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NOTE

Determination of Trace Elements in *Coptis teeta* and Soil by ICP-AES

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The contents of Ca, Mg, Fe, Mn and Zn in *Coptis teeta* Wall. and soil from Yunnan province of China were determined by inductively coupled plasma atomic emission spectroscopy (ICP-AES). The spike recoveries were between 97.7-107.4 % and the RSD were between 0.47-1.70 %. The order of the element contents was Fe > Ca > Mg > Mn > Zn in soil and Ca > Mg > Fe > Zn > Mn in rhizome of *Coptis teeta* and Mg > Ca > Fe > Mn > Zn in root of *Coptis teeta*. Ca-Fe had significantly positive correlation at the 0.05 level (r = 0.746) in soil and Ca-Mg, Ca-Fe, Ca-Mn, Ca-Zn, Mg-Fe, Mg-Mn, Mg-Zn, Fe-Mn, Fe-Zn, Mn-Zn at the 0.01 level (r = 0.824-0.991). Ca-Zn had significantly negative correlation at the 0.01 level (r = -0.870) in rhizome of Coptis teeta. Mn-Ca, Zn-Ca had significantly negative correlation at the 0.05 level (r = -0.771, -0.753) in root of *Coptis teeta*, whereas Zn-Mn had significantly positive correlation at 0.05 level (r = 0.786). Ca-Ca had significantly positive correlation at 0.01 level (r = 0.9117) between rhizome and root of *Coptis teeta* and Fe-Fe at 0.05 level (r = 0.693).

Key Words: *Coptis teeta*, Trace element, Soil, ICP-AES.

Coptis teeta Wall. (Ranunculaceae) is a perennial herb[1] and has been used as an antiinflammatoryand and antibacterial medicine for a long time[2]. It is an endemic species to northwest Yunnan, China and northeast India. The cultivation history of *Coptis teeta* in northwest Yunnan has been more than 100 years. Local minorities also harvest it to generate income for change their rural life[3,4]. As reported, the environmental factors, like soil, impacted on the biological characteristics and chemical composition of *Coptis teeta*[5,6]. The trace elements played an important role in formation of the active constituents of medicinal plants and effected variety of physiological activities of organisms[7-12]. Therefore, determination of the trace element content in *Coptis teeta* and soil is very important for the cultivation of this species.

Inductively coupled plasma atomic emission spectroscopy (ICP-AES), with little interference and high sensitivity, could determinate various trace elements simultaneously. It is suitable to assess the value of the medicinal plant by the determination of trace elements in it with ICP-AES[8,13]. In this study, the contents of main trace elements, Ca, Mg, Fe, Mn and Zn, in *Coptis teeta* and soil were determined by ICP-AES to analysis the relationship of the trace elements.

The rhizomes and roots of *Coptis teeta* and soil were collected from nine different sites in northwest Yunnan, China.

Plant samples were carefully washed *in situ* and again in the laboratory with deionized water to remove soil and dried at 60 ºC until a constant weight was obtained. 1.5 g powdered dry sample were weighted into the 30 mL porcelain crucible and heated on a hot plate, then transferred into high temperature furnace at 550 ºC. The sidewall of crucible was washed by deionized water after the sample was cooled. 1 mL HCl and 0.5 mL HNO_3 were added to the samples. The mixture was digested on a hot plate then transferred to 25 mL volumetric flaskes and made to volume with deionized water for determination of Fe and Zn; then 5 mL solution were transferred to 50 mL volumetric flaskes with 1.0 mL HCl added and made to volume with deionized water for determination of Ca, Mg and Mn.

10 g powdered dry soil were weighted into the polytetrafluoroethene breakers. 20 mL boiling water were added. The mixture with lid was boiling in the water bath for 15 min. After the water on the lid was recycling to the breaker, the mixture was filtered.

Instrument conditions: ICP-AES (Leeman Lab, PS1000, USA); R_f power: 1.0 kW; carrier gas: 1.1 L min^{-1}, auxiliary gas: 0.4 L min^{-1}, coolant gas: 15 L min^{-1}.

The spike recoveries were between 97.7-107.4 % and the RSD were between 0.47-1.70 %. The results showed good accuracy and precision of this method (Table-1).

