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THE INFLUENCE OF STRESS ON MORPHOLOGICAL AND BIOCHEMICAL PARAMETERS OF LAMB BLOOD AFTER WEANING

ANNOTATION

Raising strong, healthy, and highly productive young animals and ensuring their survival is one of the important ways to increase the efficiency of sheep farming. Technological stress has a significant impact on the health and productivity of lambs in the industry, significantly reducing the resistance and survival rate of young animals. Since weaning causes a lot of stress for lambs, the aim of this study was to investigate the effects of stress on the morphological and biochemical parameters of lambs during weaning. The article presents the results of a study of the morphological composition of blood in lambs after weaning. The results show that after weaning, the levels of leukocytes, segmented and band neutrophils, and monocytes increase in lambs. The levels of erythrocytes, hemoglobin, platelets, eosinophils, lymphocytes, and basophils decrease. The levels of calcium, inorganic phosphorus, sodium, iron, creatinine, bilirubin, total protein, albumin, and alpha-amylase were decreased in lambs after weaning. The levels of potassium, chloride, glucose, urea, cholesterol, triglycerides, and the activity of the enzymes ALT, AST, AP, GGT, choline esterase, CK, and LDH in lambs after weaning were increased. Based on the obtained data, it was established that there is a significant deviation from the normal values of hematological and metabolic indicators after weaning, which indicates the presence of stress. This proves that stress is accompanied by a disturbance in hematopoiesis and metabolic processes.

Key words: *lambs, weaning, blood, biochemistry, metabolism.*

Introduction. Raising strong, healthy, and highly productive young animals and ensuring their survival is one of the important ways to increase the efficiency of sheep farming. Technological stress has a significant impact on the health and productivity of lambs in the industry, significantly reducing the resistance and survival rate of young animals. The stressful condition arises in lambs during weaning, which is often carried out at four months of age and has biological feasibility associated with the completion, by this period, of the structural-functional development of the body systems, in particular, the digestive system, capable of carrying out the processes of fermentation of plant feeds [1].

It is considered that weaning lambs is a technological stress that arises due to a sudden change in environment, overcrowding, change of feeding, and causes lambs to feel fear and anxiety, accompanied by a shift in all indicators of homeostasis. The manifestation of the stress response depends on its strength, nature, and many interior animal indicators related to genotype [2].

Since weaning causes a lot of stress for lambs, the aim of this study was to investigate the effects of stress on the morphological and biochemical parameters of lambs during weaning.

Materials and Methods. The study was conducted on 100 Akzhaiyk meat and wool breed lambs immediately after weaning, at an average age of 4 months. The lambs were divided into two groups of 50 each (50% females and 50% males). One group was separated from their mothers, while the other group was kept with their mothers. We collected blood samples (10 ml) from the jugular vein into sterile Venoject® vacuum tubes (Terumo Europe, Leuven, Belgium). For the morphological analysis of blood during stress in lambs after weaning, we measured the blood using a hematological analyzer.

Mineral levels (Ca, P-inorganic, Na, K, Cl, and Fe), biochemical parameters (glucose, urea, creatinine, total bilirubin, total protein, albumin, cholesterol, and triglycerides), and enzyme activities (ALT-alanine aminotransferase, AST-aspartate aminotransferase, AP-alkaline phosphatase, GGT-γ-glutamyltransferase, cholinesterase, alpha-amylase, CK-creatinine kinase, and LDH-lactate dehydrogenase) were measured on a biochemical analyzer. All experimental data were statistically processed using the Excel computer program.

Results of research and discussion. When determining the morphological blood parameters during stress in sheep, the following results were obtained, which are shown in Figure 1. A reduced or increased number of leukocytes in the blood serves as an important indicator of the presence of a pathological process. A low level of leukocytes also indicates a weakened immune system. The regulation of leukocyte transport by catecholamines and glucocorticoids and their interaction in equilibrium and under stress conditions is multifaceted and therefore not fully understood. Stress hormones can affect the migratory properties of leukocytes through various mechanisms [3]. According to our studies, the leukocyte counts in the blood of lambs after weaning were 8% higher than normal.

Stress also affects erythrocyte parameters. It has been established that the main criterion is the ability of cells to increase their glucose requirements. Various adverse situations can lead to a decrease or, on the contrary, an increase in reproductive ability and an increase in the lifespan, thus disrupting the blood composition level. An increase or decrease in the number of red blood cells is associated with the presence of various pathologies [4]. After weaning lambs, their blood had a 15% decrease in the number of erythrocytes.

