

Table S1. The differential metabolites between shrimp given 0 and 6000mg/kg dietary choline.

No.	Metabolite	M/Z	Formula	VIP (OPLS-DA)	FC (6000/0)	P value
1	3,6-Ditigloyloxytropan-7-ol	318.174	C18H27NO5	3.5839	1.4836	0.04323
2	L-2-Amino-3-methylenehexanoic acid	350.2061	C7H13NO2	2.6466	1.1623	0.002594
3	PC(O-16:0/18:2(9Z,12Z))	788.5809	C42H82NO7P	2.596	1.1255	0.02227
4	13,14-Dihydro-15-keto-PGE2	351.2208	C20H32O5	2.3443	1.0961	0.02059
5	Mycosporine	262.1275	C11H19NO6	1.8346	1.0732	0.04879
6	PE-NMe2(16:0/18:1(9Z))	790.5614	C41H80NO8P	1.956	1.0694	0.04182
7	PE(15:0/20:1(11Z))	776.5448	C40H78NO8P	1.6237	1.0443	0.04722
8	PE-NMe2(15:0/18:2(9Z,12Z))	774.5292	C40H76NO8P	1.6666	1.0399	0.01122
9	PC(16:0/22:6(3Z,6Z,9Z,12Z,15Z,18))[U]	806.5666	C46H80NO8P	1.0195	0.9849	0.03542
10	PC(16:0/20:5(5Z,8Z,11Z,14Z,17Z))	780.5511	C44H78NO8P	1.0519	0.9841	0.03679
11	PC(16:0/20:5(5E,8E,11E,14E,17E))[U]	780.5488	C44H78NO8P	1.1621	0.9829	0.005741
12	PC(18:1(11Z)/22:6(4Z,7Z,10Z,13Z,16Z,19Z))	832.5818	C48H82NO8P	1.1142	0.9818	0.03107
13	Lamivudine sulfoxide	266.0199	C8H11N3O4S	1.1888	0.9814	0.005128
14	D-Pipecolic acid	130.0859	C6H11NO2	1.0474	0.9797	0.01148
15	Bis(2-ethylhexyl) phthalate	413.2648	C24H38O4	1.1539	0.9783	0.04662
16	PE-NMe2(18:0/20:5(5Z,8Z,11Z,14Z,17Z))	794.5664	C45H80NO8P	1.1501	0.9779	0.01903
17	PC(18:3(6Z,9Z,12Z)/20:5(5Z,8Z,11Z,14Z,17Z))	802.5329	C46H76NO8P	1.2881	0.977	0.01091
18	PC(18:0/20:5(5Z,8Z,11Z,14Z,17Z))	808.5818	C46H82NO8P	1.4866	0.9723	0.001586
19	C17 Sphinganine	288.2885	C17H37NO2	1.2418	0.9709	0.01368
20	L-2-Amino-5-hydroxypentanoic acid	116.0705	C5H11NO3	1.5021	0.965	0.02016
21	LysoPE(18:0/0:0)	480.3093	C23H48NO7P	1.7644	0.9621	0.003419
22	Choline	104.107	C5H13NO	1.8202	0.9586	0.0006582
23	2-Pyrrolidinone	86.06028	C4H7NO	1.478	0.9575	0.01296
24	2-Mercapto-2-methyl-1-pentanol	117.0738	C6H14OS	1.5397	0.9545	0.01937
25	Acetyl-DL-Leucine	172.0969	C8H15NO3	1.5314	0.9534	0.01597
26	Octadecanamide	316.3198	C18H37NO	1.5609	0.9529	0.005178
27	N-Stearoyl GABA	352.3197	C22H43NO3	1.7729	0.9497	0.0002882
28	PE(18:0/0:0)	482.3225	C23H48NO7P	1.778	0.949	0.004454
29	L-Proline	160.0347	C5H9NO2	1.8356	0.9481	0.001248
30	Porphobilinogen	227.1017	C10H14N2O4	1.6802	0.9479	0.006026
31	Pipericine	336.3246	C22H41NO	1.6236	0.9353	0.02678
32	Ent-Prostaglandin F2alpha	353.233	C20H34O5	2.2297	0.925	0.02686
33	5-trans-PGE2	351.2173	C20H32O5	2.2929	0.9193	0.04832
34	3-((3R,5S)-3-butyloctahydroindolizin-5-yl)propan-1-ol	240.2314	C15H29NO	1.8873	0.9162	0.01805
35	(4E,d14:1) sphingosine	226.2157	C14H29NO2	2.4117	0.9078	0.005845
36	(2'E,4'Z,7'Z,8E)-Colnelenic acid	334.2365	C18H28O3	2.1824	0.905	0.003282
37	15-deoxy-delta-12,14-PGJ2	315.1961	C20H28O3	2.4286	0.8867	0.04921
38	C16 Sphingosine	254.2468	C16H33NO2	2.6533	0.8813	0.003957
39	12-epi Leukotriene B3	337.2382	C20H34O4	3.4316	0.8509	0.003297
40	11-deoxy-PGE1	321.2412	C20H34O4	2.9745	0.8453	0.005221
41	LTB3	321.2412	C20H34O4	3.1259	0.8364	0.006828
42	6-pentadecyl Salicylic Acid	349.2725	C22H36O3	3.8071	0.7637	0.0004888

