

**Supplemental Table S1** Optimized UPLC-MS/MS parameters for the quantification of phytohormones.

No.	Compound	Scan Mode (ESI)	MRM transition	<sup>1</sup> RT (min)	<sup>2</sup> CV(V)	<sup>3</sup> CE (eV)
1	ABA	-	263.1>153.0	7.07	30	10
2	tZR	+	352.0>220.0	2.63	30	17
3	CA	+	465.3>429.4	9.64	27	17
4	TY	+	449.4>431.4	10.91	20	15
5	IAA	+	176.0>130.0	5.83	30	16
6	SA	-	137.0>93.0	5.47	25	15
7	tZ	+	220.0>136.0	2.06	30	16
8	GA3	-	345.0>143.1	4.72	28	15

<sup>1</sup> RT, retention time; <sup>2</sup> CV, cone voltage; <sup>3</sup> CE, collision energy.

**Supplemental Table S2** Primer sequences of the genes for qPCR verification.

Name	Primer	Sequence
ACTIN	Forward	5'-CTTGCACCAAGCAGCATGAA-3'
	Reverse	5'-CCGATCCAGACACTGTACTTCCTT-3'
Pg_S1335.25	Forward	5'-TTGCAGGCAATATCGTCGTG-3'
	Reverse	5'-GCAGGCCAGGGTAAGATTTG-3'
Pg_S5688.1	Forward	5'-GCTACTCCACCATCTACGCT-3'
	Reverse	5'-CTCATAGAGGCTCGTCGACC-3'
Pg_S1157.44	Forward	5'-TGCAGCAGTTTGATTGGGAA-3'
	Reverse	5'-GTGGCTTGAATTTGTTCCGC-3'
Pg_S0988.8	Forward	5'-GATCCGTCTACATGGCCAGA-3'
	Reverse	5'-ATCGCCACTGGTAGACACAA-3'
Pg_S6254.1	Forward	5'-CGTCTCGTGTTGGCTAATGG-3'
	Reverse	5'-CTCAACCAGTCCCACTCAGT-3'
Pg_S4448.3	Forward	5'-ACCCTCTTTGCAAGCCTAGT-3'
	Reverse	5'-AACTCGAAGCACATCTCCCA-3'
Pg_S7224.4	Forward	5'-CACCAGTTTTGTGCCGATCA-3'
	Reverse	5'-CGACTTTCCCAGCAAACGAA-3'
Pg_S1395.27	Forward	5'-GGTGGTGATGGAGGAGTGAA-3'
	Reverse	5'-CTATCAACCCTCGGCATTGC-3'

**Supplemental Table S3.** Differential metabolites in ginseng leaves identified by metabolomics analysis based on the UPLC-QTOF/MS.

Mode	Rt <sup>a</sup>	m/z	Adduct	Metabolite	Fold Change <sup>b</sup>	p-value	VIP
ESI(-)	26.99	515.3037	(M-H) <sup>-</sup>	Adynerin	2.897	0.030	1.510
	31.97	317.1409	(M+CH <sub>3</sub> COO) <sup>-</sup>	3-Deoxy-2-keto-6-phosphogluconic acid	4.515	0.023	1.342
	39.32	293.2119	(M-H) <sup>-</sup>	13-OxoODE	2.518	0.021	3.987
	39.75	295.2275	(M-H) <sup>-</sup>	9(S)-HODE	2.679	0.000	2.884
	47.79	339.3252	(M-H) <sup>-</sup>	Behenic acid	2.607	0.011	1.060
	52.88	98.00013	(M+K-2H) <sup>-</sup>	Ethanolamine	5.805	0.002	1.382
	57.55	115.0027	(M-H) <sup>-</sup>	Fumarate	0.601	0.014	1.017
	79.19	89.02397	(M-H) <sup>-</sup>	3-Hydroxypropionic acid (beta-lactic acid)	0.463	0.017	1.679
	120.17	124.9873	(M+Na-2H) <sup>-</sup>	Malonic acid	0.490	0.026	1.664
	121.04	71.01332	(M-H) <sup>-</sup>	Pyruvaldehyde	0.540	0.036	1.501
	122.08	173.0095	(M-H) <sup>-</sup>	Dehydroascorbic acid (Oxidized vitamin C)	0.406	0.004	10.132
	126.01	193.0495	(M-H) <sup>-</sup>	Scytalone	4.825	0.004	1.480
	146.70	195.0649	(M-H) <sup>-</sup>	Xanthoxylin	4.859	0.000	1.031
	149.93	255.2318	(M-H) <sup>-</sup>	Palmitic acid	0.559	0.036	2.224
	167.49	191.0192	(M-H <sub>2</sub> O-H) <sup>-</sup>	D-Galactarate	0.566	0.013	2.257
	169.28	134.047	(M-H) <sup>-</sup>	Adenine	1.347	0.039	1.571
	178.04	191.0562	(M-H) <sup>-</sup>	Quinate	3.286	0.015	6.710
				1-Palmitoyl-2-linoleoyl-sn-glycero-3-			
	189.30	671.4677	(M-H) <sup>-</sup>	phosphate	1.800	0.004	8.936
	194.94	223.0815	(M+CH <sub>3</sub> COO) <sup>-</sup>	L-Rhamnose	2.443	0.035	1.131
	200.92	843.5146	(M+CH <sub>3</sub> COO) <sup>-</sup>	Ginsenoside Rg3	1.919	0.015	5.674
	226.54	213.1235	(M-H) <sup>-</sup>	d-Dethiobiotin	5.147	0.003	1.207
	238.56	209.1174	(M+Na-2H) <sup>-</sup>	3-Hydroxycapric acid	0.480	0.022	1.244
	255.53	147.0447	(M-H <sub>2</sub> O-H) <sup>-</sup>	Tropic acid	34.211	0.043	3.182
	255.53	164.0717	(M-H) <sup>-</sup>	L-Phenylalanine	33.465	0.045	9.748
	256.41	131.0341	(M-H <sub>2</sub> O-H) <sup>-</sup>	D-Lyxose	0.546	0.006	1.515
	256.47	149.0449	(M-H) <sup>-</sup>	D-Ribose	0.530	0.005	2.347

