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Full Length Research Paper

The effects of water type on growth, survival and condition of *Poecilia velifera*

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Seven growth periods were completed on juvenile velifera (*Poecilia velifera*) for a period of 2 weeks to determine the optimal water type for best daily growth, food intake, feed conversion ratio, weight gain, survival and condition factor. Four water types (T1 = 25°C W_1, T2 = 30°C W_1, T3 = 25°C W_2, T4 = 30°C W_2) were used to grow up *P. velifera* for 105 days. In each aquarium, fifteen individuals were stocked and fed to satiation twice a day. Bulk weight of each group was measured 2 weeks interval. Growth rate did not increase with water temperature. Water quality made difference. Fish with W_1 grew better than with W_2. Fish in T1 had the best growth (daily growth 10.37 mg/day). Food intake was the highest in T1. Feed conversion ratio did not differ significantly among groups. Survival was low among 4 groups (T1, T2, T3, and T4 were 55.6, 53.3, 53.3, and 33.3%, respectively), but not significant. Condition factor was the best in T1 (1.61).

Key words: Water type, *Poecilia velifera*, growth, temperature, survival.

INTRODUCTION

World total fisheries production is 152 millions metric tonnes and fishery commodities global production trade was $178 billion US dollars in 2006. Ornamental fish industry holds an important place in the global fishery production and trade. The largest market for aquarium fish is led by countries of the European Union and the United States of America and has become the greatest importer of ornamental fish in the world (Livengood and Chapman, 2007). The volume and value of ornamental fish export in the world are 47,548 ton and $703 million US dollars (FAO, 2007). Additionaly, freshwater fish makes 90 - 96% of ornamental fish trade (Livengood and Chapman, 2007).

Poecilia velifera originated from the rivers of North Carolina, Florida, and NewMexico states in the USA and belongs to Order *Cyprinodontiformes*, Familiy *Poecilidae*, Genus *Poecilia*. They share the same genus with guppy (*Poecilia reticulata*) and gambusia fish (*Gambusia affinis*) and molly fish (*Poecilia vitta*, *Poecilia latipinna*, *and Poecilia sphenops*). Female fish grow until 6 cm long and male fish grow to 8 cm long. Males are more colorful than females and have a long adipose fin that gives them fabulous appearances in dorsal region.

Several biotic and abiotic factors influenced the fish growth.There are optimum water quality requirements for each species, however it is important to consider the effects of each parameter individually and within interactions, as well as individual differences ocurring among fish coming from different geographic and genetical backround.

The aim of this study was to assess the effects of temperature and water quality parameters on growth and survival of *P. velifera* by assessing their daily growth, food intake, feed conversion ratio, weight gain, survival and condition factor.

MATERIALS and METHODS

The experiment was carried out using the juvenile velifera grown at the Aquarium Unit of Adnan Menderes University, Agricultural Faculty, Fisheries Department in Aydin, Turkey. Triplicate groups of fish (n = 15) were held in 4 types of water (T1 = 25°C W_1, T2 = 30°C W_1, T3 = 25°C W_2, T4 = 30°C W_2) (two different water sources,

Abbreviations: W_1, Water type 1; W_2, water type 2; **T,** temperature; **DG,** daily growth; **FCR,** feed conversion ratio; **FI,** food intake; W_i, initial mean body weights; W_f, final mean body weights; **WG,** weight gain.

Table 1. Water quality parameters of two sources.

Parameters (mg/L**)**	**Sources**	
	W_1	W_2
Total Hardness ($CaCO_3$)	732.5	109.8
Alkalinity ($CaCO_3$)	600.0	90.0
Calcium	89.8	0.02
Magnesium	12.4	4.37
Bicarbonate	348.9	71.4
EC	842.2	147.8
Ammonia	0.22	0.10
Nitrite	0.007	0,000
Nitrate	74.8	28.8

W_1 and W_2). Water quality parameters of two water sources are given in Table 1. On day 0, initial mass was taken per aquarium and fish were fasted for 24 h before stocking. Fish were fed *ad libitum* with Sera vipan and flora twice a day. Temperatures were arranged 25 ± 0.24 and 30 ± 0.16°C per aquarium at the beginning, and maintained constant during the experiment. Temperature and pH were measured weekly. Fish were bulk weighed on day 0, 15, 30, 45, 60, 75, 90 and 105. Before measurement, fish were anesthized with MS-222. Daily growth, feed intake, feed con-version ratio, weight gain, survival, and condition factor were calculated (Hargreaves and Kucuk, 2001):

