

Feature-Based Molecular Networking for the Exploration of the Metabolome Diversity of Common Egyptian *Centaurea* Species in Relation to Their Cytotoxic Activity

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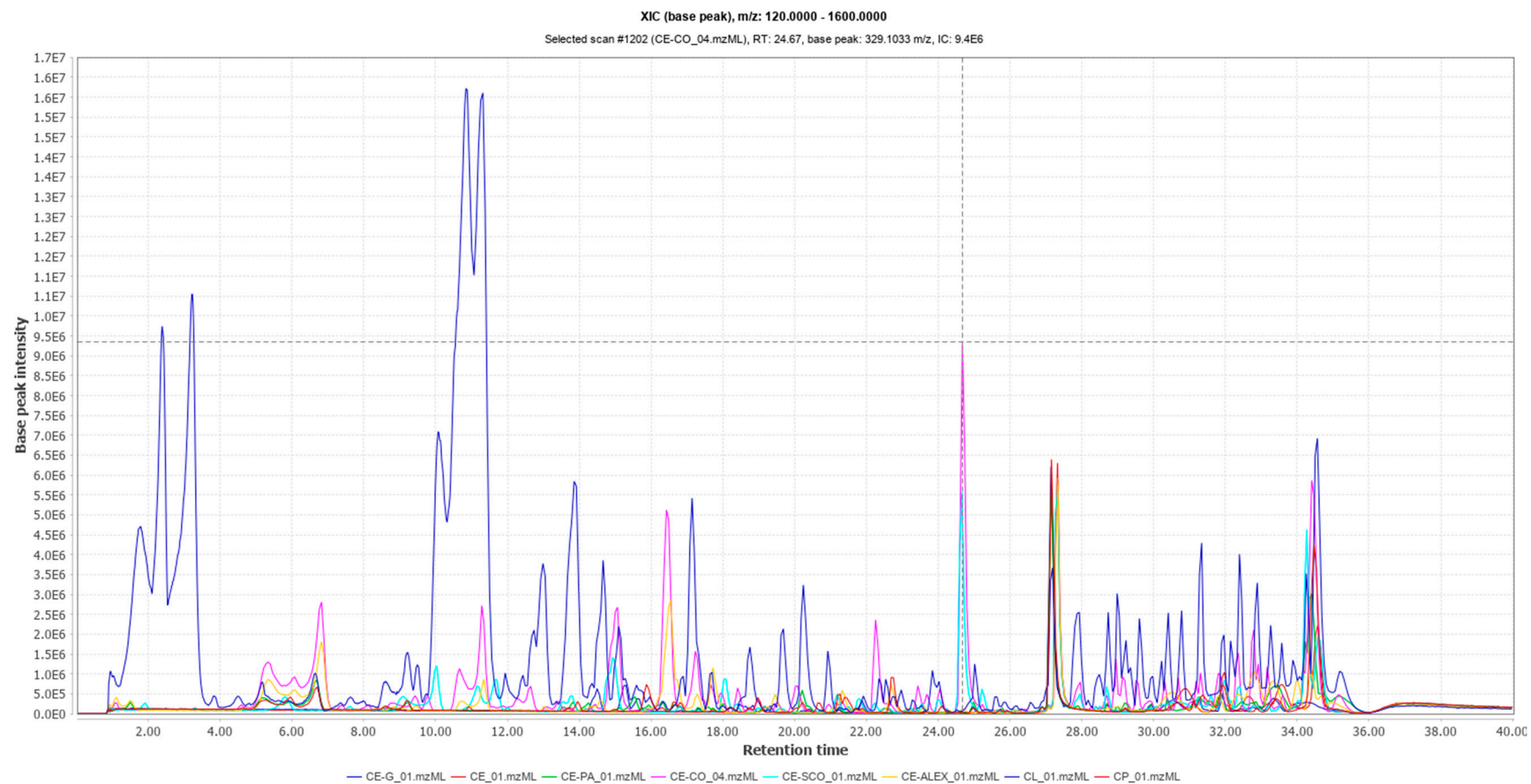
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Supplementary Data

Supplementary Figure S1: Overlaid base peak chromatogram of the studied *Centaurea* species in the positive ionization mode.



Supplementary Table S1: Compound assignment of the studied *Centaurea* species extracts as revealed by UPLC-HRMS/MS analysis. Ce: *C. eryngioides* Ca: *C. alexandrina*, CC: *C. calcitrapa*, Cg: *C. glomerata*, Cpa: *C. pallescens*, Cs: *C. scoparia*, Cl: *C. lipii*, and Cpu: *C. pumilio*.

