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Determination of Mercury Levels in Edible Tissues of Various Fish Samples from Sır Dam Lake

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Abstract: Mercury (Hg) levels in *Cyprinus carpio* (carp) (n: 20) and *Siluris glanis* (wels) (n: 13) from Sır Dam Lake, Kahramanmaraş, were measured during 2002 and 2003. The fish samples were obtained from fishermen. Hg levels ranged from 0.03 to 0.18 µg/g dry weight in carp samples and from 0.16 to 0.38 µg/g dry weight in wels samples. Even though no high levels of Hg were determined in the fish, a possible hazard may occur in the future depending on the agricultural and industrial development in this area.

Key Words: *Cyprinus carpio, Siluris glanis*, mercury

Sır Barajı'ndaki Bazı Balık Örneklerinin Yenilebilen Kısımlarımda Civa Düzeylerinin Belirlenmesi

Özet: Çalışmada 2002-2003 yıllarında Kahramanmaraş Sır Barajı'nda balıkçılığı yapılan *Cyprinus carpio* (sazan) (n:20) ve *Siluris glanis* (yayın) (n:13) örneklerinin kaslarında civa (Hg) analizleri yapılmıştır. Analiz sonuçları µg/g kuru ağırlık olarak verilmiştir. Buna göre civa düzeyleri, sazan örneklerinde 0,03-0,18, yayın örneklerinde 0,16-0,38 µg/g kuru ağırlık şeklindedir. Çalışmada incelenen balık örneklerindeki civa düzeyleri düşük olmasına rağmen bölgede gelecekte endüstri ve tarımın gelişmesine bağlı bir kirlilik olabileceği düşünülmektedir.

Anahtar Sözcükler: *Cyprinus carpio, Siluris glanis*, Civa

Introduction

Mercury (Hg) is one of the most important pollutants both because of its effect on marine organisms and because it is potentially hazardous for humans. The toxicology and environmental behavior of Hg are complex since its toxicity, mobility, and bioaccumulation depend on its chemical form (1). Historically, Hg has been used by many cultures for a variety of symbolic and useful purposes, such as in good luck charms, to ward off evil, as colorant and in cosmetics (2,3); has played a predominant role in alchemy; and was thought to have medicinal uses, such as in curing syphilis, in the 19th century (4).

The major anthropogenic Hg sources stem from its use in industries, such as in the manufacture of plastic, chlorine, caustic soda (sodium hydroxide), caustic potash (potassium hydroxide) and antifouling paint. Household waste (e.g. battery, thermometer, barometer, fluorescence lamps, thermostat valves) and medical wastes (e.g. various batteries, thermometer, barometer, sphygmomanometer, thermostat valves in radiator, fluorescence lamps, dental amalgam) and switch in automobiles and brake systems can also be sources of Hg. Fossil fuel burning, base metal smelting, waste incinerators and Hg-based fungicides used in agriculture are also important input sources of Hg in the environment. Natural sources of Hg include volcanic emissions, degassing from soils, and volatilization from the ocean. As a natural element, Hg is present as Hg vapors in the atmosphere, as inorganic Hg in the geosphere (to a very large extent encountered as mercuric sulfide cinnabar) and as inorganic or organic Hg in the hydrosphere. Among organic Hg species, methylmercury (MeHg) is the most abundant, and is bioaccumulated by aquatic organisms and biomagnified through the food chain (5).

Fish obtain most of their Hg body burden through their food (6-8); however, little is known about how Hg becomes incorporated into the lower parts of the food web (9).

This paper provides new data for Hg levels in the muscle of *Cyprinus carpio* (carp) and *Siluris glanis* (wels) from Sır Dam Lake, Kahramanmaraş. A number of studies have been carried out in the same area determining heavy and trace metal concentrations in different fish samples (10,11).

