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# Application News

# No. A568

**Atomic Absorption**

# Direct Measurement of Minerals (Fe, Zn, Cu, Mn) in Wine Using Flame Atomic Absorption Spectrophotometry

Flame atomic absorption spectrophotometers are capable of the direct measurement of samples with a complex matrix and also feature easy operability and maintainability. Although samples normally require digestion by heating prior to measurement, there are cases where samples in liquid form, such as beverages, can be measured directly.

This article introduces an example of the direct measurement of minerals, iron (Fe), zinc (Zn), copper (Cu), and manganese (Mn), that are included in a commercially available wine using a flame atomic absorption spectrophotometer.

T. Kawakami

## Measurement Samples and Method

Commercially available red and white wines were selected as samples for measurement without pretreatment.

Wine samples with a standard added at constant volumes were measured and then spike-and-recovery tests were performed. In addition, to evaluate measurement stability, the concentration of Fe was measured for 40 samples of the same red wine.

## Instrument Configuration and Measurement Conditions

The AA-7000 atomic absorption spectrophotometer was used for measurements.

Table 1 lists the main measurement conditions.

For the purpose of matrix-matching, ethanol was added to the standard as a reagent to obtain a 10 v/v% solution.

**Table 1 Measurement Conditions**

| Measurement Element | Fe | Zn | Cu | Mn |
|---|---|---|---|---|
| Analytical Wavelength | 248.3 nm | 213.9 nm | 324.8 nm | 279.5 nm |
| Slit Width | 0.2 nm | 0.7 nm | 0.7 nm | 0.2 nm |
| Background Correction | Deuterium lamp method | | | |
| Flame Type | Air-acetylene | | | |
| Burner Height | 9 mm | 7 mm | | |
| Burner Angle | 0° | | | |
| Integration Time and Repetition Times | 3 s × three times | | | |
| Standard Concentration (mg/L) | 0 | 0 | 0 | 0 |
| | 0.20 | 0.05 | 0.05 | 0.10 |
| | 0.40 | 0.10 | 0.10 | 0.20 |
| | 1.00 | 0.25 | 0.25 | 0.50 |
| | 2.00 | 0.50 | 0.50 | 1.00 |

## Measurement Results

Figs. 1 to 4 show the calibration curves of each element.

Table 2 shows the characteristic concentration (the concentration for 0.0043 absorbance units), which was calculated based on the measurement results of the standards, and the detection limit (3σ) for each of the elements.

Table 3 shows the measurement results of the wines and the recovery rates.

The results from measuring the concentration of Fe in the red wine for 40 samples are shown in Fig. 5. The average concentration for the 40 samples is 1.74 mg/L and the relative standard deviation (%RSD) is 1.2 %.

