Lucrări ştiinţifice **Zootehnie şi Biotehnologii**, vol. **41 (2)** (**2008**), Timişoara

RESEARCHES REGARDING THE TECHNOLOGICAL PERFORMANCES OF CARP REARING DURING WINTER PERIOD IN THE CONDITIONS OF A RECIRCULATING AQUACULTURE SYSTEM

CERCETĂRI PRIVIND PERFORMANȚELE TEHNOLOGICE ALE IERNĂRII CRAPULUI (*CYPRINUS CARPIO*) ÎN CONDIȚIILE UNUI SISTEM RECIRCULANT

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The techniques of carp culture are highly diversified, ranging from the extensive production in pond or open water with no fertilization or supplemental feeding to highly intensive systems in concrete tanks or cages. Among the different carp species, common carp is the best species reared in intensive monoculture, the others (Chinese and Indian carps) being usually cultivated in polyculture (P. Kestemont, 1995). An experiment was conducted in inside recirculation system conditions to identify the technological performances on carp growth and survival at the Fishing and Aquaculture Department, Galati, during winter period (February, 2007 – March, 2007). The 1-year-old carp (Cyprinus carpio) 4792g; 4594 g; 4561 g and 4525 g (total weight) grew to 7384g; 7017g; 6924g and 7125 g in 44 days in aquarium 1, 2, 3 and 4, respectively. In all aquariums, the fish appeared healthy and no mortality was observed. Feed conversion efficiencies (FCE) had similar values among all aquariums, the highest FCE being found in B4 aquarium with 1, 57 value. Water quality parameters were acceptable range for fish culture. Results show that the carp rearing during winter period in the inside recirculation system is a very good economic solution.

Key words: recirculation system, common carp, rearing, temperature

Introduction

Without doubt the carps are the most largely cultivated species throughout the world. The notoriety of these species in aquaculture, due to the combination of several factors such as feeding habits at a low level of the food chain, high survival and growth performances under culture conditions, and tolerance to high variations in water quality and diseases, has led to the development of numerous production systems in both temperature and tropical regions. Water temperature is the most important factors for fish growth were observed by Brett and Groves (1979) and Corey et al. (1983) investigated growth rate increases with increasing water

temperature, but when the temperature becomes super optimal, it has a negative instead of a stimulatory influence (G. Tiwari et all, 2006). During winter period, in our country the water temperature drops below -3^{o}C and also in Galati it descends down to -5 ^{o} C.Halver (1972) and Jhingran (1985) noticed in low temperature regions, the metabolic activity of fish is greatly reduced, which affects the growth of fish. Since the water temperature in Galati drops below the desirable range during the months of October – March and in the remaining 6 months summer season does not suffice to allow economic yield. Thus, in the temperate climate, extension of the growth period is recommended to enhance the fish production to be economically feasible.

Aquaculture practice in recirculation system is still in experimental stage in Romania due to lack of suitable design and not available easily. In addition, higher investments are required. The aim of this study was to access the effects of water temperature on growth and survivability of common carp in recirculation system condition in winter months.

Materials and Methods

1. Experimental Set –up / Design

A recirculating system experiment was carried out from February, 01, 2007 to March, 16, 2007. From a constructive point of view the recirculating system is compiled from:

a) Rearing modules unit;
b) Water conditioning units, formed by:
- Mechanical filtration unit;
- Biological filtration unit;
- Water sterilization unit;
- Oxygenation unit;
c) Water distribution unit.

a) Rearing modules unit – is represented by 4 rectangle aquariums made from glass with 10 mm width, sticked with waterproof silicon (BISON); each aquarium has the following dimensions lenght-100cm, width - 80cm and height - 40cm, which makes possible a total volume of 300 litters / aquarium, the total volume of the system is 1,2 m^3 . The number of the rearing units assures a right flexibility regarding biotechnological indicators as well as the possibility of accomplishing the needed experimental variants in order to have conclusive results of technological approach.

b) Water conditioning unit has the mission to control and maintain in optimal range the main water quality parameters as: oxygen concentration, ammonia nitrogen concentration, total suspended solids concentration, pH and carbon dioxide. Thus, for the TSS (total suspended solids) and settable solids control the recirculating system has been provided with a submerged sand filter. The mechanical filter has a foot plate with tronconic items of hard plastic material

where a number of long gaps are realized; through those gaps the filtrated water is passing without involving the filtration material represented by the quartz sand. For the biological filtration have been used a trickling filter. The main concept of the ,,trickling" filter is represented by its function which is the nitrification process achievable through a large surface area where the nitrifiers grows to form a bacterial film over which the water is flowing in sprinklings in order to make possible the ammonia oxidation. We have chosen a material with large specific surface (300 m^2 / m^3) with a spherical form called bactoballs. The sterilization and disinfection process is realized with a UV installation mounted on the principal supply flow of the rearing units. The technical characteristics of the UV lamp, TERA POND, Type UV-C 35000 is the power -36Watt, that assures the right amount of gamma radiation with optimal length wave for the technological flow. For oxygen concentration supply dictated by the stocking intensification degree, the recirculation system was provided also with an oxygenation unit formed by one compressor RESUN AIR-PUMP, Model: ACO-018A with a flow of 260l/min.

c) Water distribution installation consist in three pumps, GRUNDFOS, type UPBASIC 25-6 180, max.10bar, which assures the technological flow necessary for each rearing unit. The inflow for the aquariums: 4×12=48 l/min

2. Instruments

The main parameters (temperature, dissolved oxygen, and pH) from the recirculating system were determinate with oxy-meter - Oxi315i and pH-meter type pH -315i, for nitrogen compounds measurements have been used the photometer PCMULTIDIRECT. An electronic weighing m/c (3 kg) with least count of 1 g was used to measure the weight of fish.

