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Effects of Alien Organisms on Growth of Common Carp, *Cyprinus carpio* Cultivated in Earthen Ponds

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Abstract: The experiment was conducted at Agricultural Research Station-Aquaculture Unit- Agriculture College- Basrah University in six earthen ponds (600 m^3). The stady inclouding of alien organizms effect on growth of common carp *Cyprinus carpio*. Using an agricultural shadow as a filtering fabric was put in inlets pipes (T1), while T2 without filters. Fishes was daily feeding by a commercial sinking pellets manufactured by Agricultural Consultant Office belonging to Agriculture College, With a ratio of 3% from fishes weight. Total length and weight of fishes were measured at the beginning and at the end of the experiment. The weight of subsamples for fishes were taken periodically and daily feed changed after each weighing. At the end of the experiment the alien organism in all ponds were collected, classified and weighed individualy except shrimp. Results of current experiment revealed that there were significant differences (P≤0.0.5) in final weigh, wight increment, daily growth rate and feed conversion rate between fishes reared in ponds with and without filter. These differences may be related to differences in numbers and weighs of alien organisms in these ponds (97 individuals of six fish species in ponds without filter comparing with two individuals of one fish species in ponds with filter, and also 16314 g of shrimp in ponds without filter comparing with 440 g in ponds with filter). From the results of the current experiment, it can be concluded that culturist must used filters in inlet pipes of their ponds to prevent or reduced the entering of alien organizms to these ponds.

المستزرعة في الاحواض الارضية*Cyprinus carpio*تاثير الاحياء الغريبة في نمو اسماك الكارب الشائع،

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المستخلص: اجريت الدراسة الحالية في ستة احواض ارضية (٦٠٠ متر مكعب) تابعة لوحدة الاستزراع المائي في محطة البحوث الزراعية في الهارثة التابعة لكلية الزراعة-جامعة البصرة، لغرض فحص تاثير الاحياء الغريبة (غير المستهدفة في الأستزراع) على نمو اسماك الكارب الشائع، *Cyprinus*

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carpio. وضع المرشح المصنوع من شبكة الظلة الزراعية في مدخل المياه لثلاثة احواض (المعاملة الاولى) وتركت الثلاثة احواض اخرى من غير مرشح (المعاملة الثانية). غذيت الاسماك يوميا بنسبة تغذية قدرها ٣٪ من الوزن الحي للاسماك باستعمال حبيبات علفية مركزة غاطسة مصنعة في معمل الاعلاف التابع للمكتب الاستشاري الزراعي لكلية الزراعة. تم قياس طول الاسماك الكلي ووزنها في بداية التجربة وفي نهايتها، بينما قيست اوزان الاسماك بشكل دوري وعدل الغذاء اليومي بعد كل قياس. في نهاية التجربة تم جمع كل الاحياء الغريبة في الاحواض ثم صنفت ووزنت افرادها ماعدا الروبيان الذي استخرج وزنه الكلي. اشارت نتائج الدراسة الحالية بوجود اختلافات معنوية (P≤0.0.5) في الوزن النهائي والزيادة الوزنية ومعدل النمو اليومي ومعدل التحويل الغذائي بين الاسماك المستزرعة بالاحواض المزودة بمرشح والاحواض الخالية منه. ربما تعود هذه النتائج الى الاختلافات في اعداد واوزان الكائنات الغريبة التي وجدت في الاحواض (٩٧ سمكة تعود الى ستة انواع في الاحواض الغير مجهزة بمرشح مقارنة بسمكتين تعود لنوع واحد في الاحواض المجهزة بمرشح، اضافة الى ١٦٣١٤ غم من الروبيان في الاحواض ذات المرشح مقارنة ب ٤٤٠ غم من الروبيان في الاحواض الحاوية على مرشح). الاستنتاج العام من نتائج التجربة الحالية هو ضرورة استخدام مستزرعي الاسماك مرشحات في مدخل مياه الاستزراع لمنع او تقليل الاحياء الغريبة من الدخول الى احواض الاستزراع.

الكلمات المفتاحية: الاحياء الغريبة، معدل النمو اليومي، المرشحات، الوزن النهائي.

