Supplementary materials

Figure caption:

Fig. S1 Body weight of different groups. Normal(N), normal diet feed; Model(M), high fat diet feed; N+FPM, normal diet feed plus polysaccharides from fermented *M. charantia* juice at middle dose with 100 mg/kg b.w.; N+NFP, normal diet feed plus polysaccharide from non-fermented *M. charantia* juice 100 mg/kg b.w.; FPL, high fat diet feed plus polysaccharides from fermented *M. charantia* juice at low dose with 50 mg/kg b.w.; FPM, high fat diet feed plus fermented *M. charantia* juice at middle dose with 100 mg/kg b.w.; FPH, high fat diet feed plus fermented *M. charantia* juice at high dose with 200 mg/kg b.w.; NFP, high fat diet feed plus polysaccharides from fermented *M. charantia* juice at middle dose with 100 mg/kg b.w. All values are expressed as means ± standard deviation.

*indicates significant difference compared with model groups, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Fig. S2 The relative of abundance pie chart of taxonomic composition of community at phylum level

Fig. S3 Relative abundance of main phyla in different groups. Normal(N), normal diet feed; Model(M), high fat diet feed; FPL, high fat diet feed plus polysaccharides from fermented *M. charantia* juice at low dose with 50 mg/kg b.w.; FPM, high fat diet feed plus fermented *M. charantia* juice at middle dose with 100 mg/kg b.w.; FPH, high fat diet feed plus fermented *M. charantia* juice at high dose with 200 mg/kg b.w.; NFP, high fat diet feed plus polysaccharides from fermented *M. charantia* juice at middle dose with 100 mg/kg b.w. All values are expressed as means ± standard deviation.

