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A. I. DMYTROTSA, postgraduate
Institute of Agriculture of Carpathian Region of NAAS
Hrushevskoho street, 5, v. Obroshyne, Lviv region, Lviv district, Ukraine, 81115, e-mail: andrianadmitroca@gmail.com.

HEMATOLOGICAL INDICATORS AND ACTIVITY OF TRANSAMINASES IN THE BLOOD SERUM OF FARROW SOWS DEPENDING ON THE MICROCLIMATE OF THE PREMISES*

A number of scientific studies have established that during the farrow period sows are particularly sensitive to the action of various stress factors, including housing conditions, which lead to a violation of the activity of the antioxidant status system in their body and the occurrence of oxidative stress. Therefore, maintaining the optimal parameters of the microclimate in the premises where animals are kept during this period is important factor of the proper course of metabolism in the body of sows, fetuses and in the entire farrow process.

The article presents the results of experimental studies on the influence of such microclimate parameters as temperature, air humidity and the level of harmful gases (methane, ammonia, hydrogen sulfide, carbon dioxide, nitrogen oxide) on the number of erythrocytes, leukocytes and hemoglobin content in the blood and the activity of transamination enzymes – alanine aminotransferase (ALT) and aspartate aminotransferase (AST). The article also provides data on the use of Vikasol and Alkosel antioxidant additives in the main diet of farrowing sows with the aim of correcting of hematological indicators and the activity of transamination enzymes in blood serum by the violation of the microclimate parameters of the premises.

As a result of the conducted research, it was established that increased parameters of air temperature and relative humidity in the premises for keeping farrowing sows significantly reduce the number of erythrocytes, leukocytes and the hemoglobin content in the animals' blood. The use of Vikasol supplements in the diet of sows increased the number of erythrocytes, leukocytes and the hemoglobin content by 3.7%; 8.5%; 13.8%; and the use of Alkosel – respectively by 2.4%; 22.7% and 5.07%. The combined use of both preparations increased the number of erythrocytes by 4.2%; leukocytes – by 21.1% and hemoglobin content by 29.2% compared to the control. As for transamination enzymes, the use of Vikasol reduces the activity of ALT by 10.4%, the use of Alkosel – by 18.5%. The combined use of both preparations – by 27.5%, increasing the activity of AST from 4.7% to 21.4% in relation to standards.

Keywords: Vikasol, Alkosel, indoor microclimate, transamination enzymes, hematology, farrowing sows.

* Scientific supervisor – doctor of biological sciences S. O. Vovk.

Дмитроца А. І.
Інститут сільського господарства Карпатського регіону НААН

Гематологічні інгредієнти і активність трансаміназ у сироватці крові поросних свиноматок залежно від мікроклімату приміщень

Низкою наукових досліджень встановлено, що в період поросності свиноматки особливо чутливі до дії різних стресових факторів, зокрема й умов утримання, які призводять до порушення діяльності системи антиоксидантного статусу в їхньому організмі та виникнення оксидаційних стресів. Тому дотримання оптимальних параметрів мікроклімату в приміщеннях для утримання тварин у цей період є важливим фактором належного перебігу обміну речовин в організмі маток та плодів і в цілому процесу поросності.

Представлено результати експериментальних досліджень щодо впливу таких параметрів мікроклімату, як температура і вологість повітря та рівень шкодочинних газів (метан, аміак, сірководень, вуглекислий газ, оксид азоту) на чисельність у крові еритроцитів, лейкоцитів й вміст гемоглобіну і активність ензимів преамінування аланінамінотрансферази (АЛТ) та аспартатамінотрансферази (АСТ). Також наведено дані щодо використання у складі основного раціону поросних свиноматок добавок антиоксидантів Вікасолу та Алкоселю для корекції гематологічних показників та активності ензимів преамінування у сироватці крові за порушень параметрів мікроклімату приміщень.

У результаті проведених досліджень встановлено, що підвищені параметри температури повітря і відносної вологості у приміщенні для утримання поросних свиноматок істотно знижують кількість еритроцитів і лейкоцитів та вміст гемоглобіну в крові тварин. Застосування у раціоні свиноматок добавок Вікасолу збільшило кількість еритроцитів і лейкоцитів та вміст гемоглобіну на 3,7; 8,5; 13,8 %, а використання Алкоселю – відповідно на 2,4; 22,7 і 5,07 %. Поєднане застосування обох препаратів збільшило кількість еритроцитів на 4,2 %, лейкоцитів – на 21,1% і вміст гемоглобіну – на 29,2 % щодо контролю. Що ж стосується ензимів преамінування у крові, то застосування Вікасолу зменшує активність аланінамінотрансферази (АЛТ) на 10,4 %, Алкоселю – на 18,5 %, поєднане використання обох препаратів – на 27,5 %, водночас підвищуючи активність аспартатамінотрансферази (АСТ) з 4,7 % до 21,4 % щодо нормативів.

