

## IMPACT OF LEAD ACETATE ON GROWTH PARAMETERS AND BEHAVIOUR IN BUNNI *MESOPOTAMICHTHYS SHARPEYI*

Abdulmotalib J. Al-Rudainy<sup>1</sup>✉, S. A. Mustafa<sup>2</sup> and N. M. Salman<sup>2</sup>

<sup>1</sup>Coll. Agric. Engin. Sci., University of Baghdad; <sup>2</sup> Coll. Vet. Med., University of Baghdad

### ABSTRACT

A total of 100 fingerlings of Bunni, *Mesopotamichthys sharpeyi* weighing between 10-15g were used in the current experiment. The experimental fish treatments involved adding different concentrations of lead acetate exposure as follows: T1 control treatment ; T2 and T4 exposed to 0.2mg/l and 0.4mg/l of lead acetate with complete replacement of water aquarium every two days and added lead acetate continuously in the same proportion. T3 and T5 exposed to lead acetate of 0.2 and 0.4 mg/l in first time only without adding the above percentage of lead acetate with complete replacement of water aquarium every two days. , Results showed after 30 days of exposure that the total weight gain ranged between -5.14g to 3.69g in T2 and T1 respectively. Values of Relative growth rate (RGR) ranged from -38.64-30.59% in T2 and T1 respectively, while the values of specific growth rate (SGR) ranged between -0.0018-0.0039 % / day respectively in the same treatments. The study found that higher concentrations of lead (0.4 mg/l) and continuous exposure had the most detrimental effects on the weight loss, feed intake and the behavior of fish.

**Key words:** Fish, Heavy metal, pollution, nutrition.



Copyright© 2025. The Author (s). Published by College of Agricultural Engineering Sciences, University of Baghdad. This is an open-access article distributed under the term of the Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cite.

**Received: 22/9/2024, Accepted: 18/12/2024, Published: 31/3/2026**

### INTRODUCTION

Many fish species occupy high trophic levels in aquatic environments, making them key consumers in the food chain (Bashir et al.,2020). Consequently, they are principally susceptible to diet-borne pollutants, which can accumulate and be transferred up the food chain ,these pollutants pose significant threats to fish populations, as well as to the health of the entire ecosystem (Binukumari et al., 2017). Fish are an important source of animal protein in many countries around the world, many countries depend on fish to cover 50% of their daily demand on animal proteins (Binukumari et al., 2017). *Mesopotamichthys sharpeyi* belonged to family Cyprinidae, spread in Tigris and Euphrates rivers, and in most local water bodies especially in the south and middle regions of Iraq. Heavy metals are natural constituents for all environments, they are very dangerous materials because of their

persistence, toxicity at low concentration and their ability to be incorporated into the food chain and concentrated by aquatic organisms (Ali and Jawad,2012; Mohammad et al.,2024). Heavy metals have toxic effects on different organs. They can enter into water via drainage, atmosphere, soil erosion and almost human activities by different ways (Dethloff et al., 2001; Gavrilesco et al.,2015; Ezulden et al.,2020 ; Badawi and Magdy, 2023). Heavy metals can enter from contaminated water into a fish body by different routes and accumulate in organisms (Mustafa and Al-Rudainy;2021). Lead (Pb) occurs widely in the environment, and it can enter our bodies through drinking water, and the air we breathe, as well as through food (Mustafa and Al-Rudainy;2021; Hama Aziz and Mustafa,2024). Exposure of Pb can cause many effects depending on level and duration of Pb (Al-Rudainy,2015). Lead is introduced and accumulated in the

environment by different ways, most of it by Pb dust from pigments, mining of its ores, combustion of leaded gasoline and use of ammunitions in hunting (Mustafa and Al-Rudainy;2021; Hama Aziz et al.,2023). There are several ways to be exposed of lead, usually by inhalation, digestion of food, water, skin contact and due to it is use as gasoline additives, the workers of maintenance department are most exposed to pollution with Pb (Hama Aziz et al.,2023). Inhalation, is the main way for lead exposure by workers in the refining generators, mining, use and reclamation of lead industries (Manoj et al.,2024). In countries that still use gasoline containing lead, fuel stations and remnants of cars and proximity to crowded roads are major sources of exposure to lead pollution (Hama Aziz et al.,2023). The present study aimed to detect the impact of lead acetate [ $Pb(CH_3COO)_2$ ] on growth parameters including total weight gain, specific growth rate, relative growth rate, daily increasing, mortality, survival rate and feed conversion ratio, feed efficiency ratio as well as behavior of experimental fish.

