THE INFLUENCE OF THE DISEASE STATE ON THE MAINTENANCE STATUS FOR RAINBOW TROUT

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Abstract

The salmonids represent a valuable food source for humans, thanks to a high nutritional value and digestibility. In recent times, the authorities are preoccupied with insuring the health and well-being of the consumers, by obtaining high quality, healthy and safe aquaculture products. The aim of this paper is health status monitoring for rainbow trout (Oncorhynchus mykiss), during the disease caused by Yersinia rukeri, quantified through the biochemical composition of the meat. Yersiniosis is a illness that leads to significant economical losses in aquaculture industry. The biological material – rainbow trout Oncorhynchus mykiss – was monitored monthly for 7 months. The biochemical analysis of trout meat was realized at the moment of identification of pathogenic bacterium Yersinia rukeri through microbiological methods, after 15 days following a 10 day treatment with antibiotics. The experiment demonstrated that the disease state compromises growth performance and nutritional value of the infected biological material. However, the results indicated that after a 15 day period following the treatment, the maintenance status of rainbow trout will get better, without recovering the weight loss determined by the disease.

Key words: rainbow trout, yersiniosis

INTRODUCTION

In Romania, there are adequate conditions for salmonids growth and development, the second important branch of pisciculture.

Salmonids represent a very valuable food source for humans, thanks to it's high content of proteins, high biological value and high digestibility.

In recent times, the authorities are preoccupied with insuring the health and well-being of the consumers, by obtaining high quality, healthy and safe aquaculture products.

The monitored species was rainbow trout (*Oncorhynchus mykiss*), a freshwater predatory fish, belonging to the *Salmonidae* famiy, reared in the trout farm situated in NE Romania, in Bistriţa drainage basin, supplied with water from this basin.

Fish brood necessary for basin population was purchased from trout farms equipped with incubation station. The fingerlings were reared in earthen basins with concrete margins. Feeding diets had a protein content between 45% and 65% and a lipid content between 12% and 15%, depending on the trout weight.

The purpose of this paper is the monitoring of rainbow trout (*Oncorhynchus mykiss*) condition status, quantified by meat biochemical composition, in the case of a disease caused by *Yersinia rukeri* bacterium, which has a devastating effect economically and concerning the animal welfare [1].

MATERIAL AND METHOD

The biological material – rainbow trout *Oncorhyncus mykiss* – was monitored monthly for a 7 moths period (April – October 2018). Water samples were collected every month.

Water sample analysis was conducted according to work protocols indicated in standard analysis methods for surface waters [2].

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pH determination was conducted according to SR ISO 10523:1997 standards, with a lab pH Meter - INO Lab pH 720 – with temperature probe.

Chemical Oxygen Demand was determined according to SR ISO 6060:1996.

Nitrogen and phosphorus compounds were determined according to standard methods for analysing water and residual waters /2005, using a DR 2800 spectrophotometer, equipped with the water quality kit HACH-LANGE.

To determine the rest of parameters that are used for establishing the water quality from a chemical point of view, the work protocols indicated in the current standard analysis methods for surface waters and the methods from specialized literature were respected.

Data interpretation was conducted according to Normative provisions regarding the classification of surface water quality in order to establish the ecological status of water bodies (Ord. MMGA no. 161/2006)[3] correlated with specialized literature data for waters used in fish farms.

Biochemical analysis of fish meat was conducted at the start of the disease, on healthy and sick specimens, after a 10 days treatment with antibiotic and after 14 and 21 days from the completion of the treatment.

Meat samples analysis was performed using the procedures indicated by standard analysis methods for fish meat.

The moisture was determined by Standard Official Methods of the AOAC (1990).

The total ash was determined by Furnace Incineration described by AOAC (1990).

The crude proteins content of the samples was determined using the Kjeldahl method of AOAC 17th edition, 2000, Official Method 928.08 Nitrogen in Meat (Alternative II), which involved protein digestion and distillation, where F (conversion factor), is equivalent to 6.25.

The total fats were determined using the Soxhlet method, equipped with Gerhardt Brand Multistate Controller, with modified ether extraction methods AOAC 960.39.

Statistical analysis

All analyses were carried out in triplicate. Statistical analysis was carried out using Microsoft Excel. The average values are compared with the standard deviations. The statistical interpretation of the considered data shows a variation within the allowable threshold of $P<0.05$.

RESULTS AND DISCUSSIONS

Physicochemical analysis of water

One of the determining factors for salmonids growth is the presence of an adequate quality and quantity of water. The physicochemical water proprieties have a significant influence on the fish growth parameters, fish health and fish meat quality, in the frame of food security.

The analysis of water physicochemical parameters, monitored monthly, reveal favourable values for comfortable trout growth during the entire experiment (table 1).

The water had a minimum concentration of 7.75 mg/l oxygen and a neutral pH during the entire experiment.

The nitrogen compounds had values between the accepted limits, according to Ord. no. 121/2006 regarding surface water classification and according to Bud. I., 2007 [4]. The fodder was dosed correctly, the metabolism was almost complete, without expelling residue or toxins in water.