3. Biological Experiment

The 44 days growth trial was carried out in recirculation system to evaluate growth performance and survivability during winter month. The same quantity of water was filled in four aquariums. Common carp (*Cyprinus carpio*) were obtained from ICDEEAPA Galati. After 7 days of acclimatization, the fish were weighed following one day of food deprivation with an initial total weight of 18. 472 kg were transferred to the rearing aquariums 1, 2, 3 and 4. The total initial weight per aquariums was: 4792 g (B_1), 4594 g (B_2), 4561 g (B_3) and 4525 g (B_4). The feed represented by Troco prime pellets was given of 1, 5 % of body weight during the period 1 – 16 February and 2% of body weight since February, 16 to March, 16. Pellets were distributed in five portions on day in interval 8:00 and 20:00. The pellets contain: fish meal, wheat, fish oil, wheat gluten, palm oil and premix. The level of crude protein contained was 42 %. The biochemical composition of pellets is presented in the table 1. Wastes and uneaten feed was siphoning every day. The fish sampling was done in 16 and 44 days interval through out the experiment to obtain the weight for each aquarium.

Table 1

Biochemical composition of pellets

Parameter	UM	Value
Crude protein	%	42
Crude fat	%	18
Fiber	%	1,7
Ash	%	8,8
Calcium	%	1,7
Phosphorus	%	1, 2
Lysine	%	2,8
Methionine	%	1
Vit. A	U.I. / kg	15000
Vit. D3	U.I. / kg	2000
Vit. E	mg / kg	200
Vit. C	mg / kg	150
Cupru ($CuSO_4$)	mg / kg	5
Seleniu (Na_2SeO_4)	mg / kg	0,3

4. Growth Parameters

In aquaculture, several models applicable to the concave portion of the growth curve have been used. The formula most commonly used is the "instantaneous growth rate" or "specific growth rate" (SGR) and is based on the natural logarithm of body weight. The growth was estimated by weighing all fish on 0, 16 and 44 days. The specific growth rate (SGR) was calculated as % change in body weight per day according to Brett and Groves (1979):

$$SGR = 100*(\ln FBW - \ln IBW) / day$$

where FBW and IBW are the final and initial mean body weights respectively.
The Feed conversion efficiency (FCE) of the supplementary feeding was calculated as:

$$FCE = (M_f - M_i) / F$$

where M_f is the final fish body mass (g), M_i is the initial fish body mass (g) and F is the total feed dry matter (g).

Results and Discussions

1. Growth performance and feed efficiency.

The details of growth, survival and feed utilization of all aquariums at the end of the experimental period are summarized in Table 2. In all aquariums, the fish appeared healthy and no mortality was observed.

Table 2

Details of growth, survival and feed utilization of all aquariums

Parameters / Treatment	Aquarium 1	Aquarium 2	Aquarium 3	Aquarium 4
Mean initial weight (g)	79.87	71.78	77.31	68.58
Mean final weight (g)	123	109.64	117.36	107.95
Weight gain (g)	43.2	37.86	40.05	39.38
Growth rate	0.98	0.86	0.91	0.89
SGR (%/day)	0.97	0.95	0.95	1.04
FCE	1.65	1.67	1.74	1.57
PER	1.44	1.43	1.37	1.52

Total weight of common carp in all the aquariums increased over 44 days of the experiment. Variations in total weight of common carp reared in recirculation system are represented in figure 1.