257.80	203.0828	(M-H) <sup>-</sup>	L-Tryptophan	18.447	0.012	6.885
257.80	383.15	M <sup>-</sup>	N-Acetyl-D-lactosamine	4.109	0.020	4.403
258.36	239.0763	(M+CH <sub>3</sub> COO) <sup>-</sup>	D-Fructose	0.358	0.000	2.292
259.11	71.0133	(M-H <sub>2</sub> O-H) <sup>-</sup>	Dihydroxyacetone	0.448	0.003	2.044
270.85	130.0875	(M-H) <sup>-</sup>	L-Norleucine	10.836	0.007	7.976
271.72	218.1041	(M-H) <sup>-</sup>	Pantothenate	4.243	0.009	4.302
274.24	945.5471	(M-H) <sup>-</sup>	Ginsenoside Re	1.810	0.027	4.802
294.05	359.1177	(2M-H) <sup>-</sup>	D-Allose	0.338	0.004	1.664
294.38	239.0769	(M+CH <sub>3</sub> COO) <sup>-</sup>	D-Mannose	0.488	0.012	2.117
294.71	181.0702	(M+CH <sub>3</sub> COO) <sup>-</sup>	D-Threitol	7.006	0.002	2.243
298.02	116.0715	(M-H) <sup>-</sup>	L-Valine	61.358	0.049	5.315
299.33	105.0196	(M-H) <sup>-</sup>	Glyceric acid	0.534	0.001	10.846
329.94	191.0194	(M-H <sub>2</sub> O-H) <sup>-</sup>	D-Glucarate	5.686	0.017	2.065
330.69	172.0975	(M-H) <sup>-</sup>	Acetyl-DL-Leucine	13.311	0.006	2.181
348.50	141.0162	(M-H <sub>2</sub> O-H) <sup>-</sup>	2-Oxoadipic acid	0.489	0.003	2.159
348.85	118.0504	(M-H) <sup>-</sup>	L-Threonine	9.646	0.004	2.181
349.31	158.082	(M-H) <sup>-</sup>	Acetyl-DL-Valine	5.877	0.008	1.240
350.79	327.1298	(2M-H) <sup>-</sup>	L-Fucose	1.987	0.013	1.925
369.96	145.0624	(M-H) <sup>-</sup>	L-Glutamine	5.607	0.001	7.203
369.96	127.0511	(M-H) <sup>-</sup>	Dihydrothymine	5.323	0.001	2.989
371.82	195.0516	(M-H) <sup>-</sup>	Galactonic acid	2.760	0.000	5.373
372.59	131.0468	(M-H) <sup>-</sup>	L-Asparagine	16.346	0.000	7.828
372.59	113.0357	(M-H) <sup>-</sup>	Dihydrouracil	16.212	0.000	5.091
372.59	114.0196	(M-H) <sup>-</sup>	Maleamic acid	14.221	0.000	3.369
374.61	154.0618	(M-H) <sup>-</sup>	L-Histidine	21.545	0.036	1.703
378.89	306.0758	(M-H) <sup>-</sup>	Glutathione	8.240	0.013	1.888
379.66	135.0301	(M-H) <sup>-</sup>	L-Threonate	0.387	0.007	2.688
429.53	606.0732	(M-H) <sup>-</sup>	UDP-N-acetylglucosamine	3.525	0.004	1.000
430.71	171.0062	(M-H) <sup>-</sup>	Glycerol 3-phosphate	4.482	0.025	1.433
433.96	133.0141	(M-H) <sup>-</sup>	L-Malic acid	0.612	0.008	1.636