It is known that animals fed with whole milk often experience iron deficiency and subsequent anemia compared to animals fed with fresh milk, with lower growth rates and greater susceptibility to diseases. Therefore, milk also affects hemoglobin levels, and milk substitutes for lambs cannot fully replace maternal milk. In general, it can be concluded that, as with lambs, conditions without access to maternal milk can lead to subclinical anemia [5]. Hemoglobin concentration in the blood of lambs after weaning decreased by 18%.

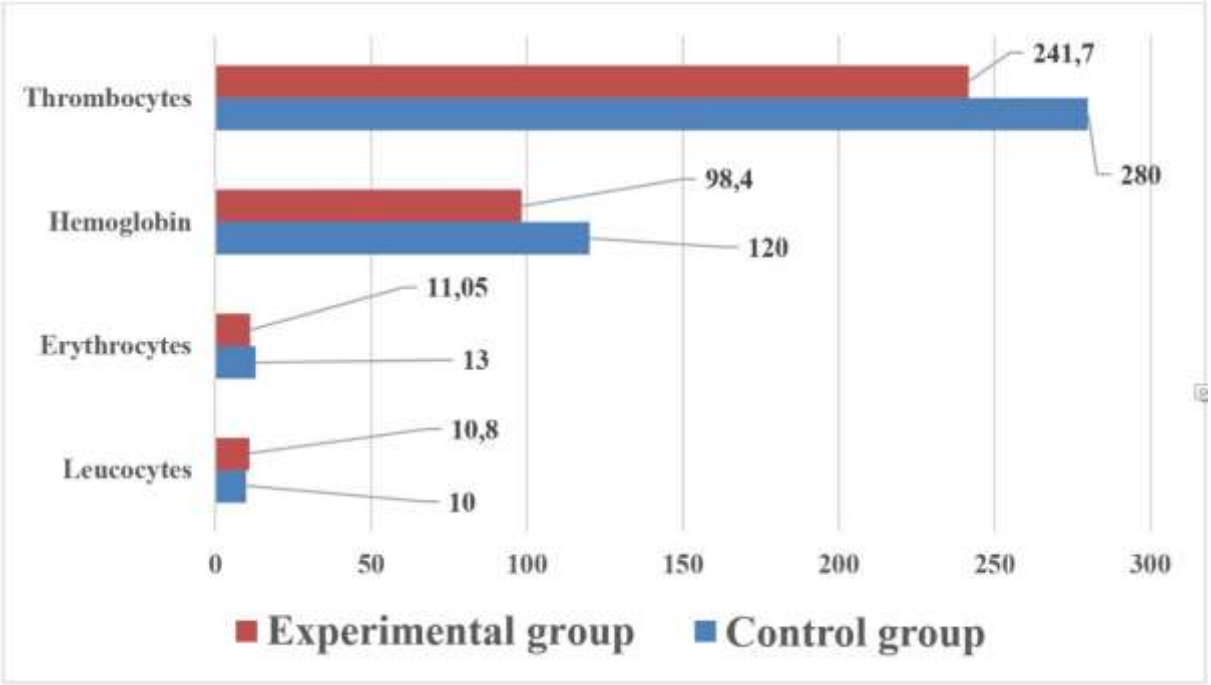

Figure 1 - Morphological blood parameters in lambs under stress

Platelets accelerate the coagulation reactions in the blood plasma. In addition, they participate in the body's inflammatory reactions. An increased level of platelets may indicate iron-deficiency anemia, thrombocytosis, megakaryoblastic leukemia, or inflammatory reactions. A decrease in platelets, often caused by immune factors, blood loss, and fibrinolysis, can be reduced after infusion therapy due to blood thinning; in bone marrow diseases, the effects of infectious and invasive diseases, hormonal drugs, as well as as a result of stress. The level of platelets in the blood of lambs after weaning was 14% below the norm.

Neutrophils form the basis of immunity, they perform a protective function and kill pathogenic microorganisms and their toxins that poison the body. The development of neutrophils is controlled by cytokines. During inflammation, the number of neutrophils in the body increases significantly. Neutrophils are the basic protectors of the blood, but at the same time, they move intensively to the focus of inflammation. They exit the arteries and veins and capillaries and can also move back and forth. They enter pus and give it a corresponding color. Segmented cells in the blood of lambs increased by 5.2%.