Abbreviation: VIP, Variable Importance in the Projection; FC, fold change. FC >1, metabolites were upregulated in shrimp given 6000mg/kg dietary choline chloride.

Table S2. The differential metabolites between shrimp given 0 and 12000mg/kg dietary choline.

No.	Metabolite	M/Z	Formula	VIP (OPLS- DA)	FC (12000/0)	P value
1	3,6-Ditigloyloxytropan-7-ol	318.174	C18H27NO5	2.8316	1.3207	0.03123
2	L-2-Amino-3-methylenehexanoic acid	350.2061	C7H13NO2	3.2235	1.2136	0.002773
3	Angularine	352.1776	C18H25NO6	2.4069	1.1473	0.02984
4	PAz-PC	666.4323	C33H64NO10P	2.505	1.1395	0.006747
5	Tetraphyllin B sulfate	404.0076	C12H17NO10S	2.2492	1.1293	0.04526
6	13,14-Dihydro-15-keto-PGE2	351.2208	C20H32O5	2.4558	1.1044	0.006433
7	4-Methylene-L-glutamine	159.0758	C6H10N2O3	1.9114	1.094	0.0176
8	Capnine	352.2502	C17H37NO4S	2.3706	1.0915	0.001307
9	PE-NMe2(16:0/18:2(9Z,12Z))	788.5469	C41H78NO8P	1.909	1.071	0.02791
10	(+)-cis-5,6-Dihydro-5-hydroxy-4-methoxy-6-(2-phenylethyl)-2H-pyran-2-one	281.1373	C14H16O4	1.8129	1.0693	0.02083
11	PE-NMe2(16:0/18:1(9Z))	790.5614	C41H80NO8P	1.8526	1.0598	0.02368
12	Alpha-Methylstyrene	119.0852	C9H10	1.6741	1.0574	0.0282
13	N-Methyl-1H-indole-3-propanamide	446.2523	C12H14N2O	1.7512	1.0536	0.01595
14	Thromboxane B3	432.2367	C20H32O6	1.7093	1.05	0.02494
15	Nepsilon-Acetyl-L-lysine	189.1227	C8H16N2O3	1.6832	1.0447	0.000493
16	PC(14:0/14:0)	678.505	C36H72NO8P	1.4933	1.0442	0.02726
17	1H-Indole-3-acetamide	157.0755	C10H10N2O	1.3287	1.0442	0.04048
18	5-Methyldeoxycytidine	242.1125	C10H15N3O4	1.4027	1.0405	0.03409
19	Glycerophosphocholine	280.091	C8H20NO6P	1.2392	1.0398	0.0405
20	PE(15:0/20:1(11Z))	776.5448	C40H78NO8P	1.5581	1.0397	0.02704
21	PC(15:0/18:2(9Z,12Z))	744.5513	C41H78NO8P	1.5203	1.0388	0.03536
22	2-octenoylglycine	241.1537	C10H17NO3	1.271	1.0286	0.02298
23	Semilepidinoside B	365.1349	C17H22N2O7	1.1492	1.027	0.04733
24	Cyclobrassinone	213.0146	C11H8N2O2S	1.0146	1.0197	0.03098
25	PC(14:0/18:1(11Z))	732.5516	C40H78NO8P	1.204	1.0196	0.01234
26	Lamivudine sulfoxide	266.0199	C8H11N3O4S	1.0537	0.984	0.003397
27	PC(18:0/20:3(8Z,11Z,14Z))	834.5973	C46H86NO8P	1.3885	0.9776	0.000441
28	N-Stearoyl GABA	352.3197	C22H43NO3	1.195	0.9772	0.002144
29	C17 Sphinganine	288.2885	C17H37NO2	1.1208	0.9766	0.04475
30	Tetraethylene glycol	195.1221	C8H18O5	1.2216	0.9736	0.01685
31	Stearoylcarnitine	464.3143	C25H49NO4	1.4342	0.9627	0.03344
32	Choline	104.107	C5H13NO	1.7691	0.9579	0.006398
33	PE(18:0/0:0)	482.3225	C23H48NO7P	1.8534	0.9482	0.001486
34	LysoPE(18:0/0:0)	480.3093	C23H48NO7P	2.1029	0.9426	0.001735
35	Fusarochromanone	334.1747	C15H20N2O4	1.628	0.9299	0.04096
36	3-((3R,5S)-3-butyloctahydroindolizin-5-yl)propan-1-ol	240.2314	C15H29NO	1.7694	0.9247	0.01117
37	5-trans-PGE2	351.2173	C20H32O5	2.8503	0.8946	0.005207
38	(4E,d14:1) sphingosine	226.2157	C14H29NO2	2.6886	0.8914	0.001027
39	Ent-Prostaglandin F2alpha	353.233	C20H34O5	2.7004	0.8866	0.01846
40	C16 Sphingosine	254.2468	C16H33NO2	2.7366	0.868	0.002026
41	15-deoxy-delta-12,14-PGJ2	315.1961	C20H28O3	2.9458	0.8552	0.007009

