



Determination of Mineral Elements in the Fern Genus *Pyrrrosia* Mirbel from Yunnan, China

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The contents of nine mineral elements (Ca, Cr, Cu, Fe, K, Mg, Mn, Na and Zn) in nine species (*Pyrrrosia porvsa*, *Pyrrrosia drakeana*, *Pyrrrosia gralla*, *Pyrrrosia lingua*, *Pyrrrosia petiolosa*, *Pyrrrosia subfurfuraceae*, *Pyrrrosia calvata*, *Pyrrrosia nudicaulis*, *Pyrrrosia tonkiensis*) of fern genus *Pyrrrosia* Mirbel from Yunnan province of China were determined by atomic absorption spectrophotometry. Fern samples contained Ca (296.54-4033.32 $\mu\text{g g}^{-1}$), Cr (183.58-326.49 $\mu\text{g g}^{-1}$), Cu (15.07-75.21 $\mu\text{g g}^{-1}$), Fe (53.66-548.58 $\mu\text{g g}^{-1}$), K (7690.02-19459.30 $\mu\text{g g}^{-1}$), Mg (1779.09-7423.35 $\mu\text{g g}^{-1}$), Mn (4.60-394.32 $\mu\text{g g}^{-1}$), Na (68.66-759.55 $\mu\text{g g}^{-1}$) and Zn (14.68-93.08 $\mu\text{g g}^{-1}$). The mineral element contents of fern genus *Pyrrrosia* showed a wide variability among different species.

Key Words: Polypodiaceae, Genus *Pyrrrosia*, Mineral element, Atomic absorption spectrophotometry.

INTRODUCTION

The genus *Pyrrrosia* Mirbel (Polypodiaceae) comprises about 100 species, widely distributes from tropical and subtropical Asia to Africa and Australia¹. Twenty three species of *Pyrrrosia* distribute in Yunnan, China². The habitat for fern genus *Pyrrrosia* is mostly on rocks and old tree trunks in mountains. *Pyrrrosia* leaf is a traditional Chinese medicine for the treatments of cough, urinary calculus and bloody urine^{3,4}. The ethanol extract of *P. petiolosa* showed an antioxidant activity⁵.

The research of mineral element contents in medicinal plant is necessary because the elements take part in formation of the active constituents in direct and indirect way^{6,7}. It is also important to determine mineral elements in herbal medicines for quality control in order to protect consumers from contamination^{8,9}. There are several reports in literature on the mineral element content in medicinal plants and fungi from Yunnan¹⁰⁻¹³. However, little is known on genus *Pyrrrosia*. In this study, the levels of 9 mineral elements in 9 species of fern *Pyrrrosia* were determined by atomic absorption spectrophotometry.

EXPERIMENTAL

Nine species of fern genus *Pyrrrosia* samples were collected from five different locations in Yunnan, China (Table-1). The reference substances were provided by the National

TABLE-1
SPECIES AND LOCATION OF FERN GENUS *Pyrrrosia* SAMPLES

No.	Species	Location	Longitude (°E)	Latitude (°N)
1	<i>Pyrrrosia porosa</i>	Pingbian, Yunnan	103.67	22.68
2	<i>Pyrrrosia drakeana</i>	Xichou, Yunnan	104.68	23.42
3	<i>Pyrrrosia gralla</i>	Kunming, Yunnan	102.73	25.04
4	<i>Pyrrrosia lingua</i>	Pingbian, Yunnan	103.67	22.68
5	<i>Pyrrrosia petiolosa</i>	Weixi, Yunnan	99.27	27.15
6	<i>Pyrrrosia subfurfuraceae</i>	Wenshan, Yunnan	104.24	23.37
7	<i>Pyrrrosia calvata</i>	Wenshan, Yunnan	104.24	23.37
8	<i>Pyrrrosia nudicaulis</i>	Weixi, Yunnan	99.27	27.15
9	<i>Pyrrrosia tonkiensis</i>	Pingbian, Yunnan	103.67	22.68

Research Center for Certified Reference Materials. The analytical reagents (nitric acid and muriatic acid) were from Beijing Beihua Fine Chemical Co., Ltd. The water was deionized water (18.2 M Ω cm).