Neutrophils help the immune system fight infections and heal injuries. The absolute number of neutrophils determines whether there are enough neutrophils in your body, or whether their quantity is higher or lower than normal. Neutropenia is a condition in which the number of neutrophils is too low, leading to swelling and recurrent infections. Neutrophilia, also known as neutrophilic leukocytosis, occurs when the number of neutrophils is too high, which is often the result of a bacterial infection. The level of band neutrophils in the blood of lambs increased by 7.4% after weaning.

Eosinophils are blood cells that consist of leukocytes and protect the animal's body. After they appear, they enter the bloodstream and within a few hours reach the tissues where they work. When a focus of infection or tumor appears in the body, eosinophils are involved, specific receptors on cells responsible for immunity are activated. The level of these blood cells (eosinophils) is reduced in their bone marrow. They are reduced during emotional stress. After the lamb beating, the level of eosinophils in the blood was 20% below normal.

The main function of monocytes is to absorb pathogenic microorganisms that threaten health. This process is called phagocytosis. Unlike other types of leukocytes that die during phagocytosis, monocytes feel good and continue to work even when foreign agents enter the body. The level of monocytes in the blood of lambs after beating increased by 11%.

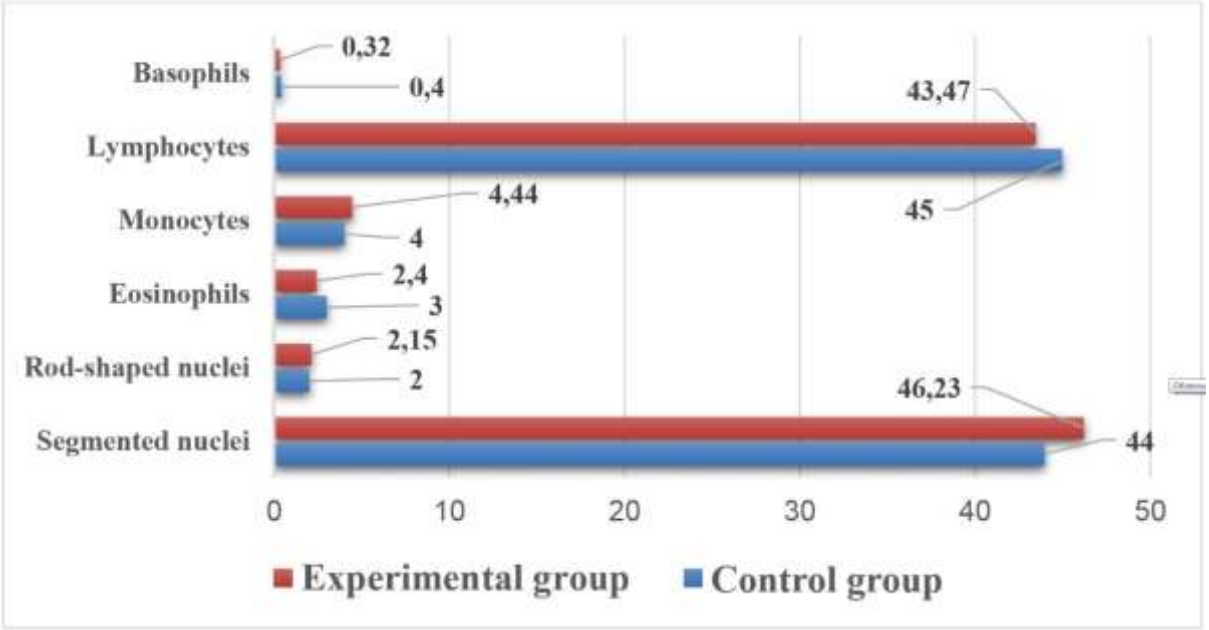

Figure 2 - The leukogram indicators in the blood during stress in lambs

A decrease in lymphocytes is associated with a weakening of the immune system, as a result of which the animal's body becomes sensitive to pathogenic microorganisms, the likelihood of inflammatory processes, allergic reactions, cancer, and infections increases. The danger to health is not in lymphopenia, but in the disease that causes it. Ongoing lymphopenia indicates a recently acquired viral disease. However, low levels of lymphocytes here are a consequence of serious pathologies. After the lymphocyte damage, the indicators in the blood of lambs were below normal.

Basophils are a type of leukocyte involved in allergic and other immune processes. Basopenia is not dangerous for the animal's health, for example, during the migration of basophils from the blood to the site of a tumor. Empty basophils are a diagnostic criterion indicating the presence of an inflammatory reaction. Basophils are one of the most important indicators in clinical blood research. The level of basophils increases in allergic, inflammatory, parasitic, and some other diseases. The basophil count in the blood of lambs after weaning was 3.4% lower (Figure 2) [6, 7, 8, 9].

