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Morphobiochemical Parameters of Blood in Traumatism in Moose under Domestication

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Abstract

This article presents the results of studying the causes and extent of the spread of hoof diseases among the adult population of elk under domestication conditions. First, the most characteristic clinical signs of the manifestation of pathology of the distal extremities in moose and changes in the morphobiochemical parameters of blood are considered. Second, an interpretation of the results of blood analysis of experimental animals is given for some indicators to early detection of the development of pathological conditions. Finally, proposed preventive measures for animals, depending on the season and feeding conditions.

Disciplinary: Veterinary Science, Biochemical Science.

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1 Introduction

The domestication of moose posed several questions for specialists, particularly on developing diagnostics, prevention, and measures to combat diseases of various etiologies. Keeping animals in limited areas (pens, open-air cages, feeding areas), the monotony of imported feed, the inclusion of unnatural feed in the diet, physical inactivity to a certain extent, and also deterioration of the quality of forest lands lead to the registration of diseases of various etiologies in them. In addition, a certain place among them is occupied (up to 30%) by orthopedic diseases.

When elk are kept in an open-air cage on an asphalted area or partially lined with bricks, gravel, or sand, there is a violation of the growth of hooves since their growth exceeds the degree of abrasion. In this case, some changes in legs when resting on the ground lead to a change in joints, flexor, and extensor muscles. First of all, it manifested by limbs defeat, accompanied by hoof horn deformation, inflammation of the joints, and lameness. Restriction of elk in natural feed during domestication leads to disruption of the normal functioning of its body and the young animals obtained from it [3, 7].

Inflammatory processes in the body of animals are accompanied by morphological and functional changes and the restructuring of all links of metabolism. Subsequently, this is reflected by fluctuations in metabolic substrates and corpuscles in the blood. The impact on the body such stress factors causes a complex of adaptive processes, which are also accompanied by changes in physicochemical properties of blood [5].

In this regard, the purpose of our research was to study the degree of spread of hoof diseases among the adult population under domestication conditions to determine the most characteristic clinical signs and changes in morphobiochemical blood parameters in this case.

2 Materials and Methods

The research was based on the Sumarokovsky State Nature Reserve and the Kostroma State Agricultural Academy. The work also used the Department of Natural Resources and Environmental Protection of the Kostroma Region data, the primary data of the veterinary reporting of the state nature reserve.

The object of the research is the European elk (lat. Alcesalces), subspecies - European.

For studying the degree of hoof diseases spread in the first ten days of March, clinical and orthopedic clinical examination of the adult livestock of the farm (females in the second half of pregnancy, n = 20). According to earlier developed without stress method, there was blood sampling from 10 clinically healthy and 6 sick animals according to our earlier developed without stress method [14].

Hematological parameters (the number of erythrocytes, leukocytes, leukogram, ESR) were determined visually by the generally accepted method, and biochemical - serum (total protein (TP, g/l); albumin (Alb, g/l); urea (Urea, mmol/l); creatinine (Creat, mkmol/l); glucose (Glu, mmol/l); alanine - and aspartate aminotransferase (AST, e/l and ALT, e/l); alkaline phosphatase (ALP, e/l); indirect bilirubin (T. bil, mkmol/l); direct bilirubin (D. bil, mkmol/l); gamma-glutamyltransferase (GGT, e/l); lactate dehydrogenase (LDH, e/l); blood osmolarity (Osm, mOsm/kg) ; creatine kinase CK, e/l; amylase (Ami, e/l); cholesterol (Chol, mmol/l); triglycerides (Trig, mmol/l); calcium (Ca, mmol/l); phosphorus (P, mmol/l); sodium (Na, mmol/l); potassium (K, mmol/l); chlorine (Cl, mmol/l); magnesium (Mg, mmol/l) on the IDEXX CatalystOne automatic analyzer Globulin quantity (Glob , g/l), albumin/globulin (Alb/Glob), calcium/phosphorus (Ca/P,) ratio, de Ritis coefficient (AST/ALT) - by calculation method. The results were statistically processed.

3 Result and Discussion

The long-term experience of the Sumarokovskaya moose farm shows that in the domestication of moose, the main problem is caused by diseases caused by the conditions of their maintenance and feeding of young animals and broodstock.

Moose's calves are kept in a common group in a limited area for one and a half months, regardless of the date of birth until June 15, following the imprinting technology. During this period, they recorded massive diseases, accompanied by respiratory-diarrheal syndrome and, in separate years, significant mortality.