Introduction

The total aquaculture fish production comprise in 2018 around 46% of total world fish production, so it must be increased at least five times in order to face the demand during the next two decades (FAO, 2020). It must be initiate new production systems with high fish density such as recirculating aquaculture systems to face these increasing demand. Martins *et al*., 2010 mentioned that the expansion of traditional fish culture projects such as earthen ponds lead to deteriorate water quality and then reducing the capacity of these projects. The most common species that generates a significant part of fish production in inland freshwater around the world was common carp, *Cyprinus carpio.* This species was nearly the alone cultivated species in Iraq which cultured in ponds and cages. In Iraq there were un correct understanding for the scientific fish culture and management practices, for this reason the production of common carp per hectare is much lower than other countries around the world. FAO (2022) reported that common carp was the fourth important freshwater cultivated species around the world in 2020 after grass carp, *Ctenophayngon idella,* silver carp, *Hypophthalmichthys molitrix*, and Nile tilapia, *Oreochromis niloticus* (FAO, 2022).

Stocking rates and the availability of natural food were the most two important factors affected the growth and production of cultivated fishes (Badilles *et al*., 1996; Hassan & Mahmoud, 2011; Roy *et al*., 2018). It is hardly to determine the optimum fish densities of different cultivated species and also of the same species in different rearing systems, but to improve fish performance and economic profitability, it is important to determine these densities.

Weimin & Diana (٢٠٠٩) mentioned that native species protection is an important issue facing several countries in Asia, where the introduction of alien species is viewed with skepticism. The main effects of alien species were predation, competition, hybridization with native species that disrupt the processes and functions of ecosystems (Walsh *et al*., 2012). De Silva *et al*. (2007) recorded many reasons for the number of freshwater fish species that became extinct, endangered or becoming rare, and one of these reasons, was the introduction of alien species. So, the rerearches dealing with the impacts of alien species is very important to develop solutions for conservation problems (Richardson & Ricciardi, 2013). Introduction of alien species was done for improved aquaculture yield and biological control, but these species had the ability to alter ecosystem through many functions such as predation, hybridization, introduction of parasites, competition and alteration of existing food webs (Wellcome, 1988; Ogutu-Ohwayo & Hecky, 1991; FAO, 2004).

Freire & Prodocimo (2019) pointed out that the deleterious effect on the native fauna caused by Nile tilapia has been extensively reported worldwide, while Okun *et al*. (2008) stated that this fish made many changes for the native community structure and also reducing the abundance of planktonic micro crustaceans, lowering water transparency and increasing the abundance of microalgae. Mozambique tilapia, *Oreochromis mossambicus* is also known as invasive species that cause many environmental and ecological problems around the world (Canonico *et al*., 2005). Casal (2006) reported 159 fish species introduced in philipines for aquaculture (18%), ornamental (77%), mosquito control (4%) and 1% for fisheris purpose, but 24% of these species recorded in natural environments. In Europe countries there were 1200 alien species and 11% of them are invasive, causing significant environmental, economic and social damage (FAO, 2015). It is well known that alien species considered invasive only if it had adverse impacts on environment, economy and human health. The current study aims to evaluate the effects of alien organisms on the growth of common carps cultivated in earhen ponds by using filter made from agricultural shadow.

Materials and Methods

The experiment was conducted at Agricultural Research Station belong to Aquaculture Unit-Agriculture College- Basrah University, which located in Al-Hartha District about 16 km northern-east of Basrah Governorate (30º39`20.264"N, 47º 44`51.533"E). Six earthen ponds (600 m^3) were used from 24th February to 23th July 2021. Filters made from agricultural shadow was put in inlets pipes of pond 1, 2 and 3 (T1), while inlets pipes of pond 3, 4 and 5 without filters (T2). Twenty five individuals of common carp were put in each pond with initial average fish weigh range of 111.1- 140.0 g.

Fishes were fed daily using a commercial sinking pellets manufactured bAgricultural Consultant Office belonging to Agriculture College using different ingredients (Fishmeal 25%, wheat flour 28%, wheat bran 25%, barley 15%, soya meal 5% and vitamins-minerals premix 2%). Feeding level 3% of fish weight was used. Weight and total length of fishes were measured at the beginning and at the end of the experiment. Subsamples of fishes were weighed periodically to change the daily feed that divided into three meals, the first given early at the morning, the second at mid-day and the third given at afternoon. At the end of the experiment the alien organism in all ponds were collected, classified and weighed individualy except shrimp.

