

Fig. S1. κ -type was the main type in the CGN sample. (A). ^1H NMR spectrum. (B). ^{13}C NMR spectrum.

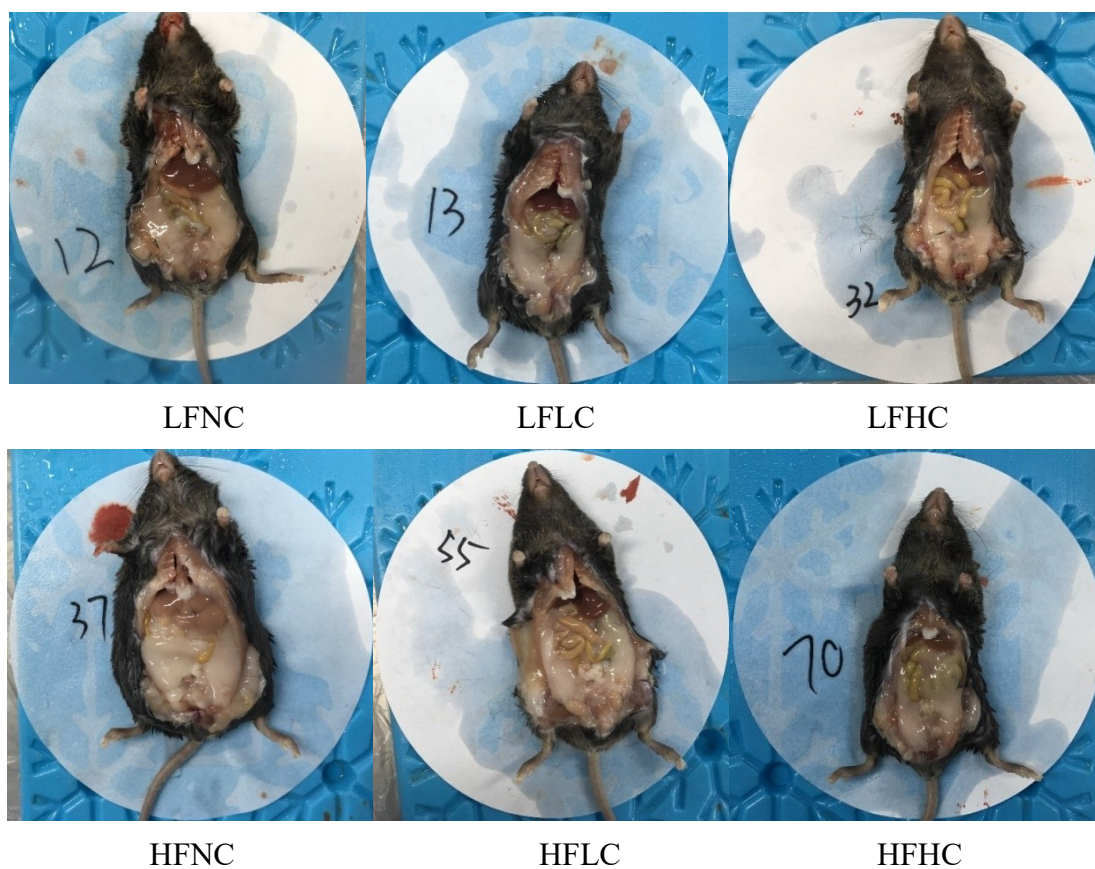


Fig. S2. Intraperitoneal morphology at the end of the dietary intervention.

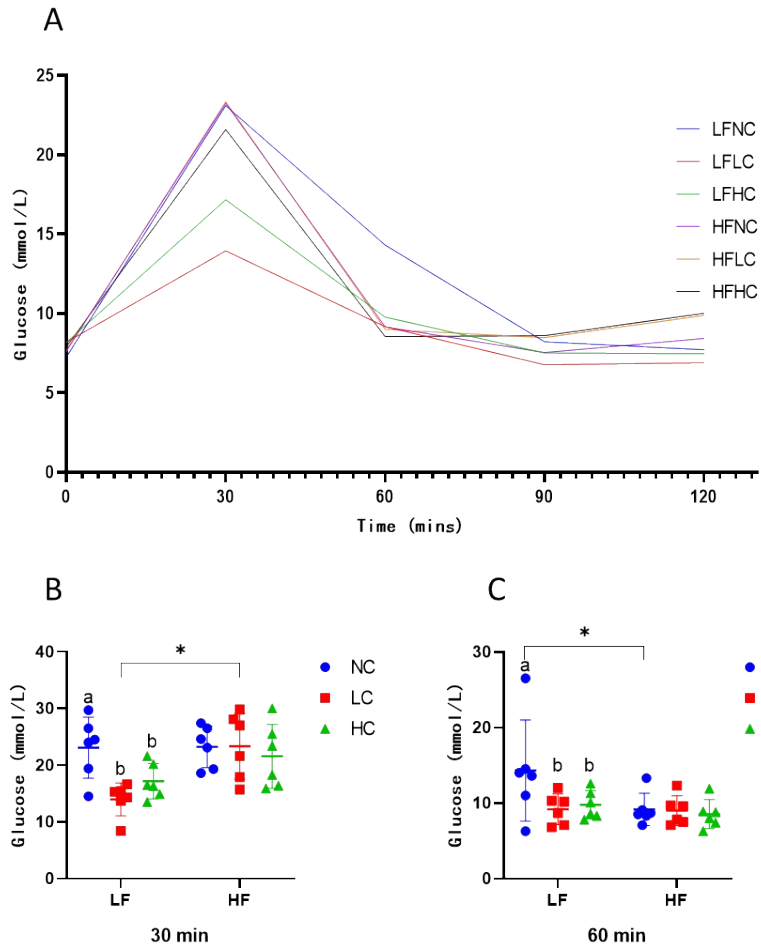


Fig. S3. Oral glucose tolerance test (OGTT). (A) the changes of blood glucose levels from 0 min to 120 min, (B) the blood glucose levels at 30 min, (C) the blood glucose levels at 60 min.

