Application Brief

Food and agriculture

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Reduced Plasma Flow ICP-OES Method for the Analysis of Fruit Juices

Fast, stable and accurate analysis

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Quantifying nutrients, micronutrients, and heavy metals

Analytical testing of food and beverage products is fundamental to product-safety, regulatory compliance, and product labeling. To meet strict quality control measures for inorganic components, regular testing is performed to identify and quantify nutrients, micronutrients, and heavy metals.

Traditionally, many food-related regulated methods specified atomic absorption spectrometry (AAS). More recent publications of regulated methods, including ILNAS-EN 16943:2017 and AOAC Official Method 2011.14, have described the analysis of food and beverages by ICP-OES (*1, 2*).

Simple methodology

With little method development needed, the simplicity of this application offers an easy transition from AAS instruments for less experienced ICP-OES operators. Also, the ICP-OES captures many elements simultaneously from a single measurement, where the AAS requires multiple measurements of the same solution.

Fitted background correction is a simple, automated background correction technique that requires no method development. Fitted models the background signal under the analyte peak and provides accurate correction of simply and complex background structures.

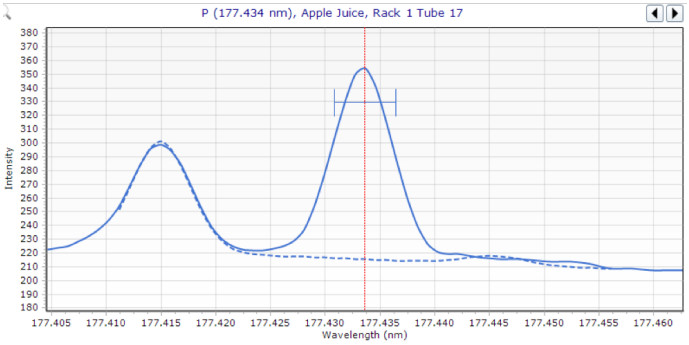

Figure 1. Fitted background correction of P 177.434 nm.

To ensure reproducible performance irrespective of the analyst, the 5110 ICP-OES uses a simple and effective torch loader mechanism that automatically aligns the torch and connects gases for fast start-up. Once loaded there is no need for further adjustment of the torch or optical alignment.

Low-cost analysis

Typically, the 5110 ICP-OES uses a plasma flow rate of 12 L/min. However, the vertically oriented torch, and the solid-state radio frequency (SSRF) system, allows for robust, stable measurement of a wide variety of fruit juices with a plasma flow rate of only 9.5 L/min (*3*).

In this study, all 16 elements were determined in 100 seconds per sample, including the IntelliQuant measurement, using a plasma gas flow rate of 9.5 L/min. The total argon consumption was 30 L per sample.

Quantitative results of 16 elements in an orange juice sample containing pulp are shown in Table 1.

Table 1. Average (n=10) measured concentration in pulpy orange juice.

Element and Wavelength (nm)	Concentration (mg/L)	Element and Wavelength (nm)	Concentration (mg/L)
Al 396.152	<LOQ	Mn 257.610	0.0039
As 188.980	<LOQ	Na 589.592	<LOQ
Ca 317.933	2.1	Ni 216.555	<LOQ
Cd 226.502	<LOQ	P 177.434	5.8
Cu 327.395	0.0075	Pb 220.353	<LOQ
Fe 238.204	0.024	S 181.972	1.7
K 766.491	55	Sn 189.925	<LOQ
Mg 280.270	3.1	Zn 202.548	0.0091

IntelliQuant analysis

If additional screening of samples is required for quality assurance purposes, a simple, quick, full wavelength semiquantitative scan can be performed.

ICP Expert software generates a periodic table heat map to visually represent the relative concentrations of elements present in a sample. A full spectrum scan of the pulpy orange juice was obtained using IntelliQuant, as shown in Figure 2. The semiquantitative analysis data is in broad agreement with the quantitative analysis data for all elements.

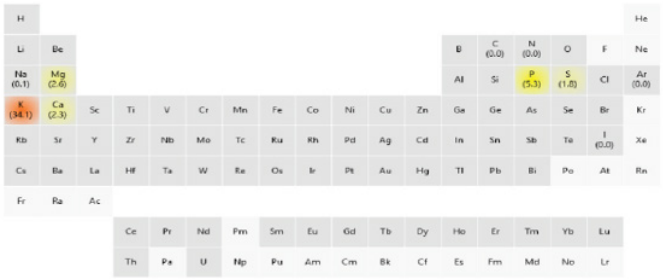

Figure 2. IntelliQuant heat map generated from the analysis of pulpy orange juice (mg/L).

Conclusion

The Agilent 5110 VDV ICP-OES provides a low-cost, easy-to-implement method enabling accurate elemental analysis of fruit juice samples with simple and complex matrices. All elements could be determined in the fruit juice samples in a single analytical run, ensuring efficient argon-gas usage.

Find out more

Full details of this study can be found in Agilent application note, publication number: 5994-0785EN.

References

1. European Standard EN 16943: 2017
2. AOAC Official Method 2011.14
3. Benefits of a vertically oriented torch—fast, accurate results, even for your toughest sample, Agilent publication, 2016, 5991-4854EN

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