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The Effect of Furazidine on the Parameters of the Leukocyte Formula of Chickens †

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Abstract: The study of the effect of antibiotics on the blood system of farm animals is an important aspect of the detection of antibiotic resistance in humans. In the presented study, the effect of furazidine on the parameters of the leukocyte formula of Hysex Brown cross chickens was studied. The results of the experiment revealed a change in the number of pseudoeosinophils in the blood on the first (8.9%), third (8.9%), and fifth (5.9%) days after discontinuation of the drug. However, on the ninth day after discontinuation of the drug, the number of psevdoeosinophils in the blood returned to its initial values, which indicates the absence of toxic stress on the body.

Keywords: antibiotics; antibiotic resistance; chicken meat; agriculture; furazidine; blood; leukocyte formula

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1. Introduction

Global consumption of chicken meat is constantly growing, as poultry meat is an inexpensive and valuable source of protein. However, poultry meat consumers are concerned about the uncontrolled use of antimicrobials in agriculture. According to literature data, in 2010, the total volume of antibiotic use in animal husbandry amounted to 63,151 ± 1560 tons, and by 2030, it is projected to increase by 67% [1].

Antimicrobials that accumulate in poultry meat and organs can pose two main dangers: the development of antibiotic resistance in humans when consuming such products, as well as some toxicological effects. Among them, allergic reactions, as well as gastrointestinal disorders, may occur most often.

Currently, organic acids, phytobiotics, probiotics, and immunomodulators are offered as alternative antibiotics [2]. Their use is not as effective as the use of antimicrobials since they act locally on specific enterobacteria. Taking into account that bird diseases cause serious economic damage to the poultry industry, increasing mortality and reducing body weight gain and feed conversion rate, the use of such alternatives is limited. Thus, there is a need for either additional studies of alternatives to antibiotics or an in-depth study of the effects of antibiotics on poultry.

Currently, studies are known on the effectiveness of lincomycin and bacitracin in the fight against necrotic enteritis in broiler chickens [3], the effect of feed additives on the poultry immune system [4], and the effect of ciprofloxacin on the leukocyte formula of chicken blood in experimental staphylococcal infection [5]. There is also evidence to study the efficacy of enrofloxacin, tilmicosin, spectinomycin, and tilosin in experimental chicken salmonellosis [6]. A review of the literature showed that the effect of nitrofuran antibiotics on the blood of poultry has not been sufficiently studied.

The aim of this work was to study the effect of furazidine on the parameters of the leukocyte formula in birds.

Furazidine is a substance derived from nitrofuran, similar in properties to nitrofurantoin (furazolidone). The mechanism of action of furazidine consists of damage to the ribosomal proteins of bacteria, which leads to disruption of many parameters of bacterial vital activity—pressure of protein synthesis, aerobic energy metabolism, synthesis of nucleic acids, and the cell wall. The antibiotic is active against such microorganisms as *E. coli*, *Enterobacter*, *Citrobacter*, *Corynebacterium*, *Salmonella*, *Shigella*, *Klebsiella*, *Neisseria*, *Staphylococcus aureus*, *S. epidermidis*, and *Streptococcus faecalis*. Currently, it is used to treat urinary tract infections. Side effects include dyspeptic symptoms (nausea, vomiting, diarrhea), hepatotoxicity, ototoxicity, hemotoxicity, and rarely serious pulmonary reactions (pulmonary fibrosis) [7].

2. Materials and Methods

To study the effect of furazidine on the blood of poultry, 2 groups of one-day-old Hysex Brown chickens were formed. The first group was a control group (n = 30), and the second experimental group received furazidine at a dose of 200 mg/L (n = 30) for 10 days. Blood sampling was performed in 6 chickens from each group on the 1st, 3rd, 5th, 7th, and 9th days after drug withdrawal. When assessing the effect of furazidine on poultry blood, the ratio of basophils, eosinophils, pseudoeosinophils, lymphocytes, and monocytes was studied. The research methodology was approved by the Ethics Committee of the Belgorod State National Research University.

The blood parameters of chickens were evaluated using standard blood smear microscopy methods, followed by the calculation of the leukocyte formula. To do this, the finished blood smears were fixed with 96% alcohol for 20 min. Then, after drying, the Romanov-mu-Gimza smears were stained [8].

Statistical processing of digital material included the calculation of the average value (M) and the standard error of the average (m) in Microsoft Excel 2010. The significance of the differences was assessed using the nonparametric Mann–Whitney U-test. The differences were considered statistically significant at $p < 0.05$. Microscopy of a poultry blood smear is shown in Figure 1.

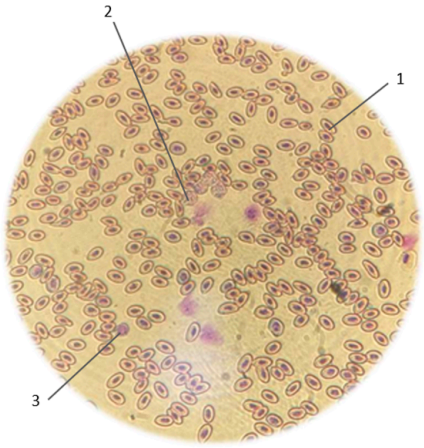

Figure 1. Microscopy of a blood smear of a Haysex Brown cross poultry. Note: 1—erythrocytes; 2—pseudoeosinophils; 3—lymphocytes.

