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ORIGINAL ARTICLE

The Impact of Vibration of Different Frequencies on the Body of Broiler Chickens in Industrial Keeping Conditions

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KEYWORDS

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ABSTRACT: This article studies the effect of vibration of different frequencies on the body of Hubbard F15 broiler chickens. The analysis of changes in leukogram parameters, leukocyte indices found that 8 hours after exposure to vibration with frequencies of oscillatory movements of 140 and 160 per minute, the stage of stress anxiety develops, passing after 24 hours into the stage of resistance. Vibration action with a frequency of 120 vibrational movements per minute does not cause deviations in leukogram parameters characteristic of a stress response and is a subthreshold stress effect.

INTRODUCTION

The intensification of agricultural production has led to an increased load on the body of farm animals [1]. During the period of growing and keeping, the animal is exposed to numerous factors, feeding, conditions of keeping, and transportation have the greatest stress load [2, 3]. The study has shown that the development of stress adversely affects the efficiency of agriculture, namely, productivity, and reproductive capacity decrease, while morbidity, production waste, feed costs, etc. increase [2, 4-7].

An important element of modern animal husbandry is the prevention and timely correction of stress, primarily the recognition of deviations in homeostasis, the assessment of the body's adaptive reserves. The blood leukogram is a sensitive indicator of adaptation processes, as hormonal regulation during the development of stress causes rapid and reliable changes in the percentage of leukocytes [7]. Sadykova, 2020, shows a correlation between the number of leukocytes with the state of the immune and endocrine systems, biochemical parameters of blood, which reflects the nonspecific resistance of the organism [8].

The objective of the research was to study the adaptation processes in the body of poultry when exposed to vibration of different frequencies based on changes in the leukogram parameters.

MATERIALS AND METHODS

The object of the study was Hubbard F15 broiler chickens aged 120 days, grouped according to the principle of analogs, based on their origin, live weight, and clinical condition in 4 groups of 30 animals each. The poultry was fed and kept in accordance with the zootechnical standards for this crossbreed during cage placement. Chickens in group 1 served as control and were not exposed to vibration, birds in group 2, 3, and

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4 were exposed to vibration at 120, 140, and 160 vibrations per minute, respectively.

The researchers studied the leukogram and leukocyte indices: the ratio of heterophiles and lymphocytes, leukocyte intoxication index (LII), blood leukocyte shift index (BLSI) [3, 8], hematological and biochemical parameters of hens' blood. Blood sampling from the ridge for smears was carried out before and 8 and 24 hours after exposure - a drop of blood on a defatted glass slide [3, 7],

RESULTS AND DISCUSSION

The leukocyte formula has an important diagnostic value in medical and veterinary practice, as well as in determining the adaptive capabilities of the organism [8]. The experiment found that the morphological composition of the white blood of broiler chickens had significant differences in some parameters in the control and experimental groups. Table 1 shows a leukogram of the blood of broiler chickens when adapting to vibration of different frequencies.

Table 1. Blood leukogram of Hubbard F15 broiler chickens during adaptation to vibration

Parameter, %	Group	Blood test time		
		Before the exposure	**8 hours after the exposure**	**24 hours after the exposure**
Eosinophils	1	7.3±0.3	7.1±0.3	7.4±0.4
	2	7.1±0.1	7.0±0.3	7.9±0.4
	3	7.2±0.3	6.6±0.2*	7.9±0.5
	4	7.4±0.2	2.2±0.1**	7.5±0.4
Basophils	1	2.9±0.2	2.8±0.2	2.9±0.3
	2	2.8±0.2	2.5±0.3	2.8±0.1
	3	2.9±0.3	1.9±0.2**	2.6±0.2
	4	2.7±0.2	1.2±0.2***	2.1±0.2*
Band neutrophils	1	1.6±0.2	1.4±0.3	1.3±0.3
	2	1.7±0.1	1.4±0.2	1.9±0.3
	3	1.6±0.2	1.2±0.1	1.8±0.1
	4	1.8±0.2	0.9±0.1**	1.8±0.1
Segmented neutrophils	1	21.8±0.6	22.8±0.4	22.6±0.4
	2	22.8±0.3	19.3±0.6***	21.9±0.8
	3	22.7±0.2	29.7±0.3***	25.7±0.8**
	4	22.6±0.3	38.9±0.4***	25.9±0.5**
Lymphocytes	1	57.9±0.7	57.6±0.6	57.6±0.7
	2	57.8±0.4	63.7±0.6***	58.3±0.6
	3	56.9±0.5	53.8±0.4***	55.0±1.1
	4	57.4±0.4	49.4±0.4***	55.3±1.0
Monocytes	1	7.8±0.4	7.9±0.3	7.9±0.3
	2	7.7±0.2	6.1±0.4**	7.2±0.3
	3	7.6±0.3	6.8±0.2**	7.0±0.2*
	4	7.8±0.3	7.4±0.2	7.4±0.2

