

Supplementary materials

1. LC-MS method

The LC method employed a Waters ACQUITY UPLC HSS T3 (2.1 mm×100 mm, 1.8 μm) equipped with an online filter and maintained at 40°C. Peaks were separated using a mobile phase of 0.1% formic acid water and acetonitrile with a gradient program at a flow rate of 0.2 mL/min. The optimum ion source parameters were as follows: ESI source temperature, 300 °C; spray voltage, 3525.4 V; sheath gas pressure, 35 psi; auxiliary gas pressure, 10 psi. Mass spectra of carotenoids were acquired with an m/z 100-1500 scan range. Mass spectra of carotenoids were acquired with an m/z 100-1500 scan range.

The gradient program as follows:

Times/S	0.1% formic acid (%)	Acetonitrile (%)
0	5.0	95.0
2	10.0	90.0
5	17.0	83.0
8	18.0	82.0
10	23.0	77.0
14	30.0	70.0
17	38.0	62.0
20	90.0	10.0
22	90.0	10.0
23	5.0	95.0

Table S1 chemical constituents identified in extracts form licorice

No.	Time (min)	Negative ions (m/z)		Positive ions (m/z)		Identification
		[M-H] ⁻	MS ²	[M+H] ⁺	MS ²	
1	7.48	579.1735	417.1204[M-H-glc] ⁻ , 255.0669[M-H-2glc] ⁻	-	-	Glucoliquiritin (Liquiritigenin -7,4'-diglucoside)
2	7.74	425.2528	221.1544	423.2216	-	Kanzonol H
3	9.16	563.1423	-	565.1586	403.0819[M+H-glc] ⁺ , 271.9175[M+H-api-glc] ⁺	Schaftoside
4	10.49	577.1581	485.1078[M-H-C ₆ H ₄ O] ⁻ , 473.8525, 383.8653	579.1732	-	Isoviolanthin
5	10.75	549.1631	417.1216[M-H-api] ⁻ , 255.0669[M-H-api-glc] ⁻ , 135.0084	551.1767	419.1351[M+H-api] ⁺ , 257.0818[M+H-api-glc] ⁺	Liquiritin apioside
6	10.91	417.1203	255.0669[M-H-glc] ⁻ , 135.0084, 119.0497	419.1365	257.0820[M+H-glc] ⁺ , 239.0711, 211.0764, 163.0398	Liquiritin
7	12.92	593.0906	-	595.6331	-	Vicenin-2
8	13.84	549.1631	255.0669[M-H-api-glc] ⁻ , 135.0084	551.1767	419.1348[M+H-api] ⁺ , 257.0820[M+H-api-glc] ⁺ , 239.0712,	Isoliquiritin apioside
9	14.36	417.1202	255.0668[M-H-glc] ⁻ , 135.0084	419.136	257.0818[M+H-glc] ⁺ , 137.0239	Isoliquiritin
10	15.61	255.0669	-	257.0819	137.024[M+H-120] ⁺ ,	Liquiritigenin
11	15.69	475.9218	-	431.1352	269.0820[M+H-glc] ⁺	Ononin