Environmental parameters were measured included both temperature, pH and salinity of the pond water were measured at each weighing of fishes by (Mps556YSI). These sampling during experiment period were used to calculate the following equations:

$$Weight\ increments\ (WI, g)\ =\ FW - IW$$
$$Daily\ growth\ rate\ (DGR, gday - 1)\ =\ FW - IW\ \ days - 1$$
$$Specific\ growth\ rate (SGR\%day - 1)\ =\ 100 * [(ln\ FW) - (ln\ IW)]\ days - 1$$
$$Where: FW\ =\ Final\ fish\ weight\ (g);\ IW\ =\ Initial\ fish\ weight\ (g)$$

The following equation was used to calculate the length-weight relationship for fishes at the beginning and the end of the experiment for each treatment:

$W = aLb$ (Pauly, 1983).

Where W= weight of fish in g, L= Length of fish in cm, a = describe the rate of change in weight with length (intercept), and b = weight at unit length (slope).

The condition factors (K) were estimated before and after experiment using the following equations:

1- Fulton's condition factor, the value of K was calculated according to Froese (2006): $K3\ =\ 100\ w/L3$

2- Modified condition factor (Ricker, 1975) was estimated following Gomiero & de Souza Braga (2005):

$Kb\ =\ 100\ w/Lb$

3- Relative condition factor 'Kn' (Le Cren, 1951) was estimated by Le Cren (1951):

$Kn\ =\ W/\ \hat{}w$

Where W= the actual total weight of the fish in g, ^w= the expected weight from length-weight relationship formula. The results of current experiment was conducted with a completely randomized design, and the differences between the means were tested by analysis of variance (ANOVA). The significant differences were tested by LSD test at 0.5% probability level by SPSS program Ver. 26. Fish classification was based on (Coad, 2010).

Results

The measurements of average fish weight and environmental parameters during the experiment were showed in table (1). The range of initial average weight was 111.1 g in pond 3 and 140.0 g in pond 5. Water temperature ranged from 17 ^{0}C during Feb. to 30 ^{0}C during July, pH ranged between 7.8-8.1 and salinity between 3.14-4.23 PSU. The growth criteria of the six ponds for the two treatments were shown in table (2). The highest average final weight (645.0 g) achieved by T1, while the lowest (573.2 g) achieved by T2. Statistical analysis for FW showed significant differences ($P \leq 0.05$) between T1 and T2. The highest average weight increment (523.2 g) was achieved by T1, while the lowest (448.3 g) achieved by T2. Statistical analysis for WI showed significant differences ($P \leq 0.05$) between T1 and T2. Fishes in T1 recorded average daily growth rate of 3.49 gday^{-1}, while fishes in T2 recorded 2.99 gday^{-1}. Statistical analysis for

DGR showed significant differences ($P \leq 0.05$) between T1 and T2. The average specific growth rates recorded were 1.11 and 1.02 $\%day^{-1}$ for T1 and T2 respectively. Statistical analysis for SGR showed no significant differences ($P>0.05$) between the two treatments. Fishes in T1 recorded best average feed conversion rate (2.27) comparing with fishes in T2, where feed conversion rate was 2.89. Statistical analysis for FCR showed significant differences ($P \leq 0.05$) between T1 and T2. Statistical analysis for fish mortality ratio showed no significant differences ($P>0.05$) between the two treatments, where it was 1.2% for T1 and 1.1% for T2.

Table (3) shows data on length and weight of common carp before and after the experiment. In the two treatments there was an increase in total length and weight. The highest increase (16.1 cm) in total length was achieved by T1, while lowest increase was 15.2 cm achieved by T2. Fig. (1) pointed out the length-weight relationship for fishes before the experiment. There was a negative allometric pattern of growth (b less than 3) in the two treatments as b values were 2.8495 and 2.9122 for T1 and T2 respectively. Fig. (2) illustrate the length-weight relationship for the two treatments after the end of experiment with positive allometric pattern of growth (b more than 3) in the treatments where b values were 3.3041 and 3.1649 for T1 and T2 respectively.

