many diseases, and the success of treatment depends on the choice of immune correction agents and methods.

The results of the research (Mesquita *et al.*, 2021) and production trials allow us to recommend immunomodulators for implementation in industrial poultry farming practice, which is economically profitable and contributes to a significant increase in poultry products. Sch. Bernd *et al.* (2020) believe that the pharmaceutical industry currently offers many immunomodulatory drugs for industrial poultry production, and their safety, and impact on poultry performance and poultry products have been studied. A. Disetlhe *et al.* (2019) point out that immunostimulants are used in poultry farming to normalise the immunodeficiency state. They can activate metabolism, increasing natural resistance, poultry growth energy, and feed conversion to ensure poultry safety, which has a positive impact on production profitability.

M. Alrawashdeh (2018) studied the development of immunostimulant drugs and their effect on the poultry body. Among such modern drugs are 1,2,4-triazole derivatives, which are used in industry, agriculture, veterinary medicine, and humane medicine. In veterinary practice, 1,2,4-triazole derivatives are used to provide immunomodulatory, cardio- and hepatoprotective, anti-inflammatory, antifungal and antiviral effects.

M. Korish & Y. Attia (2019) believe that the most important mechanism of pharmacodynamics of one of the 1.2,4-triazole derivatives, thiotriazoline, is its multifaceted effect on energy metabolism. Healthy and nutritious nutrition is the most important factor in public health. Ukraine offers a wide range of poultry meat. Poultry meat differs from cattle meat in terms of its high content of complete proteins (poultry, 19.5%; beef, 13.0%), and poultry fat has a lower melting point (36.5°C), which makes it easier for humans to digest. In addition, turkey meat is a low-allergenic product, which makes it ideal for baby food. Therefore, turkey meat is an excellent source of animal protein. The chemical composition and amino acid profile of turkey meat have been studied in several studies (Li *et al.*, 2017; Boz *et al.*, 2019; Gumulka & Poltowicz, 2020).

According to researchers (Hascik *et al.*, 2019; Cech *et al.*, 2021), compared to other poultry, turkeys have the highest carcass weight (>70%), consisting of >60% muscle tissue and <28% breast muscle. It contains a high amount of protein (28% vs. 14-18% in other poultry meat), moderate amounts of fat (2-5%), is rich in B vitamins and has lower cholesterol levels than other poultry meat.

The synthetic derivatives of 1,2,4-triazole include new compounds GKPF-109, the effect of which on the poultry organism is poorly understood, given the novelty of the triazole class as a medicinal and prophylactic agent. The research aims to improve the technological methods of increasing the productivity of broiler turkeys with derivatives of triazole compounds.

MATERIALS AND METHODS

The study was conducted in the period from 2022 to 2023 at Odesa State Agrarian University. The scientific and economic experiment was conducted to study the effect of new triazoline derivatives GKPF-109 at a dose of 0.5 ml/bird per day on turkey productivity and meat quality. Derivatives of 1,2,4-triazole synthesised at Zaporizhzhia State Medical University were used for the study: GKPF-109 – Morpholin-4-ium-2-((4-amino-5-(3-metyl-pyrasol-5-il)-1,2,4-triasol-3-il)tio) acetate. The experiment was conducted on Big-6 turkeys aged 1-105 days. The technological parameters of turkey rearing were in line with the recommendations for working with this cross. Changes in the dynamics of the live weight of turkeys were measured weekly by weighing them. Live weight is an indicator of poultry development, summarising the impact of feeding and housing conditions.

The birds were housed, fed, and cared for and all manipulations were carried out following the European Convention for the Protection of Vertebrate Animals Used for Experimental and Scientific Purposes (Strasbourg, 1986) and the General Ethical Principles for Experiments on Animals, adopted by the First National Congress on Bioethics (Kyiv, 2001). The experiments were conducted in compliance with the principles of humanity set out in the European Community Directive (Directive 2010/63/EU). The clinical and physiological condition of the turkeys was determined by daily inspection of the livestock, paying attention to behaviour, appetite and health status. The physiological state of turkeys was checked at the beginning and end of the experiment by morphological and biochemical parameters of turkey blood. On the 28th day and 105th day, 20 blood samples were taken from each group from the subcostal vein.

To determine the health status of turkeys, morphological blood analysis was performed according to the following indicators: blood content of red blood cells, leukocytes, haemoglobin, erythrocyte sedimentation rate (ESR), blood content of rods, segmented lymphocytes, eosinophils, monocytes (Sadovnikov *et al.,* 2009; Kanda *et al.,* 2020). In addition, the biochemical parameters of turkey blood (total protein, calcium, phosphorus, and reserve alkalinity (Sadovnikov *et al.,* 2009) were determined and studied.

For a more complete and objective assessment of the meat qualities of turkeys, anatomical cutting, and complete deboning of 10 female carcasses in each group was carried out. To assess the meat productivity, turkeys were slaughtered and anatomically processed. When slaughtering turkeys in a private yard, the bird is taken by the head and the throat is cut 1.5-3 cm below the earlobe. The duration of exsanguination is 1.53 minutes. The quality of the carcass depends on the thoroughness of feather removal. If there are skin tears and scratches on the carcass, the grade of the carcass is reduced, regardless of its fatness.

