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Growth development of young common carp *Cyprinus carpio* through dietary sodium chloride supplementation

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Abstract

This study was designed to evaluate the growth response of young common carp *Cyprinus carpio* to dietary salt levels. Five different test diets were prepared as a control diet without added salt, and four diets with 0.5, 1.0, 1.5 and 2.0% added salt. Fish (20.15 ± 0.21 to 20.65 ± 0.64 gm /fish) was randomly distributed into the aquaria at a rate of 12 fish / 40 L . The water temperature was in the region of 27 ± 0.130 °C. Fish were fed either a diet containing 0.5, 1.0, 1.5 and 2.0% sodium chloride with a feeding rate of 3% of life body weight twice daily for 7 days a week for 60 days. No significant difference between the treatments was noticed. The best Final body weight, percent weight gain, and specific growth rate (SGR) were found with 1.5 % salt diet ($P<0.05$), whereas the lowest growth was gained in 2% salt. Generally, Food conversion ratio (FCR) and food conversion efficiency (FCE) were improved for carp fingerlings fed on diets contain NaCl ranged from 0.1 to 1.5% ($P<0.05$). The results suggested that dietary supplementation of NaCl influenced the body composition and can be beneficial for the young common carp reared in freshwater used in the fish culture.

Keywords; Growth development; Feed parameters; common carp; Dietary; Sodium Chloride; Freshwater.

Introduction

Common carp is one of the most significant fish species for aquaculture all over the world [1] and represent the species of choice due to its high growth rate, ease in reproduction , tolerance to environmental stress and its market demand. However, common carp, in particular is commonly accepted to Iraqi consumers. Feed cost of fish culture is about 30-70% of total production cost [2]. Supplementation of diets

has the potential to be profitable due to improving the growth rate or reduce the time of fish culture. Herbal products, antibiotics and hormones have been used widely in fish culture to improve the fish growth. Freshwater fish use the salt from the surrounding water to keep their osmotic balance, a process that uses energy. Dietary supplementation of sodium chloride could be helpful in decreasing the energy utilized. Therefore, it has been reported that freeing energy could be directed into growth as an alternative [3]. A few studies have been made to examine the dietary role of sodium chloride in the freshwater fish culture but there was no specific information on the effect of dietary sodium chloride (NaCl) on the growth, Feeding utilization and meat quality of common carp**.**

The present study used sodium chloride in the fish diet to assess the effects of different sodium chloride levels on the growth and feed utilization of the young common carp (*Cyprinus carpio*).

Materials and methods

One hundred and eighty carp fingerlings with an average body weight ranged from 20.15 ± 0.21 to 20.65 ± 0.64 gm were collected from outdoor of marine Science Center's fish farm, Basrah and kept in the tanks for seven days before being randomly distributed into five equal groups treatments and three replicate for each treatment) representing four nutritional groups with 0, 0.5, 1, 1.5 and 2% of NaCl (Table 1).

The experimental fish were weighed every 10 days in order to estimate the daily feed rate which was 3% of the total biomass at twice / day for seven days. Fish in all tanks were fed by hand. The total period of the experiment was 60 days. Water temperature, pH and O2 were measured during the experiment.

Experimental diets were formulated from practical ingredients (Table 1) where the control diet (A) was without NaCl and the other diets were supplemented by 0.5, 1, 1.5 and 2% of NaCl respectively.

Table 1.The composition of ingredients (for 100g feed) and chemical analysis of the experimental diets.
Growth and feed parameters were determined following [4] as:

Ingredients (%)	Experimental diets				
	A Control	B	C	D	E
Fish meal	18	18	18	18	18
Soybean meal	25	25	25	25	25
Wheat flour	15	15	15	15	15
Corn	20	20	20	20	20
Wheat bran	15	14.5	14	13.5	13
Barley	4	4	4	4	4
Sun flower oil	1	1	1	1	1
Vitamin & Minerals	2	2	2	2	2
NaCl	-	0.5	1.0	1.5	2.0
Total	100	100	100	100	100
Crude protein	28.46	28.39	28.32	28.24	28.16
Crude fat	3.07	3.05	3.03	3.01	2.99
Ash	6.02	5.99	5.98	5.97	5.95
Moisture	9.19	9.14	9.09	9.04	8.99
carbohydrates	53.26	53.43	53.58	53.74	53.91

Mean weight gain (MWG) = Mean final weight - Mean initial weight

Specific growth rate (SGR) = 100 (ln W2- ln W1) / T

where

W1: average initial

W2: average final body weights, respectively

T: time (days))

Feed conversion ratio (FCR) = Food consumed (g)/Weight gain (g)

Feed conversion efficiency (FCE) = (Body weight gain (g)/ feed intake (g)) X 100

Survival rate = Number of survive fish / number of fish at the beginning X100.

