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# Analysis of Physical Properties and Evaluation of Heavy Element Concentrations in Euphrates River's Fish in Nasiriyah City

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***Abstract*-Environmental pollution is one of the most prominent problems that facing the world at the present time. The current study was conducted on the Euphrates River in the center of Nasiriyah city during the period time from September 2023 to Marsh 2024. Three locations were used in this study. The length of the river and some physical and chemical parameters of the water were studied. The temperature of the water and air was measured, in addition to the distribution of four heavy metals in fish. The current results were showed that the air temperature increased significantly in the third water position, and decreased significantly in the other water position, the water temperature increased significantly in the first water position, while decreased significantly in the other water positions. In contrast, the level of Neutrophil increased significantly in the second water position and decreased in the first water position at p. value < 0.05. The current results were showed a significant increase in the level of both Cd and Pb in muscle compared with gills, while the level of both Zn and Cu decreased significantly in muscle compared with gills. The study also recorded a significant difference at p. value < 0.05 in the level of trace elements between muscles and gills of fish during summer. The current results showed a significant increase in the level of all involved trace elements (Cd, Pb, Zn and Cu) in gills of fish comparing with muscles of fish during winter, and showed a significant difference at p. value < 0.05, between gills and muscles.**

**Keywords: NTU, Air-temperature, Water-temperature, Trace Element**

## I. INTRODUCTION

Over the past few decades, it Environmental pollution has become one of the world's major concerns. There was a shortage of fresh water for technological progress, manufacturing speed, population growth, agricultural practices, and unplanned urbanization. Furthermore, runoff from agricultural fields and untreated domestic sewage, toxic sanitary and industrial waste all contribute to ongoing pollution due to limited freshwater supplies [1]. Pollutants exacerbate environmental problems in natural waters [2].

Water constitutes 71% of the Earth's surface, with oceans comprising approximately 98% of this total. Freshwater comprises approximately 2% of the total, representing a minor fraction. A portion of water is allocated to various sectors for humanitarian objectives and in Water is contaminated due to human activity, resulting in high levels of pollutants., like bacteria, microorganisms, and various compounds. Research indicates that 80% of diseases arise from water pollution and insufficient water supply. Methods that facilitate the sterilization of water [3]. The proportion of water in Iraq constitutes about 15% of its total area. There must be different types of rivers, lakes, streams, etc. Ensuring the protection and sustainability of these basic human resources [4] Pollutant levels in the Euphrates River sediments are the primary source of pollution, a result of increased human and industrial activities in the region [5].

The problem of environmental pollution is one of the most prominent challenges facing the world at the present time. This problem has been exacerbated as a result of the rapid industrial and agricultural development and the great expansion of human activity, in addition to the modern technologies that have been developed [6]. It was revealed that the US Environmental Protection Agency (EPA) defines aquatic pollution as any change in the physical properties, chemical or biological effects of the aquatic environment that have an sufficient impact to cause harm to public health and ecosystems. In addition, the rate of water pollution occurs much faster than purification processes [7]. Heavy elements are defined as chemical elements whose specific gravity exceeds 5 g/mL and are present in very low levels. Its atomic weight ranges from 63,546 to 200,590. These elements present in environmental water either in a dissolved or suspended form [8].

Heavy metals can be extracted from various natural and human sources. Rock weathering is one of the most important natural sources, while human sources come from industrial activity, fertilizer use, and wastewater discharge. Agricultural activity also contributes to the increase in heavy metals through the use of fertilizers and pesticides [9]. Water can become contaminated with heavy metals from agriculture through several factors, such as agricultural residues, fertilizers, herbicides, and excess salts formed as a result of irrigation water use [10]. These metals include cadmium, lead, chromium, nickel, copper and zinc, which enter the water due to fertilizer and pesticide applications. Studies have shown that water pollution with these metals can negatively affect human and animal health [11].