Sampling. Three meat samples weighing at least 200 g each were taken from each carcass. Processing and deboning of gutted turkey carcasses were carried out following DSTU 3143-95 Poultry meat (carcasses of chickens, ducks, geese, turkeys, guinea fowls). To do this, the wings were divided at the shoulder joint, the thighs at the hip joint, and the breast part at the junction of the thoracic and vertebral ribs (coracoid line). If necessary, the wing was divided into three parts, and the limb into two parts by joints separated by lines perpendicular to the axis of the respective bones.

The effect of new triazoline derivatives GKPF-109 on the zootechnical indicators of turkey development was studied; an anatomical examination of the internal organs of the bird was carried out. As a result of anatomical processing, the average carcass weight, slaughter yield, and yield of edible and inedible parts were determined. Parts of the carcass obtained during processing were deboned. The weight of meat and bone weight were considered during deboning, and the weight of edible parts of the carcass was determined by weighing, expressing them as a percentage of carcass weight.

Slaughter yield is the ratio of slaughter weight to live weight, expressed as a percentage. It is determined by which body parts are included in the slaughter weight. In poultry, the slaughter yield depends on the specifics of post-slaughter processing of the carcass: In ungutted poultry, it is the highest, as it includes the weight of the bloodless and plucked carcass with fat, head, limbs and internal organs; in semi-gutted poultry, the carcass weight includes fat but no intestines; in full gutting, both blood, feathers, down and intestines are removed, as well as all internal organs, and even the head to the second neck vertebra, limbs to the tarsus and wings to the elbow joint were removed following DSTU 3136:2017 Poultry for slaughter. Technical conditions.

Organoleptic (appearance, smell, consistency, fat condition, quality of broth during cooking) and physicochemical studies of turkey meat were carried out following DSTU 3143-95 (1995). The organoleptic characteristics of turkey meat and broth: appearance, aroma, colour, texture, juiciness, and taste were assessed on a 9-point scale by a 7-person panel. The meat was tested for microbiological parameters following DSTU 3143:2013 (2013). Statistical processing of the results was performed using the Statistica 6.0 software package. The significance of the difference in means was assessed by Student's t-test.

RESULTS AND DISCUSSION

Morphological and biochemical parameters of turkey blood. To evaluate the effect of new triazoline derivatives GKPF-109 on the body of turkeys, it is necessary to monitor the morphological and biochemical composition of the blood. This is because many factors can affect blood composition. Poultry blood tests are a valuable indicator that can be used to detect diseases of various etiologies at early stages of diagnosis (Table 1, Fig. 1).

Table 1. *Morphological parameters of turkey blood (n=10)*

Indicators	Age of the bird, day	Control	Studied
Haemoglobin, mmol/l	28	129±2.00	136±5.36**
	105	134±2.18	141±4.55***
Red blood cells, 10^{12}/l	28	1.94±0.02	2.26±0.08*
	105	1.98±0.03	2.33±0.1**
White blood cells, thousand/mm^3	28	20.16±0.3	19.84±0.2
	105	22.48±0.5	22.78±0.4*
ESR, mm/h	28	2.26±0.2	2.19±0.1
	105	2.40±0.3*	2.13±0.1
Rod-core, %	28	1±0.01	3±0.01
	105	5±0.01	1±0.01
Segmental, %	28	17±2	28±3
	105	21±3	26±3
Monocytes, %	28	0	0
	105	0	0
Lymphocytes, %	28	70±5	58±4
	105	76±7	72±6
Eosinophils, %	28	1±0.01	2±0.01
	105	3±0.01	1±0.01
Basophils, %	28	0	0
	105	0	0

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

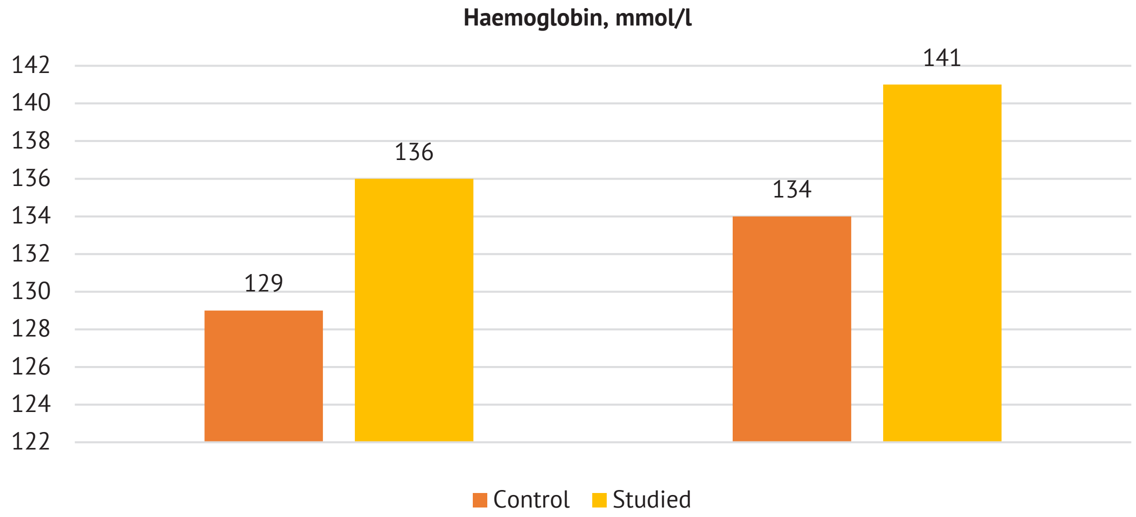

Figure 1. *Dynamics of haemoglobin concentration in the turkey blood*

The physiological state of the experimental turkeys treated with the triazoline compound GKPF-109 was assessed by their general appearance, behaviour, frequency of feeding and watering, as well as by the results of biochemical blood tests. During the study, the turkeys in the experimental group were observed to be clinically healthy, with good appetite, good response to external stimuli, and no signs of disease. The litters of the control and experimental groups were formed, without visible signs of digestive disorders, indicating physiological norms of the gastrointestinal tract.

