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A study of some growth parameters for common carp *Carpinus carpio L* cultured in floating cages.

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Abstract

The current study included measuring some of the chemical and physical properties of the water of the study area and estimating the concentration of three heavy elements (lead, copper, zinc) in the tissues of common carp *Cyprinus carpio L* (gills, muscles, viscera) and measuring growth rates and weight gains at three different densities. The samples were collected from a private farm that raises fish in floating cages on the Euphrates River from 11/18/2022 to 4/18/2023 Different densities were also studied to obtain the best culture density. Three densities (21_25_28 fish / m3) were used, with 500 fish for the first treatment, 900 fish for the second treatment, and 1100 fish for the third treatment, with an average weight of (120_140) g. Diet of Iranian origin was used for the three treatments. The results of the statistical analysis showed that there were significant differences during the months of the study, where the highest rate was in the month of March. And between the qualitative growth rate and the presence of significant differences between the months of the study, where the highest rate was in the month of February. The rate of feed conversion and the efficiency of feed conversion when conducting the statistical analysis indicated that there were significant differences, as the highest rate was in the month of November, as well as between the chemical analysis of fish muscles at the beginning of the experiment and the end of the experiment.

I. INTRODUCTION

Fish has an important nutritional value, as its value is not less than other sources, as it contains large proportions of animal protein, as well as proportions of essential fats, in addition to vitamins and important minerals such as calcium, iron, zinc, iodine, and phosphorus (Nasser, 2022). I preferred carp farming in Iraqi farms because they are characterized by their high growth weights, ease of providing their feed requirements, resistance to environmental conditions, acceptance by the consumer, adaptation to a polluted environment, tolerance of a wide temperature range, and the ability to adapt to agricultural systems (Tang *et al*., 2013). Water has a major role to carry out the vital processes that occur in living

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organisms. Its pollution leads to damage to their bodies and disruption of the environmental balance. And the problem of pollution has become one of the problems facing humans and living organisms, and it has increased as a result of industrial and agricultural development and population increase (Al-Kinani, 2015). Water pollution with heavy elements is one of the serious problems due to industrial and agricultural progress, which has a significant impact as a result of throwing waste into the waters of rivers and lakes. The bioaccumulation of heavy metals in fish varies depending on the way it is absorbed, the type of heavy metal, and the type of fish. And the concentrations of heavy elements present in the water body do not indicate the degree of pollution without observing their accumulation in aquatic organisms (Ibrahim *et al*., 2020). Rivers are exposed to pollution with heavy elements such as copper, lead, and zinc as a result of natural sources such as earthen rocks and mineral ores, or industrial ones, or as a result of household and factory waste, or agricultural waste that affects the ecosystem. Pollution with heavy elements is one of the important environmental problems because of its ability to accumulate and the difficulty of its decomposition, even if it is in low concentrations (Fahad, 2014). The current study aimed to study the growth of fish cultured in floating cages

II. MATERIALS AND METHODS

The experiment was conducted in one of the areas of Dhi Qar Governorate - the city of Nasiriyah in one of the private farms in the Euphrates River in the Fadhiliya area, south of the city of Nasiriyah, about 10 km from the center of Nasiriyah in coordinates. The farm consists of 18 floating cages in which common carp fish are cultured. The fish farm is located on the Euphrates River. The structures of the floating cages were made of iron and painted to prevent the occurrence of rust or corrosion. A corridor was made between the cages with a width of approximately 50 cm and was covered with planks of wood. Nets were added inside the structure of the cage as it holds the fish. The nets are 1.5 m deep inside the water and a distance of 1 m was left under the cages and placed on Their sides are buoys, as they keep the cages floating above the surface of the water, and these are either made of cork or plastic barrels, and the dimensions of the cages are approximately 3 x 4 m and a depth of 2 m. A diet of Iranian origin with a chemical composition was used (Table 1).

Substance	Percentage %
Protein	٣٨,٩٠
Fat	١١,٣٥
Humidity	٦,٩٦
Fiber	٢,٩٣
Carbohydrates	٣٩,٨٦

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Samples were collected monthly for a period of 6 academic months from the study station from 6/11/2022 to 6/4/2023. The samples were collected in polyethylene plastic bottles with a capacity of 250 ml for each sample, and samples for the determination of dissolved oxygen by means of glass bottles (Winkler bottles) with a capacity of 250 ml. The sample was placed in a cork container containing ice until arrival. Several field tests were conducted, including measuring the water temperature with a mercury thermometer scaled from 0-100. During the collection of samples, it was measured while the thermometer was immersed in water to ensure the accuracy of the reading, and the results were expressed in percentage.

III. RESULT AND DISCUSSION

Field measurements in this study showed that the lowest air temperature was 11 C ◦ in January and the highest temperature was 34 C ◦ in October. It is due to changes in the seasons of the year, the length of the daylight hours, the angle of incidence of the sun's rays, and the difference in the times of collecting samples, and this is consistent with (Turki, 2018; 2022, nassir & kamil).

Table (1) shows the air and water temperature values during the study period.

