

RESEARCH ON THE QUALITY OF THE LIVING ENVIRONMENT AND ITS INFLUENCE ON THE HEALTH OF STURGEONS IN A FISH FARM IN EAST ROMANIA

CERCETĂRI PRIVIND CALITATEA MEDIULUI DE VIAȚĂ ȘI INFLUENȚA ACESTUIA ASUPRA SĂNĂTĂȚII STURIONILOR ÎNTR-O FERMĂ PISCICOLĂ DIN ESTUL ȚĂRII

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ABSTRACT | REZUMAT

The quality of the sturgeon's living environment, the equipment used in the farm, the microclimate factors (noise, lighting), the biosecurity of the area where the fish farm is located, and the quality of the staff working in these units influence the health of the fish. During the study, water and blood samples were taken from sturgeons. The physicochemical parameters (temperature, turbidity, pH, dissolved oxygen, nitrogenous compounds, organic substance - KMnO₄, total hardness, residual chlorine, iron, copper, phosphorus, sulphates, phenols, and detergents) were determined from the water samples with the help of the photocolorimeter "Nova 60". The results were compared with the norms in force regarding the quality of surface waters (Order 146/2006) and the reference values for sturgeons. From the blood samples, haematological parameters (haematocrit, haemoglobin, number of erythrocytes, leukocytes, and platelets) and biochemical parameters (urea - BUN, creatinine - CRE, phosphorus - PHOS, total proteins - TP, albumin - ALB, globulin - GLOB) were determined, alanine aminotransferase - ALT/GPT, aspartate transferase - AST/COT, glutamyl transpeptidase GGT, glucose - GLU, lactate dehydrogenase - LDH, and triglycerides - TRIG). The haematological parameters were determined by classical methods, and the biochemical ones with the Vetest 8008 device (dry biochemistry). The obtained results were compared with reference values for sturgeons. As a result of the research, the water quality for most of the determined parameters is adequate, except for the degree of oxygen saturation. The haematological parameters are within the reference values, and among the biochemical parameters, slightly increased values were determined for GPT, GLU, PHOS, LDH, and TRIG as a result of handling stress. Correlating the results obtained for the three categories of parameters, the final conclusion is that the sturgeons benefit from appropriate welfare reflected in a good health status of the evaluated fish.

Keywords: water, biochemical parameters, haematological parameters, sturgeon, fish farm

Calitatea mediului de viață al sturionilor, utilajele folosite în fermă, factorii de microclimat (zgomotele, iluminatul), biosecuritatea zonei unde este amplasată ferma piscicolă și calitatea personalului care lucrează în aceste unități influențează sănătatea peștilor. În cadrul studiului efectuat au fost prelevate probe de apă și sânge de la sturioni. Din probele de apă au fost determinați parametri fizico-chimici (temperatura, turbiditatea, pH-ul, oxigenul dizolvat, compușii azotați, substanța organică - KMnO₄, duritatea totală, clorul rezidual, fierul, cuprul, fosforul, sulfații, fenolii și detergenții) cu ajutorul fotocolorimetrului „Nova 60”. Rezultatele au fost comparate cu normele în vigoare privind calitatea apelor de suprafață (Ordinul 146/2006) și valorile de referință pentru sturioni. Din probele de sânge au fost determinați parametri hematologici (hematocritul, hemoglobina, numărul de eritrocite, leucocite și trombocite) și parametri biochimici (uree - BUN, creatinină - CRE, fosfor - PHOS, proteine totale - TP, albumine - ALB, globuline - GLOB, alantaminotransferaza - ALT/GPT, aspartaminotransferaza AST/COT, glutamiltranspeptidaza GGT, glucoza - GLU, lactatdehidrogenaza - LDH și trigliceridele - TRIG). Parametrii hematologici au fost determinați prin metode clasice, iar cei biochimici cu aparatul Vetest 8008 (biochimie uscată), rezultatele obținute au fost comparate cu valori de referință pentru sturioni. În urma cercetărilor calitatea apei pentru majoritatea parametrilor determinați este corespunzătoare cu excepția gradului de saturație în oxigen. Parametrii hematologici sunt în valorile de referință, iar dintre parametrii biochimici s-au determinat valori ușor crescute la GPT, GLU, PHOS, LDH și TRIG, ca urmare a stresului de manipulare. Corelând rezultatele obținute la cele trei categorii de parametri, concluzia finală este aceea că sturionii beneficiază de bunăstare corespunzătoare reflectată într-o stare de sănătate bună a peștilor evaluați.

