Effect of potassium chloride and growth hormone supplementation on survival, nutrition and growth in juvenile *Common carp* fish Cyprinus carpio exposed to salinity

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Abstract

The current study was conducted on juveniles of the common carp, *Cyprinus carpio*, which is one of the most important fish for breeding in Iraq. The study included the effect of adding different percentages of potassium chloride and growth hormone to the diet on survival, nutrition and growth rates when suddenly exposed to different salt concentrations (7 and 15) g/L. Juvenile common carp fish showed the ability to tolerate a sudden rise in salt concentrations (7 and 15) g/l when fed on diets with different percentages of potassium chloride and growth hormone compared to control diet fish. A significant increase ($P\leq0.05$) was recorded in the survival rates of treatment T3 (97%) on the fourteenth day compared to the sample T1 (87%) in the saline concentration 7 g/L. And the treatment T3 and T5 (87% and 80%) respectively compared to the sample T1 (67%) at the saline concentration 15 g/L.The results of the current study show that the growth rates increased in the treatments to which potassium chloride and growth hormone were added at the expense of other treatments. As for the feeding efficiency of juvenile common carp, it is clear that the rate of food conversion improves by increasing the proportion of potassium chloride and growth hormone in the diet.

Keywords: potassium chloride, growth hormone, juvenile, *Common carp*

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Introduction

The large increase in the population has led to increased interest by scientists and researchers in fisheries to develop the exploitation of this wealth and maintain its sustainability to meet the requirements of animal protein (Takei and Hwang, 2016). Aquaculture is one of the most growing sectors of meat production in the world, and estimates indicate an increase in the extension of table fish by 3.1% over the previous one. While the world population increased by 1.6 percent, the average per capita consumption of fish in the world increased from about 19.4 kg / year during the sixties to 20 kg in 2017, and the percentage is expected to increase due to the increase in demand. Therefore, the workers in the field of fisheries tended to develop this sector, which is considered one of the permanent and inexhaustible resources in the light of optimal economic exploitation (FAO, 2020). The high salinity of fresh water resources in southern Iraq, especially the Shatt al-Arab estuary, is one of the most important negative factors affecting the breeding of freshwater fish in this region. The salty tongue penetrating into the Shatt al-Arab has led to environmental and material deteriorations on the fish stocks, and the region is still witnessing The salty tongue penetrating into the Shatt al-Arab led to environmental and physical deterioration of the fish stock, and the region is still the fourth treatment increased significantly from the rest of the treatments. The study indicates that salts can be added to food to improve growth and survival in water with high salinity.

materials and methods

experiment fish:

Juvenile common carp (*Cyprinus carpio*) were brought from the ponds of the aquaculture unit of the College of Agriculture, University of Basra, with an average total weight of (44.82 g ± 11.82) and an average total length (12.5 cm ± 2.33). The fish were transported to the laboratory using plastic bags and by refrigerated transport. To reduce stress, the fish were randomly and evenly distributed in glass aquariums (30 x 60 x 40) cm in order to acclimatize them for a week under laboratory conditions and a 3% control diet.

Manufacture of nutritional feeds:

Feed materials available in the local markets were used as main raw materials in the manufacture of experimental diets, which are wheat flour, barley flour, soybean powder and fish meal from the feed factory of the Marine Science Center / University of Basra.

A mixture of vitamins and minerals prepared by the Arab Company for Veterinary Real Estate and Pesticides (made in Jordan). The chemical composition of the feed materials was determined based on Takeuchi et al. (2002).

After making the calculations for the materials included in the formulation of the diets, the quantities used of those raw materials needed for feeding during the experiment period were determined as shown in Table (1).

witnessing increases in salinity from time to time, which affected the aquatic environment in general and fish farming activities in the region in particular (Younis and Al-Shamary, 2011).The process of osmotic regulation in fish is one of the energy-consuming processes that negatively affect growth, and this process is under hormonal control that controls the movement of ions within and through members of osmotic regulation, directly or indirectly (Tait *et al*., 2017). Some studies have addressed the role of fish hormones in adapting to low and high osmotic environments because hormones in the blood plasma of teloste fish such as growth hormone and cortisol are accompanying the ionic regulation process when fish adapt to sea or fresh water (Froese and Pauly, 2018), Whereas, growth hormone plays an important role in the process of acclimatization towards water salinity by increasing the activity of the Na+/K+ ATPase enzyme and the number and size of the chloride cell (Dang *et al*., 2000). The effect of saline feeding on the concentration of sodium and potassium ions in the blood plasma and the volume of Packed cell volume of common carp fish showed that fish fed on diets containing sodium and potassium gave the best growth rates and increased the activity of digestive enzymes in their juveniles at specific saline concentrations (Al-Saadi and Al-Khashali, 2015). Mzengereza et al., (2015) explained through his study to determine the response of *Oreochromis shiranus* fish on growth, survival and efficiency of saline feeding use, the feed conversion efficiency (FCR) was better in the second treatment (1.51) and the third treatment (1.44), The highest was in the fourth treatment in which additions of sodium chloride were used. The survival rate in

The substances to be added were added growth hormone GH from Dutto animal health company of Chinese origin and potassium chloride KCl from Weat coast pharmaceutical works company of Indian origin to the manufactured diets in the proportions shown below:

1- (T1): A standard diet containing 0% growth hormone and potassium chloride.
2- (T2): Potassium chloride (Kcl) 3%.
3- (T3): Potassium chloride, KCl, 7%.
4- (T4: 1% growth hormone GH)
5- (T5): A diet containing 3% of growth hormone (GH)

Table (1): shows the components of the diet and the proportions of each.