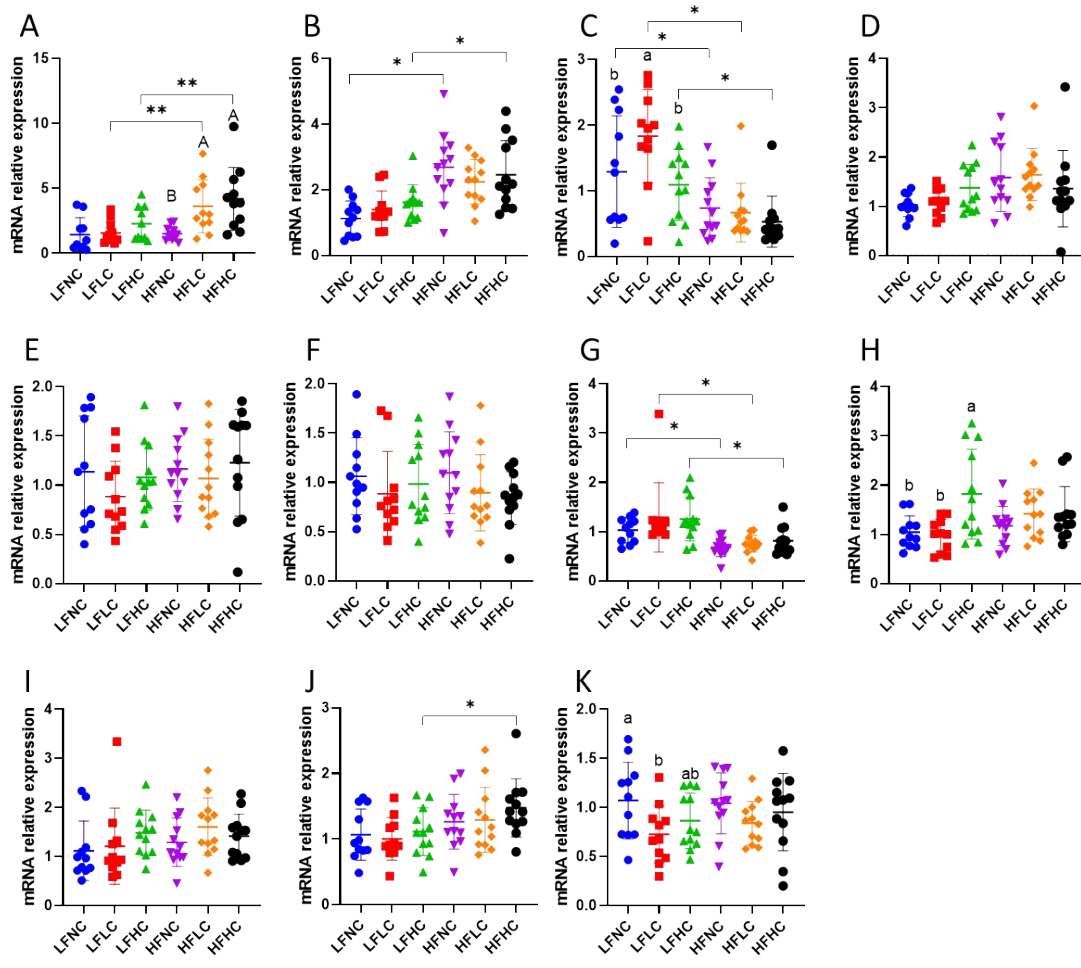


Fig. S4. mRNA levels of *Cyp7a1* (A), *Pparg* (B), *Ppard* (C), *Mlxipl* (D), *Gpam* (E), *Srebf1* (F), *Creb1* (G), *Prkaal* (H), *Ppargc1a* (I), *Ppargc1b* (J), and *G6pc* (K) in liver.

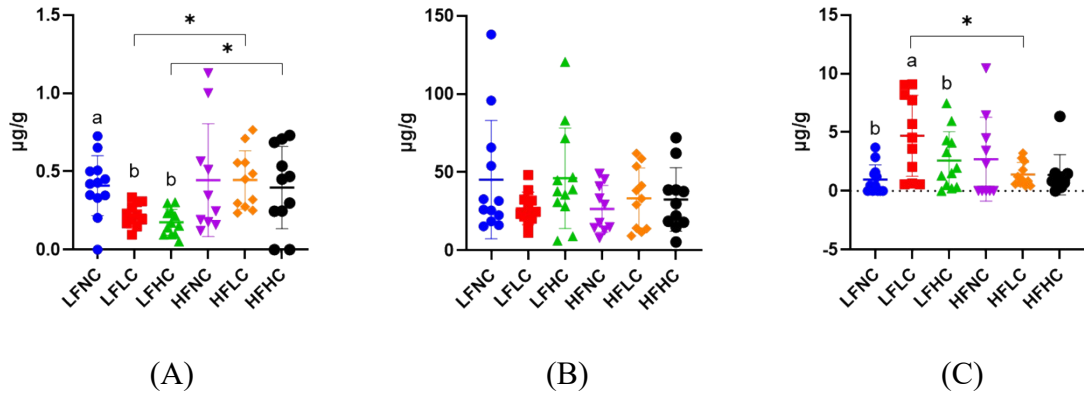


Fig. S5. Concentration of NorDCA (A), 12-ketoLCA (B) and UCA (C) in colonic contents.