## MATERIALS AND METHODS

### Experimental fish and design

The present study was conducted at Fish Diseases Laboratory, College of Veterinary Medicine, University of Baghdad. A total of 100 fingerlings of Bunni, *M. sharpeyi* weighing 10-15g, with no visible signs of disease were acclimated to laboratory

condition for 14 days before beginning of the experiment. Glass aquaria were used in the experiment, with dimensions of 70×40×40cm, using de-chlorinated tap water filled the aquaria to reach 60L and enough oxygen supply, water was changing every 24hr, after feeding in order to maintain a healthy environment with enough oxygen. Fish were randomly distributed into five treatments (each treatment consists of 10 fish per aquarium with two replicates/treatment). T1 served as control treatment without any adding of lead acetate; second treatment (T2) exposed to lead acetate 0.4mg/l with complete exchange of water aquarium every two days and added lead acetate continuously in the same proportion; third treatment (T3) exposed to lead acetate 0.4 mg/l in first time only without adding the above percentage of lead acetate with change of water aquarium entirely every two days during experimental period' forth treatment(T4) exposed to lead acetate 0.2mg/l with complete replacement of water aquarium every two days and added lead acetate continuously in the same proportion; fifth treatment (T5) exposed to lead acetate 0.2 mg/l in first time only without adding the above percentage of lead acetate with change of water aquarium entirely every two days during experimental period. During the 30-days experimental period, fish were fed a commercial diet at a rate of 3% body weight having 26% total protein content (Table 1).

**Table1. Composition of experimental diet**

Proximate composition	%
Fish meal	10
Soybean	25
Barley	30
Wheat	34
Vitamins and Salts	1

Water parameters were recorded every three days of the experimental period such as water temperature °C, dissolved oxygen mg/l , and pH. During the experiment period the observations of toxic symptoms such as behavior, stress, movement...etc. Body weight was measured before and after the experiment for any alteration during the experiment period. Fish were monitored during the

experimental period, dead fish were removed and survival was reported.

**Growth performance:** All the growth performance parameters were calculated according to the following equations:

$$\text{Body weight gain} = \text{Mean final weight} - \text{Mean initial weight}$$

$$\text{Daily weight gain} = \frac{W_2 - W_1}{T} \dots\dots\dots W_2 = \text{Mean final weight}, W_1 =$$

Mean initial weight, (T) = Duration of experiment.

Feed conversion ratio (FCR)=Total feed consumed by fish / Total weight gain of fish

Feed conversion efficiency (FCE) =Total weight gain of fish / Total feed consumed by fish ×100

Relative growth rate (RGR.) = Final weight – Initial weight / Initial weight× 100

Specific growth rate (SGR) = Ln of final weight (LnW<sub>2</sub>) - Ln of initial weight (LnW<sub>1</sub>) / Duration of experiment (T) ×100

Survival rate = Number of live fish at the end of experiment / Number of live fish at the beginning of experiment x 100

**Statistical analysis:** The influence of various factors on research parameters was determined using the SAS software, or Statistical Analysis System. In this study, the least significant difference test (ANOVA) was employed to compare means in a significant way. P value was considered significant difference less than 0.05.

## RESULTS AND DISCUSSION

**Water quality** Water temperature ranged between 23 – 24°C for all experimental treatments, dissolved oxygen level ranged between 6.16mg/l in T4 to 6.50mg/l in T1, while pH values ranged between 6.76 – 7.32 in T5 and T1 respectively (Tab.2). Results of statistically analysis show no significant (p>0.05) among experimental treatments. Temperature plays as an important role in increasing heavy metals toxicity, high

temperatures make toxic chemicals more soluble and increase the toxicity of many heavy metals, leading to increased sensitivity of the organisms for toxic (Mustafa,2020). The difference in dissolved oxygen content was very low among treatments. The dissolved oxygen contents in treatments were similar because aerators were installed in all the aquariums, but, this variable is influenced by a number of factors, especially temperature. Dissolved oxygen concentration is an important water quality parameter that affects the growth and survival of fish (Jawahar et al.,2016; Vali et al.,2020). The effect of Pb acetate also depends on the species and size of the fish, water temperature, pH and exposure time (Rose and Lakshmanan,2024).The optimal water temperature ranged between 24–26°C. Temperature is an important factor, which regulates the biogeochemical activities in the aquatic animals such as fish (Faleh et al.,2015 ; Al-Dubakel et al.,2022). Reduction in dissolved oxygen content has negative effects on growth, and other biological activities of fish, and very low dissolved oxygen content is lethal to fish (Assefa and Abunna ,2018; Al-Dubakel et al.,2022). Finally, pH also plays an important role in dissolving heavy metal ions and affecting movement and distribution (Davendra,2020). These values within the limiting of live for warm fish (Mohammad et al.,2024).