Statistical analysis

The effects of the feed dietary sodium chloride on growth, survival rate and feed utilization of young carp were analysed. using one-way analysis of variance (ANOVA) and significant differences among treatment means were compared using Duncan's multiple range test (DMRT) using SPSS version 17[5]. Significance was tested at 0.05 level.

Results and discussions

The result of water analysis showed that water temperature was 27.5 (±0.13) ºC, dissolved oxygen mean 6.18(±0.47) and pH value was 7.31(±0.12). High survival rate was found during the experiment (100%) (Table 2). However, the survival rate was not significantly affected by the supplementation of the diet with sodium chloride.

Growth

The weight gain and specific growth rate (SGR) of young carp (*C. carpio***)** fed with diets supplemented and without sodium chloride (Control) are shown in Table 2. The final body weight of the fish groups fed on diet B (0.5%), C (1%) and D (1.5%) had significantly ($P<0.05$) higher than final body weight of the fish at control diet (A) and diet E(2%). Growth performance increased significantly ($P < 0.05$) for the fish fed with diet D followed with diet C and the lowest was recorded at control treatment (A).

The maximum growth of the fish during 60 days was found in treatment D (65.12 ± 0.17) and followed by treatment C (50.87±1.08) and treatment B (40.83 ± 1.34) whereas the lowest growth was recorded in E (20.14 ± 1.22). The best weight gain (0.247± 0.004) of the fish per day was recorded by the fish fed with diet (D) containing 1.5% which was significantly ($P < 0.05$) higher than that of fish fed with diet (C) containing 1.0% (0.189±0.003), diet (B) containing 0.5% (0.155±0.001) and the fish fed with control diet (0.110±0.004), while the diet E recorded the lowest value (0.078±0.002) (Table 2). The highest value of SGR was recorded at treatment D, followed by treatment C and B. Their values were 0.93 ± 0.01, 0.76 ± 0.01 and 0.63 ± 0.02 respectively ($P < 0.05$).

Feed Utilization

Results of feed intake and feed conversion ratio (FCR) of common carp juveniles fed different diets are also shown in Table 2. The best FCR was found in diet at treatment D (2.21±0.07) followed by treatment C (2.85±0.04) and the poorest was recorded at Treatments E (6.09 ± 0.33) with significant difference at P<0.05 (Table 2). The highest values of Food conversion efficiency (FCE) were found at Treatment D (45.36± 0.08) followed by Treatment C (35.04± 0.52) while the lowest was recorded at the Treatment E (16.42± 0.91) with significant difference at (P<0.05) (Table 2).

Table 2. Growth parameters and feed utilization fingerlings of common carp fed salt incorporated diets.

Growth parameters	A Control	B Nacl(0.5%)	C Nacl(1.0%)	D Nacl(1.5%)	E Nacl(2.0%)
Initial weight rate (gm)	20.15± 0.21^{a}	20.45 ± 0.49^{a}	20.05 ±0.21^{b}	20.50± 0.28^{b}	20.65 ± 0.64^{b}
Final weight rate (gm)	26.10 ± 0.42^{a}	28.80 ± 0.42^{b}	30.25±0.07^{c}	33.85 ± 0.49^{d}	24.85 ± 0.49^{a}
Weight increment rate (gm	5.95 ± 0.21^{a}	8.35 ± 0.07^{b}	10.20±0.14^{c}	13.35 ± 0.21^{d}	4.20 ± 0.14^{e}
Growth rate (gm/day)	0.110±0.004^{a}	0.155±0.001^{b}	0.189±0.003^{c}	0.247± 0.004^{d}	0.078±0.002^{e}
Relative growth rate (%)	29.53 ± 0.74^{a}	40.83 ± 1.34^{b}	50.87±1.08^{c}	65.12 ± 0.17^{d}	20.14 ± 1.22^{e}
Specific growth rate (%/day)	0.48 ± 0.01^{a}	0.63 ± 0.02^{b}	0.76±0.01^{c}	0.93 ± 0.01^{d}	0.34 ± 0.01^{e}
Food conversion ratio (FCR)	4.24 ± 0.07^{a}	3.15 ± 0.04^{b}	2.85±0.04^{b}	2.21±0.007^{c}	6.09 ± 0.33^{d}
Food conversion efficiency (FCE)	23.58±0.40^{a}	31.71± 0.41^{b}	35.04±0.52^{c}	45.36± 0.08^{d}	16.42±0.91^{e}
Survival rate	%100	%100	%100	%100	%100