Cuvinte cheie: apa, parametri biochimici, parametri hematologici, sturioni, piscicultura

As a result of the ever-increasing demand for caviar, the profitability of sturgeon growth is affected primarily by the quality of their living environment. Fish are in permanent intimate contact with the environment through the large surface of the gills, so water quality is the most critical aspect of their living environment (7, 9). Sturgeons are species of chondrosteian fish taxonomically classified in the Family *Acipenseridae*, Order *Acipenseriformes*, which includes

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fish species originating in the Triassic (8). Sturgeons are long-lived fish; over time they have undergone few morphological changes, tolerate different temperatures, have few predators. The recent large losses among sturgeons were due to environmental pollution, overexploitation of natural resources, and changes in hydromorphological parameters (2, 3). The breeding of sturgeons in fish farms must take into account certain requirements, such as avoiding the noises produced by different machines in the farm, adequate lighting, building the breeding tanks so that the faeces of the fish are easily removed, ensuring the optimal concentration of oxygen in the water, biosecurity of the area, protection against predators, disease prevention, etc. (4, 8). The quality of the personnel working in these fishing units is very important to be able to identify in time the deterioration of the water quality due to inadequate fish components and the deterioration of the functionality of the technical systems (3, 5).

MATERIALS AND METHODS

In a fish farm in the east of the country, water and blood samples were taken from sturgeons raised on the farm. The following physico-chemical parameters were determined from the water samples taken: temperature, dissolved oxygen, pH, nitrogen compounds (N-NO₂⁻; N-NO₃⁻; N-NH₄⁺); organic matter (KMnO₄), total hardness, iron, copper, phosphorus, sulphates, phenols, detergents, and residual chlorine. The water temperature was determined with the help of the aquatic thermometer with a float, and the other water quality parameters were determined with the help of the Nova 60 photocolorimeter, which has as its working principle the establishment of the optical density at various wavelengths depending on the monitored parameter. The results were compared with the norms in force, Ord. 161/2006 - regarding the quality of surface waters and the limits provided for the growth of sturgeons. The evaluation of the health

of the fish was done after taking blood samples by puncturing the caudal vein with a ventral point of choice. The following haematological parameters were determined from the blood samples taken: haematocrit (Hct), haemoglobin (Hb), number of erythrocytes, number of leukocytes, number of platelets. The determinations were made by classical methods. Biochemical parameters were also determined: (urea-BUN, creatinine - CRE, phosphorus - PHOS, total proteins - TP, albumin - ALB, globulin-GLOB, Alanine Aminotransferase-ALT/GPT, aspartate transferase AST/COT, glutamyl transpeptidase GGT, glucose - GLU, lactate dehydrogenase-LDH and triglycerides -TRIG). The biochemical analyses were performed using the Vetest 8008 device (dry biochemistry), and the obtained results were compared with the reference values (parameters) provided for sturgeons.

RESULTS AND DISCUSSIONS

The average results of the physico-chemical parameters of the water in the sturgeon breeding ponds are shown in Table 1.

Analysing the obtained results, a series of statistically significant elements were found. The favourable water pH for sturgeons is between 7 - 8.5 pH units, and the average value determined was 8.57. pH values between 6 - 7 and 8.5 - 9 can influence the toxicity of nitrates in the water. Extreme values of the pH of the water can irritate the brachial tissue of the sturgeons, and in order to protect themselves from the harmful effect of the pH, they produce a greater secretion of mucus that covers the body of the fish, making it difficult for them to breathe. Also, the acidic pH of the water negatively affects the feeding processes of the fish, which leads to the insufficient use of nutrients and the slowing down of their development. In the acid environment, a reduction in the mobility of the fish with surface swimming and air "piping" is observed.

