INFLUENCE OF DIFFERENT WATER TEMPERATURE ON INTENSIVE GROWTH PERFORMANCE OF NILE TILAPIA *(OREOCHROMIS NILOTICUS, LINNAEUS, 1758)* IN A RECIRCULATING AQUACULTURE SYSTEM

Catalina (Ciortan) Mirea[1*], V. Cristea[1], Iulia Rodica Grecu[1], Lorena Dediu[1]

[1] *"Dunarea de Jos" University of Galaţi, Romania*

Abstract

Nile tilapia (Oreochromis niloticus, Linnaeus, 1758) with average weight of 33,5±1,0 g were used to study the effect of different temperatures on growth performance, survival rate and biochimical parameters from tissue. They were stocked in 12 rearing units at 20, 24,30 and 28ºC (control) water temperature for 30 days. Diet of 41% protein was offered as feed, 3 times daily. Growth measurements of tilapia were recorded on beginning and at the end of the experiment. Results showed that growth performance for Nile tilapia was not significantly (p>0.05) descreased at 20 and 24ºC. Survival rate was the same for the treatments. The feed conversio ratio (FCR) for fish increased with the temperature, but the difference between the high temperature (28 and 30ºC) was not significant (p>0.05). Results showed that the termic range 20 – 30ºC was suitable for intensive culture of Nile tilapia regarding the optimum growth performance and survival rate.

Key words: nile tilapia, biochemical parameters, feed conversio ratio

INTRODUCTION

Tilapia are sometimes known as "aquatic chicken" due to their high growth rates, adaptability to a wide range of environmental conditions, and ability to grow and reproduce in captivity and feed on low trophic levels [10].

RAS are more suitable for warm water fish such as channel catfish, striped bass and tilapia can tolerate lower quality condition and higher temperature [10].

The optimum temperature range in rearing systems is $25 – 31^0$C.

At water temperature of 16^0C, tilapia stop feeding, under 20^0C do not spawn while sever mortality occurs at 12^0C. That why is not recommended introduction of this species in traditional systems of our countries with environmental conditions outside of its limits of tolerance [3].

The purpose of this study was to present the effect of different temperature on growth performance, survival rate and biochemical parameters from tissue of Nile tilapia (*Oreochromis niloticus*).

MATERIAL AND METHOD

The experiment was carried out within the pilot recirculating system of Aquaculture, Environmental Science and Cadastre Department, University "Dunarea de Jos" of Galati.

The experimental activity period lasted for 30 days, from January until February 2012, in twelve rearing units with a capacity of 45 l/unit (45×30×39 cm). The system was provided with mechanical filtration type TETRATEC EX 400. De-chlorinated water in the rearing units were aerated by a constant supply air of compressed air pump type RESUN Quiet LP 100 , and the water was exchange once a day with 50% of water from each unit, before morning feeding. Dissolved oxygen and temperature was daily measured in the morning with Hannah HI 98186 oximeter, and NO_2^-, NO_3^-, NH_3, were measured with Spectroquant Nova 400.

Experimental fish. Nile tilapia (*Oreochromis niloticus*) used in this experiment were 33.7 ± 5 g mean average

*Corresponding author: catalinamirea@yahoo.com
The manuscript was received: 18.02.2013
Accepted for publication: 09.09.2013

weight and 12±0.8cm of length. Fish were homogenous in size, body weights and healthy. They were fed on the same diet like in the experiment for 2 weeks before the study to adapt them to the experiment conditions. Through the adaptation period the week and the dead fish were eliminated daily.

Experimental design. The fish was stocked into 12 rearing units at 20, 24, 30 and 28°C (as Control). Automatic heaters with thermostat were used to obtain the temperatures. The number of tilapia stocked in the rearing units was in a rate of 15 fish per unit for 30 days with three replicates for each treatment.

Commercial diet was used in the experiment; the pellets size was 2 mm, which had 41% crude protein.

The daily feeding tare was 3% of the total stocking biomass according to the feeding chart; the fish were fed three times daily. The feed was offered spreading by hand in the unit.