Note: significant changes compared to the control group (group 1)

* - at P <0.05; ** - P <0.01; ** * - P <0.001.

The blood of broiler chickens of group 2 showed significant changes in leukogram parameters 8 hours after vibration exposure at 120 vibrations per minute, namely, the content of segmented neutrophils decreased by 15.4% of monocytes by 22.8%. At the same time, there was an increase in the number of lymphocytes by 11% compared with the same value in the control group.

Blood leukograms of chickens of groups 3 and 4, subjected to vibration at 140 and 160 vibrations per minute, respectively, had more pronounced deviations of parameters in comparison with values of group 2. At the same time, the direction of changes in the leukocyte formula when exposed to vibration at 140 and 160 vibrations per minute was of the same type and differed from the changes in the leukogram in group 2 with the exposure to 120 vibrations per minute, namely, a decrease in the content of eosinophils, basophils, stab neutrophils, lymphocytes and an increase in the number of segmented neutrophils. The degree of the revealed changes increased with the increase in the impact strength.

A vibration action with a vibration frequency of 140 rpm after 8 hours led to a significant decrease in the number of eosinophils by 9.6%, basophils by 34.5%, lymphocytes by 6.6%, monocytes by 22.8%, the content of segmented neutrophils increased by 30.3% compared to the values of the control group.

Eight hours after exposure to vibration at 160 vibrations per minute. The blood leukogram of broiler chickens underwent the following significant changes: a decrease in the number of eosinophils \by 69.9%, basophils by 58.6%, stab neutrophils by 43.8%, lymphocytes by 19.4%, and an increase in the number of segmented neutrophils by 70.6% compared to the values of the control group.

The experiment found that 24 hours after exposure to vibration at the studied frequencies the blood leukograms of broiler chickens of the experimental groups had less significant differences in comparison to the indicators of blood sampling 8 hours after exposure; the severity of deviations in parameters was also lower. The content of segmented neutrophils in group 3 exposed to vibration at 140 vibrations per minute exceeded the value of the control group by 12.7%, while monocytes were lower by 11.4%. In group 4 exposed to vibration at 160 vibrations per minute, the number of segmented neutrophils was higher by 13.6%, and the content of basophils was lower by 27.5%.

The leading humoral link in the implementation of the stress response is adrenocorticotropic hormone (ACTH) secreted by the anterior pituitary gland. ACHT activates the adrenal cortex and secretion of glucocorticoids, mineralocorticoids that implement the adaptive reactions of the stress anxiety stage. Lanin, D.V., 2014, have shown that there is a correlation between the level of glucocorticoids and the content of eosinophils in the peripheral blood, namely, an increase in the content of cortisol leads to eosinopenia [10]. A decrease in the content of eosinophils, noted in group 3 and 4 with the greatest impacts of vibration, may indicate the release of ACTH into the bloodstream with subsequent activation of the adrenal cortex and, thus, reflect the nonspecific components of the stress response of the of anxiety or mobilization stage [10, 11, and 12].

Literature review showed that the objective criterion of stress reaction is an increase in the content of segmented neutrophils and a decrease in the content of peripheral blood lymphocytes due to the presence of a high content of cortisol, which suppresses the thymic-lymphatic apparatus [7, 11 and 12]. Our studies found pronounced neutrophilia and lymphopenia under the influence of the moderate and highest vibration exposure in group 3 and 4, which may be a sign of the development of the stress reaction anxiety stage. Broiler chickens of group 2 showed the opposite changes in these types of blood cells, namely, a decrease in the number of segmented neutrophils and an increase in the number of lymphocytes, which indicates a pre-threshold effect that does not lead to the development of stress.