ESI(+)	438.96	173.009	(M-H) <sup>-</sup>	cis-Aconitate	4.609	0.049	1.595
	439.04	129.0188	(M-H) <sup>-</sup>	Mesaconic acid	4.397	0.049	1.750
	440.74	300.0483	(M-H) <sup>-</sup>	N-Acetylglucosamine 1-phosphate	5.208	0.031	1.429
	475.53	242.0794	(M+CH <sub>3</sub> COO) <sup>-</sup>	Phosphorylcholine	4.503	0.003	1.450
	477.13	191.0203	(M-H) <sup>-</sup>	Citrate	2.856	0.046	4.712
	522.43	173.1043	(M-H) <sup>-</sup>	L-Arginine	5.778	0.001	1.953
	52.70	322.27216	(M+H) <sup>+</sup>	alpha-Linolenoyl ethanolamide	8.714	0.022	2.401
	54.48	277.21578	(M+H) <sup>+</sup>	Stearidonic Acid	1.939	0.008	6.702
	58.30	279.23068	(M+H) <sup>+</sup>	alpha-Linolenic acid	2.015	0.000	3.520
	71.51	295.22671	(M+Na) <sup>+</sup>	16-Hydroxypalmitic acid	1.382	0.047	3.162
	71.64	330.26214	M <sup>+</sup>	Eicosapentaenoic Acid ethyl ester	2.053	0.000	3.704
				(4Z,7Z,10Z,13Z,16Z,19Z)-4,7,10,13,16,19-			
	73.75	328.24669	M <sup>+</sup>	Docosahexaenoic acid	1.667	0.001	2.295
	75.79	306.11608	(M-H+2Na) <sup>+</sup>	Arg-Ser	0.381	0.003	1.145
	96.91	250.09153	(M+H-H <sub>2</sub> O) <sup>+</sup>	Adenosine	3.009	0.024	1.157
	111.19	247.13122	(M+H-H <sub>2</sub> O) <sup>+</sup>	Abcisic Acid (cis,trans)	2.391	0.011	1.065
	126.46	325.1987	(M+K) <sup>+</sup>	Retinol (Vitamin A)	0.482	0.025	3.142
	138.39	229.14215	(M+CH <sub>3</sub> COO+2H) <sup>+</sup>	Jasmine lactone	0.464	0.007	2.492
	162.28	280.16389	(M+NH <sub>4</sub> ) <sup>+</sup>	Pro-Phe	7.299	0.002	2.694
	163.59	213.1467	(M+CH <sub>3</sub> COO+2H) <sup>+</sup>	Limonene-1,2-epoxide	1.651	0.009	1.528
	164.11	313.27248	(M+H-H <sub>2</sub> O) <sup>+</sup>	1-Palmitoylglycerol	0.563	0.016	5.661
	169.41	136.06031	(M+H) <sup>+</sup>	Adenine	1.248	0.035	2.090
	179.42	177.05301	(M+H-H <sub>2</sub> O) <sup>+</sup>	3-Hydroxy-4-methoxycinnamic acid	20.104	0.005	5.098
	187.70	522.35411	(M+H) <sup>+</sup>	1-Oleoyl-sn-glycero-3-phosphocholine	0.292	0.034	10.954
	210.04	145.09587	(M+CH <sub>3</sub> CN+H) <sup>+</sup>	Dimethylglycine	1.810	0.033	1.034
	218.63	295.10168	M <sup>+</sup>	Prunasin	1.373	0.048	1.648
	254.98	222.09564	(M+H) <sup>+</sup>	N-Acetyl-D-glucosamine	13.309	0.037	1.291
	255.10	149.05775	(M+H-H <sub>2</sub> O) <sup>+</sup>	Phenyllactic acid	6.216	0.008	1.859
	255.12	166.08472	(M+H) <sup>+</sup>	L-Phenylalanine	7.578	0.009	8.750
	257.06	145.04766	(M+Na) <sup>+</sup>	Erythritol	0.406	0.003	2.199

