Journal of Biology

Open access

# Assessment of Biosorption and Transfer of Heavy Metals (chromium and copper) by Microalgae (Arthrospira platensis), Amphipoda (Pontogammarus maeoticus) and Beluga fish of Caspian Sea (Huso huso)

**Aboolghasem Amri Sahebi[1], Babak Doustshenas[1], Reza Safari [2, *], Arash Larki[1]**

[1] Department of Marine Biology, Faculty of Marine Sciences and Oceanography, Khorramshahr University of Marine Science and Technology, Khorramshahr, Iran

[2, *] Assistant professor, Caspian Sea Ecology Research Institute, Fisheries Science Research Institute, Agricultural Education and Extension Research Organization, Sari, Iran

## RESEARCH ARTICLE

## ABSTRACT

The Caspian Sea is a closed environment from the entry of river waters pollutant. The amount and type of metals have a different effect on organisms from the base to the top of a food chain pyramid. The purpose of this research is to compare the absorption of copper and chromium in a period of time by microalgae as the base pyramid, microbenthos as the interface between phytoplanktons and nekton, and fish as the top of the Caspian Sea food pyramid. The working method included the preparation stage for the production, storing and injection metals into the samples and the digestion stage of the samples for their reading by the atomic absorption spectroscopy (AAS). In this research, the absorption metal by algae and gammarus showed a significant difference between copper and chromium ($P<0.01$). Algae showed a better efficiency in chromium metal absorption and during the period of time, it had a high initial absorption. Gammarus had a better efficiency in absorbing copper metal and over time showed an upward trend in metal absorption. A significant difference was seen between algae and gammarus in the absorption of metals in co-cultivation ($P<0.01$). Algae showed superiority, in direct competition. A significant difference was seen in the accumulation of metals in muscle and liver tissue of fish ($P<0.01$). Liver tissue showed more accumulation of metals. A significant difference was seen in metal absorption by fish tissues ($P<0.01$). Tissues were observed more accumulation of copper metal. Among the adsorbent samples, algae had the most absorption and gammarus had the most accumulation in fish body tissues. The result of this research, Algae absorbed metals from the environment in a short period of time and it excreted from the body without being transported in the tissue. In contrast, Gammarus absorbed metals from the environment and finally transfers them to fish as food. Therefore, the absence of algae in an ecosystem causes the direct transfer of heavy metals to microorganisms such as gammarus, and during the consumption of these organisms by fish, it will have harmful effects on their health and ultimately on humans.

**KEYWORDS**

Biosorption, Heavy metals, Spirulina microalgae, Gammarus amphipoda, Beluga fish

**Correspondence to:** Dr. Reza Safari, Assistant professor, Caspian Sea Ecology Research Institute, Fisheries Science Research Institute, Agricultural Education and Extension Research Organization, Sari, Iran, Email: safari1351@gmail.com

**Received**: January 07, 2024, **Accepted**: January 17, 2024, **Published**: January 24, 2024

**DOI:** 10.1042/JB.6.1.0013

**Citation**: Reza Safari, 2024, Assessment of Biosorption and Transfer of Heavy Metals (chromium and copper) by Microalgae (Arthrospira platensis), Amphipoda (Pontogammarus maeoticus) and Beluga fish of Caspian Sea (Huso huso). JOB. Vol 6.



## INTRODUCTION

The Caspian Sea has a large amount of metal from sewage due to being closed and supplying most of the incoming water from rivers. Organic and mineral materials are discharged into the environment due to domestic, agricultural, and industrial activities and finally turn into organic and mineral pollutants [1]. Unlike organic pollutants, heavy metals are not degradable but tend to accumulate in organisms. Therefore, wastewaters combine with inorganic nitrogen and phosphorus due to resistance and the presence of heavy metals, and cause damage to the food chain [2]. Bio sorption has particular importance due to its contribution to the environment and its excellent performance in removing heavy metals [3]. The purpose of this research is to compare and influence the amount of Gammarus macrobenthos (*P. maeoticus*) and spirulina microalgae (*Arthrospira platensis*) in the maximum concentration of bio sorption and also the final lethality limit of heavy metals chromium and copper. At the end of this stage was the process and amount of heavy metals absorbed in the diet of beluga fish (*H*uso *huso*) at the top of the food pyramid of the Caspian Sea.

