SHIMADZU

Application News

Inductively Coupled Plasma Atomic Emission Spectrometry

Analysis of Plants – 2

■ Description

The multi-type ICPE-9000 ICP emission spectrometer was used to analyze several plant standards (tea leaf, olive, citrus leaf). Figs. 1 to 3 show the semi-quantitation values, and Table 1 shows the quantitation results. The results closely agree with the certified value for each element. Figs. 4 to 7 show the spectral profiles and calibration curves.

■ Sample

- Powdered tea leaf sta1ndard NIES No.7
- Olive standard BCR CRM-62
- Citrus Leaf SRM1572

■ Pretreatment

Perform heat-digestion using nitric acid, hydrochloric acid and a small amount of hydrofluoric acid. After letting the sample cool, adjust the volume appropriately, and use this as the analytical sample.

■ Analytical Conditions

Instrument	:	**ICPE-9000**
Radio Frequency Power	:	1.2 (kW)
Plasma Gas	:	10 (L/min)
Auxiliary Gas	:	0.6 (L/min)
Carrier Gas	:	0.8 (L/min)
Sample Introduction	:	Coaxial Nebulizer
Sample Aspiration	:	1.0 (mL/min)
Misting Chamber	:	Cyclone Chamber
Attached Instruments	:	Mini Torch
View Direction	:	Axial/Radial

Table 1: Quantitation Results of Plant Standards (μg/g)

Element	Tea Leaf (NIES No. 7)		Olive (BCR CRM-62)		Citrus Leaf (NIST SRM1572)	
	Quantitation Value	Certified Value	Quantitation Value	Certified Value	Quantitation Value	Certified Value
Al	760	775±20	256	(260)	101	92±15
As	<0.4		<0.4		2.8	3.1
Ba	13.5		83		22.0	21
Ca	3280	3200±120	16800	(17500)	30800	31500±1000
Cd	0.03	0.03	0.11	0.1	0.03	0.03
Cr	0.17	(0.15)	1.03		0.71	0.8±0.2
Cu	7.0	7±0.3	45.3	46.6±1.8	15.7	16.5±1.0
Fe	95.4		284	(280)	84	90±10
K	18800	18600±700	3300	(3100)	17800	18200±600
Mg	1480	1530±60	1120	(1200)	5690	5800±300
Mn	706	700±25	55.7	57±2.4	21.8	23±2
Ni	6.5	6.5±0.3	1.05		0.52	0.6±0.3
P	3600	(3700)	1030	(1050)	1250	1300±200
Pb	0.8	0.8±0.03	24.3	25±1.5	12.0	13.3±2.4
Sr	3.70	3.7	35.2		98.0	100
V	0.06		0.72		0.22	
Zn	31.1	33±3	15.4	16±0.7	28.8	29±2

*Values in parentheses are reference values

Tea Leaf / 25						
1000 mg/L or greater						
1 mg/L or greater	Al 71 +	B 1.2	Ca 70	Fe 8.4	K 145	Mg 46
	Mn 25	Na 5.2	P 150	S 11	Si 1.6	
1 μg/L or greater	Ba 140	Cr 37	Cu 740	Dy 26	In 250	Li 3.3
	Ni 320	Rh 190	Sr 58	Th 220	Ti 21	Zn 550
Up to 1 μg/L						
Below detection limit μg/L	Ag < 14	As < 380	Au < 130	Be < 0.43	Bi < 470	Cd < 14
	Ce < 66	Co < 36	Er < 22	Eu < 3.1	Ga < 57	Gd < 18
	Ge < 430	Hf < 79	Hg < 10	Ho < 9.7	I < 1400	Ir < 880
	La < 13	Lu < 4.0	Mo < 70	Nb < 110	Nd < 44	Os < 510 +
	Pb < 220	Pd < 44	Pr < 46	Pt < 210	Re < 57	Ru < 100
	Sb < 290	Sc < 2.0	Se < 490	Sm < 29	Sn < 180	Ta < 71
	Tb < 20	Te < 540	Tl < 320	Tm < 8.6	U < 190	V < 37
	W < 510	Y < 2.3	Yb < 7.1	Zr < 4.1		

Figure 1: Semi-Quantitation Values (Tea Leaf Digest Solution)

