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Effect of Ph on the Growth and Survival of Juvenile Common Carp (*Cyprinus Carpio* L.)

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Abstract

Common carp (*Cyprinus carpio* L.) juveniles averaging 7.68± 0.25 - 8.12± 1.14 g in weight were used for 6 weeks to investigate their survival and growth preferences. The experimented carp were stocked at 12 tanks formerly adjusted with different pH levels values as: 6.0, 7.0, 8.0 and 9.0. Growth and survival of common carp was assessed every Sunday of each week. Growth rates significantly ($P < 0.05$) increased at pH 7 and pH8 respectively. Therefore, the results suggest that the water with pH ranged from 7 to 8 was the best range for growth performance and survival rate of carp. Feed conversion ratio (FCR) improved at pH 6 and 9 respectively. In general, the results indicated that water pH 7- 8 could be more appropriate to juvenile carp culture for best growth performance and survival rate.

Keywords: Juvenile Common Carp , pH, Growth , Survival rate.

تأثيرالأس الهيدروجيني على نمو وبقاء يافعات الكارب الشائع .(*Cyprinus carpio* L.)

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الخلاصة

أُستخدمت يافعات الكارب الشائع *Cyprinus carpio* L. وبمعدل وزن تراوح من 7.68± 0.25 – 8.12 ± 1.14 ولمدة 6 أسابيع لغرض معرفة عمر بقاءها وأفضلية نموها. وزعت يافعات الكارب في 12 حوض خلال فترة التجربة وبمستويات مختلفة من الأس الهيدروجيني (6.0 ، 7.0 ، 8.0 ، و9.0). سجل معدل النمو ونسبة البقاء كل يوم أحد من كل أسبوع. أشارت نتائج التحليل الاحصائي وجود أختلافات معنوية ($p< 0.05$) تزداد عند الأس الهيدروجيني 7.0 و8.0 على التوالي. توضح النتائج بان الماء عند الأس الهيدروجيني من 7.0 الى 8.0 يحقق أفضل معدل نمو ونسبة بقاء للكارب. يتحسن معدل التحويل الغذائي FCR عند الأس الهيدروجيني 6.0 و9.0 على التوالي . وبشكل عام تشير النتائج الى ان الماء ذو الأس الهيدروجيني الأس الهيدروجيني الذي يتراوح بين 7.0 الى 8.0 يكون اكثر مفضلا في تربية الكارب الشائع للحصول على أفضل نمو ونسبة بقاء.

Introduction

The carp *Cyprinus carpio* (L.) is very demanded fish for human consumption [1- 3] and considered as one of the best suitable freshwater for culture due to its good growth and excellent consumption for the artificial food [2, 4, 5]. Water is very essential for the fish to carry out all their physical roles in water. Water pH is essential for fish production due to pH of water influence on the ordinary physiological functions of the fishes [6]. Juvenile fish are very sensitive to pH levels. It is very critical

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for their life if it became more or less than optimal level. [7] stated that the good level of pH for fish culture ranged from 6.5-9.0. The ability of the fish survive in acid waters may associated to their capability to sustain ion stability [8]. On the other hand, fish could survive in alkaline water due to their regulation ability [9,10]. The lethal consequences of elevated pH are documented as a possible factor added to the changeable success of fish production. Consequently, the current study was designed to examine the effect of different pH levels on growth performance and survival of common carp juveniles below laboratory conditions

Materials & Methods

Juvenile common carp of different weights 7.24± 0.23 g - 8.12± 1.14 g were collected from Marine vertebrates Department, Basrah university farm and kept for one week as acclimation period. The fish then transferred to 12 glass aquaria (40×70×60 cm) with four different levels of pH such as 6, 7, 8 and 9 (3 replicates of each) of fresh water maintenance for a period of 60 days.

The daily feeding rate was 3% of the total stocking carp fish juveniles biomass. The feed quantity was adjusted at the beginning of each next two weeks, according to the actual body weight of the fish in each aquarium. The fish fed on the experimental diet twice a day.

The growth performance [11,12] was estimated as the following:

Body weight gain (BWG) = (W1-W0)

Average daily body weight gain (ADG) was calculated as:

Weight gained fish/day = (W1-W0) / t

Specific growth rate (% day) was assessed:

SGR= (ln W1 – ln W0) x 100/t [13, 14].

Feed conversion rate (SGR) =D. f. / (W1-W0) [14, 15].

Survival rate (SR) (%) = Ni x 100 /N0 [11,13,16]

Where W1 = Final wet weight (g); W0= Initial wet weight (g); t = time interval (days); N*i* = Number of fishes at the end; N0 = Number of initial stocked fishes:

D. f. = Dry feed intake (g)

Statistical analysis

The data obtained in this study were analyzed by one-way ANOVA and significant differences among groups were identified using SPSS version 17. Significance was tested at 0.05 level.