42	11-deoxy-PGE1	321.2412	C20H34O4	2.6204	0.8549	0.03317
43	12-epi Leukotriene B3	337.2382	C20H34O4	3.3125	0.8509	0.002524
44	LTB3	321.2412	C20H34O4	3.3008	0.8305	0.002658
45	6-pentadecyl Salicylic Acid	349.2725	C22H36O3	4.0106	0.7564	8.72E-05

Abbreviation: VIP, Variable Importance in the Projection; FC, fold change. FC >1, metabolites were upregulated in shrimp given 12000mg/kg dietary choline chloride.

Table S3. The differential metabolites between shrimp given 6000 and 12000mg/kg dietary choline.

No.	Metabolite	M/Z	Formula	VIP (OPLS-DA)	FC (12000/6000)	P value
1	2-S-cysteiny-DOPA	281.057938	C12H16N2O6S	2.3258	1.1367	0.04626
2	4-Methylene-L-glutamine	159.0758403	C6H10N2O3	2.3513	1.1286	0.006801
3	N-(gamma-Glutamyl)ethanolamine	155.0808709	C7H14N2O4	2.171	1.1062	0.015
4	Furaneol 4-glucoside	255.0884998	C12H18O8	1.8562	1.0775	0.02426
5	N-Methyl-1H-indole-3-propanamide	446.2522699	C12H14N2O	1.8358	1.0573	0.02835
6	Thromboxane B3	432.236738	C20H32O6	1.7391	1.051	0.04967
7	PC(15:0/20:3(5Z,8Z,11Z))	770.566584	C43H80NO8P	1.5313	1.0449	0.04953
8	PC(14:0/14:0)	678.5049518	C36H72NO8P	1.4946	1.0433	0.04528
9	N-(5-Methyl-3-oxohexyl)alanine	202.1430469	C10H19NO3	1.2676	1.0428	0.04504
10	(S)-Succinyldihydrolipoamide	352.0618263	C12H21NO4S2	1.2132	1.0381	0.04474
11	N-ACETYLPROLINE	158.0806144	C7H11NO3	1.0908	1.0373	0.04508
12	(R)-(+)-2-Pyrrolidone-5-carboxylic acid	130.0495223	C5H7NO3	1.434	1.0357	0.01041
13	PE-NMe2(18:0/20:5(5Z,8Z,11Z,14Z,17Z))	794.5663656	C45H80NO8P	1.3973	1.0349	0.03429
14	L-Proline	160.034699	C5H9NO2	1.2391	1.0334	0.02064
15	N-Stearoyl GABA	352.319661	C22H43NO3	1.1179	1.029	0.02509
16	Alpha-(Methylenecyclopropyl)glycine	128.0702467	C6H9NO2	1.0934	1.0284	0.03409
17	2-octenoylglycine	241.1537007	C10H17NO3	1.1985	1.0255	0.03098
18	L-4-Hydroxyglutamate semialdehyde	128.0339403	C5H9NO4	1.3387	1.0247	0.03434
19	PE(18:0/22:6(4Z,7Z,10Z,13Z,16Z,19Z))	805.5516927	C45H78NO8P	1.176	1.0245	0.04895
20	PC(14:0/18:1(11Z))	732.5515592	C40H78NO8P	1.296	1.0243	0.016
21	PC(18:1(11Z)/18:2(9Z,12Z))	784.5818936	C44H82NO8P	1.2547	1.0218	0.02587
22	PC(15:0/20:2(11Z,14Z))	772.5824567	C43H82NO8P	1.0812	1.0196	0.02817
23	N-[2-(3,4-dihydroxyphenyl)ethyl]-3-(4-hydroxy-3-methoxyphenyl)propanimidic acid	330.1378104	C18H21NO5	2.6935	0.8814	0.02959

Abbreviation: VIP, Variable Importance in the Projection; FC, fold change. FC >1, metabolites were upregulated in shrimp given 12000mg/kg dietary choline chloride.