257.56	205.09591	(M+H) <sup>+</sup>	L-Tryptophan	4.367	0.000	6.341
257.63	118.06341	(M+H) <sup>+</sup>	Indole	3.991	0.000	1.943
257.63	146.05828	(M+H-2H <sub>2</sub> O) <sup>+</sup>	DL-O-tyrosine	3.531	0.000	2.824
257.64	170.05794	(M+H-H <sub>2</sub> O) <sup>+</sup>	Indoleacrylic acid	3.679	0.000	1.256
261.02	152.05531	(M+H) <sup>+</sup>	2-Hydroxyadenine	0.446	0.004	4.743
261.02	284.09717	(M+H) <sup>+</sup>	Guanosine	0.541	0.035	2.995
269.96	132.1002	(M+H) <sup>+</sup>	L-Leucine	10.673	0.000	4.428
272.54	220.11642	(M+H) <sup>+</sup>	Pantothenate	4.855	0.027	2.883
274.07	120.07913	(M+H-H <sub>2</sub> O) <sup>+</sup>	Tyramine	9.195	0.003	4.583
298.58	147.04277	(M+H-H <sub>2</sub> O) <sup>+</sup>	trans-3-Coumaric acid	2.098	0.043	1.562
298.93	165.05353	(M+H) <sup>+</sup>	trans-2-Hydroxycinnamic acid	5.922	0.001	4.448
298.93	136.07469	(M+H-H <sub>2</sub> O) <sup>+</sup>	Dopamine	5.444	0.001	3.959
298.93	182.08042	(M+H) <sup>+</sup>	L-Tyrosine	5.563	0.001	4.897
299.76	188.06943	(M+H-H <sub>2</sub> O) <sup>+</sup>	DL-Indole-3-lactic acid	3.803	0.043	1.170
302.95	287.05324	(M+H) <sup>+</sup>	Kaempferol	2.287	0.025	1.203
348.61	120.06419	(M+H) <sup>+</sup>	L-Threonine	6.557	0.000	1.840
350.13	265.11085	M <sup>+</sup>	Thiamine	1.950	0.016	1.845
370.42	84.04389	(M+H-H <sub>2</sub> O) <sup>+</sup>	1-Aminocyclopropanecarboxylic acid	4.251	0.000	4.294
370.44	147.07537	(M+NH <sub>4</sub> ) <sup>+</sup>	L-Pyroglutamic acid	4.288	0.000	6.427
370.71	104.06986	(M+H) <sup>+</sup>	4-Aminobutyric acid	0.675	0.003	2.136
373.06	133.05978	(M+H) <sup>+</sup>	L-Asparagine	10.938	0.000	6.531
379.14	308.08947	(M+H) <sup>+</sup>	Glutathione	5.811	0.021	2.075
388.09	124.0388	(M+H) <sup>+</sup>	Nicotinate	4.234	0.005	5.727
388.80	156.07565	(M+H) <sup>+</sup>	L-Histidine	1.993	0.017	2.105
390.09	360.14761	(M+NH <sub>4</sub> ) <sup>+</sup>	Sucrose	0.450	0.002	2.539
417.10	304.14853	(M+CH <sub>3</sub> COO+2H) <sup>+</sup>	Agomelatine	0.482	0.004	1.658
424.84	522.20124	(M+NH <sub>4</sub> ) <sup>+</sup>	Maltotriose	0.430	0.040	1.739
448.57	277.13795	(M+H) <sup>+</sup>	L-Saccharopine	5.745	0.000	1.425
473.74	184.07322	(M+H) <sup>+</sup>	Phosphorylcholine	2.350	0.023	8.855
515.30	189.13391	(M+H) <sup>+</sup>	L-NG-Monomethylarginine	3.753	0.005	5.523

526.37	158.09088	(M+H-H <sub>2</sub> O) <sup>+</sup>	L-Citrulline	3.074	0.009	2.437
528.00	203.14902	(M+H) <sup>+</sup>	NG,NG-dimethyl-L-arginine(ADMA)	6.796	0.037	3.673
528.62	175.1186	(M+H) <sup>+</sup>	L-Arginine	2.205	0.018	14.004
529.35	147.11104	(M+NH <sub>4</sub> ) <sup>+</sup>	L-Pipecolic acid	2.597	0.026	1.546
555.97	189.15761	(M+H) <sup>+</sup>	N6,N6,N6-Trimethyl-L-lysine	4.818	0.003	1.367

Rt<sup>a</sup>: retention time (sec); <sup>b</sup> Fold change was the ratio of average relative quantitation obtained from the diseased group (DL)/ control group (CL).

**Supplemental Table S4.** Differential metabolites in ginseng stems identified by metabolomics analysis based on the UPLC-QTOF/MS.