No.	Class	RT	<i>m/z</i> , adduct	MS ²	Compound name	Molecular formula, error (ppm)	References	Ce	Ca	Cc	Cg	Cpa	Cs	Cl	Cpu
1	Cinnamic acid ester	8.97	369.1179 [M+H] ⁺	177, 145, 117	Feruloylquinic acid ^a	C ₁₉ H ₂₀ O ₉ (0.59)	11, GNPS libraries	-	-	+	+	-	+	+	-
2	Germacranolide sesquiterpene lactone glycoside	9.7	446.2385 [M+NH ₄] ⁺	231, 203, 185, 175, 157, 147	Dihydroparthenolide -O- hexoside isomer I ^b	C ₂₁ H ₃₂ O ₉ 0.08	31	+	-	+	-	-	-	-	-
3	Coumarin	10.33	193.0499 [M+H] ⁺	161, 150	Scopoletin/ isoscopoletin ^a	C ₁₀ H ₈ O ₄ (0.44)	32,33	-	+	-	-	-	-	-	-
4	Coumarin	10.65	193.0497 [M+H] ⁺	161, 150	Scopoletin/ isoscopoletin ^a	C ₁₀ H ₈ O ₄ (0.88)	32,33	-	+	-	-	-	-	-	-
5	Germacranolide sesquiterpene lactone	11.07	436.1966 [M+ C ₂ H ₃ N+H] ⁺	102, 74, 56	7-hydroxy-10-(hydroxymethyl)-6-methyl-3-methylidene-2-oxo--cyclodeca[b]furan-4-y-3,4-dihydroxy-2-methylidenebutanoate ^a	C ₂₀ H ₂₆ O ₈ (0.84)	34	-	-	-	-	-	-	+	-

6	Germacranolid e sesquiterpene lactone glycoside	11.37	446.2380 [M+NH ₄] ⁺	231, 203, 185, 175, 157, 147	Dihydroparthenolide -O- hexoside isomer II ^b	C ₂₁ H ₃₂ O ₉ (0.08)	31	+	-	+	-	-	-	-	-
7	Germacranolid sesquiterpen e lactone	11.56	464.2252 [M+ C ₂ H ₃ N +H] ⁺	316, 128, 102, 84	10-(hydroxymethyl)- 3,6-dimethyl-2-oxo- cyclodeca[b]furan-4- yl -4-(acetyloxy)-2- (hydroxymethyl)but- 2-enoate ^a	C ₂₂ H ₃₀ O ₈ (0.22)	35	-	-	-	-	-	-	+	-
8	Cadinanolides sesquiterpene lactone	11.63	382.2220 [M+ C ₂ H ₃ N+H] ⁺	336, 296, 296, 268, 250, 232, 130, 102, 84	acetoxy-dihydroxy- tetrahydro- artemisinic acid methyl ester ^b	C ₁₈ H ₂₈ O ₆ (0.05)	36	-	+	+	+	+	+	+	+
9	Flavonoid-O- glycoside	11.71	671.18 [M+H] ⁺	347, 332, 197, 193, 145	Spinacetin-O- gentiobioside ^b	C ₂₉ H ₃₄ O ₁₈ (0.07)	37	-	+	-	-	+	-	-	-
10	Germacranolid sesquiterpen e lactone	12.04	462.1227 [M+ C ₂ H ₃ N +H] ⁺	220, 174, 128	4-acetylcnicin ^a	C ₂₂ H ₂₈ O ₈ (1.00)	38	-	-	-	-	-	-	+	-

