

## Supplementary Information

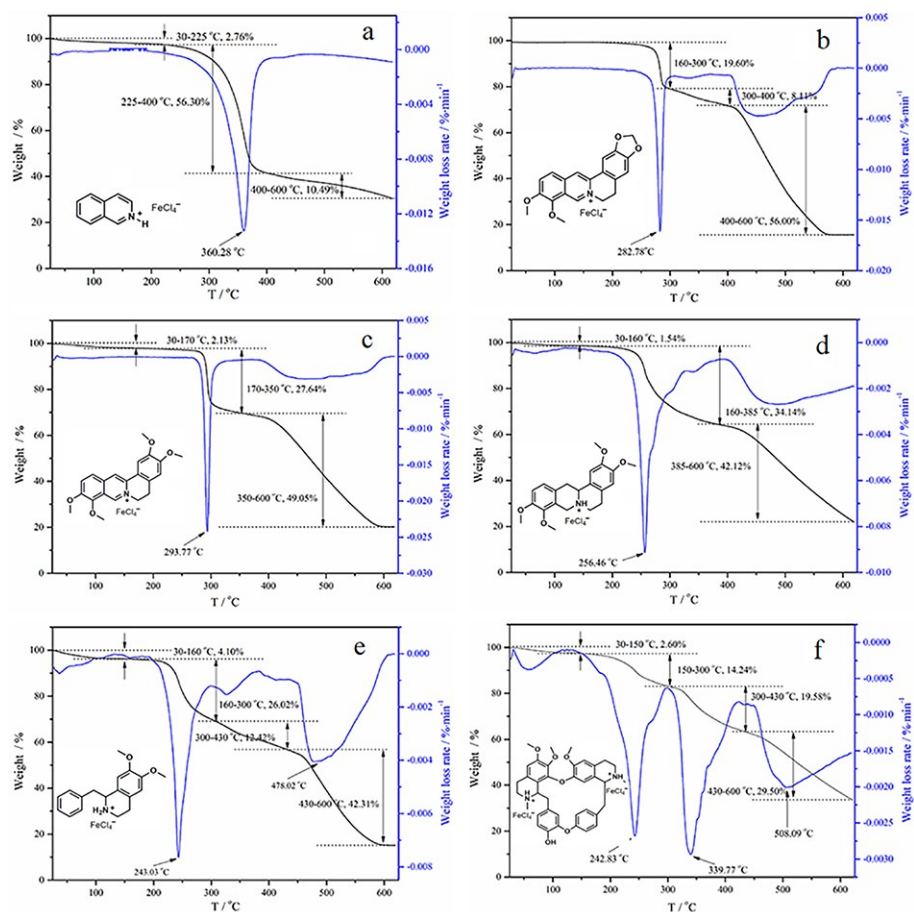
### **A new integrated method of magnetic separation for isoquinoline alkaloids from *Coptis chinensis* based on their magnetized derivates and key physical properties**

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**Fig. S1.** TG/DTG analysis of [isoquin·H][FeCl<sub>4</sub>](a), [berberine][FeCl<sub>4</sub>](b), [palmatine][FeCl<sub>4</sub>](c), [tetrahydropalmatine·H][FeCl<sub>4</sub>](d), [tetrahydropapaverine·H][FeCl<sub>4</sub>](e) and [berbamine·H][FeCl<sub>4</sub>]<sub>2</sub>(f)

**Table S1** Solubility properties of six magnetic compounds in common solvents at room temperature

Solvents	A	B	C	D	E	F
water	+++++	+	+++	++	+++++	+++
methanol	+++++	++	++	++++	+++	+++++
acetonitrile	+++++	+	++	+++++	+++++	+++
ethanol	+++++	+	-	+++	+	++
acetone	+++++	+	++	+++++	+++++	++
chloroform	--	-	-	++	-	--
isopropanol	+++	-	-	+	-	--
ethyl acetate	+++++	-	-	+++++	++	--
n-propanol	++++	-	-	++	++	--
n-butanol	+++	-	-	+	+	--
dichloromethane	+	++	-	++++	+	--
isobutanol	+	-	-	--	+	--
toluene	--	-	-	--	--	--
cyclohexane	--	--	--	--	--	--
n-hexane	--	--	--	--	--	--

Note: A, B, C, D, E and F represent [isoquin-H][FeCl<sub>4</sub>], [berberine][FeCl<sub>4</sub>], [palmatine][FeCl<sub>4</sub>], [tetrahydropalmatine-H][FeCl<sub>4</sub>], [tetrahydropapaverine-H][FeCl<sub>4</sub>] and [berbamine-H][FeCl<sub>4</sub>]<sub>2</sub>, respectively; insoluble (--), practically insoluble (-), very slightly soluble (+), slightly soluble (++), sparingly soluble (+++), soluble (++++), freely soluble (+++++), very soluble (+++++).