**Table 2. Some physical-chemical(Mean±SE)parameters of the water during the experimental period**

Water properties Treatments	Temp.(°C)	D. oxygen (mg/l)	pH
T1	23 ± 0.66 <sup>a</sup>	6.50 ± 0.45 <sup>a</sup>	7.32 ± 0.21 <sup>a</sup>
T2	23 ± 0.67 <sup>a</sup>	6.33 ± 0.11 <sup>a</sup>	6.82 ± 0.15 <sup>a</sup>
T3	24 ± 0.85 <sup>a</sup>	6.35 ± 0.17 <sup>a</sup>	7.82 ± 0.06 <sup>a</sup>
T4	23 ± 0.43 <sup>a</sup>	6.16 ± 0.32 <sup>a</sup>	6.77 ± 0.13 <sup>a</sup>
T5	24 ± 0.50 <sup>a</sup>	6.11± 0.22 <sup>a</sup>	6.76 ± 0.13 <sup>a</sup>

**Feeding indices** The results in Table 3 show an increases in the weight of the fish in the first treatment (control), reaching 3.69g during the duration of the experiment, accompanied by a daily weight increase reached 0.12g, while the weight gain decreased clearly in the second treatment, in which lead acetate was added every two days with water change, reaching -5.14g. in comparison with

the third treatment, lead acetate was added at the beginning of the experiment only, with the water changed every two days, it was observed that the weight of the fish in the treatment reached -1.68g, which is less than the value of the second treatment. This situation applied to the fourth and fifth treatments, as the weight decreased from 13.22g to 10.10g, with a negative value reached of

-3.12g in the fourth treatment, and a negative value in the weight gain amounted to -0.99g in the fifth treatment, which was added lead acetate at the beginning of the experiment only, with the water changed every two days. The results of statistical analysis indicate that there are significant differences ( $p \leq 0.05$ ) in the first treatment compared to the others of the treatments in the total weight gain criterion. Significant differences in the daily weight gain factor also showed that there are significant differences ( $p \leq 0.05$ ) among the first treatment compared to the second, third, and fifth treatments (Table 3). The values of feed conversion ratio ranged from 3 in the first treatment to 4.1 in the second treatment, while the third and fourth treatments recorded the same values of food conversion ratio (Ali and Jawad,2012) and decreased to 3.2 in the fifth treatment, and this was reflected in the rates of food conversion efficiency values, as the second treatment recorded lower. The value reached 24.39% and the highest value recorded in the first treatment (33.33%).As indicates in Table (Ahmed and Al-Dubakel.,2024). Significant differences ( $p \leq 0.05$ ) were observed when comparing the first treatment with the second, third, and fourth treatments. However, no significant differences ( $p > 0.05$ ) were found between the first and fifth treatments, and between the third and fourth treatments. This may be attributed to the accumulation of lead acetate in the tissues of the experimental fish, particularly in the gills, blood, digestive tract, kidneys, and liver. As a result, a

significant reduction in growth was observed in the fish exposed to this metal, particularly in the second and fourth treatments. The results also showed a loss of appetite in the fish, with large amounts of uneaten food remaining at the bottom of the aquariums in these two treatments. Adding lead acetate only at the beginning of the experiment in the third and fifth treatments, with water changes every two days, helped reduce the accumulation of lead acetate, particularly in the gills. Although there was a decrease in fish weight in the second and fourth treatments. This finding is consistent with results from several studies (Ali et al.,2024). The accumulation of metal in different parts of the fish body depends on many factors such as feeding behaviors, water solubility, environmental factors, season and fish physiology including species, age, size, reproductive state, fish health, bioavailability of the metal, and variations between habitats (Bhattacharjee et al.,2017). The exposure of fish to metallic toxicity can cause loss of appetite that is not only associated with ration but also involve acclimation, appetite and FCE if it is principally desired to realize how a toxicant could affect the fish growth, therefore, it is essential to know about fish nutrition, appetite, acclimation and FCE during growth trials under metal stress conditions (Gökçek and Tepe,2009 ; Tessema et al.,2020 ; Nigar et al., 2021; Ruaa and Fahad,2023). Muhammed (2024) reported significant interactions among feed intake, growth, oxygen consumption and ionic regulation in grass carp due to chronic exposures of heavy metals.

