Sigma J Eng & Nat Sci 35 (4), 2017, 751-755

Sigma Journal of Engineering and Natural Sciences
Sigma Mühendislik ve Fen Bilimleri Dergisi

Research Article

ZINC AND COPPER BIOACCUMULATION LEVELS IN MUSCLE, GILL AND LIVER TISSUES OF AN ENDEMIC FISH SPECIES (SEYDISUYU STREAM BASIN / ESKIŞEHIR / TURKEY)

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Received: 21.07.2017 Revised: 16.09.2017 Accepted: 14.09.2017

ABSTRACT

Seydisuyu Stream, which is one of the most important branches of Sakarya River, is located on the Central Anatolia Region of Turkey. Seydisuyu Stream Basin has a globally important boron mine on its watershed area and the system exposed to an intensive agricultural, domestic and industrial pollution. In the present study, zinc and copper bioaccumulation levels in muscle, gill and liver tissues of Sakarya chub species (*Squalius pursakensis* (Hankó, 1925)) living in Seydisuyu Stream were investigated. The data obtained were compared with Turkish Food Codex (TGK) and Food and Agriculture Organization (FAO). According to detected data, the highest zinc and copper levels were recorded in gill and liver tissues Sakarya chub species in general and zinc levels recorded in muscle of Sakarya chub species were higher than the limits of TGK and FAO.
Keywords: Zinc, copper, *Squalius pursakensis*, Seydisuyu Stream Basin.

1. INTRODUCTION

Fresh water quality is decreasing day by day due to extreme developments of industry and technology and rapid growth of world population and potamic systems are among the most vulnerable water bodies to pollution (Tokatlı et al., 2014a). Heavy metals are among the most important environmental pollutants and fishes are good indicators of heavy metal contamination in the aquatic environment (Köse et al., 2015).

Seydisuyu Stream Basin is located in the Central Anatolia Region of Turkey and Seydisuyu Stream is one of the most important branches of Sakarya River. Mining activities, agricultural and

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domestic discharges are the major pollution sources for the system and it carries all the included pollution to the Black Sea through Sakarya River (Çiçek et al., 2013).

Squalius pursakensis (Hankó, 1925) named as Sakarya chub is endemic to the Sakarya River Basin. While there are many threats in the area (dams and pollution) none seem to be strong enough to seriously impact this species. The species occurs in many more than 10 independent locations and its population may be stable or if declining is doing so very slowly. It is therefore assessed as Least Concern according to **Red List Category** (http://www.iucnredlist.org/).

The aim of this research was to determine the zinc and copper bioaccumulation levels in muscle, gill and liver tissues of *S. pursakensis* living in Seydisuyu Stream.

2. MATERIAL AND METHOD

2.1. Study area and collection of samples

Seydisuyu Stream Basin is located in the Eskişehir Province of Turkey between the localities of 38.0851 – 39.0361 north latitude and 30.0161 – 31.0071 east longitudes (Çiçek et al., 2013; Tokatlı et al., 2013). 12 stations were selected on the basin, but *S. pursakensis* samples (Figure 1) could be caught only from 8 stations (1st, 2nd, 5th, 6th, 7th, 8th, 10th and 11th Stations). Field studies were conducted in 2011 – 2012 and as a result of the field studies, a total of 1684 fishes were composed of 549 female, 869 male and 266 immature individuals (Figure 2). Within the scope of this project, growth of this endemic cyprinid species of Northwest Anatolia was researched and a total of 50 fish samples were used for heavy metal investigations including at least 5 fishes of different sizes from each stations. Study area and selected stations are given in Figure 3.