Mode	Rt <sup>a</sup>	m/z	Adduct	Metabolite	Fold Change <sup>b</sup>	p-value	VIP
ESI(-)	31.78	317.1408	(M-H) <sup>-</sup>	Zearalenone	9.448	0.040	1.262
	39.53	255.2334	(M-H) <sup>-</sup>	Palmitic acid	9.493	0.001	11.764
	39.99	339.3251	(M-H) <sup>-</sup>	Behenic acid	12.934	0.000	2.952
	40.13	367.3566	(M-H) <sup>-</sup>	Tetracosanoic acid	16.834	0.011	2.924
	49.91	311.2934	(M-H) <sup>-</sup>	Arachidic acid	6.215	0.001	1.101
	59.36	271.085	(M-H) <sup>-</sup>	Arbutin	32.672	0.033	2.518
	61.10	295.2281	(M-H) <sup>-</sup>	9(S)-HODE	11.006	0.038	10.737
	62.15	293.2121	(M-H) <sup>-</sup>	9-OxoODE	5.546	0.003	5.564
	68.05	185.0117	M <sup>-</sup>	3-Phosphoserine	3.207	0.001	1.835
	75.73	159.0656	(M-H) <sup>-</sup>	3,3-Dimethylglutaric acid	7.916	0.039	1.813
	143.06	163.0393	(M-H) <sup>-</sup>	4-Hydroxycinnamic acid	0.156	0.002	1.228
	143.40	257.0768	(M-H) <sup>-</sup>	Ribothymidine	6.005	0.000	1.068
	150.98	279.2319	(M-H) <sup>-</sup>	Linoleic acid	2.102	0.005	1.021
	187.12	133.0501	(M+CH <sub>3</sub> COO) <sup>-</sup>	Hydroxyacetone	7.775	0.011	2.439
	187.24	671.4676	(M-H) <sup>-</sup>	1-Palmitoyl-2-linoleoyl-sn-glycero-3-phosphate	1.378	0.029	4.646
	218.14	133.0502	(M-H <sub>2</sub> O-H) <sup>-</sup>	Ribitol	9.368	0.003	1.988
	230.28	147.0658	(M-H) <sup>-</sup>	Mevalonic acid	3.795	0.015	1.242
	239.11	242.0774	(M-H) <sup>-</sup>	Cytidine	3.241	0.003	1.439
	249.83	409.2343	(M-H) <sup>-</sup>	1-Palmitoyl Lysophosphatidic Acid	2.297	0.036	1.168
	257.73	203.0826	(M-H) <sup>-</sup>	L-Tryptophan	3.251	0.027	4.923
	259.40	71.01338	(M-H <sub>2</sub> O-H) <sup>-</sup>	Dihydroxyacetone	0.553	0.009	1.523
	261.90	282.0845	(M-H) <sup>-</sup>	Guanosine	6.112	0.013	3.622
	262.65	105.0194	(M-H) <sup>-</sup>	Glyceric acid	0.301	0.034	4.466
	263.17	239.0768	(M+CH <sub>3</sub> COO) <sup>-</sup>	Alpha-D-Glucose	0.586	0.036	1.089
	268.44	328.0453	(M-H) <sup>-</sup>	Adenosine 3',5'-cyclic phosphate (cAMP)	5.222	0.037	2.928
	273.07	218.1042	(M-H) <sup>-</sup>	Pantothenate	2.522	0.017	3.644
	281.45	148.0435	(M-H) <sup>-</sup>	L-Methionine	0.176	0.001	1.984

294.50	161.045	(M-H <sub>2</sub> O-H) <sup>-</sup>	D-Tagatose	0.511	0.001	2.423
294.53	239.0766	(M+CH <sub>3</sub> COO) <sup>-</sup>	D-Mannose	0.235	0.000	2.616
298.11	89.02417	(M-H) <sup>-</sup>	DL-lactate	0.297	0.008	2.524
299.59	128.0353	(M-H) <sup>-</sup>	L-Pyroglutamic acid	0.334	0.004	7.782
321.67	304.0329	(M-H) <sup>-</sup>	Cytidine 2',3'-cyclic phosphate	4.451	0.007	1.413
323.15	344.0396	(M-H) <sup>-</sup>	3',5'-Cyclic guanosine monophosphate	5.583	0.036	2.819
330.72	172.0975	(M-H) <sup>-</sup>	Acetyl-DL-Leucine	8.922	0.012	1.684
349.70	158.0819	(M-H) <sup>-</sup>	Acetyl-DL-Valine	9.792	0.022	1.208
358.07	159.0291	(M-H) <sup>-</sup>	2-Oxoadipic acid	6.930	0.026	1.071
363.06	401.1305	(M+CH <sub>3</sub> COO) <sup>-</sup>	Galactinol	0.215	0.000	15.366
363.60	237.0614	(M+CH <sub>3</sub> COO) <sup>-</sup>	2-Dehydro-3-deoxy-D-gluconate	2.598	0.000	3.170
369.73	145.0624	(M-H) <sup>-</sup>	L-Glutamine	0.404	0.002	14.891
369.73	127.0515	(M-H) <sup>-</sup>	Dihydrothymine	0.437	0.003	6.054
369.73	125.035	(M-H) <sup>-</sup>	Thymine	0.457	0.004	1.300
370.37	177.0397	(M-H) <sup>-</sup>	L-Gulonic gamma-lactone	4.367	0.026	1.608
371.24	161.0454	(M-H) <sup>-</sup>	3-Hydroxy-3-methylglutaric acid	4.589	0.008	1.863
372.00	191.0554	(M-H) <sup>-</sup>	Quinate	0.204	0.029	2.167
372.18	131.0466	(M-H) <sup>-</sup>	L-Asparagine	3.125	0.019	6.022
372.18	113.0357	(M-H) <sup>-</sup>	Dihydrouacil	3.168	0.019	3.922
372.18	114.0195	(M-H) <sup>-</sup>	Maleamic acid	2.863	0.021	2.503
386.74	117.0192	(M-H) <sup>-</sup>	Succinate	14.536	0.016	3.012
388.83	179.0567	(M-H) <sup>-</sup>	myo-Inositol	0.188	0.000	8.176
390.47	147.0293	(M-H) <sup>-</sup>	Citramalic acid	4.524	0.041	2.304
402.26	133.0149	(M-H) <sup>-</sup>	L-Malic acid	2.033	0.010	6.967
407.06	160.061	(M-H) <sup>-</sup>	DL-2-Aminoadipic acid	15.155	0.031	2.155
410.14	503.1605	(M-H) <sup>-</sup>	Raffinose	0.273	0.001	1.301
416.88	175.0359	(M+Na-2H) <sup>-</sup>	3,4-Dihydroxyphenyl ethanol	3.927	0.023	1.185
431.44	191.0193	(M-H <sub>2</sub> O-H) <sup>-</sup>	D-Glucarate	4.051	0.016	1.910
432.47	209.0301	(M-H) <sup>-</sup>	D-Galactarate	38.381	0.041	4.961
440.29	173.0097	(M-H) <sup>-</sup>	cis-Aconitate	5.644	0.002	3.555