In the last period of pregnancy, the broodstock, being in the winter camp since January 15, received large quantities of oatmeal, rich in crude protein. Protein overfeeding in combination with physical inactivity caused by difficulty in movement in deep snow conditions, the confinement of elk to feeding grounds (Figure 1) contribute to the development of hoof pathologies and related diseases.

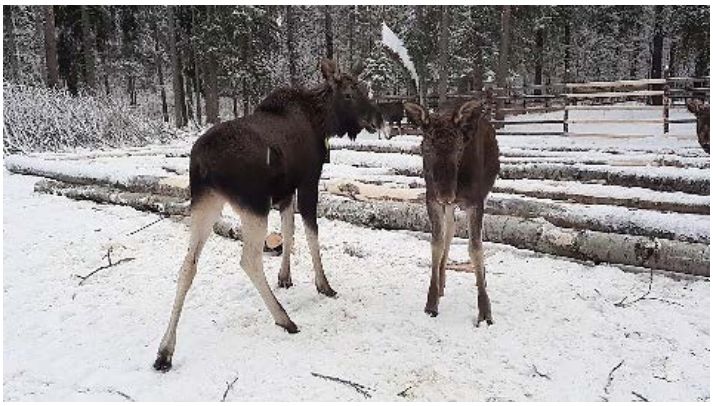

Figure 1: Moose Grazing Forage Areas

During the clinical examination of the parent flock (n = 20), in six of them (30%), lesions of the distal extremities of varying severity were recorded. The most severe forms were noted in two. First, the animals lay more, rose reluctantly, with a groan. Then, with repeated unsuccessful attempts to fully stand on all limbs, they continued to move on the bent wrist joints of the limbs (Figure 2).

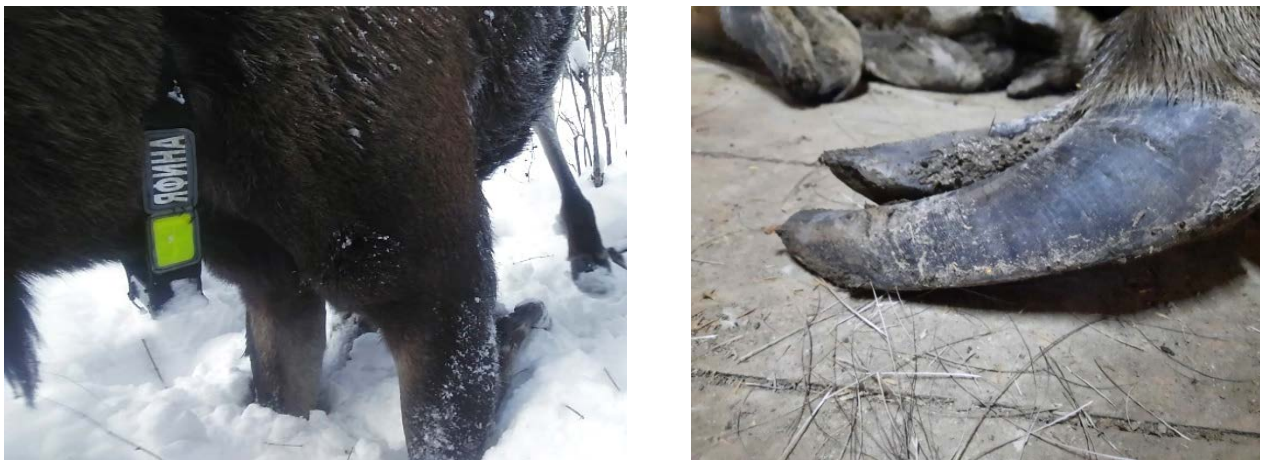

Figure 2: Moose cow with severe hoof lesions

On examination, deformity of the hooves was recorded with a more pronounced degree of damage to the forelimbs. The hooves were acute-angled with an elongated, rounded, slightly curved toe part. On the side of the sole, the presence of a strongly overgrown crumb was noted. The coronary joint was enlarged, hot, with a pronounced pain reaction on palpation. In the remaining four moose cows, a similar clinical picture was observed with lighter degrees of severity.

Hematological parameters of healthy and sick moose cows are in Table 1.