Table (4) shows the parameters of the length weight-relationship for common carp before and after the experiment. Statistical analysis showed that there were no significant differences ($P>0.05$) between values of b with value 3 (Isometric pattern of growth) of common carp before and after the experiment for the two treatments. Table (5) show condition factors for common carp at the beginning and the end of the experiment. Results appeared decreasing in modified condition factor (Kb) after the experiment from 2.7988 to 0.4623 in T1 and from 2.2974 to 0.4540 in T2. Statistical analysis of the results showed there were no significant differences ($P>0.05$) in the three models of condition factors after the experiment.

Table (6) shows alien organisms found in the six ponds after the end of experiment. Six fish species {Redbelly tilapia (*Coptodon zillii*), sailfin molly (*Poecilia latipinna*), abu mullet (*Planiliza abu*), crucian carp (*Carassius uratus*), dusky frillgoby (*Bathygobius fuscus*) and congaturi halfbeak (*Hyporhamphus limbatus*)}were founds in adition to native shrimp (*Metapenaeus affinis*). Numbers and weight of fishes and shrimp differ greatly from ponds with filters (T1) comparing with ponds without filter (T2). Largest number (42) of alien fishes found in pond 4 with higest (320.9 g) fish individual weight represented by redbelly tilapia. Highest shrimp weight (6722 g) was found in pond 5, while there were no shrimp and no alien fish in pond 2. It has pointed from the results that only two individuals of alien fishes found in T1 comparing with 97 individuals in T2.

Table (1) The average measurements of fishes weight according to the environment parameters.

Date	Average Fish Weight (g) ±SD						Temp. (ºC)	pH	Sal. (PSU)
	T1P1	T1P2	T1P3	T2P4	T2P5	T2P6			
24/2/2021	128.1 ±38.7	126.1 ±60.2	111.1 ±50.7	111.8 ±37.3	140.0 ±45.7	122.7 ±51.0	17	8.0	3.19
18/3	187.0 ±35.7	150.0 ±89.7	126.1 ±55.6	148.5 ±38.9	176.0 ±55.6	162.5 ±51.9	21	7.8	3.22
8/4	227.0 ±55.8	226.9 ±88.2	230.7 ±88.9	225.0 ±67.5	311.4 ±87.5	222.7 ±69.0	25	7.9	3.14
29/4	279.8 ±84.9	300.7 ±100.8	310.6 ±77.5	287.6 ±99.6	370.9 ±100.5	270.9 ±120.8	26	7.9	3.34
20/5	402.7 ±11.4	303.6 ±130.6	330.5 ±76.4	318.8 ±140.5	375.0 ±100.9	372.5 ±111.1	27	8.0	3.88
17/6	527.5 ±133.2	460.0 ±130.7	395.8 ±120.9	419.4 ±130.4	410.0 ±133.2	397.0 ±165.9	27	8.1	4.01
2/7	600.5 ±165.4	555.8 ±164.3	510.8 ±144.4	490.8 ±166.3	470.7 ±160.7	460.7 ±177.4	29	8.0	4.23
23/7	654.9 ±193.1	654.4 ±192.2	625.6 ±189.6	572.3 ±192.9	563.7 ±173.3	583.5 ±209.6	30	8.0	4.11

Table (2) Growth criteria of the two treatments in the experiment.

Growth Criteria	Treatments					
	T1 (with filter)			T2 (without filter)		
	P1	P2	P3	P4	P5	P6
FW	654.9	654.4	625.6	572.3	563.7	583.5
Average	645.0 a			573.2 b		
WI (g)	526.8	528.3	514.5	460.5	423.7	460.8
Average	523.2 a			448.3 b		
DGR ($gday^{-1}$)	3.51	3.52	3.43	3.07	2.82	3.07
Average	3.49 a			2.99 b		
SGR ($\%day^{-1}$)	1.09	1.09	1.15	1.09	0.93	1.04
Average	1.11 a			1.02 a		
FCR	2.18	2.34	2.28	2.55	3.14	2.98
Average	2.27 a			2.89 b		
Mortality rate (%)	0.4	0	3.2	0.4	0.8	2
Average	1.2 a			1.1 a		

Different letters in one row shows a significantly different ($P \leq 0.05$).

Table (3) length and weight data of common carp before and after the experiment.