Fish is a very important food source for humans and the last link in the aquatic food chain. Its meat contains low


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calories and high proteins [12]. Heavy metals have a direct impact on aquatic life, including fish. Their abundance in the water affects fish reproduction and collection, although fish able to accumulate heavy metals in their vital parts like muscles, which are an important food source for humans [13]. Heavy metals are also absorbed from the skin, gills and body tissues and concentrated in the liver, kidneys and reproductive glands, leading to their accumulation in fish [14]. Some studies have found that fish have the ability to sense harmful and urgent changes in the water when elements reach high concentrations [15].

Carp is considered one of the best types of fish, as it began to be bred in China (before that 2000 BC). Several strains of Carps were produced, which were later developed increases interest in them and learn more about them. This type has been introduced t in Iraq for the first time in 1955 at the Al- Al-Zafaraniya fish farms, south of Baghdad. Then, they were raised in the Tigris River, where carps are abundant in the bottom of rivers as well as in shallow lakes [16]. The present study focused on measuring the concentrations of specific heavy metals, namely lead (Pb), cadmium (Cd), zinc (Zn), and copper (Cu), in the gills and muscles of common carp (Cyprinus carpio) due to the frequent contamination of aquatic environments with these metals. Assessment of the physical and chemical properties of water across two distinct seasons.

## II. MATERIALS AND METHOD

### A. The Study Area

The current study was conducted on the Euphrates River in the city center Nasiriyah city for the period from September 2023 to March 2024. The three locations were used in this study were the length of the river S1 (Olive Bridge),S2(Al-Sadinawiyya), andS3 (Al-Fadhiliya).

### B. Sample Collection

120 fish samples were collected in this study and divided into 60 samples each season. The temperature and turbidity of water and air were measured, in addition to studying the distribution of four heavy metals in fish. The Euphrates River is one of the main rivers in Iraq, with a length of 2775 km, and its salinity increases towards the south, and it is important for human and industrial use, orchards, palm trees and field crops [17].

### C. Extraction of heavy metals from fish tissues

A dry weight sample was taken from fish tissues (gills, muscles, viscera) after the sample was dried in an oven. The sample was heated at 120 ̊C for a while. After 24 hours, the sample was ground and placed in a special 250 ml beaker. A mixture of concentrated acid HCL (4.5 ml) and 3HNO (1.5 ml) were added to it and heated on a hot plate at 80 ̊C and then4 ml of concentrated mixture (prochloric and hydrofluoric acid in a 1:1 ratio) were added. When the mixture started to evaporate near dryness, the filtrate was supplemented with deionized distilled water to 25 ml. Adopted (ROPME1983) method for digesting fish samples for the purpose of measuring heavy metals were then used.

### D. Statistical Analysis

The current study data were statistically analysed by using SPSS version 26, based in using one way ANOVA, LSD, and independent sample t test at p. value <0.05 [18]. Each p. value has two stars indicate a high significant at p. value of 0.01. P. value with one star indicates significant at 0.05, while p. value without star indicates a non-significant difference.

## III. RESULTS

### A. Physical Characteristics of Water Positions During Summer

The current findings indicate a significant increase in air temperature during the third water mode, while a significant decrease was observed in the other water mode. The water temperature exhibited a significant increase in the first water mode, followed by a notable decrease in the subsequent water modes. The level at NYU exhibited a significant increase in the second water mode and a decrease in the first water mode, with $p < 0.05$, as indicated in Table 1.