Daily growth (DG) (mg day^{-1}) = (W_f - W_i) / day.
Feed conversion ratio (FCR) = dry feed ingested / (W_f -W_i)N_f.
Food intake (FI) = total feed consumption.
Weight gain (WG) = W_f - W_i.
Survival = (N_f - N_i) x100.
Condition factor = (W_f / L_f^3) x 100.

where W_i and W_f are initial and final mean body weights, respectively and N_f, N_i are the number of harvested and stocked fish, respectively. L_f is the final length. Differeces in mean values of DG, FI, FCR, weight gain, survival and condition factor among each treatment were analyzed by univariate in general linear model of SSPS (9.0) with $p < 0.05$. Difference between the means was examined using Duncan's multiple range test.

RESULTS

P. velifera showed differences in growth, which was strongly influenced by water type as seen in Figure 1. Fish in T1 gained weight significantly and no significant differences in growth appeared between T2 and T3. Fish in T4 had the worse growth rate in the experiment. Daily growth is shown in Table 2, with the best rates for fish in T1 (10.37 mg/day). Feed conversion ratio did not have significant difference among treatment groups. Survival was generally low in four groups (55.6, 53.3, 53.3 and 33.3% in T1, T2, T3 and T4, respectively). In Table 3, fish in T1 gained higher weight (1.48 g) than other three groups (0.94, 0.71 and 0.76 g in T2, T3 and T4, respectively). After 105 days trial, fish in T1 (1.61) had the best condition factor and followed by T3, T2 and T4 (1.54, 1.47 and 1.45, respectively).

DISCUSSION

Water is a vital component to breed fish. Aquaculturists believe that fish breeding system can be improved by managing physical or chemical parameters of water. If we can alter one parameter such as temperature, dissolved oxygen (range of species demands), fish production can be increased. Values of hardness, alkalinity, and cation contents give same results as well. Several studies have been conducted to assess the effect of temperature on fish growth (Tidwell et al., 1999; Person-LeRuyet et al., 2004; Mciwem, 2006; Björnsson et al., 2007; Okamura et al., 2007; Kling et al., 2007; Handeland et al., 2008; Sahoo et al., 2008), as well as for crustaceans growth (Kemp and Britz, 2008). A few studies have been carried out on the effect of hardness and calcium concentration on fish and aquatic animals (Townsend et al., 2003; Hammond et al., 2006; Adhikari et al., 2007; Blanksma et al., 2009), some of them include ornamental fish growth under different environmental conditions. No studies have been recently done since marketing fish or crustaceans take the first order in trade.

Values of total hardness, alkalinity, ammonia, nitrite and nitrate in W_1 were higher than those in W_2, although pH values of W_1 and W_2 were identical (W_1 =7.77 ± 0.088 and 7.42 ± 0.062). The results obtained from this study showed that W_1 was better than W_2 to rear velifera. Hardness, bicarbonate and alkalinity were higher for W_1 than for W_2. Better hardness means better calcium and magnesium in water. Fish take calcium from both water and diet to build up formation of skeletal structures such as bone, fins and scales (Boyd, 1990; Lovell, 1998). High hardness (Ca^{2+} and Mg^{2+} cation concentrations) supported velifera growth in this system. Generally, fish obtain enough calcium from water and natural foods in the diet. Fish take calcium for certain biochemical functions such as osmoregulation, blood cloting, muscle function, nerve impluse transmission and enzyme activators besides skeletal formation. When calcium is low in water and in diet, the fish removes it from bones for metabolic gradient. Calcium deficiency has not been indicated in carp and catfish, but rarely seemed in salmonids. And catfish and tilapia raised in calcium-free water needed calcium supply in their diet for optimum growth (Lovell, 1998). Magnesium is also needed for hard tissue constitutions, enzyme activators in carbonhydrate metabolism and protein synthesis, osmoregulation and maintenance of glossy muscle in fish. Deficiency of magnesium leads to similar signs of calcium deficiency like poor body development, low survival, flabby muscle in channel catfish, carp and rainbow trout. When magnesium content is as low as 1 - 3 mg/L in fresh water, fish needs 0.025 - 0.07% magnesium in diet (Lovell, 1998). In this study, fish in W_1 demonstrated well growth compared to fish in W_2 because W_1 water had very high hardness and alkalinity, which came from bicarbonate salts of calcium and magnesium. Part of this hardness, called temporary