The indicators of the mineral composition of blood serum are shown in Figure 3. Hypocalcemia is the most common calcium disorder in sheep and is often observed during parturition. This also occurs in transported sheep and other stressful situations. The peak calcium demand occurs at 10 days of age. During pregnancy, about 20% of the total calcium in sheep bones is mobilized to supplement calcium in the diet to meet the lamb's calcium needs. This demand for sheep bone reserves increases to 70% at the beginning of lactation, and the remaining calcium comes from pasture [10]. The concentration of calcium in the blood serum of lambs after weaning was below normal and decreased by 11.7%.

Sheep grazing on pastures with a phosphorus deficiency often do not grow well, which is explained by the low protein content in the pasture. It is quite likely that young sheep attempting to raise twin lambs will have a higher phosphorus requirement. Tissue catabolism in the body, including bone resorption, will be intensified, leading to further bone density loss. Old pastures often have low quality and low mineral content. A low level of phosphorus in the diet can reduce the output of milk protein [11]. The concentration of inorganic phosphorus in the blood serum of lambs after weaning was below normal by 11.8%.

The concentration of sodium in the serum is an indicator of the amount of sodium relative to the amount of water. An increase in sodium in the blood serum implies hyperosmolality, while a decrease in sodium in the blood serum does not always imply hyposmolality. Hyponatremia develops when a patient cannot excrete ingested water or when the total osmolarity of the urinary tract and losses of fluids in an unconscious state are higher than that of ingested or parenterally administered fluids [12]. The concentration of sodium in the blood serum of lambs after weaning decreased by 16%.

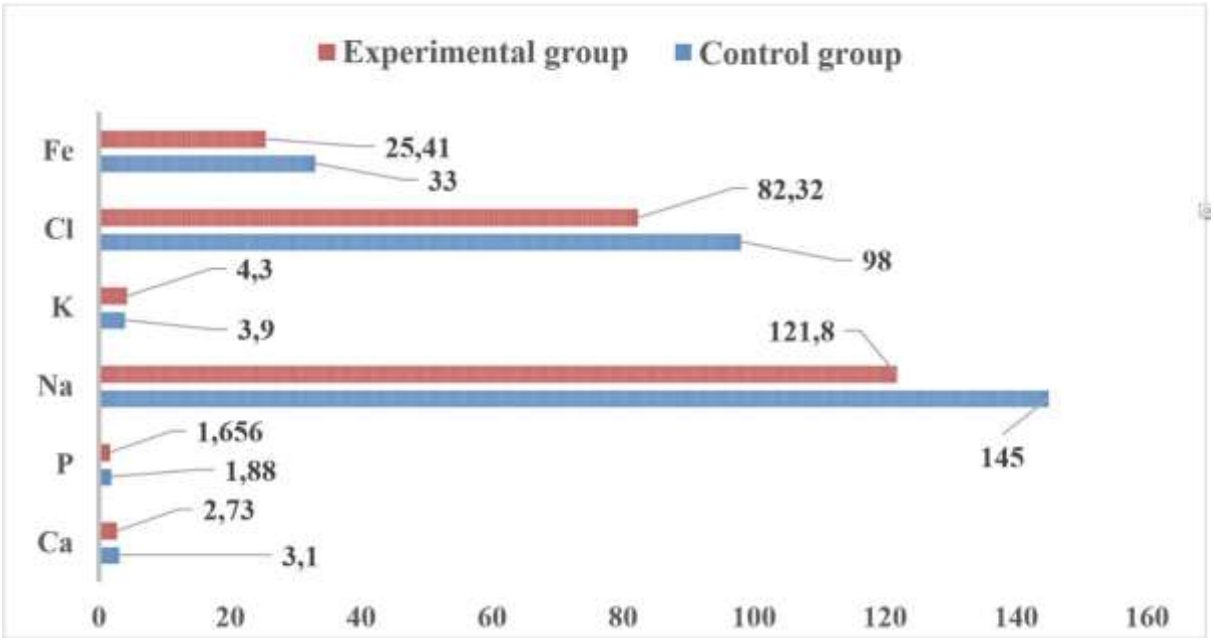

Figure 3 - The indicators of the mineral composition of blood serum

Potassium is an important electrolyte in the body. High levels of potassium in the blood are known as hyperkalemia, and low levels are called hypokalemia. Potassium helps muscles function and transmit information between nerves and muscles. Potassium also supports blood pressure. The kidneys control the level of potassium in the blood. Mild hypokalemia does not cause serious symptoms, and if present, they include fatigue, muscle cramps, and constipation. Severe hypokalemia increases the risk of acute respiratory failure and heart rhythm disturbances [13]. The concentration of potassium in the blood serum of lambs after beating is also increased by 7%.