**Table S2** Experimental data and computational results of magnetic susceptibility

Current/A	Magnetic field/Oe	$\Delta m_{\text{sample+tube}}/\text{mg}$	$\Delta m_{\text{tube}}/\text{mg}$	$\chi_{\text{ig}} \times 10^5/\text{emu} \cdot \text{g}^{-1}$	$\chi_{\text{g}} \times 10^5/\text{emu} \cdot \text{g}^{-1}$
[isoquin·H][FeCl <sub>4</sub> ](m=0.8935 g, h=6.90 cm)					
1.52	2000	12.2	0.6	5.449	
2.25	3000	27.3	1.1	5.493	
3.01	4000	48.0	2.2	5.401	
3.76	5000	73.7	3.2	5.321	5.366±1.5%
4.53	6000	106.1	4.5	5.325	
5.31	7000	143.7	6.2	5.293	
6.17	8000	187.3	8.2	5.279	
[tetrahydropapaverine·H][FeCl <sub>4</sub> ](m=0.4662 g, h=4.55 cm)					
1.52	2000	5.60	0.4	3.533	
2.25	3000	12.5	0.7	3.563	
3.01	4000	21.8	2.0	3.363	
3.76	5000	34.1	3.6	3.315	3.392±3.2%
4.53	6000	49.0	5.0	3.321	
5.31	7000	66.4	6.8	3.305	
6.17	8000	87.2	8.5	3.342	
[tetrahydropalmatine·H][FeCl <sub>4</sub> ](m=0.7357 g, h=6.50 cm)					
1.52	2000	6.70	0.2	3.428	
2.25	3000	14.9	0.5	3.386	
3.01	4000	26.5	1.3	3.353	
3.76	5000	41.6	2.5	3.352	3.345±1.5%
4.53	6000	59.2	3.9	3.316	
5.31	7000	80.5	5.6	3.296	
6.17	8000	105.0	7.9	3.287	
[palmatine][FeCl <sub>4</sub> ](m=0.2500 g, h=4.65 cm)					
1.52	2000	2.8	0.5	2.895	
2.25	3000	6.4	1.3	2.853	
3.01	4000	10.9	2.4	2.674	
3.76	5000	16.8	3.5	2.678	2.703±4.5%
4.53	6000	23.5	4.9	2.601	
5.31	7000	31.7	6.3	2.609	
6.17	8000	41.3	8.1	2.611	
[berberine][FeCl <sub>4</sub> ](m=0.4651 g, h=7.50 cm)					
1.52	2000	2.8	0.3	2.483	
2.25	3000	6.5	1.1	2.384	
3.01	4000	11.5	1.8	2.396	
3.76	5000	17.9	3.1	2.352	2.386±2.0%
4.53	6000	25.7	4.3	2.361	
5.31	7000	35.8	6.3	2.392	
6.17	8000	45.9	8.3	2.334	
[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub> (m=0.7834 g, h=6.90 cm)					
1.52	2000	4.0	0.2	2.061	
2.25	3000	8.8	0.5	2.001	
3.01	4000	16.2	1.3	2.021	
3.76	5000	25.8	2.5	2.022	2.021±1.0%
4.53	6000	37.6	3.9	2.031	
5.31	7000	50.9	5.6	2.006	
6.17	8000	67.0	7.9	2.004	

**Table S3** Adsorbed mass of magnetic compounds with different particle-size on the unit area of the magnet (375.7 mT, 25°C)

Magnetic compounds	Average particle size*/mm	Adsorbed mass/g	g/m <sup>2</sup>	mol/m <sup>2</sup>
[isoquin·H][FeCl <sub>4</sub> ]	0.180	0.0241	1228	3.746
	0.150	0.0412	2099	6.404
	0.106	0.0850	4331	13.21
	0.075	0.1311	6680	20.38
[tetrahydropapaverine·H][FeCl <sub>4</sub> ]	0.180	0.0280	1427	2.632
	0.150	0.0462	2354	4.343
	0.106	0.0893	4550	8.394
	0.075	0.1423	7251	13.38
[tetrahydropalmatine·H][FeCl <sub>4</sub> ]	0.180	0.0190	968.2	1.747
	0.150	0.0346	1763	3.182
	0.106	0.0574	2976	5.371
	0.075	0.0943	4428	7.992
[palmatine][FeCl <sub>4</sub> ]	0.180	0.0123	626.8	1.139
	0.150	0.0148	754.1	1.371
	0.106	0.0197	1004	1.825
	0.075	0.0243	1238	2.251
[berberine][FeCl <sub>4</sub> ]	0.180	0.0090	458.6	0.859
	0.150	0.0118	601.3	1.126
	0.106	0.0152	772.5	1.447
	0.075	0.0208	1060	1.985
[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub>	0.180	0.0149	759.2	0.755
	0.150	0.0188	958.0	0.952
	0.106	0.0237	1208	1.200
	0.075	0.0316	1610	1.601

\*0.180 mm corresponds to 80~100 mesh; 0.150 mm corresponds to 100~150 mesh; 0.106 mm corresponds to 150~200 mesh; 0.075 mm corresponds to 200 mesh; average error range: ±6.0%.