11	Germacranolide e sesquiterpene lactone	12.58	496.2529 [M+ C ₂ H ₃ N +H] ⁺	450, 318, 130, 102, 84	incaspitolide D ^b	C ₂₃ H ₃₄ O ₉ (-0.53)	39	-	-	+	-	-	-	-	-
12	Flavonoid -C- glycoside	13.80	433.1135 [M+H] ⁺	313, 283	(iso)vitexin ^a	C ₂₁ H ₂₀ O ₁₀ (0.01)	40	-	-	-	+	+	-	+	-
13	Flavonoid -O- glycoside	13.83	495.1129 [M+H] ⁺	333, 318	Patuletin-O- glucoside, isomer I ^a	C ₂₂ H ₂₂ O ₁₃ (0.25)	41	-	+	-	+	+	-	+	+
14	Lignans	13.97	538.2286 [M+NH ₄] ⁺	359, 341, 323, 291, 163, 137	Matairesinol -O- glucoside ^a	C ₂₆ H ₃₂ O ₁₁ (0.25)	42	-	+	-	-	-	-	+	+
15	Flavonoid -O- glycoside	14.30	495.1133 [M+H] ⁺	333, 318, 287	Patuletin -O- glucoside isomer II ^a	C ₂₂ H ₂₂ O ₁₃ (0.04)	43	-	+	-	-	+	+	-	-
16	Flavonoid -O- glycoside	14.58	595.1663 [M+H] ⁺	287, 205	Luteolin-7-O- rutinoside ^a	C ₂₇ H ₃₀ O ₁₅ (0.86)	44	+	+	+	-	-	-	-	-
17	Flavonoid -O- glycoside	14.60	495.1137 [M+H] ⁺	333, 318	Patuletin-O- glucoside, isomer III ^a	C ₂₂ H ₂₂ O ₁₃ (0.48)	41	-	+	+	+	+	+	-	-
18	Flavonoid -O- glycoside	14.65	449.1082 [M+H] ⁺	432, 287, 269	Luteolin-7-O- glucoside ^a	C ₂₁ H ₂₀ O ₁₁ (-0.94)	45	-	+	+	+	-	+	+	-
19	Flavonoid -O- glycoside	14.69	479.1185 [M+H] ⁺	317, 302,	Isorhamnetin -O- glucoside ^a	C ₂₂ H ₂₂ O ₁₂ (-0.07)	46	-	-	+	+	+	+	+	-

				257, 165											
20	Cinnamic acid amides	14.73	314.1388 [M+H] ⁺	177, 145, 121	N-Feruloyl tyramine isomer I ^b	C ₁₈ H ₁₉ O ₄ (-1.56)	47, GNPS	+	+	+	-	-	+	-	+
21	Lignans	14.84	552.2282 [M+NH ₄] ⁺	373, 355, 337, 323, 305, 295, 237, 219, 201, 137	Arctiin / Arctigenin- O-glucoside isomer I ^a	C ₂₇ H ₃₄ O ₁₁ (0.09)	42,48	-	+	-	-	-	+	-	+
22	Guaianolides sesquiterpene lactone	14.85	472.2333 [M+ C ₂ H ₃ N+H] ⁺	228, 210, 182, 128	Daucoguaianolactone F ^b	C ₂₄ H ₃₀ O ₇ (0.24)	49	-	-	-	-	-	-	+	-
23	Guaianolides sesquiterpene lactone	14.89	432.2012 [M+ C ₂ H ₃ N +H] ⁺	227, 209, 199, 183, 98	8-(acetyloxy)-9- hydroxy-9- (hydroxymethyl)-3,6- dimethylidene-2-oxo- octahydroazuleno[4,5 -b]furan-4-yl 2- (hydroxymethyl)prop -2-enoate ^a	C ₂₁ H ₂₆ O ₇ (-0.11)	50	-	-	-	-	-	-	+	-
24	Flavonoid -O- glycoside	14.99	477.1029 [M+H] ⁺	301, 286	Hispidulin-7-O- glucuronide isomer I ^a	C ₂₂ H ₂₀ O ₁₂ (-1.11)	51	-	+	-	+	+	-	+	+

25	Flavonoid -O-glycoside	15.14	509.1289 [M+H] ⁺	347, 332, 317	Spinacetin -O-glucoside isomer I ^a	C ₂₃ H ₂₄ O ₁₃ (-1.48)	52	-	+	-	-	+	-	-	-
26	Flavonoid -O-glycoside	15.23	581.1502 [M+H] ⁺	287, 269	Luteolin-O-pentosyl – hexoside ^b	C ₂₆ H ₂₈ O ₁₅ (-0.23)	Öztürk et al., 2019	-	+	-	-	-	+	-	-
27	Flavonoid -O-glycoside	15.39	479.1185 [M+H] ⁺	317, 302, 274, 229	Isorhamnetin -O-glucoside isomer I ^a	C ₂₂ H ₂₂ O ₁₂ (-0.7)	46	-	+	-	+	+	-	+	+
28	Lignans	15.52	582.2568 [M+NH ₄] ⁺	385, 353, 267, 207	Acetyl matairesinoside, Yunnanensin B ^b	C ₂₈ H ₃₆ O ₁₂ (0.86)	53	-	-	-	-	-	-	+	-
29	Lignans	15.62	552.2438 [M+NH ₄] ⁺	373, 355, 337, 323, 305, 295, 237, 219, 201, 137	Arctiin / Arctigenin-O-glucoside isomer II ^a	C ₂₇ H ₃₄ O ₁₁ (0.09)	42,48	-	+	+	+	+	-	+	+
30	Flavonoid -O-glycoside	15.71	477.1029 [M+H] ⁺	301, 286	Hispidulin-O-glucuronide isomer II ^a	C ₂₂ H ₂₀ O ₁₂ (-1.11)	51	-	-	-	-	-	-	-	+

