



Research Article

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CLINICAL-LABORATORY STUDIES OF THE BIRDS OF PREY OF THE ORDER FALCONIFORMES CONTAINED IN THE CONDITIONS OF KENNEL

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ABSTRACT

*Biochemical and hematological parameters of clinically healthy birds of prey of three species of the order Falconiformes contained in the conditions of kennel were investigated. The data obtained were analyzed in relation to their importance for assessing health status of the birds. Macro and microscopic study of faeces as well as detection of helminth eggs were carried out. Extensiveness of helminth invasion of 13 bird species in kennel was 24.6%. 7 helminth species were identified. The highest frequency of occurrence was found for nematode *Capillaria falconis*, which may indicate the formation of the resistant foci of capillariasis in the conditions of aviary.*

Keywords: *Diurnal birds of prey, Falconiformes, biochemical blood indices, morphological composition of blood, investigation of faeces samples, extensiveness of invasion, helminth species*

INTRODUCTION

Years of experience shows that only breeding of rare species, the carriers of the gene pool of the population, in artificial conditions with subsequent reintroduction (repatriation) in nature can become a full measure of their preservation, especially because, in the light of modern ethological concepts, this process with proper implementation does not represent insurmountable problems [1]. In some countries (UK, USA, Canada, Egypt, United Arab Emirates and Kazakhstan) special programs for restoring the populations of birds of prey in artificial conditions, including rehabilitation, maintenance and breeding, are successfully developed and put into practice. The relevance of environmental protection measures is determined primarily by the fact that the current changes in ecosystems, caused by anthropogenic interventions, are significant and occur in a short time. This means that species, which even have a sufficiently high numbering in the natural biotopes, can appear on the brink of extinction in the near future [2].

In the kennels, which are involved in environmental programs, birds are mainly distributed to groups combined on the basis of systematic proximity and similarity of habitat conditions [1]: the first group - species on the brink of

extinction, environmental activities in natural biotopes are ineffective (eastern imperial eagle and others); the second group - for these species the decrease of population in nature due to the anthropogenic transformation of habitats is predicted (falcons, gyrfalcons, etc.); the third group - relatively numerous species, traditional protection methods are effective for them (golden eagles, sea eagles, etc.). It should be noted that the birds of prey in the trophic webs of biogeocoenoses occupy the top position - top of the food pyramid, many of them are specialized predators, facultative predators or scavengers, and their number in nature is never numerous. It is unique indicators of ecosystems prosperity, which support its biodiversity. Many species are on the pages of the International Red Book, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), on the pages of regional and national Red Books, including the Red Book of the Russian Federation [1].

In recent years on the territory of the Russian Federation a number of specialized kennels has appeared, which successfully put into practice the environmental protection programs aimed at preserving the gene pool of birds of prey. The creation of such kennels means moving from passive to active wildlife protection measures. However, for effectiveness of this measures is necessary to master the technology of keeping and breeding of species in artificial conditions that are often associated with objective difficulties. In this connection, an important task is to develop a standard, well-documented and tested technology [1], an integral part of which is veterinary care.

Currently, issues of veterinary medicine of wild and exotic birds are being actively developed. In Europe, America, Asia and Middle East countries a large number of professionals works in this field, there are specialized clinics and rehabilitation centers, while in Russia this area of veterinary medicine is in its infancy. Moreover, about the birds of prey in the available literature there is virtually no information relating to the reference values of biochemical, hematological and other indices that are crucial for the early diagnosis of possible diseases. For obtaining comparable studies the species, age, seasonal features, food spectrum, the phase of the reproductive cycle should be also taken into account. In the light of the foregoing, there is the necessity to accumulate the database of clinical indicators relevant to the study of the physiological status of the birds at their content in kennels, aviaries and to the monitoring in their veterinary servicing. As already mentioned, such information concerning the birds of prey is limited, what cannot be said, for example, about parrots, pigeons and some other bird species [3-4]. The bulk of the literature data about clinical parameters refer to the poultry [5].