Table S4. The differential expression genes (DEGs) between shrimp given 0 and 6000mg/kg dietary choline.

No.	Gene name	Gene description	Log ₂ FC (6000/0)	P adjust	Regulate
1	LOC113810108	anti-lipopolysaccharide factor-like	7.844017	0.000111	up
2	LOC113825867	myosin heavy chain, cardiac muscle isoform-like	5.787739	0.000863	up
3	LOC113804544	balbiani ring protein 3-like	5.458167	0.04514	up
4	LOC113815764	molt-inhibiting hormone-like, transcript variant X1	5.096405	0.035458	up
5	LOC113800626	peritrophin-1-like	4.807213	0.012688	up
6	LOC113825869	trichohyalin-like	4.693693	4.12E-06	up
7	LOC113825865	GRIP and coiled-coil domain-containing protein 2-like	4.170998	0.000183	up
8	LOC113807950	transferrin-like	4.168086	3.19E-05	up
9	LOC113820924	ETS homologous factor-like	4.051601	0.004139	up
10	LOC113825866	myosin-9-like	3.656412	0.000232	up
11	LOC113809104	myosin-3-like, transcript variant X1	3.532677	0.021486	up
12	LOC113803667	leukocyte elastase inhibitor-like	3.354274	0.044791	up
13	LOC113800111	peritrophin-1-like	3.040403	0.011662	up
14	LOC113825871	myosin heavy chain, cardiac muscle isoform-like, transcript variant X1	3.016526	0.007911	up
15	LOC113816489	sodium-dependent nutrient amino acid transporter 1-like	2.437762	0.018893	up
16	LOC113813386	differentially expressed in FDCP 8-like, transcript variant X1	2.12623	0.03013	up
17	LOC113807093	calponin homology domain-containing protein DDB_G0272472-like	1.425283	0.04982	up
18	LOC113819483	diacylglycerol kinase epsilon-like, transcript variant X3	-1.25709	0.026903	down
19	LOC113810053	zonadhesin-like	-1.52305	0.023393	down
20	LOC113826143	transient receptor potential channel pyrexia-like	-1.58665	0.033123	down
21	LOC113827567	nidogen-2-like	-1.70877	0.007347	down
22	LOC113826144	titin-like	-1.92808	0.004139	down
23	LOC113813703	microfibril-associated glycoprotein 4-like	-2.29295	0.001389	down
24	LOC113805827	carboxypeptidase A1-like	-2.36227	0.029292	down
25	LOC113828069	decorin-like	-2.4468	0.002579	down
26	LOC113813817	apolipoprotein D-like	-2.89322	1.54E-10	down
27	LOC113808791	oplophorus-luciferin 2-monooxygenase non-catalytic subunit-like	-2.92495	0.035884	down
28	LOC113819957	macrophage mannose receptor 1-like	-2.98044	0.024847	down
29	LOC113809173	perlucin-like protein	-3.2117	0.02006	down
30	LOC113809991	L-lactate dehydrogenase-like, transcript variant X2	-3.41541	0.02006	down
31	LOC113825544	alpha-L-fucosidase-like, transcript variant X1	-4.44381	0.004139	down
32	LOC113813877	heme-binding protein 2-like	-4.84094	0.039969	down
33	LOC113813873	heme-binding protein 2-like	-4.85959	0.000119	down
34	LOC113810344	heme-binding protein 2-like	-4.89099	0.034227	down
35	LOC113827864	legumain-like	-5.37446	0.02006	down
36	LOC113825084	nucleolar and coiled-body phosphoprotein 1-like	-5.40186	0.002596	down
37	LOC113813869	heme-binding protein 2-like	-5.49063	0.017872	down
38	LOC113822187	solute carrier family 15 member 2-like, transcript	-5.67644	0.000734	down