Table 1: Morphological picture of the blood of healthy and sick moose

Indicator		Healthy (n=10)	Sick (n=6)	% to control
RBC, Т/л		5.10±0.28	6.07±0.71	+19.06
WBC, Г/л		5.38±0.25	6.00±0.57	+11.48
LYM	G/l	3.39±0.20	3.70±0.25	+9,35
	%	63.11±2.92	62.50±2.17	-0,97
NEUP	G/l	0.41±0.05	0.48±0.06	+17,07
	%	7.56±0.87	8.33±0.42	+10,29
NEUS	G/l	1.42±0.19	1.69±0.27	+19,33
	%	26.11±2.74	27.50±2.11	+5,32
BAS	G/l	0.04±0.02	0.02±0.01	-59,47
	%	0.78±0.28	0.33±0.21	-57,14
EOS	G/l	0.08±0.02	0.06±0.02	-30,06
	%	1.44±0.38	0.83±0.31	-42,37
MON	G/l	0.04±0.01	0.03±0.01	-25,80
	%	0.78±0.28	0.50±0.22	-35,71
ESR, mm/h		56.44±2.07	62.67±0.76*	+11.02

Note: * - P≤ 0.05 about healthy; 2. +, -, ± –increase, decrease, and not exceeding indicators no more than 1 about the control.

Analysis of the data in Table 1 shows that injuries in moose compared with healthy ones were accompanied by a higher level of absolute values of the content of erythrocytes, leukocytes, and lymphocytes of neutrophils against the background of a slightly reduced relative content of lymphocytes (by 0.97%), but while maintaining the trend of this indicator in neutrophils (to a greater extent stab - by 10.29%, to a lesser extent - segmented - by 5.32%).

Changes in the dynamics of indicators of basophils, eosinophils, monocytes were more pronounced in the direction of their decrease in both absolute and relative values. In sick animals, a significant increase in ESR was noted.

Probably, such changes could be caused by the inflammatory response and stress experienced by the animals against the background of decreased physical activity [8].

Our data showed a significant increase in the number of erythrocytes and leukocytes against the background of a decrease in the relative values of eosinophils, basophils. In addition, a significant decrease in the relative indices of lymphocytes against the background of an increase in rod and segmented neutrophils under conditions of situational stress was also reported earlier in studies [4, 11].

Data characterizing biochemical parameters in healthy and sick moose are in Table 2.

Table 2: Biochemical parameters of the blood of healthy and sick moose

	Healthy (n=10)	Sick (n=6)	% to control
TP, g/l	81.17±1.68	80.17±2.06	-1.23
Alb, g/l	33.78±1.44	32.17±1.97	-4.77
Glob, g/l	47.39±1.20	48.00±0.38	+1.29
Alb/Glob	0.72±0.04	0.67±0.04	-6.94
Urea, mmol/l	2.97±0.27	2.80±0.43	-5.72
Creat, mkmol/l	184.78±10.14	171.17±9.33	-7.37
Glu, mmol/l	6.06±0.39	6.63±0.29	+9.41
AST, e/l	87.51±6.79	82.42±8.26	-5.82
ALT, e/l	36.97±2.93	34.45±3.08	-6.82
AST/ALT	2.44±0.24	2.42±0.21	-0.82
ALP, e/l	131.00±12.14	162.50±14.55	+24.05
T. bil, mkmol/l	2.37±0.56	1.82±0.34	-23.21
D. bil, mkmol/l	1.87±0.36	1.38±0.17	-26.20
GGT, e/l	10.39±1.42	9.47±1.82	-8.85
LDH, e/l	476.13±21.72	473.95±26.55	-0.46
Osm, mOsm/кg	268.60±0.97	268.15±0.93	-0.17
CK, e/l	57.98±5.00	55.55±7.60	-4.19
Ami, e/l	74.22±3.77	79.97±4.60	+7.75
Chol, mmol/l	1.83±0.07	1.92±0.13	+4.92
Trig, mmol/l	0.52±0.06	0.67±0.08	+28.85
Ca, mmol/l	2.90±0.04	2.89±0.04	-0.34
P, mmol/l	1.59±0.11	1.60±0.12	+0.63
Ca/P	1.93±0.19	1.86±0.13	-3.63
Na, mmol/l	130.87±0.98	132.68±0.29	+1.38
K, mmol/l	7.41±0.50	5.76±0.24*	-22.27
Cl, mmol/l	102.77±0.71	101.45±0.66	-1.28
Mg, mmol/l	1.59±0.03	1.67±0.05	+5.03

Analysis of Table 2 shows that out of 27 indicators, the most pronounced differences (changes in the direction of decreasing or increasing by 4% and higher) were established for 17. For the remaining 10, minor deviations from the indicators of healthy moose cows were recorded.

