Diseases of Common Carp Fry in Recirculating Aquaculture Systems (RAS) as an Effect of Direct Transfer from Open Aquaculture Systems

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Abstract

In this case study, the high densities of fish in the rearing facility make an easy transfer and multiplication of specific pathogens. The limited space in which the fish are forced to live is itself a factor that overstates adaption mechanisms and can lead to the weakening of resistance to diseases.

The authors presents the main parasitosis of cyprinids registered during the first period in closed recirculating aquaculture system after the transfer from open aquaculture system. These are represented by: spring viraemia of carp, ligulosis, lernaeosis, bothriocephalosis, saprolegniosis during the experimentation period of six weeks in a closed system.

Results of this study shows the relationship between environmental factors and parasitosis development and the characteristics of the diseases registered in urban Recirculating Aquaculture Systems from epidemiology, pathology, etiology and diagnostics points of view.

In conclusion, biosecurity measures must be applied in any kind of aquaculture activity and fish health must be monitored continuously so any treatments to be appropriate and applied as efficiently as possible.

Keywords: biosecurity principles, common carp (*Cyprinus carpio* L.), fish diseases, Recirculating Aquaculture Systems

1. Introduction

As the worldwide rapid development of science and technology as well as the positive attempts in fish and other aquatic animals, aquaculture industry is showing the tendency to flourish [1].

Cyprinids are the major group of freshwater fish that have a global significance as a source of food, for sport, for their ornamental appeal, and as experimental models for research [2].

Fish are susceptible to the different types of pathogens, including viruses, bacteria, fungi, and parasites, as well as various non-infectious agents [3].

Many diseases are transmitted via water, and important pathogens are often endemic in fish populations that inhabit the water source [3].

Many (if not most) of the diseases that are among the most serious problems in cultured fish are caused by exotic pathogens; that is, they were inadvertently introduced into a region via infected fish from another geographic area. At the same time, worldwide demand for high-quality aquaculture products makes disease control increasingly important. Thus, an effective biosecurity program is vital to maintaining healthy animals and to reducing the risk of acquiring disease in a facility.

Biosecurity refers to the implementation of methods to prevent (or manage if already present) the transmission of infectious diseases in a culture operation. Effective biosecurity can also exclude

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or reduce the spread of pathogens that might be endemic to a farm's geographic region but have not yet contaminated that particular farm [3]. Biosecurity is also important in preventing the escape of pathogens from a farm, if it is contaminated with a certain pathogen, so that it does not affect wild populations or adjacent farms.
In aquaculture, maintainig the health of a fish stock is essential in achieving profitable and high–quality production. Fish health is not only achieved through disease management. This include all aspects of a productio farm that have an impact on fish health such as water quality management, sanitation and quarantine, all of which are part of the Integrated Fish Health Management Program.
In the present paper the focus is on some selected samples from major groups, including a description of the some important associated diseases in farmed fish and suggestions for prevention and cure applied.

2. Materials and methods

Experimental design. The experimental activity was carried out at the Experimental Recirculating System of the Department of Aquaculture, facility of University "Dunărea de Jos" of Galați, Romania, during 6 weeks.
The Experimental Recirculating System is composed of twelve rearing units (water volume 0,132 m^3 each), mechanical filter, biological filter, UV lamp for water sterilization and disinfection, 3 pumps, described in the thesis of Mirela Mocanu (Crețu) [4].
In this experiment, was used 3500 fry carp with almost similar body weight and size (mean weight 1.5 g and mean size 4 cm). Fish was obtained from the last natural carp reproduction in the Open Growth System in August 2018.
The fish were accommodated during two weeks, using a feeding (diet 1) with a protein content of 65% and the following ingredients: squid meal, fish meal, krill meal, micro-algae, soy lecithin, fish gelatin, hydrogenated vegetable fat. In the next four weeks, the fish were fed with diet 2 containing 50% protein and the following ingredients: fish meal, poultry meal, corn gluten, wheat gluten, wheat flour, animal fat, fodder, hemoglobin, vitamins, and minerals.
The fish were hand feed, in three meals per day (09:00 h, 14:00 h, and 18:00 h) in split–ration at 5% body weight (BW). The nutrient contents of the experimental diets are presented in Table 1.