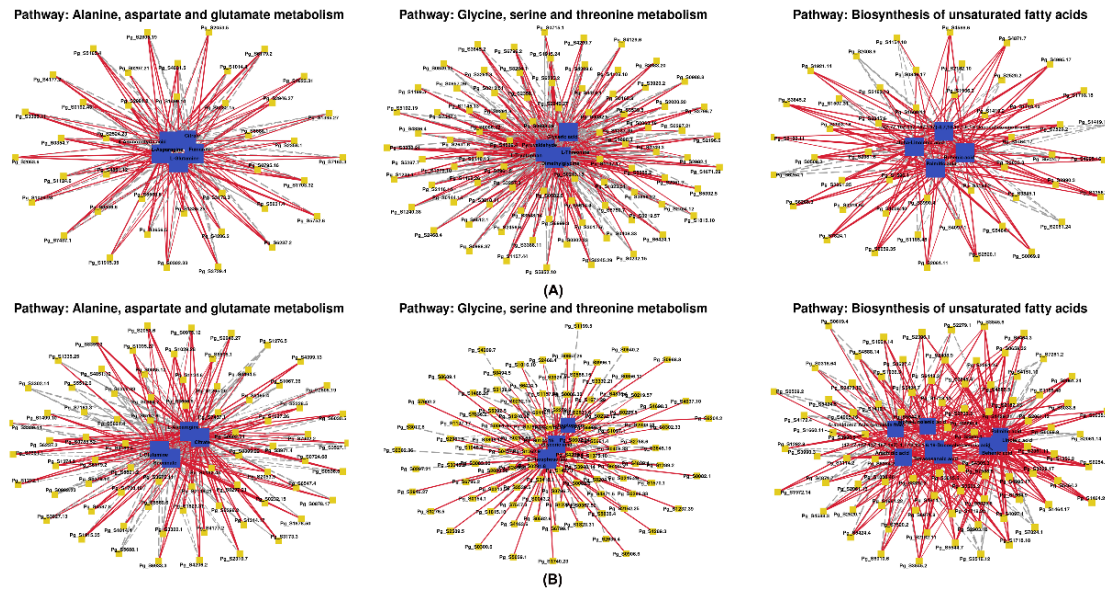


ESI(+)	440.45	129.0193	(M-H) <sup>-</sup>	Citraconic acid	5.774	0.002	4.039
	444.36	154.0615	(M-H) <sup>-</sup>	L-Histidine	0.388	0.004	1.201
	454.35	259.0218	(M-H) <sup>-</sup>	alpha-D-Galactose 1-phosphate	6.329	0.023	1.009
	460.06	341.1072	(M-H) <sup>-</sup>	Sucrose	0.326	0.000	1.105
	504.01	191.0205	(M-H) <sup>-</sup>	Citrate	30.281	0.008	13.654
	37.67	322.2717	(M+NH <sub>4</sub> ) <sup>+</sup>	Arachidonic Acid (peroxide free)	8.556	0.018	1.337
	52.51	147.0425	(M+H-H <sub>2</sub> O) <sup>+</sup>	4-Hydroxycinnamic acid	0.311	0.040	1.781
	59.61	279.2303	(M+H) <sup>+</sup>	alpha-Linolenic acid	5.429	0.008	5.576
	71.99	330.2623	M <sup>+</sup>	Eicosapentaenoic Acid ethyl ester (4Z,7Z,10Z,13Z,16Z,19Z)-4,7,10,13,16,19-	3.161	0.002	5.173
	74.15	328.2462	M <sup>+</sup>	Docosaehaenoic acid	1.937	0.003	1.544
	109.79	247.1313	(M+H-H <sub>2</sub> O) <sup>+</sup>	Abscisic Acid (cis,trans)	9.014	0.049	1.627
	115.63	135.1151	(M+H-H <sub>2</sub> O) <sup>+</sup>	Perillyl alcohol	14.204	0.004	1.786
	121.75	153.1256	(M+H-H <sub>2</sub> O) <sup>+</sup>	Linalool oxide	13.612	0.010	1.454
	123.71	377.2142	(M+K) <sup>+</sup>	(+)-8,9-DHET	5.687	0.036	1.512
	126.01	302.304	(M+H) <sup>+</sup>	Sphinganine	6.337	0.003	2.938
	146.45	318.2992	(M+H) <sup>+</sup>	Phytosphingosine	13.958	0.001	8.876
	153.65	417.1517	(2M+H) <sup>+</sup>	3,4-Dimethoxycinnamic acid	15.424	0.001	1.019
	154.34	277.2142	(M+Na) <sup>+</sup>	cis-9-Palmitoleic acid	9.044	0.012	2.662
	156.85	295.2248	(M+Na) <sup>+</sup>	16-Hydroxypalmitic acid	5.231	0.019	2.828
	168.94	136.0604	(M+H) <sup>+</sup>	Adenine	1.971	0.025	3.663
	169.45	169.1205	(M+H) <sup>+</sup>	Jasmine lactone	5.855	0.006	1.536
	182.08	265.1526	(M+H) <sup>+</sup>	Phe-Val	7.228	0.002	1.003
	184.17	245.1843	(M+H) <sup>+</sup>	Ile-Leu	4.265	0.009	1.495
	192.94	524.3673	(M+H) <sup>+</sup>	1-Stearoyl-2-hydroxy-sn-glycero-3-phosphocholine	2.377	0.026	1.167
	197.37	231.1685	(M+H) <sup>+</sup>	Val-Ile	3.204	0.045	1.295
	237.93	112.0493	(M+H) <sup>+</sup>	Cytosine	4.019	0.002	3.476
	237.93	244.0911	(M+H) <sup>+</sup>	Cytidine	4.144	0.003	2.148
	240.98	301.0707	(M+H) <sup>+</sup>	Diosmetin	0.194	0.010	1.021
	247.62	278.1493	(M+CH <sub>3</sub> CN+Na) <sup>+</sup>	Pro-Val	1.817	0.038	2.397