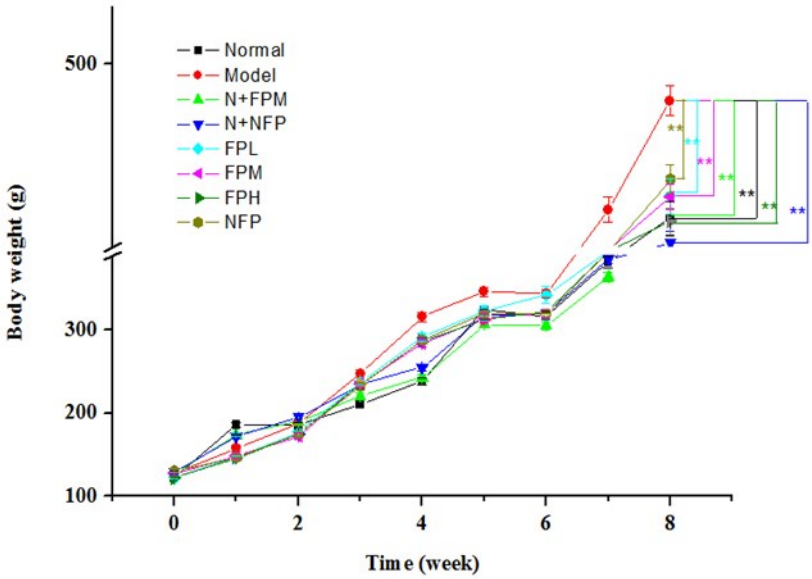

Fig. S1 Body weight

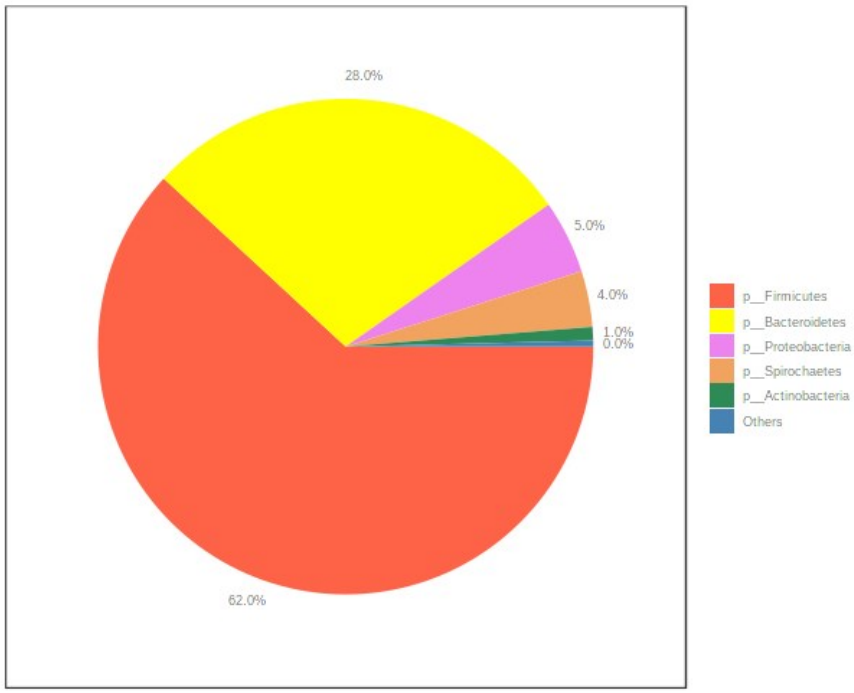

Fig. S2 The relative of abundance pie chart of taxonomic composition of community at phylum level

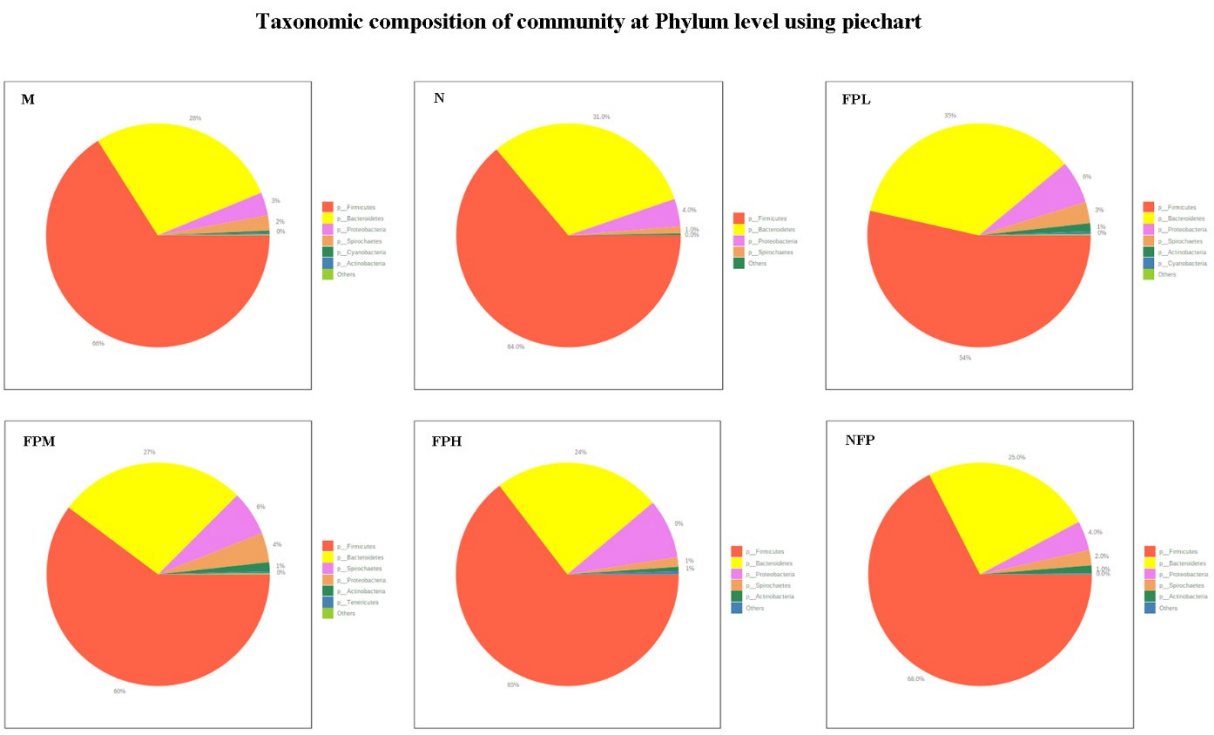

Fig. S3 Relative abundance of main phyla in different groups

Table S1. Levels of serum lipids in different groups [a]