The supply of trout basins with water provided a complete replacement of water several times a day, water temperature reaching a minimum of 7.11^0C and a maximum of 13.35^0C.

Monitoring water quality is important because it allows trout farmers to take immediate decisions regarding corrective actions.

Table 1 Values of the water physicochemical parameters in the water source and in the monitored trout rearing basin

Analysed parameters	U.M.	Water source Average±SD*	Rearing basin water Average±SD*	Values of the physicochemical parameters of water for salmonids (Bud. I., 2007)	
				Average	Limits
Temperature	^{0}C	9.36±2.25	10.2±3.15	10	4 – 20
Dissolved oxygen	mg/l	9.45±1.55	9.55±2.35	11	3 – 20
Ph	uPh	7.24±1.40	7.6±1.85	7.5	7 – 8
Total hardness	dGH	9.7±1.90	9.8±1.60	10	8 – 16
Nitrites, (N-NO_2)	mg/l	0.03±0.002	0.045±0,002	< 1	-
Nitrates, (N-NO_3)	mg/l	0.11±0.015	0,18±0.03	<0.5	-
Ammonia	mg/l	0.005±0.005	0.012±0.005	<0.5	-
Alkalinity	ml	1.95±0.5	2.2±0.4	-	-
Bicarbonates (HCO_3^-)	mg/l	122.2±15.0	144.3±18,1	-	-
Carbonates (CO_3^{2-})	mg/l	0	0	-	-
Calcium (Ca^{2+})	mg/l	24.6±2.62	20.50±2.25	-	-
Magnesium (Mg^{2+})	mg/l	0.50±1.4	0.73±2.21	0.8	0.6 – 1.0
Ca^{2+}/Mg^{2+}		9.84±2.01	4.33±2.23	-	-
Phosphate (PO_4^{3+})	mg/l	0.14±0.001	0.17±0.001	< 0.2	-
Chloride (Cl^-)	mg/l	0.53±0.02	0.82±0.035	<5.0	-

** Standard deviation*

Analysis of the biologic material involved in the experiment

Yersiniosis, the disease known as „salmonid's enteric red mouth", is a septicemic bacteriosis, specific to salmonids. Rainbow trout (*Oncorhynchus mykiss Walbaum, 1792*) is a species susceptible to infection [5]. The disease first appeared in May. Fist symptoms were the separation of sick fish from the school and lethargy with the following clinical manifestation: swelling of the abdomen (stomach and intestines filled with gas and liquid), darkening of the tegument, modifications of the eye blood flow, gills, intestinal and peritoneal haemorrhage, oral cavity with hemorrhagic appearance.

The fish with signs of disease were isolated in a quarantine basin. Following the identification of the pathogen bacterium *Y. ruckeri* through a bacteriological exam, the treatment was determined according to the antibiogram with the drug ENRODEM 50 (active component: enrofloxacin) for 10 days, administered in food.

The anatomoponderal and biochemical analysis of trout meat was performed on the healthy specimens and on those that were in the acute stage of disease, after 10 days of antibiotic treatment and after 14 and 21 days from the completion of the treatment.

Anatomoponderal analysis of biological material involved in the experiment

Rainbow trout (*Oncorhynchus mykiss)* from trout farms presents superior technological proprieties compared to other species [6].

The indices regarding meat percentage from healthy specimens, sick specimens, after 10 days of antibiotic treatment and at the completion of the treatment, are presented in table 2.

Table 2 Anatomoponderal parameters evolution for rainbow trout (*Oncorhynchus mykiss*) infected with *Yersinia* before and after treatment

Weight, g ***Average±SD****	***Head (g%)*** ***Average±SD****	***Torso (g%)*** ***Average±SD****	***Meat (g%)*** ***Average±SD****	***Scales (g%)*** ***Average±SD****	***Fins (g%)*** ***Average±SD****	***Skin (g%)*** ***Average±SD****	***Bones (g%)*** ***Average±SD****	***Organs (g%)*** ***Average±SD****
T_1HF - Healthy Fish (3 samples)								
122.4±3.57	14.13±0.25	62.45±2.10	56.63±0.16	1.44±0.16	1.23±0.03	9.74±0.15	4.88±0.07	11.95±0.12
T_1SF - Sick Fish (20 samples)								
138.81±4.15	19.97±0.56	61.12±1.75	46.29±1.12	0.76±0.15	1.51±0.02	7.11±0.35	7.72±0.075	16.64±0.15
T_2 SF - after 10 days of treatment (3 samples)								
120.70±3.40	21.33±1.02	61.71±1.65	49.11±2.01	1.08±0.09	1.39±0.20	8.42±0.45	4.18±0.24	14.49±1.22
T_3SF - 7 days after the completion of the treatment (3 samples)								
141.10±3.25	19.42±0.90	60.24±1.50	49.47±1.85	1.06±0.10	1.20±0.05	6.95±0.75	3.83±0.33	18.07±1.55
T_4SF - 14 days after the completion of the treatment (3 samples)								
158.00±3.22	16.44±1.15	65.15±1.45	51.93±1.55	1.15±0.075	1.34±0.08	7.79±0.54	5.05±0.25	16.30±2.15
T_5SF - 21 days after the completion of the treatment (3 samples)								
137.70±4.31	14.52±0.25	63.54±1.35	52.29±1.35	1.16±0.2	1.60±0.075	5.81±0.37	5.45±0.15	19.17±1.95
T_5HF - Healthy Fish (3 samples)								
174.10±5.80	14.2±0.45	70.71±0.96	60.35±0,55	1.55±0.3	1.6±0.22	8.1±1.66	4.18±0.30	10.02±1.64