(addition percentage%)Diets					Diet name
Diet T5	**Diet T4**	**Diet T3**	**Diet T2**	**Diet T1**	
25	25	25	25	25	**fishmeal**
18	18	18	18	18	**soybean**
15	15	15	15	15	**barley flour**
2	2	2	2	2	**Vegetable oil**
38	38	38	38	38	**wheat flour**
5	5	5	5	5	**Mixture of vitamins and minerals**
0	0	7	3	0	**kcl**
3	1	0	0	0	**GH**

The Diets was made and the materials were mixed for the feed to obtain the required protein. The Diets were made according to Lovell (1989) as follows:
The fodder materials were well ground and passed through a sieve with openings of 0.4 mm, then these materials were mixed in the calculated proportions, mixing well to make them homogeneous. Then add approximately 100 ml of boiling water for every 250 g of the mixture and after mixing well The temperature of the mixture was raised to 80°C and the mixture was left to cool, then vitamins, minerals, potassium chloride and growth hormone were added. After that, the diet was formed in the form of tablets by means of a plastic medicine syringe with holes (1-3) mm in diameter, and then left to dry air inside the laboratory, Then placed in elastic bags and kept in the refrigerator until use. The chemical analysis of the ration was carried out by Rapid Content Analyzer (Table 2).

Table (2): Chemical composition of the diet.

%	Chemical composition
0.15 ±2.88	**moisture**
1.72 ±32.26	**protein**
0.35 ±9.11	**fat**
0.41 ±4.52	**ash**
2.14 ±50.53	**Carbohydrates**

above. The fish were fed 3% of their body weight for the duration of the salt tolerance experiment, which lasted fourteen days, taking into consideration maintaining water quality by providing artificial ventilation, as well as changing 25% of the aquarium water daily. The survival rates of fish were determined on the first, fifth and fourteenth days of the experiment. Note that the temperature ranged between 27-28 ° C.

The survival rate was calculated according to the following equation:

(Number of live fish at the end of the experiment / Number of live fish at the beginning of the experiment) x 100

Growth experiment:

The growth experiment was started 6/21 until 8/31/2021. The initial weights of the fish were taken using a digital balance type MH-694 of Chinese origin, where their average weight was (44.82 g ± 11.82).

300 fish were distributed to thirty glass aquarium of 45 liters of water, 10 fish for each aquarium and three replicates for each treatment. The fish were transferred to two salt concentrations (7 and 15) g/L and fed for a week on pre-prepared diets (T1, T2, T3, T4 and T5) with a feeding rate of 3% of body weight for the purpose of acclimatization. After the acclimation period ended, the fish were starved for

Experimental design:

The experiments were conducted in the laboratories of the Department of Fisheries and Marine Resources, College of Agriculture, Basra University, for the period from 16/2/2021 to 29/11/2021. Unstressed fish of close weight were selected in the different experiments, and a number of other fish were kept as stock to be used when needed.

Effect of growth hormone and potassium chloride on survival rates during the salt tolerance experiment

To find out the effect of sudden transfer to salt concentrations (7 and 15) g/L on the survival rates of common carp fish after they were fed diets supplemented with different percentages of potassium chloride and growth hormone (T1, T2, T3, T4 and T5) for fourteen days.

Fifteen plastic aquariums were used for each salt concentration, with a capacity of 45 liters of water, with 10 fish for each pond and three replicates for each treatment (T1, T2, T3, T4 and T5).

The saline concentrations were prepared by dissolving a certain weight of salt (sea salt) in a liter of tap water, taking into consideration the salinity of the tap water when preparing each salt concentration from the concentrations mentioned

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three replicates for each treatment (T1, T2, T3, T4 and T5).

And ten fish for each aquarium. The fish were fed 5% of the wet body weight in the two salt concentrations (7 and 15).

The meal was presented at eight in the morning for ten days, where the remaining food was collected two hours after serving the meal using a siphon (filtered using filter paper and then air dried inside the laboratory).

After that, it is weighed in order to calculate the amount of food consumed by the fish) according to the level of Satiation according to the equation mentioned by Al-Tamimi (2007).

Satiation level % = (amount of feed consumed per day / total weight of fish) x 100

statistical analysis

Statistical analysis was carried out using a complete randomized design (CRD). The significant differences between the coefficients were determined by performing the least significant difference (LSD) test. All statistical tests were conducted using the Statistical package for social sciences (IBM SPSS), version 26.

Results

Survival rates in the saline tolerance experiment

Figure (1) shows survival rates on the first, fifth and fourteenth days of transfer to saline concentrations of 7 and 15 g/L,

noted that there were no significant differences ($P \geq 0.05$) between the treatments (T1, T2, T3, T4 and T5) on the first and fifth days of the experiment in the salt concentration 7 g/L, while a significant increase ($P \leq 0.05$) was recorded in the treatment T3 (97%) on the day. the three days before starting the experiment, with the weight of the fish in each aquarium to determine the initial weight, as the weights were close in the treatments.

