SHIMADZU

Application News

Spectroscopy – AAS

Analysis of Cu and Zn in Red Wine Using Atomic Absorption Spectrometry

No. SCA-120-026

Wine is one of the oldest cultural products in human history. Wines have been cultivated for over 8000 years. The oldest known archaeological evidence of winemaking is an 8000-year old wine- and fruit press found near Damascus. Awareness of the medicinal effects of wine also date back to this time. Hippocrates (460 – 377 B.C.) recommended wine diluted with water as a remedy against headaches and digestive disorders.

Figure 1: Grapes – the source of red wine

■ Spectroscopic methods: quality assurance

A meticulous quality control procedure is essential, and during each stage of the production process spectroscopic methods such as AAS-, ICP-, FTIR-, and UV-VIS spectroscopy are applied for quality assurance or for product characterisation. For the quantitative determination of copper and zink, the atomic absorption spectrometry is the method of choice, since the sensitivity of AA-7000F in flame atomization allows a fast and precise analytical procedure.

■ Quality Standards

The quality standards are fixed in the national wine regulations such as the German “Weinverordnung” (Bundesgesetzblatt Teil 1 Nr. 32) from 22nd May 2002, and the European Union's new wine regulations from 2009, which includes the classification of wines from different locations but also the production process, alcohol concentrations and the maximum allowable concentrations of the elements as listed in table 1.

Element	Max. Concentration [mg/L]
Al	8.00
As	0.10
B	80
Cd	0.01
Cu	2.00
Pb	0.25
Sn	1.00
Zn	5.00

Table 1: Maximum allowable concentration of elements in wine

■ Experimental work

The control of copper and zinc is a typical application for the Shimadzu flame atomic absorption spectrophotometer AA- 7000F in a fully automatic multi element sequence in combination with the ASC-7000.

Copper in concentrations of higher than 1 mg/L has a strong influence on the quality of the wine. It can cause a metallic bitter taste, and also generates turbidity. Higher copper concentrations are mainly generated from the bordeaux mixture, consisting of

copper sulphate and hydrated lime, which is used as a fungicide in the vineyards. It was invented in the Bordeaux region of France, where it is known locally as Bouillie Bordelaise. This fungicide has been used for over a century and is still used, although the copper will be accumulated in the ground.

The blank, standards and the wine samples are all placed in the autosampler and then will be automatically aspirated to the flame. The advantage of ASC-7000 is the improved rinsing mechanism shown in figure 2, the “overflow method” which is minimizing the carry over effects when analyzing high concentration samples. The blank and standard samples have been adjusted to the matrix of the wine samples using 10% ethanol.

The instrumental parameters and measuring conditions are listed in Table 2. These conditions are automatically set for each element including optimized burner height and gas flow rates.

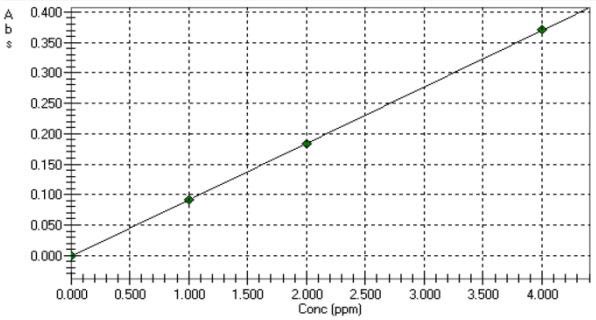

Figure 3: Copper calibration curve

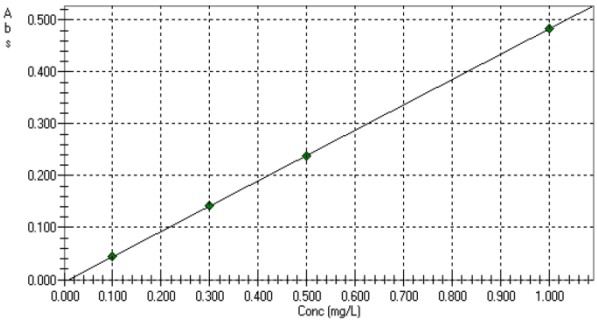

Figure 4: Zinc calibration curve

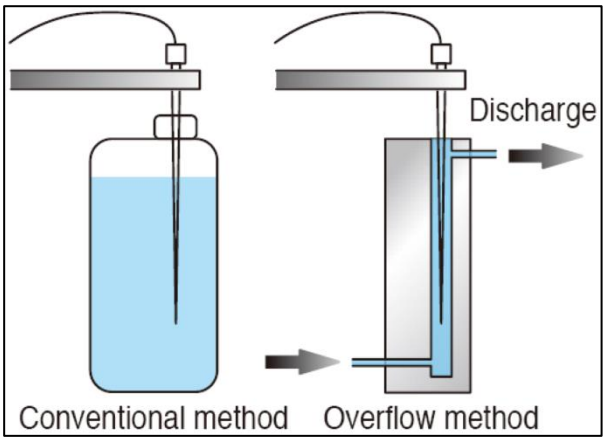

Figure 2: Rinsing method of ASC-7000

Instrument	AA-7000 with ASC-7000	
Element	**Cu**	**Zn**
Wavelength	324,8 nm	213,9 nm
Slit width	0,7 nm	0,7 nm
Lamp current	6 mA	4/ 100 mA
Background-correction	D2	SR
Flame type	Air-C2H2	Air-C2H2
Gas flow rate	1,8 l/min	2,0 l/min
Integration time	3 sec	3 sec
Calibration range [mg/L]	0,5 - 4,0	0,1 - 1,0

Table 2: Instrument and Analytical Conditions

■ Conclusion

For the determination of copper and zinc AA-7000F is the “state of the art” tool for the daily routine in quality control of wine samples. Furthermore the AA-7000 is able in combination with GFA-7000 to achieve calibration ranges as low as 1 to 10 ppb.

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