

Supplementary Information

Acid Decomposition of Yerba Mate (*Ilex paraguariensis*) Using a Reflux System for the Evaluation of Al, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Pb and Zn Contents by Atomic Spectrometric Techniques

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Table S1. Instrumental parameters for the determination of Al, Ca, Fe, Mg, Mn and Zn in yerba mate using ICP OES

Parameter	Condition
Radiofrequency power / kW	1.3
Plasma argon flow rate / (L min ⁻¹)	15.0
Nebulization argon flow rate / (L min ⁻¹)	0.8
Auxiliary argon flow rate / (L min ⁻¹)	0.8
Sample flow rate / (mL min ⁻¹)	1.0
Integration time / s	1(min)-5(max)
Read delay / s	30
Emission wavelength, λ / nm	Al (308.215)(I) ^a Ca (317.933)(II) ^b Fe (238.204)(II) ^b Mg (279.077)(II) ^a Mn (403.075)(I) ^a Zn (213.857)(I) ^b

^aAxial mode; ^bradial mode.

Table S2. Instrumental parameters for determinations of Ca, Cu, Fe, Mg, Na, K and Zn by F AES/F AAS

Parameter	Ca	Cu	Fe	Mg	Na	K	Zn
Wavelength / nm	422.7	324.7	248.3	285.2	589.0	766.5	213.9
Spectral band path / nm	0.6	2.7	1.8	1.05	1.8	0.45	2.7
Lamp current / mA	10	15	30	6	–	–	15
Air flow rate / (L min ⁻¹)	10	10	10	10	10	10	10
Acetylene flow rate / (L min ⁻¹)	2.7	2.5	2.5	2.5	2.5	2.5	2.5

Table S3. Temperature program of graphite furnace for the determination of Cd, Cr and Pb in yerba mate by GF AAS

Step	Temperature / °C	Ramp	Hold / s	Argon flow rate / (mL min ⁻¹)
Drying	110	1	30	250
Drying	130	15	30	250
Pyrolysis	600 ^a /800 ^b /1000 ^c	10	20	250
Atomization	1500 ^a /2200 ^b /1700 ^c	0	5	0
Cleaning	2500	1	3	250

^aCd; ^bCr; ^cPb.

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Table S4. Concentrations (mg kg⁻¹) of Al, Ca, Fe, Mg, Mn and Zn measured by ICP OES in yerba mate sample (E) after the additions of analytes (n = 3)

Analyte	Addition / (mg kg ⁻¹)	Reflux system	Recovery / %	Microwave digestion	Recovery / %
Al	50	46.3 ± 6.4 (13.8)	92.6	56.4 ± 6.8 (12.7)	112.8
Ca	2000	1860.8 ± 190.4 (10.2)	93.0	2160.1 ± 96.8 (4.5)	108.0
Fe	50	45.7 ± 2.3 (5.0)	91.4	54.7 ± 5.6 (10.2)	109.4
Mg	1500	1207.2 ± 18.2 (1.5)	80.5	1599.5 ± 67.4 (4.2)	106.6
Mn	1500	1598.2 ± 25.4 (1.6)	106.5	1431.8 ± 15.9 (1.1)	95.4
Zn	100	92.9 ± 1.3 (1.4)	92.9	100.3 ± 1.8 (1.8)	100.3

Table S5. Measured concentrations of Ca, Cu, Fe, K, Mg, Na, Zn, Cr, Cd and Pb after addition of different concentrations to the yerba mate samples (n = 3)

Analyte	Addition	Sample F	Sample I
Ca / (mg g ⁻¹)	2.5	16.89 ± 0.13 (0.8)	22.74 ± 0.63 (2.8)
	5.0	19.55 ± 0.27 (1.4)	24.86 ± 0.05 (0.2)
	7.5	21.25 ± 0.56 (2.6)	27.70 ± 0.69 (2.5)
Cu / (mg g ⁻¹)	0.025	0.036 ± 0.002 (5.6)	0.039 ± 0.004 (10.2)
	0.075	0.088 ± 0.001 (1.1)	0.088 ± 0.002 (2.3)
	0.15	0.169 ± 0.001 (0.6)	0.164 ± 0.005 (3.0)
Fe / (mg g ⁻¹)	0.15	0.67 ± 0.01 (1.5)	0.56 ± 0.01 (1.8)
	0.25	0.78 ± 0.06 (7.7)	0.67 ± 0.03 (4.5)
	0.50	0.98 ± 0.07 (7.1)	0.89 ± 0.07 (7.9)
K / (mg g ⁻¹)	3.5	16.83 ± 0.91 (5.4)	16.21 ± 0.04 (0.2)
	7.0	20.25 ± 0.48 (2.4)	20.03 ± 1.14 (5.7)
	10.0	23.83 ± 2.63 (11.0)	23.97 ± 2.13 (8.9)
Mg / (mg g ⁻¹)	4.0	12.84 ± 0.14 (1.1)	11.12 ± 0.18 (1.6)
	7.5	16.26 ± 0.97 (6.0)	14.35 ± 0.15 (0.9)
	10.0	19.03 ± 1.33 (7.0)	17.29 ± 1.09 (6.3)
Na / (mg g ⁻¹)	0.025	0.17 ± 0.01 (5.9)	0.19 ± 0.01 (5.3)
	0.075	0.22 ± 0.01 (4.5)	0.24 ± 0.01 (4.2)
	0.15	0.28 ± 0.01 (3.6)	0.32 ± 0.01 (3.1)
Zn / (mg g ⁻¹)	0.05	0.23 ± 0.01 (4.3)	0.099 ± 0.003 (3.0)
	0.1	0.28 ± 0.01 (3.6)	0.143 ± 0.001 (0.7)
	0.2	0.37 ± 0.01 (2.7)	0.256 ± 0.004 (1.6)
Cr / (µg g ⁻¹)	0.25	1.72 ± 0.03 (1.7)	1.32 ± 0.08 (6.1)
	0.50	1.97 ± 0.04 (2.0)	1.63 ± 0.11 (6.7)
	1.0	2.44 ± 0.01 (0.4)	2.09 ± 0.05 (2.4)
Cd / (µg g ⁻¹)	0.1	0.75 ± 0.01 (1.3)	0.26 ± 0.02 (7.7)
	0.25	0.93 ± 0.02 (2.2)	0.38 ± 0.01 (2.6)
	0.5	1.20 ± 0.01 (0.8)	0.59 ± 0.02 (3.4)
Pb / (µg g ⁻¹)	0.25	1.46 ± 0.01 (0.7)	1.36 ± 0.11 (8.1)
	1.0	2.39 ± 0.04 (1.7)	2.07 ± 0.13 (6.3)
	2.0	3.05 ± 0.10 (3.3)	3.15 ± 0.31 (8.8)