Growth parameters. The following parameters were used to evaluate tilapia growth performance:

- Weight gain (W) = Final Weight (Wt) – Initial Weight (W0) (g);
- Individual Weight Gain (IWG) (g/ex) = (Final Weight (Wt) – Initial Weight (Wo))/ Total Fish Exemplars;
- Food Conversion Ratio (FCR) = Total feed (F)/Total Weight Gain (W) (g/g);
- Specific Growth Rate (SGR) = 100 × (ln Wt – ln Wo)/t (%BW/day);
- Protein Efficiency Ratio (PER) = Total Weight Gain (W)/Amount of protein fed (g) ;

Processing the statistical data. Statistical analysis was performed using t test (α = 0.05). The coefficient of variation (CV) was calculated as the ratio of the standard deviation to the mean in order to have a measure of dispersion.

RESULTS AND DISCUSSIONS

The recorded values showed suitable environmental conditions for rearing Nile tilapia during the experimental period (Chart no.1. and 2).

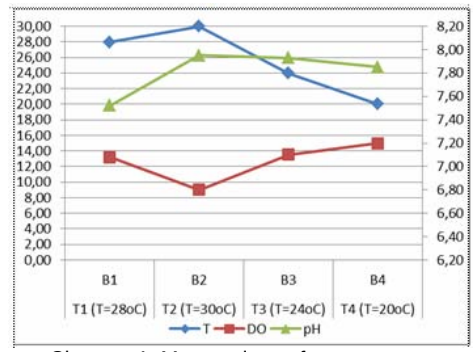

Chart no.1. Mean values of temperature, dissolved oxygen and pH during the experiment

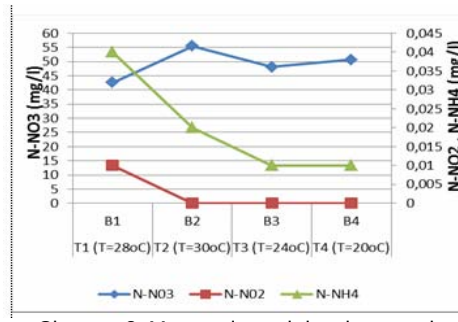

Chart no.2. Mean values nitrite,nitrate and ammonium during the experiment

These values are in agreement with those of El-Sherif and al.,(2009) who noted that the optimum range for growth and food conversion was 21- 28°C. The values of pH during the experiment was 7.52 the minimum and 7.95 the maximum this values are in the optimum range of Nile tilapia in agreement with El-Sherif et al., (2009)[8].

Chart 1 showed further that DO was in the optimum range for Nile tilapia like El – Sherif et al., (2009) showed that the best growth rate DO ranged from 7 to 8.3 mg L^{-1}.

Equation biomass crop growth for the study interval is: $Wi=0{,}0558*Lt^{2.5628}$ and $Wf=0{,}0264*Lt^{2.8842}$ (Chart no. 3 and 4), as determined by somatic measurements at the beginning and end of the experiment. General characteristic of growth, defined as the coefficient "b" (bi=2.5628 şi bf=2.8842) indicate a much faster rate of weight gain in comparison with length parameters. In general, the coefficient b in the length – weight rate has ranged between 2 and 4 and it is considered a measure of the conditions offered by the environment [6]. In addition, the factor condition (b) is used to obtain

information on feeding status of fish and to make comparisons between different populations living in different habitats[9].

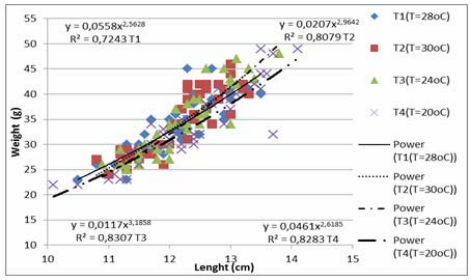

Chart no.3. Lenght-weight correlation of Nile tilapia at the begining of the experiment

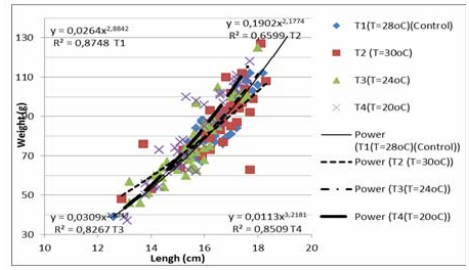

Chart no.4. Lenght-weight correlation of Nile tilapia at the end of the experiment