Regarding the organic substance, the results ob-

Table 1

**The average values of the physico-chemical water quality parameters
for the sturgeon breeding ponds**

The determined parameter	Values obtained	Reference values
Water pH	8.57 µg	6.5 - 9 µg
The organic substance (KMnO ₄)	30.57 mg/l	5 - 60 mg/l
Total Water Hardness	17.38 °D	8 - 20 °D
Nitrites (NO ₂)	0.036 mg/l	0 - 0.2 mg/l
Nitrates (NO ₃)	3.06 mg/l	1 - 5 mg/l
NH ₃	0 mg/l	0 - 0.2 mg/l
Residual chlorine	0.003 mg/l	0 - 0.005 mg/l
Dissolved oxygen	7.64 mg/l	4 - 14 mg/l
Oxygen saturation	78.27%	80 - 95 %
Temperature	20.11 °C	19 - 24 °C
Fe (iron)	0.2 mg/l	1 mg/l
Cu (copper)	0.1 mg/l	< 0.3mg/l
phosphorus	absence	2 mg/l
Sulphates	absence	2 mg/l
Phenol	0.05 mg/l	0.2 mg/l
Detergents	0.01 mg/l	< 0.1 mg/l

Table 2

Average values of haematological parameters

The determined parameter	Values obtained	Reference values
Haematocrit (Hct)	35.4 %	26 – 46 %
Haemoglobin (Hb)	6.8 g/dl	5.7 – 8.7 g/dl
No. of erythrocytes	$0.98 \times 10^6 \mu\text{l}$	$0.65 - 1.09 \times 10^6 \mu\text{l}$
No. of leukocytes	42.16 μl	28.37 – 90.78 μl
No. of platelets	60.15/ μl	32.10 – 122.1/ μl

tained are the reference values. Amounts of organic substances below 5 or above 60 mg KMnO₄/l water can directly lead to the appearance of sturgeon respiratory problems, the development of bacteria as a subsequent source of infections, asphyxiation of eggs in incubators, and as indirect effects the reduction of light, the decrease in the amount of oxygen from water, and the decrease in productions.

The average value of total water hardness (17.38 °D) falls within the reference limits (8 - 20 °D). Total hardness values below 8.0 °D and above 20 °D of the water can lead to whitening of the eggs and deformations of the protein sac and can indicate the presence of some toxic metals in the water. The average value of nitrites in water was 0.036 mg/L, a value that falls within the reference limits (0 - 0.2 mg/L). The higher values of nitrites in the water slow down the growth rate of sturgeons. Nitrates determined from the water samples recorded an average value of 3.06 mg/L, a value that falls within the reference limits of 1-5 mg/L, and ammonia was absent in all water samples.

Analysing the values obtained, the content of free chlorine in the water is found to be within the reference limits allowed for sturgeons. A long-term exposure of sturgeons to concentrations higher than 0.04-0.2 mg/L of active chlorine can cause agitation, spasmodic movements of the fins, suffocation, congestion, and haemorrhages in the gills. The average value of dissolved oxygen in the water was 7.64 mg/l, a value that falls within the reference limits for sturgeons (4-

14 mg dissolved oxygen/L of water), and the degree of oxygen saturation was 78.27% close to the minimum limit of 80% of the reference values. The lack of oxygen in the water represents an important stress factor for sturgeons, which leads to a decrease in the performance of the fish, and the degree of saturation in oxygen below 80% can lead to changes in the colour of the gills and their "fringing". The water temperature for growing sturgeons must have values between 19 - 24°C. The average value of the water temperature, according to the data in table no. 1, was 20.11 °C, which shows us that it was within the reference limits allowed for sturgeons. The water temperature above 24 °C influences the increase in the metabolic rate and the fertility of the fish. Sudden temperature fluctuations of the water in the sturgeon breeding pools influence their ability to adapt to quite serious changes in their health status (5, 11).

Table 2 shows the mean values of the haematological parameters. The average values of iron, copper, phosphorus, sulphates, phenols (polyphenols), and detergents are within the limits provided for the growth of sturgeons. The determined values fall within the optimal parameters and thanks to the existing filtration systems at the level of the growth basins.