**Table 3. Feed indices (Mean±SE)in experimental treatments.**

Feeding indices Treatment	Total wt. gain	Daily wt. gain	F.C.R.	F.C.E.(%)
T1	3.69 ± 0.02 <sup>a</sup>	0.12 ± 0.01 <sup>a</sup>	3.0 ± 0.3 <sup>b</sup>	33.33 ± 1.6 <sup>a</sup>
T2	- 5.14 ± 0.07 <sup>e</sup>	- 0.17 ± 0.02 <sup>b</sup>	4.1 ± 0.3 <sup>a</sup>	24.39 ± 1.2 <sup>c</sup>
T3	- 1.68 ± 0.03 <sup>c</sup>	- 0.56 ± 0.01 <sup>d</sup>	3.5 ± 0.2 <sup>c</sup>	28.57 ± 2.5 <sup>b</sup>
T4	- 3.12 ± 0.02 <sup>d</sup>	- 0.10 ± 0.03 <sup>b</sup>	3.5 ± 0.2 <sup>c</sup>	28.57 ± 2.6 <sup>b</sup>
T5	- 0.99 ± 0.03 <sup>b</sup>	- 0.33 ± 0.03 <sup>c</sup>	3.2 ± 0.4 <sup>b</sup>	31.32 ± 2.7 <sup>a</sup>

Different alphabetic letters indicated significant variations at ( $p \leq 0.05$ ).

**Growth performance** The highest values of the relative growth rate were recorded 30.59% in T1, while a negative value was recorded for the fifth treatment (-7.61%), and the decline in the values of the relative growth rates continued to reach -38.64% in the second treatment (Table 4).The values of the specific growth rates ranged between -0.0071– 0.0039% /day in the second and first treatments, respectively, as shown in Table (4). The survival rate was different in the experimental treatments, as it was highest in the first treatment at 100% and lowest was the second treatment (40%),

while the third and fifth treatments recorded the same percentage (60%). Results of the statistical analysis showed a significant increase ( $p \leq 0.05$ ) of first treatment in terms of relative growth, specific growth and survival rate compared to the rest of the treatments, with a significant increase ( $p \leq 0.05$ ) of third and fifth treatments compared to the second and fourth treatments. However, there was no significant differences ( $p > 0.05$ ) between the third and fifth treatments. Relative growth and specific growth rates are useful for assessing young fish over short periods, but they are not

suitable for larger fish or longer culture periods. Lead acetate can be toxic or even lethal to fish, shellfish, marine mammals, and birds (Govind and Madhuri,2014). Fish growth serves as an indicator of population health, reflecting the life conditions of the organisms and can be used to detect stress caused by contamination (Hertika et al.,2021 ; Panda et al.,2023). When humans consume contaminated seafood or come into direct contact with these toxins, they may experience negative health effects, including poisoning, respiratory

issues, or skin rashes. Faleh et al. (2015) mentioned that the concentration at which 50% (LC<sub>50</sub>) of the fish died after 72 hours was 4.24 mg/l (Faleh et al.,2015). Lead are highly toxic to aquatic organisms (particularly fish) at low concentration because fishes are not able to regulate their levels in tissues, under conditions of low Pb concentrations and prolonged exposure the concentration of Pb in liver and kidney is shown to gradually increase (Ramos-Misra et al.,2019).

**Table 4. Growth parameters (Mean±SE) in experimental fish**

Growth parameters Treatment	Relative growth rate (%)	Specific growth rate (%/day)	Mortality	Survival rate (%)
T1	30.59±0.06 <sup>a</sup>	0.0039± 0.08 <sup>a</sup>	0	100
T2	-38.64±0.00 <sup>d</sup>	- 0.0071±0.00 <sup>d</sup>	6	40
T3	-14.00 ±0/00 <sup>b</sup>	- 0.0022±0.00 <sup>b</sup>	4	60
T4	-23.00± 0.00 <sup>c</sup>	- 0.0039± 0.00 <sup>c</sup>	5	50
T5	- 07.61±0.00 <sup>b</sup>	- 0.0018±0.00 <sup>b</sup>	4	60

Different alphabetic letters indicated significant variations at (p≤0.05).