Table 1: Physical characteristic of water positions during summer

| Summer | Air-TM | Water-TM | NTU |
|---|---|---|---|
| | Mean ± S. D | | |
| **Position 1** | $30.33 \pm 0.20^{b}$ | $22.53 \pm 0.45^{a}$ | $1.49 \pm 0.04^{c}$ |
| **Position 2** | $30.76 \pm 0.25^{b}$ | $20.06 \pm 0.75^{b}$ | $10.2 \pm 0.49^{a}$ |
| **Position 3** | $31.33 \pm 0.28^{a}$ | $19.86 \pm 0.32^{b}$ | $6.96 \pm 0.05^{b}$ |
| **p. value** | 0.008 | 0.002 | < 0.001 |
| **LSD** | 0.50 | 1.07 | 0.57 |

### B. Physical Characteristics of Water Positions During Winter

The current results were showed that the air temperature increased significantly in the third water position, and decreased significantly in the other water position. The water temperature increased significantly in the first water position, while decreased significantly in the third water positions. The level of NTU increased significantly in the second water position and decreased in the first water position at p. value < 0.05, as shown in Table 2.

Table 2: Physical characteristic of water positions during winter

| Winter | Air-TM | Water-TM | NTU |
|---|---|---|---|
| | Mean ± S. D | | |
| **Position 1** | $22.36 \pm 0.05^{b}$ | $17.40 \pm 0.40^{a}$ | $6.33 \pm 0.25^{c}$ |
| **Position 2** | $22.46 \pm 0.45^{b}$ | $16.26 \pm 0.25^{b}$ | $22.2 \pm 0.32^{a}$ |
| **Position 3** | $23.13 \pm 0.23^{a}$ | $15.03 \pm 0.05^{c}$ | $7.36 \pm 0.11^{b}$ |
| **p. value** | 0.037 | < 0.001 | < 0.001 |
| **LSD** | 0.58 | 0.55 | 0.48 |

### C. A Comparison between Level of Trace Elements between Muscle and Gills of Fish in Summer

The current results showed a significant increase the concentration of Cd and Pb in muscle compared with gills, while the concentration of Zn and Cu decreased significantly in muscle compared with gills. Our study also recorded a significant difference at p. value < 0.05 in the level of trace elements between muscles and gills of fish during summer as shown in Table 3.

Table 3: A Comparison between level of trace elements between muscle and gills of fish in summer:

| Trace Elements | Muscles No. 30 | Gills No. 30 | p. value |
|---|---|---|---|
| | Summer Mean ± S. D | | |
| **Cd** | 0.488 ± 0.121 | 0.010 ± 0.005 | $< 0.001^{**}$ |
| **Pb** | 19.80 ± 4.007 | 0.017 ± 0.005 | $< 0.001^{**}$ |
| **Zn** | 104.7 ± 21.43 | 448.3 ± 24.00 | $< 0.001^{**}$ |
| **Cu** | 4.551 ± 0.676 | 5.667 ± 0.965 | $< 0.001^{**}$ |

### D. A Comparison between Level of Trace Elements between Muscle and Gills of Fish in Winter

The current results showed a significant increase in the level of all involved trace elements (Cd, Pb, Zn and Cu) in gills of fish compared with muscles of fish during winter, and showed a significant difference at p. value < 0.05, between gills and muscles, as shown in Table 4.

Table 4: A Comparison between level of trace elements between muscle and gills of fish in winter

| Trace Elements | Muscles No. 30 | Gills No. 30 | p. value |
|---|---|---|---|
| | Winter Mean ± S. D | | |
| **Cd** | 0.005 ± 0.001 | 0.190 ± 0.058 | < 0.001** |
| **Pb** | 0.921 ± 0.244 | 2.145 ± 0.435 | < 0.001** |
| **Zn** | 90.10 ± 3.174 | 378.9 ± 43.38 | < 0.001** |
| **Cu** | 1.182 ± 0.317 | 2.724 ± 0.535 | < 0.001** |

## IV. Discussion

### A. Physical Characteristics of Water

Our results consistent with the results of a study was done by Al-Shaheen and Sakai, [19] where there was an increase in air and water temperature in certain locations while it was low in others. While it contradicts the results of a study was done by Hassan and Ibrahim [20] where the air and water temperature were relatively stable during the summer with no change in temperatures. This consistent with a study was done by Hussein and Hasan [21] where air and water temperatures were found to decrease in some locations during the winter, in addition to changes in turbidity levels in some study locations. This difference is due to the influence of atmospheric temperature, in addition to that water flow varies with seasons, drought, winds and climate change.