## MATERIALS AND METHODS

First in the preparation stage, each of the algae, gammarus and fish samples was caught and then cultured separately. In the digestion process, the samples enter the laboratory stage. At the end of this process, the reading direction by the atomic absorption spectroscopy was created in the form of numbers. Finally, the numbers were obtained by statistical software in the form of tables and graphs.

## RESULTS

The absorption of heavy metals copper (Cu) and chromium (Cr) observed in the highest amount in algae and the lowest amount in Gammarus, liver, and then muscle tissue. The amount of absorption of heavy metals in algae culture observed to be higher for chromium than copper metal. It showed its effect in inhibiting heavy metals for the liver and muscle tissue. The amount of absorption of heavy metals in Gammarus culture observed to be higher for copper than chromium metal. It showed its effect on the transfer of metals in the liver and then in the muscle tissue. In co-cultivation, chromium metal observed with the highest metal absorption by algae and copper metal with the highest metal accumulation by body tissues. Algae are effective in inhibiting the transfer of metals to Gammarus in co-culture.

## DISCUSSION AND CONCLUSION

In this research, a comparison was in transferring heavy metals from spirulina algae to Gammarus and then to beluga fish. In the present research, a general comparison of the accumulation of heavy metals observed in fish tissue, including algae (muscle) < co-culture (muscle) < Gammarus (muscle) < algae (liver) < co-culture (liver) < Gammarus (liver). Based on the transfer of heavy metals through the food chain, the maximum absorption of metal seen by algae, and in the next stage, it transferred to the Gammarus and then with a smaller amount to the liver and muscle tissue of fish. It can be that the increase of algae at the base of the pyramid does not cause the transfer of heavy metals and its harmful effects on the top of the pyramid. Gammarus, by absorbing heavy metals, especially copper metal, accumulates and transmits them more strongly to the fish tissue. Therefore, algae in the food composition of fish will increase metal absorption and, as a result, reduce the accumulation and transfer of metals to fish tissue. Also, the accumulation of metal in the body tissue of the fish observed through the consumption of Gammarus (treatment 2) more than the direct injection of metal (treatment 4). Based on the results, Algae has an inhibitory role and Gammarus has a transporter role for heavy metals in fish body tissue. There are two possibilities for the effect of algae on fish body tissue. In the first possibility, the algae absorb the metals from the environment, and during consumption in the fish diet, it not transferred to the fish body. Finally, it is excreted from the fish body (the possibility of this research). In the second possibility, the algae absorb the metals from the fish's body and finally the algae with metals are removed from the fish's body (need more time). Also, there are two possibilities for the effect of Gammarus on fish body tissue. In the first possibility, Gammarus absorbs the maximum metals from the environment and finally transfers all the absorbed metals as food to the fish (the possibility of this research). In the second possibility, it provides of digestion and absorption of Gammarus in the fish body is more than that of algae and provides enough time for the maximum absorption of metals in the fish tissue (requires metal absorption experiments during the digestive process). As a result, if algae are not present in an ecosystem, it causes the direct transfer of heavy metals to tiny organisms such as Gammarus. During the consumption of these organisms by fish and, finally humans, it will have harmful effects on health in the long term. Therefore, algae cannot be directly food for fish in nature, but in the water ecosystem chain, they refine heavy metals for fish by directly absorbing metal from the environment and also by consuming algae by tiny organisms such as Gammarus as mediators.

## REFERENCES


1) Abdel-Raouf N, Al-Homaidan A, Ibraheem I. Microalgae and wastewater treatment. Saudi J Biol Sci. 2012, 19:257-275.
2) Souza PO, Ferreira LR, Pires NR, Filho PJS, Duarte FA, et al. Algae of economic importance that accumulate cadmium and lead: a review. Rev. Bras Farmacogn. 2012, 22:825-837.
3) Wang X, Chen L, Xia S, Zhao J, Chovelon JM, et al. Biosorption of Cu (II) and Pb (II) from aqueous solutions by dried activated sludge. Min Eng. 2006, 19:968-971.