#### Fish behavioral

Behavioral changes increased with increased concentration of lead acetate; behavioral changes observed in fish are as follows in Table (5). The rates at which the swimming behavior depends on species of fish and sensitive to low of dissolved oxygen levels, DO also regulate the availability of certain nutrient in water (Ahmed and Al-Dubakel,2024). Many physical and biological factors affect the amount of dissolved oxygen in water, the physical factors that influence DO are temperature, salinity ...etc (Ahmed and Al-Dubakel,2024). Metabolic activity in warm water fish increase with rise in temperature, thus, increasing a fishes demand for oxygen (Al-Dubakel et al.,2022). Fish can absorb lead by ion exchange through their gills, skin, ingestion of contaminated food, or through adsorption on fish tissues (Abu-Zahra et al.,2024; Khalefa et al.,2024 ; Rose and Lakshmanan, 2024). Once inside the fish body, they can be carried to the body through the bloodstream (Mustafa,2020). Carrier proteins play a role in transferring these metals to body organs and tissues, where they can bind to metal binding proteins (Al-Jabryn,2022; Rose and Lakshmanan, 2024). This binding allows heavy metals to accumulate in different tissues, mainly in organs such as the liver, kidneys and gills

potentially reaching high levels over time (Dwinna et al.,2020). High levels of lead can disrupt normal biological functions and interfere with different physiological process (Mustafa,2020). They can cause damage to organs, tissues, and cells, resulting in chronic health problems, reduced food intake even death (Al-Rudainy,2015). The accumulation of lead in different parts of the fish body depends on many factors such as feeding behavior, water solubility, fish physiology, species, age, size, reproductive state, fish health, bioavailability of the metal, and variations between habitats (Mustafa and Al-Rudainy, 2021 ; Panda et al.,2023). Freshwater fish tend to absorb water while losing salts, whereas marine fish are more likely to lose water and retain salts (Mustafa,2020). The mortality of the fish increased along with increasing the lead acetate concentrations and length of exposure periods (Faleh et al.,2015).

**Table 5. Behavior of *M. sharpeyi* exposed to different concentrations of lead acetate for 30 days**

Treatments	Movement	Food Intake	Respiration	Reaction to External Stimuli	Death Time
T1	Natural swimming throughout the experiment	Normal	Normal	Normal	Without deaths
T2	Abnormal swimming after 3 days, loss of equilibrium, fast movement, fish aggregate, finally sinking to the bottom	Loss of appetite after 2 days, continues until the end of the experiment	Increased operculum movement, continues until the end of the experiment	reduce response to external effect	First death after 2 days
T3	Natural swimming after 14 days	Loss of appetite after 12 days, then resumed pellet intake	Little - increase in gill operculum movement	Little response to external effect	First death after 7 days, effect of lead acetate disappears after 24 days
T4	Natural swimming after 18 days	Loss of appetite after 2 days, then resumed pellet intake	Increased operculum movement, continues until the end of the experiment	reduce response to external effect	First death after 4 days
T5	Natural swimming after 10 days	Loss of appetite after 8 days, then resumed pellet intake	Little increase in gill operculum movement	Little response to external effect	First death after 10 days, effect of lead acetate disappears after 20 days

### CONCLUSION

The results of this study indicate that lead acetate exposure significantly and negatively impact the growth, feed intake, and behavior of *M. sharpeyi* fingerlings. Higher concentrations of lead acetate (0.4 mg/l) and continuous exposure resulted in the most severe effects, including reduced weight gain, negative relative growth rates, and diminished specific growth rates. The behavioral changes are often a reflection of the physiological stress fish experience due to heavy metal toxicity, which can lead to long-term health issues and even death if exposure persists.

### CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

### DECLARATION OF FUND

The authors declare that they have not received a fund.

### REFERENCES

Abu-Zahra, N. I., A.A. A.El-Shenawey, S.A. Y. Atia & G.I. Ali. 2024. Lead acetate exposure

induces growth retardation, immune suppression, oxidative/antioxidant imbalance, and histological alterations in *Oreochromis niloticus*: A Mitigation Trial via *Chlorella Vulgaris*.

<https://doi.org/10.21608/ejvs.2025.325924>.

Ahmed, M. M. & A.Y. Al-Dubakel.2024. Effect of different feeds on growth rate and survival of common carp (*Cyprinus carpio* L.) larvae. Basrah J. Agric. Sci. 37(1):47-54, 202. <https://doi.org/10.37077/25200860.2024.37.1.04>

Al-Dubakel, A.Y., S.S. Al-Noor, A.M. Mojer, M.M. Taher & S. J. Muhammed.2022. Comparison of growth of common carp, *Cyprinus carpio* cultivated in and outside cages in earthen ponds in Basrah, Iraq. Biol. Appl. Environ. Res.6(2):204-217. <https://doi.org/10.51304/baer.2022.6.2.204>

Ali, A.M. & L.A. Jawad.2012. Larval development of the cyprinid fish *Barbus sharpeyi* (Gunther,1874). Journal of Fisheries and Aquatic Science.7(5):307-319. <https://doi.org/10.3923/jfas.2012.307.319>