Table 1 Technological indicators for Nile tilapia

Experimental variant	T1 (T=28oC)	T2 (T=30oC)	T3 (T=24oC)	T4 (T=20oC)
Indicator/tank	B1	B2	B3	B4
Initial biomass (g)	505,33	505,67	506,67	505,3
Final biomass (g)	1280,3	1272,3	1102	1235
Increase biomass growth (g)	765	766,67	595,33	729,67
Initial number of fish	15	15	15	15
Final number of fish	15	15	15	15
Survival (%)	100	100	100	100
Initial average weight (g/ex)	33,68	33,7	33,77	33,68
Final average weight (g/ex)	85,35	84,82	73,46	82,38
Growing days	30	30	30	30
GR (daily growth rate) (g/day)	51,6	51,11	39,6	48,64
SGR (%/day)	3,09	3,07	2,58	2,97
Individual growth gain (g)	25,87	25,5	19,84	24,32
Total amount of feed distributed (g)	590	588,3	588,6	588
FCR (g feed/g gain biomass)	0,76	0,76	0,99	0,8
Daily biomass (% biomass)	3	3	3	3
PER	3,19	3,17	2,46	3,02

Technological indicators of Nile tilapia growth obtained at the end of the experimental period are summarized in Table 1 and graphically presented in Chart. no. 5 and 6. The following is a critical analysis of the most significant technological indicators, namely, specific growth rate (SGR) and feed conversion ratio(FCR).

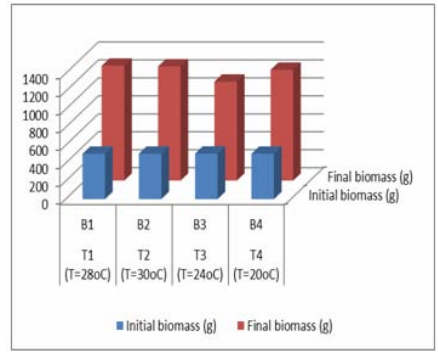

Chart no.5. Evolution of growth

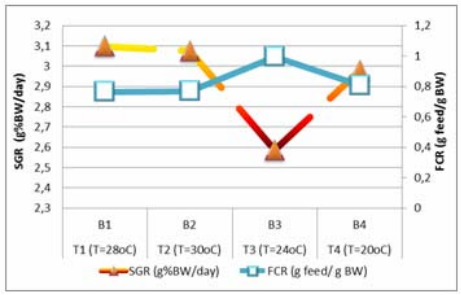

Chart no.6. Changes in feed conversion ratio and specific growth rate

Technological indicators resulted at the end of the experiment had the following values: specific growth rate (SGR) was 3,09 g%/day (T1), 3,07 g%/day (T2), 2,58 g%/day (T3) and 2,97 g%/day (T4), feed conversion factor (FCR) was 0,76 g feed /g gain biomass (T1), 0,76 g feed/g gain biomass (in T2), 0,99 g feed / g gain biomass (in T3) and 0,80 g feed/ g gain biomass (in T4).

Both indicators were higher in T4. Chart no.6 shows inverse correlation that exists between SGR and FCR development, namely: a low FCR is always obtained when the SGR increases (Chart no.6).

Initial storage density was constant in the four experimental treatments. Final biomass varied in direct proportion to the size of fish, from 1280,3 g T1, 1272,3 g in T2, 1102 g in T3 up to 1235 in T4. This indicates an increase in biomass with 765 g of initial biomass in T1 and an increase of 729,67g in T4. Variant T4, the most important in this experiment, indicates an increase in final biomass compared with in T1which was the control.

CONCLUSIONS

Recirculating systems allow a high degree of biomass intensity production by an advanced control of physico-chemical parameters of the breeding system in accordance with the quantity and biochemical structure of the feed administered, and the demands imposed by ensuring optimal hygienic conditions for fish growth. [4] Intensive recirculating systems allow fish growth in every region, and provide complete control over the growing medium. They also allow a large percentage of water reuse. [18]

There is a great interest in increasing the low temperature tolerance of nile tilapia.

