

Application News

No. AD-0163

Food Analysis / ICPE-9800 Series

Analysis of Trace Elements in Fish Sample with ICP-AES (ICP-OES) on ICPE-9800

□ Introduction

Fish is one of the most important food resource that is widely consumed in many parts of the world due to its high protein content, low saturated fats and omega-3 fatty acid. It is also rich in calcium and phosphorus. However, because of industrial discharges from human activities, fish may have trace levels of toxic elements such as arsenic, cadmium and lead which are absorbed from the environmental water and the foods they eat. The toxicity of these metals poses a concern to human health through the consumption of fish. Here, Shimadzu ICPE-9820, a simultaneous inductively coupled plasma atomic emission spectrometer (ICP-AES) was used to conduct a simultaneous analysis of elements in fish. The ICPE-9820, with its mini-torch plasma and spectrometer permitting all elements / all wavelengths simultaneous analysis, provides high sensitivity and throughput measurement while reducing running cost.

□ Experimental

The sample used in this analysis was Fish Protein Certified Reference Material for Trace Metals (DORM-4), from National Research Council Canada. There were two sets of preparation. The sample, 0.5 g, was placed in a digestion vessel followed by addition of 5.0 mL of concentrated nitric acid, 2.0 mL of hydrogen peroxide and 1.0 mL of water. The mixture was digested using microwave-assisted digestion system based on AOAC 999.10 procedure. After the digestion process, deionized water was added to the digested sample to a final total volume of 20.0 mL.

The calibration standards were prepared from 1000 ppm copper (Cu), iron (Fe) and zinc (Zn) standards, and 100 ppm ICP multi-element standard solution IX, which contains arsenic (As), cadmium (Cd), chromium (Cr), nickel (Ni), lead (Pb) and selenium (Se). The standard solutions were purchased from Merck Millipore, Germany. Type E-1 ultra pure water with resistivity of 18 ΩW was used. Three different calibration ranges were prepared to cover the range of the elements based on the certified values. The calibration standards were acid matched to the digested samples.

Measurement was conducted using the Shimadzu ICPE-9820 simultaneous ICP-AES spectrometer, equipped with the mini-torch.

The typical measurement conditions are shown in Table 1. The elements, wavelength and calibration ranges used are shown in Table 2.

Table 1. Instrument and measurement conditions

Instrument	: ICPE-9820	
Radio Frequency Power	: 1.20	(kW)
Plasma Gas Flow Rate	: 10.0	(L/min)
Auxiliary Gas Flow Rate	: 0.60	(L/min)
Nebulizer Gas Flow Rate	: 0.70	(L/min)
Nebulizer	: Coaxial Nebulizer	
Spray Chamber	: Cyclone Chamber	
Plasma Torch	: Mini-torch	
Observation	: Axial	

Table 2. Elements, wavelength and calibration ranges

Element	Wavelength	Concentration Range
As	193.759	0 to 0.2 ppm
Cd	214.438	
Cr	205.552	
Ni	231.604	
Pb	220.353	
Se	203.985	0 to 2 ppm
Cu	224.700	
Zn	206.200	0 to 20 ppm
Fe	239.147	

Results and Discussion

The quantitative results for the trace elements were within the certification range of Fish Protein CRM DORM-4 as shown in Table 3. The spectral profiles of standards and samples are displayed in Figure 1.

Conclusions

The ICPE-9800 can provide simultaneous analysis of trace elements in fish CRM sample with high accuracy, which include low concentrations of Cd and Pb.

Table 3. Quantitation results of Fish CRM DORM-4 on ICPE-9800

Element	Fish CRM DORM-4			IDL (ppm)*
	Measured Value (mg/kg)	(Duplicate) Measured Value (mg/kg)	Certified Value (mg/kg)	
As	6.7	6.6	6.80 ± 0.64	0.008
Cd	0.298	0.303	0.306 ± 0.015	0.0002
Cr	1.85	1.76	1.87 ± 0.16	0.0007
Cu	15.1	15	15.9 ± 0.9	0.002
Fe	336	323	341 ± 27	0.03
Ni	1.24	1.29	1.36 ± 0.22	0.0004
Pb	0.43	0.45	0.416 ± 0.053	0.002
Se	3.7	3.8	3.56 ± 0.34	0.01
Zn	51.7	49.4	52.2 ± 3.2	0.0003

*Instrument Detection limit (IDL) is calculated as three times the standard deviation of 10 replicate measurements of a calibration blank

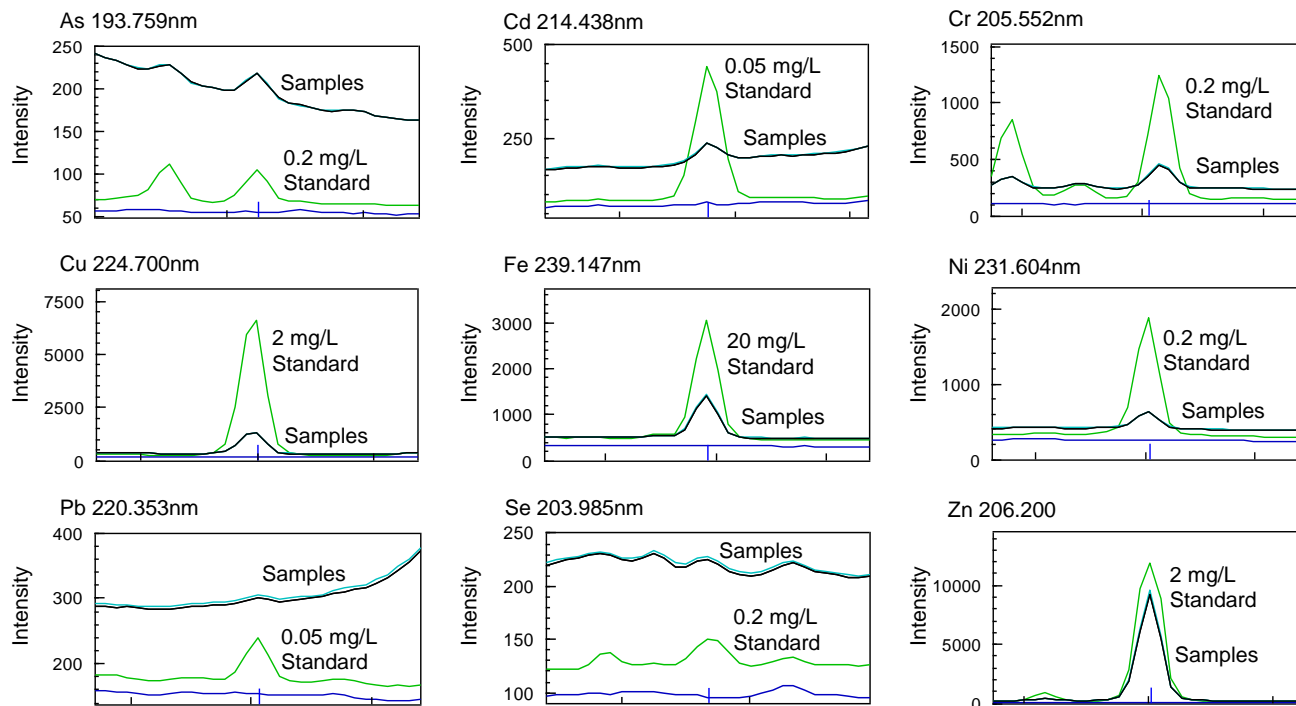


Figure 1. Spectral Profiles of different elements on ICPE-9800