Treatments	Length range (cm)	Weight range (g)	Mean length (cm)	Mean Weight (g)
Before experiment				
T1 (with filter)	13.2-25.0	44.0-266.0	19.3	121.8
T2 (without filter)	13.6-24.6	43.0-242.0	20.0	124.8
After experiment				
T1 (with filter)	26.2-43.4	216.0-1213.0	35.4	645.0
T2 (without filter)	28.0-43.8	247.0-1270.0	35.2	573.2

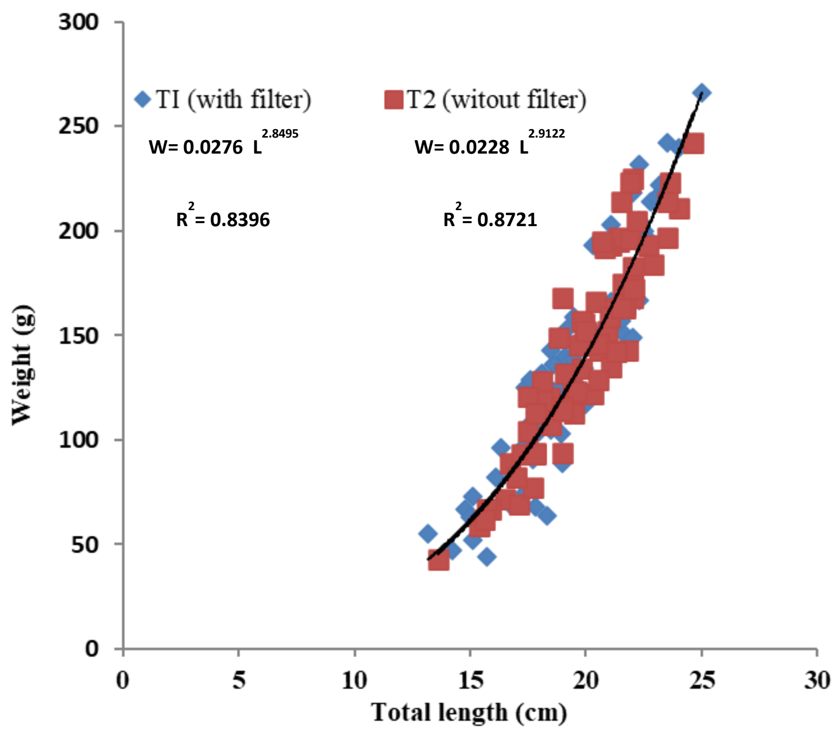

Fig. (1) Length-weight relationship for the two treatments of common carp before the experiment.

1.

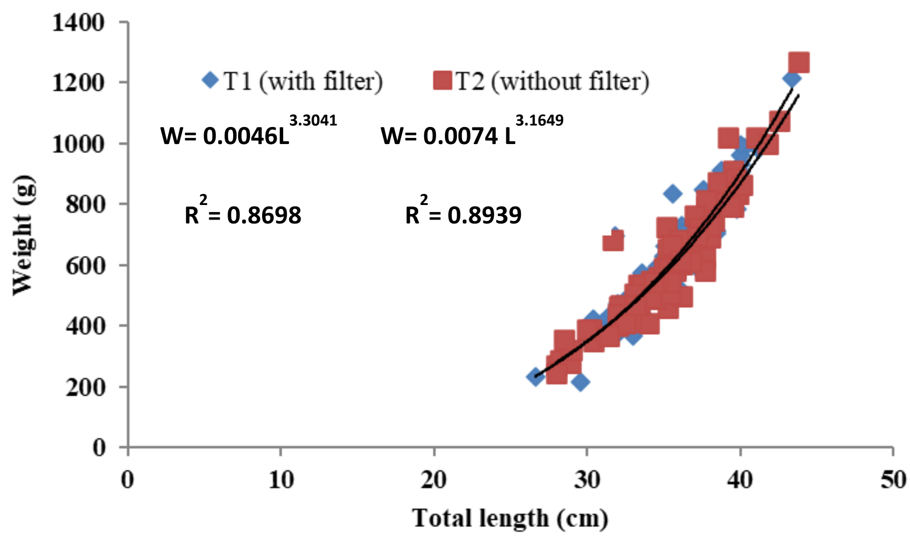

Fig. (2) Length-weight relationship for the two treatments of common carp after experiment.

Table (4) Values parameters of Length-weight for common carp before and after experiment.