Sodium chloride in the body plays an important role in maintaining osmotic pressure and water-salt balance. Chloride ions, together with potassium and sodium ions, participate in forming the membrane potential of cells, activate certain enzymes, and eliminate toxins and wastes. The condition when blood chlorides are increased is called hyperchloremia and it is primarily formed as a result of a disturbance in water-salt balance [14]. The concentration of chloride in the blood serum of lambs after beating exceeded the norm by 16%.

Malnutrition of Fe is an important cause of anemia in sheep, and parasitic diseases also lead to this problem. Poisoning is also a cause of anemia. Animals fed whole milk often experience iron

deficiency with subsequent anemia, lower growth rates, and greater susceptibility to disease. Iron-deficiency anemia in lambs has been identified as a risk factor for the development of bloat and gastritis. Some researchers have identified anemia as the main cause of death in suckling lambs [15]. The concentration of iron in the blood serum of lambs after weaning decreased by 23%.

The indicators of the biochemical composition of blood serum are shown in Figure 4. Disruption of glycemic regulation, often referred to as stress hyperglycemia, is widespread in critically ill and injured patients. During critical conditions, complex interactions between counterregulatory hormones and cytokines lead to excessive glucose production, which is also associated with insulin resistance. Stress increases glycogenolysis and gluconeogenesis. Glycogenolysis is triggered by an increase in catecholamines, while gluconeogenesis is triggered by an increase in glucagon in response to stress. In animals, hypoglycemia is most commonly observed in young and old animals [16]. The blood serum glucose levels in lambs after separation were 17% higher than normal.

Rapid breakdown of proteins and kidney damage rapidly increase the level of urea in the blood. The amount of urea depends on the level of protein consumed, and the causes of increased blood urea are feverish conditions, complications of diabetes, and increased adrenal hormonal function. The elevated level of urea serves as a marker for reduced glomerular filtration. Azotemia, which is also a cause of increased urea, is most often due to inadequate excretion due to kidney disease. Urea decreases in many liver diseases [17]. The blood serum urea levels in lambs after separation were 8% higher than normal.

Creatinine is a product of the non-enzymatic breakdown of creatine and creatine phosphate that occurs in the muscles. The level of creatinine in the blood remains within normal limits until the glomerular filtration rate decreases to critical values, especially in patients with low muscle mass. Then the level increases. Creatinine levels are reduced by almost half in pregnant animals due to the increase in blood volume, which leads to an increased blood flow to the kidneys and thus an increasing degree of filtration; all of this leads to an increase in creatinine clearance. In older animals, the formation of creatinine decreases within normal limits [18]. The levels of creatinine in the blood serum of lambs after pounding decreased by 32%.

Bilirubin is normally formed as a result of the breakdown of hem-containing proteins such as hemoglobin, myoglobin, and cytochrome. Hemoglobin breakdown occurs in cells of the reticuloendothelial system of the bone marrow, spleen, lymph nodes, and liver, where the end products are excreted in bile and eliminated from the body. An increase in bilirubin can indicate either excess destruction of red blood cells or impaired excretion of bilirubin from the body, such as in liver jaundice, blockage of the bile ducts, and other conditions [19]. The levels of bilirubin in the blood serum of lambs after pounding decreased by 6.4%.

Determining the level of total protein is important for kidney and liver diseases, metabolic disorders, oncology, infections, and monitoring the effectiveness of therapy. In cases of insufficient nutrition and depletion, protein levels sharply decrease. Protein levels increase in liver diseases. In ewes, it is related to the ability to conceive, provide proteins for fetal development, and nourish newborn lambs, while in rams, it is related to the synthesis of germ cells [20]. The total protein levels in the blood serum of lambs after pounding were reduced by 6.6%.

An elevated level of albumin is not typical for serum. However, a low or very low level of albumin in the serum can indicate pathology. The condition with a low level is called hypoalbuminemia. A low level is observed in a wide range of health problems, including diabetes, cancer, and liver disease, and is primarily a result of the disease, not its cause. A low level of albumin can also be caused by leakage from blood vessels, trauma, inflammation, and sepsis [21]. The albumin levels in the blood serum of lambs after pounding were below normal by 9%.