The experiments (Table 1, Fig. 1) show that the haemoglobin content in the experimental group on day 28 (136 mmol/l) is 5.4% higher than in the control group (129 mmol/l). In addition, at 105 days, the haemoglobin content in the blood of the experimental group reached 141 mmol/l, which is 5.2% higher than in the control group. The analysis of Figure 2 shows that the red blood cell content in the experimental group on day 28 (2.26 10^{12}/l) and day 105 (2.33 10^{12}/l) increased by 16.5% and 17.7%, respectively, compared to the control group on day 28 (1.94 10^{12}/l) and on day 105 (1.98 10^{12}/l) (Fig. 2).

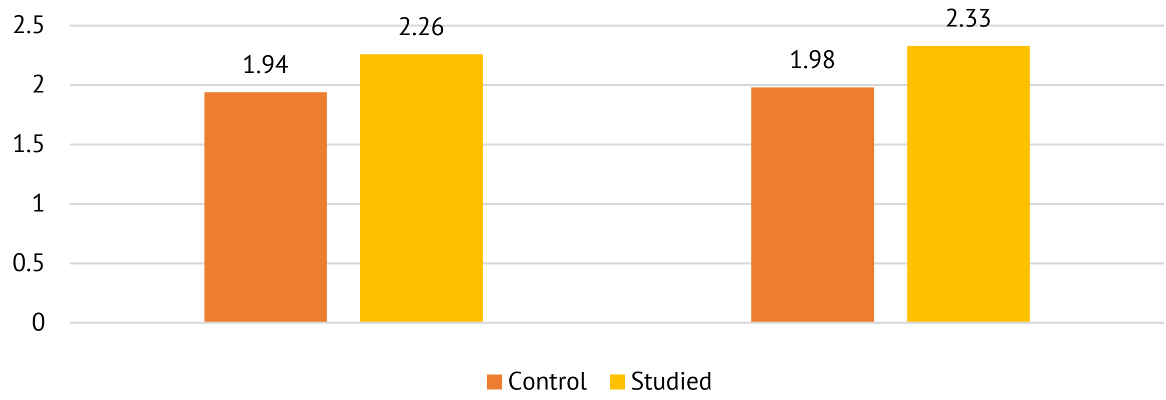

Figure 2. *Dynamics of red blood cells in the blood of turkeys, 10^{12}/l*

In addition, the results show that the leukocyte content of both the experimental and control groups is almost the same without any significant changes during the turkey-rearing period. However, no significant difference was observed between the two groups in terms of leukocyte monitoring (neutrophils, eosinophils, basophils, lymphocytes, and monocytes) ESR, mm/h (Fig. 3).

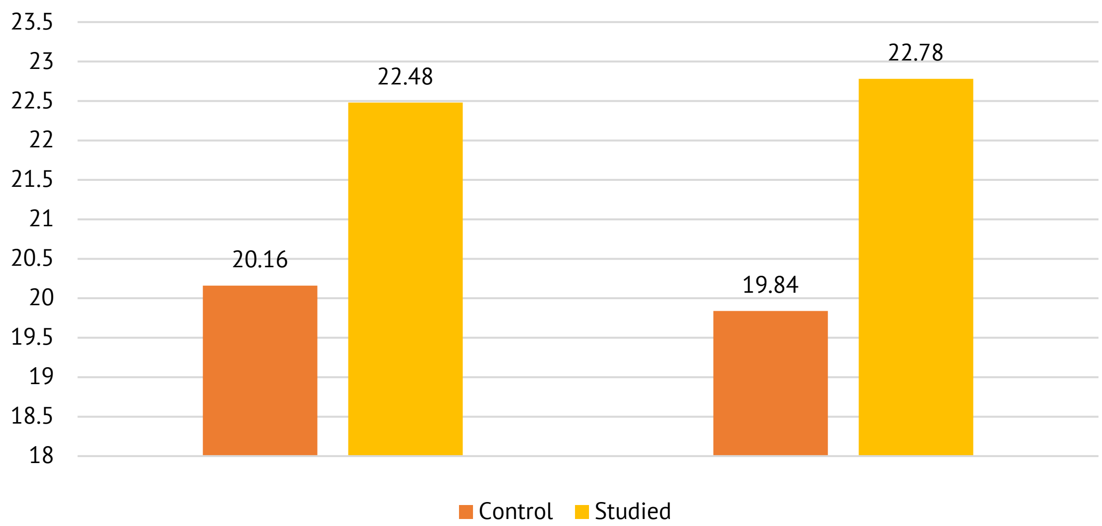

Figure 3. *Dynamics of leukocytes in the blood of turkeys, thousand/mm^3*

The results of the erythrocyte sedimentation rate (Fig. 4) show that on day 28, the experimental group (2.19 mm/h) was 3.1% lower than the control group (2.26 mm/h). At the same time, at 105 days, an analysis of the erythrocyte sedimentation rate shows that it is 11.25% lower in the experimental group (2.13 mm/h) than in the control group (2.40 mm/h). To maximise the production potential of poultry, body functions must be in perfect balance, known as homeostasis. In this context, knowledge of the levels of certain blood parameters provides important information to determine the state of balance of the body, which reflects the requirements for metabolic processes (Fig. 4).