### B. Valuation of Trace Element in Fish

The seasonal variations in the distribution of trace metals (Cd, Pb, Zn, Cu) between fish gills and muscles can be explained by differences in exposure routes, metabolic activity, and detoxification mechanisms. In summer, the notable rise in Cd and Pb concentrations in muscles relative to gills may be attributed to elevated dietary intake and metabolic redistribution, as higher temperatures promote feeding rates and metal incorporation into muscle tissue [22, 23]. The increased levels of Zn and Cu in gills during summer likely indicate their critical roles in enzyme function and oxygen exchange, as gills serve as the primary sites for uptake from water [24]. During winter, the elevated levels of all examined metals (Cd, Pb, Zn, Cu) in gills relative to muscles can be attributed to the decreasing in the metabolic activity, which results in slower detoxification and metal clearance, alongside the enhanced adsorption on gill surfaces in colder conditions [25]. The findings underscore the impact of seasonal physiological variations on metal bioaccumulation patterns in fish tissues.

The current results showed high concentrations of both lead and cadmium in muscles compared to gills during the summer season, unlike the winter season. The reason for this may be attributed to the increased accumulation of heavy elements in hot seasons compared to cold seasons due to the increase in metabolic activities and the high level of metabolism, which increased the concentration of elements in the body [26]. In addition to the presence of some human activities represented by the intensity of traffic movement of transportation vehicles and the continuous disposal of agricultural waste and its transfer to the river.

The findings indicated that copper accumulation was the greatest in the gills and least in the muscles. This was because of the tendency of fish muscles to accumulate elements less than other organs, as the mucous layer serves as a primary defense mechanism against the infiltration of heavy elements into muscle tissue by forming complexes with these elements [27].

Zinc is a crucial element for normal human growth and development [28]. The findings indicated that zinc accumulation was greatest in the gills during winter and summer, while the muscles exhibited the lowest levels of accumulation. The World Health Organisation (2005) states that the acceptable concentration of zinc is 200 ppb. The results of the current study consistent with some studies, including [29].

## V. Conclusion

The study highlights significant environmental pollution in the Euphrates River in Nasiriyah, as evidenced by variations in water and air temperatures across different locations. The analysis of heavy metals in fish tissues revealed higher concentrations of Cd and Pb in muscles compared to gills, while Zn and Cu levels were higher in gills. Seasonal variations were also observed, with trace elements showing higher accumulation in gills during winter. These findings indicate that the Euphrates River is contaminated with heavy metals, posing potential risks to aquatic life and human health. Further research and strict environmental regulations are needed to mitigate pollution and protect the river's ecosystem.

## Conflict of Interest

Authors declare that they have no conflict of interest.

## References


[1] M. Kummu et al., "The world’s road to water scarcity: shortage and stress in the 20th century and pathways towards sustainability," *Scientific Reports*, vol. 6, no. 1, Dec. 2016, doi: 10.1038/srep38495.

[2] M. N. Koleva, A. J. Calderón, D. Zhang, C. A. Styan, and L. G. Papageorgiou, "Integration of environmental aspects in modelling and optimisation of water supply chains," *The Science of the Total Environment*, vol. 636, pp. 314–338, Apr. 2018, doi: 10.1016/j.scitotenv.2018.03.358.

[3] Z. H. Nasser and K. K. Fahad, "Study of some Growth Parameters of Grass Carp Ctenopharyngodon idella V. Cultured in Floating Cages," *IOP Conference Series: Earth and Environmental Science*, vol. 1262, no. 7, p. 072065, Dec. 2023, doi: 10.1088/1755-1315/1262/7/072065.