Figure 1. A Sakarya chub sample caught from Seydisuyu Stream Basin

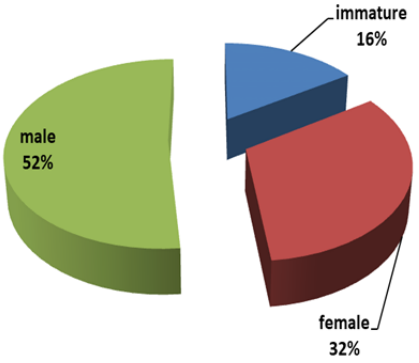

Figure 2. Gender ratios of Sakarya chub samples

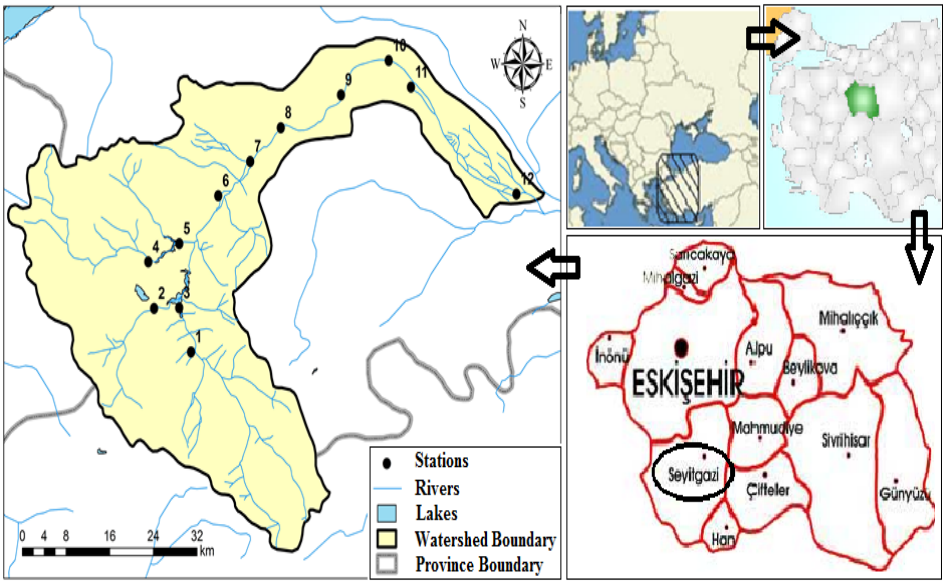

Figure 2. Study area and selected stations

2.2. Chemical Analysis

Fish samples could be collected from 8 stations (1st, 2nd, 5th, 6th, 7th, 8th, 10th and 11th Stations) by using a modified Honda generator (Honda Motor Co., Ltd., Tokyo, Japan). The fishes were first wrapped in polyethylene plastic, put into an isolated container, and brought to the laboratory. Than the fishes were immediately frozen and stored at –20 ^{o}C until dissection. Before analysis, the fishes were thawed and a 0.5 gr sample was taken from each tissue (muscle, gill, and liver). The fish samples were dried for 24 hours at 105 ^{o}C. Three thawed, 0.5 gr homogenates from each tissue were taken and $HClO_4$:HNO_3 acids of 1:3 proportions were inserted to the reactors, respectively. Fish tissue samples were digested in a microwave digestion unit. Afterward, the samples were filtered in such a way as to make their volumes up to 100 ml with ultrapure, distilled water (ASTM, 1985; EPA, 1998; 2001).

Zinc and copper levels in fish tissues were determined by Inductively Coupled Plasma Atomic Emission Spectroscopy (Varian 720 ES, Varian, Inc., Palo Alto, California) via triplicate measurements.

3. RESULTS AND DISCUSSION

The average concentrations of zinc and copper bioaccumulation levels in muscle, gill, and liver tissues of *S. pursakensis* caught from Seydisuyu Stream are given in Figure 3. In the present research, the highest zinc and copper levels were generally recorded in gill and liver tissues fishes. The highest copper concentration was recorded as 73.75 mg kg^{-1} in liver tissues of fishes caught from 8th Station and the highest zinc concentration was recorded as 375.86 mg kg^{-1} in gill tissues of fishes caught from 11th Station. Many researchers have reported that heavy metal accumulations in gill and liver tissues of fishes that are known as metabolically active organs were higher than detected in muscle tissues of fishes (Demirak et al., 2006; Yang et al., 2007; Tokatlı et al., 2014b).

