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COMPARATIVE STUDY OF THE HEAVY METAL LEVELS IN GREY MULLET (*MUGIL CEPHALUS*) FROM THE NORTHERN AND SOUTHERN BULGARIAN BLACK SEA COAST

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ABSTRACT

The heavy metals pollution of aquatic ecosystems is a serious environmental threat that affects aquatic biomes. In this regard, various fish species which can accumulate heavy metals are valuable bioindicators of water pollution. The aim of the present study was to determine the levels of As, Pb, Cd, Hg, Mn, Zn, and Al in gray mullet (*Mugil cephalus, Linnaeus, 1758*). The samples were collected during the fishing season between June and September 2020 from Varna and Burgas regions. The concentrations of lead, cadmium, and mercury were below the maximum levels and this trend was observed for both studied areas. The element with the highest concentration for the Varna region was manganese and for Burgas – zinc.

Key words: heavy metals, grey mullet, *Mugil cephalus*, Black Sea.

Introduction

Contamination of water resources and hydrobionts is a significant environmental problem, especially with regard to human health. Heavy metals are non-degradable chemical elements that have the ability to accumulate in plant and animal species and through their participation in the food chain can enter the human body (Arnaudova et al., 2008; Norouzi et al., 2017).

Figure 1: Black Sea region
(https://www.world-grain.com/articles/13815-poll-black-sea-wheat-exports-to-hold-steady)

Globally, the Black Sea (Fig.1) is the largest anoxic water basin below 180 m depth. It is a semi-closed sea in which flow some of the largest European rivers – the Danube, the Dniester, and the Dnieper. For this reason, it is considered one of the most polluted seas (Makedonski et al., 2015; Fazio et al., 2020). This, together with numerous anthropogenic activities, is a prerequisite for the

pollution of the Black Sea and its inhabitants to be the subject of a number of studies (Stancheva et al., 2013; Makedonski et al., 2015; Bat et al., 2018a; Fazio et al., 2020).

Grey mullet (*Mugil cephalus, Linnaeus 1758*) (Fig. 2) is a herd fish inhabiting coasts of many seas and oceans. This is a cosmopolitan species with important commercial importance (Bekova and Raikova, 2016; Kazarnikova et al., 2020) which feeds mainly on zooplankton and detritus (FAO, 2021).

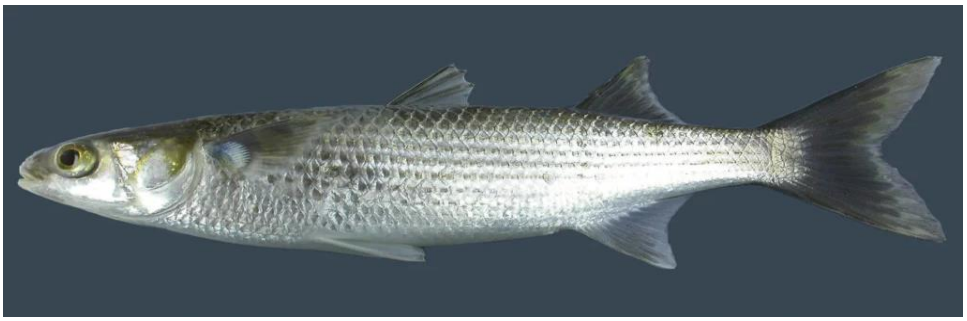

Figure 2: Gray Mullet (*Mugil cephalus*)
(https://ncfishes.com/freshwater-fishes-of-north-carolina/mugil-cephalus)

Because of its wide distribution and special eating habits, the determination of the concentrations of heavy metals in the Black Sea grey mullet should be a subject of intensive scientific research.

Materials and methods

The fresh fish samples were taken from commercial catches at two locations in Black Sea along Bulgarian coastal area, Varna and Burgas during fishing season 2020. Specimens of similar body weight and length were selected. All samples were stored at -20ºC until to pre-treatment and chemical analysis.

The fish samples were taken randomly and only consumable sizes were used. They were thoroughly washed with ultra-pure water and then the specimens were measured for total length. The mean lengths of Mugil cephalus were 32±3 cm.