31	Flavonoid -O-glycoside	15.77	447.0927 [M+H] ⁺	271	Apigenin -O-glucuronide isomer I ^a	C ₂₁ H ₁₈ O ₁₁ (-0.6)	51	-	-	+	-	+	-	+	+
32	Lignans	15.81	327.1594 [M+H] ⁺	163, 137	Secoisolariciresinol ^b	C ₂₀ H ₂₂ O ₄ (0.84)	54	-	+	+	-	+	+	+	-
33	Flavonoid -O-glycoside	15.87	447.0934 [M+H] ⁺	271	Apigenin -O-glucuronide isomer II ^a	C ₂₁ H ₁₈ O ₁₁ (2.74)	51	+	+	+	+	+	-	+	+
34	Flavonoid -O-glycoside	15.90	463.1240 [M+H] ⁺	301, 286	monomethoxy trihydroxyflavone - O-glucoside isomer I ^a	C ₂₂ H ₂₂ O ₁₁ (-0.95)	55	-	+	-	+	+	-	+	+
35	Cinnamic acid amides	15.95	314.1385 [M+H] ⁺	177, 145, 121	N-feruloyl tyramine isomer II ^b	C ₁₈ H ₁₉ NO ₄ (0.15)	47, GNPS libraries	-	-	-	+	+	-	+	+
36	Flavonoid -O-glycoside	16.18	433.1132 [M+H] ⁺	271	Apigenin-O-hexoside ^a	C ₂₁ H ₂₀ O ₁₀ (-0.51)		-	+	+	-	-	-	-	-
37	Flavonoid -O-glycoside	16.38	479.1191 [M+H] ⁺	317, 302, 257, 165	Isorhamnetin -O-glucoside isomer II ^a	C ₂₂ H ₂₂ O ₁₂ (-0.11)	46	-	+	-	-	-	-	-	-
38	Guaianolides sesquiterpene lactone glycoside	16.38	464.1936 [M+C ₂ H ₃ N+H] +	220, 202, 181	Dehydrolactuside C ^b	C ₂₁ H ₂₆ O ₉ (3.19)	56	-	-	-	-	-	-	+	-
39	Lignans	16.46	552.2438 [M+NH ₄] ⁺	373, 355, 337,	Arctiin / Arctigenin-O-glucoside isomer III ^a	C ₂₇ H ₃₄ O ₁₁ (0.09)	42,48	-	+	-	-	-	-	-	-

				323, 305, 295, 237, 219, 201, 137												
40	Flavonoid -O-glycoside	16.67	509.1298 [M+H] ⁺	347	Spinacetin -O-glucoside isomer II ^a	C ₂₃ H ₂₄ O ₁₃ (-1.6)	52	+	+	+	+	+	+	-	-	
41	Flavonoid -O-glycoside	16.73	493.1342 [M+H] ⁺	331, 316	Trihydroxy-dimethoxy-flavone - O-glucoside isomer I /Jaceoside ^a	C ₂₃ H ₂₄ O ₁₂ (-0.96)	57	-	-	+	+	+	+	+	+	
42	Flavonoid -O-glycoside	16.84	463.1235 [M+H] ⁺	301, 286, 255	monomethoxy trihydroxyflavone - O-glucoside isomer II ^a	C ₂₂ H ₂₂ O ₁₁ (-1.59)	58	-	+	+	+	+	+	-	-	
43	Flavonoid -O-glycoside	16.86	523.1451 [M+H] ⁺	361, 346, 328	Trimethoxy trihydroxyflavone-O-glucoside isomer I (Centaurein) ^a	C ₂₄ H ₂₆ O ₁₃ (0.3)	59	-	-	-	-	+	-	-	-	
44	Germacranolides sesquiterpene lactone	17.33	480.2583 [M+C ₂ H ₃ N +H] ⁺	434, 318, 130, 102, 84	incaspitolide A ^b	C ₂₃ H ₃₄ O ₈ (-0.2)	60	-	-	+	-	-	-	-	-	
45	Acylated flavonoid -O-glycoside	17.57	537.1239 [M+H] ⁺	333, 318, 301,	Pentahydroxy - monomethoxy flavone -O-acetyl	C ₂₄ H ₂₄ O ₁₄ (-0.05)	GNPS libraries	-	-	-	t	+	-	-	-	