		variant X1			
39	LOC113813588	sodium-dependent nutrient amino acid transporter 1-like	-5.72589	0.004139	down
40	LOC113801169	hormone receptor 4-like, transcript variant X1	-5.92713	0.000292	down
41	LOC113807681	b(0,+)-type amino acid transporter 1-like	-6.09243	0.001117	down
42	LOC113820757	perlucin-like protein	-6.10047	0.002238	down
43	LOC113830327	methylglutaconyl-CoA hydratase, mitochondrial-like	-6.24728	0.04287	down
44	LOC113815264	bile salt-activated lipase-like	-6.50885	0.008475	down
45	LOC113810374	heme-binding protein 2-like	-7.18469	1.22E-06	down
46	LOC113810377	heme-binding protein 2-like	-7.25731	0.022913	down
47	LOC113813881	heme-binding protein 2-like	-7.70394	0.004163	down
48	LOC113813875	heme-binding protein 2-like	-7.85354	0.007157	down
49	LOC113830401	organic cation transporter protein-like	-7.95365	0.004662	down
50	LOC113813867	heme-binding protein 2-like	-8.41596	0.000465	down
51	LOC113813866	heme-binding protein 2-like, transcript variant X1	-8.44133	0.000388	down
52	LOC113819956	macrophage mannose receptor 1-like, transcript variant X1	-9.0643	1.24E-07	down
53	LOC113813597	sodium-dependent nutrient amino acid transporter 1-like	-9.13228	1.11E-06	down
54	LOC113823268	facilitated trehalose transporter Tret1-2 homolog, transcript variant X1	-10.4695	0.026903	down

Abbreviation: FC, fold change. Log₂FC >0, DEGs were upregulated in shrimp given 6000mg/kg dietary choline chloride.

Table S5. The differential expression genes (DEGs) between shrimp given 0 and 12000mg/kg dietary choline.

No.	Gene name	Gene description	Log ₂ FC (12000/0)	P adjust	Regulate
1	LOC113827106	28S ribosomal protein S22, mitochondrial-like	5.95414	4.21E-05	up
2	LOC113821248	indole-3-acetaldehyde oxidase-like	4.324374	0.01008	up
3	LOC113804075	calcium-activated chloride channel regulator 1-like	3.1413	0.041365	up
4	LOC113811900	GATA zinc finger domain-containing protein 10-like	2.929035	0.011643	up
5	LOC113824772	chromatin-remodeling ATPase INO80-like	2.269296	0.04208	up
6	LOC113812427	3-oxoacyl-[acyl-carrier-protein] reductase FabG-like	2.14331	0.032453	up
7	LOC113824965	period circadian protein-like	1.800082	0.00389	up
8	LOC113828937	period circadian protein-like, transcript variant X1	1.703999	0.014564	up
9	LOC113827646	serine/threonine-protein phosphatase 6 regulatory ankyrin repeat subunit C-like	1.651592	0.041365	up
10	LOC113804391	nuclear factor interleukin-3-regulated protein-like	1.220087	0.015099	up
11	LOC113818954	N-acetylneuraminate lyase-like	-2.03882	0.035011	down
12	LOC113813817	apolipoprotein D-like	-2.13075	0.01008	down
13	LOC113815249	metallothionein-1-like	-2.16507	0.01008	down
14	LOC113804871	zinc finger protein 665-like	-2.45801	0.004784	down
15	LOC113815366	carotenoid isomeroxygenase-like	-3.00587	0.001461	down
16	LOC113828559	branchpoint-bridging protein-like, transcript variant X1	-3.21203	0.000813	down
17	LOC113813873	heme-binding protein 2-like	-3.22311	0.000142	down
18	LOC113828746	TRIO and F-actin-binding protein-like	-3.29939	0.000647	down
19	LOC113815038	sphingomyelin phosphodiesterase-like	-3.30807	0.032453	down
20	LOC113827839	zyxin-like	-3.5391	1.09E-06	down
21	LOC113828299	cyclin-dependent kinase inhibitor 1C-like	-3.64207	4.2E-05	down
22	LOC113824723	crustacyanin-A2 subunit-like	-3.66914	0.001193	down
23	LOC113828474	formin-2-like	-3.70746	0.01008	down
24	LOC113815367	beta,beta-carotene 15,15'-dioxygenase-like	-3.83031	0.000853	down
25	LOC113824728	crustacyanin-A1 subunit-like	-3.98163	0.000813	down
26	LOC113824726	crustacyanin-A2 subunit-like	-4.15613	8.97E-05	down
27	LOC113824735	crustacyanin-A2 subunit-like	-4.22246	0.00389	down
28	LOC113824722	crustacyanin-A2 subunit-like	-4.4782	2.12E-09	down
29	LOC113824721	crustacyanin-C1 subunit-like	-4.56512	8.63E-05	down
30	LOC113800930	low-density lipoprotein receptor 1-like	-4.60708	0.041365	down
31	LOC113806288	leukocyte elastase inhibitor-like	-5.19245	3.19E-05	down
32	LOC113824731	crustacyanin-C1 subunit-like	-5.32356	0.004105	down
33	LOC113820707	protein patched homolog 2-like	-5.4304	0.008441	down
34	LOC113824736	crustacyanin-A2 subunit-like	-5.84059	0.000853	down
35	LOC113823683	probable cytosolic oligopeptidase A	-7.05389	0.000911	down
36	LOC113800662	glutathione S-transferase 1-like	-9.40786	0.000894	down

Abbreviation: FC, fold change. Log₂FC >0, DEGs were upregulated in shrimp given 12000mg/kg dietary choline chloride.