Literature contains data on the role of the thyroid gland in the adaptive processes of the body, a relationship between the level of thyroxine, triiodothyronine, and the peripheral blood leukogram, namely, an increase in the secretion of these hormones that leads to a decrease in the content of basophils [11]. The obtained experimental data when using vibration action at 140 and 160 vibrations per minute, i.e. moderate and the highest, reflect a decrease in the number of basophils in the blood leukograms of broiler chickens in the experimental groups. Thus, we can assume that the given influences were sufficient to activate the thyroid function.

One of the criteria for the tension of adaptation processes during the development of a stress reaction is the changes in monocytes in a leukogram. Literature evidences that an increase in the number of monocytes is an unfavorable sign characterizing the tension of the adaptive capabilities of the organism and an overdose of the active factor. Our studies, when exposed to vibration with a maximum oscillation frequency, found no significant differences in the content of monocytes, which may indicate the onset of a stress reaction without tension of compensatory mechanisms [9].

Changes in the leukogram of broiler chickens of group 4 were characterized by a 43.8% decrease in comparison with the initial level in the relative number of immature forms - stab neutrophils, which may be due to their transition to a mature form and subsequent migration of neutrophilic leukocytes into the circulation system for phagocytic function [4].

Sadykova, 2020, shows that a body can overcome a single, short-term stressful effect without the development of stages of resistance and stress depletion. The return of leukogram indices, blood biochemical parameters to the initial values may indicate the restoration of homeostasis and overcoming stress. Our studies, 24 hours after exposure to vibration, showed significant differences in leukograms of broiler chickens of group 3 and 4 in the content of segmented neutrophils, monocytes, basophils, and lymphocytes, however, these changes were less pronounced compared with blood sampling 8 hours after the exposure, which may indicate the onset of the stress resistance stage [9].

The ratio of granulocytes and agranulocytes of white blood cells, measured with leukocyte indices, reflects the state of specific immune responses, the hormonal status of the pituitary-adrenocortical system and is promising from the standpoint of diagnosing stress and assessing nonspecific adaptive reactions of the body [7, 13]. Table 2 shows the results of the study of leukocyte indices during the adaptation of broiler chickens to vibration of different frequencies.

Table 2. Blood leukocyte indices of broiler chickens during adaptation to vibration

Index	**Group**	**Blood test time**		
		Before the exposure	**8 hours after the exposure**	**24 hours after the exposure**
G/L	1	0.40±0.02	0.41±0.03	0.39±0.03
	2	0.39±0.02	0.30±0.01**	0.38±0.02
	3	0.40±0.01	0.55±0.01**	0.47±0.02**
	4	0.39±0.02	0.79±0.01**	0.47±0.02**
LII	1	0.05±0.01	0.04±0.02	0.04±0.03
	2	0.05±0.01	0.04±0.01	0.05±0.00
	3	0.05±0.01	0.07±0.00*	0.04±0.02
	4	0.05±0.01	0.23±0.03**	0.06±0.00*
BLSI	1	0.53±0.01	0.52±0.02	0.53±0.02
	2	0.54±0.02	0.43±0.02*	0.53±0.04
	3	0.53±0.02	0.65±0.02**	0.62±0.03*
	4	0.53±0.02	0.76±0.04**	0.60±0.02*

Note: significant changes compared to the control group (group 1) * - at P <0.05; ** - P <0.01; ** * - P <0.001.

The ratio of heterophiles (segmented neutrophils) and lymphocytes (G/L index) in broiler chickens of all experimental groups 8 hours after exposure to vibration had significant differences compared with control (at $p < 0.01$ and $p < 0.001$). Group 2 exposed to low frequency vibration had a decrease in the G/L ratio by 25% compared to the control value. With an increase in the vibration frequency in group 3 and 4, the G/L ratio increased by 37.5% and 97.5%, respectively. Porto M.L., 2020; Mahmoud, U.T., 2017; Sayfutdinova, L.V., 2019, show that the G/L ratio is an objective indicator of the development of a stress response. An increase in this ratio indicates the development of a stress reaction, which was noted in group 3 and 4 and is consistent with the dynamics of leukogram cells reflecting the development of stress in chickens of these groups. 24 hours after exposure, the G/L ratio had significant differences in broiler chickens of groups 3 and 4 and was, on average, 18% higher than the control value; such changes may indicate overcoming the stress effect and the development of the stress resistance stage[14].

