Application Brief

Food and Agriculture

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Multi-element Analysis of Trace Metals in Animal Feed using ICP-OES

Advantages of the Agilent 5110 VDV or SVDV ICP-OES for high throughput labs

Introduction

Twenty-three elements were determined in multiple animal feed certified reference materials (CRMs), prepared using microwave digestion. To provide a simple, high throughput, low cost solution, while maintaining excellent detection limits and accuracy, an Agilent 5110 Vertical Dual View (VDV) ICP-OES was used. Since the 5110 VDV can be upgraded onsite to a Synchronous VDV instrument if a lab's requirements change, the productivity of the two configurations was compared.

A seven port Advanced Valve System (AVS 7) was fitted to the ICP-OES to increase sample throughput and reduce argon consumption.

Ease-of-use features such as Agilent's Easy-fit torch, the AVS 7, and ICP Expert software provided productive and reproducible results while keeping costs under control. A combination of fitted background correction (FBC) and Fast Automated Curve Fitting (FACT) modeling was used for background correction.

Analysis time and argon use

An average analysis time of 64 seconds per sample, with corresponding average argon consumption of 24 L per sample was recorded. A comparison of the Vertical Dual View (VDV) mode of the instrument to its Synchronous Vertical Dual View (SVDV) mode revealed that the latter could run samples 25% faster with 25% less argon. Over approximately six hours, the SVDV instrument can analyze 34% more samples with no sacrifice in accuracy.

CRM recoveries

Detection limit data for the 23 elements is shown in Table 1. The recoveries for all certified elements measured above the LOQ in two CRMs are shown in Figure 1. All recoveries were within ± 10% of the certified value, where certified values were provided, showing the accuracy of the method for the determination of a range of elements at high and low concentrations.

Table 1. Method detection limits and limits of detection for all elements.

Element & Wavelength (nm)	MDL (mg/kg)	LOQ (mg/kg)
Al 396.152	0.381	1.27
As 188.980	0.717	2.39
B 249.772	0.063	0.21
Ba 233.527	0.023	0.08
Ca 373.690	0.830	2.77
Cd 226.502	0.022	0.07
Co 228.615	0.055	0.18
Cr 267.716	0.076	0.25
Cu 327.395	0.035	0.12
Fe 238.204	0.065	0.22
K 766.491	4.33	14.4
Mg 279.078	2.40	8.0

Element & Wavelength (nm)	MDL (mg/kg)	LOQ (mg/kg)
Mn 257.610	0.011	0.04
Mo 202.032	0.115	0.38
Na 589.592	0.791	2.64
Ni 231.604	0.265	0.88
P 214.914	2.74	9.1
Pb 220.353	0.817	2.72
S 181.972	1.38	4.6
Se 196.026	0.810	2.70
Sr 216.596	0.086	0.29
V 292.401	0.052	0.17
Zn 206.200	0.240	0.80

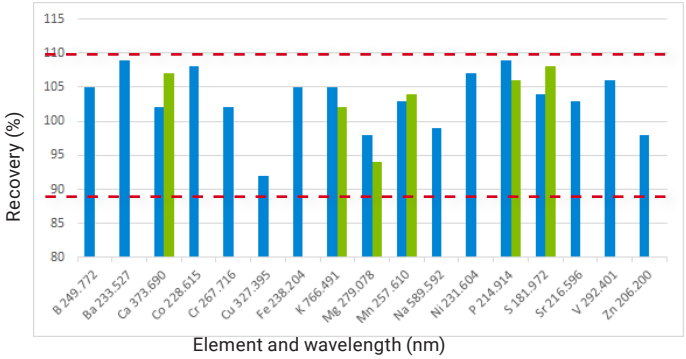

Figure 1. The % recoveries for the Lucerne CRM (shown in blue) and the Soft Winter Wheat CRM (shown in green) for each element.

Long-term stability

To test long-term stability, more than 330 digested samples were run over a six hour period and a QC sample was analyzed every 10 samples. Figure 2 shows the recovery of all elements to be within ± 10%. The relative standard deviation of this data was less than 3% for all elements, indicating excellent robustness and precision over the extended run.

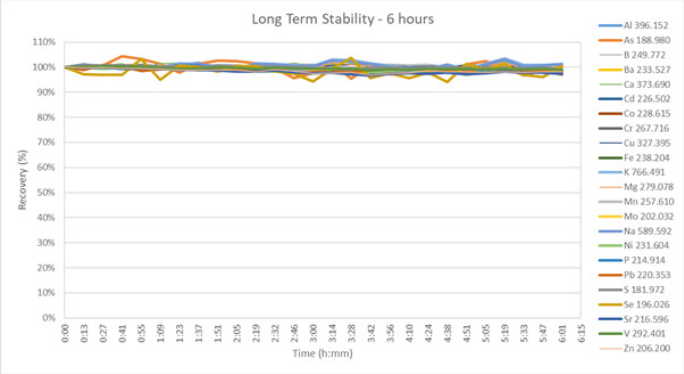

Figure 2. Long-term stability: recovery of a QC sample analyzed every 10 samples over a six hour period.

Conclusions

Routine measurements of trace elements in animal feed products can be carried out with excellent accuracy and precision using the Agilent 5110 ICP-OES VDV with AVS 7. The AVS 7 seven port switching valve increased productivity and maintained excellent precision and the ability to accurately measure high and low concentration elements.

Benefits of the Agilent 5110 VDV ICP-OES method include:

Accurate and precise results, while maintaining low operating costs with sample analysis times of 64 s and argon consumption of 24 L per sample.

Stable results over extended periods, minimizing the need for recalibration, and maximizing sample throughput.

Performing the same analysis using the SVDV mode of the ICP-OES resulted in an approximately 33% increase in throughput. The analysis used approximately 25% less argon —without compromising results.

Full details of this study can be found in the application note.

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