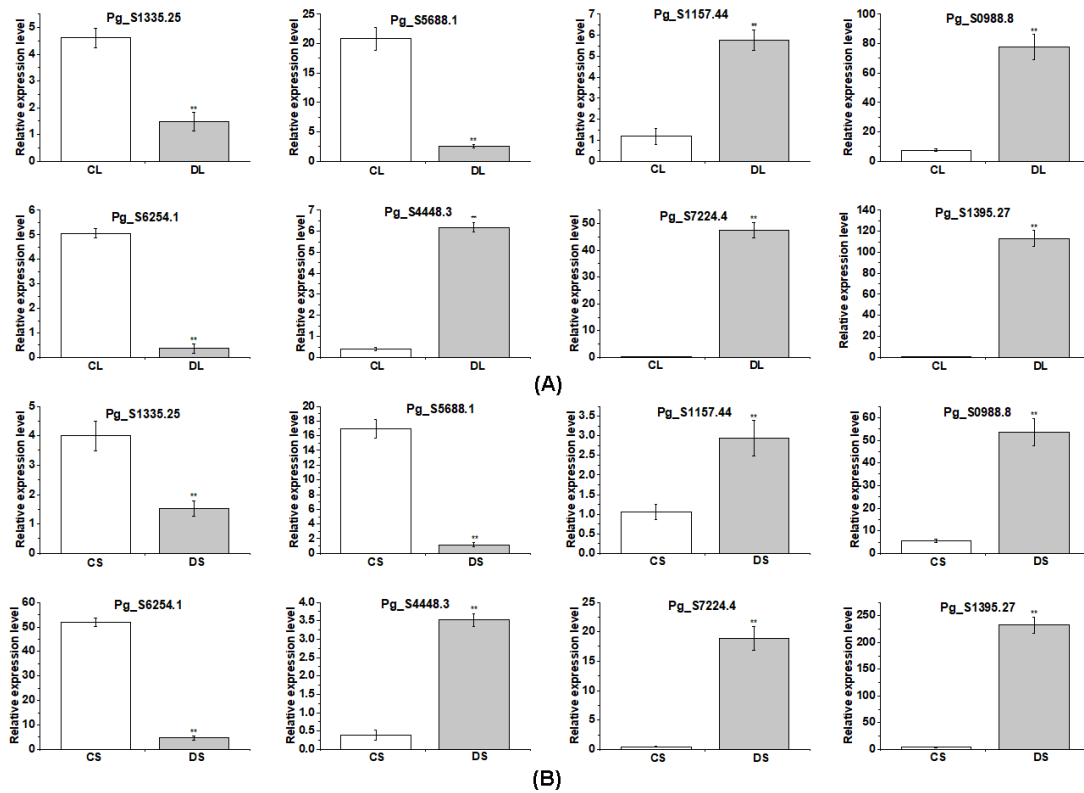
253.66	186.0741	(M+H-2H <sub>2</sub> O) <sup>+</sup>	N-Acetyl-D-glucosamine	4.400	0.011	1.185
256.31	203.0512	(M-2H+3Na) <sup>+</sup>	Phenelzine	0.202	0.001	4.347
260.37	152.0552	(M+H) <sup>+</sup>	2-Hydroxyadenine	4.065	0.005	3.368
260.39	284.0968	(M+H) <sup>+</sup>	Guanosine	3.475	0.007	2.127
266.74	330.0578	(M+H) <sup>+</sup>	Adenosine 2',3'-cyclic monophosphate	4.876	0.034	2.732
280.97	147.0429	(M+H-H <sub>2</sub> O) <sup>+</sup>	trans-3-Coumaric acid	0.031	0.015	3.290
298.14	165.0537	(M+H) <sup>+</sup>	trans-2-Hydroxycinnamic acid	0.201	0.030	4.270
298.19	182.0802	(M+H) <sup>+</sup>	L-Tyrosine	0.214	0.030	4.658
298.20	136.0747	(M+H-H <sub>2</sub> O) <sup>+</sup>	Dopamine	0.214	0.031	3.899
320.67	306.0467	(M+H-H <sub>2</sub> O) <sup>+</sup>	Cytidine 5'-monophosphate	4.154	0.009	1.271
322.21	346.0531	(M+H) <sup>+</sup>	3',5'-Cyclic guanosine monophosphate	5.211	0.035	2.443
331.47	288.2009	(M+H) <sup>+</sup>	Ile-Arg	3.177	0.008	1.067
349.46	265.1107	M <sup>+</sup>	Thiamine	1.973	0.016	2.240
355.43	146.0912	(M+H) <sup>+</sup>	4-Guanidinobutyric acid	3.680	0.001	2.997
355.90	175.1061	(M+H) <sup>+</sup>	N2-Acetyl-L-ornithine	2.772	0.017	1.147
362.79	307.1005	(M+H-2H <sub>2</sub> O) <sup>+</sup>	Galactinol	0.336	0.005	2.746
362.88	127.0373	(M+H) <sup>+</sup>	1,3,5-Benzenetriol	0.341	0.005	2.815
362.88	360.1486	(M+NH <sub>4</sub> ) <sup>+</sup>	Sucrose	0.298	0.005	9.360
370.59	191.0385	(M-H+2Na) <sup>+</sup>	L-Glutamine	0.211	0.009	1.969
372.49	133.0598	(M+H) <sup>+</sup>	L-Asparagine	5.447	0.009	6.040
384.45	258.1097	M <sup>+</sup>	Glycerophosphocholine	10.274	0.023	6.404
389.66	176.0907	(M+H) <sup>+</sup>	N-Carboxyethyl-.gamma.-aminobutyric acid	4.437	0.018	2.330
398.52	84.04361	(M+H-H <sub>2</sub> O) <sup>+</sup>	1-Aminocyclopropanecarboxylic acid	0.407	0.003	4.449
399.36	263.1337	(M+H) <sup>+</sup>	Pro-Phe	3.036	0.013	1.984
401.86	304.1485	(M+CH <sub>3</sub> COO+2H) <sup>+</sup>	Agomelatine	7.507	0.001	2.392
401.94	147.075	(M+NH <sub>4</sub> ) <sup>+</sup>	L-Pyroglutamic acid	0.355	0.004	6.122
403.37	276.1645	(M+H) <sup>+</sup>	Thr-Arg	0.403	0.019	1.099
406.91	162.0753	(M+H) <sup>+</sup>	DL-2-Aminoadipic acid	15.862	0.011	3.769
413.59	246.1545	(M+H) <sup>+</sup>	Arg-Ala	0.386	0.020	2.074
433.39	218.1481	(M+H) <sup>+</sup>	Ala-Lys	0.289	0.021	1.554

