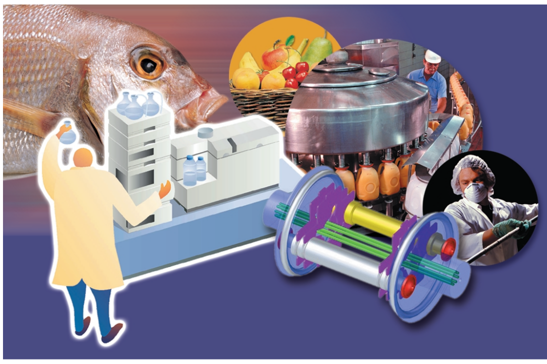

Discover the Full Capabilities of ICP-MS in Food Safety

Ensuring the quality of food supplies is essential, and strict regulations are enforced to maintain quality and food safety. With legislation covering many different food types, most food laboratories need to analyze large numbers of samples annually.

Measuring elemental content of foods was made easier with the advent of more robust inductively coupled plasma mass spectrometry (ICP-MS) instrumentation. ICP-MS provides rapid multielement analysis at trace levels, breaking the bottleneck created by older, slower techniques such as graphite furnace atomic absorption spectroscopy (GFAAS).

In its simplest form, ICP-MS is a direct replacement for older elemental analysis techniques. In combination with chromatographic separation, ICP-MS opens up new capabilities for the food laboratory. Agilent Technologies 7500 Series ICP-MS instruments have been designed for use as standalone analyzers or for use with a variety of chromatographic techniques.

Measuring Traces in Milk Powder

Table 1 summarizes the analysis of NIST 1549 Milk Powder using an Agilent 7500a ICP-MS instrument. The milk powder was digested using a standard method in a microwave digestion system, diluted in 0.1% nitric acid and analyzed with 5 replicate measurements. Concentration data was calculated using external calibration in 0.1% nitric acid.

Element	Found (mg/kg)	Certified (mg/kg)	%RSD
Mn	0.26	0.26	1.3%
Cu	0.69	0.70	1.1%
Zn	48	46	0.2%
Se	0.19	0.11	9.1%
Pb	0.020	0.019	3.0%

Table 1. Analysis of NIST 1549 Milk Powder using an Agilent 7500a - note the generally excellent agreement with the literature values and precision (%RSD)

Reaching New Limits

There are some interferences, though fewer than with more traditional inorganic techniques, that can compromise ICP-MS detection limits for certain key elements, see Table 2. The 7500 Octopole Reaction System (ORS) was developed to eliminate these interferences, allowing for trace measurement even in difficult matrices. The data in Table 3 was obtained from the analysis of a perchloric/nitric acid digestion of NIST 1573 Tomato Leaves using an Agilent 7500 ORS. The excellent agreement between the reference and obtained values for Cr, Fe and As for multiple isotopes illustrates how the ORS eliminates interferences from ArC, ArO and ArCl. The data was obtained in a single acquisition highlighting the wide dynamic range of the 7500 Series.

Element	Molecular Interference	Element	Molecular Interference
Cr	$^{40}Ar^{12}C$, $^{36}Ar^{16}O$	Cu	$^{40}Ar^{23}Na$
V	$^{35}Cl^{16}O$	As	$^{40}Ar^{35}Cl$
Fe	$^{40}Ar^{16}O$	Se	$^{40}Ar^{37}Cl$, $^{40}Ar^{38}Ar$, $^{40}Ar^{40}Ar$, $^{32}S^{16}O_3$

Table 2. Typical interferences in biological/clinical matrices

Element	Certified (mg/kg)	Found (mg/kg)	Element (mg/kg)	Certified (mg/kg)	Found
^{43}Ca	5.05%	5.08%	^{63}Cu	4.7	4.4
^{39}K	2.70%	2.62%	^{65}Cu	4.7	4.4
^{52}Cr	1.99	1.79	^{75}As	0.112	0.115
^{53}Cr	1.99	1.79	^{78}Se	0.054	0.06
^{54}Fe	368	368	^{111}Cd	1.52	1.42
^{56}Fe	368	368			

Table 3. Analysis of NIST 1573 Tomato Leaves using the 7500 ORS

Extending the Capabilities of the Laboratory

Combining ICP-MS with a separation technique such as liquid chromatography (LC) creates a very sensitive tool for the measurement of element species in toxicological studies. The toxicity of an element depends on its oxidation state or how it is bound to a molecule. For example, the inorganic forms of arsenic, arsenite and arsenate, are highly toxic, whereas simple organoarsenic species such as dimethylarsinic acid and methylarsonic acid are much less toxic. Arsenobetaine, the dominating arsenic compound in marine animals, and arsenoriboses present at high concentrations in marine plants exhibit low toxicity. Marine algae may contain arsenoriboses as well as inorganic arsenic at high concentrations. To assess the risk of inorganic forms of arsenic entering the food chain via marine algae, the chemical forms of the arsenic present in these samples needs to be determined. An Agilent 1100 LC system connected to a 4500 ICP-MS was used for the determination of the arsenic compounds. A chromatogram of a water/methanol extract of a brown algae (total arsenic concentration ~30 mg As/kg dry mass) is shown in Figure 1. The data shows that ~7% of the water/methanol extractable arsenic (~70%) was present as highly toxic arsenate.

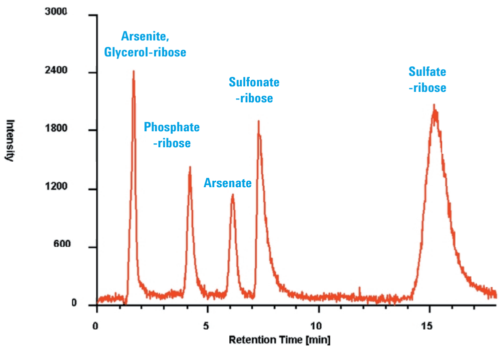

Figure 1 - Chromatogram of a water/methanol extract of a brown algae. Data courtesy of Dr W Goessler, University of Graz, Austria

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