The fish were fed two meals a day, the first at half past eight in the morning and the second at two o'clock in the afternoon, and the feeding was adjusted depending on the weight of the fish taken after every two weeks, for the purpose of monitoring growth throughout the ten-week experiment period.

During this period, the water was aerated using air pumps. In addition, the water was changed daily at a rate of 25%. Wire clips were used for the purpose of covering the aquariums to keep the fish from jumping out.

Standards studied in the experiment:

1- Weight Gain

Weight gain (gm) = Final weight (gm) - Starting weight (gm)

2- Relative Growth Rate (RGR)

Relative growth rate (%) =] weight gain (g)/starting weight (g)] x 100

3- Specific Growth Rate (SGR)

Specific growth rate (%/day) = [(natural logarithm of final weight (g) – natural logarithm of starting weight (gm)/period (day)] x 100

4- Daily growth rate (D.G.R)

Daily growth rate (g/day) = [final weight (gm) – starting weight (gm)]/period (day)

5- Food Conversion Rate (FCR)

Feed conversion ratio = (FCR) food weight (gm) / weight gain of fish (gm)

6- Conversion Efficiency (FCE) Food

Feed conversion efficiency (%) = increase in body weight (g) / food intake (g)] x 100

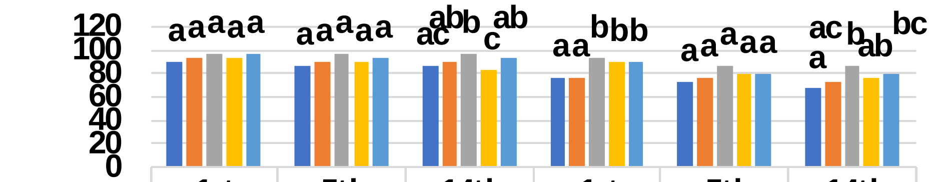
Satiation Level

The Satiation experiment was conducted after completion of the growth experiment. 30 pools were equipped with

80%), respectively, compared to T1 sample (67%) in saline concentration 15 g/L on the fourteenth day of transfer.

fourteenth compared to the T1 sample (87%).

Also, a significant increase (P≤0.05) was recorded in treatment T3 and T5 (87% and



	1st	5th	14th	1st	5th	14th
	PUS7			PUS15		
T1	90	87	87	77	73	67
T2	93	90	90	77	77	73
T3	97	97	97	93	87	87
T4	93	90	83	90	80	77
T5	97	93	93	90	80	80

period (day)

Figure (1) Survival rates of common carp juveniles in different treatments at saline concentrations (7 and 15) g/L.

growth parameter:

Table (3) shows some growth parameters of common carp fish fed on diets of different proportions of potassium chloride and growth hormone (T1, T2, T3, T4 and T5) at salt concentrations of 7 and 15 g/L during the growth experiment period that lasted for seventy days.

The results showed at the saline concentration 7 g/L that there was a significant difference (P<0.05) in the rate of total weight gain in treatment T2, T3 (potassium chloride), T4 and T5 (growth hormone) compared with treatment T1 (control).

The highest total weight increase rate was 141.57 g in treatment T3, 113.93 in treatment T2, 105.46 in treatment T5 and 102.26 in treatment T4 compared to 89.65 g in treatment T1 (control).

also found in the saline concentration of 15 g/L a significant (P≤0.05) in the total weight gain rate in treatment T2, T3, T4 and T5 compared with treatment T1.

The highest total weight gain rate was recorded: 118.74 g in treatment T3, 100.33 g in treatment T5, 91.95 g in treatment T4 and 85.97 g in treatment T2 compared to 72.48 g in treatment T1. Figure (2)

Also, a significant increase (P<0.05)) was observed in the relative and specific growth rate in treatments T2, T3, T4 and T5 at the saline concentration of 7 g/L compared to treatment T1. It recorded the highest value of the relative growth rate in treatments T3, T2, T4 and T5 (31.23%, 25.89%, 23.49% and 23.40%), respectively, compared to a relative growth in treatment T1 of (20.29%).

The value of the specific growth rate in treatments T3, T2, T5 and T4 was (0.544, 0.470, 0.420, and 0.422)%/day, respectively, compared to the specific growth in treatment T1 of (0.385)%/day. Figure (3 and 4)

A significant increase (P<0.05)) was observed in the relative and specific growth rate in treatments T2, T3, T4 and T5 at the saline concentration 15 g/L compared to the control treatment (T1).

The value of the relative growth rate in treatments T3, T5, T4 and T2 was (26.11%, 22.08%, 20.22% and 19.01%), respectively, compared to a relative growth in treatment T1 of (16.36%).

The value of the specific growth rate in treatments T3, T5, T4 and T2 was (0.464, 0.418, 0.368, and 0.348)%/day, respectively, compared to the specific growth in treatment T1 of (0.303)%/day. Figure (3 and 4)
The results showed at the saline concentration 7 g/L that there was a significant (P≤0.05) in the daily growth rate in treatments T2, T3, T4 and T5 compared with treatment T1.