Groups	TC (mmol/L)	TG (mmol/L)	LDL-C (mmol/L)	HDL-C (mmol/L)
Normal	1.64 ± 0.20***	1.20 ± 0.23***	0.26 ± 0.03***	1.26 ± 0.04
Model	2.33 ± 0.36	5.54 ± 1.28	0.47 ± 0.11	1.18 ± 0.06
N+FPM	1.77 ± 0.25***	1.29 ± 0.26***	0.30 ± 0.03***	1.38 ± 0.06
N+NFP	1.70 ± 0.26***	1.42 ± 0.31***	0.32 ± 0.05***	1.37 ± 0.06
FPL	1.96 ± 0.14	2.98 ± 0.81***	0.43 ± 0.06	1.33 ± 0.05
FPM	1.99 ± 0.39	4.39 ± 1.21	0.43 ± 0.09	1.32 ± 0.06
FPH	2.14 ± 0.32	3.80 ± 1.37***	0.49 ± 0.09	1.37 ± 0.07
NFP	2.31 ± 0.26	4.50 ± 0.52	0.48 ± 0.64	1.48 ± 0.04**

a. TC, total cholesterol; TG, triglyceride; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol. All values are expressed as means ± standard deviation. Significant difference existed compared with Model group, *, $p<0.05$; **, $p<0.01$, ***, $p<0.001$

91 **Table S2.** 103 identificated metabolites from the METLIN MS and MS/MS database

Common name	Class	Adducts	Retention time (min)	m/z	Formula	HMDB
LysoPC(18:3(9Z,12Z,15Z))	Glycerophosphocholines	M+H	15.56528	518.3232	C26H48NO7P	HMDB0010388
Deoxycytidine	Pyrimidine nucleosides	M-H	2.524767	226.0827	C9H13N3O4	HMDB0000014
Taurocholic acid	bile acid	M+H, M+NH4	5.645917	533.3251	C26H45NO7S	HMDB0000036
L-Carnitine	Carnitines(Organonitrogen compounds)	M+H	2.85935	162.1125	C7H15NO3	HMDB0000062
Cytidine	Pyrimidine nucleosides	M+H	10.48608	244.0924	C9H13N3O5	HMDB0000089
L-Glutamic acid	glutamic acid and derivatives	M-H	15.77977	146.0453	C5H9NO4	HMDB0000148
L-Tyrosine	Tyrosine and derivatives	M-H	18.71543	180.0664	C9H11NO3	HMDB0000158
Isocitric acid	tricarboxylic acids and derivatives	M-H	3.9484	191.0191	C6H8O7	HMDB0000193
Indoleacetic acid	Indolyl carboxylic acids and derivatives	M+H	4.21035	176.0707	C10H9NO2	HMDB0000197
L-Acetylcarnitine	Fatty acid esters (Fatty Acyls)	M+H	16.76088	204.1227	C9H17NO4	HMDB0000201
Sphinganine	Amines	M+H	14.27587	302.3052	C18H39NO2	HMDB0000269
Uric acid	Purines and purine derivatives	M+H	23.8108	169.0358	C5H4N4O3	HMDB0000289
1,3,12-Trihydroxycholan-24-oic acid	Steroids and steroid derivatives	M+H	23.22067	409.2949	C24H40O5	HMDB0000371
7alpha-Hydroxy-3-oxo-5beta-cholan-24-oic acid	Bile acids, alcohols and derivatives	M+H	13.43408	391.2838	C24H38O4	HMDB0000503
L-Arginine	Amino acids, peptides, and analogues	M+H	17.85015	175.1185	C6H14N4O2	HMDB0000517
Cholic acid	bile acid	M-H	23.68432	407.2783	C24H40O5	HMDB0000619
Deoxycholic acid	Bile acids, alcohols and derivatives	M-H	6.369183	391.2861	C24H40O4	HMDB0000626
Deoxycholic acid glycine conjugate	Bile acids, alcohols and derivatives	M+H	10.59358	450.3231	C26H43NO5	HMDB0000631
D-Fructose	monosaccharides	M-H	14.887	179.057	C6H12O6	HMDB0000660
Linoleic acid	doubly unsaturated fatty acid	M-H	12.34873	279.2322	C18H32O2	HMDB0000673
L-Methionine	methionine and derivatives	M-H	12.84188	148.0443	C5H11NO2S	HMDB0000696