Analysing the values obtained, it is found that all the indicators are within the reference limits for sturgeons. The average results of blood biochemical parameters (urea - BUN, creatinine - CRE, phosphorus - PHOS, total proteins - TP, albumins - ALB, globulins - GLOB, ala-

Table 3

Average values of blood biochemical parameters

#	The determined parameter	Um	Average value determined	Reference values
1	BUN	mg/dl	3.15	3.740
2	CRE	mg/dl	-	0.342
3	PHOS	mg/dl	11.83 ↑	10.69
4	ALB	g/dl	1.21	1.26
5	TP	g/dl	4.83	5.00
6	GLOB	g/dl	3.62	4.07
7	GPT	U/L	106.63 ↑	100.65
8	GOT	U/L	243.33	265.16
9	GGT	U/L	-	0.02
10	GLU	mg/dl	132.00 ↑	91.08
11	LDH	U/L	2124.66 ↑	2007.15
12	TRIG	mg/dl	726.00 ↑	6,99 – 9,66

nine aminotransferase - GPT, gamma-glutamyl transferase - GOT, lactate dehydrogenase - LDH, glucose - GLU, triglycerides - TRIG, are shown in Table no. 3.

Analysing the obtained results, it is found that for most of the determined parameters, the values are within the reference limits for sturgeons, with the exception of: PHOS, GPT, GLU and TRIG. Thus, urea (BUN) is included in the reference values for *Acipenserides*. Changes in this parameter appear in renal or brachial disorders of fish. The increase in blood urea reflects an increased concentration of carbon dioxide and ammonia in the water. Creatinine did not register values, being below the sensitivity limit of the kits. Phosphorus (PHOS) is an important mineral element that recorded average values above the reference value by 1.11 times. Changes in this parameter occur in sturgeon kidney disorders. Total proteins (TP) recorded values that fall within the reference values. Total proteins were determined to investigate the degree of hydration and hepato-renal function of fish. The role of these proteins is to intervene in maintaining the osmotic pressure of the blood and in the transport of vitamins, hormones, and minerals. Plasma proteins decrease in correlation with changes in water pH, intensification of catabolism, and periods of fish starvation, as a result of haemorrhages or the presence of infectious agents (5). Albumin (ALB) represents the largest part of total serum proteins and is synthesised by the liver. The average values determined are normal according to the reference values. Changes in this parameter appear in anaemias as well as in liver or kidney diseases.

Serum globulins (GLOB) recorded average values of 3.62 g/dl, which are within the reference limits. A decrease in this parameter shows a deficient immune system of sturgeons as a result of chronic infections (3, 4, 11). GPT (alanine aminotransferase) recorded slightly increased values compared to the reference values as a result of the intense muscular effort of the sturgeons at the time of their capture, but also due to the increase in ammonia concentration, the alkaline pH, or the decrease in the oxygen concentration in the water (1, 3). Blood glucose (GLU) exceeded the reference value by approximately 1.5 times, this increase may be due to the stress of sturgeon handling and as a result of the demands of the fish's living environment (12). Lactate dehydrogenase (LDH) as an average determined value exceeded the reference value by 1.06 times. The increase in LDH reflects possible liver, heart, or muscle damage. Triglycerides (TRIG), according to the values in Table 3, exceeded the reference limits by 1.06 times, exceedances that can be due as in the case of the other parameters of handling stress.

CONCLUSIONS

The average water pH value of 8.57 pH units ensures an alkaline living environment for sturgeons. The physicochemical parameters of the water (nitrites, nitrates, total hardness, ammonia, free chlorine, temperature, dissolved oxygen, and organic substances) are included in the reference values for the sturgeon. The degree of

oxygen saturation of the water had an average value of 78.6%, a value located below the lower limit allowed. The average values of the haematological parameters (haematocrit, haemoglobin, no. of erythrocytes, no. of platelets, and no. of leukocytes) were included in the reference values. Most of the biochemical parameters (urea, phosphorus, total proteins, albumins, globulins, and GOT) are within the reference values for sturgeons: slightly increased values were recorded for GPT, blood glucose, PHOS, LDH, and TRIG as a result of handling stress. Correlating the results regarding the water quality with the haematological and biochemical parameters of the evaluated sturgeons, an average well-being of the fish can be found in the fish farm studied.

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