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# Study of the concentration level of heavy metals in water and some tissues of common carp, *Carpinus carpio L*. which is cultured in cages in the Euphrates River

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## Abstract

The current study included measuring some chemical and physical properties of the water of the study area and estimating the concentration of three heavy elements (lead, copper, and zinc) in the tissues of the common carp (Gills, muscles, and viscera) of *Cyprinus carpio L*. Samples were collected from one of the private farms that raise fish in floating cages on the Euphrates River from 11/18/2022 to 4/18/2023. The study also included measuring water temperature, air, turbidity, electrical conductivity, total dissolved solids, pH And dissolved oxygen samples taken from the water were analyzed as well as samples taken from fish tissues on a monthly basis. The results of the study showed that the air temperature ranged between(6.8-10.2)C. Water temperature (17_33), turbidity (6.8_10.2), electrical conductivity (1.04_2.13), total dissolved solids (7752_18730) mg/l, and pH value (7.2_7.82) between neutral to lightly basic. The dissolved oxygen value ranged between (6.78 - 7.92) mg/l during the months of the experiment. The standard methods were used to estimate the concentration of heavy metals in water and tissues by flame atomic absorption spectrometer. The results showed that the highest total concentration of lead, copper and zinc was recorded in the water during the winter season (1.533, 2.300, 6.700) µg/L. Recorded in tissues for lead in the gills and viscera, the highest values were in spring (9.533, 6.500) µg/L, respectively. Copper recorded the highest value in the gills and viscera, respectively, and the concentrations were high in the autumn season (16.793, 18.723) µg/g dry weight, respectively. g dry weight respectively, the results showed that the accumulation of heavy elements was in the following order .

Concentrations in the water are zinc < copper < lead

And in the tissue as follows

lead Gills < muscle < viscera

copper gills < viscera < muscle

Zinc gills < muscle < viscera

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.

**Key words : common carp ,heavy metals .**

# 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 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 by 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 and to determine the concentrations of some heavy metals (zinc, copper, and lead) in three tissues of common carp (gills, muscles, and viscera).

# 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 its sides And placed buoys on its sides as they keep the cages. 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 Fadhiliyah area south of the city of Nasiriyah, about 10 km from the center of Nasiriyah in the 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 cage structure as it holds fish. The nets are 1.5 m deep inside the water and a distance of 1 m is left under the cages and placed on Its 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. 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. The parts (the gills, muscles, and viscera) were taken to measure the concentrations of heavy metals in them. Several field tests were conducted, including measuring the water temperature with a mercury thermometer graduated from 0 - 100 °C. . 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. The measurement was done periodically during the sampling and the results were expressed. Flame atomic absorption spectrometry was used to measure heavy metals in the samples. And according to the equation described by (Al-Marami,2021).

$$Econ = A \times B \times df \backslash D$$

Econ: concentration of elements in the sample (µg/g dry weight)

A: elemental concentration extracted from the calibration curve (mg/L)

B: Final volume of sample (ml)

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df: Dilution Factor, if used, it is as follows

$df$ = volum of dilution sample solution in ml \ volum of a liquot taken for dilution im ml

D: dry weight of the sample (g)

## 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 |

**Heavy elements in water**: The results showed that when zinc was measured, the lowest concentration was (2.400 µg/L) during April, and the highest concentration was recorded (6.700 µg/L) in December. In December, figure (1) shows the concentrations of zinc and lead. The results of the statistical analysis showed that there were significant differences ($P \leq 0.01$) between the months of the experiment. The changes in the concentrations of heavy elements in the months of the experiment are due to the change in temperature, or as a result of the decomposition of organic matter, or the lack of industrial waste or its increase during the conduct of the experiment, or as a result of the presence of phytoplankton and zooplankton, in addition to that there is a relationship between physical and chemical factors with the concentrations of heavy elements In water, this was confirmed by a study (Salman, 2011; Al-Qusayr, 2012; Al-Khafaji and Hussein, 2015 ).

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**Table (2) Concentration of heavy metals in the water during the study period**

| Lead | Zinc | Copper | Elements / Month |
|---|---|---|---|
| 0.716 | 5.400 | 1.800 | November |
| 1.533 | 6.700 | 2.300 | December |
| 0.030 | 3.800 | 2.400 | January |
| 0.050 | 6.700 | 2.700 | February |
| 0.046 | 5.600 | 1.300 | March |
| 0.205 | 4.200 | 1.500 | April |
| 0.43 | 5.4 | 2 | General average |
| * | N.S. | * | Moral level |
| micrograms/litre | | | Unit |

**Heavy metals in fish:** Table (3) of the element lead in gills shows that the highest concentration was (9.966 µg/g) dry weight during December, and the lowest concentration was recorded (2.66 µg/g) dry weight in November. The results of the statistical analysis showed that there were significant differences at the level ($P \leq 0.05$). Muscles, the highest concentration of lead element accumulation (6.133 µg / g) dry weight in February and the lowest concentration (1.166 µg / g) dry weight in November, the results of the statistical analysis show that there are no significant differences between the months of the experiment in the muscles. And the viscera, lead concentrations had the highest concentration (6.500 µg / g) dry weight in December, while the lowest concentration was (2.00 µg / g) dry weight in January. The results of the statistical analysis showed that there were significant differences at the level ($P \leq 0.01$) between the months of the experiment.