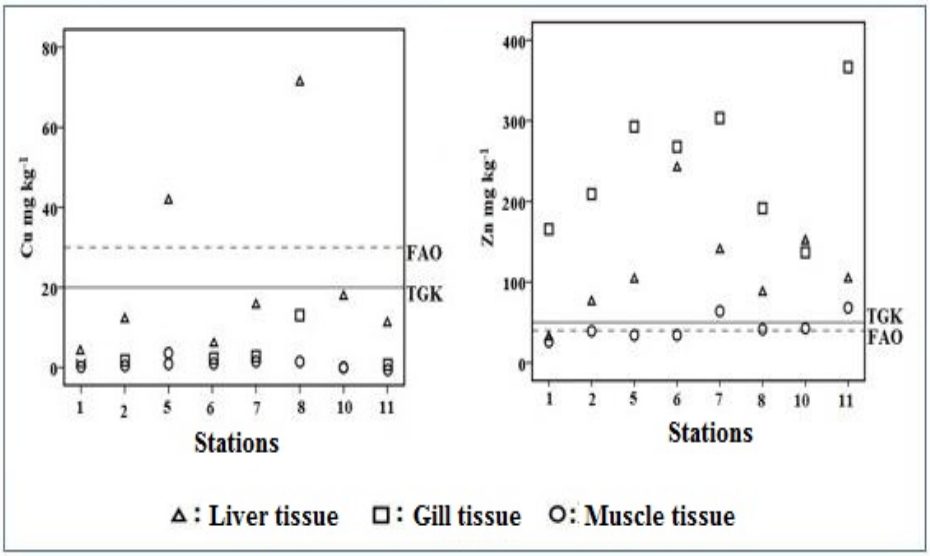

Figure 3. Zinc and copper levels in tissus of *S. pursakensis*

According to the Turkish Food Codex Standard and Food and Agriculture Organization, permissible levels for Zn are 50 and 40 mg kg^{-1}, respectively (FAO, 1983; TGK, 2002). The Zn concentrations in the muscle of *S. pursakensis* at the 7th, 8th, 10th and 11th Stations on Seydisuyu Stream were higher than the permissible levels set by the Turkish Food Codex and FAO (FAO, 1983; TGK, 2002) (Figure 2). These results may be attributable to the existence of many pollutant factors in the study area of these stations, such as discharge of effluents from domestic and agricultural sources.

The highest average Cu bioaccumulation levels were determined in the liver tissues of *S. pursakensis* at the 8th and 5th Stations and the lowest Cu bioaccumulation levels were determined in the muscle tissues of *S. pursakensis* in general. The comparison data showed that Cu levels in muscle tissues of Sakarya chub fishes of Seydisuyu Stream were lower than the limit values of FAO (30 mg kg^{-1}) and Turkish Food Codex (20 mg kg^{-1}) guidelines (FAO, 1983; TGK, 2002).

In a study performed in Yedigöller Region of Kütahya Province (located in Sakarya River Basin), where were using as a solid waste landfill area, Zn and Cu levels in muscle tissues of *S. pursakensis* were investigated. According to data observed, Cu and Zn levels were recorded as 14.26 and 16 mg kg^{-1} respectively (Arslan et al., 2012). If we compare our data with this research, Zn levels recorded in muscle tissues of *S. pursakensis* in Seydisuyu Stream Basin were significantly higher than deteced in Yedigöller Region.

In another study performed in Porsuk Stream Basin (located in Sakarya River Basin), Zn and Cu levels in muscle, gill and liver tissues of *S. pursakensis* were investigated. As similar to the present research the highest Zn levels were determined in gill tissues and the highest Cu levels were determined in liver tissues of S. *pursakensis* (Köse et al., 2015). If we compare our data with this research, Zn levels in Seydisuyu Stream Basin were higher than detected in Poesuk Stream Basin.

4. CONCLUSION

The results of this research indicate that zinc and copper content of these fishes are in a quite high level. If this bioaccumulation in this significant biotic factor of this environment continues to

increase, population density of Sakarya chub could decrease and also health of local people, who eats this species regularly, could be affected negatively.

Acknowledgement

The authors would like to thank for the financial and technical supports supplied by Anadolu University, Turkey. This investigation has been supported by the project numbered as 1101F011 accepted by Anadolu University, Commission of Scientific Research Projects.

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