This study evaluate the effect of environmental and dietary factors on the physiology when Nile tilapia is exposed at temperature lower or higher then her optimum. Altrought the result showed that we can obtain good results at 20^{o}C, that had to be consider to be a great value for aquaculturists.

ACKNOWLEDGEMENTS

The work of Catalina Mirea (Ciortan), was supported by Project SOP HRD – TOP ACADEMIC 76822/2010, funded by the European Union and the Romanian Government. The authors particularly thank the project management team for the financial support.

REFERENCES

[1] Avnimelech,Y (2003) – Control of microbial activity in aquaculture system: active suspension ponds. World Aquaculture 34 (4), 19-21.

[2] Beveridge, M.C.M. and McAndrew, B.J.(eds) (2000) – Tilapias: Biology and Exploitation. Kluwer Academic Publishers, Dordrech/Boston/London, pp.505.

[3] Cecilia Bucur, Mioara Costache, Daniel Oprea, Marica Nino, Studies and Observations on the Spawning of Oreochromis Niloticus Species Reared at SCDP Nucet – Dambovita, Scientific papers: Animal Science and Biotehnologies, 2012, 45(2)

[4] Cristea V.: Ingineria sistemelor recirculante din acvacultura, Ed. Didactica si Pedagogica, 2002;

[5] Dos Santos, M.J.M, and Valentini, W.C (2002) – Production of Nile tilapia Oreochromis niloticus and freshwater prawn Macrobranchium rosenbergii stoked at different density in polyculture systems in Brazil. Journal of the World Aquaculture Society 33, 369-376.

[6] El-Sayed, A.-F.M. (1992) – Effects of substituting fish meal with Azolla pinnata in practical diets for fingerling and adult Nile tilapia Oreochromis niloticus L. Aquaculture anf Fisheries Management 23, 167-173.

[7] El-Sayed, A.-F.M. (2002) – Effects of stoking density and feeding levels on growth and feed efficiency of Nile tilapia, Oreochromis niloticus (L) fry. Aquaculture research 33, 621-626.

[8] Mohamed Saad El- Sherif and Amal Mohamed Ibraim El-Feky, 2009, Performance of Nile tilapia (Oreocromis nioticus) fingerlings. Influence of different Water Temperatures, International Journal of Agriculture & Biology, 11:301-305
[9] Ionica (Bancu) Enache, V. Cristea, Lorena Dediu, T. Ionescu,Corina (Badalan) Sion, Georgiana Petronela (Sandu) Călin,L. Oprea, Daniela Cristina Gheorghe, The influence of genetic variability on the growth performance of common carp in a recirculating aquaculture system, Lucrări Ştiinţifice - vol. 56, Seria Zootehnie, 2011
[10] Food and Agriculture Organization of the
[11] United Nations: The state of world fisheries and aquaculture, 2010
[12] Hardjamulia, I.A. and Rukyani,A. (2000) – Improved Nile tilapia (GIFT strain) cultured in Indonesia. NAGA: The ICLARM Quartely 23, 38-39.
[13] Hickling, C.E. (1962) – The cultivation of tilapia. Scientific America 208, 143-152.
[14] Klaus B., Măzăreanu C., Pricope F., Cărăuş I., Marinescu V., Rujinschi R.: Producţia şi productivitatea ecosistemelor acvatice. Editura Ion Borcea, Bacău, 2003.
[15] Mires, D. and Amit, Y. (1992) – Intensive culture of tilapia in quasi-closed water cycled flow-through ponds – the Dekel aquaculture system. Israeli Journal of Aquaculture /Bamidgeh 44, 82-86.
[16] Pillay, T.V.R. (1990) – Aquaculture Principles and Practices. Fishing New Books, Blackwell Science, Oxford, UK, pp 575.
[17] Oprea L., Georgescu R.: Nutriţia şi alimentaţia peştilor, Editura Tehnică, Bucureşti, 2000;
[18] Van de Nieuwegiessen, P. G.: Welfare of African catfish, effects of stocking density. PhD Thesis, Wageningen University, The Netherlands, 2009, ISBN: 978-90-8504-986-9