Table S1. The fatty acid compositions of test oils

Fatty acid composition	Soybean DAG oil (%)	Soybean TAG oil (%)
C16:0	19.09	18.77
C18:0	4.32	4.5
C18:1	25.13	25.89
C18:2	51.32	50.67
C18:3	0.14	0.17

Table S2. The compositions of different mouse diets

Ingredient	**Normal diet**	**Soybean TAG oil-based high-fat diet**	**Soybean DAG oil-based high-fat diet**	**Soybean DAG oil-based low-fat diet**
Casein (%)	20.0	28.8	28.8	20.0
L-cystine (%)	0.3	0.4	0.4	0.3
Corn starch (%)	39.7	0	0	36.2
Maltodextrin (%)	13.2	18.0	18.0	13.7
Sucrose (%)	10.0	9.9	9.9	10.0
Cellulose (%)	5.0	7.2	7.2	5.0
Soybean triacylglycerol oils (%)	7.0	27.5	0	0
Soybean diacylglycerol oils (%)	0	0	27.5	10.0
Mineral premix (%)	3.5	6.5	6.5	3.5
Vitamin premix (%)	1.0	1.4	1.4	1.0
Choline bitartrate (%)	0.3	0.3	0.3	0.3
Dietary lipids (g/100g)	7.0	34.9	34.9	10.0
DAG content (g/100g)	0	0	19.6	5.2
Energy supplied by lipids (%)	15.7	59.9	59.9	15.7
Energy supplied by DAG (%)	0	0	33.7	22.0

Table S3. The levels of branched-chain amino acid and bile acid in mice blood

Class	**Metabolite**	**SPF+Low-TAG**	**SPF+Low-DAG**	**GF+Low-DAG**
Primary bile acid	Cholic acid (CA) (μmol/L)	0.75±0.85	1.46±1.10*	0.01±0.01
	Taurocholic acid (TCA) (μmol/L)	13.28±29.42	0.23±0.10	1.33±1.66
	Glycocholic acid (GCA) (μmol/L)	0.06±0.05	0.09±0.08	0.04±0.03
	Chenodeoxycholic acid (CDCA) (μmol/L)	0.42±0.05	0.46±0.14	0.45±0.03
	Taurochenodeoxycholic acid (TCDCA) (μmol/L)	0.49±1.04	0.08±0.07	0.21±0.30
	Glycochenodeoxycholic acid (GCDCA) (μmol/L)	0.03±0.01	0.07±0.05*	0.03±0.02
	α-Muricholic acid (α-MCA) (μmol/L)	14.29±31.28	0.93±0.53	23.56±35.18
	β-Muricholic Acid (β-MCA) (μmol/L)	0.56±0.45	0.85±0.79	0.13±0.06
	ω-Muricholic acid (ω-MCA) (μmol/L)	3.66±7.84	0.42±0.21	0.19±0.17
Secondary bile acid	Deoxycholic acid (DCA) (μmol/L)	0.85±0.18	1.30±0.31*	0.44±0.10
	Glycolithocholic acid (GLCA) (μmol/L)	0.03±0.00	0.09±0.08*	0.02±0.01
	Isolithocholic acid (IsoLCA) (μmol/L)	0.03±0.01	0.07±0.05*	0.04±0.01
	Ursodeoxycholic acid (UDCA) (μmol/L)	0.14±0.06	0.25±0.15*	0.03±0.02
	β-Ursodeoxycholic Acid (β-UDCA) (μmol/L)	0.05±0.00	0.11±0.08*	0.02±0.02
	Tauroursodeoxycholic acid (TUDCA) (μmol/L)	0.55±1.16	0.12±0.11	0.26±0.24
	Hyodeoxycholic acid (HDCA) (μmol/L)	0.03±0.01	0.14±0.06*	0.00±0.01
	Taurohyodeoxycholic acid (THDCA) (μmol/L)	1.22±1.99	0.37±0.09	0.12±0.13
Branched-chain amino acid (BCAA)	Leucine (μmol/L)	159.42±25.54	162.52±32.88	161.87±26.76
	Isoleucine (μmol/L)	84.37±14.23	96.46±26.47	95.18±23.34
	Valine (μmol/L)	638.74±158.46	1063.79±531.04	738.79±180.61
Branched-chain keto acid (BCKA)	Ketoleucine (μmol/L)	65.37±19.08	101.71±18.96*	231.69±96.07
	3-Methyl-2-oxopentanoic acid (μmol/L)	91.38±15.32	136.17±25.45*	302.92±110.72