The clinical examination of birds is accompanied by the taking of blood and dung for laboratory tests, which allow making an objective understanding of the level and status of metabolism, to conduct differential and early diagnostics of diseases, to assess the condition of various organs and systems.

The goal of our investigation was to study the clinical laboratory indices of birds of prey for the development of diagnostic criteria. The objectives of the study included: the study of hematological blood parameters; the macro and microscopic studies as well as detection of helminth eggs of the faeces of birds of prey (order *Falconiformes*) contained in kennel conditions and determining the significance of the studied indicators for assessing the state of birds' health.

MATERIALS AND METHODS

53 blood samples from the birds of three species of family *Falconidae* (peregrine falcon, saker falcon and gyrfalcon) and 122 samples of fresh faeces from the birds of 13 species of order *Falconiformes* from a specialized kennel of the Russian Public Fund of the protection of birds of prey in the Tula region were used in the work. Taking the blood of birds was carried out from the jugular vein. During hematological studies the counting of leukocytes and erythrocytes and hemoglobin determination were carried out. Because the red blood cells of birds are not destroyed in Turk's solution [5], for determining the number of leukocytes in the hemocytometer, dilution by 0.1% Azure II solution on 0.85% sodium chloride solution or by 0.01% crystal violet solution on 3.8% sodium citrate solution with formalin was used. Biochemical blood tests were carried out on a semi-automatic analyzer «Clima MC-15" (Spain) with sets of liquid stable reagents on a spectrophotometer equipped with a microprocessor. Detection of helminth eggs was carried out by flotation method using a saturated solution of ammonium nitrate (Kotelnikov method) [8]. During the work, hematological, biochemical, microscopic, statistical research methods and detection of helminth eggs were used.

Results

For studying the biochemical and hematological parameters the representative selections of the birds of *Falconidae* family (*Falconiformes*) of three species presented in the kennel by the highest number of animal units in the amount of: peregrine falcon (*Falco peregrinus*) - 18; saker falcon (*Falco cherrug*) - 25; gyrfalcon (*Falco rusticolus*) - 10 were formed. For the study, birds, which enough time was in captive conditions, adapted to the captivity, were selected, age differences were not significant values (the very young, older and recently received animal units were not included in the experimental group).

It is known that in clinical dispensary examination of birds in the poultry industry, a full study of the body systems of certain control groups, which are formed, based on age and physiological state, is conducted [5]. In our studies, during physical inspection, all birds were considered clinically healthy, conditions of their keeping and feeding were fully in line with the peculiarities of the species, feeding was carried out according to the accepted standards [1]. Research was also conducted under natural conditions (in aviaries), while attention was drawn to the behavior of the bird and its general condition (physical activity, breathing, coordination, condition of plumage and pigmentation of the extremities, the lack of fresh injury or damage, the condition of the eyes, the frequency and character of the act of defecation). For all these indicators deviations weren't noted. All studies were carried out in the least responsible physiological and ethological period - in October and November (outside the breeding season, preparation for nesting and nesting as well as seasonal moulting, when clinical parameters may be varied to a large extent).

Obtained data on the results of the biochemical studies of blood serum are presented in Table 1.

Table 1. The biochemical parameters of blood serum of the birds of order *Falconiformes* contained in the kennel.