Hippuric acid	Benzoic acids and derivatives	M+H	11.81648	180.0653	C9H9NO3	HMDB0000714
Indoleacrylic acid	Indoles and derivatives	M+H, M+NH4	10.39642	205.0967	C11H9NO2	HMDB0000734
Stearic acid	Long-chain fatty acids	M-H	15.25347	283.2632	C18H36O2	HMDB0000827
Ribothymidine	Pyrimidine nucleosides	M+H, M+NH4	3.5467	276.1199	C10H14N2O6	HMDB0000884
Sphinganine 1-phosphate	Sphingolipids	M+H	5.741217	382.2723	C18H40NO5P	HMDB0001383
Alpha-Linolenic acid	polyunsaturated fatty acid	M-H	5.893017	277.2164	C18H30O2	HMDB0001388
Myristoleic acid	Long-chain fatty acids	M-H	3.97095	225.185	C14H26O2	HMDB0002000
N-Oleoylethanolamine	Amines	M+H	11.45993	326.3051	C20H39NO2	HMDB0002088
Docosahexaenoic acid	Very long-chain fatty acids	M+H	16.3649	329.2476	C22H32O2	HMDB0002183
Dodecanoylcarnitine	Fatty acid esters	M+H	16.23725	344.28	C19H37NO4	HMDB0002250
Indole-3-propionic acid	Indolyl carboxylic acids and derivatives	M+H	17.45735	190.086	C11H11NO2	HMDB0002302
Docosatrienoic acid	very long-chain fatty acids	M-H	11.08843	333.2791	C22H38O2	HMDB0002823
8,11,14-Eicosatrienoic acid	Long-chain fatty acids	M-H	16.2774	305.25	C20H34O2	HMDB0002925
Palmitoleic acid	unsaturated fatty acid	M-H	15.63445	253.2175	C16H30O2	HMDB0003229
Vaccenic acid	Long-chain fatty acids	M-H	4.398167	281.2476	C18H34O2	HMDB0003231
N1-Methyl-4-pyridone-3-carboxamide	Pyridines and derivatives	M+H	10.85938	153.0657	C7H8N2O2	HMDB0004194
8-HETE	Eicosanoids	M-H	4.337317	319.2276	C20H32O3	HMDB0004679
16(R)-HETE	Eicosanoids	M-H	9.06725	319.2294	C20H32O3	HMDB0004680
Tetradecanoylcarnitine	Fatty acid esters (Fatty Acyls)	M+H	28.1543	372.3126	C21H41NO4	HMDB0005066
18-Hydroxyarachidonic acid	Eicosanoids(Fatty Acyls)	M+H	27.86037	321.2432	C20H32O3	HMDB0006245
Linoelaidic acid	Lineolic acids and derivatives (Fatty Acyls)	M+H	28.22682	281.2479	C18H32O2	HMDB0006270
Docosapentaenoic acid (22n-3)	Very long-chain fatty acids （ Fatty Acyls）	M-H	28.09873	329.2497	C22H34O2	HMDB0006528
9(S)-HPODE	Lineolic acids and derivatives	M-H	16.77855	311.222	C18H32O4	HMDB0006940
LysoPA(18:2(9Z,12Z)/0:0)	Glycerophospholipids	M+H	8.951833	435.2515	C21H39O7P	HMDB0007856