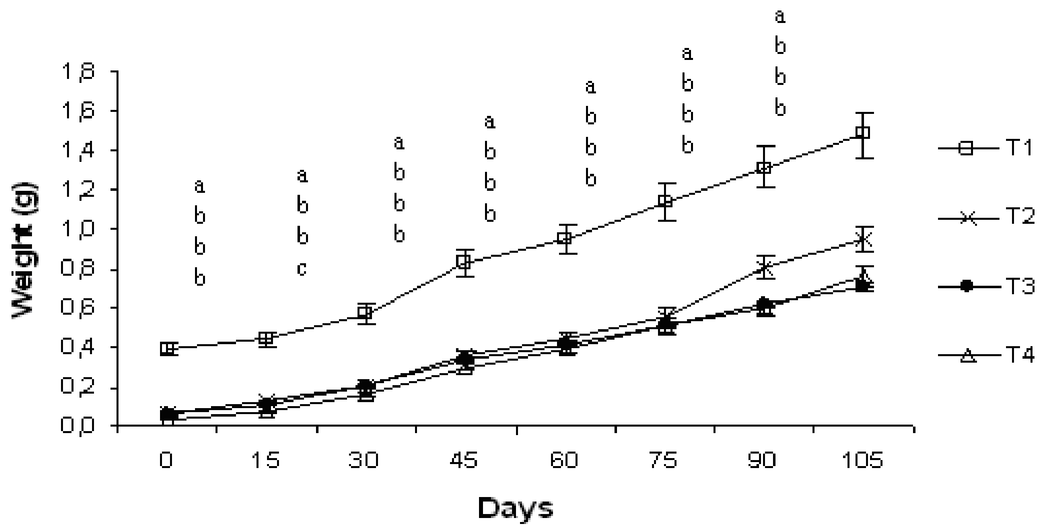

Figure 1. Growth of velifera in four water types for 105 days.

Table 2. The effects of water types on daily growth, food intake, feed conversion ratio and survival within 105 days (mean ± SD, n = 15).

Water types	Daily growth, mg per day	Food intake, g	FCR	Survival %
T1	10.37 ± 2.11[a]	25.77 ± 1.03[a]	24.59 ± 6.75[a]	55.6 ± 15.39[a]
T2	8.34 ± 0.18[ab]	17.65 ± 1.57[b]	20.16 ± 0.77[a]	53.3 ± 00.00[a]
T3	6.19 ± 1.61[b]	14.78 ± 0.50[c]	23.43 ± 4.85[a]	53.3 ± 13.34[a]
T4	6.89 ± 1.82[b]	13.15 ± 0.50[c]	19.32 ± 6.47[a]	33.3 ± 13.34[a]

SD = Standard deviation.

Table 3. The effects of water types on ending weight, weight gain and condition factor within 105 days (mean ± SD, n = 15).

Water types	Ending body weight, *g*	Weight gain, *g*	Condition factor
T1	1.48 ± 0.191[a]	1.09 ± 0.225[a]	1.61 ± 0.309[a]
T2	0.94 ± 0.040[b]	0.88 ± 0.017[ab]	1.47 ± 0.172[ab]
T3	0.71 ± 0.167[b]	0.65 ± 0.174[b]	1.54 ± 0.116[ab]
T4	0.76 ± 0.191[b]	0.72 ± 0.194[b]	1.45 ± 0.146[b]

SD = Standard deviation.

hardness, is precipitated in aquarium equipments by heating. Another part of hardness consists of nitrate (NO_3^{2-}), chloride (Cl^-) and probably sulfate (SO_4^{2-}), called permanent hardness (Noga, 1996). That of W_1 is very high, probably due to the combination of both permanent and temporary hardness. For trade or business purposes, it may not be convenient to rear fish and to produce damages on aquarium equipments, which will generate more costs. Furthermore, frequent exchanging of water and cleaning aquarium distrub fish and trigger stress which results in decreased feeding and growth (Ross and Ross, 1999).

Survival rate values were the highest in T1 (55.6%) and the lowest in T4 (33.3%). It was 53.3% in T2 and T3. Mortality of velifera was high, though survival among four groups did not varied significantly. This low survival may have been related to calcium and magnesium content of water sources. W_1 had excess divalent cations while W_2 showed almost lack of them.

Daily growth was the highest in T1 fish (10.37 mg/day) followed by T2, T3 and T4 (8.34, 6.19 and 6.89 mg/day, respectively). Feed intake also supported the same results.