TABLE-1
PRECISION AND RECOVERY OF THE METHOD

Element	Detection wavelength (nm)	Detection limits (μg mL^{-1})	Recovery (%)	RSD (%)
Ca	267.7	0.036	97.7	1.70
Mg	285.2	0.066	100.3	0.09
Fe	248.3	0.049	99.9	1.32
Mn	279.5	0.070	107.4	0.99
Zn	213.9	0.084	98.5	0.47

The contents of the main trace elements in soil are presented in Table-2. The order of the average contents of the trace elements in soil was Fe > Ca > Mg > Mn > Zn. The contents of the trace elements changed greatly in different sites. The contents of the trace elements ranged 2270-11560 mg kg^{-1} (Ca), 1050-4620 mg kg^{-1} (Mg), 3960-26220 mg kg^{-1} (Fe), 50-418 mg kg^{-1} (Mn) and 19-63 mg kg^{-1} (Zn). The order of the average contents of the trace elements was Ca > Mg > Fe > Zn > Mn in rhizome of *Coptis teeta* and Mg > Ca > Fe > Mn > Zn in root of *Coptis teeta*. The result indicated that the distribution of the trace elements differed in different parts of *Coptis teeta*.

TABLE-2
MEAN, STANDARD DEVIATION, MINIMUM AND MAXIM OF THE TRACE ELEMENT CONTENTS IN SOILS AND RHIZOME AND ROOT OF *Coptis teeta* (mg kg^{-1})

Element	Soil	Rhizome	Root
Ca	5536 ± 3274 2270-11560	2934 ± 500 2495-3877	2310 ± 591 1638-3323
Mg	2240 ± 1317 1050-4620	2895 ± 246 2450-3248	3086 ± 445 2124-3627
Fe	15343 ± 7909 3960-26220	372.0 ± 178.4 168.6-523.3	765.3 ± 446.7 242.7-1478
Mn	169 ± 133 50-418	131.3 ± 38.3 93.4-183	288.6 ± 91.9 153.2-415.9
Zn	34.9 ± 14.0 19-63	313.3 ± 43.8 236.1-364.1	114.7 ± 22.9 77.0-151.1

The correlation analysis of the trace element in soil is tabulated in Table-3. Ca-Fe had significantly positive correlation at the 0.05 level (r = 0.746) and Ca-Mg, Ca-Fe, Ca-Mn, Ca-Zn, Mg-Fe, Mg-Mn, Mg-Zn, Fe-Mn, Fe-Zn, Mn-Zn at the s0.01 level (r = 0.824-0.991) in soil.

TABLE-3
CORRELATION OF THE TRACE ELEMENTS IN SOIL

	Ca	Mg	Fe	Mn	Zn
Ca	1				
Mg	0.824**	1			
Fe	0.746*	0.897**	1		
Mn	0.835**	0.991**	0.892**	1	
Zn	0.809**	0.932**	0.825**	0.906**	1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis of the trace elements between rhizome and root of *Coptis teeta*. is demonstrated in Table-4. The result showed that Ca-Zn had significantly negative correlation at the 0.01 level (r = -0.870) in rhizome of *Coptis teeta*. Mn-Ca, Zn-Ca had significantly negative correlation at the 0.05 level (r = -0.771, -0.753), whereas Zn-Mn had significantly positive correlation at 0.05 level (r = 0.786) in root of *Coptis teeta*. Ca-Ca had significantly positive correlation at 0.01 level (r = 0.9117), Fe-Fe at 0.05 level (r = 0.693) between rhizome and root of *Coptis teeta*.

TABLE-4
CORRELATION OF THE TRACE ELEMENTS BETWEEN RHIZOME AND ROOT OF *Coptis teeta*

	Ca	Mg	Fe	Mn	Zn
Ca	**0.917****	0.265	0.265	-0.771*	-0.753*
Mg	0.131	**0.409**	-0.103	-0.046	-0.225
Fe	0.393	-0.290	**0.693***	-0.420	-0.644
Mn	-0.199	-0.015	-0.315	**0.642**	0.786*
Zn	-0.870**	0.218	-0.523	0.477	**0.644**

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed); Note: The correlation of the trace elements in rhizome of *Coptis teeta* is under the diagonal, in root of *Coptis teeta* is above diagonal and between rhizome and root of *Coptis teeta* is on diagonal.

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