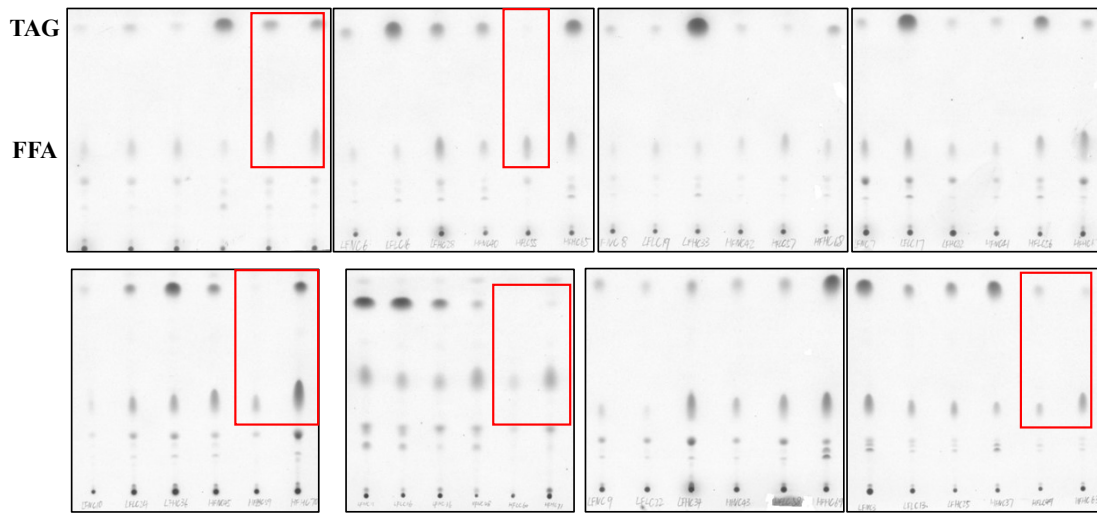


Fig. S6. The blots of lipid extracted from ileal contents on the silica G gel plates.

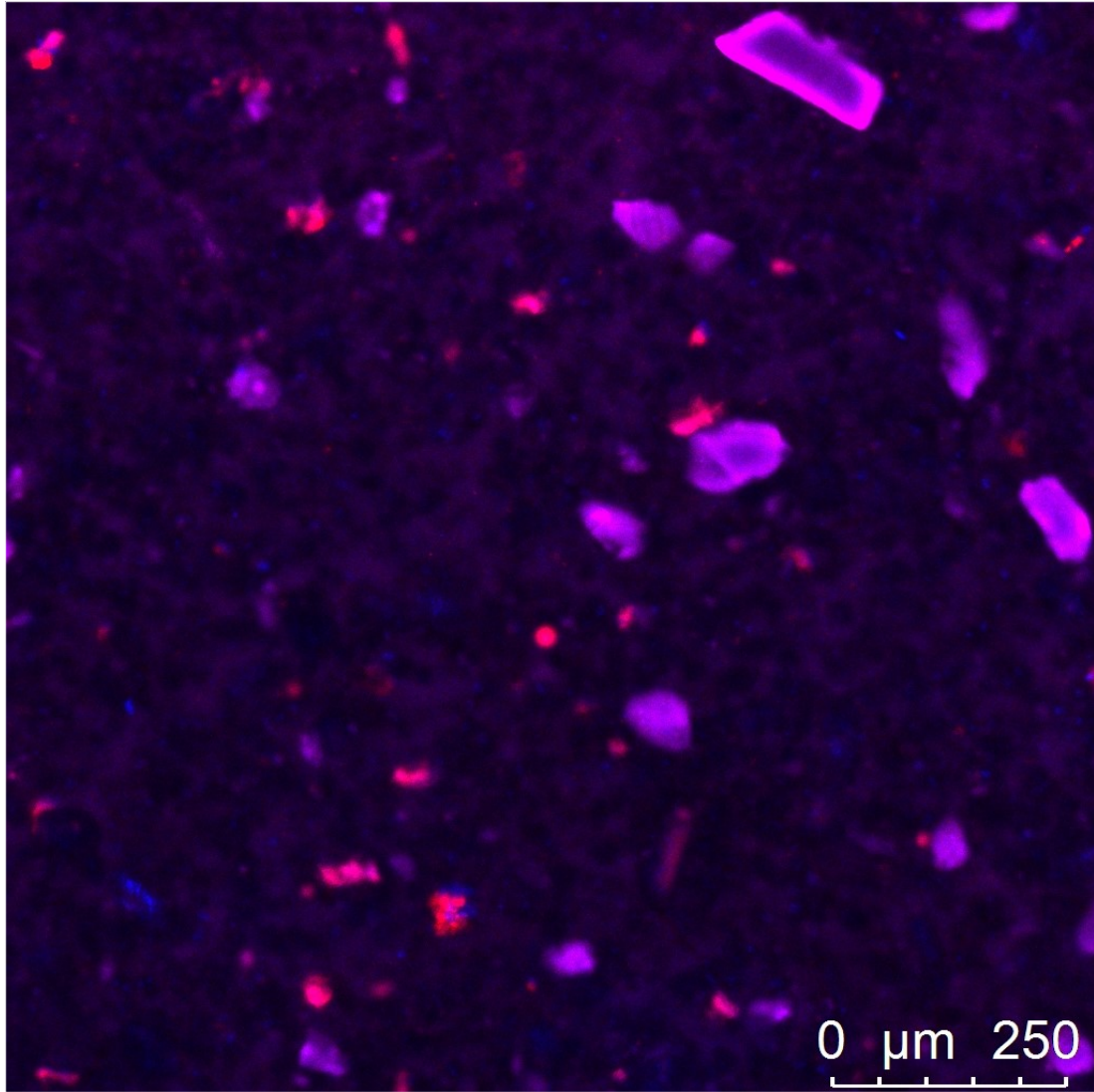


Fig. S7. *In vitro* digesta of HFNC diet (mixture, merged).