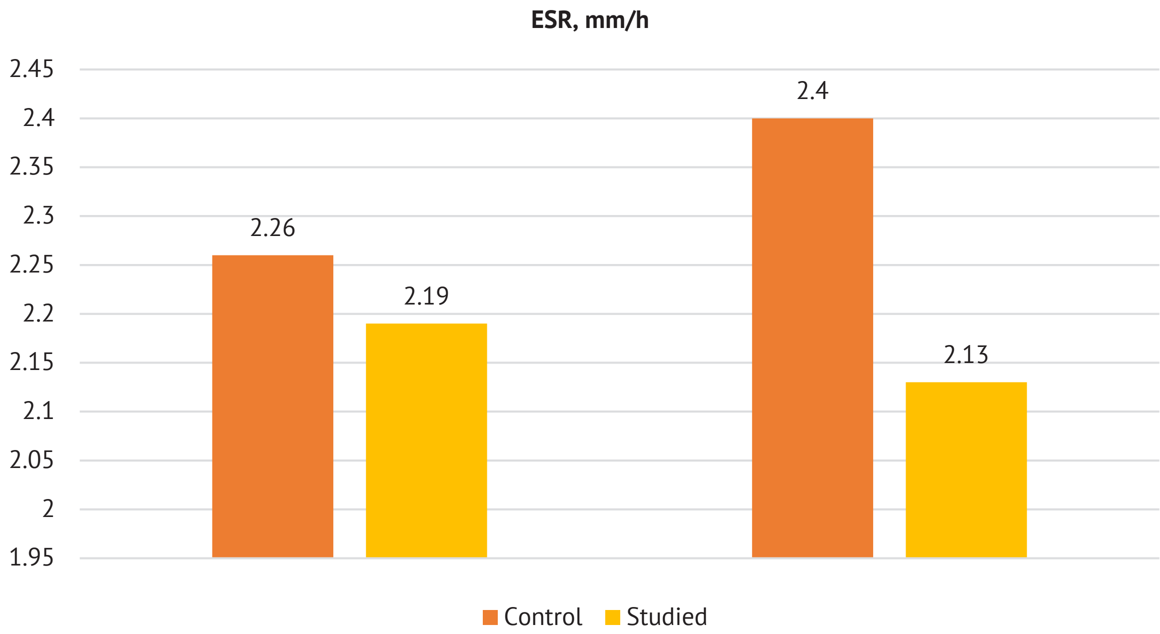

Figure 4. *Dynamics of ESR in turkey blood, mm/h*

The next stage of the study was the biochemical parameters of blood serum. Thus, age and related production processes in the rearing of poultry of meat type are important factors that can affect the intensity of metabolism and induce changes in the structure of serum proteins (Table 2).

Table 2. *Biochemical parameters of blood serum*

Indicator	Age, days	Control	Studied
Females (n=10)			
Total protein, g/l	28	49.37±0.15	50.13±0.19*
	105	49.74±0.26	51.2±0.3**
Calcium, mmol/l	28	4.15±0.01	4.21±0.02**
	105	3.99±0.06	4.20±0.01**
Phosphates, mmol/l	28	2.16±0.03	2.25±0.02*
	105	2.06±0.02	2.20±0.01
Ca:P ratio	28	1.92±0.02	1.87±0.02
	105	1.93±0.02	1.90±0.01
Reserve alkalinity, mmol/l	28	49.9±0.23	50.5±0.34
	105	50.2±0.13	50.41±0.21

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

Poultry blood proteins are an important indicator in assessing health status and are the basis of general biochemistry, which allows identifying metabolic changes. The results in Table 2 and Figure 5 show that the total protein content on day 28 in the blood of turkeys of the experimental group (50.13 g/l) is 1.5% higher than in the control group (49.37 g/l), and on day 105 in the experimental group (51.2 g/l) is 2.9% higher than in the control group (49.74 g/l). Considering that blood proteins play an important physiological role in the body and in maintaining homeostasis, determining their concentration in sick poultry is of paramount importance for assessing the health status of the organism (Fig. 5).