**Table (3): Measuring the concentration of lead (the gills, muscles, and viscera) during the study period (arithmetical mean ± standard error)**

| General average | April | March | February | January | December | November | Tissue \ Month |
|---|---|---|---|---|---|---|---|
| 6.459 ± 0.5 | 8.700 ± 1.127a | 8.500 ± 0.898 | 9.533 ± 0.382a | 2.866 ± 0.176 b | 6.500 ± 0.241b | 2.655 ± 0.241 | Gills |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | Ab | |
| 4.905 ± 0.32 | 5.406 ± 0.745b | 5.833 ± 0.105b | 6.133 ± 0.311b | 3.900 ± 0.397a | 6.500 ± 0.219 b | 1.66 ± 0.166b | Muscles |
| 4.683 ± 0.27 | 4.633 ± 0.222b | 5.300 ± 0.341b | 6.300 ± 0.191b | 2.000 ± 0.104c | 6.500 ± 0.241b | 3.366 ± 0.578a | Viscera |
| * | * | * | * | * | * | * | General average |
| micrograms/litre | | | | | | | Unit |

Table (4) shows the concentrations of copper. The results recorded the highest concentration in gills (16.793 µg / g) dry weight in December, and the lowest concentration recorded in gills (7.633 µg / g) dry weight in January. The results show that there are significant differences On the level ($P \leq 0.01$) between the months of the study. The concentration of copper in the muscles recorded the highest concentration (15.433 µg / gm) dry weight in April, the lowest concentration (7.433 µg / gm) dry weight in November. The results show that there are significant differences at the level ($P \leq 0.01$) between the study months and copper concentrations. In the intestines, the highest value was recorded (18.723 µg / g). Dry weight was in January, and the lowest value (8.43 µg/g) was recorded in April. The results show that there are significant differences at the level ($P \leq 0.01$) between the months of the study. When comparing the results, it was shown that the highest accumulation of copper was in the gills, muscles and viscera, and there were significant differences between the results at the level ($P \leq 0.01$) between the months of the study.

**Table (4): Measuring the concentration of copper (the gills, muscles, and viscera) during the study period (the arithmetic mean ± the standard error)**

| General average | April | March | February | January | December | November | Tissue \ Month |
|---|---|---|---|---|---|---|---|
| 12.480 ± | 9.200 ± | 13.100 ± | 14. 373 ± | 7.633 ± | 16.793 ± | 13.783 ± | |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.03 | 1.397 b | 0.965b | 10.366 b | 0.328 c | 1.699 c | 0.453 a | Gills |
| 10.809 ± 0.96 | 15.433 ± 0.907a | 10.933 ± 2.423b | 12.016 ± 0.556 b | 7.31 ± 0.146 c | 11.723 ± 1.458 b | 7.433 ± 0.315c | Muscles |
| 11.959 ± 1.74 | 8.433 ± 0.991b | 12.6000 ± 1.093a | 14.703 ± 3,930a | 7.833 ± 0.268b | 18.723 ± 3.9482c | 9.466 ± 0.247a | Viscera |
| * | * | * | * | * | * | * | General average |
| micrograms/litre | | | | | | | Unit |

Table (5) shows the concentrations of zinc. The results show that the highest recorded concentration of zinc in gills was (65.533 µg/g) dry weight in January, and the lowest concentration was (3..333 µg/g) dry weight in March. The results show that there are differences Significant level ($P \leq 0.01$) between the months of the study. The highest concentration of zinc in muscles was (18.366 µg/g) dry weight in January, and the lowest concentration was (1.866 µg/g) dry weight in December. The results showed that there were significant differences at the level ($P \leq 0.01$) between the months of the study. While the concentration of zinc in the gut recorded the highest concentration (17.866 µg/g) dry weight in January, and the lowest concentration (1.940 µg/g) dry weight in April, the results showed that there were significant differences at the level ($P \leq 0.01$) between the months of the study.

**Table (5): Measuring the concentration of zinc (gills, muscles, viscera) during the study period (arithmetic mean ± standard error)**

| General average | April | March | February | January | December | November | Tissue \ Month |
|---|---|---|---|---|---|---|---|
| 14.518 ±0.65 | 3.800 ±0.530a | 3.333 ± 0.720ab | 3.800 ± 0.683a | 65.533 ±0.927a | 4.800 ± 0.575a | 5.844 ±a0.516 | Gills |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5.350 ±0.27 | 3.406 ±0.494a | 3.866 ±0.419a | 2.200 ±0.276b | 18.366 ±1.012b | 1.866 ±0.252c | 2.400 ±0.191c | **Muscles** |
| 5.317 ±0.30 | 1.940 ±0.194b | 2.100 ±0.325b | 2.700 ±0.152ab | 17.866 ±0.838b | 3.133 ±0.105b | 4.166 ±0.190b | **Viscera** |
| * | * | * | * | * | * | * | **General average** |
| micrograms/litre | | | | | | | **Unit** |

When comparing the results, the highest accumulation of zinc was shown in gills, viscera, and muscles in October and November. The results showed significant differences at the level ($P \leq 0.01$) between gills, muscles, and viscera between the study period. The results of the current study showed that the concentrations of heavy metals in fish tissues in the Euphrates River are as follows

Lead gills > muscles > viscera

Copper gills > viscera > muscles

Zinc gills >muscles > viscera

High concentrations of heavy metals in carp fish mean that they have a high ability to withstand and adapt to unfavorable conditions (Jedran *et al*., 2012). And the continental feeding of carp fish (Nasser, 2022). It appears in the results that the highest accumulation is in the gills because it has direct contact with water or has the main role for oxygen exchange processes and also the main site for the absorption of chemicals and pollutants. The presence of heavy elements in the guts and muscles indicates their long-term accumulation. (Pandey *et al*., 2017). The high concentrations during the fall and winter season are due to soil leaching operations, the amount of rainfall and the tapping operations of agricultural lands that carry various pesticides and fertilizers (Al-Najjar, 2009).The results of the current study agreed with some studies, including (Majid *et a l*., 2016; Al-Maramdi, 2021; Nasser, 2022).

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