Olive / 20						
1000 mg/L or greater						
1m g/L or greater	Al 47 +	B 1.4	Ba 2.6	Ca 540	Cu 5.7	Fe 32
	K 74	Mg 43	Mn 2.7	Na 13	P 59	Pb 1.4
	S 14	Sr 1.6				
1 μg/L or greater	Cr 97	Li 7.5	Ni 78	Si 140	Th 30	Ti 200
	V 57	Y 4.3	Zn 350			
Up to 1 μg/L						
Below detection limit μg/L	Ag < 21	As < 560	Au < 170	Be < 0.91	Bi < 430	Cd < 20
	Ce < 110	Co < 43	Dy < 38	Er < 34	Eu < 5.5	Ga < 96
	Gd < 28	Ge < 270	Hf < 100	Hg < 15	Ho < 48	I < 2300
	In < 200	Ir < 1200	La < 23	Lu < 5.2	Mo < 95	Nb < 120
	Nd < 86	Os < 770 +	Pd < 66	Pr < 76	Pt < 1300	Re < 78
	Rh < 120	Ru < 310	Sb < 410	Sc < 3.5	Se < 710	Sm < 48
	Sn < 250	Ta < 110	Tb < 31	Te < 720	Tl < 510	Tm < 14
	U < 330	W < 770	Yb < 11	Zr < 6.1		

Figure 2: Semi-Quantitation Values (Olive Digest Solution)

Citrus Leaf /25						
1000 mg/L or greater						
1 mg/L or greater	Al 7.8 +	B 3.6	Ca 760	Cu 1.7	Fe 6.9	K 249
	Mg 160	Na 17	P 59	S 19	Si 1.0	Sr 3.5
1 μg/L or greater	Ba 410	Cr 55	Li 4.2	Mn 830	Pb 560	Rh 230
	Th 55	Ti 39	Y 5.9	Zn 460		
Up to 1 μg/L						
Below detection limit μg/L	Ag < 24	As < 700	Au < 75	Be < 1.1	Bi < 500	Cd < 25
	Ce < 130	Co < 59	Dy < 17	Er < 40	Eu < 6.4	Ga < 110
	Gd < 33	Ge < 350	Hf < 130	Hg < 18	Ho < 17	I < 2900
	In < 230	Ir < 1500	La < 27	Lu < 6.0	Mo < 120	Nb < 180
	Nd < 100	Ni < 60	Os < 750 +	Pd < 76	Pr < 87	Pt < 370
	Re < 88	Ru < 180	Sb < 510	Sc < 4.1	Se < 880	Sm < 56
	Sn < 320	Ta < 120	Tb < 36	Te < 870	Tl < 580	Tm < 16
	U < 380	V < 65	W < 960	Yb < 13	Zr < 7.4	

Figure 3: Semi-Quantitation Values (Citrus Leaf Digest Solution)