The indicators characterizing the presence and severity of intoxication processes in the body are integral indicators of intoxication, which use the indicators of the leukocyte formula [15]. By changing the leukocyte formula, considering other hematological parameters, the intensity of adaptation processes can be assessed [16-18]. Table 2 shows that during the experiment, 8 hours after stressing, the leukocyte intoxication index (LII) significantly increased under the influence of the moderate and the strongest stimulus in groups 3 and 4. Such changes in LII can speak of intoxication processes in the body, which is a negative sign in the development of stress [11]. 24 hours after exposure, the leukocyte intoxication index exceeded the control value only in group 4 by 20%.

As stress develops, the ratio between agranulocytic and granulocytic blood leukocytes changes; therefore, to diagnose adaptation processes, their staging and tension, the blood leukocyte shift index (BLSI) is used [6, 12, 19-23]. During the experiment, the leukocyte shift index (BLSI) 8 hours after exposure had significant differences in broiler chickens of all experimental groups compared to the control. Low-frequency vibration in group 2 cause the rate to decrease by 18.9%, which confirms the absence of stress in this group. When exposed to moderate and high frequencies, the index increased in groups 3 and 4 by 22.6% and 43.4% respectively. These changes in the indicator indicate an increase in the content of granulocyte blood leukocytes, and, consequently, the presence of a stress response [7]. One day after exposure to vibration, the shift index of blood leukocytes was significantly higher than the control value by an average of 17% in groups 3 and 4.

CONCLUSIONS

The analysis of the blood leukogram of broiler chickens taken 8 hours after exposure to vibration of different frequencies shows that in group 2 the vibration frequency of 120 vibrations per minute had a subthreshold value and did not cause stress, while in groups 3 and 4, the vibration strength was sufficient for the development of a stress response and the changes in leukogram cells reflected characteristic changes in the stage of anxiety or stress mobilization. Exposure to vibration at 160 vibrations per minute caused the development of stress, proceeding with the tension of the body's functional capabilities, which is proved by indirect signs of activation of the thyroid gland function, glucocorticoid system, and the presence of intoxication processes in the body.

Twenty-four hours after exposure, the blood of broilers exposed to medium and high vibration levels had significant deviations of leucogram parameters noted; these changes may indicate overcoming of the stress effect and the development of the stress resistance stage.

REFERENCE

1.John, A., Oluwafemi, R. A., 2019, Hematology and Serum Biochemical Indices of Growing Rabbits Fed Diet Supplemented with Different Level of Indigofera

Zollingeriana Leaf Meal, Progress in Chemical and Biochemical Research, 2(4), 170-177.

2. Rezki S., dan Pawarti., 2014. Pengaruh pH Plak Terhadap Angka Kebersihan Gigi Dan Angka Karies Gigi Anak Di Klinik Pelayanan Asuhan Poltekkes Pontianak Tahun 2013. ODONTO Dental Journal. 1(2), 13-17.

3. John A., 2019. Effect of Feeding Different Levels of Luffa aegyptiaca Extracts on the Growth Performance of Broiler Chicken Fed Corn-Soya Meal Diet. International Journal of Advanced Biological and Biomedical Research. 7(4), 287-297.

4. Savitri G., Primarti R., Gartika M., 2017. Hubungan frekuensi asupan minuman manis dengan akumulasi plak pada anak. J Ked Gi. 29(2), 2-5.

5. John A., 2019. Effects of Dried Centella Asiatica Leaf Meal as a Herbal Feed Additive on the Growth Performance, Heamatology and Serum Biochemistry of Broiler Chicken. International Journal of Advanced Biological and Biomedical Research. 7 (3), 225-236.

6. John A., 2019. Heamatology, Serum Biochemistry, Relative Organ Weight and Bacteria Count of Broiler Chicken Given Different Levels of Luffa Aegyptiaca Leaf Extracts. International Journal of Advanced Biological and Biomedical Research. 7(4), 370-380.

7. Sirat N., 2014. Pengaruh Aplikasi Topikal Dengan Larutan NaF dan SnF2 Dalam Pencegahan Karies Gigi. Journal Kesehatan Gigi. 2(2), 222-231.