Cholesterol is necessary for the production of vitamin D, the production of various steroid hormones by the adrenal glands, and the synthesis of bile acids. Excess cholesterol leads to atherosclerosis of the blood vessels. Therefore, metabolic disorders are the main causes of high cholesterol, including hypodynamia, overeating, abundance of harmful and fatty foods, deficiency of vitamin D and omega-3. High cholesterol in females is often due to excess weight or low levels of estrogen. High cholesterol in males occurs at a younger age [22]. Cholesterol levels in the blood serum of lambs after weaning were increased by 11%.

Triglycerides accumulate calories and provide energy to the body. A high level of triglycerides can contribute to the hardening or thickening of arterial walls, increasing the risk of heart disease, and can also cause acute inflammation of the pancreas. High levels of triglycerides often indicate conditions that include too much fat, high blood pressure, high triglyceride levels, high blood sugar levels, and abnormal

cholesterol levels [23]. Triglyceride levels in the blood serum of lambs after weaning were increased by 13%.

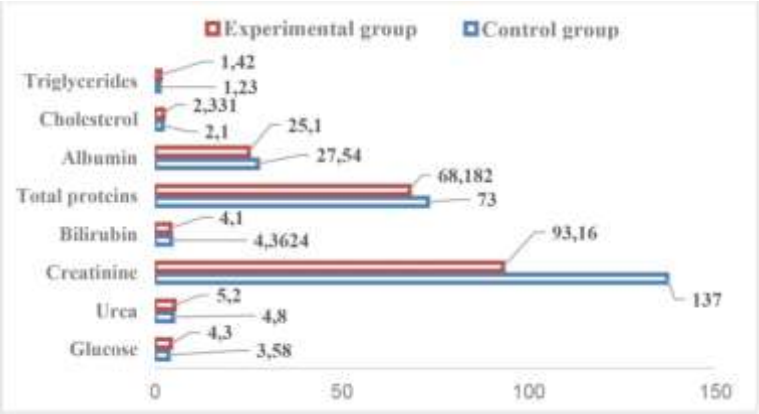

Figure 4 - Indicators of the biochemical composition of blood serum

The indicators of enzymatic activity in blood serum are shown in Figure 5. ALT actively participates in the metabolism and synthesis of various amino acids. ALT can enter the blood only when tissues are damaged. The activity of AST, ALT, and alkaline phosphatase increases during the resolution of chronic heart failure. An increase in the activity of ALT and AST can also be detected in practically healthy carriers of hepatitis B surface antigen. ALT may be below normal in cases of necrotic liver atrophy. In addition, a basic deficiency of vitamin B6 may also affect the reduction of ALT levels [24]. The indicator of ALT enzyme activity in blood serum of lambs after pounding was above normal and increased by 9.2%.

AST is found in large amounts in heart tissues, as well as in liver cells, nervous tissue, and kidneys. Vitamin B6 is a coenzyme analogue of AST. The enzyme is considered to be at a relatively low level in the normal range, but when tissue damage occurs, AST gradually increases in the blood, being released from damaged cells. The more serious the tissue damage, the higher the AST level in the blood. High activity of this transaminase is a clear indicator of an extremely severe condition. If AST gradually but persistently rises, it indicates an expanding zone of infarction. AST activity may also be due to necrotic phenomena in the liver [25]. The indicator of AST enzyme activity in blood serum of lambs after pounding increased by 20%.

Each part of your body produces its own type of ALP. Abnormal levels of ALP in your blood can be a sign of liver disease, bone disease, and chronic kidney disease. Problems with the liver and bone disease cause different types of ALP. Moderately high levels can be a sign of many different conditions, including lymphoma, heart failure, or some infections. Low levels are less common. They can be a sign of zinc deficiency, malnutrition, pernicious anemia, thyroid disease, Wilson's disease, or hypophosphatasia, a rare genetic disorder that affects bones and teeth [26]. The activity of the AP enzyme in the blood serum of lambs after pounding was increased by 11%.

Gamma GT is located on the cells of the kidneys, liver, pancreas, and bile ducts. Its sharp increase in the serum indicates dangerous changes in the liver or disorders of the bile ducts. Gamma GT is a highly sensitive enzyme, and its elevation is often associated with stagnant bile due to inflammation of the bile ducts. The enzyme is sensitive to changes in the liver and gallbladder, allowing for the detection of dangerous diseases at an early stage [27]. The activity of the GGT enzyme in the blood serum of lambs after pounding increased by 14%.