• Treatments	• a	• b	• r^2	• t value (calculated)	• Significance of t
Before experiment					
T1	0.0276	2.8495	0.8396	3.1661	0.9738
T2	0.0228	2.9122	0.8721	2.9152	0.1052
After experiment					
T1	0.0046	3.3041	0.8698	١,٤٠٥٦	0.1968
T2	0.0074	3.1649	0.8939	0.2391	0.4253

Table (5) Models of condition factors for common carp before and after the experiment.

• Treatments	• Condition factors		
	• Modified • condition factor • Kb= 100 W/ L^b	• Relative condition factor • Kn= W/ W^	• Fulton's • condition factor • K3= 100 W/ L^3
Before experiment			
T1	2.7988 a±0.4398	1.0141 a±0.1593	1.7951 a±0.2873
T2	2.2974 b±0.3042	1.0076 a±0.1334	1.7672 a±0.2348
After experiment			
T1	0.4623 c±0.0599	1.0051 a±0.1214	1.3670 b±0.1653
T2	0.4540 c±0.0517	0.9860 a±0.1125	1.3386 b±0.1507

Different letters in one column is significantly different (P≤0.05).

Table (6) Numbers and weight ranges of alien organisms found in the ponds at the end of the experiment.

Treat.	Alien organisms												
	Coptodon zillii		*Poecilia latipinna*		*Planiliza abu*		*Carassius uratus*		*Bathygobius fuscus*		*Hyporhamphus limbatus*		*Metapenaeus affinis*
	No	WR (g)	No	WR (g)	No	WR (g)	No	WR (g)	No	WR (g)	No	WR (g)	W (g)
T1P1	-	-	-	-	1	14.1	-	-	-	-	-	-	320
T1P2	-	-	-	-	-	-	-	-	-	-	-	-	-
T1P3	-	-	-	-	1	5.3	-	-	-	-	-	-	120
T2P4	16	15.2-320.9	1	7.3	5	10.0-32.4	-	-	20	1.9-3.2	-	-	5038
T2P5	10	0.6-210.7	4	4.2-7.6	12	6.3-11.7	1	110	12	2.0-19.6	-	-	6722
T2P6	15	28.6-110.8	-	-	-	-	-	-	-	-	1	2.4	4556

Discussion

Water temperature, dissolved O2, salinity, pH and ammonia concentration affected cultivated fishes (Stickney, 2000; Piska & Naik, 2013). As is known from that The optimum water temperature for common carp ranged between 25-28 ^{0}C in tropical and subtropical regions , nevertheless many researchers recorded a desirable range (20-30°C) of water temperature for common carp in ponds (Bhatnagar & Devi, 2013; Mocanu *et al*., a,b2015; Oprea *et al*., 2015).In current experiment water temperature, pH and salinity were as optimum environmental factors for growth of common carp. Laiz-Carrión *et al*.(2005) stated that water salinity more than 7 PSU lead to increasing osmoregulation metabolism and then lead to negative effects on fish growth and feed conversion.

Results of the experiment revealed that there were significan differences (P< 0.0.5) in final weigh, wight increment, daily growth rate and feed conversion rate between fishes reared with and without filter, while there were no differences (P>0.05) in specific growth rate and mortality ratio. These differences may be related to diffences in numbers and weighs of alien organisms in these ponds (97 individuals of six fish species in ponds without filter comparing with two individuals of one fish species in ponds with filter, and also 16314 g of shrimp in ponds without filter comparing with 440 g in ponds with filter). The six fish species founds in ponds without filter, the Redbelly tilapia was the most dangerous on fish farms followed by sailfin molly. The reason of that these two species are highly efficient reproductive strategy, simple food requirements and their ability to live in a variety of conditions. Negative impacts of tilapia species were documented very well by many reasearchers (Englund, 2000; Costa-Pierce, 2003; Casal, 2006; Vitule *et al*., 2009). Canonico *et al.* (2005) pointed out that tilapia species are highly invasive and exist under feral environmental conditions in which they have been introduced. Many fish farms in Iraq (especially in Basrah) were failed because of tilapia fishes that have inexpensive prices (about 500 Iraqi dinnar for one kg compared with 4000-5000 dinnars for common carp). Small tilapia fishes also enter to floating cages in Basrah and became bigger to compete with common carp on feeds (Personal observation).