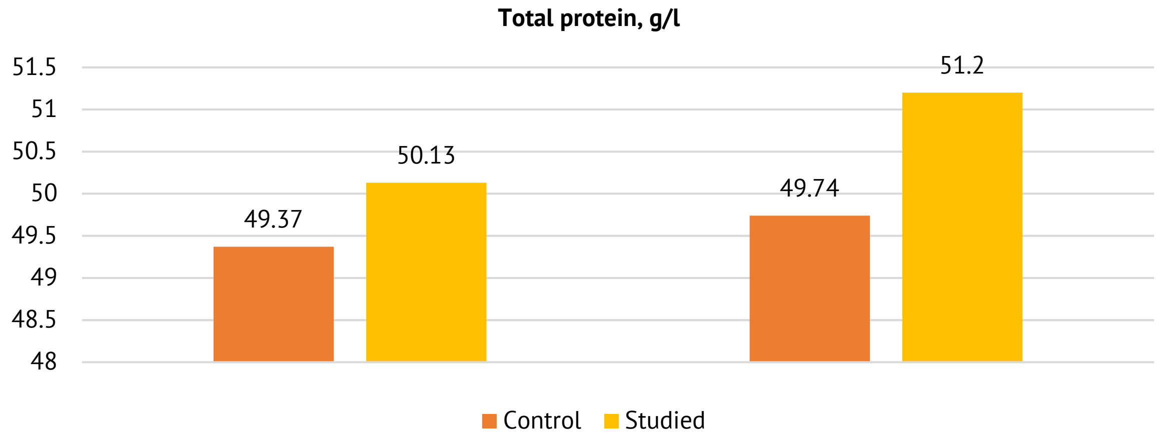

Figure 5. *Total protein content in turkey blood, g/l*

The data in Figure 6 show that the level of calcium and phosphorus in the blood of turkeys of the control group on day 28 (4.15 mmol/l and 2.16 mmol/l) is 1.5% and 4.2% lower, respectively, than in the experimental group (4.12 mmol/l and 2.25 mmol/l), At the same time, on the 105th day, the level of calcium and phosphorus in the blood of turkeys of the experimental group (4.20 mmol/l and 2.20 mmol/l) exceeded the levels in the control group (3.99 mmol/l and 2.06 mmol/l) by 5.3% and 6.8%, respectively.

In addition, Table 2 shows no significant changes between the levels of reserve alkalinity, mmol/l, in both the experimental and control groups at different age periods (Fig. 6).

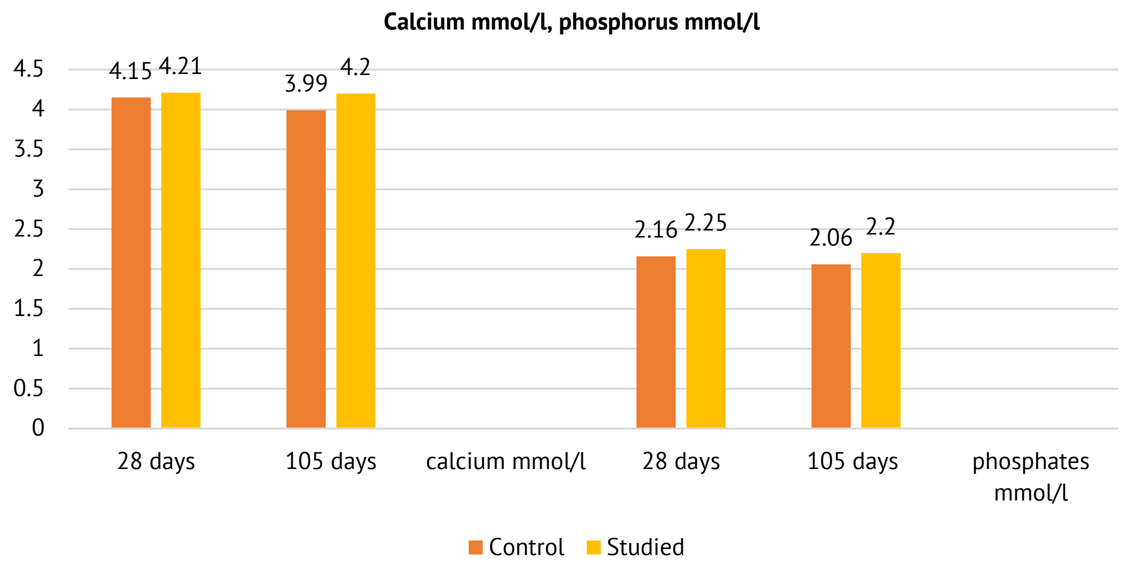

Figure 6. *Calcium and phosphorus levels in turkey blood, mmol/l*

At the end of the experiment, to test the efficiency of digestion and metabolism in turkeys, the general morphological composition of the blood was analysed, and the content of total blood protein showed a significant increase in the experimental group by 2.9% compared to the control group. This may indicate that GKPF-109 can increase metabolic efficiency in turkeys. In the biochemical analysis, a significant difference was observed in the increase in haemoglobin and red blood cells in the experimental group of turkeys by 5.2% and 17.7%, respectively.

Thus, the increase in the number of red blood cells, haemoglobin, and total protein in the blood of turkeys of the experimental groups suggests that the drug can stimulate the processes of erythropoiesis and protein synthesis without affecting the stability of haemopoiesis and the stability of the overall blood composition.

Turkey meat productivity and quality. Quantitative and qualitative characteristics of turkey meat are evaluated after slaughter. The addition of the triazoline compound GKPF-109 to the turkey diet leads to an increase in pre-slaughter weight, semi-gutted carcass weight and gutted carcass weight of the experimental group (9787 g, 8359 g and 7480 g) by 7.6%, 7.1% and 7.6%, respectively, compared to the control group (9100 g, 7806 g and 6950 g) (Table 3).

Table 3. *Turkey meat qualities*

Indicators	Control	Studied
Number of females	10	10
Pre-slaughter weight, g	9100±99.30	9787±95.61***
Semi-gutted carcass weight, g	7806±74.22	8357±76.49***
Of the pre-slaughter weight, %	85.78%	85.39%
Weight of gutted carcass, g	6950±62.73	7480±76.03***
Slaughter yield, %	76.37%	76.43%

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

According to the results presented in Table 4, there is a large difference between the weight of different parts of turkey carcasses of the experimental and control groups: the weight of the breast in the control group (2589 g) is 7.9% lower than in the experimental group (2788 g), and the weight of the back of the experimental group (1446 g) is 7.1% higher than in the control group (1548 g). In addition, the hip weight was 7.8% higher in the experimental group (1240 g) than in the control group (1150 g), 143 g) by 8% and 6.3%, respectively (Table 4).

