



Multielement Analysis of Clinical Samples by Octopole Reaction Cell ICP-MS

Many laboratories involved in trace metal analysis of clinical and biological samples are replacing existing Graphite Furnace Atomic Absorption Spectroscopy (GFAAS) instrumentation with reaction cell Inductively Coupled Plasma Mass Spectrometry (ICP-MS). While ICP-MS has previously been used for the multielement analysis of clinical samples, new reaction cell technology has significantly improved the measurement of some clinically important analytes.

The Agilent 7500c ICP-MS features an Octopole Reaction System (ORS) to remove the plasma and matrix based interferences that inhibit the analysis of elements such as Cr, As and Se by conventional ICP-MS. The design of the ORS enables the routine, multielement determination of trace level analytes in complex and varying matrices. Advantages of the 7500c for clinical analysis include:

- Simplicity of set-up and ease of use of the ORS for multi-element analysis due to the use of simple cell gases He and H₂
- Single calibration and effective interference removal for multiple matrices e.g. plasma, serum and blood
- Robust, proven performance over extended periods with clinical sample matrices
- Speed of analysis and operating cost benefits compared to GFAAS. A 7500c can replace multiple GFAAS units
- Greater elemental coverage than GFAAS, plus additional analytes can be measured at no extra cost

Simple Sample Preparation

A simple 10x dilution with 2% HNO₃ is normally used for urines, while alkaline solubilization is usually preferred for serum, plasma and whole blood. However, in this analysis, all the sample matrices were run against a single calibration

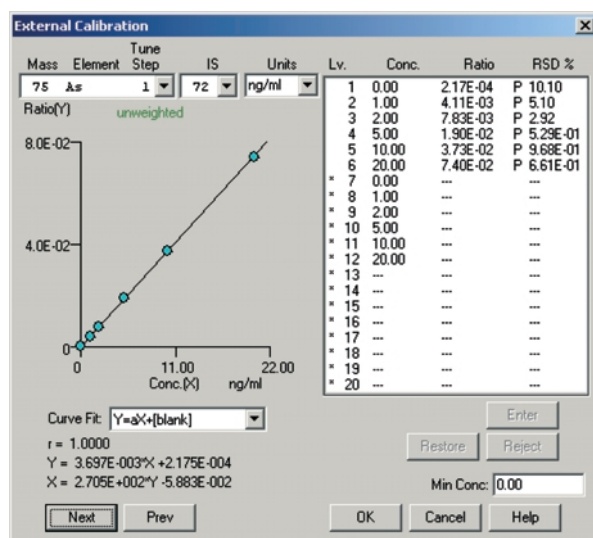


Figure 1 Arsenic calibration acquired in collision (He) mode from 0 to 20ug/L, with good linearity at the 1ug/L level.

in the alkaline solubilization matrix. For each sample type, 0.5mL of the sample was diluted 1:10 with a solubilization matrix containing 10g/L 25% NH₄OH, 20g/L butan-1-ol, 0.5g/L ammonium EDTA and 0.5g/L Triton X.

Specimen	Target Value ¹	Range	7500c Test Result ²
Serum - 1 Quebec E-01-11			
Cu (63)	320	270 - 370	288
Zn (66)	640	560 - 720	645
Se (78)	55	46 - 65	55
Serum - 2 Quebec E-01-13			
Cu (63)	1000	890 - 1110	920
Zn (66)	1140	1030 - 1260	1224
Se (78)	122	109 - 136	137
Blood - 1 SAS IQC-1			
Cd (111)	2.4	2.0 - 2.8	2.2
Pb (208)	126	110 - 140	128
Blood - 2 SAS IQC-2			
Cd (111)	5.5	5.1 - 6.0	4.9
Pb (208)	320	300 - 340	313
Blood - 3 SAS IQC-3			
Cd (111)	11.8	11.1 - 12.4	11.0
Pb (208)	680	650 - 710	701
Urine - 1 Quebec S-02-05			
As (75)	135	107 - 164	141
Urine - 2 Quebec S-02-02			
As (75)	24	4 - 44	26
Urine - 3 Quebec B-01-08			
Cr (52)	1.04	0.31 - 1.77	1.17
Urine - 4 Quebec B-01-11			
Cr (52)	46	43 - 50	46

Table 1. Comparison of target values and 7500c ICP-MS results (all in ug/L) for selected elements in serum, blood and urine. Data courtesy of the Interlaboratory Comparison Program, The Centre for Toxicology, Quebec National Institute of Public Health and the Regional Laboratory for Toxicology, City Hospital, Dudley Road, Birmingham, U.K.

Notes:

1. Target values: ranges derived from the zonal scoring system used by the Quebec EQA scheme and (for Bloods 1 - 3) TEQAS, Guildford, UK
2. Mean of two repeat sequences

Data and Conclusions

The data shown in Table 1 demonstrates the accuracy of the 7500c in multiple clinical sample matrices. Data was acquired in a single analytical sequence, run against a single alkaline calibration. The interference removal power of the ORS allows the 7500c to measure clinically important elements at levels that previously required GFAAS. The multielement capability of the 7500c means that it can replace several GFAAS instruments in a clinical lab, while enabling the lab to offer additional analytes with no extra analytical cost.