- Ali, I., S. Zulqarnain, S. Rasheed, A. Hussain & I. Saeed. 2024. Effect of lead acetate toxicity on the histological and biochemical changes in liver and kidney of fish rohu (*Labeo rohita*). Biol. Clin. Sci. Res. J. Vol. 884.  
DOI: <https://doi.org/10.54112/bcsrj.v2024i1.884>
- Al-Jabryn, D.H. 2022. Heavy metals in some commercially fishery products marketed in Saudi Arabia. Food Science and Technology. 1-8.  
<https://doi.org/10.1590/fst.34222>
- Al-Rudainy, A.J. 2015. Effects of sub-lethal exposure to lead acetate on haematological indices and growth rate of bunnii *Mesopotamichthys sharpeyi*. Adv. Anim. and Vet. Sci. 3(1):569- 573.  
<http://dx.doi.org/10.14737/journal.aavs/2015/3.11.569.573>
- Assefa, A. & F. Abunna. 2018. Maintenance of fish health in aquaculture: review of epidemiological approaches for prevention and control of infectious disease of fish. Veterinary Medicine International.  
<https://doi.org/10.1155/2018/5432497>.
- Badawi, A. & S. Magdy. 2023. Evaluation of the pollution extent of heavy metals in the sediment of the Nile Delta, Mediterranean Coast, Egypt. Eyp. J. Aquac. Res. 49(2):221–228. <https://doi.org/10.1016/j.ejar.2023.01.002>
- Bashir, I., F. A. Lone, R. A. Bhat, S. A. Mir, Z. A. Dar & S. A. Dar. 2020. Concerns and threats of contamination on aquatic ecosystems. Bioremediation and Biotechnology: Sustainable Approaches to Pollution Degradation. 1–26.  
[https://doi.org/10.1007/978-3-030-35691-0\\_1](https://doi.org/10.1007/978-3-030-35691-0_1)
- Bhattacharjee, A., K. Chakraborty & A. Shukla. 2017. Cellular copper homeostasis : Current concepts on its interplay with glutathione homeostasis and its implication in physiology and human diseases. Metallomics. 1376-1388.  
<https://doi.org/10.1039/c7mt00066a>
- Binukumari, S., K. Anusiya-Devi & J. Vasanthi. 2017. Applications in environmental risk assessment of biochemical analysis on the Indian freshwater fish, (*Labeo rohita*) exposed to monocrotophos pesticide. Journal of Environmental Toxicology and Pharmacology. 47: 200- 205.  
<http://dx.doi.org/doi:10.1016/j.etap.2016.08.014>
- Davendra, S. M. 2020. A Review on Impact of Water Pollution on Freshwater Fish Species and Their Aquatic Environment. In Book: Advances in Environmental Pollution Management: Wastewater Impacts and Treatment Technologies. Edition:1. Chapter: 2:10-28.  
DOI:10.26832/aesa-2020-aepm-02
- Dethloff, G.M., H.C. Bailey & K.L. Maier. 2001. Effects of dissolved copper on select haematological, biochemical and immunological parameters of wild rainbow trout, *Oncorhynchus mykiss*. Environ. Contam. Toxicol. 40:371-80.  
<https://doi.org/10.1007/s002440010185>
- Dwinna, A., A. Sutriana, N. Nazaruddin, T. Armansyah, E. Etriwati, M. Hanafiah, H. Hafizuddin, D. Irmawati, H. Awaluddin, A. Waluddin & B. Ulfa. 2020. Histopathological Changes in the Gills of *Oreochromis mossambicus* Exposed to Mercury Chloride (HgCl<sub>2</sub>). Adv. Biol. Sci. Res. 74-78. 2nd International Conference on Veterinary, Animal, and Environmental Sciences. (ICVAES 2020).  
DOI:10.2991/absr.k.210420.017
- Ezulden, M.A., K. M. Essmuaa, A. Atarhony & R. Alrkhaus. 2020. Study of accumulation of some heavy elements in the waving of four types of fish collected from the beaches of Tripoli and Misrata. J. Hum. Appl. Sci. No.10:131-144. DOI:10.13140/RG.2.2.32264.03844
- Faleh, I.B., M.S. Noor, A.J. Al-Rudainy & A.J. Shubber. 2015. Monitoring the effect of lead acetate on histopathological changes in *Barbus sharpeyi*. Am. J. Appl. Sci. Res. 1(2): 10-17.  
<https://doi.org/10.11648/J.ajsr.20150102.12>
- Gavrilescu, M., K. Demnerov´a, J. Aamand, S. Agathos & F. Fava. 2015. Emerging pollutants in the environment: present and future challenges in biomonitoring, ecological risks and bioremediation. New Biotechnology. 32:147–156.  
<https://doi.org/10.1016/j.nbt.2014.01.001>

