WATER QUALITY MONITORING INTO A RECIRCULATING AQUACULTURE SYSTEM FOR INTENSIVE REARING OF CARP (*CYPRINUS CARPIO*) JUVENILES FED WITH PROBIOTICS SUPPLEMENT

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Abstract

Dynamics of water quality parameters in an intensive recirculating system of juvenile carp (Cyprinus carpio) is dependent on many factors, the most important being the stocking density, feeding intensity and biochemical composition of the feed. The objective of this work is the monitoring of chemical parameters of physical environment in culture conditions in a recirculating system using a probiotic feed and monitor the evolution of these parameters during the experiment. We have evaluated the main water quality parameters, namely temperature, the pH, oxygen, ammonia, nitrites, nitrates and chlorine. Temperature, water and oxygen and the reaction caused by sensors in the automatic control system quality water, and for other parameters was used to determine colorimetric method with kits with Merck type Spectroquant Nova 400. With the use of a probiotic feed containing 30% protein and varying concentrations of probiotic BioPlus 2B®, consisting of Bacillus licheniformis (DSM 5749) and Bacillus subtilis (DSM 5750) in a ratio of 1:1, recycled water quality was maintained in the allowable spread of culture supported by the species. During the experiment, their values were within the following spacing: ammoniacal nitrogen ($N\text{-}NH_4^+$) from 0,17 to 0,86 mg / l; Nitrites ($N\text{-}NO_2$) 0,24 to 0,54 mg / l; Nitrate ($N\text{-}NO_3$) 16,7 – 20,4 mg / l and chlorine (Cl^-) 23,4 to 32,3 mg / l.

Key words: recirculating system, probiotic feed, water quality, carp

INTRODUCTION

The main technological goal to be achieved in an intensive recirculating system consistes in giving ecophysiological medial conditions to the particularities of culture species.

Water quality in a recirculating culture system is determined, how critical it in DO concentration, unionized ammonia nitrogen, nitrite and CO2. Concentration levels of nitrates, pH and alkalinity water constitutes also important parameters of water quality (Cristea and others 2002). Water chemistry has a decisive influence on the development of biological material, directly or indirectly on it, organic or inorganic substances solvent at the process water, in amounts corresponding to the physiological, ensuring a normal development. Any diversion of these substances in concentrations optimal spacing, negative affect and in many cases irreversible development of biological material. Quality control of water with a very high organic loading, specific situation recirculating aquaculture systems, requires appropriate and prudent use of integrated hardware management techniques applied.

Water quality culture, that it can maintain the optimal requirement imposed by technology, affecting feed conversion efficiency. A poor quality water leads to a high, uncompetitive, the feed conversion ratio, which require high operating costs of the system.

MATERIAL AND METHODS

Research in this paper fall within the type experimental investigations have been conducted in a recirculating system for

intensive aquaculture in the Department of Aquaculture, Cadastre and Environmental Sciences, University "Dunarea de Jos".

Biological material, a batch of 320 fishes of juvenile carp, increased intensive aquaculture recirculating system using a feed Classic Aller-type (30% protein content) has been incorporated / supplement of a probiotic product of different concentrations BioPlus ® 2B, consisting of Bacillus licheniformis (DSM 5749) and Bacillus subtilis (DSM 5750) in a ratio of 1:1. Distribution of biological material in the four recirculating system unit growth was 80 fishes / breeding with an initial biomass of 28 kg/m^3.

Basically, the pilot recirculating system was organized the expriment consists of four units with a capacity increase of 1m^3 each question, a quality water conditioning compartment (Fig. 1.).

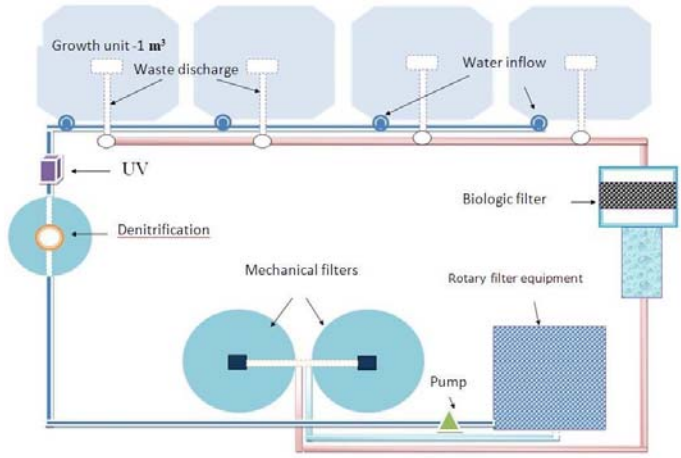

Fig. 1. The configuration of the experimental recirculating system.