Thus, sick animals showed more pronounced low albumin levels, albumin-globulin ratio, the concentration of urea, creatinine, aspartate aminotransferase, alanine aminotransferase, direct and indirect bilirubin, gamma-glutamyltransferase and potassium (22.27%, at P≤ 0.05) higher - glucose, alkaline phosphatase, amylase, magnesium.

Perhaps, such changes could be due to less pronounced metabolic processes in sick animals against the background of physical inactivity and the inflammatory process in case of limb disease [9, 12]. Lower values of the albumin-globulin ratio are associated with an increase in the globulin fraction. At the same time, the decrease in albumin, the main proteins in the transport and deposition of substances, is probably due to a reduction in metabolic processes, especially in muscle tissue against the background of limited motor activity.

It is known that the level of urea (the end product of protein breakdown) can increase with physical work. In this regard, a lower concentration of this indicator in injured animals could be

caused by decrease in motor activity against a background of inflammation in the distal part of the extremities [13].

It is known that in the third trimester of pregnancy in the body, there is the deposition of nutrients, including glycogen, against the background of an increase in insulin production, which in turn also leads to a decrease in blood glucose levels [15]. However, sick moose cows have an elevated blood sugar level, which is probably due to stress against the background of physical inactivity. In this state of the body, counter-insular hormones are formed, the activity of the sympathoadrenal system increases, and the production of insulin and the level of glucose uptake by the muscles decreases [1, 5]. In addition, a higher level of glucose in the blood of sick animals is probably associated with the migration of neutrophils into the inflammation focus, which has a phagocytic reaction.

It can be assumed that the lower concentration of creatinine in sick animals may be due to low muscle contractility. The formation of creatinine and ATP is facilitated by activating motor activity, which is deprived of injured moose.

For the regulation of muscle contractions, Ca^{2+} ions are also required, the level of which increases tenfold when entering from the depot cisterns of the cytoplasmic reticulum. In pregnant animals, there is a delay in the tissues of mineral substances due to their participation in the work of enzymes [1]. Therefore, even a slight decrease in calcium in sick animals (by 0.34%) is probably associated with lower muscle activity and a lower content of albumin, a reserve source of amino acids [2, 6]. A less intensive level of amino acid metabolism is also indicated by lower indices of gamma glutamine transferase 9.47 ± 1.82 in healthy and 10.39 ± 1.42 e/l of sick animals.

It can be assumed that the lower indices of aminotransferases – AST and ALT in injured moose cows could be caused by a decrease in the catalytic activity of transamination enzymes due to oxidative deamination of amino acids.

The higher concentration of potassium in healthy animals' blood is possible because when muscles work, they actively consume carbohydrates. And this chemical element is an activator of many enzymes, including those involved in glycolysis - phosphofructokinase, etc.

It was found that in healthy animals, the concentration of total and direct bilirubin exceeds the indicators of patients (2.37±0.56 and 1.82±0.34 versus 1.82±0.34 and 1.38±0.17 μm/l). Considering the obtained data in the context of an increase in both the absolute and the relative number of eosinophils against the background of a lower number of erythrocytes in healthy animals than patients, this may indicate a higher degree of invasion. The infection in sick moose is probably much lower due to the restriction of their movement, confinement to a certain territory, and a decrease in the possibility of contact with sources of invasion. This condition of the animal leads to liver dysfunction and the development of toxic anemia, followed by an increase in bilirubin concentration in the blood.

4 Conclusion

Visual examination of the limb pathology showed deformity of the hooves, hypertrophic changes in the tissues of the crumb, and soreness of the hooves of the forelimbs, which leads to the movement of animals with support on the wrist joints. In sick animals, erythrocytosis, neutrophilic and lymphocytic leukocytosis, as well as monocytopenia are recorded. In a biochemical study in sick moose cows, out of 27 indicators, 17 (63%) had pronounced differences (more than 4%) in the direction of increase or decrease in comparison with healthy ones, the remaining 10 (37%) did not differ significantly.

For preventing surgical pathology of the distal extremities in moose, it is necessary to carry out timely trimming and trimming of the hooves before transferring to the winter camp. And in the spring-autumn period, practice foot baths with disinfectant solutions or treat the hooves using knapsack sprayers. In addition, for strengthening the hoof horn (to promote the synthesis of high-quality keratin), animals should be included in their diet in the form of additional feeding with sulfur-containing vitamins biotin (H), thiamine (B_1), methyl methionine (U).

5 Availability of Data and Material

Data can be made available by contacting the corresponding author.

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