The highest daily growth rate was recorded at 2.832 g/day in treatment T3, 2.279 g/day in treatment T2, 2.109 in treatment T5 and 2.045 in treatment T4 compared to 1.793 g/day in treatment T1.

It was also found in the saline concentration of 15 g/L a significant (P≤0.05) in the daily growth rate in treatments T2, T3, T4 and T5 compared with treatment T1.

The daily growth rate was 2.375, 2.007, 1.839 and 1.720 g/day in treatment T3, T5, T4 and T2, respectively compared with treatment T1 1.450 g/day.
Figure (5)

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Table (3): Initial and final biomass, total weight gain (gm), relative growth rate (%), specific growth rate (%/day), daily growth rate (gm/day) and food conversion ratio for common carp juveniles in different treatments exposed to two salt concentrations. 7 and 15 g/L. (Values are mean ± standard deviation).

daily growth rate (gm/day)	specific growth rate (%/day)	relative growth rate (%)	total weight gain (gm)	final biomass	Initial biomass	**tretment**	saline concentration
0.026±1.793 [a]	0.016±0.385 [a]	0.79±20.29 [a]	1.29±89.65 [a]	9.64± 531.87 [a]	10.93± 442.22	T1	**7**
0.061±2.279 [b]	0.009±0.470 [b]	0.73±25.89 [b]	3.04±113.93 [b]	2.41± 554.04 [a]	0.64± 440.11	T2	
0.129±2.832 [c]	0.015±0.544 [c]	1.01± 31.23 [c]	6.47±141.57 [c]	12.47± 594.72 [b]	6.01± 453.15	T3	
0.072±2.045 [d]	0.001±0.422 [d]	0.04±23.49 [d]	3.58 ±102.26 [d]	19.46±537.63 [a]	15.89± 435.37	T4	
0.017±2.109 [d]	0.014±0.420 [d]	0.88±23.40 [d]	0.87±105.46 [d]	21.47±556.65 [a]	20.60± 451.19	T5	
0.088±1.450 [a]	0.008±0.303 [a]	0.91±16.36 [a]	4.38±72.48 [a]	6.36±515.55 [a]	1.99± 443.08	T1	**15**
0.079±1.720 [b]	0.004±0.348 [b]	0.32±19.01[b]	3.92±85.97 [b]	16.97± 538.14 [b]	13.05± 452.17	T2	
0.037±2.375 [c]	0.012±0.464 [c]	0.77±26.11[c]	1.84±118.74 [c]	4.59± 573.7 [c]	6.43 ± 454.97	T3	
0.022±1.839 [d]	0.016±0.368 [b]	0.95±20.22 [a]	1.08±91.95 [d]	15.01 ± 547.18 [b]	16.09 ± 455.24	T4	
0.007±2.007 [e]	0.035±0.418 [e]	0.22±22.08 [d]	0.36±100.33 [e]	2.48± 554.63 [bc]	2.84± 454.31	T5	

Different letters in the same column indicate a significant difference (P<0.05).

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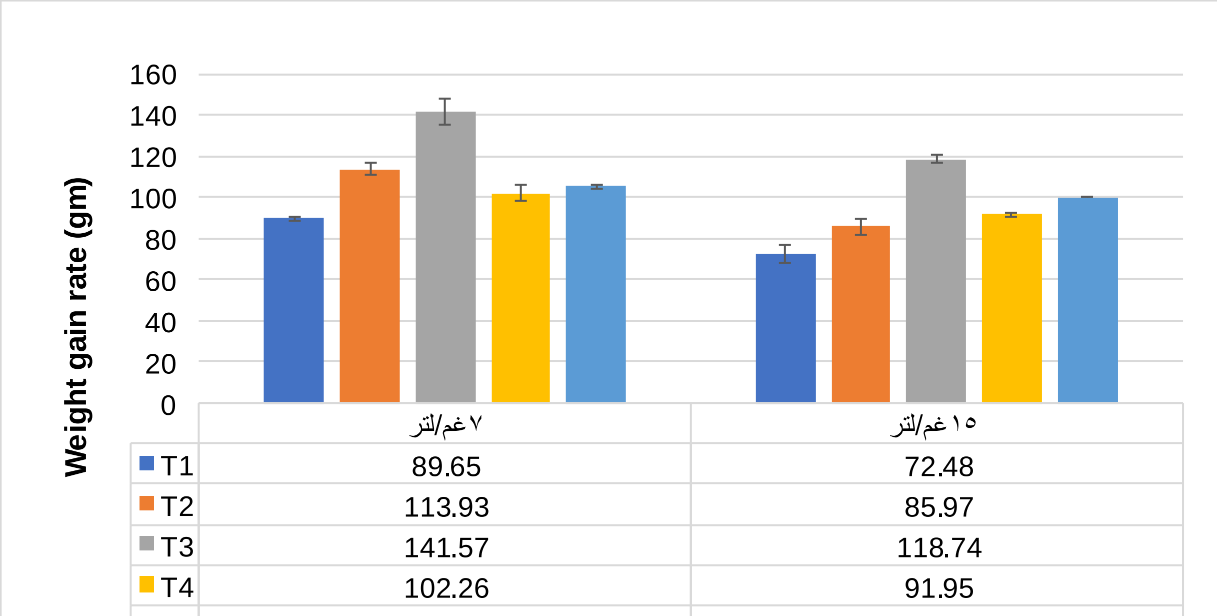