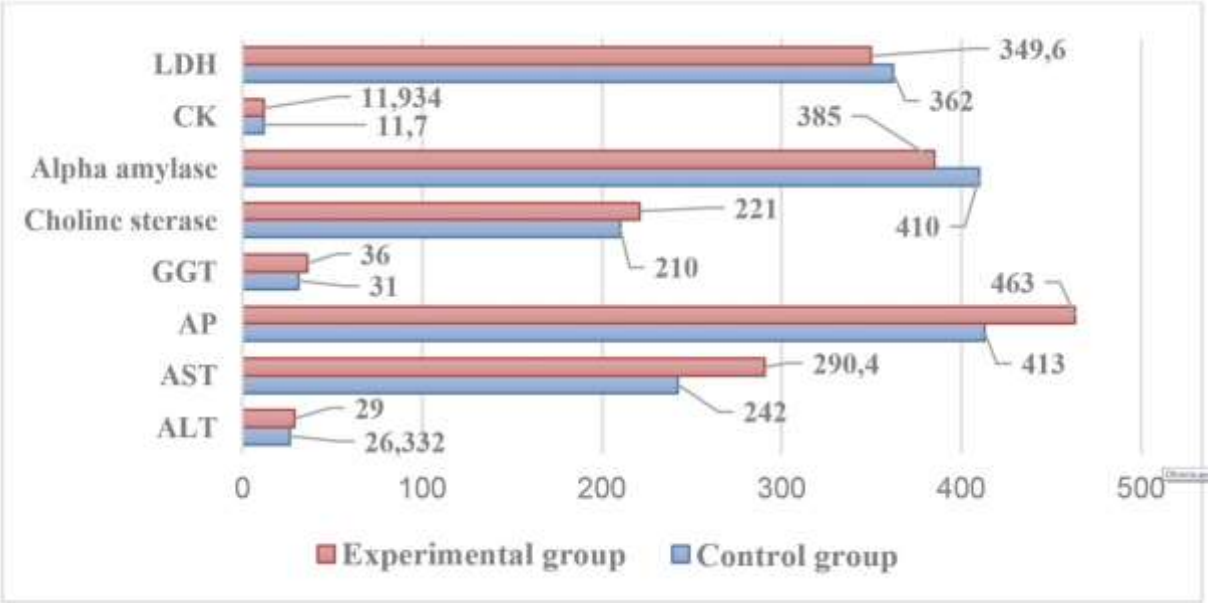

Figure 5 - Indicators of enzymatic activity of blood serum

An increase in cholinesterase signals hypertension, possible nephrosis, diabetes of all types, some mental illnesses, and oncological processes in the mammary glands. In addition, cholinesterase can be elevated in pregnant women during the first trimester. Cholinesterase successfully protects the body from various toxins, especially carbamates, organophosphorus compounds, and others that unfortunately are present in food products [28]. The activity of the enzyme Cholinesterase in the blood serum of lambs increased by 5% after pounding.

Alpha-amylase is a calcium-dependent enzyme. Its level should not exceed the norm in early age young animals. At the age of 2, its level increases. One of the possible diseases is pancreatitis or inflammation of the pancreas. Surgical intervention also leads to an increase in the level. Acute or chronic hepatitis can lead to a decrease. The levels of amylase in the blood of both males and females can be reduced if they have a high level of cholesterol [29]. The activity of the enzyme Alpha amylase in the blood serum of lambs decreased by 6% after pounding.

Creatine kinase found in tissues that use a lot of energy, such as muscles and the brain. Creatine kinase leaks into the blood when these tissues are damaged. That's why levels of this enzyme in the blood can tell us whether there has been tissue damage, such as a heart attack, stroke, sports injury, or muscle disease. Elevated levels of CK indicate recent tissue damage [30]. The activity level of CK in the blood serum of lambs after beating was higher than normal by 2%.

LDH is a signal of tissue damage and can be caused by many different conditions, including infections, liver, heart, kidney, and muscle diseases, anemia, and cancer. Young animals usually have higher levels, and this level gradually decreases into adulthood. Several different infections can raise LDH levels. Conditions that cause damage or decrease oxygen supply to the heart can raise LDH levels. LDH also increases in heart failure [31]. The activity level of LDH in the blood serum of lambs after beating was higher than normal by 3.4%.