Morphological examination of the internal organs of turkeys (heart, spleen, glandular part of the stomach, muscular part of the stomach, kidneys, air sacs) revealed that in all groups they were in a state without any pathological changes (Table 5).

Table 4. *Meat quality and conformity of different parts of turkey carcasses*

Indicators	Control	Studied
Number of females	10	10
Pre-slaughter weight, g	9100±99.30	9787±95.61***
Weight of semi-gutted carcass, g	7806±74.22	8357±76.49***
Of the pre-slaughter weight, %	85.78%	85.39%
Weight of the alarmed turkey carcass, g	6950±62.73	7480±76.03***
Including breast	2589±40.4	2788±45.6**
%	37.25%	37.27%
Backbone	1446±36.8	1548±35.9**
%	20.80%	20.7%
Thighs	1150±24.7	1240±25.5**
%	16.55%	16.58%
Shin	805±14.1	807±14.3*
%	11.59%	11.63%
Wing	817±12.9	882±13.6**
%	11.76%	11.79%
Neck skin	143±7.7	152±8.3*
%	2.05%	2.03%

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

Table 5. *Internal organ mass*

Indicators	Control	Studied
Pre-slaughter weight, g	9100±99.29	9787±95.60***
% of pre-slaughter weight	100%	100%

Table 5, Continued

Indicators	Control	Studied
Liver, g	83.72±1.11	92.11±1.26*
% of pre-slaughter weight	0.92%	0.94%
Spleen, g	4.55±0.2	5.12±0.2
% of pre-slaughter weight	0.05%	0.05%
Heart, g	25.48±0.75	29.50±0.81*
% of pre-slaughter weight	0.28%	0.3%

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

The study results of internal organs showed that the absolute weight of the internal organs of the poults of the experimental group was significantly higher than that of the control group, which was noticeably manifested in the weight of the liver and heart, which increased to 92.11 g (10.02%) and 29.50 g (15.78%) compared to the control (P<0.05).

Organoleptic evaluation of turkey meat. When analysing the organoleptic characteristics of meat and the quality of broth when cooking turkey meat, it was found that the organoleptic characteristics of turkey meat were better in the experimental group than in the control group, when conducting a scoring assessment of appearance, aroma, colour, taste, a significant increase in the indicators of the experimental group (8.1, 8.3, 8.2 and 8.1) was found, which is more than in the control group (7.8, 8, 7.9 and 7.8) by 3.9%, 3.8%, 3.8% and 3.9%, respectively (Table 6).

Table 6. *Organoleptic characteristics of turkey meat and broth quality*

Indicators	Group	
	Control	Studied
	Meat	
Appearance	7.8±0.40	8.1±0.50*
Aroma	8.0±0.24	8.3±0.57*
Colour	7.9±0.25	8.2±0.54
Texture	7.8±0.54	7.8±0.83
Succulence	8.0±0.00	8.1±0.44
Taste	7.8±0.65	8.1±0.71*
Overall score	47.3±7.41	48.6±6.92
Stock		
Appearance	7.7±0.70	8.0±0.63
Aroma	7.9±0.62	8.4±0.50**
Colour	8.1±0.25	8.3±0.44*
Taste	8±0.52	8.1±0.77
Richness	7.3±0.70	7.5±1.02
Overall score	39±5.09	40.3±6.46

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

The results of the study (Table 6) show that the addition of GKPF-109 to the turkey diet leads to a significant increase in the results of the broth evaluation of turkey meat scores of the experimental group in terms of appearance, smell, colour, and taste (8, 8.4, 8.3 and 8.1) by 3.9%, 6.3%, 2.5% and 1.3% more than in the control group (7.7, 7.9, 8.1 and 8.1). The next stage of the study was the physical and chemical evaluation of turkey meat. The results presented in Table 7 show that the pH and ammonia-ammonia nitrogen content in white and red turkey meat does not differ significantly between the control and experimental groups, the peroxidase reaction is positive, and the content of ammonia and ammonium salts is negative. However, microscopy of smear prints from the surface layers of red and white turkey meat shows a significant decrease in the number of microorganisms in the experimental group compared to the control group by 36.4% and 42.1%, respectively.

Table 7. *Physical and chemical properties of turkey meat*

Indicators	Control group		Studied group	
	Red meat	White meat	Red meat	White meat
pH	6.01±0.16	5.97±0.10	5.91±0.09	5.85±0.09
Ammonia nitrogen (mg KaON)	1.12±0.07	1.08±0.09	0.98±0.08	0.88±0.06
Reaction to peroxidase	Positive	Positive	Positive	Positive
Ammonia and ammonium salts content	Negative	Negative	Negative	Negative
The number of microorganisms in one field of view of the smear prints				
External layer	3.30±0.90	3.80±0.98	2.10±1.04*	2.20±0.98*
Deep layer	3.1±1.14	2.90±1.04	2.10±1.54	2.10±0.94

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

Poultry meat, in particular turkey meat, has a different degree of colour compared to meat from other farm animals, with muscle tissue ranging from light pink (white meat) to dark red (red meat) depending on the myoglobin content; red limb meat contains less protein, more fat and cholesterol, and white meat (breast muscles) contains more carnosine, glycogen, and adenosine triphosphate.

During the chemical analysis of turkey meat, it was observed that the myoglobin content in white muscles is 0.05 – 0.08%, and in red muscles – several times higher (Table 8).

