International Journal of Science, Environment and Technology, Vol. 6, No 2, 2017, 1343 – 1346

ISSN 2278-3687 (O)
2277-663X (P)

GROWTH OF GENETICALLY IMPROVED FARMED TILAPIA (*OREOCHROMIS NILOTICUS*) IN INDOOR RECIRCULATING AQUACULTURE SYSTEM

M. Menaga and S. Felix
Fisheries College and Research Institute, Ponneri, Chennai- 601 204
Tamilnadu Fisheries University
E-mail: felix@tnfu.ac.in

Abstract: A 60days experiment was conducted to investigate the water quality and growth parameters of raising genetically improved farmed tilapia (GIFT) in a recirculating aquaculture system (RAS). The stocking density was 9.02kg m^{-3} in all tanks at the beginning of the study initial weight was 24 g $fish^{-1}$ and reached 115.5 g $fish^{-1}$ in control and 138.2 g $fish^{-1}$ in RAS tanks at the end of the study. The total weight gain and specific growth rate of the RAS fish were, respectively, 141% and 114% higher than those of the Control fish. The feed conversion ratio for RAS was 17% lower than that for the control. The accumulations of ammonium nitrogen (0.07± 0.10 mg L^{-1}) and nitrate nitrogen (85 mg L^{-1}) were observed in the RAS tanks. The phosphate concentration in the control tanks (4.01 ± 0.34 mg L−1) was substantially lower than that in the RAS tanks.
Keywords: GIFT, RAS, Growth, Weight gain, FCR.

Introduction

The advantages of using a recirculating aquaculture system (RAS) appeal to both the aquaculture industry and society (Kolarevic *et al.*, 2012). In RAS fish tanks, water is recycled by using waste treatment infrastructures, such as drum filters and biological filters, for controlling and stabilizing the environmental conditions of the fish, reducing the amount of water used, and improving fish welfare (Martins et al., 2010). Detritivorous species such as shrimp and tilapia that are filter feeders are ideal for such a system (Azim and Little, 2008). The idea of conducting the current study is based on the reality that RAS model can be used to culture fish in indoor closed water. An experiment was conducted to evaluate genetically improved farmed tilapia (GIFT) welfare in RAS tanks, to compare dissolved inorganic nitrogen dynamics, to evaluate fish growth using RAS in aquaculture.

Materials and methods

The experimental scale-RAS used in the current experiment was equipped with three tanks (the volume of each tank was 4 m^3, and the working volume in the current experiment was 3

*Received Mar 12, 2017 * Published Apr 2, 2017 * www.ijset.net*

m^3 of water), one sand filter and biological filters. Control tanks of the same capacity were used in triplicates. Three hundred tilapia (average individual weight 24.17 ± 2.49 g) were stocked at 9.02 kg m^{-3} in each tank at the beginning of the experiment. The fish were fed a commercial-pellet diet (Growel Feeds Private Limited, Andhrapradesh, India) that contained 39% crude protein, and 8.0% crude lipids. The feeding rates were based on observations of the fish's feeding behaviour during the adaptation period and fixed at 2.0% of the total stocking biomass daily, and adjusted fortnightly after weighing the fish samples every 10 days (Azim and Little, 2008).The temperature, DO and pH were measured daily between 08:30 and 09:30, ammonia (NH_3-N) nitrite (NO_2^--N) and nitrate (NO_3^--N) were analyzed using a standard method (APHA, 2005). The NH_3-N, NO_2^--N, NO_3^--N and PO_4^{3-}-P were measured every 3 days. Statistical analysis was performed using SPSS 16.0 for Windows and differences in were considered significant when P> 0.05. One way analysis of variance was used on the experimental parameters including growth parameters and water quality of control and the RAS tanks.

Results and discussion

The obvious accumulation of NO_3^--N (85 mg L^{-1}) and the nearly undetectable NO_2^--N level (0.002 mg L^{-1}) in the RAS tanks indicated that the biological filters function effectively in the experimental RAS (Tab.1). NO_2^--N is an intermediate during both nitrification and denitrification (Chuang et al., 2007). The accumulation of NO_3^--N is common in intensive aquaculture (Wang et al., 2004), probably because of the free NH_3 inhibition during nitrification and denitrification (Shi et al., 2011). A targeted method for phosphorus removal in the current RAS was not developed; therefore, the accumulation of PO_4^{3-}-P in the RAS tanks was 41 ± 2.35 mg L^{-1} at the end of the experiment .Previous studies on phosphorus dynamics in freshwater aquaculture systems have revealed that much of the phosphorus added with the feed is unutilized by the cultured fish and that a relatively large fraction (80%–90%) is released into the fish culture systems (Barak et al., 2003).