For each water quality parameters and methods used to determine specific equipment and whose range of measurement is presented in Table 1.

Table 1. Equipment used for monitoring the water quality parameters during the experiment

Indicators/ Quality parameters	Equipment used	Determination method	Measuring range
Oxygen	WATT Sensolyt 700 IQ (SW) type sensors	Sensor measuring method	0,0-7,89 mg/l
pH	WATT Sensolyt 700 IQ (SW) type sensors	Sensor measuring method	6,5-8,1 unit. de ph
Temperature	WATT Sensolyt TrioxiTherm	Sensor measuring method	19-26,2 ºC
Ionized ammonia $N\text{-}NH_4^+$	Spectroquant Nova 400	Merck kit 1.14752 colorimetric metod for determination	0,53-1,65 mg/l
Nitrite-nitrogen NO_2^-	Spectroquant Nova 400	Merck kit 1.14776 colorimetric determination method	0.02-1,04 mg/l
Nitrate-nitrogen NO_3^-	Spectroquant Nova 400	Merck kit 1.14942 colorimetric determination method	4,5-26 mg/l
Cl^-	Spectroquant Nova 400	Merck kit 1.14897 colorimetric determination method	29,4-31,7 mg/l

RESULTS AND DISCUSSION

Research undertaken have made the assumption that the intensity of feeding, biochemical composition of food, metabolism intensity, the quantity of food unused affect water quality in breeding.

Findings of the culture system water quality monitoring was done by daily temperature, oxygen and pH's with sensors mounted at each unit growth, namely the periodic determination of nitrates, nitrites, ammonia and chlorine; values so determined were compared with those optimal for the species cultured admissible addressed in the study (Table 2).

Table 2. Optimal admitted levels of the main physical and chemical water parameters of a recirculating aquaculture system for CYPRINUS CARPIO

Parameter analyzed	Measure unit	Optimal value
Temperature	^{O}C	21-27
Dissolved oxygen	mg/l	6-8
	% (saturation)	70-105
Cl^-	mg/l	1-100
pH	u pH	7,0-8,0
Ammonia nitrogen (NH_3)	mg/l	<0,02
Total ammonia-nitrogen (TAN)	mg/l	<2,00
Nitrite-nitrogen (NO_2^-)	mg/l	<0,10
Nitrate-nitrogen (NO_3^-)	mg/l	<30,00

Evolution of water quality parameters

Temperature

Carp, euriterm species, tolerates a temperature range 32°C rather than three, which makes it the most widespread species in freshwaters. When water temperature drops below 10°C, the intensity of feeding carp is reduced, and at temperatures below 7°C the feeding process stops. For optimal thermal comfort spread growth is faster, more efficient feed conversion and increased resistance to disease (Masseria et al., 1999). During the experiment, temperature of the culture medium was within the optimum spacing, in terms of physiological requirement of the species (fig. 2).

pH

In the process of nitrification resulting H^+ ions to consume water alkalinity and lower pH of the system. To the extent that pH is allowed to fall, the rate of nitrification, respectively the fish productivity of the system will register lower values. Therefore, the management and operation of a recirculating system design requires a good knowledge of the fundamental relationship between pH and alkalinity, and how to use this relationship in order to maintain optimum water reaction imposed by the nitrification process (figure 2). Management's pH in a closed cycle aquaculture involves evaluating the alkalinity consumption rate (nitrification rate) and the type and amount of supplement to be used to recover lost alkalinity.

Dissolved oxygen

Dissolved oxygen (DO) is one of the most important water quality parameters that determine, in so limited, the bearing capacity, respectively stocking densities in a recirculating system. The limitation comes from the relatively high oxygen requirement of aerobic organisms within the system, relatively low solubility of oxygen in water, the absence of photosynthesis and water purifying reduced rate.