Materials and Methods

Study Area

The Ceyhan river basin is located in the eastern Mediterranean region of Turkey and drains into the Mediterranean Sea in the South. It covers 20 670 km^2 spread over three major provinces (Kahramanmaraş, Osmaniye and Adana) and has a potential of up to 590 000 ha of irrigatable land. Sir Dam Lake, with a surface of 4 750 ha and a maximum capacity of 10 120 hm^3, was constructed between 1987 and 1991 and is the second most important dam in the Ceyhan river basin (Figure 1). The dam aimed to irrigate approximately 100 000 ha of land, to generate electrical power and to reduce the occurrence of floods. Agricultural production in the region is dominated by cotton (~50%) and wheat (36%), followed by groundnuts, maize, fodder, rice and watermelon. Annual fish production was estimated at approximately 86 tons in 1997. Several potential sources of pollution are present around the lake, including paper, textile, oil and milk industries, but also waste from slaughterhouses or households (10,12).

Fish Samples and Analytical Procedure

Cyprinus carpio (carp) (n:20) and *Siluris glanis* (wels) (n:13) from Sır Dam Lake, Kahramanmaraş, were measured during 2002 and 2003. The fish samples were obtained from fishermen.

C. carpio (carp) belongs to the *Cyprinidae* family and is a benthopelagic fish with an omnivorous feeding mode (insect larvae, crustaceans, annelids, plants and molluscs). Wels belongs to the *Siluridae* family and is mainly

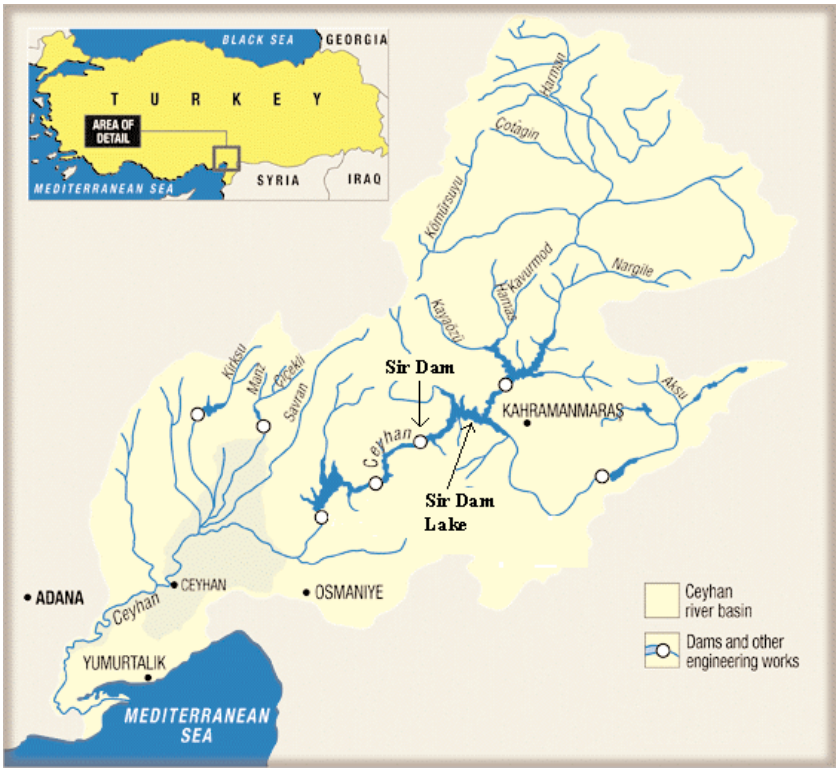

Figure 1. The map of the sampling site.

carnivorous with its main diet composed of fish, amphibians, and small aquatic animals.

The sampled muscle was conserved frozen at -20 °C. It was then blended, dried in an oven at 50 °C to constant mass and grounded to a fine powder. Glass and plastic utensils were washed with detergent, plunged in a bath of mixed nitric acid (35 ml l^{-1}) and chlorhydric acid (50 ml l^{-1}) for a minimum of 24 h, rinsed 3 times in deionized (Milli-Q quality) water and dried in an oven at 50 °C before use.

