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Zinc, lead, copper, and cadmium determination in canned and fresh fish samples by anodic stripping voltammetry and inductively coupled argon plasma

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Abstract

A human diet should satisfy the necessary energy and nutrient needs including poly unsaturated fatty acids, essential amino acids, vitamins and fat. Fish contains all these substances, and most importantly its fatty acid content is known to support good health. However, the benefits of fresh and canned fish consumption, especially tuna and sardines, may be offset by the presence of toxic metals at levels exceeding the safety standards. The concentrations of trace metals Zn, Pb, Cu, and Cd in fish samples (Anchovy, Blue fish, Clam, Grey Mullet, Red Mullet, Striped red Mullet, Mackerel, Monk, Sea Bass, Sardine, Sole, Tuna, Whitting) caught within Gallipoli region of the Aegean Coast of Turkey, and canned fish of different brands purchased from the markets in Istanbul and Gallipoli were determined using Anodic Stripping Voltammerty (ASV) and Inductively Coupled Argon Plasma (ICP). For each sample, between wet weight of 1.5 and 2.0 g of fish muscle was weighed. It was placed in a reflux vessel with 12 mL of concentrated nitric acid and perchloric acid mixture in 10 mL:2 mL ratio, and the digestion process continued between 15 hrs and 20 hrs. Each digest resulted in a clear solution, and evaporated to almost dryness on a hot plate by washing with deionized water couple of times. Digests were then diluted to 25 mL with deionized water and kept in polyethylene bottles prior to analysis. The method parameters of ASV were the following: Differential Pulse with +50 mV; Electrolysis time, 30 to 300 s (depending on the concentrations) at –1300 mV with stirring and 10 s at –1300 mV without stirring; starting potential, –1200 mV, end potential, -100 mV; sweep rate, 60 mV/s. Half-wave potentials (E1/2) were recorded as: Zn : -1.05 V±0.02 V, Cd: -0.65 V± 0.02 V, Pb: -0.46 V± 0.02 V, Cu: -0.10 V ± 0.02 V. The ASV analysis was subject to the effect of electrolyte composition. In order to elucidate this effect different buffer compositions were tested (oxalate, acetate, acetate with KCl), and the peak currents were recorded. Oxalate buffer composition was utilized thru out the rest of the experiments. The method parameters of ICP were set according to the emission lines of each metal and the corresponding concentration ranges of trace metals in fish digests. The literature survey indicated that the publications on the concentrations of trace elements such as zinc, copper, lead, cadmium, mercury, and arsenic in fishery in Turkey are not sufficient. More research and assessments of seafood quality are needed.

Biography

Neylan Dirilgen received her Ph.D. degree in Environmental Sciences Institute of Bogazici University, Istanbul-Turkey. She is a full time professor and has been teaching Analytical Chemistry in the Chemistry Department of Bogazici University since 1992. Her research interests are Electroanalytical Chemistry and Spectroscopy. Her works are basically based upon the development of analytical methods in solving problems related to heavy metal pollution in aquatic systems and in soil.