8. Karaarslan E.S., Aytac F., Cadirci B.H., Agaccioglu M., Tastan E., Yilmaz G., Ozkocak B.B.C., 2018. Evaluation of the Effects of Different Remineralizing agents on Streptococcus mutans Biofilm Adhesion. Journal of Adhesion Science and Technology. 32(23), 2617-2627.

9. Sriyono, Widiyanti N., 2009. Ilmu Kedokteran Pencegahan, Medika FK UGM., Yogyakarta. pp. 31-40.

10. Kidd E.A.M., Bechal S.J., 2013. Dasar-Dasar Karies Penyakit dan Penanggulangan, EGC., Jakarta Hal. 98-118.

11. Guswan G., Yandi S., 2017. Hubungan Pengetahuan Dan Tindakan Ibu Terhadap Indeks Plak Anak Tk Ibnu Akbar Jalan Parak Pegambiran Kecamatan Lubuk Begalung Padang. Jurnal Kedokteran Gigi. 29(4), 7-9.

12. Tedjosasongko U., Pradopo S., dan Nuraini P., 2008. Perubahan Oral Flora Dan Sensitifitas Karies Gigi Anak Setelah Pengulasan Fluoride Secara Topikal. J Penelit Med Eksakta. 7(1), 9-15.

13. Al-Batayneh O., 2009. The Clinical Applications of Tooth Mousse TM and CPP-ACP Products in Caries Prevention: evidence-based recommendations. Smile Dental Journal. 4(1), 8-12.

14. Bollido M.E., 2019. Growth Performance and Profitability of Broilers with Vermi Meal on Fermented Ration Under Two Management Systems. International Journal of Advanced Biological and Biomedical Research. 7(3), 274-286.

15. Sysa, A., Labai, M., Kvasyuk, E., Ivuts, U., Khanchevskii, M., 2019, Influence of arabinofuranosylcytosine-5`-monophosphate and its emoxipin salt on viability and functional status of peripheral blood lymphocytes subpopulations, Progress in Chemical and Biochemical Research, 2(4) 178-184.

16. Andrini M., Titien I., Rantinah S., 2013, Pengaruh Aplikasi Topikal Casein Phosphopeptide Amorphous Calcium Phosphate (CPP-ACP) Terhadap Pertumbuhan Stereptococcus Alpha dan Akumulasi Plak Gigi. J Ked Gi. 4(4), 268-272.

17. Ukwubile, C. A., Ikpefan, E. O., Bingari, M. S., Tam, L., 2019, Acute and subchronic toxicity profiles of Melastomastrum capitatum (Vahl) Fern. (Melastomataceae) root aqueous extract in Swiss albino mice, Progress in Chemical and Biochemical Research, 2 (2) 74-83.

18. Abida, Tauquir Alam, M., Asif, M., 2020, Study of Some Hyndantion Derivatives as Anticonvulsant Agents Progress in Chemical and Biochemical Research, 3 (2) 93-104.

19. Motevalli, S. M., Mirzajani, F., 2019, Biotic / Abiotic Stress Influences on Human Epidermal Keratinocyte Cells, Progress in Chemical and Biochemical Research, 2(2), 53-58.

20. Modi, B., Kumari Shah, K., Shrestha, J., Shrestha, P., Basnet, A., Tiwari, I., Prasad Aryal, S., 2021, Morphology, Biological Activity, Chemical

Composition, and Medicinal Value of Tinospora Cordifolia (willd.) Miers Advanced Journal of Chemistry-Section B, 3 (1) 36-54.

21. Suarez-Lopez J., Pi-Avila J., Machado-Martinez R., Quevedo-Benitez Y., Abdo-Cuza A., 2021, Relationship between Systemic and Cerebral Perfusion in Neurocritical Patients, *GMJ Medicine*, 2(2), 62-65.

22. Shahmoradi M., Askaripour M., Rajabi S., Dzigandzli G., 2021 Beneficial Effects of Curcuminon on Rats with Polycystic Ovary Syndrome: Evaluation of the Gene Expression of GLUT4, Erα and Insulin Resistance, *GMJ Medicine*, 2(1), 1-8.

23. Shalbafan M., Rezaei Behbehani G., Ghasemzadeh H., 2019, Study of Interaction of Human Serum Albumin with Doxorubicin (Anti-Cancer Drug) by Docking Simulation', *Chemical Methodologies*, 3(3), 348-353.