	flavonoid -O-glycoside		[M+H] ⁺		glucuronide ^a	(0.62)											
53	Lignans	18.49	373.1637 [M+H] ⁺	305, 291, 274, 246, 177, 151, 137	[(dimethoxyphenyl methyl)-3- [(hydroxy-methoxyphenyl) methyl]- tetrahydrofuranone/ Arctigenin ^a	C ₂₁ H ₂₄ O ₆ (0.39)	63	-	+	-	+	+	+	+	+	+	+
54	Flavonoids	18.74	317.0657 [M+H] ⁺	302, 274, 257	Quercetin methyl ether isomer I ^a	C ₁₆ H ₁₂ O ₇ (1.16)	66	-	+	+	+	+	+	+	+	+	+
55	Lignans	18.98	390.1914 [M+NH ₄] ⁺	291, 235, 177, 151, 137	[(dimethoxyphenyl methyl)-3- [(hydroxy-methoxyphenyl) methyl]- tetrahydrofuranone ^a	C ₂₁ H ₂₇ O ₆ (-1.11)	63	-	-	-	+	+	-	+	+	+	
56	Acylated flavonoid -O-glycoside	19.01	491.1192 [M+H] ⁺	301, 286	Luteolin-O-acetyl hexoside ^b	C ₂₃ H ₂₂ O ₁₂ (1.06)	67	-	-	-	-	-	-	-	-	-	+
57	Acylated flavonoid -O-glycoside	19.15	521.1291 [M+H] ⁺	317, 302, 274	Isorhamnetin -O-acetyl hexoside ^b	C ₂₄ H ₂₄ O ₁₃ (0.79)	68, GNPS libraries	-	+	+	+	+	+	+	+	+	-
58	Acylated flavonoid -O-glycoside	19.12	551.1389 [M+H] ⁺	347, 332	Syringetin O-acetyl hexoside ^b	C ₂₅ H ₂₆ O ₁₄ (-0.94)	69	-	-	-	+	-	-	-	-	-	-

59	Lignans	19.38	373.1651 [M+H] ⁺	291, 235, 177, 151, 137	[(dimethoxyphenyl) methyl]-3- [(hydroxy- methoxyphenyl) methyl]- tetrahydrofuranone / Arctigenin (Isomer II) ^a	C ₂₁ H ₂₄ O ₆ (-1.65)	63	-	+	+	+	+	+	+	+	-
60	Flavonoids	19.67	287.0550 [M+H] ⁺	269, 241, 153, 135	Luteolin ^a	C ₁₅ H ₁₀ O ₆ (0.42)	70 GNPS libraries	-	+	-	-	-	-	-	-	+
61	Flavonoids	19.86	317.0658 [M+H] ⁺	302, 274, 257	quercetin methyl ether ^a	C ₁₆ H ₁₂ O ₇ (- 0.9)	71	-	+	-	+	+	+	+	+	+
62	Flavonoids	20.02	375.1079 [M+H] ⁺	359, 342, 317, 299	Quercetagenin tetramethyl ether ^a	C ₁₉ H ₁₈ O ₈ (0.26)	72	-	-	-	-	-	-	-	+	+
63	Flavonoids	20.06	331.0819 [M+H] ⁺	316, 301, 275	Trihydroxy- dimethoxyflavone isomer II ^a	C ₁₇ H ₁₄ O ₇ (-0.19)	73,74	-	-	-	-	-	-	-	+	+
64	Flavonoids	20.27	301.0705 [M+H] ⁺	286, 258, 168	Trihydroxy- monomethoxyflavon e (Isomer I) / Hispidulin ^a	C ₁₆ H ₁₂ O ₆ (0.44)	51	+	+	+	+	+	+	+	+	+