Index	Measure units	Peregrine falcon (n=18)		Saker falcon (n=25)		Gyrfalcon (n=10)	
		min/max	M±m	min/max	M±m	min/max	M±m
Total protein, including	g/l	27.0/44.0	35.5±1.10	30.0/55.0	42.5±1.27	35.0/55.0	20.0±2.06
albumins	g/l	10.0/17.0	13.5±0.45	10.0/20.0	15.0±0.51	13.0/20.0	16.5±0.72
globulins	g/l	17.0/27.0	22.0±0.65	17.0/30.0	23.5±0.66	15.0/35.0	25.0±2.06
Urea	mmol/l	0.0/2.0	1.0±0.13	0.0/2.0	1.0±0.10	0.0/2.0	1.0±0.21
Uric acid	umol/l	600/1100	850±32.38	750.0/ 1300.0	1400.0± 27.99	600.0/ 1300.0	950±71.94
Creatinine	umol/l	30.0/55.0	42.5±1.62	30.0/60.0	45.0±1.53	35.0/60.0	47.5±2.57
Glucose	mmol/l	10.0/13.0	11.5±0.19	10.0/15.0	12.5±0.25	13.0/15.0	14.0±0.21
Cholesterol	mmol/l	5.0/7.0	6.0±0.13	5.0/9.0	7.0±0.21	5.0/ 8.0	6.5±0.31
Alanine aminotransferase	u/l	100.0/150.0	125.0±3.24	110.0/ 170.0	195.0±3.08	110.0/ 160.0	135.0±5.14
Aspartate transaminase	u/l	12.0/23.0	17.5±0.71	12.0/23.0	17.5±0.56	12.0/21.0	16.5±0.92
Lactate dehydrogenase	u/l	100.0/300.0	200.0±12.95	100.0/ 350.0	225.0±12.72	130.0/ 350.0	240.0±22.61
Alkaline phosphatase	u/l	60.0/150.0	105.0±5.82	80.0/ 150.0	115.0±3.59	90.0/ 160.0	125.0±7.19
Calcium	mmol/l	2.0/3.0	2.5±0.06	2.0/3.0	2.5±0.05	2.5/3.0	2.75±0.05
Phosphorus	mmol/l	1.0/1.5	1.25±0.03	1.0/1.5	1.25±0.03	1.0/2.0	1.5±0.10
Potassium	mmol/l	1.5/2.5	2.0±0.06	1.5/2.5	2.0±0.05	1.5/2.5	2.0±0.10
Chlorides	mmol/l	100/120.0	110.0±1,3	110.0/ 130.0	120.0±1.02	100.0/ 125.0	112.5±1.54
Sodium	mmol/l	150/175.0	162.5±1.62	150.0/ 175.0	162.5±1.27	130.0/ 170.0	150±4.11
Ferrum	umol/l	5.0/15.0	10.0±0.65	7.0/15.0	11.0±0.41	8.0/15.0	11.5±0.72

Table 2 shows in the comparative aspect the data obtained by different authors concerning the biochemical indicators of the blood serum of birds (except agricultural) and their estimated clinical interpretation.

Table 2. Biochemical parameters of the blood of birds in the norm, according to different authors and their interpretation [3, 4, 7, 8, 9, 10, 11].

