

Supplementary Table 1: Top 50 Lipid species based on t-test.

Lipid Species	t.stat	P value	FDR adj P value
FFA(22:0);[M-H]-	5.8769	4.03E-05	0.015838
FFA(18:2);[M-H]-	5.8119	4.51E-05	0.015838
Unknown_FAHFA 36:1	5.7633	4.91E-05	0.015838
FFA(18:1);[M-H]-	5.5066	7.73E-05	0.01871
Unknown_FAHFA 34:0	5.2039	0.000134	0.021838
CAR 16:0	5.1969	0.000135	0.021838
Unknown_FAHFA 38:4	5.0471	0.000178	0.024652
FFA(20:4) Arachidonic acid;[M-H]-	4.8262	0.000269	0.032551
Unknown_FAHFA 40:4	4.7156	0.000331	0.035633
Unknown_FAHFA 37:3	4.6549	0.000372	0.035974
FFA(20:1);[M-H]-	4.4667	0.000532	0.046824
FFA(24:1);[M-H]-	4.3822	0.000626	0.050488
CAR 18:0	4.3362	0.000684	0.05093
FFA(18:0);[M-H]-	3.9186	0.001544	0.10677
CAR 18:1	3.8642	0.001719	0.10908
Unknown_FAHFA 38:6	3.8252	0.001856	0.10908
PI 36:2	-3.7438	0.00218	0.10908
PC 40:5	3.7369	0.00221	0.10908
Unknown PC 40:5@7.38	3.7369	0.00221	0.10908
FFA(20:0);[M-H]-	3.7267	0.002255	0.10908
Unknown_FAHFA 36:4	3.7023	0.002367	0.10908
PC O-40:5	3.5141	0.003437	0.13986
CerP 42:2;2O	3.4949	0.003571	0.13986
Unknown_FAHFA 35:0	3.4917	0.003594	0.13986
FFA(16:0);[M-H]-	3.4892	0.003612	0.13986
SM 40:1;2O	3.4429	0.00396	0.14745
Unknown_FAHFA 32:3	3.4	0.004313	0.15464
PC 38:4	3.3418	0.004842	0.16741
FFA(24:0);[M-H]-	3.2841	0.005432	0.18131
PC 41:5	3.2263	0.006093	0.1966
Unknown_FAHFA 40:3	3.1812	0.006665	0.20812
PC O-39:5	3.1525	0.007057	0.21346
PE O-42:5	3.1247	0.007457	0.21542
Unknown PC 38:6@4.72	3.1174	0.007566	0.21542
FFA(22:2);[M-H]-	3.0457	0.008724	0.23715
PI 39:4	-3.0354	0.008904	0.23715
FFA(20:5);[M-H]-	3.0264	0.009065	0.23715
PC 36:4	2.9505	0.010536	0.26415
LPC O-24:1	-2.9454	0.010643	0.26415
TG 35:0	-2.8642	0.012496	0.3024
Unknown Unknown_FAHFA 38:4@1.74	2.8173	0.013706	0.32274

SM 43:2;3O	-2.8064	0.014003	0.32274
PE-Cer 34:2;2O	2.7894	0.01448	0.32597
PE O-40:6	2.732	0.016207	0.35656
SM 40:2;2O	2.7202	0.016586	0.35679
CAR 14:1	2.6359	0.019559	0.38368
CAR 20:0	2.6306	0.019764	0.38368
Unknown_FAHFA 35:2	2.6172	0.020286	0.38368
PC O-21:3	-2.6125	0.020473	0.38368
FFA(22:3);[M-H]-	2.604	0.020816	0.38368

Supplementary Table 2: Lipid Species level active and suppressed lipid metabolism pathways.

Active Pathways	Pathway classification	Z-score	Predicted genes
DG(36:3)→PE(36:3)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	2.715	CEPT1
PE(30:0)→PC(30:0)	Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	2.328	PEMT
DG(34:3)→PE(34:3)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	2.29	CEPT1
DG(32:1)→PC(32:1)	Biosynthesis of PS (Glycerolipids and Glycerophospholipids), Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	2.217	CHPT1
DG(38:6)→PE(38:6)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	2.148	CEPT1
DG(34:3)→PC(34:3)	Biosynthesis of PS (Glycerolipids and Glycerophospholipids), Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	2.114	CHPT1
DG(38:6)→PC(38:6)	Biosynthesis of PS (Glycerolipids and Glycerophospholipids), Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	2.062	CHPT1
DG(35:1)→PE(35:1)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.922	CEPT1
DG(35:2)→PE(35:2)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.904	CEPT1
PE(40:7)→PC(40:7)	Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.858	PEMT
DG(32:1)→PE(32:1)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.851	CEPT1

DG(40:4)→PC(40:4)	Biosynthesis of PS (Glycerolipids and Glycerophospholipids), Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.829	CHPT1
PE(40:4)→PC(40:4)	Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.822	PEMT
DG(36:1)→PE(36:1)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.793	CEPT1
DG(38:5)→PE(38:5)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.733	CEPT1
DG(34:2)→PE(34:2)	Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.678	CEPT1
DG(36:3)→PC(36:3)	Biosynthesis of PS (Glycerolipids and Glycerophospholipids), Biosynthesis of PE (Glycerolipids and Glycerophospholipids), Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.65	CHPT1

Suppressed Pathways	Pathway Classification	Z-score	Predicted genes
PE(36:4)→PC(36:4)	Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.768	PEMT
PE(40:5)→PC(40:5)	Biosynthesis of PC (Glycerolipids and Glycerophospholipids)	1.661	PEMT

Supplementary Table 3: Species level active lipid metabolism reactions.

Active Reactions	Z-score	Predicted genes
PA(36:2) → PI(36:2)	3.679	CDS1 , CDS2 , CDIPT
DG(36:3) → PE(36:3)	2.715	CEPT1
PE(30:0) → PC(30:0)	2.328	PEMT
DG(34:3) → PE(34:3)	2.29	CEPT1
DG(32:1) → PC(32:1)	2.217	CHPT1
DG(38:6) → PE(38:6)	2.148	CEPT1
DG(38:6) → PC(38:6)	2.062	CHPT1
PC(28:1) → DG(28:1)	2.045	No genes identified yet
DG(35:1) → PE(35:1)	1.922	CEPT1
DG(35:2) → PE(35:2)	1.904	CEPT1
PE(40:7) → PC(40:7)	1.858	PEMT
DG(32:1) → PE(32:1)	1.851	CEPT1
DG(40:4) → PC(40:4)	1.829	CHPT1
PC(40:5) → DG(40:5) → PE(40:5)	1.827	CEPT1
PE(40:4) → PC(40:4)	1.822	PEMT
DG(36:1) → PE(36:1)	1.793	CEPT1
DG(38:5) → PE(38:5)	1.733	CEPT1
DG(34:3) → PC(34:3) → PA(34:3)	1.709	CHPT1 , PLD1 , PLD2
DG(34:2) → PE(34:2)	1.678	CEPT1
DG(36:3) → PC(36:3)	1.65	CHPT1

Supplementary Table 4 : Species level suppressed lipid metabolism reactions.

Suppressed Reactions	Z-score	Predicted genes
PC(34:3) → DG(34:3)	2.294	No genes identified yet
PC(38:6) → DG(38:6)	1.866	No genes identified yet
PE(36:4) → PC(36:4)	1.768	<i>PEMT</i>
PE(40:5) → PC(40:5)	1.661	<i>PEMT</i>