			[M+HCOO] ⁻				
12	17.34	725.2108	549.1630[M-H-C ₁₀ H ₃ O ₈] ⁻ , 399.1095[M-H-api-H ₂ O] ⁻ , 255.0668[M-H-C ₁₀ H ₃ O ₈ -api-glc] ⁻	727.2234	-		Licorice glycoside A
13	18.08	821.3987	351.0578[2×C ₆ H ₈ O ₆ -H] ⁻ ,	845.3964 823.4145	845.3964[M+Na] ⁺ , 647.3818[M+H-glucuronide acid] ⁺ , 471.3488[M+H-glucuronide acid ×2] ⁺ , 453.3383		Uralsaponin B
14	19.23	879.4048	351.0580[2×C ₆ H ₈ O ₆ -H] ⁻ ,	881.4197	705.3868[2×C ₆ H ₈ O ₆ -H] ⁺ , 511.3441[M+H-C ₆ H ₈ O ₆ -C ₆ H ₁₀ O ₇] ⁺ , 487.3439		22β-Acetoxyglycyrrhizic acid
15	19.47	837.3937	-	839.4088	469.3335[M+H-C ₆ H ₈ O ₆ -C ₆ H ₁₀ O ₇] ⁺ , 663.3768[M+H-glucuronide acid] ⁺ ,		Yunganoside K ₂
16	20.21	837.3937	-	839.4088	487.3438[M+H-glucuronide acid ×2] ⁺ , 469.3334[487-H ₂ O] ⁺ ,		Licorice saponin G ₂ (24-hydroxyglycyrrhizin)
17	20.22	839.409	-	841.4251	471.3494, 141.0189		Yunganoside G ₂
18	20.37	837.3937	-	839.4088	663.3768[M+H-glucuronide acid] ⁺ , 487.3438[M+H-glucuronide acid ×2] ⁺ , 469.3334[487-H ₂ O] ⁺ ,		Isomer of Licorice saponin G ₂
19	20.54	821.3992	759.4034[M-H-CO ₂ -H ₂ O] ⁻ , 351.0581[2×C ₆ H ₈ O ₆ -H] ⁻ ,	823.4136	647.3814[M+H-glc] ⁺ , 453.3380[M+H-C ₆ H ₈ O ₆ -C ₆ H ₁₀ O ₇] ⁺ ,		Glycyrrhizin isomer
20	21.03	823.4055	-	825.4302	649.3898[M+H-glucuronide acid] ⁺ , 473.3680[M+H-glucuronide acid ×2] ⁺ ,		Licorice saponin J ₂

21	21.36	367.1197	309.0416[M-H-C ₄ H ₁₀]; 297.0408[M-H-C ₅ H ₁₀];	369.1348	455.3537[487-H ₂ O] ⁺ ,	-	Glycycomarin
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Note: The compound identification was performed by the literature ^{1,2} data and chemical databases.

Reference

1. M. He, H. Y. Lv, Y. P. Li, C. M. Gonçalves, N. P. Dong, L. S. Pan, P. L. Liu, Y. Z. Liang, *Analytical Methods*, 2014, **6**, 2239-2246.
2. Y. M. Zhao, S. X. Liu, C. X. Zhang, D. L. Liu, T. J. Zhang, *Chinese Traditional & Herbal Drugs*, 2016, **47**, 2061-2068.