Table 1: Water quality Parameters in control and RAS tanks in the GIFT culture trial

Parameters	**Control**	**RAS**
Temperature(°C)	24.4± 0.50	24.1 ± 0.55
Dissolved oxygen(ppm)	5.1± 0.09	4.9± 0.08
pH	7.5± 0.08	7.4± 0.10
AmmoniaNH_3-N (ppm)	0.02± 0.01[a]	0.07± 0.10[b]

Nitrite-N (ppm)	0.001± 0.002	0.002± 0.005
Nitrate-N(ppm)	25 mg L^{-1a}	85 mg L^{-1b}
Phosphorus (ppm)	4.01 ± 0.34 mg L^{-1a}	41 ± 2.35 mg L^{-1b}

Note: Values in the same row with different superscript letters are significantly different (P>0.05).

The individual fish weight at harvest was 23% higher in the RAS fish than in the control fish. The total weight gain and SGR of the RAS fish were, respectively, 141% and 114% higher than those of the control fish. The FCR for the RAS fish was 1.37 ± 0.02, 17% better than that of the control fish, which had an FCR of 1.54 ± 0.01. The RAS in the current study was set up on laboratory scale, and the water was aerated. The water exchange rate is 9.6 times per day in the RAS. During the 50-d experimental period, the total weight gain rate in the RAS fish was 28.81 kg m^{-3}, equivalent to over 110 kg m^{-3} per year, which is close to the findings of a previous report on tilapia cultured in a commercial scale RAS (Timmons et al., 2010).

Table 2: Growth performance and feed utilization of tilapia in control and RAS tanks

Parameters	**Control**	**RAS**
Initial mean weight (g $fish^{-1}$)	24.17 ± 2.49^{a}	24.17 ± 2.49^{a}
Initial number (fish $tank^{-1}$)	300	300
Initial stocking density (kg m^{-3})	8.06	8.06
Final mean weight (g $fish^{-1}$)	115. 54 ± 36.43^{a}	138.29 ± 34.61^{b}
Survival rate (%)	$100\%^{a}$	$100\%^{a}$
Final density (kg m–3)	28.54^{a}	36.87^{b}
Specific growth rate (% day–1)	1.67± 0.43^{a}	1.90 ± 0.30^{b}
Weight gain (%)	347.26 ± 184.08^{a}	472.14 ± 143.18^{b}
Total weight gain (kg m–3)	20.48^{a}	28.81^{b}
Food conversion rate (kg kg–1)	1.54± 0.01^{a}	1.37 ± 0.02^{b}

Note: Each value represents mean ± S.D. (n = 30). Values in the same row with different superscript letters are significantly different (P>0.05).

Conclusion

The current study investigated the growth and water quality parameters of raising GIFT in indoor RAS and conventional water exchange tanks. The tilapia flourished in both environments and no mortality was found among the RAS fish.The growth and water quality parameters revealed that the RAS model was more effective than the regular water exchange tanks in tilapia culture.

References

[1] APHA, 2005. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington D C.

[2] Azim, M.E., Little, D.C., 2008. The bioflocs technology (BFT) in indoor tanks: water quality, bioflocs composition, and growth and welfare of Nile tilapia (*Oreochromis niloticus*).Aquaculture 283, 29–35.

[3] Barak, Y., Cytryn, E.,Gelfand, I., Krom, M., van Rijn, J., 2003. Phosphorus removal in a marine prototype, recirculating aquaculture system. Aquaculture 220, 313–326

[4] Chuang, H.P., Ohashi, A.,Imachi, H., Tandukar, M., Harada, H., 2007. Effective partial nitrification to nitrite by down-flow hanging sponge reactor under limited oxygen condition. Water Res. 41, 295–302.

[5] Kolarevic, J., Selset, R., Felip, O.,Good, C., Snekvik, K., Takle, H., Ytteborg, E., Bæverfjord, G., Åsgård, T., Terjesen, B.F., 2012. Influence of long term ammonia exposure on Atlantic salmon (*Salmo salar L.*) parr growth and welfare. Aquac. Res.

[6] Martins, C.L.M., Eding, E.H., Verdegem, M.C.J., Heinsbroek, L.T.N., Schneider, O., Blancheton, J.P., d'Orbcastel, E., Roque, J., Verreth, A.J., 2010. New developments in recirculating aquaculture systems in Europe: a perspective on environmental sustainability. Aquacult. Eng. 43, 83–93.

[7] Shi, Y.J., Wang, X.H., Yu, H.B., Xie, H.J., Teng, S.X., Sun, X.F., Tian, B.H., Wang, S.G., 2011. Aerobic granulation for nitrogen removal via nitrite in a sequencing batch reactor and the emission of nitrous oxide. Bioresour. Technol. 102, 2536–2541.

[8] Timmons,M.B., Ebeling, J.M., Center, N.R.A., 2010. Recirculating Aquaculture. Cayuga Aqua Ventures Ithaca, NY.

[9] Wang,W.N., Wang, A.-L., Zhang, Y.-J., Li, Z.-H., Wang, J.-X., Sun, R.-Y., 2004. Effects of nitrite on lethal and immune response of *Macrobrachium nipponense*. Aquaculture232, 679–686.