** Standard deviation*

Meat percentage registered a minimum of 46.29±1.12 g% in the acute stage of disease, with 10.34 g% less than fish with no symptom of disease. Biomass accumulation stagnated for 17 days since the start of the disease, which also included the treatment period. After three weeks the completion of treatment, the biological material from quarantine presented a 2.5 g% higher meat percentage, without recuperating the 8,06 g% difference created between sick specimens and healthy ones.

The values of meat indices for trout with no symptoms (56.63±0.16 g% - 60.35±0.55 g%) confirm that these fish have an adequate body development, are healthy and have a high meat percentage in accordance with the results obtained by Souza et al., 2015 [7] and Skałecki P. et al., 2013 [8].

The biochemical composition of biological material involved in the experiment

The biochemical analysis results for rainbow trout meat can be found in table 3.

The biochemical composition modifications were analysed in relation to the acute stage of disease, at the completion of treatment and post treatment.

Table 3 The biochemical composition and caloric value of rainbow trout meat

Weight, g ***Average±SD****	**Moisture, g %** ***Average±SD****	**Ash, g %** ***Average±SD****	**Protein, g %** ***Average±SD****	**Fats, g %** ***Average±SD****	***M/P***	**Energy value** kcal/100g
T_1HF - Healthy Fish (3 samples)						
122.4±3.57	77.20±2.15	1.25±0.35	17.25±0.85	4.30±0.55	4.48	110.72
T_1SF- Sick Fish (20 samples)						
138.81±4.15	79.69±1.99	1.47±0.40	15.38±0.15	3.46±0.15	5.18	95.24
T_2SF - after 10 days of treatment (3 samples)						
120.70±3.40	77.96±1.85	1.50±0.20	14.78±0.65	3.76±0.32	5.25	95.57
T_3SF - 7 days after the completion of the treatment (3 samples)						
141.10±3.25	80.05±2.11	1.50±0.33	14.85±0.75	3.60±0.12	5.39	94.37
T_4SF - 14 days after the completion of the treatment (3 samples)						
158.00±3.22	80.18±2.54	1.61±0.40	15.14±1.15	3.07±0.60	5.30	90.63
T_5SF - 21 days after the completion of the treatment (3 samples)						
137.70±4.31	79.36±2.63	1.79±0.65	15.26±0.11	3.59±0.22	5.20	95.95
T_5HF - Healthy Fish (3 samples)						
174.10±5.80	76.65±1.95	1.25±0.55	17.85±1.11	4.30±0.20	4.29	113.18

** Standard deviation*

***Calories conversion factors used; for proteins 4.1 kcal/g; for lipids 9.3 kcal/g*

The results for the samples harvested at the T1 moment from healthy specimens and those with first signs of disease, shows differences in protein content between healthy and sick specimens, because until the first clinical signs of disease the body was vulnerable, determining a decrease of meat nutritional value. The biochemical composition for healthy trout in similar to that obtained by R. Koshinsk et al., 2018 [9], but lower that the values for sick trout.

During the treatment and one week after treatment completion, the protein values (at T1-15.38±0.15 g% and at T2 -14.78±0.65 g%) and lipid values (at T1-3.46±0.15 g% and at T2-3.76±0.32 g%) remain decreased. Protein concentration is 1.46 g% lower and lipid concentration is 3.17 g% lower compared to the values obtained by Ihuț A. et al., 2018 [10] for rainbow trout.

After 21 days from treatment completion, the energy value for trout meat (95,95 kcal/100g) was higher because of protein and lipid accumulation, but was lower than the energy value for the specimens with no signs of disease (113.18 kcal/100g) that did not received antibiotic treatment.

Biochemical composition for trout meat after 21 days from treatment completion is similar to the biochemical composition obtained by Crețu M. et al., 2014 [11], in low density conditions.

CONCLUSIONS

- Rainbow trout *(Oncorhynchus mykiss)* infected with *Yersinia ruckeri* bacterium and treated with a drug premix, regained it's technological value and can be commercialised after at least 3 weeks after the completion of the treatment.
- Biochemical analysis of trout meat highlighted the significant negative impact on protein and lipid content, mentioning that the nutritional value of infected and treated trout is 17,23 kcal/100g lower compared to the healthy trout.
- Awareness and compliance with retention time for administered drugs and are required for the restoration of farmed trout meat quality.
- Prophylactic measures and a strict management of the technological flow in salmonids culture are necessary in order to reduce the risks, diminish losses and ensuring the animals health and welfare, food safety and security.

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