Unit	April	March	February	January	December	November	Months / Properties
C°	32	24	25	11	26	30	Air temperature
C°	29	20	19	17	21	33	Water temperature

growth criteria

Total weight gain

Table (4-6): Total weight gain (gm/fish/month) of common carp fish farmed at different densities during the study period (arithmetic mean ± standard error)

Weight gain	month / adjective
November	3.523± 43.00 c

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December	56.00± 3.227 d
January	4.627± 84.000 c
February	111.333± 0.971 b
March	3.620± 144.333 a
Moral level	**

The results of the current study showed that there were significant differences in the total weight gain during the months of the study. The results of the statistical analysis showed that there were significant differences at the level ($P \leq 0.05$) of the current study. Table (4-6) of the total weight gain shows that the highest weight gain in February was recorded (111.333 gm / fish), and the lowest weight gain was recorded in December, when it was recorded (3.523 gm / fish). The results of the current study agreed with the results of Abdel-Hadi (2021), which indicated that the best overall weight gain was at the lowest number density. And I also agreed with Abbas (2016) and he also showed that the best weight gain was in the lowest number density. And he agreed with what Al-Bahadli (2011) reached, gaining a weight gain of 241 g at a density of 40 g / fish, and this is close to the current results

Relative growth rate and qualitative growth

Table (4-7): Specific growth rate (g/fish/month) and relative growth rate (%/month) for common carp fish farmed at different densities during the study period (arithmetical mean ± standard error)

month / adjective	qualitative growth rate	relative growth rate
November	226.333 ± 5.932 e	17.333 ± 0.333 b
December	274.444 ± 9.685 d	18.111 ±0.35b
January	333.666 ± 25.209 c	17.88 ±1.263b
February	411.000 ± 20.601b	21.333±0.333 a
March	572.333 ± 11.670 a	20.111 ±0.260 a

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Moral level	**	**

The results of the current study showed in Table (4-7) of the relative growth rate that there were significant differences between the months of the study. The results of the statistical analysis showed that there were significant differences at the level ($P \leq 0.05$). It excelled in the months March, February and January, and the relative growth rate was 572,411,333 g/fish respectively. Table (4-7) shows that the specific growth rate was significantly higher among the months of the study. The results of the statistical analysis showed that there were significant differences between the treatments at the level ($P \leq 0.05$). It excelled in the months of February and March, and recorded specific growth rates (21.20 g / fish), respectively. There are no significant differences between the three months of November, December and January. The results of the current study agreed with the results of some studies, including (Al-Bahadli, 2011; Abbas et al. 2016; Abdel Hadi, 2021). Studies showed that superiority was with the lowest number densities. There are a number of studies on densities in closed systems, including the study of Ghulam (2020) between the superiority of the specific growth rate and the relative growth in the average densities, and this is not consistent with the current study. There is a study on the cultivation of two types of fish in different densities, including the study of Hamid (2020), which showed the superiority of the relative and qualitative growth rate in the lowest number densities when cultivating two types of fish, and this is consistent with the results of the current study. Another study, including Farhan *et al*.(2015), shows that the relative and qualitative growth rate was superior in the density of the lowest number for the cultivation of two types of common carp and silver carp, and this is consistent with the results of the current study

Feed conversion rate and efficiency

Table (4-8): The effect of the month on the characteristics of feed conversion efficiency and feed conversion rate (mean ± standard error)

month / adjective	feed conversion efficiency	feed conversion rate
November	3.983 ±0.533 a	0.537 ± 3.506 a
December	2.343 ±0.287 b	0.137± 2.287 b
January	1.896 ±0.162 b	0.146±2.268 b
February	2.163 ±0.136 b	0.028± 2.317 b

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March	1.933 ±0.084 b	0.447± 2.813 ab
Moral level	**	**
Averages with different letters within the same column are significantly different		

The feed conversion rate is the ratio between the weight of the food provided and the wet weight gain of the fish. It is a measure of the efficiency of the food or diet .It can be seen from Table (4-8) that the highest rate of feed conversion was recorded in two months (2,343,3,983 feed / gm), respectively, for the months of November and December A number of studies were close to the current results, which showed that the use of submersible feeds with a better feed conversion rate than floating feeds and a conversion rate excelled at the lowest densities, including a study (Al-Bahadly, 2011; Taher et al., 2015; Abdel-Hadi, 2021; Shahib, 2021). In the study of Ghulam (2020) on the culture density of carp fish in the closed system, the feed conversion rate is better in the culture density with the lowest number, and this is consistent with the current results. The study of Liu et al. (2017) conducted on flattened turbots (Pleuronectiformes) did not record any significant differences, but the cumulative average was superior to the treatment with the least number. Feed conversion efficiency is the reciprocal of the feed conversion rate as a percentage, and it is a criterion for measuring the utilization of food intake

Table (4-8) shows the months of experience. The highest feed conversion efficiency (3.506, 2.287) was recorded in November and December

Chemical analysis of fish muscles

The results of the chemical analysis of fish muscles showed in Table (4-9) that there are no significant differences between the chemical composition of the muscles before the beginning of the experiment and the end of the experiment, and that the results are close to each other. Ash and carbohydrates decreased slightly at the end of the experiment compared to the beginning of the experiment. The results are similar to a number of studies for culturing different densities, including (Ghulam, 2020; Abdel-Hadi, 2021; Shuhaib, 2021).

Table (4-9) Chemical analysis of the muscles of carp fish cultured in floating cages based on wet weight during the experimental period

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The components	Chemical composition of fish muscles before the start of the experiment	**Chemical composition of fish muscles at the end of the experiment (%)**
Humidity	67	65
Crude protein	14.4	13.25
raw fat	4.2	2.9
carbohydrates	0.85	1.5
Ash	3.45	4.28

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