433.62	343.1214	(M+H) <sup>+</sup>	alpha-Mannobiose	0.352	0.034	1.242
437.89	232.1384	(M+H) <sup>+</sup>	Gly-Arg	0.395	0.047	1.018
448.19	277.1382	(M+H) <sup>+</sup>	L-Saccharopine	10.473	0.029	2.906
448.90	272.1695	(M+H) <sup>+</sup>	Pro-Arg	0.433	0.046	1.214
457.94	365.1036	(M+NH <sub>4</sub> ) <sup>+</sup>	2'-Deoxyguanosine 5'-monophosphate (dGMP)	0.214	0.001	2.655
458.63	277.1014	(M+H) <sup>+</sup>	gamma-L-Glutamyl-L-glutamic acid	16.283	0.032	1.923
471.69	184.0733	(M+H) <sup>+</sup>	Phosphorylcholine	2.292	0.019	10.921

Rt <sup>a</sup>: retention time (sec); Fold change <sup>b</sup> was the ratio of average relative quantitation obtained from the diseased group (DS)/ control group (CS).



**Figure S1.** The network map of DRMs and DEGs in pathways of ginseng leaves (A) and stems (B). Blue squares represent the DRMs and yellow square represents DEGs, respectively. The correlation between DRMs and DEGs was calculated by the Pearson correlation coefficient and the positive correlation is shown by the red line, otherwise, it is indicated by the grey line.



**Figure S2.** qRT-PCR validation for 8 differentially expressed genes induced by *P. cactorum* in ginseng leaves (A) and stems (B). \* and \*\* indicate significant differences with  $p < 0.05$  and  $p < 0.01$ , respectively. Data shown are the means and standard deviations of 3 biological replicates (n = 3).