Also, for a more accurate assessment, the following leukocyte indices were calculated: leukocyte intoxication index (LII), leukocyte shift index (ISLC), lymphocyte granulocyte index (ILG), Krebs index (IC), leukocyte index (LI), and immunoreactivity index (IIR).

3. Results

It was found that pseudoeosinophils undergo the most pronounced changes compared with the control—on the 1st and 3rd days after discontinuation of the drug, the number of pseudoeosinophils increased by 8.9%, and on the 5th day—by 5.9% (Table 1). On the 7th

day after discontinuation of the drug, the increase in the number of pseudoeosinophils was 5%. On the 9th day, this indicator returned to its original values.

Table 1. Indicators of the leukocyte formula of poultry blood after discontinuation of the drug (n = 6, M ± m), %.

Indicators	Control Group	Experimental Group
1 day after discontinuation of the drug		
Basophils, %	2.0 ± 0.36	1.0 ± 0.00
Eosinophils, %	5.0 ± 0.77	4.17 ± 0.30
Pseudoeosinophils, %	54.0 ± 1.23	63.8 ± 2.62 *
Lymphocytes, %	36.3 ± 2.08	40.0 ± 2.63
Monocytes, %	2.0 ± 0.00	1.0 ± 0.00
3 days after discontinuation of the drug		
Basophils, %	1.83 ± 0.30	1.0 ± 0.00
Eosinophils, %	6.0 ± 0.26	4.33 ± 0.61
Pseudoeosinophils, %	55.2 ± 1.47	65.0 ± 1.03 ***
Lymphocytes, %	34.2 ± 1.47	28.5 ± 0.76
Monocytes, %	1.67 ± 0.21	1.17 ± 1.17
5 days after discontinuation of the drug		
Basophils, %	1.83 ± 0.30	1.0 ± 0.00
Eosinophils, %	6.0 ± 0.26	4.7 ± 0.21
Pseudoeosinophils, %	55.2 ± 1.47	61.1 ± 1.83 **
Lymphocytes, %	34.2 ± 1.47	31.67±1.92
Monocytes, %	1.7 ± 0.21	1.0 ± 0.00
7 days after discontinuation of the drug		
Basophils, %	2.67 ± 0.21	1.0 ± 0.00
Eosinophils, %	7.0 ± 0.25	5.7 ± 0.49
Pseudoeosinophils, %	58.17 ± 0.70	63.17 ± 1.96 *
Lymphocytes, %	30.5 ± 0.92	29.17 ± 1.92
Monocytes, %	1.17 ± 0.21	1.0 ± 0.00
9 days after discontinuation of the drug		
Basophils, %	2.67 ± 0.33	1.0 ± 0.00
Eosinophils, %	6.5 ± 0.34	5.5 ± 0.43
Pseudoeosinophils, %	59.33 ± 0.33	62.0 ± 1.18
Lymphocytes, %	29.67 ± 0.67	30.5 ± 1.48
Monocytes, %	1.83 ± 0.17	1.0 ± 0.00

Note: the standard error of the mean is presented; *—statistically significant differences between the parameter values in the control and experimental groups according to the Mann–Whitney U-test at $p < 0.05$; **—statistically significant differences between the parameter values in the control and experimental groups according to the Mann–Whitney U-test at $p < 0.01$; ***—statistically significant differences between the values of the parameters in the control and experimental groups according to the Mann–Whitney U-test at $p < 0.001$.

According to the results obtained during the study of leukocyte indices, no serious deviations were found (Table 2). During 10 days, there is a slight increase in the leukocyte intoxication index, which indicates a mild degree of endogenous intoxication of the body.

Table 2. Indicators of leukocyte indices of poultry blood after discontinuation of the drug (n = 6, M ± m), %.

Indicators	Control Group	Experimental Group
1 day after discontinuation of the drug		
LII, u.e.	1.21 ± 0.06	1.20 ± 0.13
ISLK, u.e.	1.65 ± 0.15	1.49 ± 0.16
ILG, u.e.	0.60 ± 0.05	0.69 ± 0.08
IC, cu.	1.54 ± 0.13	1.40 ± 0.16
LEE, u.e.	0.67 ± 0.05	0.76 ± 0.09
IIR, u.e.	20.7 ± 0.73	44.2 ± 2.62

