APPLICATION NOTE

Atomic Absorption

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The Analysis of Copper, Iron, and Manganese in Wine with the PinAAcle 500

Introduction

With the popularity of wine consumption continuing to grow, regulations are being implemented as to the metal content allowed in wines, such as those imposed by China for copper, iron, and manganese on imported wine[1] – the maximum permitted concentrations are shown in Table 1. These analyses can be easily accomplished using flame atomic absorption (AA) spectrometry. This work demonstrates the analysis of copper (Cu), iron (Fe), and manganese (Mn) in wine with the PinAAcle™ 500 flame atomic absorption spectrometer.

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Table 1. Chinese limits on copper, iron, and manganese in imported wines.

Element	Limit (mg/L)
Copper (Cu)	1
Iron (Fe)	8
Manganese (Mn)	2

Experimental

All analyses were performed on the PerkinElmer PinAAcle 500 AA spectrometer operating with an air/acetylene flame with hollow cathode lamps, according to the conditions in Table 2. The standard nebulizer and spray chamber were used. All samples and standards were introduced manually using self-aspiration.

The wine samples included in this study are shown in Table 3 and were analyzed neat with no sample preparation – samples were just poured from the bottles into sample tubes. To assess accuracy, all samples were measured at two different wavelengths. In addition, spike recoveries at both the regulatory limits and half of the regulatory limits were performed. All analyses were made against external calibration curves with the standards being made in deionized water. The highest calibration standard exceeded the upper regulatory limit for each element.

Results and Discussion

Tables 4-6 show typical results for the analyses for copper, iron, and manganese in the wine samples. For clarity, results from multiple analyses of each sample are not shown. These results indicate that all elements in all the wines are under the regulatory limit, with the manganese level in the chardonnay being closest to the limits. Spike recoveries were within 15% for all wines, indicating a lack of matrix interference, corroborating the accuracy of the results. Repeated analyses of all wines and spikes produced results consistent with those shown in Tables 4-6, demonstrating the stability of the method.

All samples and spikes were also measured at a second wavelength, as indicated in Table 2. The results of these analyses were consistent with those in Tables 4-6, providing further confidence that the results are accurate.

Table 2. PinAAcle 500 AA spectrometer instrumental conditions.

Parameter	Copper	Iron	Manganese
Primary Wavelength (nm)	324.75	248.33	279.48
Secondary Wavelength (nm)	327.40	302.06	279.83
Slit (nm)	0.7	0.2	0.2
Air Flow (L/min)	2.5	2.66	2.66
Acetylene Flow (L/min)	10	7.36	7.36
Calibration Standards (mg/L)	1 ,2, 3	1, 5, 12	1, 2, 5
Calibration Curve Type	Linear Through Zero	Non-Linear Through Zero	Non-Linear Through Zero

Table 3. Wines analyzed.

Type	Country of Origin
Chardonnay	Australia
Cabernet Sauvignon	France
Red	USA
White Zinfandel	USA

Table 4. Copper in wine results (regulated level = 1 mg/L).

Wine	Concentration (mg/L)	+ 0.5 mg/L (mg/L)	% Recovery	+ 1 mg/L (mg/L)	% Recovery
Chardonnay	0.29	0.80	102	1.30	101
Red	0.19	0.72	107	1.24	105
White Zinfandel	0.14	0.63	98	1.13	99
Cabernet Sauvignon	0.13	0.61	96	1.09	96

Table 5. Iron in wine results (regulated level = 8 mg/L).

Wine	Concentration (mg/L)	+ 4 mg/L (mg/L)	% Recovery	+ 8 mg/L (mg/L)	% Recovery
Chardonnay	0.57	4.63	102	8.72	102
Red	1.56	5.99	111	10.1	107
White Zinfandel	2.02	6.03	100	10.2	102
Cabernet Sauvignon	3.33	7.33	100	11.1	97

Table 6. Manganese in wine results (regulated level = 2 mg/L).

Wine	Concentration (mg/L)	+ 1 mg/L (mg/L)	% Recovery	+ 2 mg/L (mg/L)	% Recovery
Chardonnay	1.70	2.60	90	3.49	90
Red	1.30	2.24	94	3.17	94
White Zinfandel	1.06	1.94	88	2.89	92
Cabernet Sauvignon	0.97	2.04	107	2.93	98

Conclusion

This work has clearly demonstrated the ability of the PinAAcle 500 AA spectrometer to accurately measure copper (Cu), iron (Fe), and manganese (Mn) in a variety of wine samples at levels which meet the regulations imposed by China for imported wine. The Syngistix Touch™ software operated from the PinAAcle's large touchscreen display allows for simple operation when analyzing samples. If more flexibility is desired, Syngistix™ for AA software can also be used, running from an on-board computer. For increased sample throughput when analyzing large batches, a FAST Flame sample automation system can be used with the PinAAcle 500. With the faster sample throughput, equivalent results can be obtained for the analysis of Cu, Fe, and Mn in wine[2]. The flexibility of operating mode and sample introduction systems, combined with its analytical capabilities, makes the PinAAcle 500 an excellent instrument for measuring metals in wines.

References

1. "Manganese Levels in China", Wine Australia (http://www.wineaustralia.com/en/~/media/0000Industry%20Site/Documents/News%20and%20Media/News/Media%20Releases/2014/Manganese%20Levels%20in%20China.ashx).
2. Spivey N., Thompson P., "The Analysis of Copper, Iron, and Manganese in Wine with FAST Flame Atomic Absorption", PerkinElmer Application Note.

Consumables

Component	Part Number
Cu Hollow Cathode Lamp	N3050121
Fe Hollow Cathode Lamp	N3050126
Mn Hollow Cathode Lamp	N3050145
Cu 1000 mg/L Standard	N9300183 (125 mL) N9300114 (500 mL)
Fe 1000 mg/L Standard	N9303771 (125 mL) N9300126 (500 mL)
Mn 1000 mg/L Standard	N9303783 (125 mL) N9300132 (500 mL)
Autosampler Tubes	B0193233 (15 mL) B0193234 (50 mL)

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