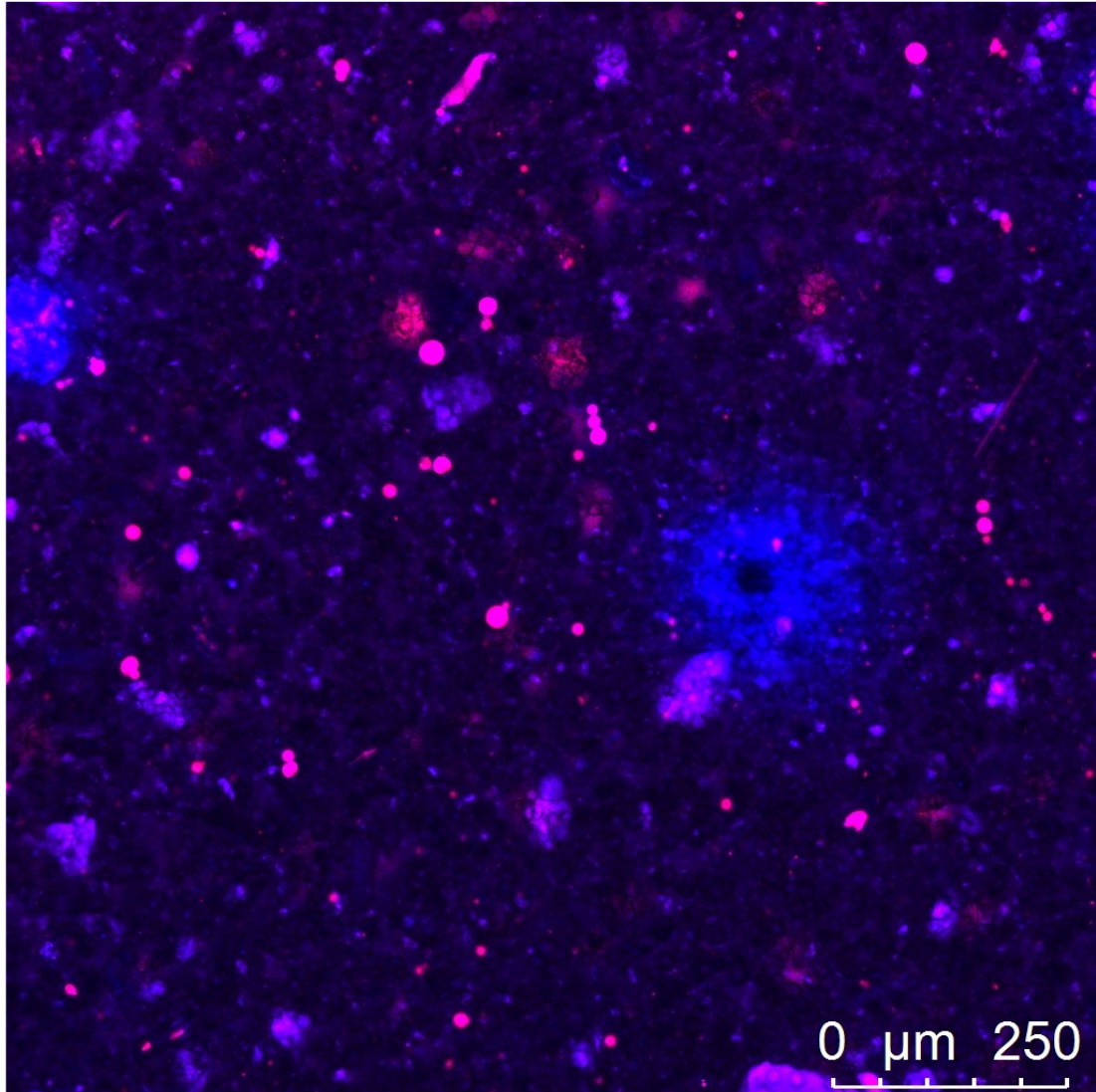


Fig. S8. *In vitro* digesta of HFLC diet (mixture, merged)