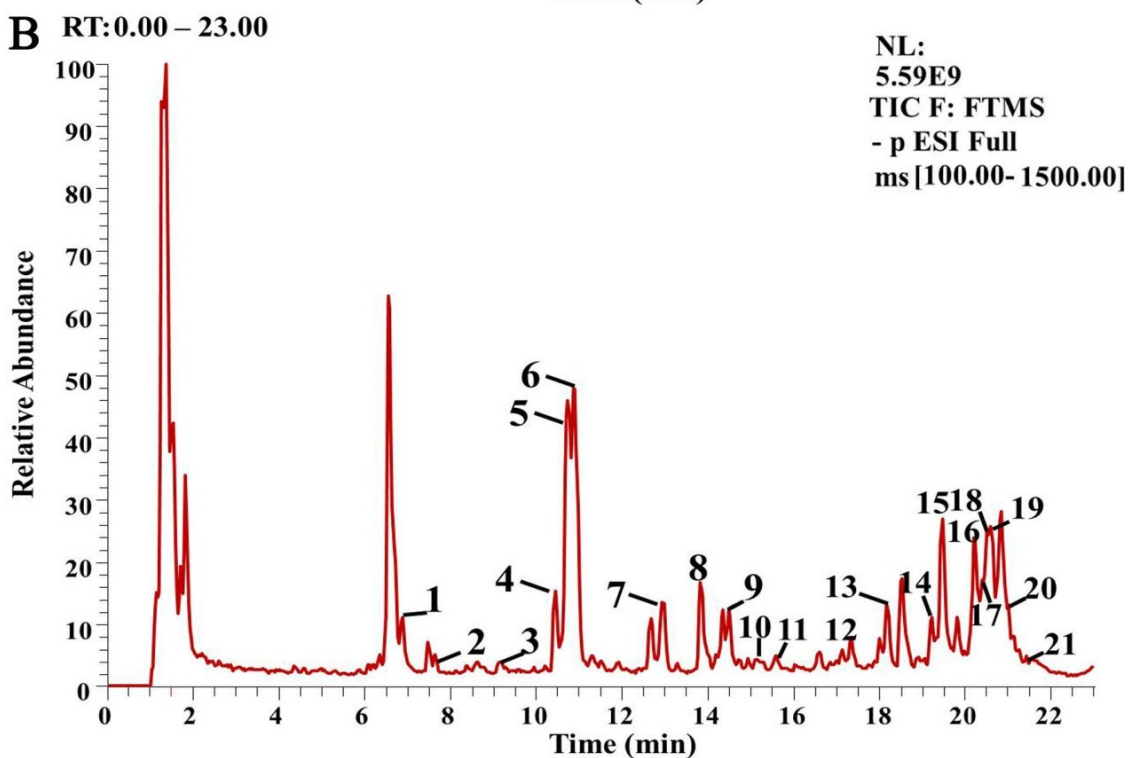
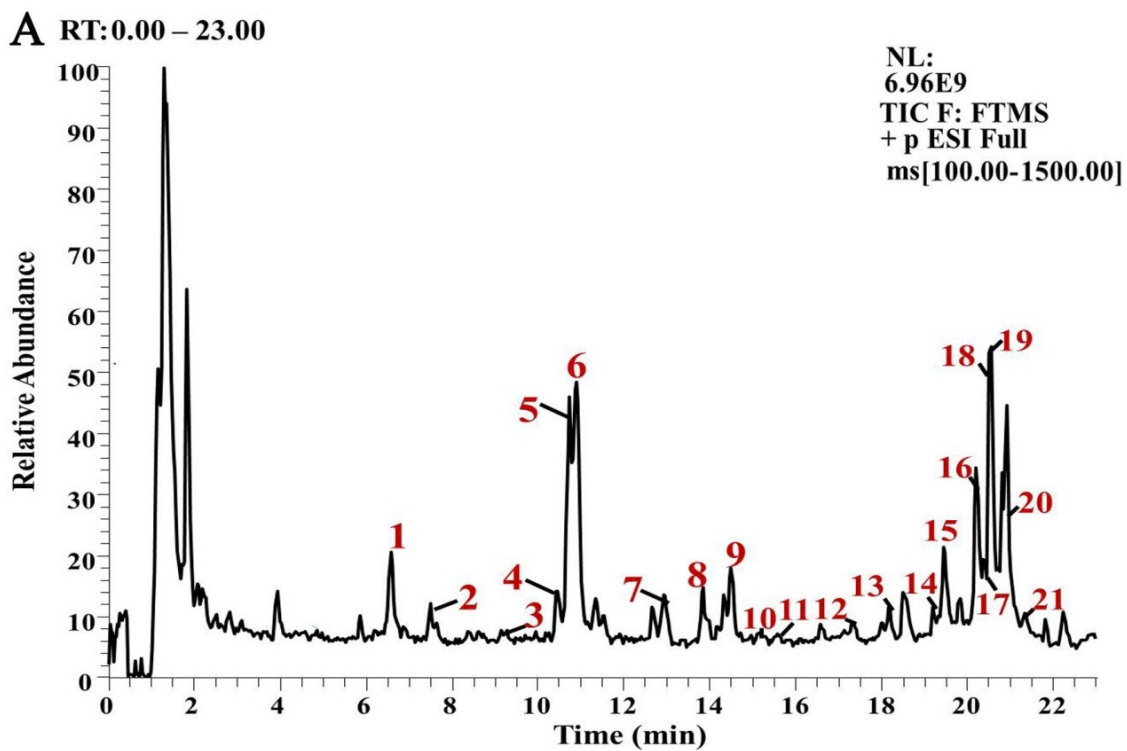


Fig.S1 Total ion chromatograms of HPLC-Q-TOF-MS by positive mode (A) and negative mode (B) for extraction of licorice.