	2-Hydroxy-3-methylbutyric acid (μmol/L)	14.22±3.20	27.80±2.93	28.99±1.93

Results were presented as mean ± SD (n=6), * indicated the significant difference (VIP>1) versus the SPF+Low-TAG group and the GF+Low-DAG group according to the orthogonal partial least squares discrimination (OPLS-DA) analysis.

Table S4.1. The levels of differential serum metabolites

Class	Metabolite	SPF+Low-TAG	SPF+Low-DAG	GF+Low-DAG
Primary bile acid	Cholic acid (CA) (μmol/L)	0.75±0.85	1.46±1.10	0.01±0.01
	Glycochenodeoxycholic acid (GCDCA) (μmol/L)	0.03±0.01	0.07±0.05	0.03±0.02
Secondary bile	Deoxycholic acid (DCA) (μmol/L)	0.85±0.18	1.30±0.31	0.44±0.10
acid	Glycolithocholic acid (GLCA) (μmol/L)	0.03±0.00	0.09±0.08	0.02±0.01
	Isoallolithocholic acid (IsoalloLCA) (μmol/L)	0.01±0.01	0.06±0.06	0.01±0.01
	Hyodeoxycholic acid (HDCA) (μmol/L)	0.03±0.01	0.14±0.06	0.00±0.01
	Ursodeoxycholic acid (UDCA) (μmol/L)	0.14±0.06	0.25±0.15	0.03±0.02
	β-Ursodeoxycholic Acid (β-UDCA) (μmol/L)	0.05±0.00	0.11±0.08	0.02±0.02
Indole	Indole-3-propionic acid (μmol/L)	0.44±0.09	0.72±0.18	0.07±0.01
Amino Acid	α-Aminobutyric acid (μmol/L)	8.97±2.17	14.66±1.85	26.48±7.88
	Acetylglycine (μmol/L)	27.51±4.40	16.52±5.63	9.70±2.49
	3-Chlorotyrosine (μmol/L)	0.33±0.02	0.51±0.17	0.29±0.04
Branched-chain keto acid (BCKA)	Ketoleucine (μmol/L)	65.37±19.08	101.71±18.96	231.69±96.07
Fatty acid	Petroselinic acid (μmol/L)	14.78±6.65	7.70±3.75	3.90±4.06
	Palmitoleic acid (μmol/L)	294.42±111.53	110.10±27.55	71.84±67.42
	Citraconic acid (μmol/L)	0.07±0.03	0.19±0.15	0.05±0.02
Organic acid	Malonic acid (μmol/L)	5.35±0.81	3.78±1.60	1.63±0.62
	3-Methyl-2-oxopentanoic acid (μmol/L)	91.38±15.32	136.17±25.45	302.92±110.72
	2-Hydroxyglutaric acid (μmol/L)	5.64±0.60	7.57±1.08	4.84±1.32
Carnitine	Methylmalonylcarnitine (μmol/L)	0.15±0.02	0.29±0.18	0.12±0.01
	Adipoylcarnitine (μmol/L)	0.06±0.01	0.04±0.02	0.02±0.01
Nucleotides	Adenosine monophosphate (AMP) (μmol/L)	0.30±0.14	1.74±2.15	0.23±0.05
Benzoic Acids	4-Hydroxybenzoic acid (μmol/L)	0.14±0.04	0.24±0.10	0.14±0.05

Results were presented as mean ± SD (n=6).