Table S6. The differential expression genes (DEGs) between shrimp given 6000 and 12000mg/kg dietary choline.

No.	Gene name	Gene description	Log ₂ FC (12000/6000)	P adjust	Regulate
1	LOC113805072	spore coat protein SP65-like	13.49988	4.2E-13	up
2	LOC113813597	sodium-dependent nutrient amino acid transporter 1-like	10.597c94	0.000395	up
3	LOC113819956	macrophage mannose receptor 1-like, transcript variant X1	9.987259	3.79E-07	up
4	LOC113830401	organic cation transporter protein-like	9.950206	0.022393	up
5	LOC113822187	solute carrier family 15 member 2-like, transcript variant X1	8.691168	1.9E-06	up
6	LOC113807681	b(0,+)-type amino acid transporter 1-like	8.012962	0.000454	up
7	LOC113830327	methylglutaconyl-CoA hydratase, mitochondrial-like	7.175249	4.48E-09	up
8	LOC113801169	hormone receptor 4-like, transcript variant X1	6.556356	5.37E-05	up
9	LOC113814499	probable nuclear hormone receptor HR3, transcript variant X1	6.552909	9.25E-05	up
10	LOC113806519	mucin-5AC-like	5.91834	0.001013	up
11	LOC113826635	ADP-ribosylation factor-like protein 5B	5.903299	0.032149	up
12	LOC113823254	dnaJ homolog subfamily C member 9-like	5.858019	0.045734	up
13	LOC113818833	excitatory amino acid transporter 1-like	4.455748	0.00944	up
14	LOC113825544	alpha-L-fucosidase-like, transcript variant X1	4.275865	0.001377	up
15	LOC113809991	L-lactate dehydrogenase-like, transcript variant X2	3.643715	0.007221	up
16	LOC113827830	suppressor of cytokine signaling 2-like	3.507174	0.043773	up
17	LOC113823026	alpha-(1,6)-fucosyltransferase-like	3.487596	0.022199	up
18	LOC113808791	oplophorus-luciferin 2-monooxygenase non-catalytic subunit-like	3.48378	0.038799	up
19	LOC113815331	excitatory amino acid transporter 3-like, transcript variant X1	3.460427	0.032912	up
20	LOC113825741	mannosylglucosyl-3-phosphoglycerate phosphatase-like	3.382708	0.032713	up
21	LOC113811889	leucine-rich repeat neuronal protein 3-like, transcript variant X2	3.297297	0.032912	up
22	LOC113808891	phosphatidylserine decarboxylase proenzyme, mitochondrial-like, transcript variant X1	3.178162	0.034475	up
23	LOC113825944	uracil phosphoribosyltransferase homolog, transcript variant X1	3.171833	0.009126	up
24	LOC113827042	testicular acid phosphatase homolog	3.102037	0.041045	up
25	LOC113823490	xaa-Pro aminopeptidase 1-like	2.848834	0.029871	up
26	LOC113802825	glutamine--fructose-6-phosphate aminotransferase [isomerizing] 2-like, transcript variant X1	2.793581	0.04657	up
27	LOC113811776	baculoviral IAP repeat-containing protein 8-like	2.744965	0.049244	up
28	LOC113819860	sodium/glucose cotransporter 5-like	2.723348	0.032622	up
29	LOC113806747	aquaporin AQP Ae.a-like	2.669321	0.018569	up
30	LOC113823293	caspase-1-like, transcript variant X1	2.587017	0.008012	up
31	LOC113818103	failed axon connections homolog	2.5865	0.038799	up
32	LOC113805827	carboxypeptidase A1-like	2.375335	0.000206	up
33	LOC113818038	arylsulfatase B-like	2.317479	0.003841	up
34	LOC113821424	protein extra-macrochaetae-like	2.302437	0.003841	up
35	LOC113805277	ecdysone receptor-like, transcript variant X1	2.239864	0.003195	up
36	LOC113814440	ornithine decarboxylase antizyme 1-like	2.018943	0.000693	up