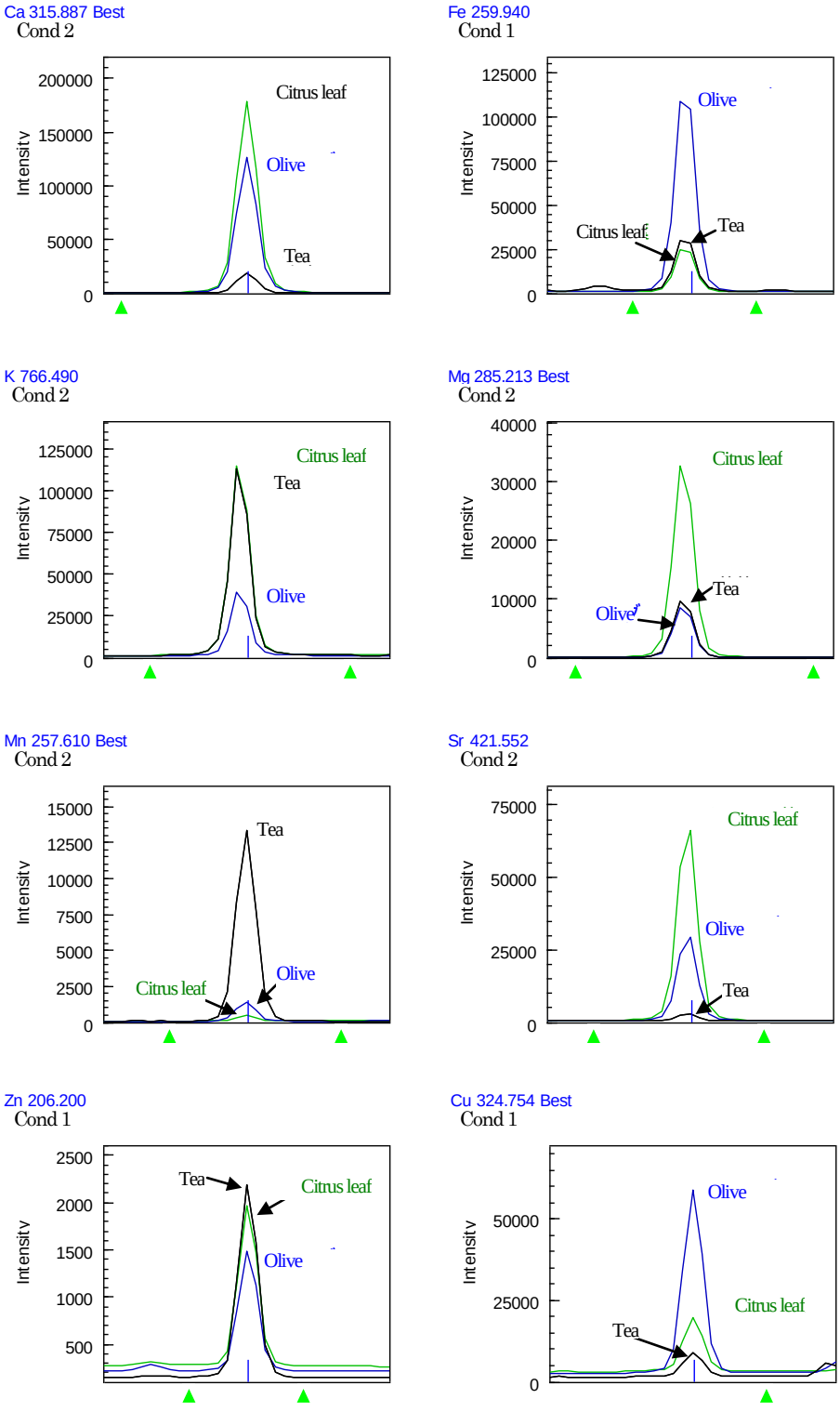

Figure 4: Spectral Profiles

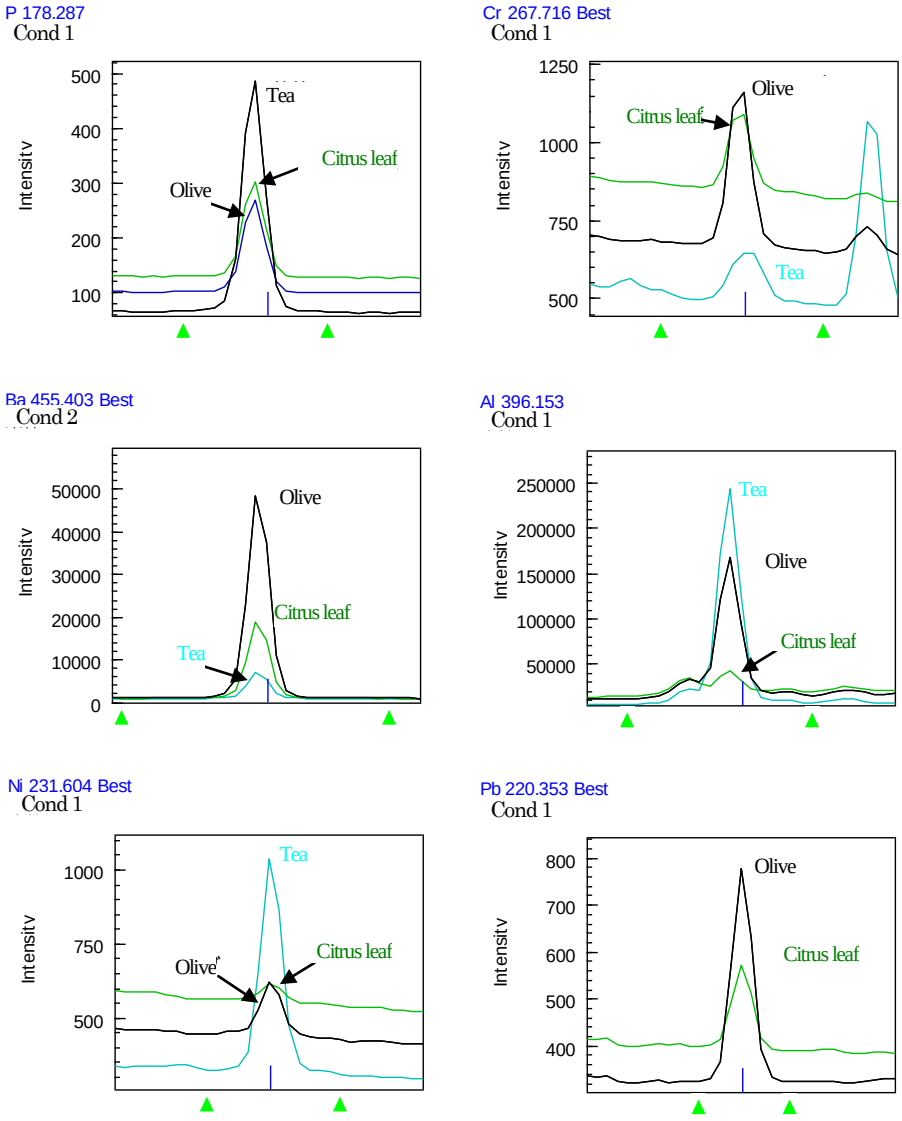