Oxygen dissolved in water management of aquaculture farming system requires knowledge of a variety of aspects, namely: the properties of gas dissolved in water; operating principle, performance indicators and methods of design and installation of

various types of equipments aeration or oxygenation. Dissolved oxygen concentration varied between admissible and optimal values of the studied species (figure 3).

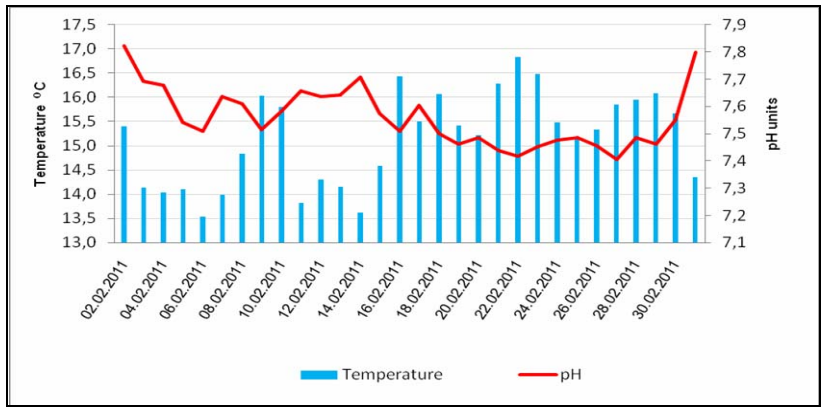

Figure 2. Variation of temperature and pH.

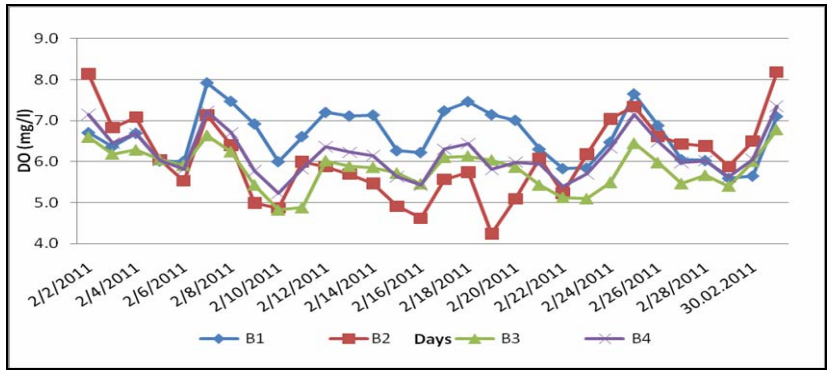

Figure 3. Dynamics dissolved oxygen.

Nitrogen compounds

Decomposition of nitrogen compounds is of great importance in aquaculture because some degradation products, mainly ammonia -NH_3 and nitrites -NO_2 are toxic; to a lesser extent and nitrates are toxic when NO_3, by accumulation, reaching high levels. In recirculating systems, waste organic matter (food consumed, manure) is decomposed by heterotrophic bacteria in the simplest organic compounds, the final product of this process is ammonia, unstable compound that is converted into ammonia.

During the period analyzed, the values of ammonium (NH_4^+) values were recorded in the spread of 0,17 to 0,86, the evolution of this parameter is presented graphically in figure 4.

During the experiment, nitrite concentration varied between 0,24- 0,54 mg/l and averaged 0.30 mg/l biofilter effluent level, well above acceptable limits for the intensive growth of carp. Figure 5 presents the dynamic evolution of nitrites in the breeding system. During the experiment conditions growth of carp in a recirculating system, nitrates have been values generally lower than 30 mg/l; lower values in the second half of the experimental period can be explained by increased frequency of washing the filters in mechanical filtration step, during which water was removed with washing (Figure 6).

