CONTAMINATION OF HEAVY METALS IN *MULLUS BARBATUS* LINNAEUS, 1758 FROM THE SOUTHERN OF THE BLACK SEA COASTS AND POTENTIAL RISKS TO PEOPLE HEALTH

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Abstract
The aim of this study is to conduct a health risk of Al, As, Cu, Zn, Hg, Fe, Cd, Pb, Mn and Ni attributed to consumption of common edible fish *Mullus barbatus* available for consumers. The estimated weekly and daily intakes showed that the heavy metals in Red mullet have no health problems for consumers.

Keywords: Metals, Black Sea

Introduction
The coasts of the Black Sea, Turkey are important fish source for people. The Black Sea is impacted principally by anthropogenic activities. The pollution of heavy metals is a serious threat because of their toxicity, long persistence, bioaccumulation and bio-magnifications in the food web. Heavy metals are accumulated in fish therefore can be transferred to people as a consumer. Marine Strategy Framework Directive of European Union (MSFD-EU) is also focused on the concentrations of heavy metals in fish in order to check for those hazards for human health [1]. Nowadays, fishing is still largely conducted by fishermen from the Black Sea coast of Turkey. The metal contamination in the coastal water can be harmful to human health, it is necessary to understand the hazard levels of pollution in seafood particularly in fish. *M. barbatus* is highly commercial fish and preferred consumed in the southern of the Black Sea and it is marketed mainly fresh. This study, therefore, was to evaluate their hazard level in relation to the maximum residual limit for people consumption.

Material and methods
Red mullet were caught from the southern coasts of the Black Sea during fishing season in 2014 among four sampling stations namely Igneada, Sinop, Samsun and Trabzon coast of the Black Sea (Fig. 1). Metal analysis in muscles of fish was performed using m-AOAC 999.10- ICP/MS (Inductively Coupled Plasma – Mass Spectrometer) method by accredited ÇEVRE Industrial Analysis Laboratory Services Trade Company (TÜRKAK Test TS EN ISO IEC 17025 AB-0364-T). EN 15763 European Standard methods was applied.

Fig. 1. Study area.

Results and Discussion
There are high levels of Zn at a significant level ($P<0.05$) in Red mullet, followed by the Fe. Hg, Cd, Pb and Al in the muscles were below the detection limits from all stations (0.02 for Hg; 0.05 for Cd; 0.05 for Pb and 0.5 for Al). Rest of the metal values are below the limitations for the fish tissues [2,3]. Cu (1.73 mg/kg wet wt.), As (0.39 mg/kg wet wt.), Zn (9.4 mg/kg wet wt.) and Ni (1.35 mg/kg wet wt.) levels in the Red mullet from Trabzon coast were higher than those in other coasts of cities from the southern of the Black Sea. Whereas Fe (7.2 mg/kg wet wt.) and Mn (1.78 mg/kg wet wt.) levels in Samsun coast were high. Cu, As, Fe and Mn levels were found 0.69, 0.09, 2.8 and 0.66 mg/kg wet wt., respectively in Red mullet of Sinop coasts, except Zn (6.1 mg/kg wet wt.) and Ni (0.61 mg/kg wet wt.). Minimum Zn 5.6 mg/kg wet wt.) and Ni (0.47 mg/kg wet wt.) levels were determined in fish from Igneada. Average daily and weekly intakes of metals per person was estimated on the basis of the concentrations measured in fish muscle and daily fish consumption rate (17.3 g/day for Turkey, this is equivalent to 121.1 g/week) [4] and presented in Table 1. Average Turkish body weight was assumed to be 70 kg. The values of EDI and EWI for metals in muscles of Red mullet are well below their corresponding permissible tolerable daily intake for 70 kg person values. In case of consumption of Red mullet from the southern of the Black Sea is no risk of people's health.

Tab. 1. Estimated Weekly Intakes (EWI) and Estimated Daily Intakes (EDI) of heavy metals in edible tissues of Red mullet from the southern Black Sea coasts [5].

Metals	PTWI[a]	PTWI[b]	PTDI[c]	EWI[d]	EDI[e]
Zn	7	490	70	0.678-1.138	0.097-0.163
Fe	5.6	392	56	0.339-0.872	0.048-0.124
Mn	2-5	140-350	20-50	0.080-0.216	0.011-0.031
Ni	0.035	2.45	0.35	0.057-0.163	0.008-0.023
Cu	3.5	245	35	0.084-0.210	0.012-0.030
As	0.015	1.05	0.15	0.011-0.047	0.002-0.007
Pb	0.025[f]	1.75	0.25	Below Detection Limit	
Cd	0.007[g]	0.49	0.07	Below Detection Limit	
Al	1	70	10	Below Detection Limit	
Hg	0.004	0.28	0.04	Below Detection Limit	

[a]PTWI (Provisional Tolerable Weekly Intake) in mg/week/70 kg body wt.
[b]PTWI for 70 kg adult person (mg/week/70 kg body wt.)
[c]PTDI (Permissible Tolerable Daily Intake) (mg/day/70 kg body wt.)
[d]EWI (Estimated Weekly Intake) (mg/week/ kg body wt.)
[e]EDI (Estimated Daily Intake) (mg/day/ kg body wt.)
[f]The current PTWI of 0.025 mg/kg body wt. is no longer be considered health protective.
[g]The Committee withdrew the PTWI of 0.007 mg/kg body wt. and established a PTMI of 0.025 mg/kg body wt.

Conclusion
It is well known that fish species in polluted coastal regions may accumulate substantial metals in their tissues which sometimes exceeded the maximum acceptable levels. Red mullet were not contaminated with the heavy metals which are below the maximum tolerable levels of EU standards. However monitoring of coastal waters following the MSFD is a requirement for further heavy metal contamination control that affects the aquatic life of the fish from the Black Sea.

References
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