Conclusion. The article presents the results of a study of the morphological composition of blood in lambs after weaning. The results show that after weaning, the levels of leukocytes, segmented and band neutrophils, and monocytes increase in lambs. The levels of erythrocytes, hemoglobin, platelets, eosinophils, lymphocytes, and basophils decrease.

The levels of calcium, inorganic phosphorus, sodium, iron, creatinine, bilirubin, total protein, albumin, and alpha-amylase were decreased in lambs after weaning. The levels of potassium, chloride, glucose, urea, cholesterol, triglycerides, and the activity of the enzymes ALT, AST, AP, GGT, choline esterase, CK, and LDH in lambs after weaning were increased.

Based on the obtained data, it was established that there is a significant deviation from the normal values of hematological and metabolic indicators after weaning, which indicates the presence of stress. This proves that stress is accompanied by a disturbance in hematopoiesis and metabolic processes.

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ТҮЙІН

Мықты, дені сау, өнімділігі жоғары жас малды өсіру және оның сақталуы қой шаруашылығының тиімділігін арттырудың маңызды жолдарының бірі болып табылады. Қой саласын жүргізу кезінде қозылардың денсаулығы мен өнімділігіне технологиялық стресс айтарлықтай әсер етеді, бұл жас жануарлардың төзімділігі мен сақталуын айтарлықтай төмендетеді. Қозыларды енесінен айыру жұмысы қозылар үшін үлкен стрессті тудыратындықтан, бұл зерттеудің мақсаты қозылар қанындағы морфологиялық және биохимиялық көрсеткіштеріне стресстің әсерін анықтау болды. Мақалада қозыларды енесінен айырғаннан кейінгі қанының морфологиялық құрамын зерттеу нәтижелері көрсетілген. Зерттеу нәтижелері қозыларды енесінен айыру кезінде лейкоциттер, сегментоядролық және таяқша ядролық нейтрофилдер мен моноциттердің көрсеткіштері жоғарылайтынын көрсетеді. Эритроциттердің, гемоглобиннің, тромбоциттердің, эозинофилдердің, лимфоциттердің және базофилдердің көрсеткіштері төмендеді. Қозылар қанындағы кальций, бейорганикалық фосфор, натрий, темір, креатинин, билирубин, жалпы ақуыз, альбумин, альфа амилаза көрсеткіштері төмендеді. Калий, хлорид, глюкоза, мочевина, холестерин, триглицеридтер, ALT, AST, AP, GT, холинэстераза, CK, LDH ферментінің белсенділігі қозыларда жоғарылаған. Алынған мәліметтерге сүйене отырып, қозыларды енесінен айыру кезінде гематологиялық және метаболикалық көрсеткіштерде нормасынан айтарлықтай ауытқу бар болатыны анықталды, бұл стресстің болуын көрсетеді. Бұл стресстің гемопоэз және метаболизм процестерінің бұзылуымен бірге жүретіндігін дәлелдейді.

РЕЗЮМЕ

Выращивание крепкого, здорового, высокопродуктивного молодняка и его сохранность - один из важных путей повышения эффективности овцеводства. При ведении отрасли существенное влияние на состояние здоровья и продуктивность ягнят оказывает технологический стресс, который значительно снижает резистентность и его сохранность молодняка. Поскольку отъем от матерей вызывает большой стресс для ягнят, цель этого исследования состояла в том, чтобы установить влияние стресса на морфологические и биохимические показатели ягнят при отъеме. В статье показаны результаты исследования морфологического состава крови ягнят после

отьема. Результаты иссследования показывают, что при отьеме ягнят от матерей показатели лейкоцитов, сегментоядерных и палочкоядерных нейтрофилов и моноцитов повышаются. Показатели эритроцитов, гемоглобина, тромбоцитов, эозинофила, лимфоцитов и базофилов понизились. Показатели кальция, неоргонического фосфора, натрия, железа, креатинина, билирубина, общего белка, альбумина, альфа амилазы у ягнят после отбивки была понижена. Показатели калия, хлорида, глюкозы, мочевины, холестерина, триглицеридов, активности фермента ALT, AST, AP, GGT, холинэстеразы, CK, LDH у ягнят после отбивки повысилась. Исходя из полученных данных было установлено, что при отъеме наблюдается существенное отклонение от норм гематологических и метаболических показателей, что свидетельствует о наличии стресса. Это доказывает что стресс сопровождается нарушением со стороны гемопоэза и обменных процессов.