[4] A. A. Obais and A. H. Al-Fatlawi, "Assessment and monitoring of Shatt Al-Hilla River within the middle Euphrates region," *Journal of Babylon University/Engineering Sciences*, vol. 20, pp. 994-1004, 2012.

[5] A. S. abd alameer Albaaj, "Analysis and evaluation of sediment pollutants of Euphrates River at Al-Nasiriyah

city, south of Iraq," *University of Thi-Qar Journal of Science*, vol. 10, no. 2, pp. 126-130, 2023.

[6] W. A. Freewan and A. M. Al-Rashidi, "The negative effects of waste on the urban environment in the city of Al-Khoms (waste into sustainable energy)," *Journal of Pure & Applied Sciences*, vol. 20, no. 4, pp. 96–102, Dec. 2021, doi: 10.51984/jopas.v20i4.1707.

[7] F. M. Hassan and A. R. Mahmood, "Evaluate the efficiency of drinking water treatment plants in Baghdad City – Iraq," *Journal of Applied & Environmental Microbiology*, vol. 6, no. 1, pp. 1–9, Dec. 2017, doi: 10.12691/jaem-6-1-1.

[8] M. J. Nasser, "Evaluation of some growth indicators and heavy elements in water and tissues of common carp Cyprinus carpio farmed in floating cages in the Euphrates River," M.S. thesis, College of Agriculture, University of Thi-Qar, Iraq,2022.

[9] F. M. Hassan and A. R. Mahmood, "Evaluate the efficiency of drinking water treatment plants in Baghdad City – Iraq," *Journal of Applied & Environmental Microbiology*, vol. 6, no. 1, pp. 1–9, Dec. 2017, doi: 10.12691/jaem-6-1-1.

[10] A. Alengebawy, S. T. Abdelkhalek, S. R. Qureshi, and M.-Q. Wang, "Heavy metals and pesticides toxicity in agricultural soil and plants: ecological risks and human health implications," *Toxics*, vol. 9, no. 3, p. 42, Feb. 2021, doi: 10.3390/toxics9030042.

[11] D. Pal and S. K. Maiti, "An approach to counter sediment toxicity by immobilization of heavy metals using waste fish scale derived biosorbent," *Ecotoxicology and Environmental Safety*, vol. 187, p. 109833, Oct. 2019, doi: 10.1016/j.ecoenv.2019.109833.

[12] C. Copat et al., "Heavy metals concentrations in fish and shellfish from eastern Mediterranean Sea: Consumption advisories," *Food and Chemical Toxicology*, vol. 53, pp. 33–37, Dec. 2012, doi: 10.1016/j.fct.2012.11.038.

[13] P. L. Garnero, M. De Los Angeles Bistoni, and M. V. Monferran, "Trace element concentrations in six fish species from freshwater lentic environments and evaluation of possible health risks according to international standards of consumption," *Environmental Science and Pollution Research*, vol. 27, no. 22, pp. 27598–27608, May 2020, doi: 10.1007/s11356-020-08756-7.

[14] R. A. Hanaf, "The relationship between some heavy metals and the productivity of phytoplankton and the biomass of some aquatic plants prevailing in selected areas of Shatt Al-Arab, Southern Iraq," PhD thesis, College of Agriculture, University of Basrah,Iraq, 2016.

[15] C. Leite et al., "The role of warming in modulating neodymium effects on adults and sperm of Mytilus galloprovincialis," *Journal of Environmental Management*, vol. 358, p. 120854, Apr. 2024, doi: 10.1016/j.jenvman.2024.120854.

[16] M. M. Taher, A. Y. Al-Dubakel, and S. J. Muhammed, "Growth parameters of common carp Cyprinus carpio cultivated in semi-closed systems," *Basrah Journal of Agricultural Sciences*, vol. 31, no. 1, pp. 40–47, Jul. 2018, doi: 10.37077/25200860.2018.74.