Many growth criteria recorded in current experiment were differ from the criteria of other experiments. DGR of current experiment ranged between 2.99-3.49 $gday^{-1}$, SGR ranged between 1.02-1.11 $\%day^{-1}$ and FCR between 2.27-2.89. Al-Jader & Al-Sulevany (2012) recorded SGR of 0.71, 0.87 and 0.76 %/day when common carp fed on three different protein ratio diets 25, 30 and 35%, respectively. Taher *et al*. (2014) recorded DGR of 3.16, SGR of 1.85 $\%day^{-1}$ and FCR of 2.63 for common carp fed 5% feeding level in floating cages. Mirror carp (*C. carpio*) recorded SGR of 4.95 and 4.80 $\%day^{-1}$ in two densities during 90 days (Hossain *et al*., 2014). Taher *et al*. (2018) pointed out that SGR of 2.44 $\%day^{-1}$ and FCR of 2.12 for common carp reared in semi-closed system for 52 days. Taher (2020) recorded DGR of 4.07-8.21 $gday^{-1}$, FCR of 2.56-7.07 when investigated four imported floating pellets. Albahadly *et al*. (2021) recorded DGR of 2.35 g/day and SGR of 0.23$\%day^{-1}$ for ungraded common carp cultivated in floating cages. The differences between the results of other studies and current study may be related to the differences in initial weights and cultivation system. Taher *et al*. (2021) recrded DGR of 5.92 and 3.70 $gday^{-1}$, SGR 1.07 and 0.98 $\%day^{-1}$, FCR of 2.24 and 2.46 for common carp cultivated with grass carp or alone respectively. Al-Dubakel *et al*. (2022) recrded DGR range of 3.41-4.33 $gday^{-1}$, SGR 0.88 -1.00 $\%day^{-1}$, FCR 2.67- 2.77 for common carp cultivated in and outside cages at earthen ponds.

- The length-weight relationship may differ according to species and also for the same species in the population due to many factors including feeding and reproduction, and it consider as an important tool for fishereies management. The value of the slope (b) for the length-weight relationship was differ according to many factors such as geographic location, environmental conditions, seasonality, stomach fullness, disease and parasite (Bagenal & Tesch, 1978). There were no significant differences ($P>0.05$) between values of b with value 3 (Isometric pattern of growth) of common carp in current experiment before and after the experiment for the two treatments, while there were an increasing from 2.8495 to 3.3041 for T1 and from 2.9122 to 3.1649 for T2. Alp & Balik (2000) recorded negative allometric growth (b= 2.8740) for common carp in Gölhisar Lake, and Tarkan *et al*. (2006) recorded b of 2.8300 for common carp in Lake İznik. Similar results have been found for the common carp cultivated in different ponds environment (Kadhar *et al* ., 2014) and for common carp from Taqtaq Region of The lower Zab River-Northern Iraq (Rashid *et al*., 2018). Positive allometric growths (b=3.319) were recorded for some populations of common carp in Almus Dam Lake and also for Ömerli Reservoir (b=3.140) (Karataş *et al*., 2007; Vilizzi *et al*., 2013). Taher *et al*. (2021) recrded b value of 3.4238 when cultivated common carp with grass carp and 3.0899 when cultivated alone in earthen ponds. Al-Dubakel *et al*. (2022)recrded b value range 3.1702-3.5704 when cultivated common carp in and outside cages at earthen ponds.

- The low value of modified condition factor (Kb) in current experiment may be related to the high value for b. Taher *et al*. (2021) recrded 0.31, 1.01 and 1.47 as Kb, Kn and K3 respectively for common carp cultivated with grass carp and 0.98, 1.01 and 1.35 when cultivated alone in earthen ponds. Al-Dubakel *et al*.(2022) recrded condition factors ranges as 0.19-0.79, 0.99-1.05 and 1.38-1.56 of Kb, Kn and K3 respectively for common carp cultivated in and outside cages at earthen ponds.

Conclusion

From results of current experiment it can be concluded that alien fishes and shrimp affected growth criteria and feed conversion ratio of common carp cultivated in earthen ponds. For this reason it is recommended for fish culturist to use filters in inlets pipes to prevent these organisms from entering to their rearing ponds.

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