Figure 5: Spectral Profiles

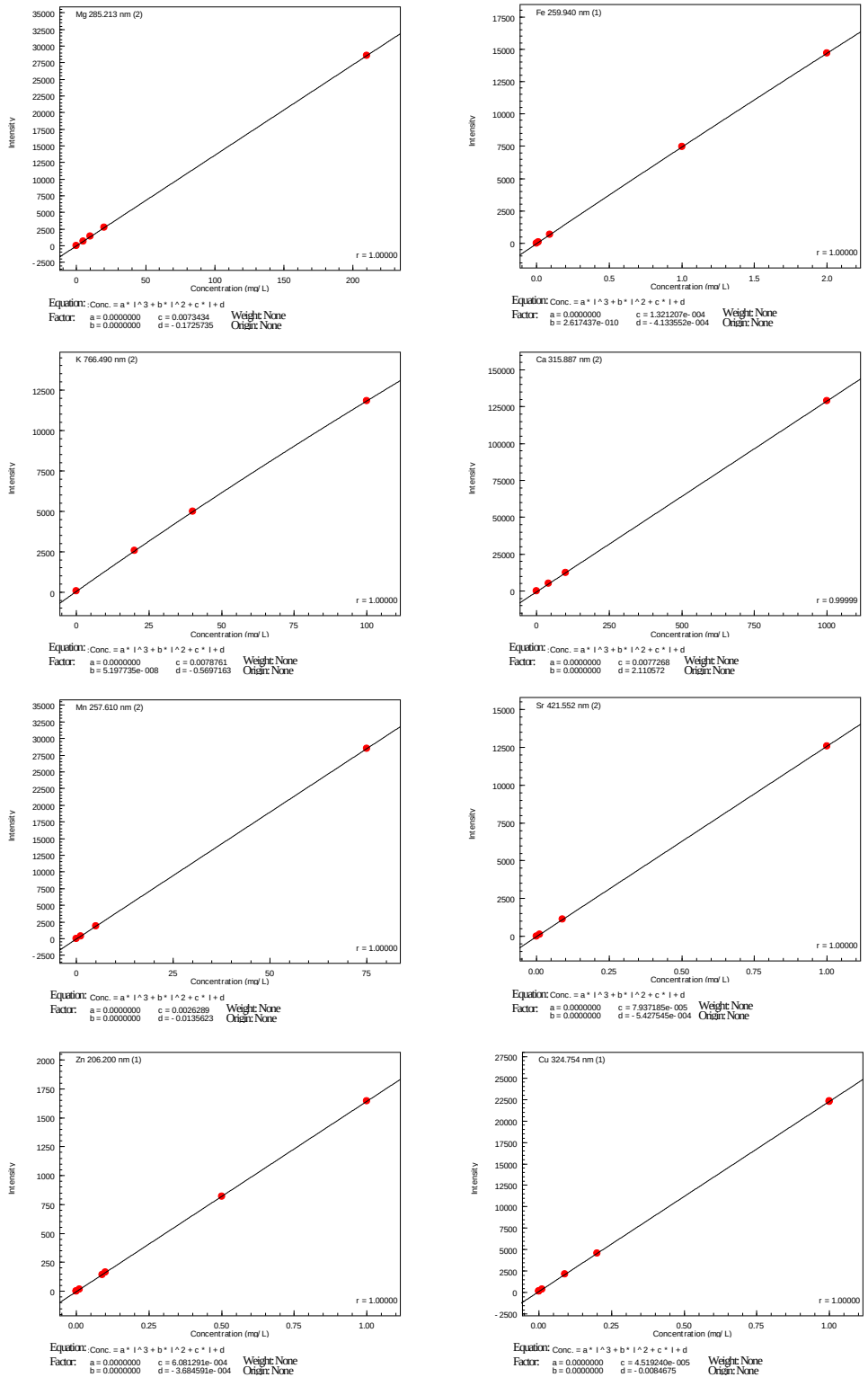

Figure 6: Calibration Curves