[17] R. M. Jasim and N. K. K. Fahad, "Study of the concentration level of heavy metals in water and some tissues of common carp, Cyprinus carpio L., which is cultured in cages in the Euphrates River," *University of Thi-Qar Journal of Agricultural Research*, vol. 12, no. 2, pp. 89–97, Oct. 2023, doi: 10.54174/utjagr.v12i2.266.

[18] S. G. Khader and H. F. Okab, "Assessment of glucose metabolism in thalassemia patients with type two diabetes in Thi-Qar, Southern Iraq," *International Journal of Health Sciences*, pp. 2929–2935, Aug. 2022, doi: 10.53730/ijhs.v6ns8.12279.

[19] S. H. Saki and M. A. Al-Shaheen, "Study of some physical and chemical properties of the southern part of Al-Hawizeh Marsh, Southern Iraq," *Iraqi Journal of Aquaculture*, vol. 19, no. 1, pp. 33–52, Sep. 2022, doi: 10.58629/ijaq.v19i1.401.

[20] A. A. Hassan and A. K. Ibrahim, "Physicochemical properties of water in Shatt Al-Basra Canal, Southern Iraq," *Journal of Environmental Sciences Thi-Qar Arts Journal*, vol. 9, no. 47, Dec. 2024, doi: 10.32792/tqartj.v9i47.535.

[21] S. A. Abed, S. H. Ewaid, and N. Al-Ansari, "Evaluation of water quality in the Tigris River within Baghdad, Iraq using multivariate statistical techniques," *Journal of Physics Conference Series*, vol. 1294, no. 7, p. 072025, Sep. 2019, doi: 10.1088/1742-6596/1294/7/072025.

[22] M. Shahjahan et al., "Effects of heavy metals on fish physiology – A review," *Chemosphere*, vol. 300, p. 134519, Apr. 2022, doi: 10.1016/j.chemosphere.2022.134519.

[23] R. W. M. Kwong, "Trace metals in the teleost fish gill: biological roles, uptake regulation, and detoxification mechanisms," *Journal of Comparative Physiology B*, vol. 194, no. 5, pp. 749–763, Jun. 2024, doi: 10.1007/s00360-024-01565-1.

[24] M. Moniruzzaman and N. C. Saha, "Impact of variation in abiotic factors and metal accumulation pattern on the annual rhythmicity of antioxidants and maintenance of oxidative balance in fish gill," *Chemistry and Ecology*, vol. 37, no. 2, pp. 149–163, Nov. 2020, doi: 10.1080/02757540.2020.1843159.

[25] P. Ganeshkar et al., "Eco-friendly nano-copper synthesis: gene and enzyme modulation for combating cadmium and ammonia toxicity in fish," *Biological Trace Element Research*, Apr. 2025, doi: 10.1007/s12011-025-04594-1.

[26] A. O. Ubalua, U. C. Chijioke, and O. U. Ezeronye, "Determination and assessment of heavy metal content in fish and shellfish in Aba River, Abia State, Nigeria," *KMITL Science and Technology Journal*, vol. 7, no. 1, pp. 16–23, Jan. 2007.

[27] A. K. Nor Hasyimah et al., "Assessment of cadmium (Cd) and lead (Pb) levels in commercial marine fish organs between wet markets and supermarkets in Klang Valley, Malaysia," *International Food Research Journal*, vol. 18, no. 3, pp. 795–802, Dec. 2011.

[28] M. Tuzen and M. Soylak, "Determination of trace metals in canned fish marketed in Turkey," *Food Chemistry*, vol. 101, no. 4, pp. 1378–1382, Apr. 2006, doi: 10.1016/j.foodchem.2006.03.044.

[29] W. J. H. Al-Marmadi, "A comparative anatomical and physiological study of the effect of some heavy metals on two species of fish in the Damlaj River and the Shamiya River," M.S. thesis, College of Education, Al-Qadisiyah University, Iraq, 2019.