PC(18:2(9Z,12Z)/20:2(11Z,14Z))	phosphatidylcholine	M+H	5.746683	810.5994	C46H84NO8P	HMDB0008145
PC(20:5(5Z,8Z,11Z,14Z,17Z)/20:0)	phosphatidylcholine	M+H	8.8975	542.325	C28H48NO7P	HMDB0008504
LysoPC(14:0/0:0)	Glycerophosphocholines	M+H	4.673567	468.3106	C22H46NO7P	HMDB0010379
LysoPC(16:1(9Z)/0:0)	Glycerophosphocholines	M+H	29.00177	494.3247	C24H48NO7P	HMDB0010383
LysoPC(18:2(9Z,12Z))	Glycerophosphocholines	M+H	7.552967	520.338	C26H50NO7P	HMDB0010386
LysoPC(20:2(11Z,14Z))	Glycerophosphocholines	M+H	8.978583	548.3704	C28H54NO7P	HMDB0010392
LysoPC(20:3(5Z,8Z,11Z))	Glycerophosphocholines	M+H	4.165417	546.3551	C28H52NO7P	HMDB0010393
LysoPC(20:3(8Z,11Z,14Z))	Glycerophosphocholines	M+H	3.513283	546.3581	C28H52NO7P	HMDB0010394
LysoPC(20:4(5Z,8Z,11Z,14Z))	Glycerophosphocholines	M+H	2.1107	544.3379	C28H50NO7P	HMDB0010395
LysoPC(22:4(7Z,10Z,13Z,16Z))	Glycerophosphocholines	M+H	14.5365	572.3709	C30H54NO7P	HMDB0010401
LysoPC(22:5(4Z,7Z,10Z,13Z,16Z))	Glycerophosphocholines	M+H	4.5242	570.3557	C30H52NO7P	HMDB0010402
LysoPC(22:6(4Z,7Z,10Z,13Z,16Z,19Z))	Glycerophosphocholines	M+H	1.413717	568.34	C30H50NO7P	HMDB0010404
LysoPE(18:0/0:0)	Glycerophospholipids	M+H	9.65925	482.3237	C23H48NO7P	HMDB0011130
MG(18:0/0:0/0:0)	Monoacylglyceride	M+H, M+NH4	7.159917	359.3165	C21H42O4	HMDB0011131
LysoPE(16:0/0:0)	Glycerophospholipids	M+H	3.856667	454.2932	C21H44NO7P	HMDB0011503
LysoPE(18:1(9Z)/0:0)	Glycerophospholipids	M+H	5.662183	480.3085	C23H46NO7P	HMDB0011506
LysoPE(18:2(9Z,12Z)/0:0)	Glycerophosphoethanolamines	M+H	9.8425	478.295	C23H44NO7P	HMDB0011507
LysoPE(20:4(8Z,11Z,14Z,17Z)/0:0)	Glycerophosphoethanolamines	M+H	9.49795	502.2938	C25H44NO7P	HMDB0011518
LysoPE(22:6(4Z,7Z,10Z,13Z,16Z,19Z)/0:0)	Glycerophosphoethanolamines	M+H	9.360267	526.2942	C27H44NO7P	HMDB0011526
MG(0:0/14:0/0:0)	Monoradylglycerols	M+H	1.157017	303.2536	C17H34O4	HMDB0011530
MG(0:0/18:1(9Z)/0:0)	Monoradylglycerols	M+H	3.909667	357.2999	C21H40O4	HMDB0011537
MG(0:0/18:2(9Z,12Z)/0:0)	Lineolic acids and derivatives（Fatty Acyls）	M+H	9.382217	355.2843	C21H38O4	HMDB0011538
p-Cresol sulfate	Arylsulfates	M-H	9.442767	187.007	C7H8O4S	HMDB0011635
LysoPC(17:0)	Glycerophosphocholines	M+H	6.9187	510.3544	C25H52NO7P	HMDB0012108
Palmitic amide	Fatty amides	M+H	14.42163	254.2479	C16H31NO	HMDB0012273
12S-HHTrE	Long-chain fatty acids	M-H	24.58277	279.1976	C17H28O3	HMDB0012535

Vitamin A2	Retinoids	M+H	15.8441	285.2214	C20H28O	HMDB0013117
D-Tryptophan	indolyl carboxylic acids and derivatives	M-H	14.63442	203.0818	C11H12N2O2	HMDB0013609
Dihomo-gamma-Linolenoyl ethanolamide	Amines	M+H	12.11248	350.3058	C22H39NO2	HMDB0013625
Tranexamic Acid	Amino acids(Organic acids and derivatives)	M+H	17.21618	158.1174	C8H15NO2	HMDB0014447
Rimexolone	20-oxosteroids	M+H	14.662	371.259	C24H34O3	HMDB0015033
Ethyl hexadecanoate	Fatty acid esters	M-H	20.74298	283.2638	C18H36O2	HMDB0029811
6-Acetyl-2,2-dimethyl-2H-1-benzopyran	1-benzopyrans	M+H	22.57672	203.1069	C13H14O2	HMDB0030816
Isopalmitic acid	Long-chain fatty acids	M-H	21.56802	255.2323	C16H32O2	HMDB0031068
Annosquamosin B	Diterpenoids	M+H	15.86243	309.2424	C19H32O3	HMDB0031379
D-Malic acid	Beta hydroxy acids and derivatives	M-H	15.21897	133.0141	C4H6O5	HMDB0031518
3-Methyl-1-phenyl-3-pentanol	Benzene and substituted derivatives	M+H	11.83932	179.143	C12H18O	HMDB0031731
2,4,12-Octadecatrienoic acid isobutylamide	Fatty amides	M+H	14.41082	334.312	C22H39NO	HMDB0032033
Ethyl tetradecanoate	Fatty acid esters	M-H	5.240083	255.2319	C16H32O2	HMDB0034153
(S)-4-(4-Methylphenyl)-2-pentanone	Monoterpenoids	M+H	5.662183	177.1272	C12H16O	HMDB0034177
Lucidone C	Oxosteroids	M+H	5.86525	405.2632	C24H36O5	HMDB0038152
Ethyl icosapentate	Fatty acid esters（ Fatty Acyls）	M+H	14.691	331.2636	C22H34O2	HMDB0039530
Valdiate	Monoterpenoids	M+H	27.41028	311.1849	C17H26O5	HMDB0040980
1-Heptadecanoylglycerophosphoethanolamine	Glycerophosphoethanolamines	M+H	15.61178	468.3078	C22H46NO7P	HMDB0061691
1-Linoleoylglycerophosphocholine	Glycerophosphocholines	M+H	16.63583	520.3416	C26H50NO7P	HMDB0061692
1-Oleoylglycerophosphoserine	Glycerophosphoserines	M+H	16.18325	524.2987	C24H46NO9P	HMDB0061694
2-Palmitoylglycerophosphocholine	Glycerophosphocholines	M+H	16.06725	496.3385	C24H50NO7P	HMDB0061702
Dehydroabietic acid	Diterpenoids	M+H	12.05798	301.2159	C20H28O2	HMDB0061925