Index	Measure units	Norm	Index increase	Index decline	Notes (index characteristic)
Total protein	g/l	25,0-50,0 30-60,0 ^{xx}	Dehydration, shock, inflammation, trauma, infection.	Chronic liver and kidney diseases, hunger, indigestion, stress, blood loss.	Less than 25.0 - poor prognosis.
Albumins	g/l	10.0-20.0 ^x	Hemoconcentration (dehydration, increased haematopoiesis).	Chronic liver and kidney diseases, protein deficiency in the diet, digestive tract diseases, endoparasitic diseases.	Only electrophoresis gives the best estimate of the amount of protein fractions (albumins, globulins) for birds.
Globulins	g/l	15.0-30.0	Hyperproteinemia together with hyperglobulinemia often indicates chronic infections (chlamydiosis, aspergillosis, tuberculosis, mycoplasmosis and others.); less - acute infection, chronic hepatitis. Often the increase may be due to the egg-laying (the production of antibodies in the formation of the egg).	Dangerous starvation, internal bleeding, diseases of the digestive system and liver.	
Glucose	mmol/l	10.0-25.0 11-28 ^x	Stress - transient increase; diabetes - more than 50.0 mmol/l	Eating disorders, chronic hepatitis, physical load, new formations.	A higher level compared with mammals. Less than 8 mmol/l - dangerously low.
Bile acids	umol/l	up to 100 ^{xx}	More than 150-200 - liver dysfunction	—*	Mainly for the birds.
Uric acid	umol/l	400-1200 ^x 119-900 mmol/l ^{xx}	Reducing of kidney function (value more than 1200); tissue destruction, hunger, gout, hypercalcemia	—*	Mainly for the birds - the main product of the metabolism of nitrogenous compounds. For the birds of prey the level increase within 12 hours after feeding.
Urea	mmol/l	0.3-2.0 ^x	It is noted during a shock and critical dehydration.	—*	Not a diagnostic for birds (does not reflect the functional state of the kidneys).
Creatinine	umol/l	30.0-60.0	—	—*	Not a diagnostic for birds.
Aspartate transaminase	u/l	10.0-60.0 up to 330 ^x	Muscle damage, hepatocyte damage.	—*	Insufficient specific index for the birds.
Alanine aminotransferase	u/l	100-250	—	—*	Insufficient specific index for the birds. Basically, has no diagnostic value.
Lactate dehydrogenase	u/l	100-750	Muscle damage, hepatocyte damage; hemolysis in the sample.	—*	
Alkaline phosphatase	u/l	25.0-500.0	Osteoporosis, injuries of bones and ligaments, infections, new formations of bones.	—*	Does not reflect the state of the liver of birds.
Cholesterol	mmol/l	5.0-10.0	Starvation, violation of the liver work.	—*	Has not unequivocal diagnostic value.
Calcium	mmol/l	2.0-3.0 up to 4,5 ^x	The females in the breeding season (6.3 and above).	Eating disorders, kidney pathology; enhanced egg laying.	Below 1.5 - accompanied by tetany of birds.
Phosphorus	mmol/l	1.0-2.0 0,6-1,45 ^x	Renal pathology.	Starvation, gastrointestinal pathologies.	
Potassium	mmol/l	1.5-3.5	Kidney pathologies, acidosis.	Diarrhea, alkalosis.	
Chlorides	mmol/l	100-150	Water loss, acute renal failure, metabolic acidosis, hypoadrenalism, brain injury	Metabolic alkalosis, nephritis and nephropathy accompanied by loss of salt.	
Sodium	mmol/l	150-175	Osteodystrophy, chronic renal failure.	Acute glomerulonephritis, heart failure, liver diseases in the terminal stage, osteomalacia.	
Ferrum	umol/l	2.0-20.0	Hemosiderosis, hemolytic anemia, acute hepatitis, glomerulonephritis, use of estrogen; hemolysis of serum in the sample.	Alimentary anemia, posthemorrhagic anemia, nephrosis.	

Notes:

* – has no clinical significance or information about the clinical significance is missing;

x – parrots;

xx – the species of bird is not specified.

Thus, on the basis of the obtained data it is revealed that the biochemical parameters of the birds of prey contained in the kennel, in the least responsible period in physiological and ethological regard, basically do not go beyond the general physiological norms for birds. However, the low availability of published data about the reference values of the indices of the diurnal birds of prey and their interpretation allows come only to general conclusions about the absence of expressed organ pathologies and course of normal biochemical processes.

Such factors as the level of bile acids, uric acid, total protein content and the ratio of protein fractions, electrolytes content have the highest diagnostic significance for the birds. It is obvious that accounting the levels of urea, creatinine, cholesterol, alanine aminotransferase and aspartate transaminase activity, which are important in the diagnosis of the pathologies of mammals [9], have minimal diagnostic significance for the birds of prey. The level of bilirubin is not subject to the study, due to the absence of the process of the transformation of biliverdin to bilirubin; biliverdin excreted in urine [11-12].

Regarding species differences in the studied falcons it is found that between the species that are in similar conditions and physiological state, expressed and statistically significant differences of basic biochemical indices are absent.