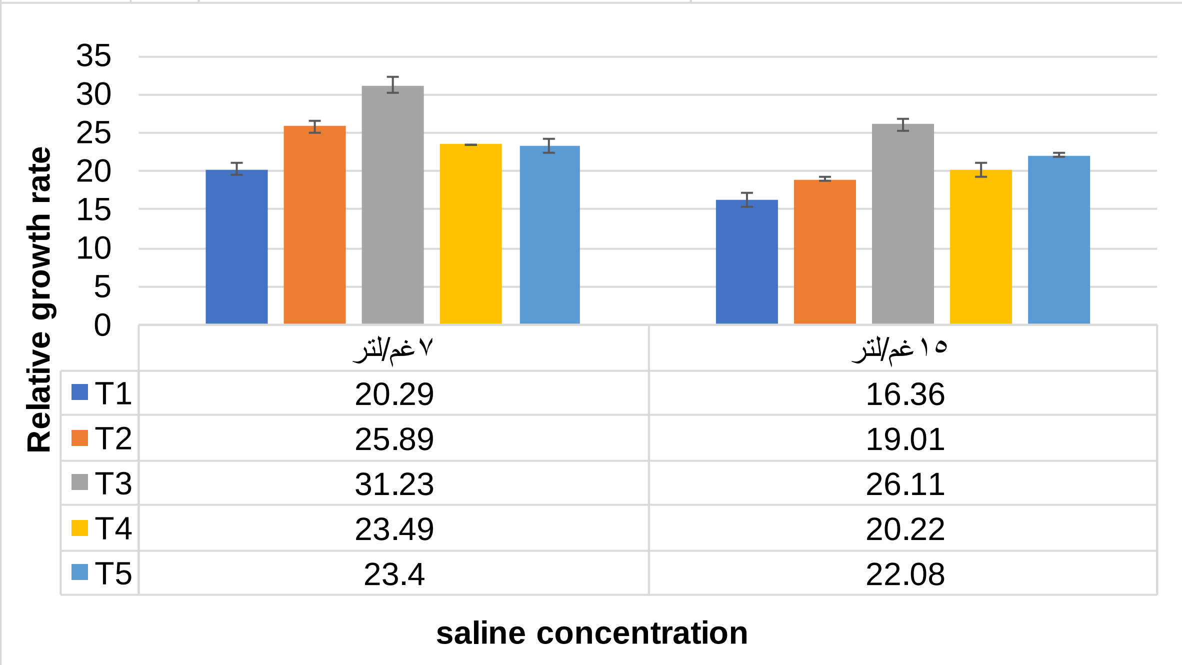

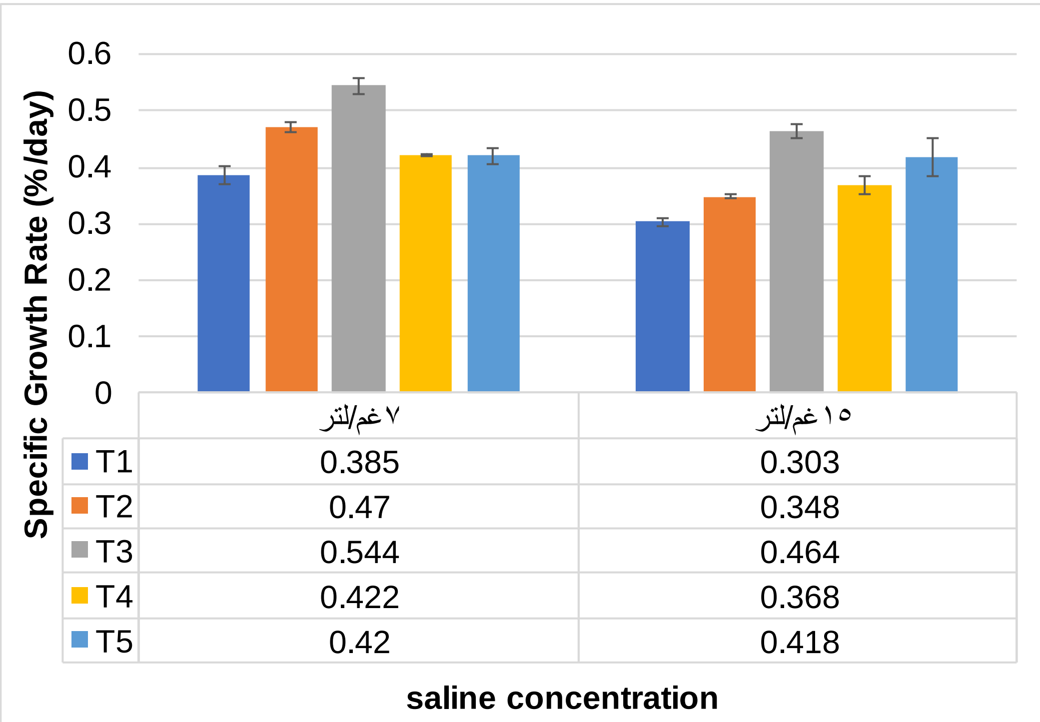

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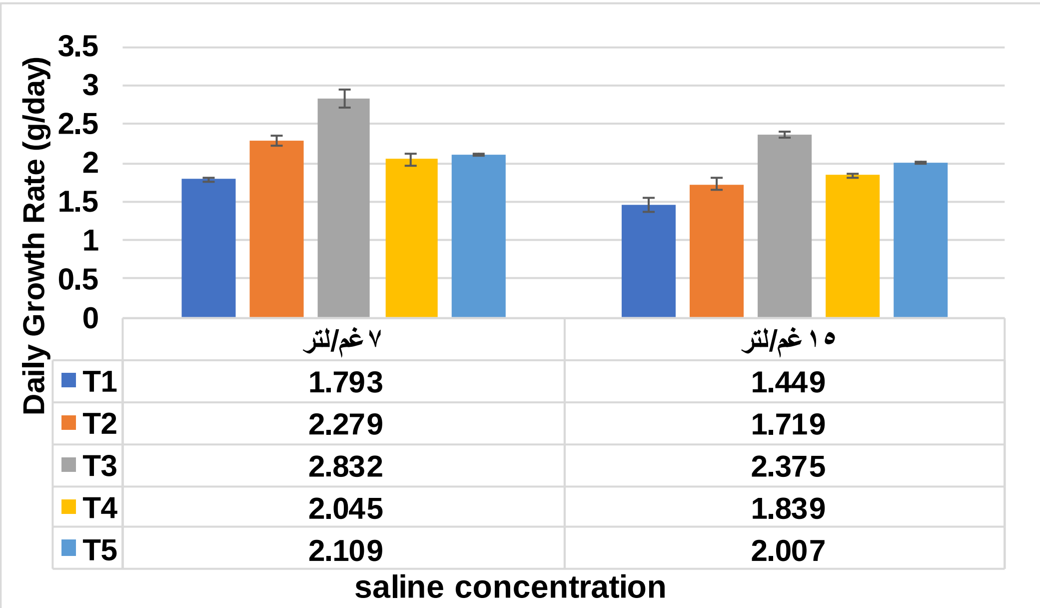
Figure (4): shows the specific growth rate (%/day) of juveniles of common carp in different treatments exposed to saline concentrations 7 and 15 g/L. (The values represent the mean ± standard deviation



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fish fed on diets with different proportions of potassium chloride and growth hormone (T1, T2, T3, T4 and T5) at the saline concentrations 7 and 15 g/L during the seventy-day growth experiment period.

The results showed that the fish in the T3 treatment at the saline concentration of 7 g/L had the best food conversion ratio of 5.12 compared with the other fish of the same saline concentration that showed the food conversion ratio of (7.27, 6.13, 6.72 and 6.41) for the treatment (T1 and T2). and T4 and T5) respectively.

Statistical analysis of the results of the current experiment proved that there were significant ($P<0.05$) differences in the values of food conversion ratios for treatment T3 compared to other treatments, and no significant differences ($P>0.05$) were recorded between treatment T2 and T5 and between T4 and T5.

Also, a significant increase ($P<0.05$) was recorded in the percentage of feed conversion efficiency for treatment T3 (19.56) compared to the other treatments T1, T2, T4 and T5. No significant differences were observed between treatment T2 and T5 and between T4 and T5 (Table 4) (Fig. 6 and 7).

The results also showed that the third treatment T3 at a saline concentration of 15 g/L had the best food conversion ratio of 6.02 compared with fish in the other treatments that showed food conversion ratios of 9.3), 8.32, 7.43 and 6.49) for treatment T1, T2, T4 and T5 respectively.

