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Determination of trace metal levels in seven fish species in lakes in Tokat, Turkey

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Abstract

The concentrations of trace metals in seven fish species collected from some lakes in Tokat, Turkey were determined using flame and graphite furnace atomic absorption spectrometry after microwave digestion methods. The average metal concentrations in the seven fish species varied in the following ranges: Fe, 64.3–197; Mn, 11.7–72.9; Zn, 11.9–38.6; Cu, 1.0–4.1; Pb, 0.7–2.4; Cr, 0.6–1.6; Ni, 1.2–3.4; Cd, 0.1–1.2 μg/g.

Keywords: Trace metals; Fish species; Atomic absorption spectrometry

1. Introduction

Recent years have witnessed significant attention being paid to the problems of environmental contamination by a wide variety of chemical pollutants, including the heavy metals (El-demerdash & Elegamy, 1999). Many plants and animal species have been proposed as bioindicators for monitoring a variety of contaminants in the marine ecosystem (Astorga-Espana, Pena-Mendez, & Gorcia-Montelango, 1999; Cid, Boia, Pombo, & Rebelo, 2001). The metals, cadmium, lead, chromium, nickel, copper and zinc are of particular interest because they are toxic to aquatic organisms and are persistent in the environment in excess (Celik & Oehlenschlager, 2004; Sadiq, 1992; Tüzen, 2003).

Contamination of aquatic ecosystems (e.g. lakes, rivers, streams) with metals has been receiving increased worldwide attention and the literature has many publications on this (Mansour & Sidky, 2002). Metallic elements are environmentally ubiquitous, readily dissolved in and transported by water and readily taken up by aquatic organisms. Metals enter the aquatic environment by atmospheric deposition, by erosion of the geological matrix, or through anthropogenic sources, such as industrial effluents and mining wastes (Alam et al., 2002).

Fish are often at the top of the aquatic food chain and many concentrate large amounts of some metals from the water (Mansour & Sidky, 2002). Fish is considered as one of the main protein sources of food for humans. Water pollution leads to fish contaminated with toxic metals, from many sources, e.g. industrial and domestic waste water, natural runoff and contributory rivers (Rashed, 2001; Tarıq, Jaffar, & Moazzam, 1991). Trace metals can be accumulated by fish through both the food chain and water (Hadson, 1988). Essentially, fish assimilate metals by ingestion of particulate material suspended in water, ingestion of food, ion-exchange of dissolved metals across lipophilic membranes, e.g., the gills, and adsorption on tissue and membrane surfaces. Metal distribution between the different tissues depends on the mode of

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exposure, i.e., dietary and/or aqueous exposure, and can serve as a pollution indicator (Alam et al., 2002). Fish living in polluted waters may accumulate toxic trace metals via their food chains. The bioaccumulation of metals is therefore an index of the pollution status of the relevant water body and is a useful tool studying the biological role of the metals present at elevated levels in aquatic organisms, especially fish (Menzer & Nelson, 1980; Tarrio, Jaffor, & Ashraf, 1991).

In this study, the levels of trace metals in fish samples collected from some lakes in Tokat, Turkey were determined by flame and graphite furnace AAS after microwave digestion.

2. Materials and methods

The fish species (*Cyprinus carpio*, *Leiciscus cephalus*, *Capoeta tinca*, *Silurus glanis*, *Capoeta capoeta*, *Atherina bayeri*, *Carassius gibelio*) were collected from seven different lakes (Hampınar, Akbelen, Dutluca, Almus, Güzelce, Kızık and Uluöz) (Fig. 1) in Tokat, Turkey, between Spring and Summer, 2003. The collected samples were transferred to the laboratory and washed with distilled water, dried in filter paper, homogenized, packed in polyethylene bags and stored below −20 °C prior to analysis (Tüzen, 2003).

De-ionized water (18.2 MΩ cm), from a Milli-Q system (Millipore, Bedford, MA, USA), was used to prepare all aqueous solutions. All mineral acids and oxidants (HNO_3 and H_2O_2) used were of the highest quality grade (Suprapure, Merck, Darmstadt, Germany). All the plastic and glassware were cleaned by soaking overnight in a 10% (w/v) nitric acid solution and then rinsed with deionized water.

Samples (0.5 g) were digested with 6 ml of HNO_3 (65%) and 2 ml of H_2O_2 (30%) in a microwave digestion system for 31 min and diluted to 10 ml with deionized water. A blank digest was carried out in the same way (digestion conditions for microwave system applied were 2 min at 250 W, 2 min at 0 W, 6 min at 250 W, 5 min at 400 W, 8 min at 550 W, then vent for 8 min). This procedure was preferred because it was accurate with respect to both time and recovery values. The recovery values were nearly quantitative (>95%) for the above digestion method.

A Perkin–Elmer Analyst 700 model atomic absorption spectrometer with deuterium background corrector was used in this study. Pb, Cd, Cr and Ni in samples were determined by HGA graphite furnace using argon as inert gas. Pyrolytic-coated graphite tubes with a platform were used and signals were measured as peak areas. Other measurements were carried out in an air/acetylene flame.

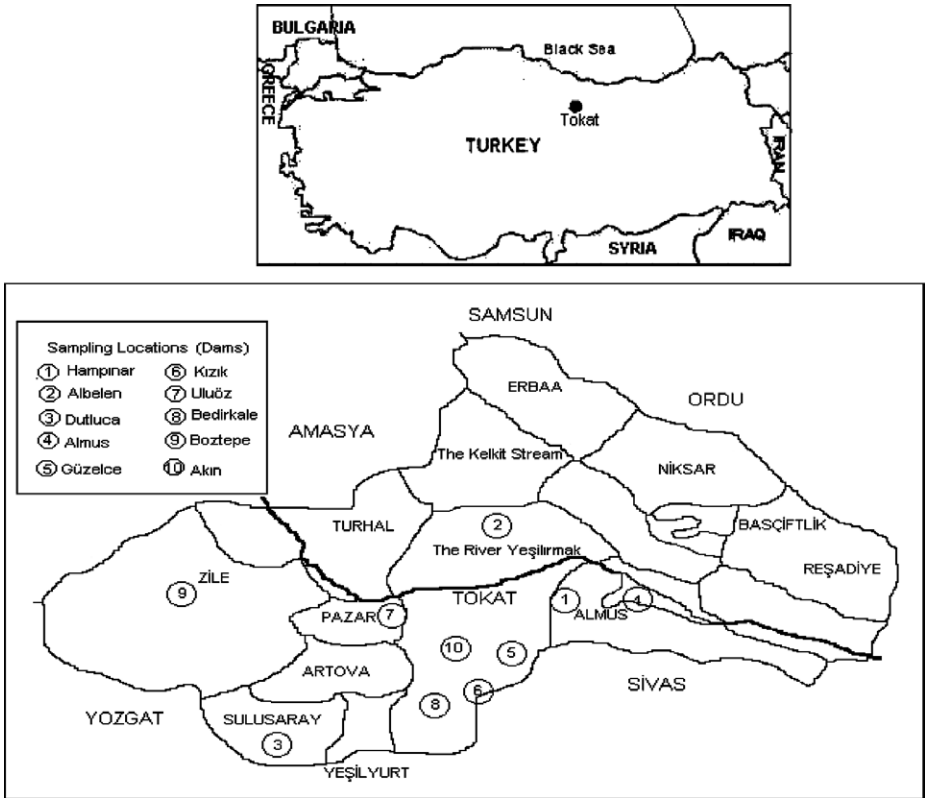

Fig. 1. The map showing the sampling area.