Table 8. *Chemical analysis of turkey meat*

Indicators	Control		Studied	
	Red meat	White meat	Red meat	White meat
Moisture, %	75.12±1.96	70.75±2.59	74.50±1.66	70.12±1.90
Dry matter, %	24.88±1.96	29.25±2.59	25.50±1.66	29.88±1.90
Protein, %	23.81±1.56	31.21±1.79	25.28±1.73**	32.04±1.59*
Fat, %	4.4 ±0.69	3.85±0.58	3.84±0.71	3.34±0.63
Mineral substances, %	0.95±0.11	0.98±0.14	1.06±0.19	1.21±0.23
Calorie content, kcal/100 g	121.43	135.95	120.14	134.87

Note: ** – P<0.05; ** – P<0.01; *** – P<0.001*
Source*: compiled by the author*

Turkey meat is distinguished from other animal meat by its high protein content. There is a significant variation in the flavour and nutritional properties of meat in different turkey breeds. Given the importance of providing the population with high-quality meat raw materials, comprehensive research is needed to determine the quality and commercial and technological characteristics of meat. The results show that the red meat of turkeys of the first experimental group is higher than the red meat of turkeys of the first control group in terms of dry matter, protein and mineral content by 2.5%, 6.14% and 11.97%, respectively.

The results presented in Table 8 show that the highest water content was in the red meat of the control group turkeys – 70.75%, and the lowest – in the white meat of the experimental group turkeys – 70.12%. The results of the protein content analysis show that the protein content in the white meat of the turkeys of the experimental group is 32.04%, which is 2.1% higher than in the white meat of the control group (31.21%) (Table 8). The protein content in the red meat of the turkeys of the experimental group was also 10.2% higher than in the control group.

The fat content in the red and white meat of turkeys of the experimental group (3.84% and 3.34%) is lower than in the control group (4.49% and 3.85%) by 14.5 and 13.3%, respectively (Table 8). The analysis of the research results (Table 8) shows that the highest amount of minerals is contained in the white meat of turkeys of the experimental group – 1.21%, which is 23.5% higher than in the control group. Table 8 shows that the calorific value of white and red meat of turkeys in the experimental group (120.14 kcal/100 g and 134.87 kcal/100 g) is 1.1% and 0.8% lower than that of turkeys in the control group (121.43 kcal/100 g and 135.95 kcal/100 g).

The demand for immunostimulants has been growing rapidly in recent years, driven by the widespread prevalence of immunodeficiencies in poultry production. These immunostimulants are most commonly used in poultry farming to improve the effectiveness of poultry vaccination and poultry productivity. During these studies, the authors noted that the results obtained by scientists after the use of immunostimulants in poultry rearing in all cases were positive, namely the impact on reducing the time of fattening, and the safety of poultry during fattening. In our research, we used haemolytic, organoleptic methods and anatomical examination of poultry to develop rational regimens for the use of immunostimulants – derivatives of the triazoline series. When choosing immunostimulants, preference was given to the triazoline derivatives GKPF-109, synthesised in recent years in Ukraine. Fedotov *et al.* (2023) point out that heterocyclic 1,2,4-triazole compounds are structural fragments of many synthetic drugs that exhibit antifungal (fluconazole, itraconazole), antidepressant (trazodone alprazolam), hepatoprotective, wound healing and antiviral (thiotriazoline) effects, which contain a 3-pyridine fragment as a substituent and lead to the appearance of substances with high pharmacological activity.

R. Dubin *et al.* (2022) and A. Paliy *et al.* (2018) found that after the introduction of new triazoline compounds, the general condition of broiler chickens was positively affected compared to the control group. The experimental chickens had an improved appetite, and the compounds had a positive effect on the gastrointestinal tract during the transition from one feed to another. An important aspect of the use of triazoline compounds in our studies was that the emphasis was placed on studying the properties and developing schemes for the use of this compound, which allowed us to develop more reasonable general schemes for the use of the compound to stimulate haematological parameters and organolipid properties of poultry carcasses.

Similar results were obtained for the feeding of triazoline compounds to broiler chickens in the experiments of O. Orobchenko *et al.* (2022), where a positive effect on reducing the time of poultry fattening was found, which is important for industrial meat poultry production. The developmental dynamics of broiler turkeys, which were used in the experiment to study the effect of triazoline compounds on meat productivity, showed that the introduction of GKPF-109 caused a large difference between the weight of different parts of the carcasses. The use of the triazoline compound GKPF-109 did not affect the morphological parameters of blood – haemoglobin, red blood cells, leukocytes, and proteins were within the physiological norm. In the experimental group, there was an increase of 8.14% in the number of red blood cells and 5.2% in the total protein content compared to the control group.

When studying the effect of the triazoline compound GKPF-109 on the meat quality of turkey poults, a positive effect was found. In the experimental group, the increase in muscle tissue increased protein by 7.5%, fat by 8.3%, and energy value by 4.8%. The results of our studies are consistent with the data of C. Hautefeuille *et al.* (2020), and M. Arif *et al.* (2018), when Carcesel was used in experiments in the diet of broiler chickens, it increased the pre-slaughter live weight and carcass weight of broiler chickens compared to the control, which was 2.76-5.02% and 2.93-5.89% higher, muscle tissue weight – by 3.32-6.75%, pectoral muscle weight – by 3.53-7.83%, and the weight of edible parts of the carcass – by 3.33-6.47%. According to T. Hofmann *et al.* (2021), the higher productivity of broilers in the experimental groups was due to the protein quality index (PQI) in broiler chickens of the experimental groups, which was 3.92-7.84% higher than in the control, and the culinary and technological index of meat was 1.81-3.61% higher. During the experiment, a positive effect on the nutritional value of meat was observed, which increased due to an increase in muscle tissue protein – by 7.5%, fat – by 8.3%, and energy value – by 4.8%.