65	Flavonoids	20.33	361.0918 [M+H] ⁺	346, 331, 303, 269	Trihydroxy- trimethoxyflavone (Isomer I) isomer ^a	C ₁₈ H ₁₆ O ₈ (-0.44)	43,75, GNPS libraries	-	+	+	+	+	-	+	+
66	Cinnamic acid amides	20.37	337.1563 [M+H] ⁺	177, 145, 117	<i>N</i> -feruloyl tryptamine ^b	C ₂₀ H ₂₀ N ₂ O ₃ (2.7)	47	-	+	-	-	-	-	-	-
67	Flavonoids	20.81	317.0657 [M+H] ⁺	302, 274	Quercetin methyl ether isomer II ^a	C ₁₆ H ₁₂ O ₇ (1.06)	66	-	+	-	-	-	-	-	-
68	Flavonoids	20.94	361.0917 [M+H] ⁺	346, 331, 303, 269	Trihydroxy- trimethoxyflavone isomer II ^a	C ₁₈ H ₁₆ O ₈ (1.09)	43	-	+	+	+	-	-	+	+
69	Flavonoids	21.16	301.0711 [M+H] ⁺	286, 258, 168	Trihydroxy- monomethoxyflavon e isomer II ^a	C ₁₆ H ₁₂ O ₆ (-1.44)	76	-	+	+	+	+	-	+	+
70	Flavonoids	21.18	271.0605 [M+H] ⁺	153, 119, 109	Apigenin ^a	C ₁₅ H ₁₀ O ₅ (-1.34)	70 GNPS libraries	-	+	-	-	-	+	-	+
71	Flavonoids	21.28	331.0819 [M+H] ⁺	316, 301, 273, 245	Trihydroxy- dimethoxyflavone isomer III ^a	C ₁₇ H ₁₄ O ₇ (-0.26)	77	-	+	+	+	+	+	+	+
72	Eudesmanolid e	21.42	446.2173 [M+ C ₂ H ₃ N	330, 286,	3-propyloxy-6- methyl-	C ₂₂ H ₂₈ O ₇ (0.03)	78	-	-	-	-	-	-	+	-

	sesquiterpene lactone		+H] ⁺	312, 70	cryloxyivangustin ^b											
73	Flavonoids	21.45	315.0864 [M+H] ⁺	300, 257, 168	Dihydroxy- dimethoxyflavone (Isomer I) ^a	C ₁₇ H ₁₄ O ₆ (-1.58)	77	-	+	+	+	-	+	+	+	+
74	Flavonoids	21.92	361.0919 [M+H] ⁺	346, 331, 303, 269	Trihydroxy- trimethoxyflavone isomer III ^a	C ₁₈ H ₁₆ O ₈ (-0.28)	43,45	-	+	-	-	+	-	-	-	-
75	Flavonoids	21.93	345.0969 [M+H] ⁺	330, 315, 284, 169	Dihydroxy- trimethoxy flavone ^a	C ₁₈ H ₁₆ O ₇ (0.5)	79	+	+	+	+	+	+	+	+	+
76	Flavonoids	22.29	315.0865 [M+H] ⁺	300, 257, 168	Dihydroxy- dimethoxyflavone isomer II ^a	C ₁₇ H ₁₄ O ₆ (-1.83)	77	+	+	+	-	+	+	-	+	+
77	Flavonoids	23.36	315.0866 [M+H] ⁺	300, 284, 257, 168	Dihydroxy- dimethoxyflavone isomer III ^a	C ₁₇ H ₁₄ O ₆ (0.87)	77	+	+	+	+	+	+	+	+	+
78	Flavonoids	23.61	315.0864 [M+H] ⁺	300, 272, 257, 168	Dihydroxy- dimethoxyflavone isomer VI ^a	C ₁₇ H ₁₄ O ₆ (1.82)	77	+	-	+	-	-	+	-	-	-
79	Flavonoids	24.05	315.0866 [M+H] ⁺	300, 257	Dihydroxy- dimethoxyflavone isomer V ^a	C ₁₇ H ₁₄ O ₆ (-1.84)	77	+	-	+	-	-	+	-	-	-

80	Flavonoids	24.09	329.103 [M+H] ⁺	314, 296, 268, 135	Monohydroxy-trimethoxyflavone isomer I ^a	C ₁₈ H ₁₆ O ₆ (-2.4)	80	+	+	+	+	+	+	-	
81	Flavonoids	24.70	329.1026 [M+H] ⁺	314, 296, 268, 135	Monohydroxy-trimethoxyflavone isomer II ^a	C ₁₈ H ₁₆ O ₆ (-0.01)	80	+	-	+	-	-	+	-	+

^a, Compounds previously isolated from *Centaurea* species

^b Compounds first time to be reported in *Centaurea* species