Table 1. Proximate composition of experimental diets

Ingredients	U.M	Diet 1	Diet 2
Moisture	%	8	-
Crude protein	%	65	50
Crude lipids	%	13	14
Ash	%	10	
Raw cellulose	%	2	2
Lysine		-	2,5
Phosphorus	%	15	1
Copper	mg/kg	-	6
Calcium	%	12	-
Sodium	%	13	-
Vitamin A	IU/kg	14 250	20 000
Vitamin D3	IU/kg	1 900	2 000
Vitamin E	mg/kg	-	200
Vitamin C	mg/kg	-	200

The water temperatures, dissolved oxygen, and pH were recorded once a week, with the sensors from the system. The nitrogen compounds ($N\text{-}NO_2^-$, $N\text{-}NO_3^-$, $N\text{-}NH_4^+$) were monitored using Spectroquant Nova400 type spectrophotometer, compatible with Merk kits. The water sample for analysis was collected early in the morning before the feeding was done.

3. Results and discussion

Water quality. All the water parameters (Mean±SD) fall within the appropriate limits for the rearing of common carp (water temperature–24.06±0.91°C, dissolved oxygen–8.15±0.15 mg L^{-1}, pH–7.77±0.76 pH units, nitrites–0.33±0.36 mg

L^{-1}, nitrates 16.00±4.51 mg L^{-1} and ammonia 0.16±0.07 mg L^{-1}).

Diseases Caused by Crustaceans

At stoking stage, the presence of the Lernaea (Figure 1) parasite was detected. The fish had crustaceans on the surface of the body. In the literature, it is highlighted that the presence of parasitosis leads to a reduction in growth rate, weight loss and mortality in affected populations.

Figure 1. *Lernaea cyprinacea* (L., 1758) infection on fry carp (original)

Infection by *Lernaea spp.* (Figure 1) is one of the most common and often harmful parasitic diseases of fish in warm water habitats, both in farms and in the wild, in Asia, Africa, and America. Economic losses result not only from disfigurement that renders the grown food and ornamental fish unsuitable for market [5].

Diagnosis and treatment

In the opinion of specialists, it is possible to bathe the fish for 1.5-2 hours in potassium permanganate solution, 1 to 50000, at 15-20°C water temperature and 1 in 100000 at a water temperature of 21-30°C.

At that time, the treatment was performed for one hour outside the growth systems using a formalin malachite green solution (0.25 ml/l water) at a water temperature of 25°C. In the literature, for the combined green malachite bath and formaldehyde, the water must contain 0.25 ml malachite green and 0.125 ml formaldehyde solution/l bath for 2 hours with additional aeration. The effectiveness of applied treatment was reported by a low mortality rate. Despite the increased number of parasitic fish, they survived at a rate of 90 percent.

Diseases Caused by Platyhelminthes

During these weeks, some fish were affected by ligulosis and bothriocephalosis. By the accumulation of a large number of parasites in the fish intestine, they are hypo dynamic, swim at the surface of the water, do not feed, lose weight, and have a much larger abdomen.

In the experimental trail the prognosis in cestodoza is low. The ligulosis was sensitive higher intensity than bothriocephalosis (2.4% vs. 1.7% of the fish stock). The pathogen agents was pleuroceroses of the *Ligula* genus, most notably *Ligula intestinalis* (L., 1758), (Figures 3a and 3b) which have been found in the cavity of the body, among the viscera.

Figure 2. *Bothriocephalus acheilognathi* infection on fry carp (original)

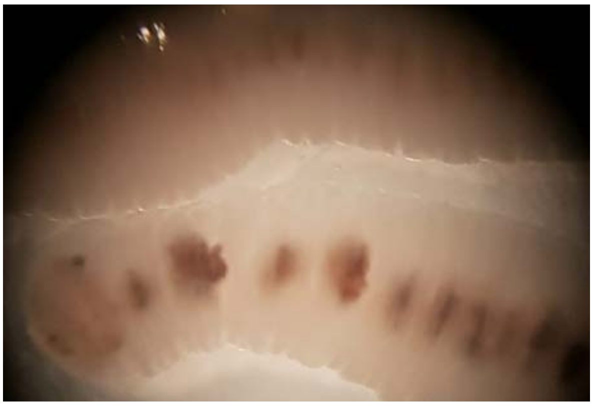

Figure 3a . Ligula intestinalis (L., 1758) infection on fry carp (original)

Figure 3b . Ligula intestinalis (L., 1758) infection on fry carp (original)

Prophylaxis and treatment

Heavy infections with *Cestoda* (Figures 2 and 3) can result in mass mortalities of carp [6].