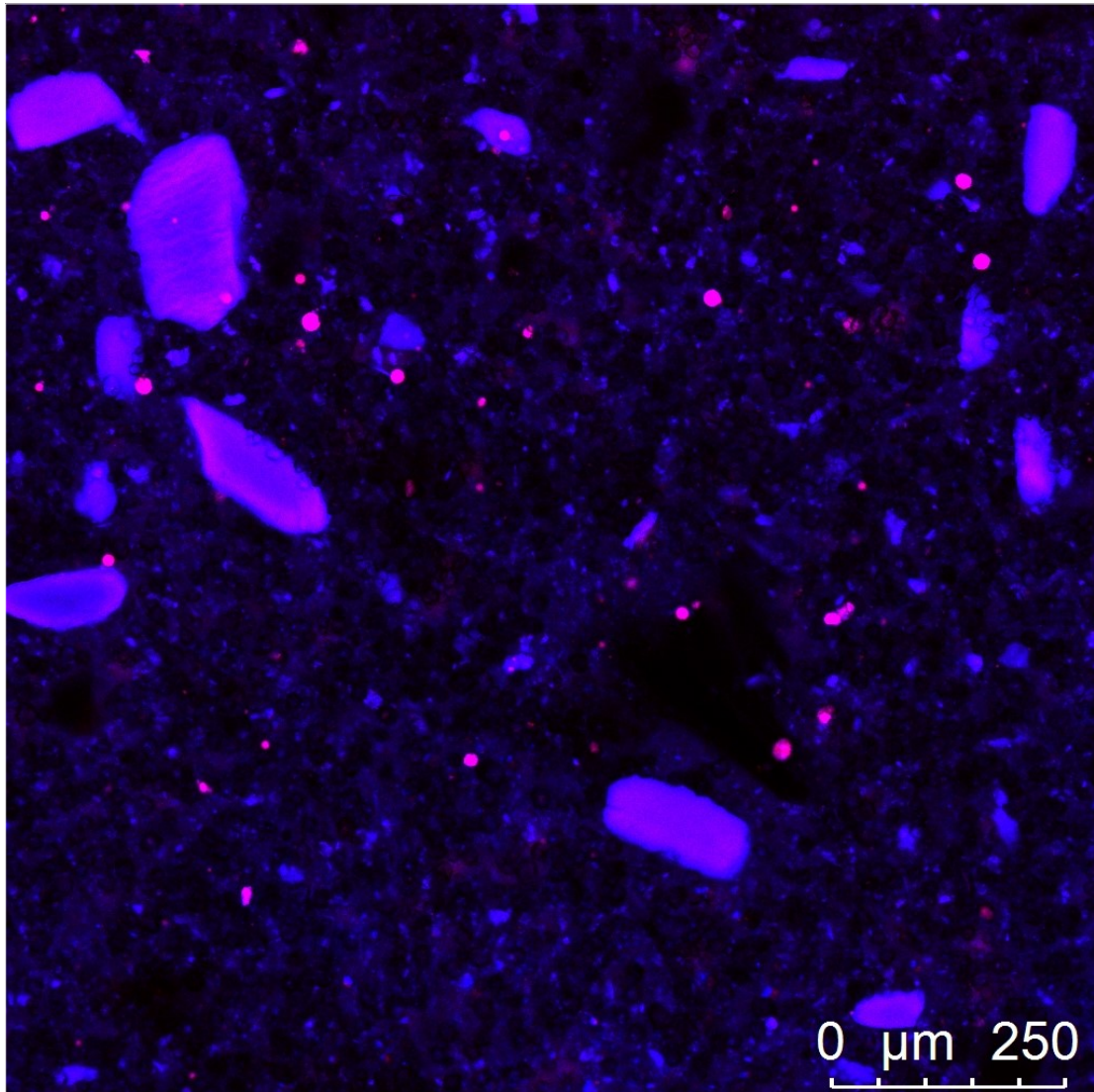


Fig. S9. *In vitro* digesta of HFHC diet (mixture, merged)

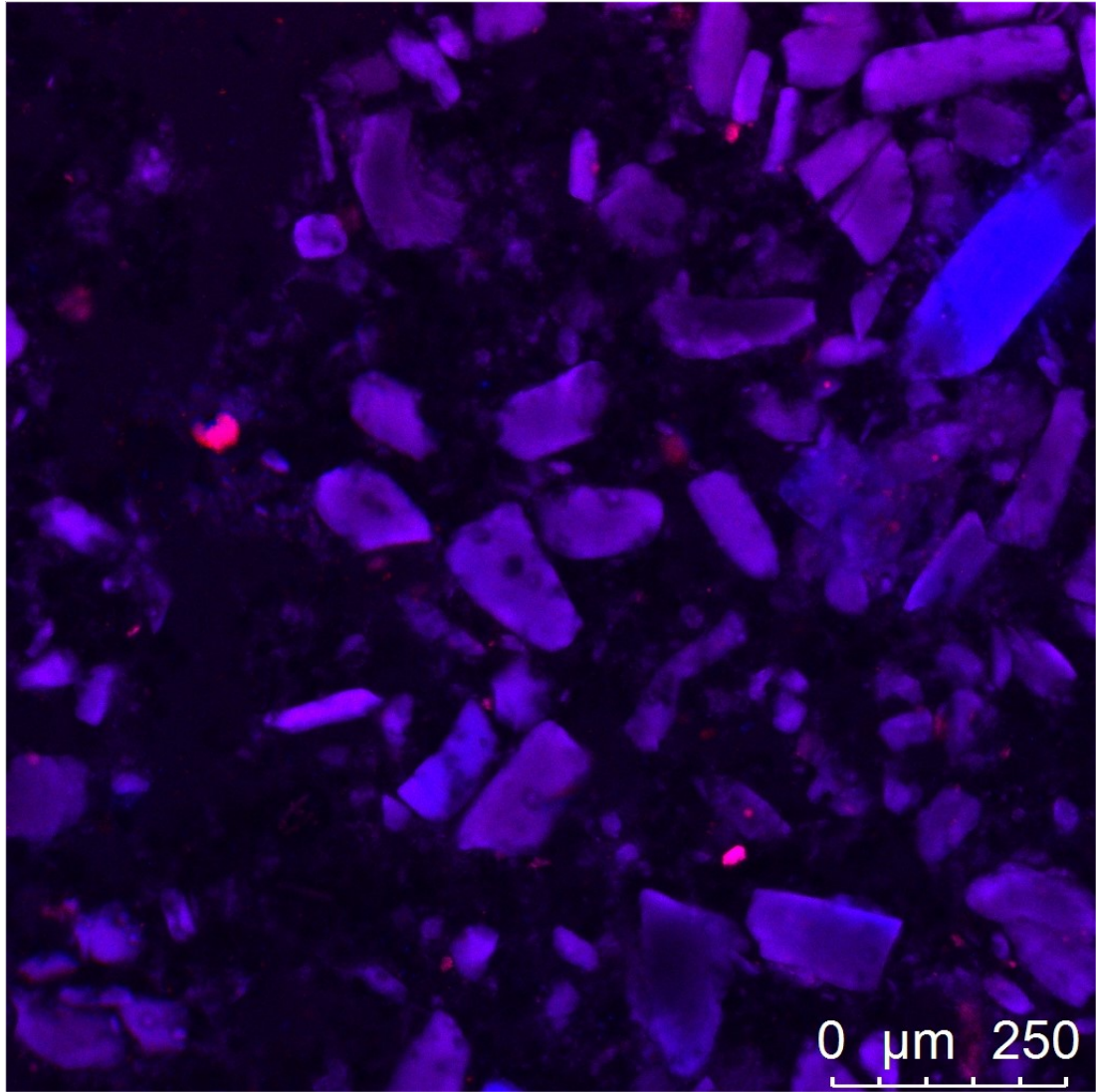


Fig. S10. *In vitro* digesta of HFNC diet (precipitate, merged)