Ключові слова: Вікасол, Алкосель, мікроклімат приміщень, ферменти преамінування, гематологія, поросні свиноматки.

Introduction. The modern production of swine breeding products is based on industrial technologies, which provide for the creation of optimal microclimate conditions for keeping animals isolated from environmental influences [12]. It is known that proper housing conditions contribute to the full realization of the genetic potential of pigs in terms of reproductive functions, high productivity and preservation of livestock, obtaining high-quality products [9].

The immune system of animals is the most vulnerable under the conditions of violation of microclimate standards of premises for keeping pigs [8]. Despite the genetic conditioning of immune functions, their manifestation in the body also depends on the age, sex of pigs and environmental factors. It has been proven that violations of such indoor microclimate parameters as relative humidity, air temperature and the content of harmful gases can contribute to a decrease in the natural resistance of pigs and their productivity [5].

The role of indoor microclimate and its influence on the course of metabolic processes in the body of pigs is highlighted in a number of scientific works [4, 11, 14], which state that extreme conditions have a negative effect on them. In particular, the physiological state of sows is negatively affected by high temperature and relative humidity, as well as the presence of harmful gases in the room [30].

As is known, pigs are very sensitive to heat stress, which is the body's reaction to high temperatures and causes changes in all animal organ systems, provoking the activation of redox processes. Therefore, on pig farms are constantly monitored the parameters of the microclimate in the premises [7].

Based on the analysis of literary sources, the negative influence of both high and low temperatures on the vital activity of monogastric animals was established. In particular, it is optimal to keep pigs of various ages comfortably within the range of 15–23°C. At the same time, the temperature in the range of 27–35°C and above has a negative effect on the vitality of the animal organism, namely, heat stress is observed, which is accompanied by a decrease in the level of oxidation-reduction processes, and therefore a deterioration in appetite and feed consumption [26]. It was also established that keeping pigs at a temperature of 35 ºC for 24 hours inhibits the body's protective functions and increases the level of endotoxins in the blood plasma, thereby increasing susceptibility to infectious diseases. [6, 27].

Excessive moisture in premises where pigs are kept also negatively affects the metabolism and productivity of animals [20, 22]. In case of insufficient ventilation of the room together with increased humidity, there is an accumulation of gaseous waste products, which irritate the covering tissues and often cause dermatoses in animals [12, 17].

Long-term keeping of animals in rooms with high humidity and a high, although non-toxic, concentration of harmful gases does not directly cause pathological changes, but contributes to the weakening of the protective functions of the body, contributes to an increase in the susceptibility of animals to stress and various diseases [14, 15].

It is known that harmful gases in excessive concentrations are toxic and can cause health problems in both humans and animals. The biggest source of pollution in the premises where pigs are kept is manure. The main dangerous gases are emitted from it into the atmospheric air – hydrogen sulfide, methane, ammonia, carbon dioxide and nitrogen oxide [28].

The results of numerous studies show that in livestock premises with excessive levels of ammonia, hydrogen sulfide, and carbon dioxide in the air, the productivity of animals decreases and the percentage of culling increases, as well as the level of feed overexpenditure per unit of production increases [18, 32].

It should be emphasized that in the conditions of an unsatisfactory microclimate in the premises for keeping pigs, the natural resistance and immunological reactivity of their organism decreases. In addition, increased amounts of harmful gases in pig houses significantly affect the health of service personnel, as well as shorten the service life of equipment and mechanisms [16].

In livestock premises, the chemical composition of the air as a result of the release of various gases from the breathing of animals and the decomposition of manure is significantly different from the surrounding air. In the process of breathing of animals, a large amount of carbon dioxide is released, and oxygen is absorbed. As a result of biochemical reactions that occur in manure, a significant amount of ammonia, carbon dioxide, hydrogen sulfide, and other harmful gases with an unpleasant smell is released into the air. [19, 21].