Results

The initial average weight of the fish at the beginning of the experiment was 7.24± 0.23 to 8.12± 1.14 g (Table-1). The final average body weight at the end of the experimental period was 9.84± 0.46 to 11.50 ± 0.44g after 42 days of stocking demonstrated large differences between pH levels with decreasing at low pH level (Table-1). The result indicated that the weight increase was highest at pH 8 (3.84± 0.59) and pH7 (3.01± 0.15), followed by pH 9 (2.37± 0.45) and pH 6 (2.25± 1.36) respectively (Table-1).

Table 1-Effect of pH value on growth of common carp (*Cyprinus carpio* L)

pH value	6	7	8	9
Period	6 weeks	6 weeks	6 weeks	6 weeks
No.of fish / Tank	10	10	10	10
No. of replicates	3	3	3	3
Initial weight (gm) ± SD	7.583± 0.253^{a}	8.006± 0.430^{a}	7.663± 0.280^{a}	8.162± 1.148^{a}
Final weight (gm) ± SD	9.84± 0.46^{a}	11.02± 0.28^{bc}	11.50 ± 0.44^{c}	10.50± 1.67^{ab}
Weight increase (gm)± SD	2.25± 1.36^{a}	3.01± 0.15^{b}	3.84± 0.59^{c}	2.37± 0.45^{a}
Daily weight increase (gm fish/day) ± SD	0.053± 0.015^{a}	0.071± 0.003^{b}	0.097± 0.014^{c}	0.056± 0.013^{a}
Relative growth rate (%) ± SD	31.315± 12.161^{a}	37.753± 3.935^{bc}	39.986± 7.713^{c}	32.386± 2.395^{ab}

Specific growth rate (SGR) (% weight /day) ± SD	0.611± 0.185 [a]	0.760± 0.068[b]	0.971± 0.146 [c]	0.603± 0.664[a]
Food conversion rate (FCR) ± SD	3.421± 0.896 [a]	2.965± 0.348[b]	2.036± 0.306 [c]	3.355± 0.407[a]

Means in each raw with different superscripts are significantly different ($P < 0.05$),
Means in each raw with same superscripts are not significantly different ($P > 0.05$).

The maximum averages of body weight (g) gain per juvenile carp per day were 3.01± 0.15± and 3.84± 0.59for the fish under pH 7 and pH 8 respectively (Table-1). While It achieved their minimum 2.25± 1.36 and 2.37± 0.45g at pH 6 and 9 (Table-1)

The daily weight increase was high at pH 7 and 8 with their values of 0.071± 0.003 and 0.097± 0.014 gm fish/day. The minimum was noticed at pH 6 (0.053± 0.015 gm fish/day) and pH9 (0.056± 0.013 gm fish/day) ($P > 0.05$).

The highest Relative growth rate (%) (50.29± 9.32) and 37.75± 3.93 was recorded at pH8 and pH7 respectively. The low Relative growth (%) recorded with pH9 (29.06± 3.55) and pH6 (31.31± 12.15) ($P > 0.05$).

The maximum values of SGR were 0.9720± 0.1460 and 0.7623± 0.0682 per day at pH9 and pH7 ($P < 0.05$). The minimum SGR value ($P > 0.05$) was found at pH9 (0.6068± 0.0006) and pH6 (0.6125± 0.1883).

The average feed conversion ratios at pH 6, 7, 8 and 9 were 4.4222± 0.8960, 3.6325± 0.2460, 3.0541± 0.3299 and 4.3552± 0.4080 respectively during 42 days of the experiment (Table-1). It is cleared from these results that FCR achieved at pH 6 and pH 9 was significantly higher ($P < 0.05$) than that achieved in pH 7 and 8.

However, fish survival during 6 weeks experiment was significantly higher (100%) at pH levels of 7.0 and 8.0. The results also indicated mortality was occurred which was about 10% at pH 6 and 9 (survival rate of 90 %) as shown in Figure-1.