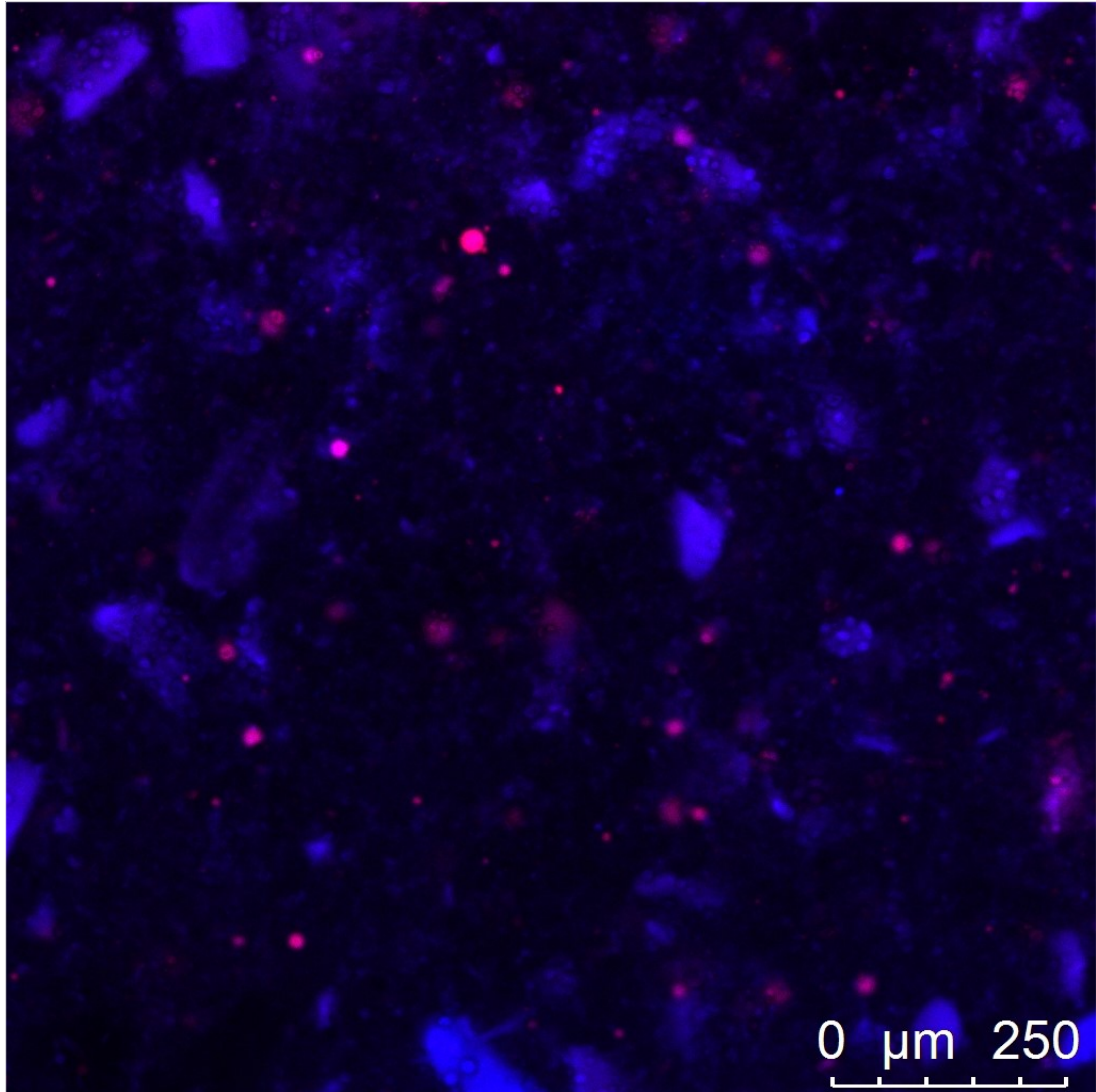


Fig. S11. *In vitro* digesta of HFLC diet (precipitate, merged)

