Determination of heavy metal levels in sardine samples

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Introduction

Metals play double edge roles which include the dietary requirement of essential trace elements and the toxicity associated with the overload of essential and toxic metals. Cadmium affects organs and tissues such as kidney, lung, skeletal system and the central nervous system. Chronic exposure to lead in humans can cause irritability, poor attention span, epigastric, vomits, convulsions, coma and even death. Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. This reasons have prompted researches in the determination of metal concentrations in food items. The studies on the transfer of heavy metals through the food chain can provide useful information for the development of surveillance programs aimed at ensuring the safety of the food supply and minimizing human exposure. Numerous techniques have been employed to analyze the heavy metal contents in fish, including flame atomic absorption spectrometry, graphite furnace atomic absorption spectrometry, inductively coupled plasma atomic emission spectroscopy and inductively coupled plasma mass spectrometry. Graphite furnace atomic absorption spectrometry (GFAAS) is a useful tool for studying trace metals because it is highly accurate, sensitive, and selective. The goal of this study is the determination of heavy metals level in canned sardines supplies on the Serbian market. The concentrations of heavy metals (Cd, Pb and Hg) in sardine muscles were determined by GFAAS.

Methodology

The sample digestion was carried out using ETHOS 1 - Advanced Microwave Digestion Labstation. After digestion, the concentrations of Pb and Cd were measured by graphite furnace method (Perkin Elmer 900T spectrometer with Zeeman AAS background corrector) with an auto sampler. Hg was analyzed by the cold vapor technique on Perkin Elmer flow injection system FIAS 100. $NaBH_4$ was used as a reducing agent, and 2% HCl was used as a carrier in FIAS analysis. The linearity of the analytical response across the studied range of concentrations was excellent, obtaining correlation coefficients higher than 0.999 (**Fig. 1-3**). The precision values associated with the analytical method, expressed as RSD values, were less than 3% for certain elements. Limit of quantification were 0.020 mg kg^{-1} for Pb and Hg and 0,005 mg kg^{-1} for Cd.