The statistical analysis of the results of the experiment showed that there were significant ($P<0.05$) differences in the values of food conversion ratios between treatment T3 and the rest of the treatments except for treatment T5.

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There was also a significant increase (P<0.05) in the percentage of feed conversion efficiency for treatment T3 (16.61) compared to treatment T1 (10.77), T2 (12.04), T4 (13.46), and T5 (15.44). (Table 4) (Fig. 6 and 7).

(%) Satiation level	treatment	saline concentrations
0.09 ± 2.15 [a]	T1	7
0.11 ± 2.48 [b]	T2	
0.18 ± 2.44 [bc]	T3	
0.20± 2.22 [ac]	T4	
0.08± 2.30 [ab]	T5	
0.72± 1.85 [a]	T1	15
0.18± 2.35 [a]	T2	
0.11± 2.29 [a]	T3	
0.19±2.25 [a]	T4	
0.10 ±2.34 [a]	T5	

Table (4): shows the feed conversion ratio and feed conversion efficiency (%) of juvenile common carp in different treatments exposed to saline concentration 7 and 15 g/L. (The values represent the mean ± standard deviation).
Table (5): shows the percentage of Satiation level (%) of juvenile common carp in different treatments exposed to saline concentrations 7 and 15 g/L. (The values represent the mean ± standard deviation).

feed conversion efficiency (%)	feed conversion ratio	treatment	saline concentration
0.40±13.76 [a]	0.21±7.27 [a]	T1	**7**
0.50±16.34 [b]	0.19±6.13 [b]	T2	
0.73±19.56 [c]	0.19±5.12 [c]	T3	
0.97±14.93 [d]	0.44±6.72 [d]	T4	
0.02±15.6 [bd]	0.01±6.41 [bd]	T5	
0.40±10.77 [a]	0.35±9.3 [a]	T1	**15**

0.46±12.04 b	0.32±8.32 b	T2	
0.37±16.61 c	0.13±6.02 c	T3	
0.10±13.46 d	0.06±7.43 d	T4	
0.66±15.44 e	0.28±6.49 c	T5	

Different letters in the same column indicate a significant difference (P<0.05).

