Application Brief

Food Testing and Agriculture

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Determination of Cu, Fe, K, Mg, Mn, Na and Zn in Food Using AAS in Fast Sequential mode

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Efficient elemental analysis of food samples

As more food products are imported and exported around the globe, greater quality control methods are needed. Some laboratories are looking for optimized systems that can efficiently and accurately analyze up to eight elements or more in as many as 100 samples per day. Such optimization is essential because it is inefficient to dedicate one analyst to manually running large numbers of samples every day.

Cu, Mn, Fe, K, Na, Mg, and Zn are seven elements most commonly measured in food testing. Flame atomic absorption spectrophotometry continues to be an appealing technique for this analysis due to its low purchase price, simple hardware and lower operational costs.

In this study, an Agilent AA 280FS flame atomic absorption spectrometer featuring Fast Sequential (FS) mode and PRecision Optimized Measurement Time (PROMT) was used to determine seven elements, Cu, Mn, Fe, K, Na, Mg, and Zn, in a wheat flour reference material.

Table 1. Instrument conditions.

Element	Cu	Mn	Fe	K	Na	Mg	Zn
Lamp current (mA)	4.0	5.0	5.0	5.0	5.0	4.0	5.0
Wavelength (nm)	324.8	279.5	248.3	766.5	589.0	285.2	213.9
Slit width (nm)	0.5	0.2	0.2	1.0	0.5	0.5	1.0
No. of standards	5						
Measurement mode	PROMT						
Inline diluter type	SIPS 10						

To analyze 100 samples per day, up to 10 calibration standards would need to be prepared, as well as diluting samples and also adding a ionization buffer, or modifiers, as required. These steps would be typical in a food lab and can introduce contamination and error into the analysis. The Agilent SIPS 10 Sample Introduction Pump System was used to automatically dilute and prepare the standards and samples, in order to maximize the efficiency of this analysis.

Remeasurement often occurs in food labs when results show errors. Errors caused by incorrectly prepared standards and sample preparation errors can all force sample remeasurement. Again, the SIPS 10 can avoid these errors, by removing the manual preparation of standards and samples.

Analysis of Cu, Mn, Fe, K, Na, Mg, and Zn

The method conditions for the each of the elements: wavelength, gas flow, lamp and lamp current, and slit width were all adjusted by the 280FS instrument. In Fast Sequential mode, instantaneous gas flow changes ensure optimized flame stoichiometry for each element. All the required hollow cathode lamps are illuminated, with a spinning selection mirror selecting the light from each lamp in the sequence. A high speed wavelength drive rapidly moves to the right wavelength for each element. This allowed all elements to be measured from one sample aspiration.

The gas flow stoichiometry for each element was controlled by the Hammer Gas Box, built into the instrument. The gas flows recommended in the Agilent Flame Atomic Absorption Spectroscopy Method Development Primer were used.

The seven elements were assayed using only one stock solution, the SIPS 10 prepared 5 calibration standards for each element. Table 1 lists method conditions for each element. The precision of each measurement was controlled by the PROMT function, where measurement time is adjusted for a set level of precision i.e. 1% RSD. Higher concentrations achieve the precision target more quickly than lower concentrations elements, so measurement time is reduced to save time and gas during analysis.

Results

Figures 1 and 2 show the standard curves for two of the seven elements. Table 2 shows the measurements of wheat flour standard GBW08503b.

Table 2. Comparison of the measured concentration of elements in a wheat flour standard GBW08503b, versus the certified concentrations.

Element	Certified value (mg/kg)	Measured value (mg/kg)	Recovery (%)
Cu	3.98±0.43	3.70	93
Mn	22.0±2.0	20.89	95
Fe	37.7±9.4	37.17	98
K	2370±100	2290	97
Na	8.3±1.1	9.10	109
Mg	616±44	598	97
Zn	20.6±1.7	19.34	94

The SIPS 10 was able to prepare accurate calibration curves with correlation coefficients exceeding 0.999 for all elements. This automation of standard preparation significantly reduced the labour associated with manual standard preparation. The use of the SIPS 10 single pump sampling system also enabled the automatic dilution of over-range samples, removing this common source of wasted time. For those sample results that were above the range of the calibration, the SIPS 10 was able to reduce remeasurement by automatically performing inline dilutions, removing the need for user intervention.

The PROMT function reduced the measurement time and the sampling volume, thus improving efficiency and reducing sample consumption.

Compared with conventional flame atomic absorption spectrometry, using the 280FS, PROMT and the SIPS 10 increased the workflow efficiency by more than three times, and reduced the analysis time by over 70%. This means more samples can be measured in less time.

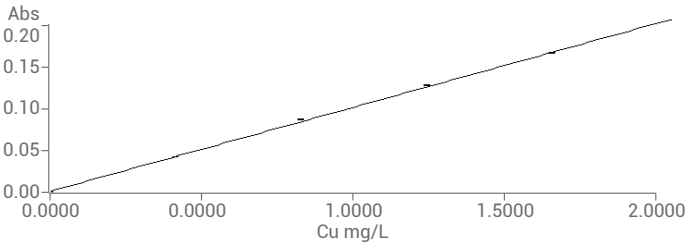

Figure 1. The calibration curve for Cu shows excellent linearity, with a correlation coefficient of 0.9997.

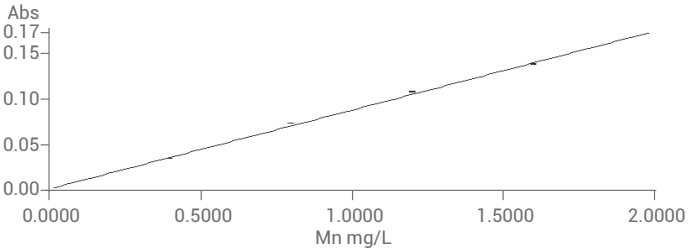

Figure 2. The calibration curve for Mn shows excellent linearity, with a correlation coefficient of 0.9995.

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