The study of the morphological composition of the blood includes hemoglobin determination, number of erythrocytes, leukocytes, and is of great importance, especially in the diagnosis of anemias and hematological malignancies, inflammatory phenomena [4, 5]. Age, season of the year, the breed and the constitution, terms of feeding and maintenance significantly affect the morphological composition of the blood [5, 13]. Erythrocytes and platelets of the birds are oval and contain nuclei. The main hematologic indices of the blood of diurnal birds of prey based on literature data are listed in the table 3. Table 4 shows the data we obtained in the study of three species of falcons.

Table 3. Hematologic parameters of the blood of birds of prey in the norm [13, 14].

Index / species of birds	Measure units	Falcons <i>Falco sp.</i>	Eagles <i>Aquila sp.</i>	Long-legged buzzards <i>Buteo sp.</i>	Hawks <i>Accipiter sp.</i>
Hematocrit	l/l	0.30-0.45	0.30-0.50	0.35-0.45	0.30-0.50
Hemoglobin	g/l	100-180	110-170	120-180	150-200
Erythrocytes	$\times 10^{12}/l$	2.0-3.5	2.0-3.0	1.65-2.5	1.5-3.0
Leukocytes	$\times 10^9/l$	7.0-20.0	10.0-20.0	5.0-22.0	10.0-20.0
Platelets	$\times 10^9/l$	5.0-50.0	10.0-50.0	5.0-45.0	5.0-50.0
Fibrinogen	g/l	<5.0	<5.0	<5.0	<5.0

Table 4. Hematologic indices of falcons in kennel conditions.

Index	Peregrine falcon (n=18)		Saker falcon (n=25)		Gyr falcon (n=10)	
	min/max	M±m	min/max	M±m	min/max	M±m
Erythrocytes, $\times 10^{12}/l$	2.5/ 4.0	3.0±0.06	3.0/4.0	3.25±0.03	3.0/4.0	3.7±0.1
Leukocytes, $\times 10^9/l$	8.0/13.0	10.5±0.36	9.0/14.0	11.25±0.28	9.0/14.0	11.1±0.51
Hemoglobin, g/l	120/160	140±2.59	110/165	137.5±2.80	112/160	147.6±4.93

Based on the average data of general clinical blood analysis (Table. 4), we can conclude that for all investigated birds obtained data do not extend beyond the physiological norm. Some increases of the level of leukocytes may occur as a stress-provoked reaction caused by manipulations with the birds. Species differences in the hematological parameters of family *Falconidae* are not expressed.

In parallel, we examined the blood for the presence of parasitic protozoa. During the investigation of blood smears using a kit for rapid staining Leucodif 200 blood parasites did not found.

For the implementation of the work tasks, in the second cycle of analyzes the samples of faeces were examined (122 samples from all 13 species of the two families of the order *Falconiformes*):

1. Family *Falconidae* (falcons), including falcons - 95 samples (peregrine falcon (*Falco peregrinus*) - 25; saker falcon (*Falco cherrug*) - 50; merlin (*Falco columbarius*) - 2; gyrfalcon (*Falco rusticolus*) - 16; common kestrel (*Falco tinnunculus*) - 2); eagles - 17 samples (the golden eagle (*Aquila chrysaetos*) - 6; eastern imperial eagle (*Aquila heliaca*) - 3; tawny eagle (*Aquila rapax*) - 2; eagles hybrids - 6); buzzards (common buzzard (*Buteo buteo*)) - 2 samples and kites (black kite (*Milvus migrans*)) - 2 samples;
2. Family *Accipitridae* (hawks) - 6 samples from hawks (northern goshawk (*Accipiter gentilis*) - 4; northern sparrowhawk (*Accipiter nisus*) - 2).

During microscopic examination of faeces, digestibility, visually estimated by the number of birds' detritus, the presence of uric acid crystals and their color as well as consistency and the amount of faeces and defecation frequency were determined. Macro and microscopic examination revealed no deviations from the norm, signs of the presence of uric acid diathesis, disturbances of digestion and digestibility of feed. Macro and microscopic examination did not reveal any deviations from the norm, signs of the presence of uric acid diathesis, disturbances of digestion and digestibility of feed. Identification of helminths was conducted using handbooks and qualifiers [15-16].