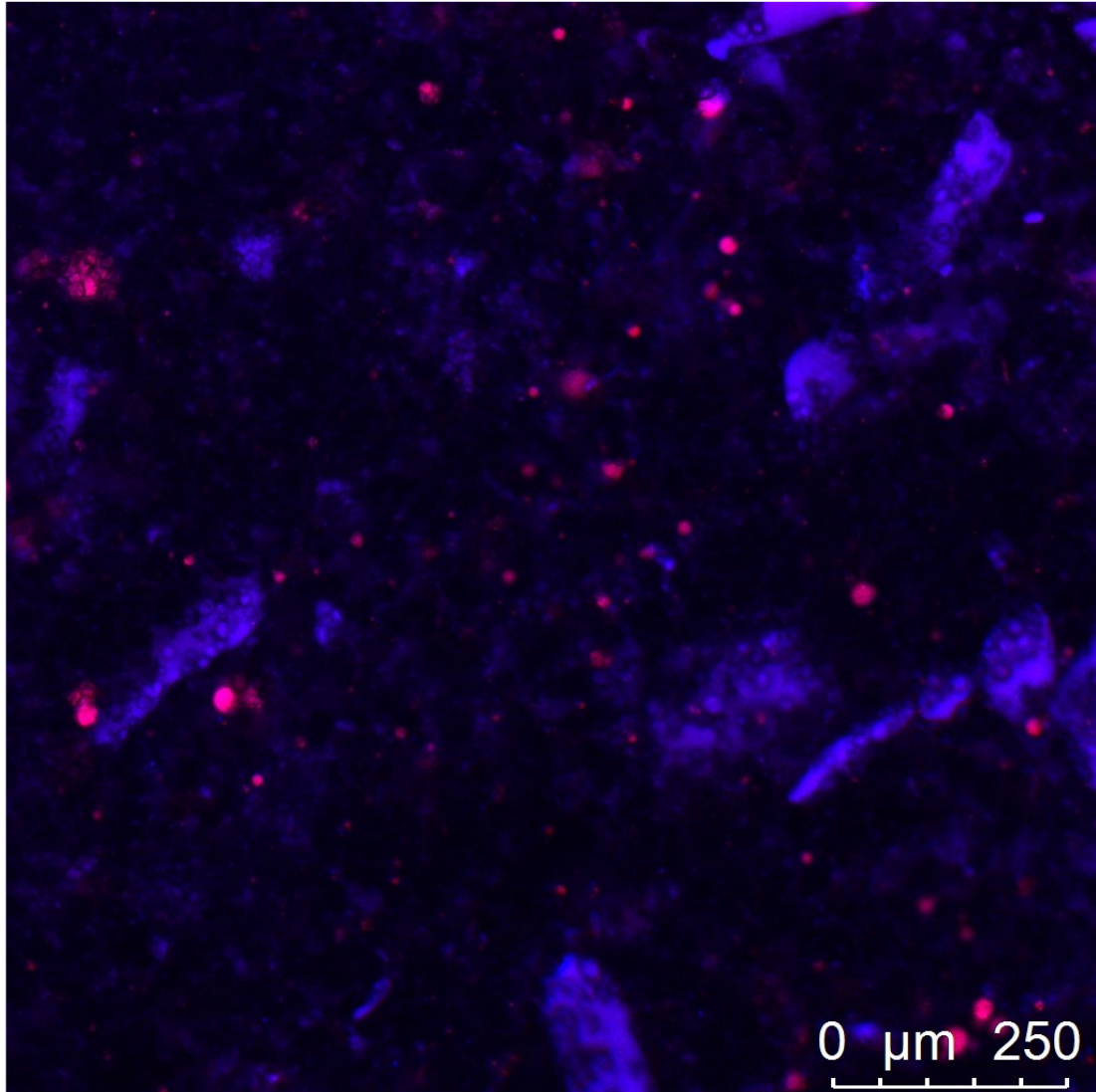


Fig. S12. *In vitro* digesta of HFHC diet (precipitate, merged)

Table S1. Formula and Caloric Information of Diets

Diet Formula (g)	Low-fat diet groups			High-fat diet groups		
	LFNC	LFLC	LFHC	HFNC	HFLC	HFHC
Pork protein	186.22	186.22	186.22	186.22	186.22	186.22
L-cysteine(protein)	2.79	2.79	2.79	2.79	2.79	2.79
Corn starch	471.32	471.32	471.32	291.99	291.99	291.99
Maltodextrin	116.39	116.39	116.39	116.39	116.39	116.39
Sucrose	67.78	67.78	67.78	67.78	67.78	67.78
Cellulose	46.55	27.93	9.31	46.55	27.93	9.31
κ -Carrageenan	0.00	18.62	37.24	0.00	18.62	37.24
Soybean oil	23.28	23.28	23.28	23.28	23.28	23.28
Lard	18.62	18.62	18.62	197.92	197.92	197.92
Mineral mix	55.87	55.87	55.87	55.87	55.87	55.87
Choline bitartrate	2.79	2.79	2.79	2.79	2.79	2.79
Vitamin mix	8.38	8.38	8.38	8.38	8.38	8.38
TBHQ	0.01	0.01	0.01	0.04	0.04	0.04
Total	1000	1000	1000	1000	1000	1000
Caloric Information (% kcal)						
Protein	19.1	19.1	19.1	14.88	14.88	14.88
Carbohydrate	69.97	69.97	69.97	40.12	40.12	40.12
Fat	10.94	10.94	10.94	45	45	45
Energy density (kcal/Kg)	3.76	3.76	3.76	4.65	4.65	4.65

Table S2. Primer Sequences for RT-qPCR

Genes	Official full names	Primers
<i>Acadl</i>	acyl-CoA dehydrogenase long chain	F: GTCATGGCTATGGCACCGA R: GCTTCAGCCTCCACTCAGATA
<i>Acaca</i>	acetyl-Coenzyme A carboxylase alpha	F: TTGTTTGGTCGTGACTGCTCT R: TGTGTTCAAATACTGCTGGGGT
<i>Cpt1a</i>	carnitine palmitoyl transferase 1A	F: CCATCCAACACGTCAAGGACA R: TCCCGTCATGGTAGAGCCAG
<i>Elovl6</i>	ELOVL family member 6, elongation of long chain fatty acids	F: TCAGATGCTGATGGGCTGTG R: GCCGATGTAGGCCTCAAAGA
<i>Ppara</i>	peroxisome proliferators-activated receptor alpha	F: GAACGACCAAGTCACCTTGC R: ACTCGCGTGTGATAAAGCCA
<i>Fasn</i>	fatty acid synthase	F: CCCATCAAGAAGTGCTGGGAT R: TATCCCTGGAGCATGGGGTC
<i>Mlxipl</i>	MLX interacting protein-like	F: GAGCGATGGTGCGAACAGC R: GGTGAAGAGTGTGTCGGAGAT
<i>Creb1</i>	cAMP responsive element binding protein 1	F: CAAACATAACCAGATCCGCACA R: TAGACGGACCTCTCTTTCCG
<i>Mgat1</i>	monoacylglycerol O-acyltransferase 1	F: ACGGGCTTGTATTCGTCCAG R: GTACGACAGGTCCAACCTGGG
<i>Gpam</i>	glycerol-3-phosphate acyltransferase, mitochondrial	F: ATCATAACGAGATGCCACCGG R: AGTTGAACTCCTCCGACAGC
<i>Gapdh</i>	glyceraldehyde-3-phosphate dehydrogenase	F: CGTGCCGCCTGGAGAAACCTG R: AGAGTGGGAGTTGCTGTTGAAGTCG
<i>G6pc</i>	glucose-6-phosphatase, catalytic	F: GTTTGGTTTCGCGCTTGGAT R: GCCGCTCACACCATCTCTTA
<i>Srebf1</i>	sterol regulatory element binding transcription factor 1	F: AAGACCGGTAGCGCTTCTCA R: CCATCTTGGCCACAGTACCT
<i>Ppargc1a</i>	peroxisome proliferative activated	F: GACCCTCCTCACACCAAACC

