Table S1. Composition of AIN-93G and HFHS diets

Ingredients	AIN-93G diet	HFHS diet
Casein	20.00%	23.31%
L-cystine	0.35%	0.35%
Corn starch	39.75%	8.48%
Maltodextrin	13.20%	11.65%
Sucrose	10.00%	20.14%
Cellulose	5.00%	5.83%
Soybean Oil	7.00%	2.91%
Lard	--	20.68%
Mineral Mix	3.50%	5.23%
Vitamin Mix	1.00%	1.16%
Choline bitartrate	0.2%	0.23%

Table S2. Fatty acids composition of fish oil, mussel oil and corn oil.

Fatty acids	FO	MO	CO
C8:0	0.09	ND	ND
C12:0	0.02	ND	ND
C14:0	2.49	3.63	0.04
C15:0	0.22	0.49	ND
C16:0	9.04	18.63	12.52
C17:0	0.47	0.65	0.08
C18:0	3.82	2.03	1.22
C20:0	0.20	ND	0.37
C23:0	1.27	1.26	ND
Total SFA	17.62	26.69	14.23
C14:1n-5	0.01	0.11	ND
C16:1n-7	5.81	11.48	0.15
C17:1n-7	ND	0.48	0.04
C18:1n-9	20.60	3.17	29.13
C20:1n-9	1.90	3.56	0.34
C22:1n-9	1.38	ND	0.04
Total MUFA	29.71	18.80	29.71
C18:3n-3	1.27	2.31	0.69
C20:3n-3	0.40	0.17	ND
C20:5n-3	24.37	20.99	ND
C22:5n-3	2.17	1.09	ND
C22:6n-3	20.04	26.74	ND
Total n-3 PUFA	48.25	51.30	0.69
C18:2n-6	2.49	1.18	55.37
C18:3n-6	0.38	ND	ND
C20:2n-6	0.22	0.63	ND
C20:3n-6	0.06	ND	ND
C20:4n-6	1.26	1.40	ND
Total n-6 PUFA	4.42	3.21	55.37

SFA, saturated fatty acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; FO, fish oil; MO, mussel oil; CO, corn oil; ND, not detected or negligible.

Table S3. Information for detected sphingolipids in mass spectrum

Compounds	Formula	Precursor ions (m/z)	Product ions (m/z)	CE(V)
Sphingosine (d18:1)	$C_{18}H_{37}NO_2$	300.2	282.2/264.2	25
Sphinganine (d18:0)	$C_{18}H_{39}NO_2$	302.2	284.2/266.4	25
Sphingosine 1-phosphate (d18:1)	$C_{18}H_{38}NO_5P$	380.2	362.1/264.2	32
Sphinganine 1-phosphate (d18:0)	$C_{18}H_{40}NO_5P$	382.2	266.2/364.2	30
Sphinganine (d20:0)*	$C_{20}H_{43}NO_2$	330.2	312.3/295.2	35
Sphingosine-1-phosphate (d17:1)*	$C_{17}H_{36}NO_5P$	366.2	250.2/348.3	30

* Internal standards. CE, collision energy

Table S4. Relationship between n-3 PUFA content and glucose and sphingolipids metabolism in liver of mice on HFHS diet.

Parameters	C20:5n-3		C22:6n-3		Total n-3 PUFA	
	r	p	r	p	r	p
AUC of OGTT	-0.150	0.553	-0.633	0.005	-0.598	0.009
AUC of ITT	-0.457	0.056	-0.594	0.009	-0.531	0.023
Fasting blood glucose (mmol/L)	0.224	0.371	-0.122	0.630	-0.064	0.801
Insulin (mU/L)	0.131	0.604	-0.150	0.553	-0.061	0.810
HOMA-IR	0.232	0.354	-0.162	0.521	-0.090	0.723
SphK1 (relative protein level)	-0.527	0.117	-0.855	0.002	-0.830	0.003
SphK2 (relative protein level)	0.588	0.074	0.867	0.001	0.903	< 0.001
P-Akt (relative protein level)	-0.212	0.556	0.394	0.260	0.406	0.244
Akt (relative protein level)	0.127	0.726	0.673	0.033	0.661	0.038
Sphingosine (pmol/mg tissue)	0.165	0.573	0.007	0.982	0.125	0.670
Sphinganine (pmol/mg tissue)	0.495	0.072	0.358	0.208	0.490	0.075
Sphingosine 1-phosphate (pmol/mg tissue)	-0.464	0.095	-0.297	0.303	-0.345	0.227
Sphinganine 1-phosphate (pmol/mg tissue)	-0.556	0.039	-0.341	0.233	-0.204	0.483

Data were expressed as Spearmen correlation coefficient and corresponding p value. HFHS, high-fat and high-sucrose; AUC, area under curve; PUFA, polyunsaturated fatty acids; OGTT, oral glucose tolerance test; ITT, insulin tolerance test; homeostasis model assessment-insulin resistance; SphK, sphingosine kinase.

Table S5. Biochemical parameters and inflammatory factors in serum.