Total Hg analyses were carried out with an Advanced Mercury Analyzer (combustion analyzer ALTEC 254) on aliquots ranging from 7 to 24 mg of dried sample weighed to the nearest 0.01 mg. Accuracy of the preparation was tested by preparing replicate TORT-2 reference standards and blanks along with each set of samples. Reproducibility was estimated as the closeness of 2 replicate measurements. The coefficient of variation given by relative standard deviations was always lower than 10%. Element levels are expressed in microgram per gram of dry weight (dw).

Results

Information on the length, weight, and age of *C. carpio* and *S. glanis* samples from Sır Dam Lake, Turkey are illustrated in Table 1. As shown in Table 1, the range and mean values for age, weight and standard length of *Cyprinus carpio* (n:20) from Sır Dam Lake were 4-8, 6.4 years; 709-1938, 1345 g; and 31.5-43.2, 36.1 cm, respectively. The range and mean values for age, weight and standard length of *S. glanis* (n:13) were 1-2, 1.1 years; 396-1544, 709.5 g; and 38.1-56, 44.5 cm, respectively.

The Hg levels ranged from 0.03 to 0.18 µg/g dw in carp samples and from 0.16 to 0.38 µg/g dw in wels samples. Mean Hg levels were 0.07 for carp and 0.26 for wels.

Discussion

According to recommendations in the literature, metal concentrations in fish tissue given in dry weight can be converted into wet weight by dividing them by factors ranging from 4 to 6 (13,14). Maximum permitted total Hg content in edible parts of fish products should not exceed 0.5 µg/g $^{-1}$ (15).

Mercury levels were below the 0.5 µg/g $^{-1}$wet weight limit recommended by the FAO/WHO (16) and WHO (17) in edible parts of the fish samples and the 0.5-1 mg/kg limit for different fish products adopted by Turkey (18).

Altındağ and Yiğit (19) determined mean Hg accumulation in the muscle of *L. cephalus*, *C. carpio*, *L. lucioperca*, and *T. tinca* as 0.012, 0.022, 0.023 and 0.028 µg/g, respectively. Mirlean et al. (20) reported the mean tissue Hg concentrations in the natural, suburban and industrial lakes, averaging across species, as 41, 93, and 117 ng g^{-1}, respectively.

Küçüksezgin et al. (21) selected red mullet (*Mullus barbatus*), red pandora (*Pagellus erythrinus*), hake (*Merluccius merluccius*), annular sea bream (*Diplodus annularis*) and common sole (*Solea vulgaris*) as monitoring species. The ranges of trace metal concentrations (µg kg^{-1} wet weight) in the Outer and Middle Bays for Hg were 12-829 and 5-315, respectively. Storelli et al. (22) recorded Hg values between 0.13 and 0.24 µg g^{-1} (0.18 µg g^{-1} wet weight).

Table 1. Biometric data and mercury levels of *C. carpio* and *S. glanis* samples from Sır Dam Lake, Turkey.

Fish species	Hg level (µg/g dry weight)		Weight (g)		Standard Length (cm)		Age	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
C. carpio n:20	0.03-0.18	0.07	709-1938	1345	31.5-43.2	36.1	4-8	6.4
S. glanis n:13	0.16-0.38	0.26	396-1544	709.5	38.1-56	44.5	1-2	1.1

n: Number of sample.

Farkas et al. (23) determined Hg levels in the muscle of eel, bream and pike-perch in Lake Balaton (Hungary) and the results were below the maximum permissible level for human consumption. Karadede and Ünlü (24) detected copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn) in different tissues of fish samples, while cadmium (Cd), cobalt (Co), Hg, molybdenum (Mo), nickel (Ni) and lead (Pb) were at undetectable levels (<0.03) in all fish samples from Atatürk Dam Lake, Turkey. A comparison with data in the literature showed that results obtained in fish samples in this work were in good agreement.

This study has documented the distribution of Hg concentrations in muscle tissues of several species of fish from Sır Dam Lake. Even though no high levels of Hg were determined in the fish, a possible hazardous situation may occur in the future depending on the agricultural and industrial development in this area.

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