The results of our organoleptic study are consistent with the studies of Sch. Bernd *et al.* (2020), A. Fatenok-Tkachuk *et al.* (2017) and S. Kabene & S. Baadel (2019). Thus, according to the authors, feeding broiler chickens with various immunostimulant preparations significantly affects the digestibility of organic matter by 3.92%, protein by 7.80%, fat by 5.35%, fibre by 6.7%, and BEV by 1.7%. They are characterised by a high average daily weight gain of 3.11-10.79% and live weight at the time of slaughter by 3.7-10.29% better feed conversion than control broiler chickens, which allows for fuller use of the biological resources of their meat productivity: to increase not only the pre-slaughter weight and carcass weight, but also the slaughter yield of gutted carcasses by 2.52-2.68%, and to increase the yield of edible parts from the carcass to 85.0-86.1%. Thus, the results obtained by the authors indicate a positive effect of the triazoline compound GKPF-109 in the diet of turkeys during all periods of development due to a higher content of red blood cells, leukocytes, haemoglobin, total protein in the blood, which accelerates the main biochemical processes in their body.

CONCLUSIONS

The addition of a triazoline compound GKPF-109 to the diet of turkeys at a dose of 0.5 ml/bird per day increases the slaughter yield of gutted carcasses by 12.4%, and semi-gutted carcasses by 12.3%. In the study of morphological and biochemical parameters of turkey blood, an increase in haemoglobin in the blood of turkeys of the experimental group was observed by 8.14%, the number of red blood cells in the blood was higher by 8.29%, the content of total protein – by 5.2%. When examining the internal organs, it was observed that the absolute weight of the internal organs of the experimental group was significantly higher than that of the control group, which was noticeably manifested in the weight of the liver and heart, which increased to 92.11 g (by 10.02%) and 29.50 g (by 15.78%) compared to the control (P<0.05). Organoleptic, bacteriological, and physicochemical parameters of turkey meat showed an increase in the nutritional value of meat due to an increase in muscle tissue protein by 7.5%, fat by 8.3%, and energy value by 4.8%. During the evaluation of the broth, the scores of turkey meat from the experimental group in terms of appearance, smell, colour, and taste (8, 8.4, 8.3 and 8.1) were 3.9%, 6.3%, 2.5% and 1.3% higher than in the control group (7.7, 7.9, 8.1 and 8.1). The results show that the red meat of turkeys of the first experimental group is higher than the red meat of turkeys of the first control group in terms of dry matter, protein, and mineral content by 2.5%, 6.14% and 11.97%, respectively. Prospects for further research are to determine the effect of the drugs on poultry infection with diseases of bacterial aetiology.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Вплив триазолінових сполук на м'ясну продуктивність тушок індиків

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Анотація. Необхідність пошуку ефективних засобів підвищення якості та збільшення виробництва м'ясної продукції птахівництва зумовлює актуальність дослідження. Введення препаратів до раціону дозволяє підвищити збереженість поголів'я та покращити якісні характеристики м'яса птиці. Мета дослідження – оцінити вплив нових похідних 1,2,4-тріазолу на деякі показники крові, а також м'ясні та забійні якості птиці. Дослідження проводилося у 2022-2023 роках в Одеському державному аграрному університеті. Дослід проводився з метою вивчення впливу нових похідних триазолу GKPF-109 у дозі 0,5 мл/птицю на добу на продуктивність індиків та якість м'яса. Дослід проводили на індичатах кросу Біг-6 віком 1-105 днів. Використовували такі методи дослідження: морфологічні та біохімічні, органолептичні, фізико-хімічні та статистичні. Вплив похідних триазолу GKPF-109 на органолептичні (зовнішній вигляд, запах, консистенція, стан жиру, якість бульйону під час варіння м'яса) та фізико-хімічні дослідження м'яса індиків за мікробіологічними показниками було проаналізовано та досліджено згідно з ДСТУ 3143:2013. Результати показали, що відбулося збільшення середньодобових приростів на 13,1 %, забійного виходу потрошених тушок на 12,4 %, напівпотрошених тушок на 12,3 % та збереженості поголів'я на 4 %. Відмічено підвищення харчової цінності м'яса за рахунок збільшення вмісту білка в м'язовій тканині на 7,5 %, жиру на 8,3 % та енергетичної цінності на 4,8 %. Органолептичні, бактеріологічні та фізико-хімічні показники м'яса індиків за використання в раціоні похідного триазолу GKPF-109 відповідали вимогам ДСТУ 3143:2013. Зроблено висновок, що додавання похідних триазолу GKPF-109 до питної води посилює гемопоез, має протизапальну та гепатопротекторну дію. Оцінка якості м'яса та бульйону індичат-бройлерів наприкінці досліду не дозволяє стверджувати про зниження їх аромату та смаку, що свідчить про відсутність негативного впливу похідних триазолу GKPF-109 та способів їх застосування на органолептичні показники м'яса, що слід враховувати при утриманні індиків

Ключові слова: похідні 1,2,4-тріазолу; індики; приріст маси; еритроцити; гемоглобін; лейкоцити