The analysis was carried out after homogenization (Vortex homogenizer), followed by microwave assisted acid digestion procedure (ETHOS UP High-performance Microwave digestion system, Milestone Inc). After digested with nitric acid an appropriate spectroscopy determination with Inductively coupled plasma mass spectrometry (ICP-MS, Thermo Fisher TM) was performed. The summarized results of this study were presented as mean values (X) (mg/kg) wet weight ± standard deviation (SD). The data were subjected to a statistical analysis with Student's-test to estimate the significance of values ($p < 0.05$).

Results and Discussion

The purpose of this study was to determine the levels of As, Pb, Cd, Hg, Mn, Zn and Al in samples of grey mullet from the Northern and Southern coasts of the Bulgarian Black Sea. The heavy metal levels in *M. cephalus* were compared with the other reported results.

The obtained data of heavy metal levels in Black Sea mullet are presented in Table 1.

Table 1: Heavy metal concentrations (mg/kg wet weight) in total tissues of grey mullet (*Mugil cephalus*) from Bulgarian Black Sea coast

Element	Unit	Varna region	Burgas region	Permissible values
As (X±SD)	mg/kg w.w	0.31 ± 0.03	0.29 ± 0.03	-
Pb (X±SD)	mg/kg w.w	< 0.05*	< 0.05*	0.30
Cd (X±SD)	mg/kg w.w	< 0.05*	< 0.05*	0.05
Hg (X±SD)	mg/kg w.w	< 0.05*	< 0.05*	0.5
Mn (X±SD)	mg/kg w.w	0.33 ± 0.03	0.47 ± 0.05	-
Zn (X±SD)	mg/kg w.w	3.11 ± 0.31	< 0.5*	-
Al (X±SD)	mg/kg w.w	< 10.0*	< 10.0*	-

**Method detection limits; ** $p < 0.05$*

The European Community (Regulation No 1881/2006) and Bulgarian Food Regulation (Ordinance № 5/9.02.2015) recommended the maximum levels for heavy metals in sea fish as follows: Pb – 0.30 mg/kg w.w, Cd – 0.05 mg/kg w.w. and Hg – 0.5 mg/kg w.w. The levels of these elements in the present study were below the maximum levels and this trend was observed for both studied areas. The results of Stancheva et al. (2013) and Fazio et al. (2020) also have not shown excessive amounts of cadmium and lead in grey mullet samples from the Bulgarian coast. The study of Tuzen (2009) of commercial fish species has demonstrated that the element with the highest concentrations was zinc. A similar trend has been observed in the present study from the Varna region (Zn-3.11 mg/kg w.w). Zinc was the element with the highest concentration and according to Makedonski et al. (2015). However, in the samples from Burgas area zinc was below the detection limits and instead of it the chemical element with the highest value was manganese (0.47 mg/kg w.w).

Arsenic is a metalloid that enters the human body through food and its bioaccumulation leads to central and peripheral nervous system disorders (Stancheva et al., 2013). The concentration levels of arsenic for the two studied areas showed similar values, although in the grey mullet samples from Varna it was slightly higher. The reverse pattern has reported by Stancheva et al. (2013) as their data has shown higher levels of arsenic for the southern Black Sea coast.

The concentration of aluminium in grey mullet specimens in this study was below the detection limit (<10.0 mg/kg w.w). A recent research from 2020 on heavy metal pollution in the Black and Ionian Seas has shown that aluminium levels in Black Sea mullet were nearly 4 times lower than those in mullet caught from the Ionian Sea (Italy) (Fazio et al., 2020).

The significant pollution of the Black Sea and the accumulation of heavy metals in marine flora and fauna, including fish, can pose an increasing risk to human health (Bat et al., 2018b). Some heavy metals are vital for the development of living organisms, while others can be potentially harmful depending on the ingested amount. All of them can have adverse effects on living organisms. In this regard, studies in this field can demonstrate the benefits or harms of fish and marine organisms consumption (Yilmaz, 2005).