**Table S4** Adsorption mass of magnetic compounds on the unit area of the magnet at different magnetic field intensities (100-150 mesh, 0.150 mm, 25°C, average error range:  $\pm 5.5\%$ )

Magnetic field/mT	Magnetic compounds	Adsorption mass/g	g/m <sup>2</sup>	mol/m <sup>2</sup>
337.5	[isoquin·H][FeCl <sub>4</sub> ]	0.0304	1549	4.725
	[tetrahydropapaverine·H][FeCl <sub>4</sub> ]	0.0336	1712	3.158
	[tetrahydropalmatine·H][FeCl <sub>4</sub> ]	0.0219	1116	2.014
	[palmatine][FeCl <sub>4</sub> ]	0.0117	596.2	1.084
	[berberine][FeCl <sub>4</sub> ]	0.0087	443.3	0.830
	[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub>	0.0159	810.2	0.805
373.5	[isoquin·H][FeCl <sub>4</sub> ]	0.0435	2217	6.762
	[tetrahydropapaverine·H][FeCl <sub>4</sub> ]	0.0469	2390	4.408
	[tetrahydropalmatine·H][FeCl <sub>4</sub> ]	0.0338	1722	3.108
	[palmatine][FeCl <sub>4</sub> ]	0.0149	759.2	1.380
	[berberine][FeCl <sub>4</sub> ]	0.0117	596.2	1.116
	[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub>	0.0186	947.8	0.942
390.2	[isoquin·H][FeCl <sub>4</sub> ]	0.0517	2634	8.036
	[tetrahydropapaverine·H][FeCl <sub>4</sub> ]	0.0564	2873	5.302
	[tetrahydropalmatine·H][FeCl <sub>4</sub> ]	0.0428	2181	3.936
	[palmatine][FeCl <sub>4</sub> ]	0.0165	840.8	1.529
	[berberine][FeCl <sub>4</sub> ]	0.0131	667.5	1.250
	[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub>	0.0214	1090	1.084
424.4	[isoquin·H][FeCl <sub>4</sub> ]	0.0645	3287	10.03
	[tetrahydropapaverine·H][FeCl <sub>4</sub> ]	0.0726	3699	6.824
	[tetrahydropalmatine·H][FeCl <sub>4</sub> ]	0.0581	2961	5.343
	[palmatine][FeCl <sub>4</sub> ]	0.0182	927.4	1.686
	[berberine][FeCl <sub>4</sub> ]	0.0148	754.1	1.412
	[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub>	0.0259	1320	1.312

**Table S5** Adsorption mass of magnetic compounds based on the unit area of the magnet at different temperature (100~150 mesh, 0.150 mm, 375.7 mT, average error range:  $\pm 5.8\%$ )

T	Magnetic compounds	Adsorption mass/g	g/m <sup>2</sup>	mol/m <sup>2</sup>
25°C	[isoquin·H][FeCl <sub>4</sub> ]	0.0412	2099	6.404
	[tetrahydropapaverine·H][FeCl <sub>4</sub> ]	0.0462	2354	4.343
	[tetrahydropalmatine·H][FeCl <sub>4</sub> ]	0.0346	1763	3.182
	[palmatine][FeCl <sub>4</sub> ]	0.0148	754.2	1.371
	[berberine][FeCl <sub>4</sub> ]	0.0118	601.3	1.126
	[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub>	0.0188	958.0	0.952
-20°C	[isoquin·H][FeCl <sub>4</sub> ]	0.4529	2308	70.39
	[tetrahydropapaverine·H][FeCl <sub>4</sub> ]	0.4861	2477	45.69
	[tetrahydropalmatine·H][FeCl <sub>4</sub> ]	0.3905	1990	35.91
	[palmatine][FeCl <sub>4</sub> ]	0.2435	1241	22.56
	[berberine][FeCl <sub>4</sub> ]	0.1764	8988	16.83
	[berbamine·H][FeCl <sub>4</sub> ] <sub>2</sub>	0.2956	1506	14.97