37	LOC113806944	serine/arginine repetitive matrix protein 1-like	1.971655	0.022199	up
38	LOC113818477	nose resistant to fluoxetine protein 6-like	1.308009	0.041879	up
39	LOC113812170	ketimine reductase mu-crystallin-like, transcript variant X4	1.269424	0.003657	up
40	LOC113804459	carboxypeptidase Q-like	1.207132	0.003841	up
41	LOC113813092	von Willebrand factor A domain-containing protein 7-like	1.155607	0.020402	up
42	LOC113828197	EF-hand calcium-binding domain-containing protein 7-like	1.123342	0.029765	up
43	LOC113825899	transient receptor potential cation channel subfamily A member 1 homolog, transcript variant X3	1.108051	0.04284	up
44	LOC113812978	macrophage mannose receptor 1-like	-1.33524	0.00062	down
45	LOC113809352	venom toxin OcyC11-like	-1.43839	0.002811	down
46	LOC113815249	metallothionein-1-like	-1.44626	0.048925	down
47	LOC113809900	sialin-like, transcript variant X1	-1.63684	0.04806	down
48	LOC113817695	balbiani ring protein 3-like	-1.76205	0.003841	down
49	LOC113827090	phenoloxidase 3-like	-1.97695	0.019026	down
50	LOC113826663	golgin subfamily A member 6-like protein 22, transcript variant X1	-2.306	0.017903	down
51	LOC113828299	cyclin-dependent kinase inhibitor 1C-like	-2.42734	0.001732	down
52	LOC113818328	multifunctional protein ADE2-like	-2.51618	0.031564	down
53	LOC113813947	facilitated trehalose transporter Tret1-like	-2.52103	0.003934	down
54	LOC113826593	alpha-1-inhibitor 3-like	-2.62332	0.034892	down
55	LOC113800363	anti-lipopolysaccharide factor-like	-2.68183	0.031564	down
56	LOC113802295	lysozyme C-like	-2.69754	0.047908	down
57	LOC113825609	sialin-like, transcript variant X1	-2.79306	0.00062	down
58	LOC113823795	trypsin-1-like	-2.7932	0.006343	down
59	LOC113810916	delta(7)-sterol 5(6)-desaturase-like	-2.88896	0.017103	down
60	LOC113809687	alpha-1-inhibitor 3-like	-2.92052	0.000315	down
61	LOC113815775	WAP four-disulfide core domain protein 5-like	-2.93304	0.012603	down
62	LOC113812834	transforming growth factor-beta-induced protein ig-h3-like	-2.99105	0.015534	down
63	LOC113802496	phenoloxidase-activating factor 2-like	-3.05477	0.012063	down
64	LOC113811681	myc-associated zinc finger protein-like	-3.22772	0.028102	down
65	LOC113828559	branchpoint-bridging protein-like, transcript variant X1	-3.31883	6.54E-05	down
66	LOC113824726	crustacyanin-A2 subunit-like	-3.31696	0.034475	down
67	LOC113827839	zyxin-like	-3.35266	1.14E-09	down
68	LOC113826214	phenoloxidase-activating factor 3-like	-3.41042	0.017903	down
69	LOC113828746	TRIO and F-actin-binding protein-like	-3.47993	0.000332	down
70	LOC113804438	type-2 ice-structuring protein-like	-3.46708	0.027005	down
71	LOC113814992	translation initiation factor IF-2-like	-3.53181	0.043773	down
72	LOC113815367	beta,beta-carotene 15,15'-dioxygenase-like	-3.82866	0.031418	down
73	LOC113824723	crustacyanin-A2 subunit-like	-3.88406	0.000421	down
74	LOC113827875	alpha-1-inhibitor 3-like	-4.02009	0.002744	down
75	LOC113826189	O-acyltransferase like protein-like	-4.01851	0.019026	down
76	LOC113824728	crustacyanin-A1 subunit-like	-4.04042	0.006632	down
77	LOC113828474	formin-2-like	-4.14341	1.39E-13	down
78	LOC113803689	uncharacterized protein PF11_0207-like, transcript variant X1	-1.69567	0.000299	down
79	LOC113815366	carotenoid isomeroxygenase-like	-4.15222	0.000118	down

80	LOC113818743	protein white-like	-4.16391	0.001112	down
81	LOC113824721	crustacyanin-C1 subunit-like	-4.27014	0.000192	down
82	LOC113805652	CD209 antigen-like protein E	-4.37184	0.031564	down
83	LOC113828724	microtubule-associated protein futsch-like	-4.53329	0.000996	down
84	LOC113823186	sulfotransferase 1C4-like, transcript variant X1	-4.78028	0.034475	down
85	LOC113824731	crustacyanin-C1 subunit-like	-4.84418	0.023571	down
86	LOC113824736	crustacyanin-A2 subunit-like	-5.16275	0.000693	down
87	LOC113827177	alcohol dehydrogenase [NADP(+)]-like	-5.29038	0.010814	down
88	LOC113807647	alpha-mannosidase 2C1-like	-5.38115	0.036814	down
89	LOC113806288	leukocyte elastase inhibitor-like	-5.83852	4.77E-10	down
90	LOC113800744	nucleoside diphosphate-linked moiety X motif 8-like	-6.36704	0.008748	down
91	LOC113823683	probable cytosolic oligopeptidase A	-8.28377	0.003483	down

Abbreviation: FC, fold change. Log₂FC >0, DEGs were upregulated in shrimp given 12000mg/kg dietary choline chloride.