Praziquantel is effective in treating adult cestode infections. There are no published studies of metacestode treatment [3].

The rearing units were washed weekly and 80% water was replaced to remove parasitic eggs from the bottom of the ponds.

At the same time, the fish was bathed weekly in potassium permanganate solution for 1 minute (1 gram of potassium permanganate per 1 liter of water) at a water temperature of 25˚C.

Fungal Diseases

Over time, 2.7% of the fish stock was affected by saprolegniosis.

Warm water fish hatcheries are particularly susceptible to water mold disease, and of importance for carp are members of the family Saprolegniaceae, especially the genus *Saprolegnia*. Dead or unfertilized fish eggs are very quickly infected by fungi, and left to proliferate, these quickly threaten healthy eggs and fry. The resulting economic losses in intensive aquaculture can be severe [7]. Typical signs of a *Saprolegnia* (Figure 4) infection (saprolegniasis) are cotton-wool-like white colonies of the fungus on the integument of the fish.

First time, to prevent multiplication, the fish affected by saprolegniosis were isolated from the growth units.

Figure 4. *Saprolegnia* infection on fry carp (original)

Treatment

The rearing units were washed and 50% water was replaced daily to improve water quality.

At the same time, the fish was bathed weekly in potassium permanganate solution for 1 minute (1 gram of potassium permanganate per 1 liter of water). Specialists recommend treating light lesions with 0,01gram of potassium permanganate in 1 liter of water for 30 minutes. As a result of the chosen treatment, saprolegniosis was eliminated and the fish did not show other characteristic symptoms.

Viral Diseases

Before the end of the experiment, was observed the presence of necrotic inflammation of the intestine at 2.8% of the fish population.

Symptoms characteristic of the acute form of the disease were manifested by group self-isolation of affected fish, lazy swimming, slow breathing at the surface of the water, and bloating of the abdomen due to fluid accumulation in the body cavity (ascites) (Figure 5).

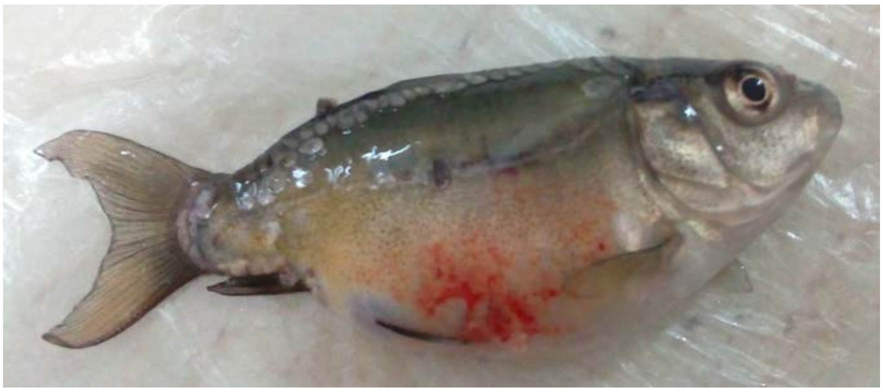

Figure 5. Spring Viraemia of Carp (SVC) infection on fry carp (original)

Of special importance among carp viruses are *Rhabdovirus carpio* (Fijan 1972), the agent of Spring Viraemia of Carp (SVC) [8], and certain fish herpesviruses, which result in significant economic losses in aquaculture and increasingly also in wild fish [9.]

Prophylaxis and treatment

Disinfection and quarantine are the only proven means of controlling SVC epidemics. Successful treatment of infected fish has not been demonstrated [10].

Immediate identification of the disease along with the control of fish populations, with proper application of disinfection measures, as well as the collection and destruction of dead bodies have led to a reduction in the spread of the disease.

To reduce outbreaks of infection, throughout the disease, the fish was bathed weekly in potassium permanganate solution for 1 minute (1 gram of potassium permanganate per 1 liter of water). Raising fish at a water temperature of 19–20°C, minimizing stress and overcrowding, and sanitary disposal of dead fish are also recommended.

4. Conclusions

In conclusion, disease prevention, by providing good water conditions and adequate quarantine procedures, is the best methods of health management for both wild and captive fish.

To prevent the occurrence of diseases in fish rearing facilities, measures are recommended to optimize fish living conditions, such as: improving water quality, reducing population density, feeding properly, and fishing of dead specimens.

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