The more feed fishes consume, the more weight they gained. This study indicated that water quality for breeding aquarium fish in T1 was better than in T2, T3 and T4. It supported fish development due to enrichment of cation, even W_1 had higher nitrogen derivatives than W_2, but velifera was not influenced. It is suggested that water type for T_1 can be comfortably used for *P. velifera*, aquarium fish.

REFERENCES

Adhikari S, Chaurasia VS, Naqvi AA, Pillai BR (2007). Survival and growth of Macrobranchium rosenbergii (de Man) juvenile in relation to calcium and bicarbonate alkainity. Turk. J. Fish. Aquat. Sci. 7: 23-26.

Björnsson B, Steinarsson A, Arnason T (2007). Growth model for Atlantic cod (Gadus morhua): Effects of temperature and body weight on growth rate. Aquaculture, 271: 216-226.

Blanksma C, Eguia B, Lott K, Lazorchak JM, Smith ME, Wratschko M, Dawson TD, Elonen C, Kahl M, Schoenfuss HL (2009). Effects of water hardness on skeletal development and growth in juvenile fathead minnows. Aquaculture, 286: 226-232.

Boyd CE (1990). Water quality in ponds for Aquaculture. Auburn University, Alabama.

FAO (2007). Fishery commodities global production and trade 1976-2006 at http://www.fao.org/fishery/statistics/global-commodities production/query/en

Hammond KS, Hollows JW, Townsend CR, Lokman PM (2006). Effects of temperature and water calcium concentration ongrowth, survival and moulting of freshwater crayfish, *Paranephrops zealandicus*. Aquaculture, 251: 271-279.

Handeland SO, Imsland AK, Stefansson SO (2008). The effect of temperature and fish size on growth, feed intake, food conversion efficiency and stomach evacuation rate of Atlantic salmon post-smolts. Aquaculture, 283: 36-42.

Hargreaves JA, Kucuk S (2001). Effects of diel un-ionized ammonia fluctuation on juvenile hybrid striped bass, channel catfish, and blue tilapia. Aquaculture, 195: 163-181.

Kemp JOG, Britz PJ (2008). The effect of temperature on the growth, survival and food consumption of the east coast rock lobster *Panulirus homarus rubellus*. Aquaculture, 280: 227-231.

Kling LJ, Muscato Hansen J, Jordaan A (2007). Growth, survival and feed efficiency for post-metamorphosed Atlantic cod (*Gadus morhua*) reared at different temperatures. Aquaculture, 262: 281-288.

Lovell T (1998). Nutrition and Feeding of Fish. Kluwer, Novell. pp. 61-64.

Livengood EJ, Chapman FA (2007). The ornamental fish trade: an introduction with perspectives for responsible aquarium fish ownership. University of Florida, IFAS extension, FA 124. http:// http://edis.ifas.ufl.edu/FA124

Mciwem JAD (2006). Water quality and accelerated winter growth of European catfish using an enclosed recirculating system. Water Environ. J. 20: 233-239.

Noga EL (1996). Fish Disease diagnosis and treatment. Mosby, St. Louis. pp. 72-73.

Okamura A, Yamada Y, Horie N, Utoh T, Mikawa N, Tanka S, Tsukamoto K (2007). Effects of water temperature on early development of Japanese eel *Anguilla japonica*. Fish. Sci. 73: 1241-1248.

Person-LeRuyet J, Mahe K, Le Bayon N, Le Delliou H (2004). Effects of temperature on growth and metabolism in a Mediterranean population of European sea bass, *Dicentrarchus labrax*. Aquaculture, 237: 269-280.

Ross LG, Ross B (1999). Anaesthetic and Sedative Techniques for Aquatic Animals, second edition, Blackwell publishing, Oxford. pp. 5-19.

Sahoo SK, Giri SS, Chandra S (2008). Rearing performance of *Clarias batrachus* larvea: Effect of age at stocking on growth and survival during fingerling production. Aquaculture, 280: 158-160.

Tidwell JH, Coyle SD, Evans J, Weibel C, McKinney J, Dodson K, Jones H (1999). Effect of culture temperature on growth, survival, and biochemical composition of yellow perch Perca flavescens. J. World Aquacult. Soc. 30: 324-330.

Townsend CR, Silva LVF, Baldisserotto B (2003). Growth and survival of Rhamdia quelen (Siluriformes, Pimelodidae) larvea exposed to different levels of water hardness. Aquaculture, 215: 103-108.