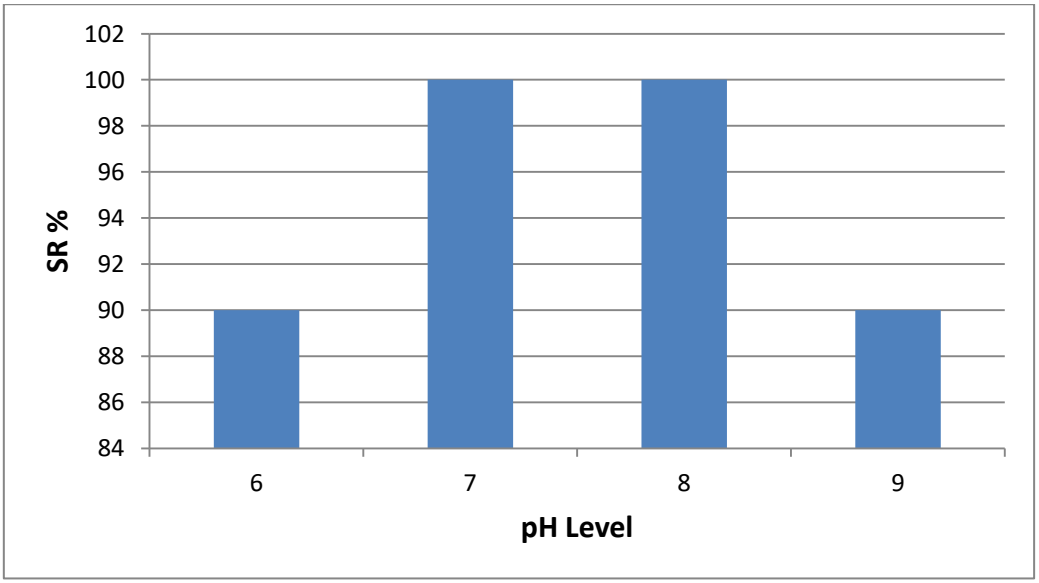

Figure 1-Survival Rate (%) of common carp(Cyprinus carpio) at different water PH levels, during 6 weeks of rearing

Discussion

This study indicated that the differences in weight after 6 weeks of the experiment were highest at pH 8 followed by pH7, pH 9 and pH6 respectively. The results also suggested that the average individual body weights of juvenile carp in the investigational groups pH 8 and pH7 were found to be the greatest respectively with survival rate 100% for both levels of pH. It has been previously reported that the pH level has an essential part for the fish [17]. The acid-base balance, ion regulation and ammonia excretion were affected by the changes in pH levels [18]. [19] concluded that the expose carp to lower pH levels (<7.5) or higher pH levels (>8.5) decreased the survival rate compared with

the other pH 7 and pH 8. The present investigation indicated that all young carps survived without any mortality at pH 7 and pH 8. This might be associated to discharge sodium ion throughout pH alteration [20], [19]. 17] stated that the exposure of the fish to alkaline waters help an increase in plasma ammonia, which is toxic to fish. Figure-1 shows fish survival rate reduce to 90% when the fish was under pH 6.0 and pH 9.0 levels. However, alkaline level (pH > 9) may relate to fish mortality by gill damage, reduced plasma ion concentrations, and reduced NH_3 elimination [21]. As a result, [22] reported that 1.0-2.0% of NaCl should be added to the fish diet to protects the fish against the affect of bitter water on fish growth. One of the previous studies, reported that many fish tolerance affected by low pH, whereas others, although more tolerant, will keep away from low pH if possible [23] . Later, [24] suggested that the growth of the majority of fish were influenced at pH reached below 6.0 or above 9.0 level . The data of current study indicated differences in the average daily body weight achieve of juveniles carp at different pH levels. The gain per fish per day decreased at pH value 6 and 9 and the best body weight were gained at pH 7 and 8 respectively (Table-1). This finding is in agreement with the results of [19] who found that the growth of carp (52.14 ± 7.13 g) increased as water pH increases from 6.0 to 8.0, and the best growth performance happens at water pH 7.5-8.0. On the other hand, [25] found that a 7.0-8.0 pH range gave the greatest functioning of several physiological responses and enzyme activities in the carp. [24] reported that the fish likely to be optimize their digestion under favorable pH circumstances in order to use nutrients in the feed more professionally, as a result increasing feed conversion.

The mean feed conversion ratio of carp at the current study increased as pH levels differ than the pH 7 and 8. This could be related to the decrease in feed consumption at pH 6 and 9 as stated by [26] for Tilapia species and [27] for catfish as increase in ammonia at pH6 while, it decreased with increased pH.

The results of this work recommend that the best range for growth and survival of juvenile carp was pH 7.0-8.0. [19] suggested that the best range for survival and growth of carp was pH 7.5-8.0 and the fish gave growth potential when reared in more alkaline water. In fact,
keeping fish with best pH levels and without growth suppression is preferable as well as will create a better quality final product [19].

Conclusion

The experiment suggested that pH water ranged from 7 to 8 was the best for growth performance and survival rate for the Juvenile carps culture with average initial weight of 7.24 ± 0.23 to 8.12 ± 1.14 g.

From this study, it is also concluded that the suitable range of pH for carp juvenile must be between 7to8.

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