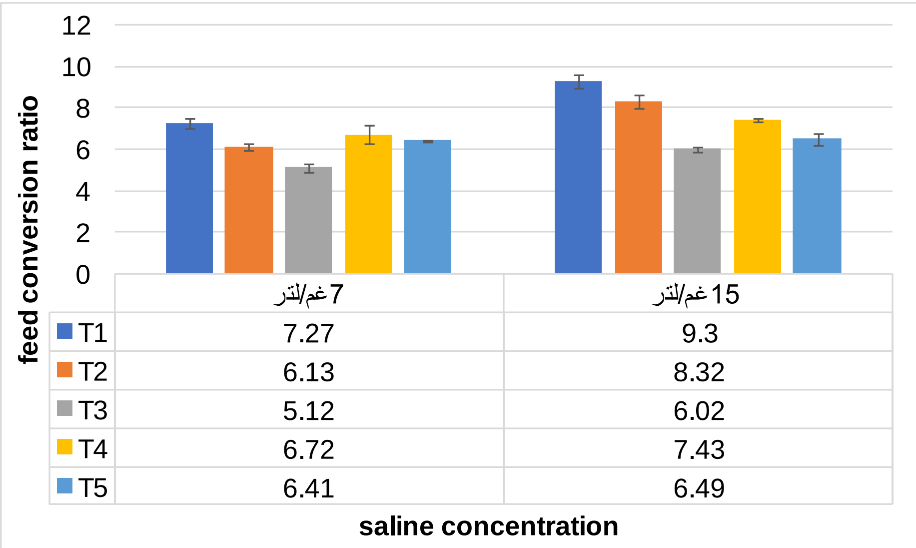

Figure (6): shows the feed conversion ratio (%) of juvenile common carp fish in different treatments exposed to saline concentration 7 and 15 g/L. (The values represent the mean ± standard deviation).

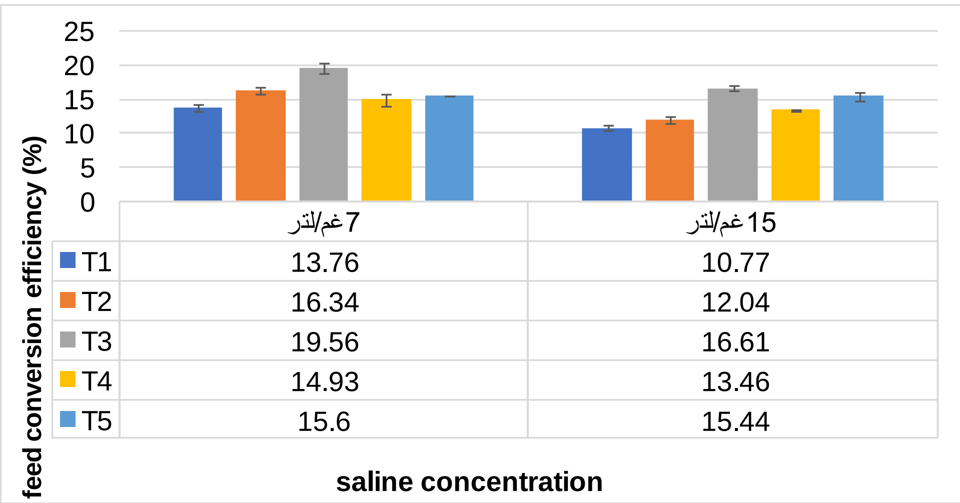

Figure (7): shows the feed conversion efficiency of juvenile common carp fish in different treatments exposed to saline concentration 7 and 15 g/L. (The values represent the mean ± standard deviation).

Statistical analysis proved that there were no significant differences (P>0.05)) in the values of Satiation level for the different treatments (T1, T2, T3, T4 and T5) at the saline concentrations 7 and 15 g/L (Table 5).

Different letters in the same column indicate a significant difference (P<0.05).

body ions, in contrast to the high ionic and saline concentrations in the surrounding water medium (Ahmed *et al.* , 2013)

In the same context, it can also be said that the addition of potassium chloride salt at a higher concentration, as well as the addition of growth hormone in a higher concentration, achieved the highest levels of survival in juvenile carp fish after 14 days of exposure to high salinity levels. High saline concentrations despite the different mechanisms of effect between salt and hormone, which were clarified by different researches (Saoud et al. 2006).

The effects of adding potassium chloride salt and other salts to fish feed before being exposed to salinity include a set of mechanisms that were suggested by a number of previous researches (Al-Saadi and Al-Khashali 2015).