Conclusion

Based on the estimated values can be concluded that there was not a significant heavy metals contamination of *Mugil cephalus* in the Bulgarian part of the Black Sea. The values of the studied chemical elements were higher for the Varna region, with the exception of manganese. The zinc found in Varna fish was the element with the highest concentration. The levels of Cd, Pb and Hg did not exceed the reference norms specified in the Bulgarian and European legislation. Based on our

results, we can conclude that the consumption of gray mullet from the Bulgarian Black Sea coast did not pose a risk to human health during the fishing season in 2020.

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References

1. Arnaudova D., Tomova E., Velcheva I. and Arnaudov A. (2008). *A Study on the Lead, Zink and Cadmium Content in various organs in fishes from Cyprinidae And Percidae families in "Studen Kladenets" And "Kardzhali" Dam Lakes*. Proceedings of The Anniversary Scientific Conference of Ecology. Plovdiv, November 1st 2008, p. 327–335
2. Bat L., Oztekin A., Sahin F., Arici E., Ozsandikci U. (2018a). *An overview of the Black Sea Pollution in Turkey*. Med FAR.; 1(2):67−86.
3. Bat L., Sahin F. and Öztekin A. (2018b). *Toxic Metal Amounts in Chelon auratus (Risso, 1810): A Potential Risk for Consumer's Health*. 7. 303−306. 10.15406/jamb.2018.07.00225.
4. Bekova R., Raikova G. (2016). *On the pattern of correlation between the fecundity, length, weight and age of Mugil Cephalus Linnaeus, 1778 (mugilidae) from the Bulgarian Black Sea coast*. Annuaire de l'Université de Sofia "St. Kliment Ohridski"Faculte de Biologie2017, volume 102, livre 4, pp. 89−96.
5. *Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in food stuffs*.
6. FAO. (2021). *http://www.fao.org/fishery/culturedspecies/Mugil_cephalus/en*.
7. Fazio F., D'Iglio C., Capillo G., Saoca C., Ivanova K., Piccione G. and Makedonski L. (2020). *Environmental Investigations and Tissue Bioaccumulation of Heavy Metals in Grey Mullet from the Black Sea (Bulgaria) and the Ionian Sea (Italy)*. Animals: an open access journal from MDPI. 10. 10.3390/ani10101739.
8. Kazarnikova A., Strigakova T., Bortnikov E., Byadgi O., Galeotti M., Beraldo P., Ermakov A., Derezina T., Poynton S. (2020). *New data on wild grey mullet (mugil cephalus linnaeus, 1758) myxosporean (myxobolus episquamalis egusa et al., 1990) in the Black Sea*. E3S Web of Conferences. 175. 02014. 10.1051/e3sconf/202017502014.
9. Makedonski L., Ivanova K., Stancheva M. (2015). *Determination of some heavy metal of selected black sea fish species*. Food Control. 72. 10.1016/j.foodcont.2015.08.024.
10. Norouzi M., Bagheri T., Mostafa G., Amirjanati A. (2017). *Toxic heavy metal concentration in soft tissues of gray mullet Liza aurata (Mugilidae: Perciformes) during the sexual maturity and sexual rest.* Iranian Journal of Fisheries Sciences. 16. 920−934.
11. *Ordinance № 5 of 9.02.2015 on determining the maximum permissible amounts of certain contaminants in food.*
12. Stancheva M., Makedonski L., Petrova-Pavlova E. (2013). *Determination of heavy metals (Pb, Cd, As and Hg) in Black Sea grey mullet (Mugil cephalus)*. Bulgarian Journal of Agricultural Science. 19. 30−34.
13. Tuzen M. (2009). *Toxic and essential trace elemental contents in fish species from the Black Sea, Turkey*. Elsevier Publishing, Food and Chemical Toxicology. vol.47, no.8, pp.1785−1790.
14. Yilmaz A.B. (2005). *Comparison of heavy metal levels of grey mullet (Mugil cephalus l.) and sea bream (Sparus aurata l.) caught in Iskenderun bay (Turkey)*. Turkish Journal of Veterinary & Animal Sciences 29: 257−262.