Parameters	Groups				p
	Normal diet+CO (n=7)	HFHS+CO (n=8)	HFHS+FO (n=7)	HFHS+MO (n=7)	
TG (mmol/L)	0.91 ± 0.41	0.76 ± 0.57	0.85 ± 0.18	1.00 ± 0.85	0.867
TC (mmol/L)	3.10 ± 2.17	2.03 ± 1.03	2.73 ± 1.33	2.34 ± 2.03	0.642
HDL-C (mmol/L)	2.50 ± 0.81	2.56 ± 0.90	2.55 ± 1.04	1.80 ± 1.64	0.536
LDL-C (mmol/L)	0.53 ± 0.19	0.48 ± 0.36	0.69 ± 0.22	0.58 ± 0.43	0.615
IL-6 (pg/mL)	91.42 ± 20.91	102.55 ± 15.84	93.01 ± 15.92	99.54 ± 14.59	0.549
IL-10 (pg/mL)	324.77 ± 27.95	341.27 ± 21.02	349.18 ± 8.93	328.01 ± 24.10	0.145
TNF-α (pg/mL)	538.96 ± 123.43	577.32 ± 87.33	578.65 ± 38.40	576.05 ± 19.72	0.741

HFHS, high-fat and high-sucrose; FO, fish oil; MO, mussel oil; CO, corn oil

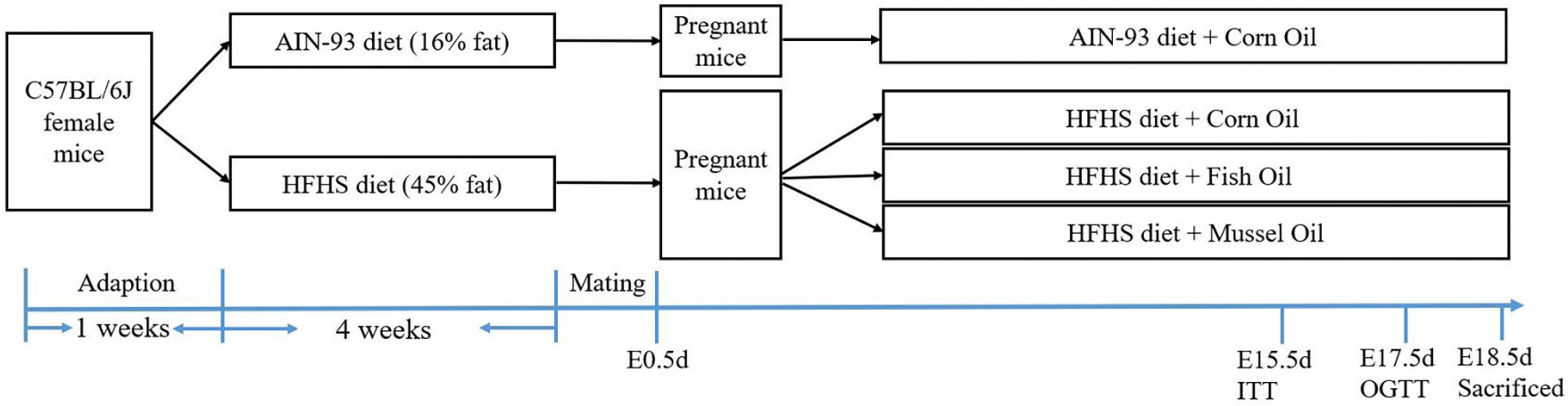

Figure S1. Diagram of study design. HFHS, high-fat and high-sucrose; ITT, insulin tolerance test; OGTT, oral glucose tolerance test.