It was found that the infection of birds by helminths amounted 24.6% (30 of 122 tested samples were infested). At the same time, signs of clinical helminthiasis were not observed. However, we cannot exclude the fact that in kennel conditions differing from natural habitat of birds, with the development of stress, changes in diet and lifestyle, decrease in immunity helminth infections at some point may become clinically apparent disease.

Among the birds of prey of aviary content 7 species of helminths were found, including nematodes - 4 species, trematodes - 2 species, acanthocephala - 1 species (Figure 1-7). Infection with helminths found in 11 of the 13 studied species of *Falconiformes*. The absence of helminths in buzzards and kites may be due to small sample.



Fig. 1. Egg of nematode *Capillaria falconis* (original, objective lens 8, eyepiece 10)



Fig. 2. Egg of nematode *Porrocaecum depressum* (original, objective lens 8, eyepiece 10)



Fig. 3. Egg of nematode *Physaloptera alata* (original, objective lens 40, eyepiece 10)



Fig. 4. Egg of nematode *Ascaridia sp* (original, objective lens 8, eyepiece 10)



Fig. 5. Egg of trematode *Strigea falconis* (original, objective lens 8, eyepiece 10)

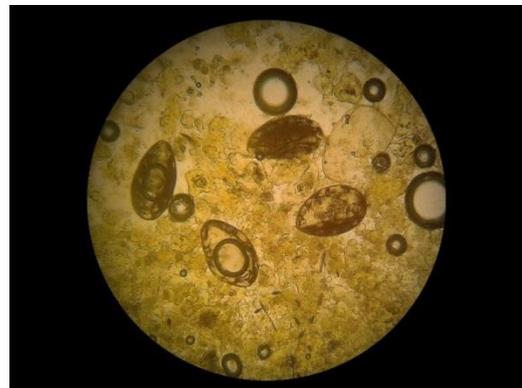


Fig. 6. Egg of trematode *Neodiplostomum attenuatum* (original, objective lens 8, eyepiece 10)



Fig. 7. Egg of helminth *Acantocephala sp.sp* (original, objective lens 8, eyepiece 10)

Nematode *Capillaria falconis* (species with a maximum frequency of occurrence) was detected in all infested birds. It indicates the formation in this kennel the resistant foci of capillariasis. In nature infection with this geohelminthiasis of the birds of prey occurs mainly through paratenic hosts (invertebrates and birds) [17]. In captivity, in the absence of paratenic hosts helminth life cycle takes place directly, via contaminated with helminth eggs feed and external environment.

In relation to the distribution of helminth fauna on bird species it may be noted that in the peregrine falcon and saker falcon two species of helminths were found (nematode *C. falconis*, trematode *Strigea falconis*), intensity of infestation amounted 12.6%; in gyrfalcon - 3 species (nematode *C. falconis*, *Porrocaecum depressum*, trematode *Strigea falconis*) with the intensity of infestation 31%, mixed invasions by the two species of helminths was observed; in hawks - 7 species (nematodes *C. falconis*, *Porrocaecum depressum*, *Ascaridia sp*, *Physaloptera alata*, trematodes *Strigea falconis* *Neodiplostomum attenuatum*, as well as acanthocephalans *Acanthocephala spp.*), intensity of infestation amounted 100% with mixed invasions in various combinations; in all species of eagles, as well as in merlin, kestrel only 1 species was found - *C. falconis*. According to the literature, identified parasitocenoses are common among *Falconiformes* in the natural environment of many regions [15, 17, 18].