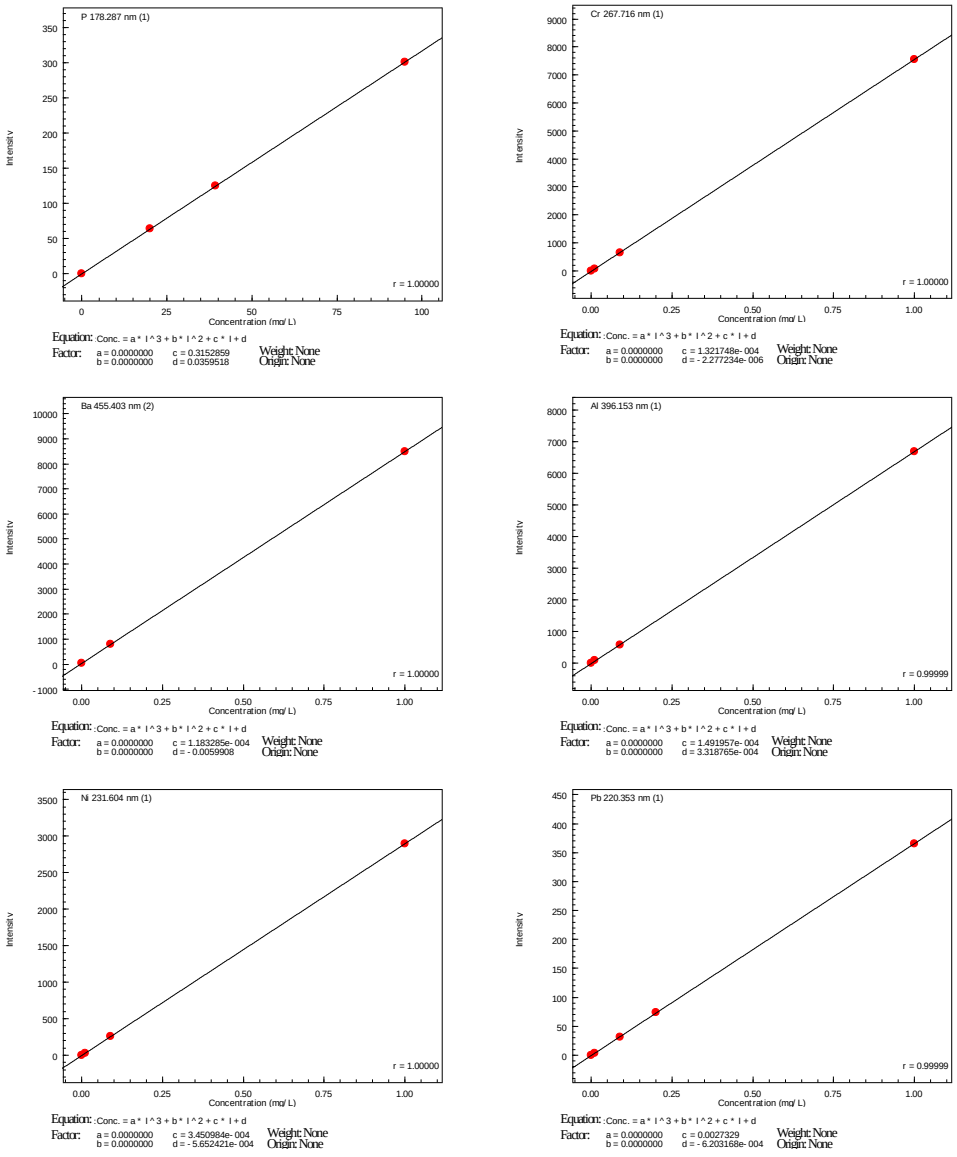

Figure 7: Calibration Curves

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