

Determination of Major and Trace Elements in the Tea Leaves by ICP-AES

Pittcon 2015 540-6P

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Introduction

Tea is one of the most popular beverages in the world. In recent years, the components in tea leaves have received great concern because they are related to health and disease. Tea contains 14 trace elements essential for human, which have positive effects on health. Such as Fe, it is part of hemoglobin. Iron deficiency can cause anemia. Zn deficiency will affect the appetite, mental retardation and neurological dysfunction. Also there is a certain range of the element amount that human daily needs. Selenium, the Research Council of the United States Food and Nutrition Board (USRDA) considers that the daily intake of youth and adult is appropriate 50-200 µg. Tea leaves can supply these trace elements above.

And the detection of multi-elements in tea leaves is very important. ICP-AES (Inductive Coupled Plasma Atomic Emission Spectrometry) has been extensively applied to the determination of major and trace elements in biological and environmental samples. ICP emission spectrometry (ICP-AES) is highly sensitive allows simultaneously analysis of multiple elements, and features a wide dynamic range. It can therefore be used for efficient analysis not only of the principle high-concentration constituents, but of trace elements as well. We introduce here the use of the multi-type ICPE-9000 for quantitative of the content of Ca, Cu, Fe, K, Mg, Mn, Na, P, S, Se and Zn.

Experimental Mechanism of HVG

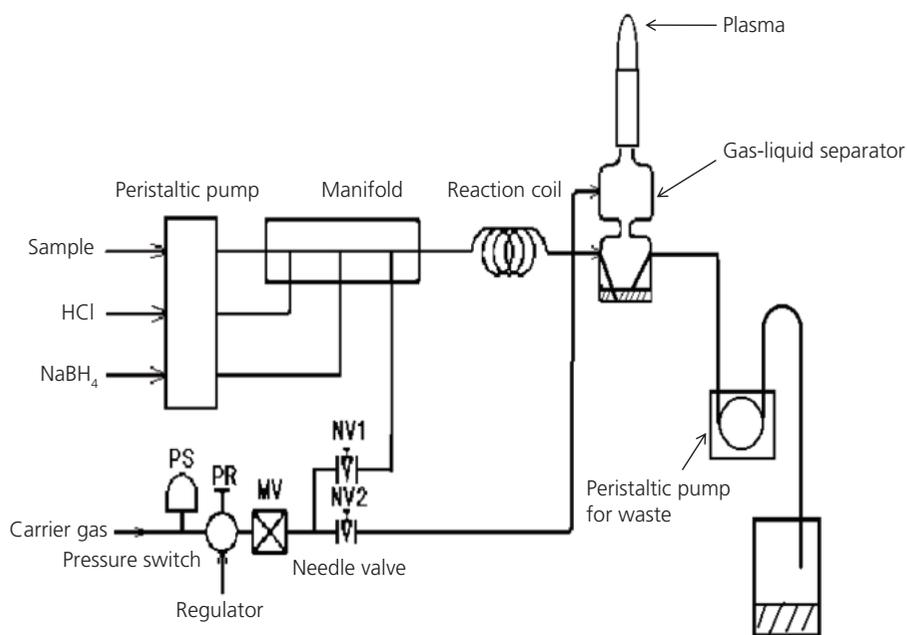


Figure 1 Reaction Mechanism of Hydride Generator

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Instrument

Analytical Conditions	
Instrument	: ICPE-9000
Radio Frequency Power	: 1.2 kW
Plasma Gas	: 10 L/min
Auxiliary Gas	: 0.6 L/min
Carrier Gas	: 0.7 L/min
Sample Introduction	: Coaxial Nebulizer / HVG-ICP
Misting Chamber	: Cyclone Chamber
Plasma Torch	: Mini Torch
View Direction	: Axial/Radial



Figure 2 Shimadzu ICPE-9000

Results

The Spectral profiles (take Se for example)

Se 196.090 Best

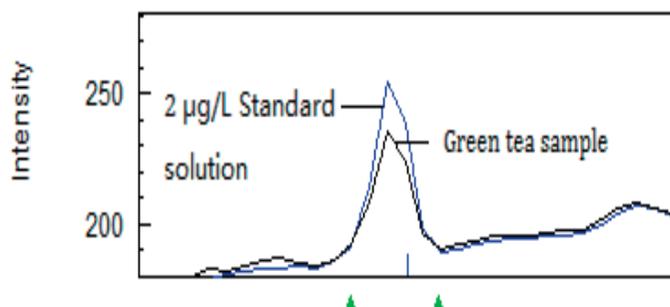


Figure 3 Spectral Profiles of Se

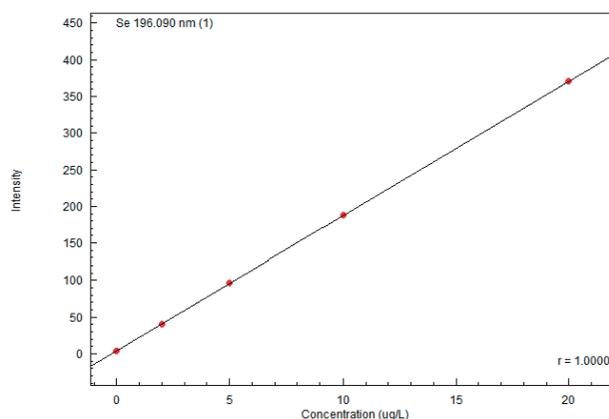


Figure 4 Calibration Curves of Se

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The Quantitation Results of the standard tea leaves as the table below

Table 1 The Quantitation Results of the standard tea leaves (GBW10016)

No.	Element	Wavelength (nm)	Detection Limit (µg/L)	GBW10016 Certified Value	GBW10016 Quantitation Results	Unit	RSD (%)
1	Ca	317.933	0.40	3160±80	3180	µg/g	2.51
2	Cu	324.754	2.00	18.6±0.7	18.1	µg/g	1.95
3	Fe	259.940	0.501	242±18	248	µg/g	2.41
4	K	766.491	34.0	1.63×10 ⁴ ±700	1.66×10 ⁴	µg/g	0.52
5	Mg	285.213	0.05	1860±110	1810	µg/g	2.88
6	Mn	257.610	0.07	500±20	506	µg/g	0.54
7	Na	589.592	3.02	90±10	90	µg/g	1.25
8	P	178.287	8.02	4500±300	4335	µg/g	2.65
9	S	182.037	4.00	3000±300	3265	µg/g	2.72
10	Se	196.090	0.005	0.098±0.008	0.093	µg/g	1.15
11	Zn	213.037	0.20	51±2	50.7	µg/g	2.16

Conclusion

Major and minor elements in the tea leaves (GBW10060) were determined by ICP-OES. The results show that the 11 elements quantitative values matched the certified value of GBW10060. The ICPE-9000 used for measurement is equipped with an echelle and CCD detector, making it possible to conduct simultaneous analysis of all elements at all wavelengths, thereby permitting high throughput measurement even for multiple analyses. And automatic change between Axial and Radial observation of ICPE-9000

enables simultaneous analysis of the major and trace elements. Further, vacuum spectroscopic system of ICPE-9000 ensures accuracy and precision of analytical lines in the ultraviolet region, such as the line of S, 182.037 nm and the line of P, 178.287 nm. This method is rapid and convenient with high accuracy and good precision, which can be widely used for major and trace elements determination in tea leaves.