*Mean in the same row with different superscripts are significantly (P <0.05) different. Mean in the same row with the same superscript are not significantly different (P>0.05)

Body Composition

Assessment of body composition after the feeding with different diets indicated differences between salt dietary treatments. There are differences between the young carp fed with salt dietary and with fish fed with dietary without salt. The whole-body protein and lipid percentages of the fish were not significantly different between dietary treatment groups at the ending of the feeding trial (Table 3).

On the other hand, fish that fed the salt diet had a significantly (P <0.05) higher protein percentage and insignificant (P>0.05) lower fat percentage compared with fish fed with control diet (not significantly

different),. The whole-body moisture percentage in fish that received the salt diet was significantly lower (P <0.05) than those in fish that were fed no salt diets (Table 3**).** The final fish body ash content was also lower than that the initial ash content except at E treatment (P > 0.05).

Table 3. Proximate whole-body composition of common carp before and after 60 days experiment.

Body composition	Before feeding	A	B	C	D	E
Moisture	78.21±0.26^{b}	77.28±0.21^{a}	77.20±0.31^{a}	77.30±0.28^{a}	77.28±0.14^{a}	77.82±0.57^{b}
Crude protein	14.32±0.29^{c}	15.31±0.19^{b}	15.69±0.26^{ab}	15.68±0.04^{ab}	15.98±0.18^{a}	15.17±0.26^{b}
Crude fat	3.27±0.43^{a}	3.23±0.48^{a}	3.20±0.46^{a}	3.14±0.31^{a}	2.79±0.33^{a}	2.78±0.14^{a}
Ash	3.50±0.14^{a}	3.48±0.34^{a}	3.21±0.15^{a}	3.18±0.29^{a}	3.25±0.34^{a}	3.53±0.28^{a}

*Mean in the same row with different superscripts are significantly (P <0.05) different. Mean in the same row with the same superscript are not significantly different (P>0.05).

Discussion

The fish survival rate was 100% for all experimental diets containing different level of salt. The range of different water quality parameters monitored over the study period was within tolerable limits for the fish cultured. In this study, an improvement in Food conversion efficiency and Food conversion ratio was found in the fish fed D level of dietary salt (Table 2). However, partial analysis of the cost-effectiveness of operations under experimental conditions suggested that the D (1.5%) diet was more effective than the other concentrations in young carp culture. Therefore, this level of sodium chloride induced the best growth for the young carps. It could be suggested from the results of the current study that the growth of young common carp cultured in local freshwater can be significantly improved by adding 1.5% salt into the fish diet. [6,7,8] reported that growth and feed conversion ratio are better by feeding diets with added salt (sodium chloride). Quantity above and lower the optimum resulted in lesser weight gain and food conversion. On other hand, [9] found that 2% gave the best growth for common carp. Better weight gain was also found with 2% sodium chloride supplementation in the diet of the eel Anguilla japonica by [10] and juveniles of red drum by [3]. The dietary salt is suggested to affect the growth by increasing food conversion efficiency in rainbow trout [11]. On other hand, It was found that the salt affect growth rate inversely when the level of supplementation interferes with the balance of other main dietary components [9]. The sort of diet is found to control the activity of digestive enzymes [12]. However, the increased digestive enzyme activity together with higher nutrient digestibility might be resulted in better utilization of nutrients from salt incorporated diets [9]. Indeed, low digestibility and faster evacuation of food have been associated with high levels of sodium chloride in diets [13]. This study found that dietary salt also influenced body composition. Higher carcass protein and fat was recorded in sodium chloride fed common carp [9].These observations are maybe related to the fish's use of proteins and glycogen as energy sources.

Conclusion

This study shows that growth performance and feeding utilization in common carp juveniles reared in fresh water can be significantly improved by adding 1.5% salt to their diet. The 1.5% diet gave the best specific growth rate, feed conversion ratio and protein efficiency ratio for juvenile common carp reared in freshwater water.

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