As for the growth hormone, many studies have indicated that the group of growth hormones can positively affect the ability of fish to face osmotic changes in the environment and to confront the osmotic stress that fish may be exposed to through many of the previously mentioned mechanisms, such as compensating the damaged mucous membranes in the gills. And the lining of the intestine, which is the

Discussion

survival rate

Survival rates in fish are an important reflection of their success in living in different environmental conditions.

It is known that extremism in one of these environmental conditions, including high salinity, directly affects the livelihood of fish and is reflected in their survival rates in the environment.

Since the main objective of the current study is to enhance the survival of fish in the face of high salinity of water and prepare the fish to carry out the process of osmotic regulation more efficiently by adding different nutrients (potassium chloride salt and growth hormone) with different concentrations to the feed.

It is noted that the survival rates of fish in different saline concentrations were not affected very significantly and remained within the expected ranges even when exposed to the highest salinity of 15 and for a period of 14 days if compared with the control diet.

This is consistent with many previous studies that indicated the possibility of carp fish to withstand high salinity levels for a limited period of time, especially when enhancing its capabilities to regulate osmosis and trying to control the internal stability of fluids and happened in the treatment Control (Nasir and Hamed., 2016).

As for the growth hormone and its well-known role in the processes of osmotic regulation of fish, through previous studies, it turned out that it has an important role as well, by compensating the damaged tissues in the gills as a result of high salinity. The presence of good levels of growth hormone also helps the fish to overcome the osmotic shock and deal with High salinity in the surrounding environment in a way that reduces energy expenditures

It makes the tissues deal with salinity, especially chloride cells, which are very necessary in freshwater fish that face waves of salinity, and this is what became clear from the results of the current study, where the growth hormone treatments ranked second in the growth rates in the experimental fish and were better than the control treatment while they were not superior. On potassium chloride, whose effect was direct, as stated in a study (Alam *et al*. 2015).

The main role of these treatments used in the current experiment is the addition of potassium chloride and growth hormone more in helping the fish to face the osmotic shock and regulating the internal fluids of the body towards the high salinity in the surrounding water medium when the salinity of the aquatic medium is raised to 7 and 15 g / liter.

Where the treatments to which potassium chloride and growth hormone were added also outperformed the control treatment in which the fish ate a diet free of these specific additives. Therefore, the role of these substances becomes more clear the more salinity the water medium in which the fish live or in which they face a problem in the process of osmotic regulation

important parts in the process of osmotic regulation, as well as the increase in the number of chloride cells, in addition to other effects on the hormonal and enzymatic level in fish, as shown by previous studies (Reindl et al, 2012).

growth parameter

Osmotic regulation in fish is closely related to energy metabolism, as fish make a great effort in the process of osmotic regulation in order to obtain the desired ions from the surrounding water medium and to get rid of excess salt ions in the blood through the process of ion exchange that occurs in conjunction with the process of respiration Through the gills (Dogan and Canli., 2019).

The process of energy expenditure in the osmotic regulation will significantly affect the different growth parameters in fish because the process of osmotic regulation is closely related to survival and has priority over growth and over other vital activities in the body. Growth, reproduction, or other vital activities that are less important (Reindl *et al*, 2012).

alt feeding plays an important role in stimulating the mechanisms of osmotic regulation in fish, especially common carp, by modifying the water medium inside the body to calculate potassium ions against sodium ions that can enter the body from the surrounding water.

When salinity increased, and this is consistent with the results of the current study, it was found that growth rates increased in the treatments in which potassium chloride was used, which means that the presence of potassium chloride contributed to reducing the energy expenditures for osmotic regulation in fish if they were not fed on potassium chloride as

It is one of the very important production factors and one of the nutritional indicators that breeders rely on in determining the success of the productive process of fish farming (Mzengereza et al., 2015).

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This is consistent with many previous studies that clarified the role of both salt nutrition and growth hormone in preparing fish to face osmotic shock and helping them to regulate the osmotic regulation of body fluids compared to fish that were not fed these specific additives (Al-Saadi, 2017);Mzengereza *et al*. 2015).

It is also clear from the table of growth experience and the figures attached to it that the higher the percentage of additions, the more this helps in reducing the energy spent on osmotic regulation and transferring it to the growth process. The same is true for T5

Compared with the T4 treatment, where it becomes clear that the higher the addition of growth hormone, the greater the growth in fish in the face of osmotic regulation, and this applies to the concentrations used 7 and 15 g of salinity, and it is consistent with the results obtained by previous studies from the study of Abbass, 2007); Gatlin *et al*. 1992; Yusefi, *et al*. 2022)

As for the feed conversion ratio and the feed conversion efficiency of juvenile common carp fish exposed to different saline concentrations in the previous experiment, it becomes clear that the feed conversion factor increases with an increase in the rate of potassium chloride and an increase in the rate of growth hormone.

This indicates that the fish were able to benefit from the feed more and did not spend additional energy in the process of osmotic regulation, and that the addition of the feed helped the fish to continue feeding, growing and living in a somewhat natural way in the face of high salinity

This becomes clearer when the salinity is raised from 7 to 15 g, where the percentage of addition was clearly more effective.

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