	receptor, gamma, coactivator 1 alpha	R: GACCCTCCTCACACCAAACC
<i>Ppargc1b</i>	peroxisome proliferative activated receptor, gamma, coactivator 1 beta	F: GTATCCAGGCACATCGAGGG R: AAGATGGACAGCTCCGTGTG
<i>Sirt1</i>	Sirtuin1	F: GAGGTGTTGGTGGCAACTCT R: AGGCTAGGTGGTGAATATGCC
<i>Sirt3</i>	Sirtuin3	F: TCTCAAGCCCGTCGATGTTC R: CAGGCCCAATGTCACTCACT
<i>Sirt6</i>	Sirtuin6	F: CGAAACATGCACTGCACCAT R: GACCCTGCGTGCTAGACAAA
<i>Pparg</i>	peroxisome proliferators-activated receptor gamma	F: TTCGATCCGTAGAAGCCGTG R: TCCTTGGCCCTCTGAGATGA
<i>Ppard</i>	peroxisome proliferators-activated receptor delta	F: CACAGTGGAGACAGTCCGAG R: CGCCATACTTGAGGAGGGTC
<i>Cebpb</i>	CCAAT/enhancer binding protein beta	F: GACAAGCTGAGCGACGAGTA R: GCTTGAACAAGTTCCGCAGG
<i>Dgat2</i>	diacylglycerol O-acyltransferase 2	F: CATCCGGAAGTTACCAGCCA R: GCCTGGGTGCCTTCTGTAAC
<i>Xbp1</i>	X-box binding protein 1	F: AGAGGTCTACCCAGAAGGACC R: TTAATGGCTTCCAGCTTGGCT
<i>Prkaal</i>	protein kinase, AMP-activated, alpha 1 catalytic subunit	F: CTACCTAGCAACCAGCCCAC R: TTCGGCAACCAAGAACGGTA
<i>Cyp7a1</i>	cytochrome P450, family 7, subfamily a, polypeptide 1	F: CAGCCTTTCCCGGGCTTTAT R: GCCTTCTGCTACCGAGTGAT
<i>mt-Nd1</i>	NADH dehydrogenase 1, mitochondrial	F: TCCGAGCATCTTATCCACGC R: GTATGGTGGTACTCCCGCTG

Table S3. Targeted Bile Acids Information

Names	Abbreviations	CAS
Allolithocholic acid	alloLCA	2276-93-9
Lithocholic acid	LCA	434-13-9
Isolithocholic acid	isoLCA	1534-35-6
23-Nordeoxycholic acid	NorDCA	53608-86-9
6-ketolithocholic acid acetate	6-ketoLCA	NA
12-ketolithocholic acid	12-ketoLCA	5130-29-0
7-ketolithocholic acid	7-ketoLCA	4651-67-6
3 β -Ursodeoxycholic acid	β -UDCA	78919-26-3
Deoxycholic acid	DCA	83-44-3
Chenodeoxycholic acid	CDCA	474-25-9
Ursodeoxycholic acid	UDCA	128-13-2
Hyodeoxycholic acid	HDCA	83-49-8
Norcholic acid	NorCA	60692-62-0
Dehydrocholic acid	DHCA	81-23-2
7,12-diketolithocholic acid	7,12-diketoLCA	517-33-9
6,7-diketolithocholic acid	6,7-diketoLCA	NA
α -Muricholic acid	α -MCA	2393-58-0
Ursocholic acid	UCA	2955-27-3
β -Muricholic acid	β -MCA	2393-59-1
Cholic acid	CA	81-25-4
Allocholic acid	ACA	2464-18-8
3 β -Cholic acid	β CA	3338-16-7
Glycolithocholic acid Sodium Salt	GLCA	24404-83-9
Glycohyodeoxycholic acid	GHDCA	13042-33-6
Glycochenodeoxycholic acid Sodium Salt	GCDCA	16564-43-5
Glycoursodeoxycholic acid	GUDCA	64480-66-6
Glycodeoxycholic acid Sodium Salt	GDCA	16409-34-0

Lithocholic acid 3-sulfate Sodium Salt	LCA-3S	34669-57-3
Sodium Glycocholate Hydrate	GCA	863-57-0
Tauroolithocholic acid Sodium Salt	TLCA	6042-32-6
Taurohyodeoxycholic acid Sodium Salt	THDCA	38411-85-7
Taoursodeoxycholic acid Sodium Salt	TUDCA	35807-85-3
Taurodeoxycholic acid Sodium Salt	TDCA	1180-95-6
Taurochenodeoxycholic acid	TCDCa	6009-98-9
Taurocholic acid Sodium Salt	TCA	145-42-6
Tauro- α -muricholic acid Sodium Salt	T- α -MCA	25696-60-0
Taurohyocholic acid Sodium Salt	THCA	NA
Tauro- β -muricholic acid Sodium Salt	T- β -MCA	145022-92-0
Chenodeoxycholic acid glucuronic acid conjugate	CDCA-G	NA

Table S4. Information on κ -CGN molecular weight

Molar mass ($\times 10^5$ g/mol)				Polydispersity		RMS radius (nm)		
M_n	M_p	M_w	M_z	M_w/M_n	M_z/M_n	r_n	r_w	r_z
4.359	5.694	5.703	7.349	1.308	1.686	79.0	85.8	94.9
($\pm 2.048\%$)	($\pm 1.197\%$)	($\pm 1.290\%$)	($\pm 3.203\%$)	($\pm 2.420\%$)	($\pm 3.802\%$)	($\pm 1.4\%$)	($\pm 0.8\%$)	($\pm 0.7\%$)