Based on the above, research aimed at studying the influence of environmental factors and microclimate parameters of rooms for keeping pigs, on their physiological state and the course of biochemical processes in the body and the development of effective methods of increasing resistance [23, 29] are of scientific and practical interest.

Considering the above, the goal of our work was to establish the influence of the microclimate parameters of the room, for keeping farrowing sows, on the hematological ingredients and activity of transaminases in cow's serum and their correction by using antioxidant additives Vikasol and Alkosel.

Research materials and methods. The research was carried out in the conditions of the pig farm of the State Research Enterprise "Radehivske" of the Institute of Agriculture of the Carpathian Region of the National Academy of Sciences of Ukraine in the summer period. Using the method of analogues, four groups of farrowing sows of the Great White breed (control and three experimental ones) of 5 heads each were formed by live weight and age. The diet of the sows of the control group consisted of

standard compound feed, which provided their needs for nutrients and biologically active substances, vitamins, macro- and microelements according to national standards and had the following composition: "AVA ZDOROVA Suporos 10%" - 10%, wheat – 10%, corn - 5%, barley – 60%, wheat bran -15%. The sows of the first experimental group were given Vikasol at a dose of 6 mg/kg of compound feed, the second group – Alkosel (a Belgian preparation based on baker's yeast treated with selenium methionine), at a dose of 5 mg/kg of compound feed, the third – a combination of both drugs in the tested doses. Animals of all groups had free access to drinking water. Supplements of these drugs began to be fed to sows from the 90th day of gestation. The duration of the experiment – 24 days. At the end of the experimental period, on the 114th day of gestation, after morning feeding, blood samples were taken from the ear vein of all sows of the control and experimental groups for biochemical studies.

In the freshly collected blood of animals, the number of erythrocytes and leukocytes and the hemoglobin content, as well as the activity of the transamination enzymes alanine aminotransferase (ALT) and aspartate aminotransferase (ALT) were determined according to the methods described in the manual "Laboratory research methods in biology, animal husbandry and veterinary medicine" (Vlizlo V.V. etc. 2012).

In addition to the above indicators, the parameters of the microclimate were determined. The air temperature in the room where the sows were kept was measured with a mercury thermometer, and the humidity – with a psychrometer – hygrometer. The determination of the level of harmful gases (NO_2, H_2S, NH_3, CO_2 and CH_4) in the air of the room was carried out by the electrochemical method using a portable multi-component gas analyzer DOZOR – 5 CM, which provides simultaneous digital indication of the concentration of all measured components on the built-in liquid crystal indicator (display with backlight), as well as separate light signaling for each measured component and a single sound signaling when the thresholds are exceeded. Adjustment of indicators and setting of gas analyzer modes is carried out using the menu, which is displayed on the alphanumeric display.

To obtain more reliable data, measurements of temperature, concentration of harmful gases, as well as relative humidity in the air were carried out at 5 points on the diagonal of the room at the level of the animal accommodation. Biometric processing of research results was carried out according to the methodology of I. R. Petrovska and co-authors [10], using the package of statistical programs STATISTICA.

Research results. It is known that the formation of the microclimate of livestock premises is influenced by the construction of the building, the

materials used in construction, as well as the technology of keeping animals. In addition, the climate zone in which the room is built affects the microclimate of the room for keeping animals. The concept of microclimate includes such components as the physical state of the air environment (temperature, humidity, atmospheric pressure, speed of movement), its gas, microbial and dust pollution, i.e. a set of physical, chemical and biological parameters [3]

According to the regulatory requirements of VNTP – APK – 02.05 "Pig enterprises (complexes, farms, small farms)", the maximum permissible concentration of carbon dioxide (CO_2) in the air of pig production premises should be no more than 0.2% (by volume) or 2 liters /m3, ammonia (NH^3) – 20.0 mg/m3, hydrogen sulfide (H_2S) – 10.0 mg/m3, CH_4 and NO_2 – not standardized, relative humidity – 70%, indoor air temperature should not exceed 22 ^{0}C [4].

The practical experience of keeping pigs in farms of medium capacity, which currently occupy a leading place in the structure of the pig industry of Ukraine, shows that ensuring ideal regulatory indicators of the microclimate in the premises requires significant efforts and capital investments. This especially applies to peak temperature and humidity loads during periods of summer heat. Therefore, when keeping and breeding pigs in real production conditions, there are certain deviations from the requirements of VNTP – APK – 02.05 [4].