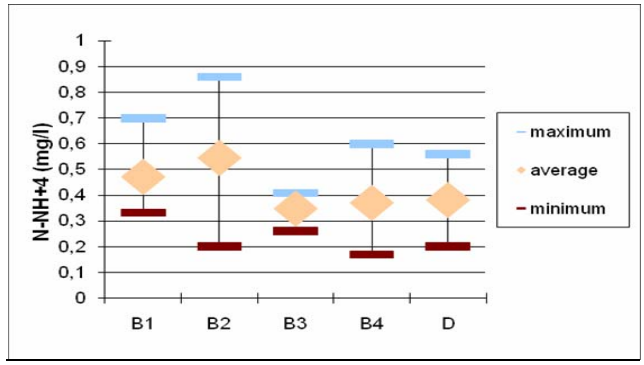

Figure 4. Dynamics evolution ammonium (N-NH_4^+)

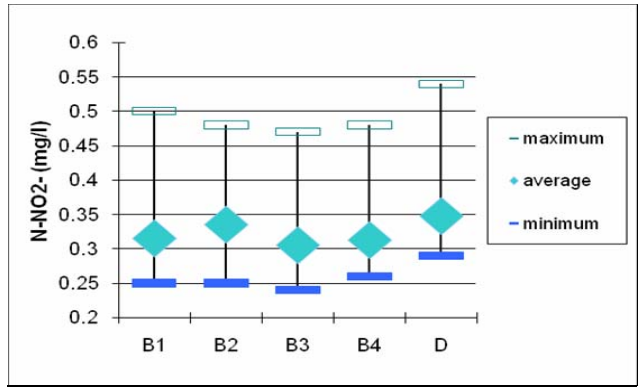

Figure 5. Dynamic evolution of nitrites (N-NO_2^-)

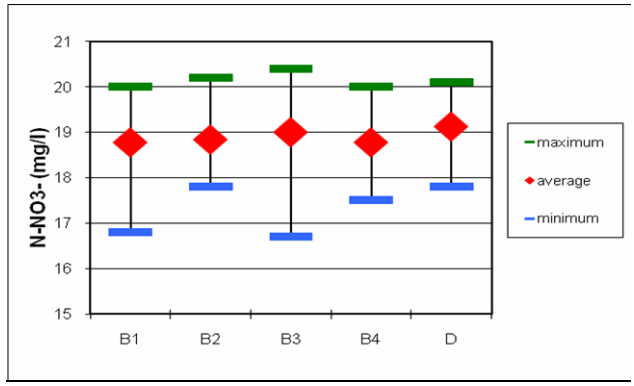

Figure 6. Dynamic evolution of nitrates (N-NO_3^-)

Chloride anion

Chloride anion (Cl^-) was determined colorimetrically and the values were substantially the same in all breeding, fitting into gap 23.4-32.3 mg/l, relatively high concentration of chloride anion may be associated with frequent washing machine filtrului regular urban water network, recognized for high chloride content. Amplitude variation chloride anion concentration in all sampling points in terms of process water with the maximum, average and minimum is presented in Figure 7.

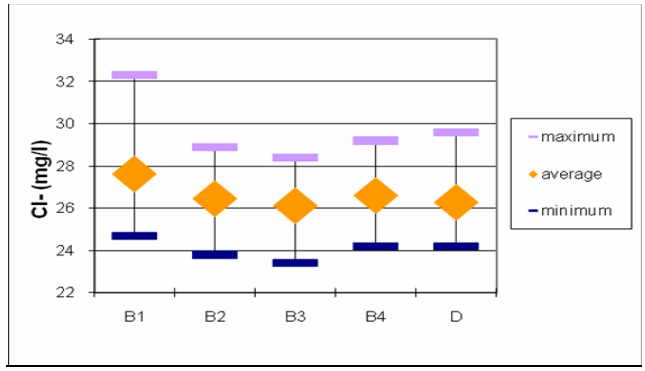

Figure 7. Chloride anion concentration variation (Cl^-)

CONCLUSIONS

Water quality parameters were maintained within acceptable limits for growth of juvenile carp throughout the experimental period; when these parameters have not been employed in optimal spacing elimination proceeded to intensive consisting of water daily to replace about 10 - 20% of the total system. Array analysis of water quality indicators show that the use of a feed has been incorporated / supplement of a probiotic product at different concentrations did not adversely affect water quality technological parameters have not been observed significant differences in all sampling points.

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