All samples were dried at 60 °C until constant weight. 0.50 g powdered samples were weighed and taken in the silica crucibles (25 mL) and added into the moderate concentrated nitric acid at room temperature for one night, then heated until the reddish brown fumes disappeared. The mixture was heated at 550 °C for 4 h, then dissolved in 1 mol L⁻¹ muriatic acid up to 25 mL. A blank control group was carried out in the same way.

All mineral elements were determined by a Solaar AA Series atomic absorption spectrometer (Thermo Elemental, USA). Instrumental parameters used for the observed elements are shown in Table-2.

TABLE-2
INSTRUMENTAL PARAMETERS USED FOR
THE INDIVIDUAL ELEMENTS

Element	Detection wavelength (nm)	Band pass (nm)	Lamp current (%)	Gas flow-rate (L min ⁻¹)	Burner height (mm)
Ca	422.7	0.5	100	1.4	11.0
Cr	357.9	0.5	100	1.4	3.0
Cu	324.8	0.5	75	1.1	7.0
Fe	248.3	0.2	75	0.9	7.0
K	766.5	0.5	100	1.2	7.0
Mg	285.2	0.5	75	1.1	7.0
Mn	279.5	0.2	75	1.0	7.0
Na	589.0	0.2	75	1.1	10.2
Zn	213.9	0.5	75	1.2	7.0

RESULTS AND DISCUSSION

Ranges and mean elemental contents in fern samples are listed in Table-3. The ranges of the elements were found to be 296.54-4033.32 $\mu\text{g g}^{-1}$ for Ca, 183.58-326.49 $\mu\text{g g}^{-1}$ for Cr, 15.07-75.21 $\mu\text{g g}^{-1}$ for Cu, 53.66-548.58 $\mu\text{g g}^{-1}$ for Fe, 7690.02-19459.30 $\mu\text{g g}^{-1}$ for K, 1779.09-7423.35 $\mu\text{g g}^{-1}$ for Mg, 4.60-394.32 $\mu\text{g g}^{-1}$ for Mn, 68.66-759.55 $\mu\text{g g}^{-1}$ for Na and 14.68-93.08 $\mu\text{g g}^{-1}$ for Zn. The fern *Pyrrrosia* samples contained K, Mg and Ca in larger contents, whereas Cr, Fe, Na, Cu, Mn and Zn were found in lower contents.

It is observed that the mineral element contents among different species of genus *Pyrrrosia* from Yunnan varied over a wide range (Table-4). Highest content of Ca was found in *P. subfurfuraceae* (3687.41 \pm 558.64 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. calvata* (300.30 \pm 3.26 $\mu\text{g g}^{-1}$). Highest content of K was found in *P. gralla* (17341.45 \pm 1909.31 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P.*

TABLE-3
CONTENTS ($\mu\text{g g}^{-1}$) OF THE MINERAL ELEMENTS IN
FERN GENUS *Pyrrrosia* SAMPLES (n = 27)

Element	Min.	Max.	Mean	SD
Ca	296.54	4033.32	948.73	1030.53
Cr	183.58	326.49	261.89	46.07
Cu	15.07	75.21	45.47	18.62
Fe	53.66	548.58	201.03	145.17
K	7690.02	19459.30	13350.17	2959.27
Mg	1779.09	7423.35	3247.36	1629.60
Mn	4.60	394.32	52.02	111.56
Na	68.66	759.55	195.69	141.37
Zn	14.68	93.08	35.77	22.59

subfurfuraceae (8223.48 \pm 467.83 $\mu\text{g g}^{-1}$). Highest content of Mg was found in *P. subfurfuraceae* (7418.40 \pm 4.28 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. drakeana* (1973.56 \pm 260.93 $\mu\text{g g}^{-1}$).