Table 2. *Cont.*

Indicators	Control Group	Experimental Group
	3 days after discontinuation of the drug	
LII, u.e.	1.30 ± 0.07	1.87 ±0.09
ISLK, u.e.	1.81 ± 0.11	2.38 ± 0.08
ILG, u.e.	0.54 ± 0.03	0.40 ± 0.01
IC, cu.	1.67 ± 0.11	2.29 ± 0.09
LEE, u.e.	0.61 ± 0.04	0.44 ± 0.02
IIR, u.e.	27.08 ± 4.82	230 ± 2.77
	5 days after discontinuation of the drug	
LII, u.e.	1.30 ± 0.07	1.64 ± 0.14
ISLK, u.e.	1.81 ± 0.11	2.12 ± 0.20
ILG, u.e.	0.54 ± 0.03	0.48 ± 0.04
IC, cu.	1.67 ± 0.11	2.00 ± 0.20
LEE, u.e.	0.61 ± 0.04	0.52 ± 0.04
IIR, u.e.	27.08 ± 4.82	36.33 ± 1.9
	7 days after discontinuation of the drug	
LII, u.e.	1.37 ± 0.05	1.75 ± 1.13
ISLK, u.e.	2.09 ± 0.08	2.37 ± 0.19
ILG, u.e.	0.46 ± 0.02	0.42 ± 0.04
IC, cu.	1.89 ± 0.09	2.22 ± 0.18
LEE, u.e.	0.53 ± 0.025	0.47 ± 0.05
IIR, u.e.	25.33 ± 4.49	34.83
	9 days after discontinuation of the drug	
LII, u.e.	1.46 ± 0.02	1.64 ± 0.09
ISLK, u.e.	2.18 ± 0.07	2.21 ± 0.15
ILG, u.e.	0.43 ± 0.01	0.45 ± 0.03
IC, cu.	2.00 ± 0.05	2.07 ± 0.14
LEE, u.e.	0.50 ± 0.01	0.50 ± 0.03
IIR, u.e.	21.08 ± 2.99	36 ± 1.18

4. Discussion

The data obtained during the study on the effect of furazidine on the leukocyte formula of chickens indicate a slight increase in the parameters of the leukocyte formula. Subsequently, on the 9th day after discontinuation of the drug, the leukoformula parameters return to normal, which indicates a non-significant effect of furazidine on the blood system of chickens.

When studying leukocyte indices, minor changes in the values of these parameters were also revealed. Such changes may be a natural process when foreign substances enter the body. Thus, the absence of significant changes in leukocyte indices indicates the absence of toxic stress on the body. Minor changes in blood parameters were also shown in the study of the drug Furamag (Furazidine) in the treatment of urinary tract infections in children [9].

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Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Van Boeckel, T.P. Global trends in antimicrobial use in food animals. *Proc. Natl. Acad. Sci. USA* **2015**, *112*, 5649–5654. [CrossRef] [PubMed]
2. Reznichenko, A.A. The use of prebiotics in broiler poultry as an alternative to antibacterial drugs. *IOP Conf. Ser. Earth Environ. Sci.* **2019**, *315*, 022037. [CrossRef]
3. Elkomy, A.A. Comparative studies on the efficacy of lincomycin and bacitracin for the control of necrotic enteritis in broiler chickens. *Int. J. Basic Clin. Pharmacol.* **2019**, *8*, 1153–1158. [CrossRef]
4. Seidavi, A.; Hosseintabar-Ghasemabad, B.; Di Rosa, A.R. *The Effects of Feed Additives on the Immune System of Poultry*; Springer: Cham, Switzerland, 2023. [CrossRef]
5. Moiseeva, A.A.; Skvortsov, V.N.; Prisny, A.A. The effect of ciprofloxacin on the leukocyte formula of chicken blood in experimental staphylococcal infection. *Sci. Notes Kazan State Acad. Vet. Med. Named NE Bauman* **2019**, *239*, 171–176.
6. Skvortsov, V.N.; Yurin, D.V.; Prisny, A.A.; Moiseeva, A.A. Comparative therapeutic and prophylactic efficacy of antimicrobial preparations in experimental salmonelloze chicken. *Curr. Issues Agric. Biol.* **2019**, *12*. Available online: https://www.bsaa.edu.ru/InfResource/library/journal_2/2-2019.pdf#page=29 (accessed on 3 September 2024).
7. Vdovichenko, V.P.; Bronskaya, G.M.; Korshak, T.A.; Kazakevich, D.V.; Sokolov, N.K.; Shchevruk, A.N.; Akulenets, E.V. Nitrofurans in pharmacotherapy of urinary tract infections. *Medical News*, 2012; No.3. Available online: https://cyberleninka.ru/article/n/nitrofurany-v-farmakoterapii-infektsiy-mochevyvodyaschih-putey (accessed on 31 August 2024).
8. Prisny, A.A.; Moiseeva, A.A.; Skvortsov, V.N. Comparative analysis of the effect of fluoroquinolones on the leukogram of chicken blood. *Sib. J. Life Sci. Agric.* **2020**, *12*, 11–24.
9. Klyuchnikov, S.O.; Gadzhialieva, M.M.; Osmanov, I.M. Furamag in the treatment of urinary system infection in children. *Russ. Bull. Perinatol. Pediatr.* **2010**, *55*, 110–112.