As a result of the research, it was established that such parameters of the microclimate as temperature and humidity in the room during the experimental period did not meet the current standards. In particular, the air temperature was 35% higher than normal, and the relative humidity was 21.4% higher. As for the level of harmful gases in the room, they were within the permissible domestic standards for keeping farrowing sows.

The results of research on the determination of hematological ingredients and the activity of transaminases in the blood of farrowing sows and the change in these indicators after the correction of the addition of the antioxidants Vikasol and Alkosel to the diet of animals are shown in Table 1.

The obtained results show that the increase in air temperature and humidity in the room reduces the number of erythrocytes and leukocytes and the hemoglobin content in the blood of the control group of pigs. Addition of antioxidant drugs to the main diet of sows significantly corrects these indicators. In particular, with the addition of Vikasol, the hemoglobin content in the blood increased by 13.8%, erythrocytes – by 3.7%, leukocytes – by 8.5%; with the addition of Alkosel - these indicators increased by 2.4% and 22.7%, respectively, while the hemoglobin content

decreased by 5.1%. The combined use of both drugs in the combined feed of sows increased the hemoglobin content by 29.2%, the number of erythrocytes by 4.2%, and the leukocytes by 21.1% compared to the control.

1. Hematological indicators and activity of transamination enzymes of farrowing sows, (M±m; n=5)

Indicator	Groups of animals			
	control	1 experimental	2 experimental	3 experimental
Hemoglobin g/l	76,8±0,43	87,4±0,48***	72,9±0,92**	99,3±0,65***
Erythrocytes g/l	6,67±0,20	6,92±0,09	6,83±0,08	6,95±0,083
Leukocytes g/l	8,81±0,08	9,56±0,19**	10,81±0,06***	10,67±0,05***
ALT, μmol/h×ml	2,98±0,09	2,67±0,30***	2,43±0,23**	2,16±0,07***
AST, μmol/h×ml	1,26±0,03	1,32±0,10*	1,45±0,13**	1,53±0,09**

Note. The asterisks in the table indicate probable differences compared to control. Accordingly: * P<0.05; **P<0.01; ***P<0.001.

Of particular interest are data on the influence of indoor microclimatic factors on activity indicators of transamination enzymes (ALT, AST), as they are considered markers for the development of pathological processes in the animal body [24, 25]. Based on the data in Table 1, it can be seen that the activity of ALT is higher relative to AST in the control group, which indicates damage to liver cells. As for experimental groups of sows, the addition of Vikasol and Alkosel to the main diet of animals shows a pronounced corrective effect on the studied indicators. In the first experimental group of animals, the activity of ALT in the blood decreased by 10.4%, and the activity of AST increased by 4.7%, in the second experimental group, the activity of ALT decreased by 18.5%, AST increased by 15%, in the third experimental group, the decrease ALT activity was 27.5%, and AST activity, on the contrary, increased by 21.4% in relation to the control.

Summarizing the obtained results, it should be noted that the temperature and humidity parameters in the premises for keeping farrowing sows, increased in relation to the standards, have a negative effect on the course of metabolic processes in the animal's body, as evidenced by changes in hematological indicators and the activity of blood transaminases, which is also confirmed by a number of authors, who conducted similar studies on other ages and productive groups of pigs [1, 2, 31].

The data obtained by us indicate that the use of adaptogenic drugs Vikasol and Alkosel in the diets of farrowing sows, under such conditions of violation of microclimate parameters, both separately and in a complex

combination, have a pronounced positive corrective effect on the indicated blood parameters.

Conclusion

Increased parameters of air temperature to (27 – 30ºC) and relative humidity (74-85%) in the room for keeping farrowing sows have a negative effect on hematological indicators and the activity of blood transaminases.

The use of Vikasol in the rations of sows under conditions of disturbed microclimate parameters increases the number of erythrocytes and leukocytes and the hemoglobin content in the blood by 3.7%; 8.5%; 13.8%; the use of Alkosel – by 2.4%; 22.7% and reduces hemoglobin content by 5.07%. The combined use of both drugs increases the number of erythrocytes in the blood by 4.2%; leukocytes – by 21.1% and hemoglobin content – by 29.2% compared to the control. As for transamination enzymes, the use of Vikasol in the diet of animals reduces the activity of ALT in the blood by 10.4%, Alkosel – by 18.5%, and the combined use of both drugs by 27.5%. The use of the above drugs in the diet of sows, on the contrary, increases the activity of AST from 4.7% to 21.4% relative to the control.

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