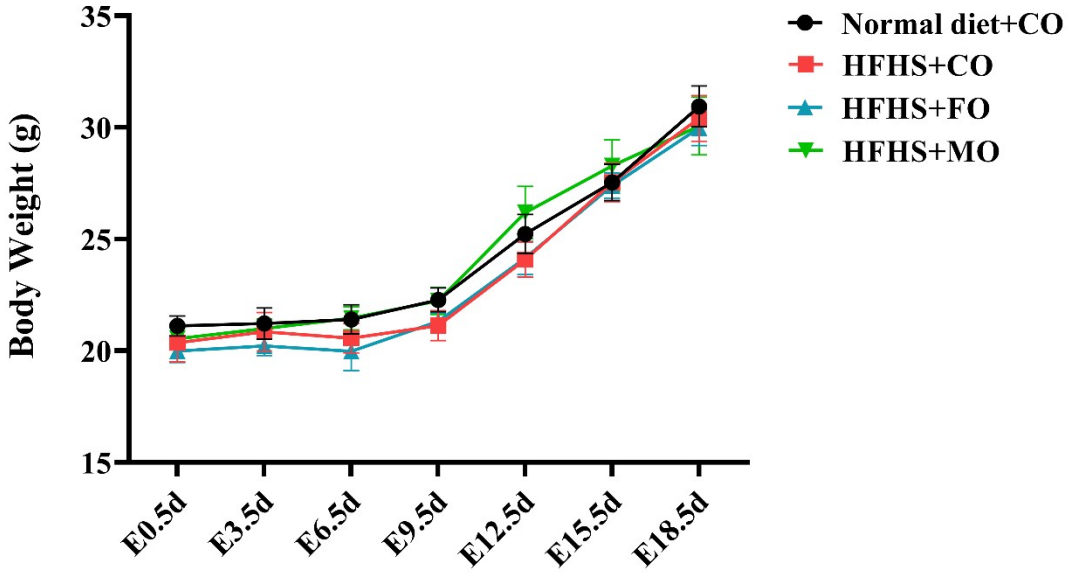

Figure S2. Body weight of mice during pregnancy (normal diet+CO, n=7; HFHS+CO, n=8; HFHS+FO, n=7; HFHS+MO, n=7). Data were expressed as mean ± SEM. HFHS, high-fat high-sucrose diet; CO, corn oil; FO, fish oil; MO, mussel oil.

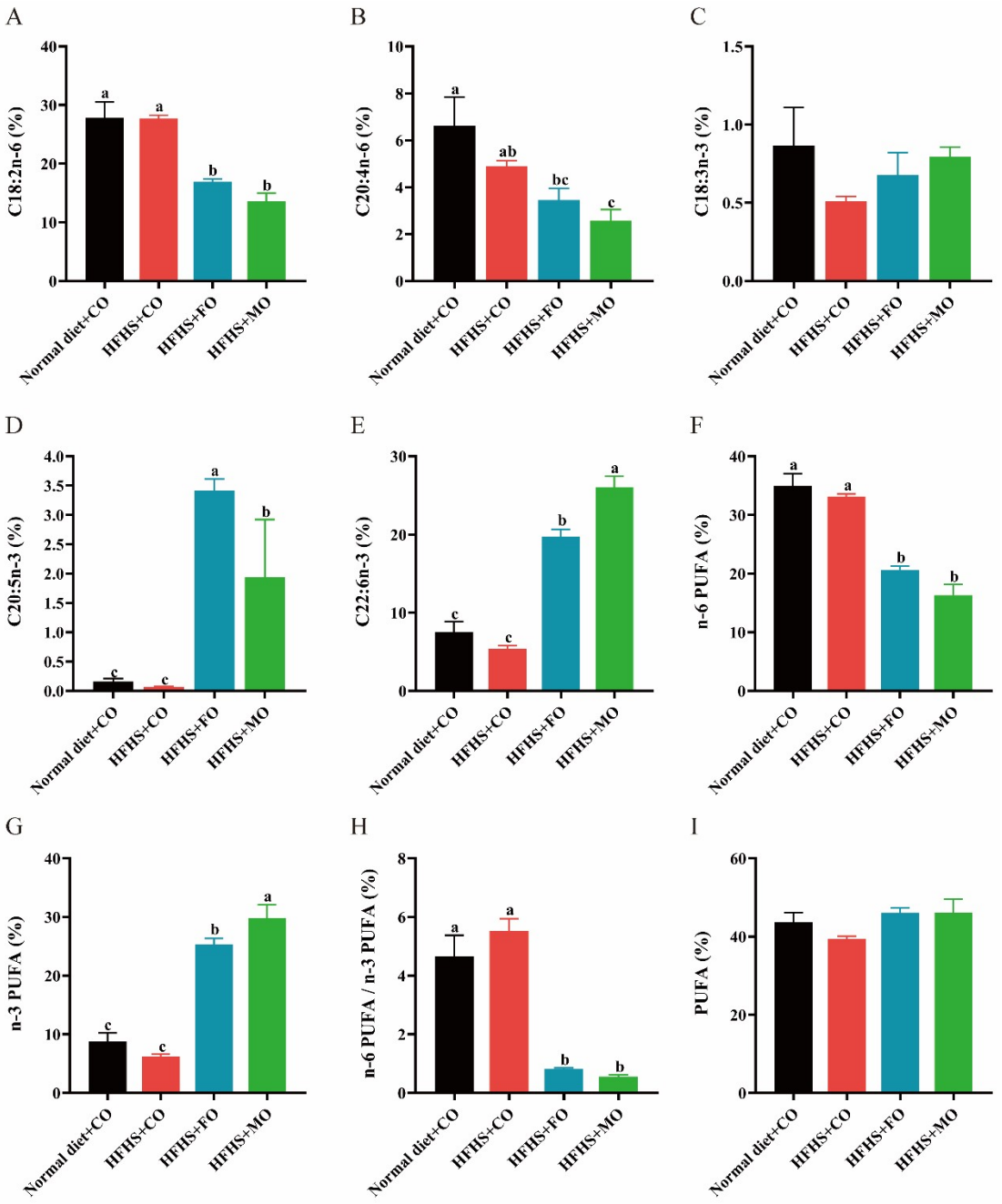

Figure S3. Fatty acids composition in liver of pregnant mice (normal diet+CO, n=7; HFHS+CO, n=8; HFHS+FO, n=5; HFHS+MO, n=5). Data were expressed as mean ± SEM. HFHS, high-fat high-sucrose diet; CO, corn oil; FO, fish oil; MO, mussel oil.