- Gökçek, C.K. & Y. Tepe. 2009. An alternative species for traditional carp polyculture in Turkey: Initial growing period. *Journal of Fisheries Sciences*. 3(3):18-23.  
<http://dx.doi.org/10.3153/jfscom.2009004>
- Govind, P. & S. Madhuri. 2014. Heavy metals causing toxicity in animals and fishes. *Res. J. Anim. Vet. Fishery Sci.* 2(2):17–23.  
<https://www.researchgate.net/publication/303213699>
- Hama Aziz, K. H. & F. S. Mustafa. 2024. Advanced oxidation processes for the decontamination of heavy metal complexes in aquatic systems: A review. *Case Stud. Chem. Environ. Eng.* 9: 100567.  
<https://doi.org/10.1016/j.cscee.2023.100567>
- Hama Aziz, K. H., F. S. Mustafa, K. M. Omer, S. Hama, R. F. Hamarawf & K. O. Rahman. 2023. Heavy metal pollution in the aquatic environment: Efficient and low-cost removal approaches to eliminate their toxicity: A review. *RSC Advances*. 13(26): 17595–17610.  
<https://doi.org/10.1039/D3RA00723E>
- Hertika, A. M. S., K. Kusriani, E. Indrayani & R. B. D. S. Putra. 2021. Density and intensity of metallothionein of *Crassostrea* sp. as biomarkers of heavy metal contamination in the Northern coast of East Java, Indonesia. *Egypt. J. Aquac. Res.* 47(2):109–116.  
<https://doi.org/10.1016/j.ejar.2021.04.006>
- Jawahar, S., A. Nafar, K. Vasanth, M.S. Musthafa, J. Arockiaraj, C. Balasundaram & R. Harikrishnan. 2016. Dietary supplementation of zeolite on growth performance, immunological role, and disease resistance in *Channa striatus* against *Aphanomyces invadans*, *Fish Shellfish Immunol.* 51: 161–169.  
<https://doi.org/10.1016/j.fsi.2016.02.019>
- Khalefa, H.S., H.O. AbuBakr, S.H., Aljuaydi, Y.H. Kotp, A.K. Al-Mokaddem & D.A. Abdel-Moneam. 2024. Aquatic assessment of the chelating ability of Silica-stabilized magnetite nanocomposite to lead nitrate toxicity with emphasis to their impact on hepatorenal, oxidative stress, genotoxicity, histopathological, and bioaccumulation parameters in *Oreochromis niloticus* and *Clarias gariepinus*. *BMC Vet. Res.* 20. 262.  
<https://doi.org/10.1186/s12917-024-04094-9>
- Manoj, K., S. Singh, A. Jain, S. Yadav, A. Dubey & S.P. Trivedi. 2024. A review on heavy metal-induced toxicity in fishes: Bioaccumulation, antioxidant defense system, histopathological manifestations, and transcriptional profiling of genes. *Journal of Trace Elements in Medicine and Biology*. Volume 83. 127377.  
<https://doi.org/10.1016/j.jtemb.2023.127377>
- Mohammad, H., R. Salighehzadeh, B. Pedram & M. Mosafar. 2024. The study of native fish of *Mesopotamichthys sharpeyi* and *Barbus grypus* in Khuzestan Province warm water fish farms with the perspective of contamination by heavy metals and risk evaluation for consumers. *Journal of Animal Biology*. 16(3):97-109.  
[10.22034/ascij.2023.1996999.1542](https://doi.org/10.22034/ascij.2023.1996999.1542)
- Muhammed, S.J. 2024. Effects of four imported floating diets on feed intake and daily feeding rate of grass carp, *Ctenopharyngodon idella* (Valenciennes, 1844). *Thi-Qar Journal of Agricultural Research*. 13(1):291-297.  
<https://doi.org/10.54174/yksw8q84>
- Mustafa, S. & A. J. Al-Rudainy. 2021. Impact of mercury chloride exposure on some of immunological and biochemical assays of common carp, *Cyprinus carpio*. *Iraqi J. Agric. Sci.* 52(3):547-551.  
<https://doi.org/10.36103/ijas.v52i3.1341>
- Mustafa, S. A. 2020. Histopathology and heavy metal bioaccumulation in some tissues of *Luciobarbus xanthopterus* collected from Tigris River of Baghdad, Iraq. *Egypt. J. Aqua. Res.* 46:123–129.  
<https://doi.org/10.1016/j.ejar.2020.01.004>
- Nigar, S., N. Gupta, A. Trivedi & V. Gupta. 2021. Lead Nitrate Induced Acute Toxicity in the Freshwater Fishes *Channa Punctatus* and *Heteropneustes Fossilis*. *Applied Ecology and Environmental Sciences*. 9(8):735-743.  
DOI: 10.12691/aees-9-8-4
- Panda, B. P., Y. K. Mohanta, S. P. Parida, A. Pradhan, T. K. Mohanta, K. Patowary, W. A. Wan Mahari, S. S. Lam, A. A. Ghfar, G. Guerriero, M. Verma & H. Sarma. 2023. Metal pollution in freshwater fish: A key indicator of contamination and carcinogenic

risk to public health. Environ. Pollut. 330. 121796.