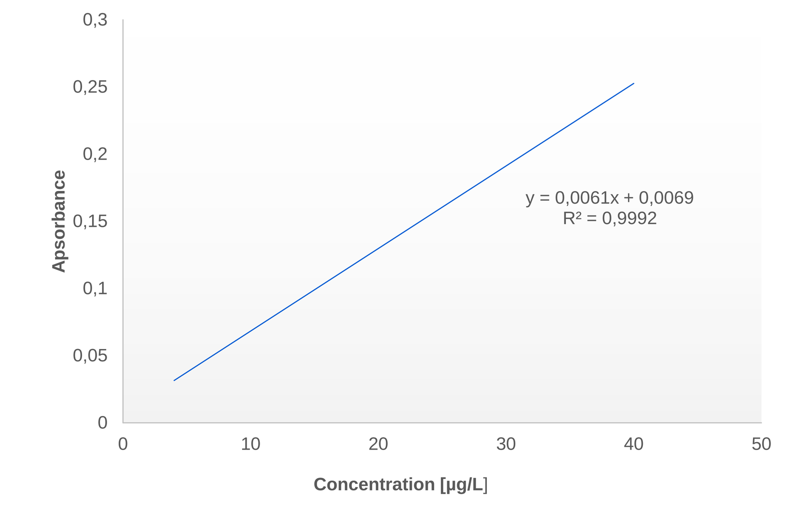

Fig. 1. Calibration curve for standard solution series of Cd

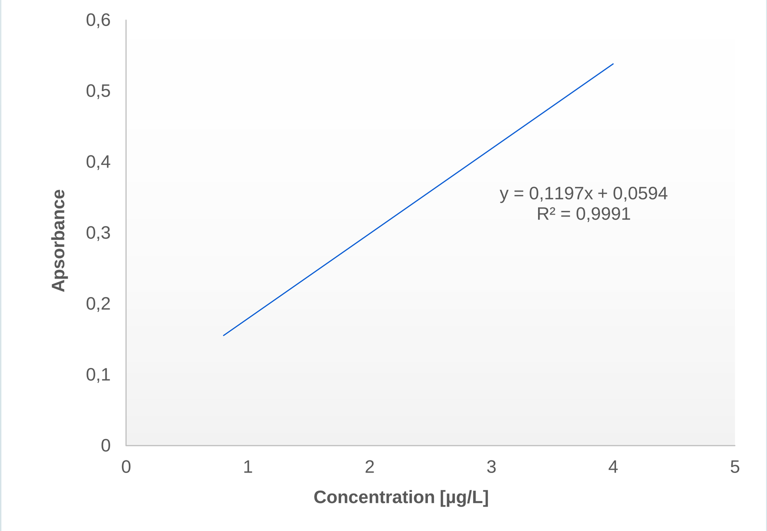

Fig. 2. Calibration curve for standard solution series of Pb

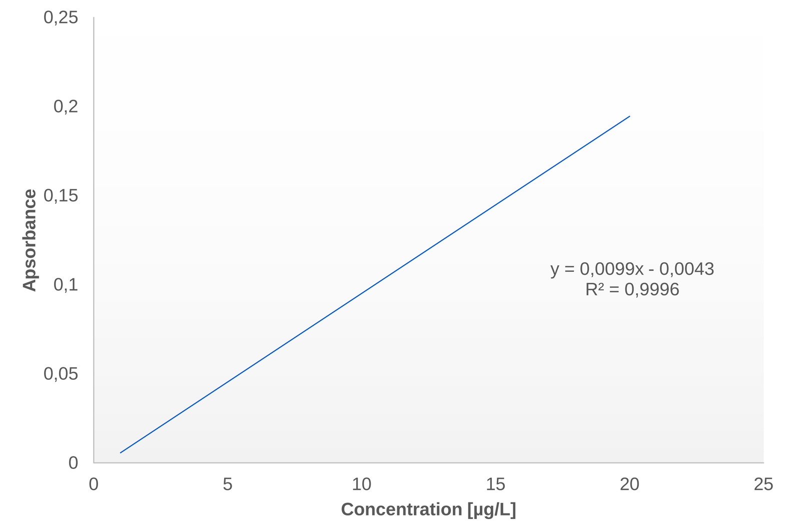

Fig. 3. Calibration curve for standard solution series of Hg

Results

The results showed that the tested sardines contained the most lead, followed by mercury and finally cadmium (**Fig. 4**). Measured concentrations of these heavy metals are below the thresholds established by national and international regulations (**Table 1**). Also, the obtained results generally coincide with the concentrations measured in neighboring countries (for example in Croatia and Bosnia and Herzegovina).

Table 1. Mean concentration for analyzed heavy metals

Metal	Mean concentration (µg/kg)	MRL (µg/kg)	LOQ (µg/kg)
Cd	0.008	0.25	0.005
Pb	0.065	0.30	0.020
Hg	0.057	0.50	0.020

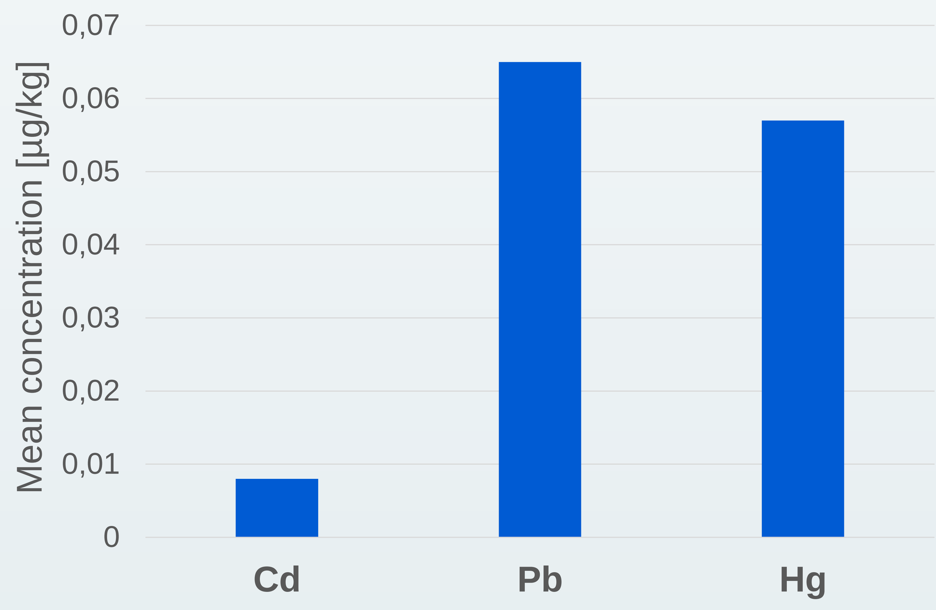

Fig. 4 The ratio of mean concentrations of Cd, Pb and Hg

Conclusion

This study improves the baselines data and information on some heavy metal concentrations in the muscle tissue of sardine which is commonly consumed in Serbia. According to the obtained data, lead had the highest concentration followed by mercury and cadmium. The higher concentrations of lead and mercury in the sardine from the markets samples could be related to industrialization, transportation, and agricultural activities. The regular control of heavy metals in the sardine is needed both for the assessment of toxic metal intake from these fish by humans and for generating data for further studies.

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