For the trace elements, the contents in fern *Pyrrrosia* were also different among species (Table-4). Highest content of Cr was found in *P. tonkiensis* (324.67 \pm 2.47 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. porosa* (188.20 \pm 7.85 $\mu\text{g g}^{-1}$). Highest content of Cu was found in *P. petiolosa* (73.46 \pm 1.53 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. gralla* (25.14 \pm 4.82 $\mu\text{g g}^{-1}$). Highest content of Fe was found in *P. tonkiensis* (529.60 \pm 32.23 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. drakeana* (67.17 \pm 14.22 $\mu\text{g g}^{-1}$). Highest content of Mn was found in *P. lingua* (360.17 \pm 29.93 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. drakeana* (5.25 \pm 0.59 $\mu\text{g g}^{-1}$). Highest content of Na was found in *P. gralla* (266.23 \pm 135.98 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. porosa* (93.57 \pm 35.71 $\mu\text{g g}^{-1}$). Highest content of Zn was found in *P. subfurfuraceae* (86.97 \pm 15.06 $\mu\text{g g}^{-1}$), whereas the lowest content was found in *P. nudicaulis* (15.06 \pm 0.33 $\mu\text{g g}^{-1}$).

The present study provides baseline data on mineral element levels in fern genus *Pyrrrosia*. The wide range of element contents implies that the fern species has an inherent characteristic absorption and accumulation for the determined mineral elements.

TABLE-4
CONTENTS ($\mu\text{g g}^{-1}$) OF THE MINERAL ELEMENTS IN DIFFERENT SPECIES OF FERN GENUS *Pyrrrosia* SAMPLES (n = 3)

Species		Ca	Cr	Cu	Fe	K	Mg	Mn	Na	Zn
<i>P. porosa</i>	Mean	985.10	188.20	28.74	118.16	13891.13	2684.13	13.04	93.57	22.81
	SD	56.09	7.85	1.09	26.14	1017.76	243.16	1.94	35.71	3.36
<i>P. drakeana</i>	Mean	353.25	209.67	36.64	67.17	16760.55	1973.56	5.25	162.67	19.23
	SD	12.81	3.65	1.61	14.22	2403.56	260.93	0.59	60.05	1.36
<i>P. gralla</i>	Mean	616.34	223.12	25.14	125.44	17341.45	2674.82	19.25	266.23	22.63
	SD	24.82	6.26	4.82	28.35	1909.31	45.56	1.62	135.98	0.71
<i>P. lingua</i>	Mean	399.85	243.34	29.11	80.56	13054.28	3134.51	360.17	163.82	43.83
	SD	0.63	9.46	3.94	11.75	3282.22	393.43	29.93	91.40	11.22
<i>P. petiolosa</i>	Mean	1046.18	277.50	73.46	111.69	12381.15	3946.93	23.94	151.63	33.46
	SD	111.28	1.68	1.53	10.84	1343.83	421.84	3.92	28.38	2.25
<i>P. subfurfuraceae</i>	Mean	3687.41	284.69	59.03	293.11	8223.48	7418.40	6.95	112.65	86.97
	SD	558.64	9.08	1.29	24.19	467.83	4.28	0.45	20.70	5.30
<i>P. calvata</i>	Mean	300.30	295.29	63.01	194.79	14245.77	3086.17	5.60	279.59	55.29
	SD	3.26	4.07	2.35	19.45	220.37	370.56	0.18	102.30	3.86
<i>P. nudicaulis</i>	Mean	528.60	310.50	62.14	288.73	11355.71	2262.56	11.44	133.34	15.06
	SD	52.99	2.54	8.66	65.27	391.28	72.97	2.20	8.23	0.33
<i>P. tonkiensis</i>	Mean	621.50	324.67	31.98	529.60	12897.97	2045.13	22.51	397.68	22.68
	SD	48.54	2.47	14.89	32.23	406.27	73.87	3.98	315.00	4.24

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