Table S4.2. The levels of differential caecal metabolites

Class	Metabolite	SPF+Low-TAG	SPF+Low-DAG	GF+Low-DAG
Primary bile acid	Cholic acid (CA) (μmol/L)	27.36±20.09	185.50±114.85	2.11±4.02
	Taurocholic acid (TCA) (μmol/L)	1.84±0.77	0.49±0.56	52.47±14.13
	Chenodeoxycholic acid (CDCA) (μmol/L)	3.14±2.54	10.97±8.06	0.55±0.61
	β-Muricholic acid (β-MCA) (μmol/L)	300.28±203.59	536.19±137.74	1.81±3.61
Secondary bile acid	Isolithocholic acid (IsoLCA) (μmol/L)	6.89±2.78	3.56±2.98	0.01±0.01
	Ursodeoxycholic acid (UDCA) (μmol/L)	6.49±3.72	22.71±10.26	0.21±0.12
	β-Ursodeoxycholic acid (β-UDCA) (μmol/L)	11.24±2.94	27.12±11.46	0.26±0.00
	β-Hyodeoxycholic acid (β-HDCA) (μmol/L)	39.72±6.02	21.67±4.08	1.35±0.00
	Ursocholic acid (UCA) (μmol/L)	5.83±6.06	13.52±6.68	0.25±0.04
	Hyocholic acid (HCA) (μmol/L)	23.61±8.70	11.04±4.03	0.57±0.00
Indole	Indole-3-propionic acid (μmol/L)	0.39±0.10	0.98±0.55	0.02±0.01
	Indole-3-carboxylic acid (μmol/L)	6.64±1.73	13.47±5.53	1.27±0.64
Amino acid	β-Alanine (μmol/L)	47.10±17.08	13.92±7.00	1.32±0.32

	N-Acetyltryptophan (μmol/L)	0.83±0.43	3.91±3.55	0.15±0.09
	Aspartic acid (μmol/L)	570.85±104.73	2372.13±948.52	828.66±143.27
Branched-chain keto acid	Ketoleucine (μmol/L)	3892.99±2171.26	1218.01±640.33	42.34±13.45
(BCKA)	3-Methyl-2-oxopentanoic acid (μmol/L)	3883.85±1998.89	1269.01±719.22	51.39±16.17
Fatty acid	Suberic acid (μmol/L)	10.33±2.17	4.45±1.07	0.65±0.32
	Methylsuccinic acid (μmol/L)	4.91±1.72	1.76±0.52	0.77±0.17
	Azelaic acid (μmol/L)	13.50±3.05	6.11±2.37	2.79±0.79
Organic acid	α-Ketoisovaleric acid (μmol/L)	32.18±20.94	9.70±4.17	0.97±0.51
	Glutaric acid (μmol/L)	7.62±2.23	4.02±1.16	1.83±0.33
	Methylmalonic acid (μmol/L)	53.11±38.27	373.20±168.80	75.83±28.18
	Oxoglutaric acid (μmol/L)	545.17±491.36	57.72±57.95	5.14±2.32
	Aconitic acid (μmol/L)	5.48±1.73	2.30±0.63	34.48±8.55
	Oxalic acid (μmol/L)	33.75±3.27	18.16±2.32	37.53±8.61
	Succinic acid (μmol/L)	198.57±69.57	796.60±357.82	30.91±9.76
Carbohydrate	Glucose (μmol/L)	1984.00±558.94	5088.01±2425.90	872.77±178.49
Carnitine	Propionylcarnitine (μmol/L)	0.00±0.00	0.11±0.13	1.08±0.26
	Acetylcarnitine (μmol/L)	0.60±0.43	3.18±3.08	10.00±3.10
Phenylpropanoic acid	2-Phenylpropionate (μmol/L)	16.53±6.58	5.51±4.09	0.02±0.01
Benzenoid	Hydrocinnamic acid (μmol/L)	45.17±18.06	15.58±11.24	0.75±0.12
	Phenylpyruvic acid (μmol/L)	436.52±234.53	129.32±65.10	1.73±1.90

Results were presented as mean ± SD (n=6).