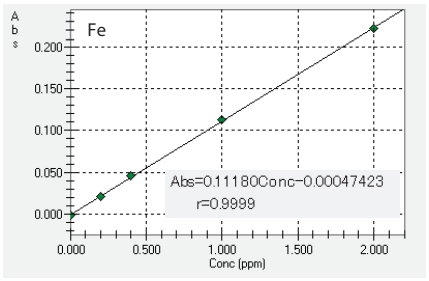


Fig. 1 **Fe Calibration Curve**

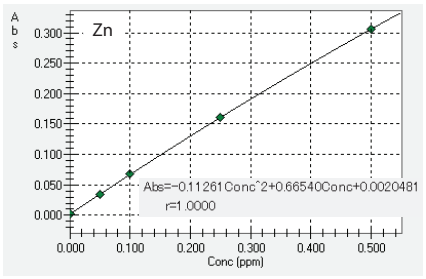


Fig. 2 **Zn Calibration Curve**

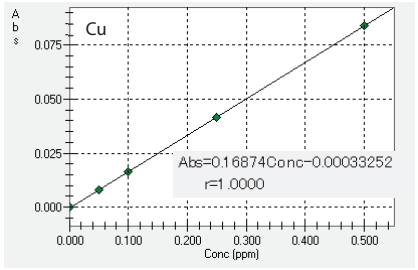


Fig. 3 **Cu Calibration Curve**

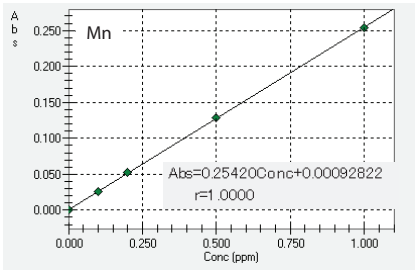


Fig. 4 **Mn Calibration Curve**

**Table 2 Characteristic Concentrations and Detection Limits**

Unit: mg/L

| Measurement Element | Fe | Zn | Cu | Mn |
|---|---|---|---|---|
| Analytical Wavelength | 248.3 nm | 213.9 nm | 324.8 nm | 279.5 nm |
| Characteristic Concentration | 0.04 | 0.007 | 0.03 | 0.02 |
| Detection Limit (3σ) | 0.04 | 0.007 | 0.005 | 0.01 |

**Table 3 Measurement Results of Wines**

Unit: mg/L

| | Fe | Zn | Cu | Mn |
|---|---|---|---|---|
| White Wine | 0.68 (94 %) | <0.007 (99 %) | <0.005 (99 %) | 0.54 (91 %) |
| Red Wine | 1.7 (88 %) | 0.44 (88 %) | 0.01*1 (94 %) | 0.57 (90 %) |

*1 Reference value (value is under quantitative lower limit)
Values in parentheses are recovery rates.

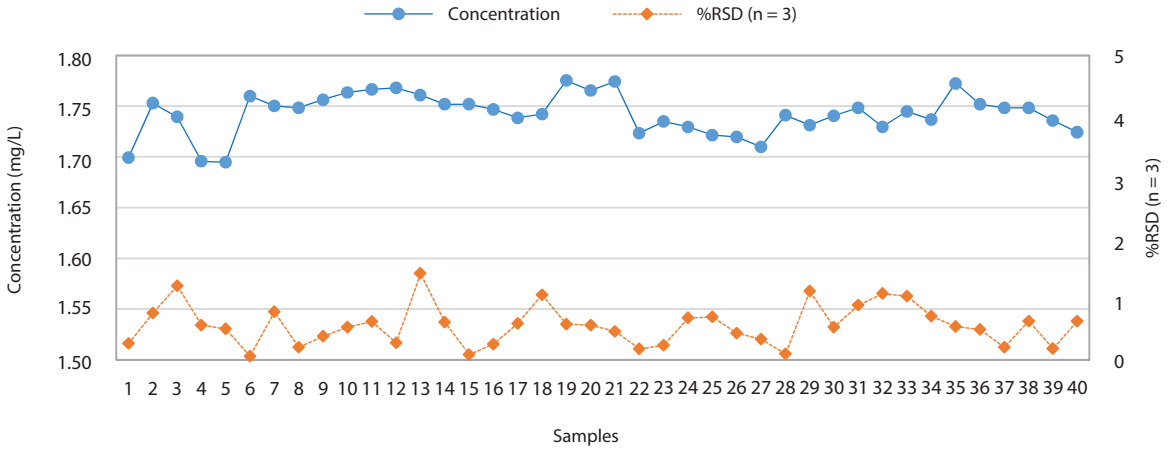


Fig. 5 **Results of Long-Term Stability Test Measuring Fe in Red Wine**

## Conclusion

The minerals in wine were measured directly without pretreatment by using a flame atomic absorption spectrophotometer and then spike-and-recovery tests were performed. In addition, a stability test was performed by consecutively measuring multiple samples.

Favorable results were obtained for both the recovery rates and stability with the recovery rates being between 88 and 98 % and the stability at 1.2 % (%RSD) through the consecutive measurement of 40 samples. These results indicate that flame atomic absorption spectrophotometry is an easy and effective method for measuring the minerals in wine.

The AA-7000 is equipped with a burner head that is made of titanium and highly corrosion-resistant. In addition, the air-cooled burner head can be easily mounted/dismounted and cleaned, facilitating maintenance work.

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