<https://doi.org/10.1016/j.envpol.2023.121796>

Ramos-Misra, J., M. Sanches-muros, M. Morote, E. Torrijos, C. Gill, R. Zamani-Ahmadm Mahmoodi & J. R. Martin. 2019. Potentially toxic elements in commonly consumed fish species from the western Mediterranean Sea (Almeria Bay): Bioaccumulation in liver and muscle tissues in relation to biometric parameters. Sciences of the Total Environment. 671: 280-287.

<https://doi.org/10.1016/j.scitotenv.2019.03.359>

Rose, R. N. & S. Lakshmanan. 2024. Impact of heavy metal lead acetate on hematology of freshwater fish *Oreochromis niloticus*. Eco. Environ. Cons:s288- s294.

<http://doi.org/10.53550/EEC.2024.v30i06s.042>

Ruaa, M. J. & K.K. Fahad.2023. A study of some growth parameters for common carp

*Carpinus carpio* L. cultured in floating cages. Thi-Qar Journal of Agricultural Research. 12(2):81-88.

<https://doi.org/10.54174/utjagr.v12i2.265>

Tessema, A., A. Getahun, S. Mengistou, T. Fetahi & E. Dejen. 2020. Reproductive biology of common carp (*Cyprinus carpio* L.) in lake Hayq, Ethiopia. Fisheries and Aquatic Sciences. 23(16):2-10.

<https://doi.org/10.1186/s41240-020-00162-x>

Vali, S., N. Majidiyan, A.M. Yalsuyi, M. F. Vajargah, M. D Prokić & C. Faggio. 2022. Ecotoxicological effects of silver nanoparticles (Ag-NPs) on parturition time, survival rate, reproductive success and blood parameters of adult common molly (*Poecilia sphenops*) and their larvae. Water. 14. 144.

<http://dx.doi.org/10.3390/w14020144>

### تأثير خللات الرصاص في معايير النمو والسلوك لسلمكة البني *Mesopotamichthys sharpeyi*

عبدالمطلب جاسم الرديني<sup>1</sup> ، سناء عبدالعزيز مصطفى<sup>2</sup>، نور محمد سلمان<sup>2</sup>  
<sup>1</sup> كلية علوم الهندسة الزراعية ، جامعة بغداد ;<sup>2</sup>كلية الطب البيطري، جامعة بغداد

#### المستخلص

استخدم 100 إصبعية من اسماك البني *Mesopotamichthys sharpeyi* تراوح وزنها بين 10 - 15غم في التجربة الحالية . تضمنت المعاملات التجريبية للاسماك إضافة خللات الرصاص بتركيز مختلفه كالاتي: T1 (معاملة السيطره): T2 و T4 تم تعريضهما الى خللات الرصاص بتركيز 0,2 و 0,4 ملغم/لتر على التوالي مع استبدال ماء الحوض بالكامل كل يومين وإضافة نفس النسبة من بشكل مستمر . تم تعريض المعاملتين T3 و T5 الى 0,2 و 0,4 ملغم/لتر من الى خللات الرصاص على التوالي في المرة الأولى فقط دون إضافة النسبة المذكورة أعلاه مع استبدال ماء الحوض بالكامل كل يومين. أظهرت النتائج بعد 30 يوما من التعرض ان الزيادة الوزنية الكلية تراوحت بين -5,14 غم إلى 3,69 غم في T1 و T2 على التوالي. تراوحت قيم R.G.R. بين -38,64 - 30,59% في T1 و T2 على التوالي، في حين تراوحت قيم S.G.R. بين - 0,0018 - 0,0039 % / يوم للمعاملتين نفسيهما على التوالي. استنتجت الدراسة الحالية بان التراكيز العالية من خللات الرصاص كان لهما التأثير الاكثر ضررا في فقدان الوزن وتناول العلف وسلوك الاسماك .

الكلمات المفتاحية : اسماك معادن ثقيلة ، تلوث ، تغذية.