DISCUSSION OF THE RESULTS

The specificity of avian diseases is the character of their course - namely, the absence of visible clinical signs until the final, decisive stage of the disease when medical intervention is, as a rule, is no longer effective [19]. According to our observations, about 90-95% of diseases cases and mortality of the birds of prey in a specialized kennel, organized according to the rules, related to noncontagious etiology. Basically, they are associated with inevitably arising violations of the natural needs of carnivores in motor activity. Due to lack of physical exercise, the next cascade of pathological changes in the body leading to the emergence of the disease appears: physical inactivity in aviaries (leading link) + copious protein foods - intoxication - dystrophy of organs and tissues [19]. In birds of prey contained in the aviaries, next diseases are objectively found: atrophy of adipose tissue and skeletal muscle, myocardial dystrophy, dystrophy of liver and kidneys, ulceration of the gastric mucosa, clinically characterized by manifestations of urine acid diathesis, metabolic nephritis, hepatitis and cholestasis, i.e. signs of the toxic dystrophy of the liver and kidneys, which develop due to lack of physical exercises even against the background of balanced feeding [20].

Thus, in conditions of a kennel with a large concentration of population in limited spaces, even with adherence of common zoohygienic conditions and full feeding, the risk of non-communicable diseases, injuries and diseases of invasive and mixed etiology significantly increases. Early and accurate diagnosis of diseases enables timely and properly organize veterinary, sanitary and prophylactic measures for their elimination. Under these conditions, biochemical and haematological studies, as markers of the functional state of the organism and the early detection of violations, in health come to the fore. For these purposes, constant monitoring of clinical indicators for the reference values, the dynamics of which affected by the objective factors related to the biology and the conditions of the content of birds is needed [3-21]. The complexity of the interpretation of indicators is also associated with a large number of physiological and ethological variables that needs accounting [3, 14].

Macro and microscopic examination of faecal samples may also serve as a reliable marker of primary diagnosis and assessment of the health status of such specific objects, like birds of prey at the aviary content. At the same time the value of these studies is increasing due to their non-invasiveness.

Investigations of parasite fauna composition can have a large enough value in the assessment of the clinical status of captive birds. The revealed composition directly depends on trophico-chorologic connections of the host. In this regard, it is logical that hawks have the most diverse composition of helminth fauna among of the diurnal birds of prey both in nature [17, 18] and in our research.

With the exception of the capillaria and ascarids, all the identified parasites belonged to biohelminths having a complicated cycle of development with the change of hosts. In birds seized from natural biotopes, in the future we should expect the lack of re-infection and natural depletion of the species composition of parasite fauna in conditions of captive content. However, it should be emphasized that most of the identified species of parasites are highly pathogenic to birds. Thus, physaloptera causes ulceration of the mucous membrane of the alimentary canal, vomiting, death [22], trematodes under unfavorable course of the disease - severe digestive disorders, diarrhea, accompanied by depression and lethargy [15, 23], acanthocephalans - perforated ulcer of the small intestine. In turn,

with high probability we can expect a significant increase in the intensity and extensiveness of geohelminthes invasion in connection with the formation of stable foci.

The published data shows the wide spread of capillariasis in nature among *Falconiformes* [15, 17, 22]. Capillaria at high intensity of infection in the intestine causes anorexia, dyspepsia, oropharyngeal and oesophageal damage of falcons [22]. All this testifies to the need for further development of adequate measures against helminthiasis detected in kennels, in the first place - with capillariasis, taking into account the biological characteristics of the birds of prey, and the need for de-worming when they are placed in captive conditions. It is also clear that the infection of all studied birds by biohelminths happened during their living in nature.

CONCLUSIONS

The values of the biochemical parameters of the blood serum of falcons at aviary content in kennel conditions examined in the period of physiological rest, do not show significant deviations from the known data and may be indicators of clinical status. Species differences in three species of the birds of family *Falconidae* is not revealed.

The obtained results can be used to enrich the available data and establish the exact reference values of the blood biochemical parameters of birds of prey family *Falconidae*.

Investigations of faeces may be a reliable marker for the primary assessment of the state of health of birds at the maintenance in artificial conditions.

A high contamination of the helminths of different taxonomic groups of the birds of prey of aviary content without clinical signs of helminthiasis was found. For the birds of prey of aviary content there is the risk of developing symptomatic capillariasis associated with the nematode *C. falconis*, in connection with the formation of stable foci of infection.

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