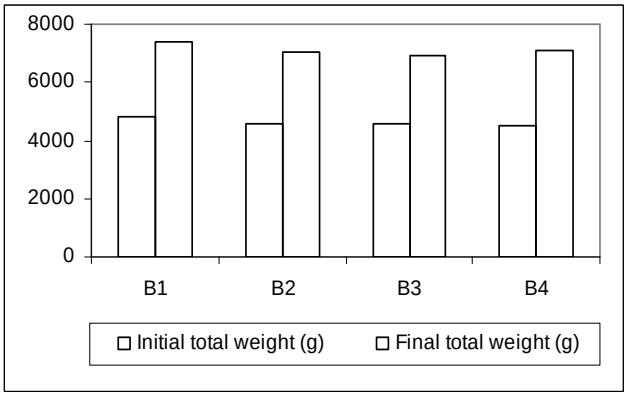

Figure 1.Variations in total weight over time in recirculating system

From this figure it was observed that the total body weight increased from 4792 g; 4592 g; 4561 g and 4525 g to 7384 g; 7017 g; 6924 g and 7125 g in aquarium 1, 2, 3 and 4, respectively. The total weight gain by B_1, B_2, B_3 and B_4 was 2592 g, 2423 g, 2363 g and 2600 g respectively during the rearing period of 44 days. Common carp growth in the tank 4 was best in the term of weight gain. The individual weight gain was 43, 2; 37, 86; 40, 05 and 39, 38 in aquarium 1, 2, 3 and 4, respectively. Values of specific growth rate were oscillated between 0, 95 and 1, 04 %/day. Feed conversion efficiencies (FCE) differed among all aquariums, the highest FCE being found in aquarium 4 with 1, 57 value. Protein efficiency ratio was the best in B4 where it was presented the value of 1, 52.

2. Water Temperature

Regarding water temperature in recirculating system, a maximum mean of 19, 7 were noticed in the month of March, while the lowest recorded 15, 5 in the month of February for aquariums 1, 2, 3 and 4, respectively. We mentioned that we

doesn't used heater. The figure 1 showed the daily variations of water during the 44 experimental days.

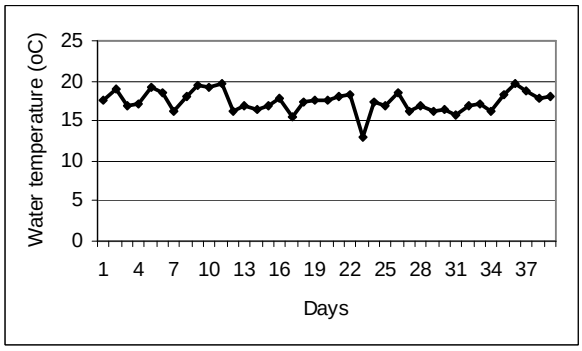

Figure 2. Daily variations of water temperature during experimental days

3. Water quality parameters. Mean pH in all the aquariums ranged from 6, 48 to 7. 68. The daily values of pH for all aquariums are presented in figure 2.

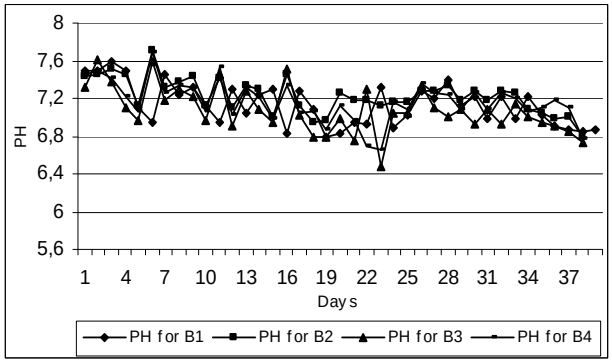

Figure 3. Daily variations of water pH during experimental days

The variation of dissolved oxygen for all aquariums is presented in figure 4.

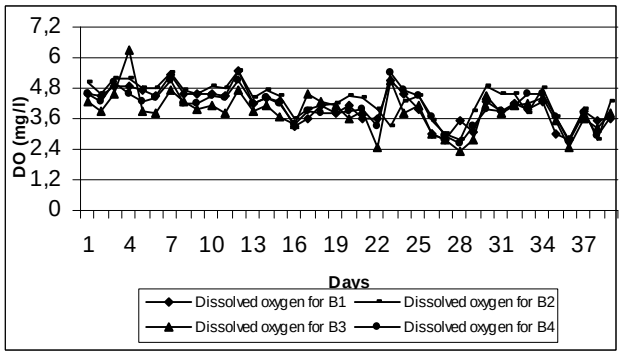

Figure 4. Daily variations of dissolved oxygen during experimental days

The nitrogen compounds were measurements ones of 6 days and the values are represented in figure 5.

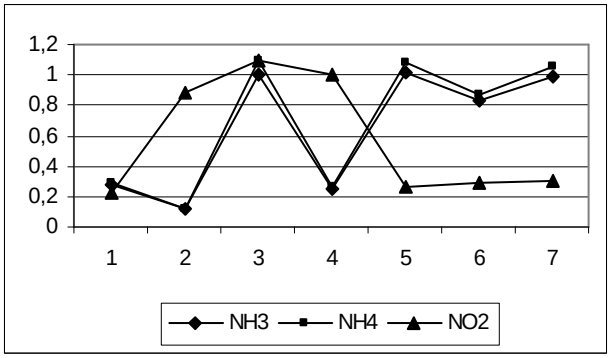

Figure 5. Variations of nitrogen compounds in recirculating system

Conclusions

1. The common carp is a species which easily adapts to the recirculating system conditions.

2. This species registered a high rearing performance expressed through high efficiency of food conversion.

3. During the experimental period, the fish presented a good resistance of stress conditions and low incidence of pathologies.

4. The problems caused by intensive carp production in recirculating systems including the increasing organic pollution caused by feed and fish excrements, the process of decomposition of these organic materials reducing of oxygen in water.

4. By adopting recirculating system technology, the year round growth of fish could be achieved through controlled environment.

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