2-acetyl-1-alkyl-sn-glycero-3-phosphocholine	Glycerophosphocholines	M+H	14.27587	524.3702	C26H54NO7P	HMDB0062195
(2E)-Decenoyl-ACP	Amino acids, peptides, and analogues	M+H, M+NH4	15.52912	147.1126	C6H11NO2	HMDB0062225
LPA(20:4(5Z,8Z,11Z,14Z)/0:0)	Glycerophospholipids	M+H	9.870367	459.2516	C23H39O7P	HMDB0062312
8Z,11Z-eicosadienoic acid	long-chain fatty acids	M-H	6.9239	307.2634	C20H36O2	HMDB0062432
2-oleoyl-sn-glycero-3-phosphocholine	Glycerophosphocholines	M+H	16.29475	522.3566	C26H52NO7P	HMDB0062651
Ethyl Arachidonate	Fatty acid esters	M+H	7.951067	333.2793	C22H36O2	HMDB0062725
FAHFA(18:1(9Z)/12-O-18:0)	Long-chain fatty acids	M-H	9.355133	563.5059	C36H68O4	HMDB0112105
PS(20:4(5Z,8Z,11Z,14Z)/0:0)	Glycerophosphoserines	M+H	18.69285	546.2837	C26H44NO9P	HMDB0112640
PS(20:5(5Z,8Z,11Z,14Z,17Z)/20:5(5Z,8Z,11Z,14Z,17Z))	Glycerophosphoserines	M+H	14.62643	544.2677	C26H42NO9P	HMDB0112697

Table S3. the related pathway based 42 metabolites improved by *Momordica charantia* polysaccharide treatment in obesity rats

Name	Hits	Raw p	FDR	Impact
Glycerophospholipid metabolism	Phosphatidylcholine	0.04411	1	0.18333
	LysoPC(18:1(9Z))			
Linoleic acid metabolism	Phosphatidylcholine	0.055852	1	0
Arachidonic acid metabolism	16(R)-HETE	0.061396	1	0
	Phosphatidylcholine			
alpha-Linolenic acid metabolism	Phosphatidylcholine	0.098413	1	0
Glyoxylate and dicarboxylate metabolism	Isocitric acid	0.1686	1	0
Aminoacyl-tRNA biosynthesis	L-Arginine	0.17579	1	0
	L-Methionine			
Citrate cycle (TCA cycle)	Isocitric acid	0.20637	1	0.04132
Sphingolipid metabolism	Sphinganine	0.21556	1	0.14286
Cysteine and methionine metabolism	L-Methionine	0.27714	1	0.09464
Tryptophan metabolism	Indoleacetic acid	0.37965	1	0
Pyrimidine metabolism	Cytidine	0.37965	1	0.00709
Biosynthesis of unsaturated fatty acids	Stearic acid	0.38695	1	0
Fatty acid biosynthesis	Stearic acid	0.39416	1	0
Arginine and proline metabolism	L-Arginine	0.40129	1	0.08228

Table S4. The relative abundance of main phyla in different groups

Taxa(phylum)	M(%)	N(%)	FPL(%)	FPM(%)	FPH(%)	NFP(%)
p__Firmicutes	66.01	63.93	53.54	60.22	64.59	67.52
p__Bacteroidetes	27.77	30.8	35.42	27.28	24.33	24.70
p__Proteobacteria	3.33	3.97	6.19	4.29	8.59	4.27
p__Spirochaetes	2.21	1.03	3.10	6.46	1.40	2.22
Others	0.67	0.28	1.75	1.75	1.08	1.28