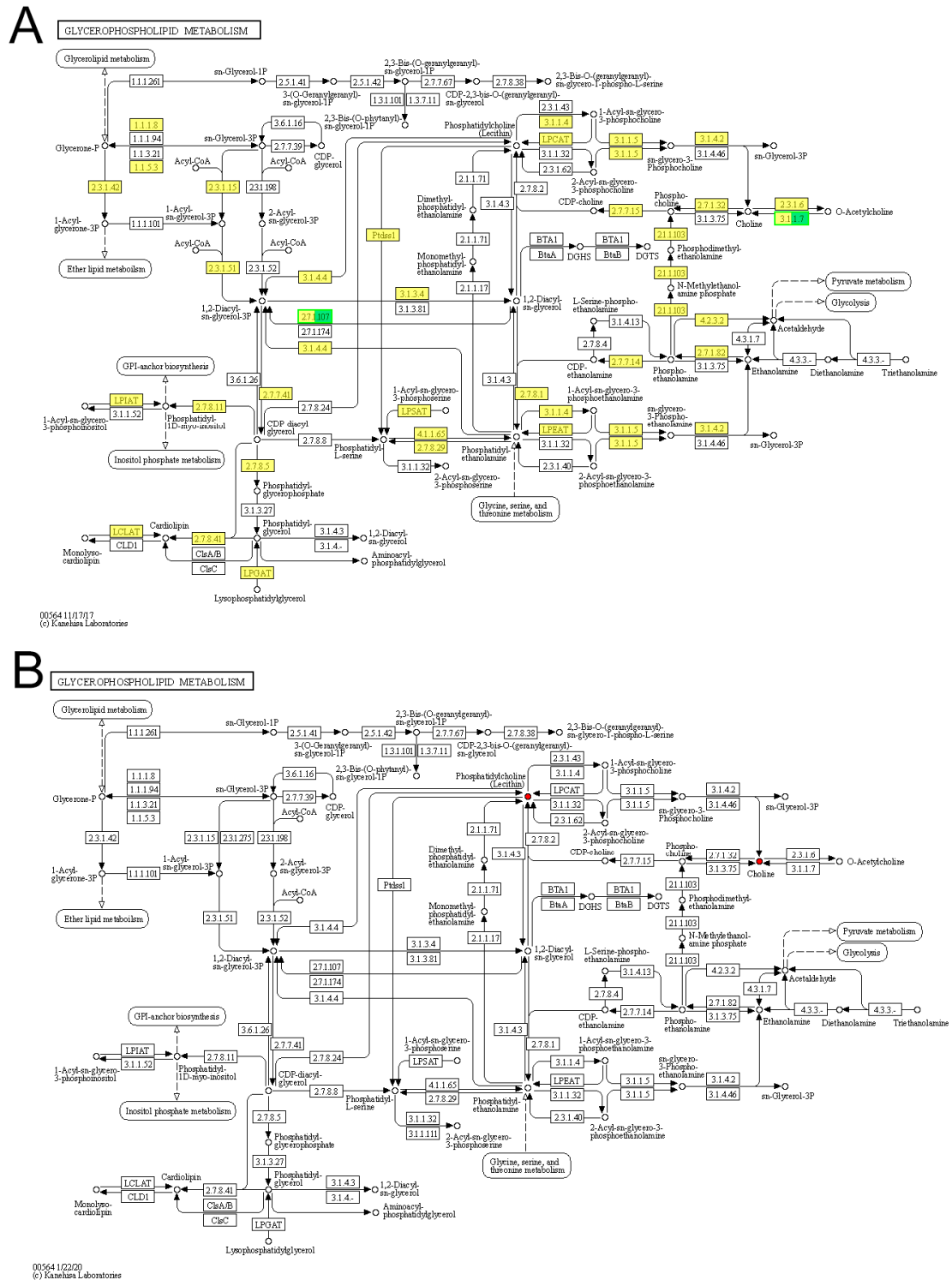


Figure S1. The KEGG pathway enrichment analysis for glycerophospholipid lipid pathway between shrimp fed 0 and 6000 mg/kg dietary choline (A, transcriptome; B, metabolome). Green squares represent downregulated genes in shrimp fed 6000 mg/kg choline. Red circle represent downregulated metabolites in shrimp fed 6000 mg/kg choline.