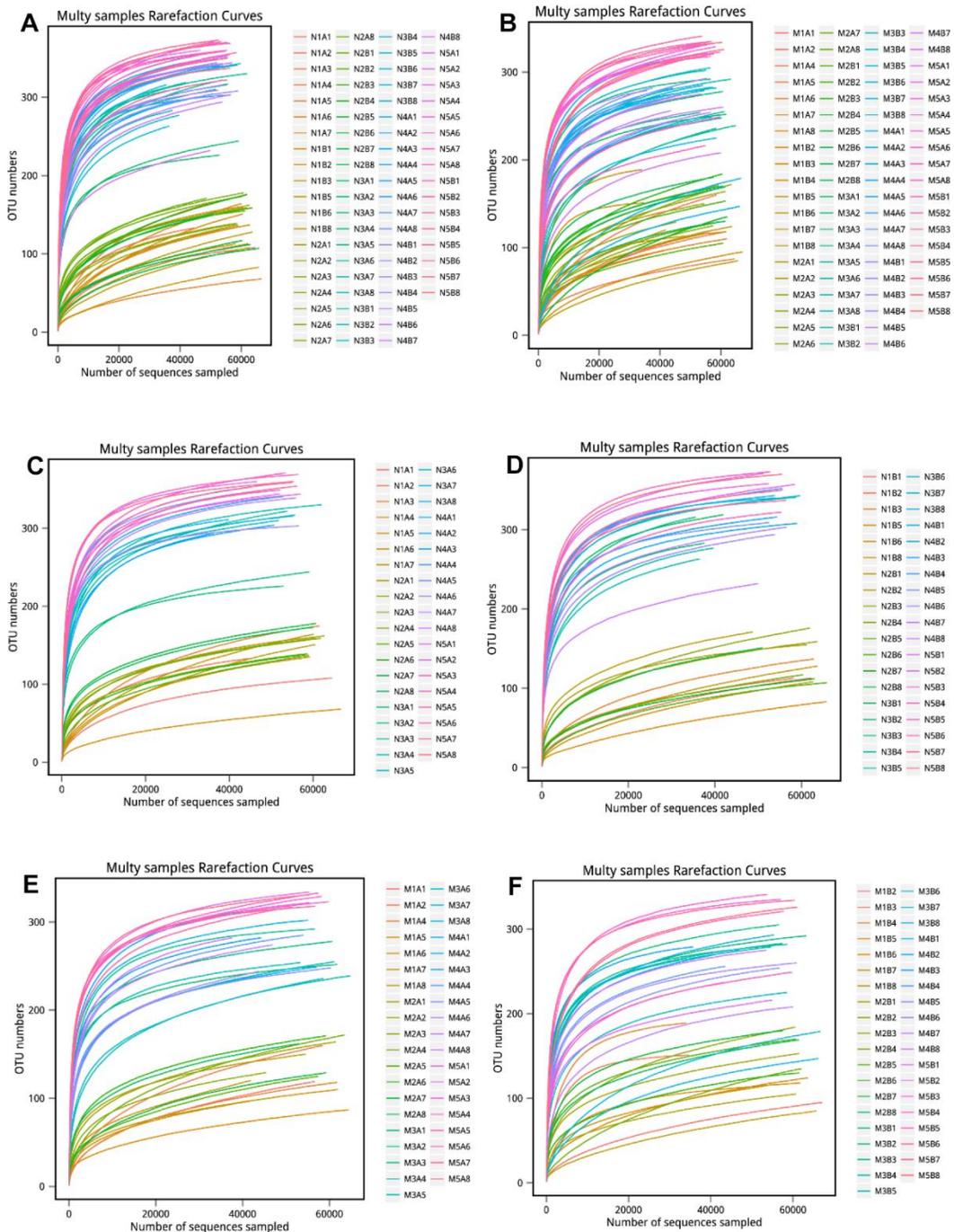
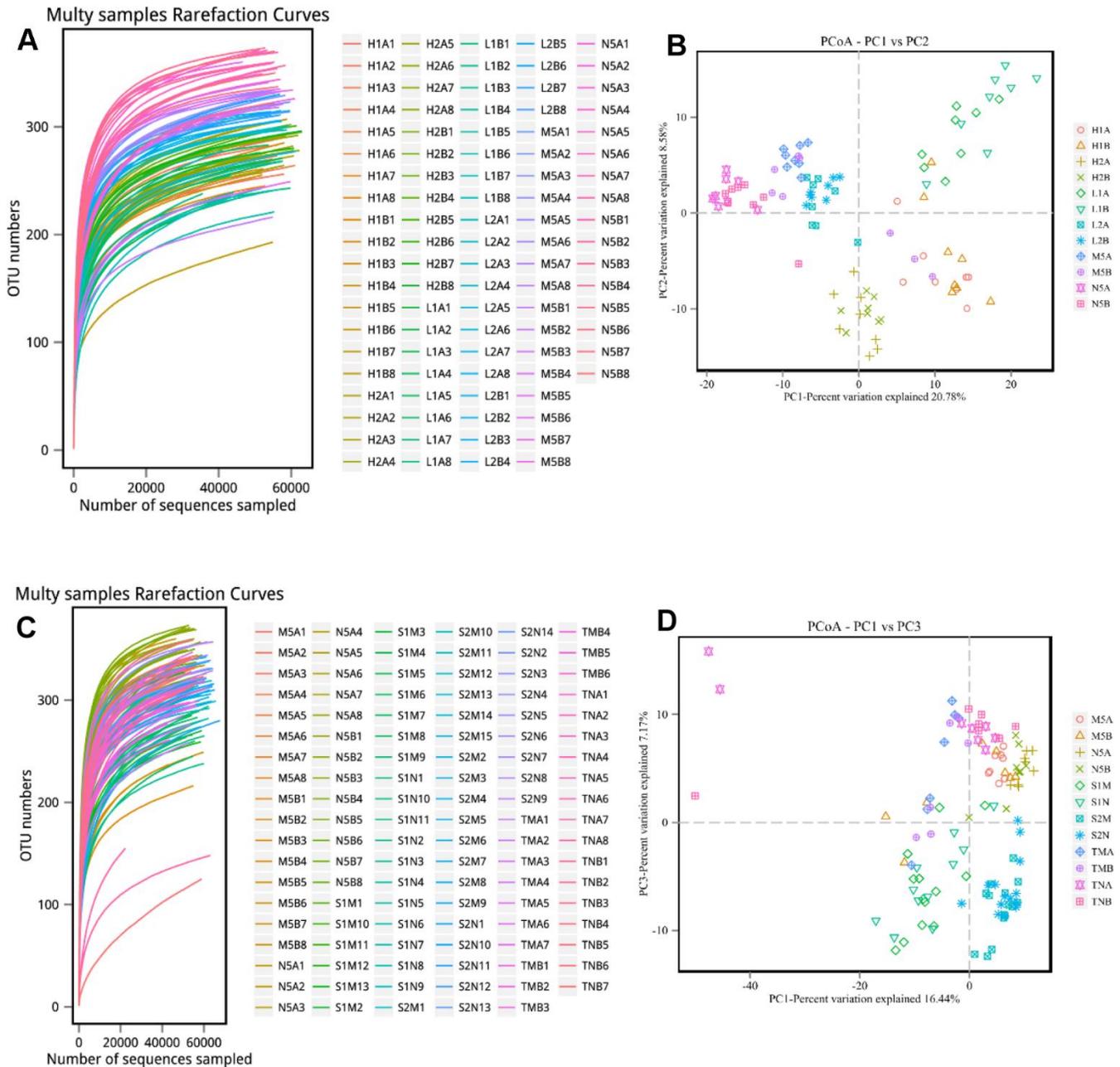


SUPPLEMENTARY FIGURES

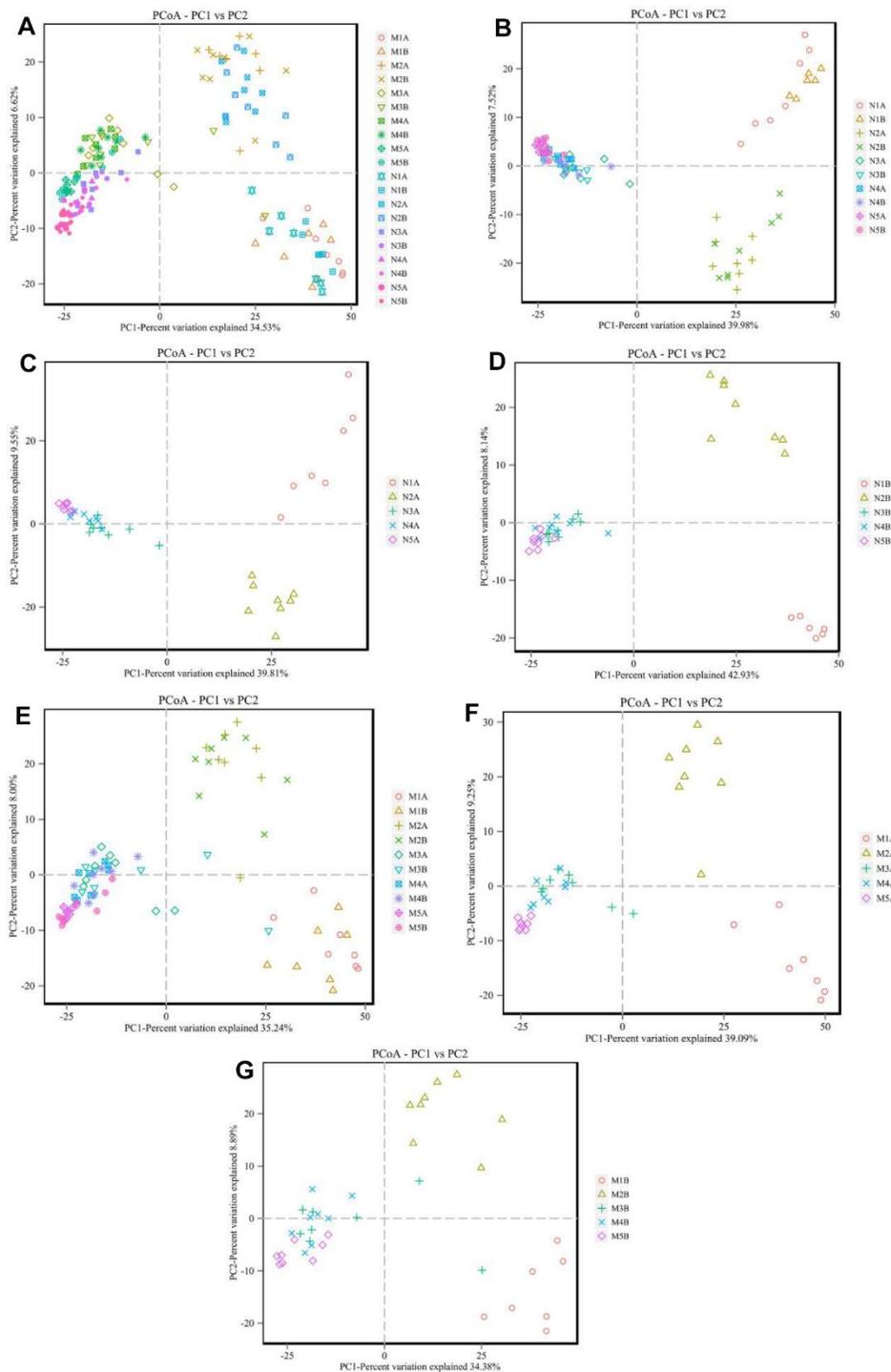


Supplementary Figure 1. Influences of maternal high sugar and fat diet on the alpha diversity of gut microbiota of offspring.

(A) All the control samples; (B) All the HSHF fed samples; (C) All the control male samples; (D) All the control female samples; (E) All HSHF male samples; (F) All HSHF female samples. The symbol of N1A is the 7-day control male samples, N1B is the 7-day control female samples, and N2A for 14-day, N3A for 21-day, N4A for 28-day, N5A for 56-day male samples, N2B for 14-day, N3B for 21-day, N4B for 28-day, N5B for 56-day female samples; M1A is the 7-day HSHF male samples, M1B is the 7-day HSHF female samples, and M2A for 14-day, M3A for 21-day, M4A for 28-day, M5A for 56-day male samples, M2B for 14-day, M3B for 21-day, M4B for 28-day, M5B for 56-day female samples. Data are presented as the means \pm SD of 8 independent experiments. * $p < 0.05$ and ** $p < 0.01$ vs. the model group by one-way ANOVA, followed by the one-way ANOVA test.

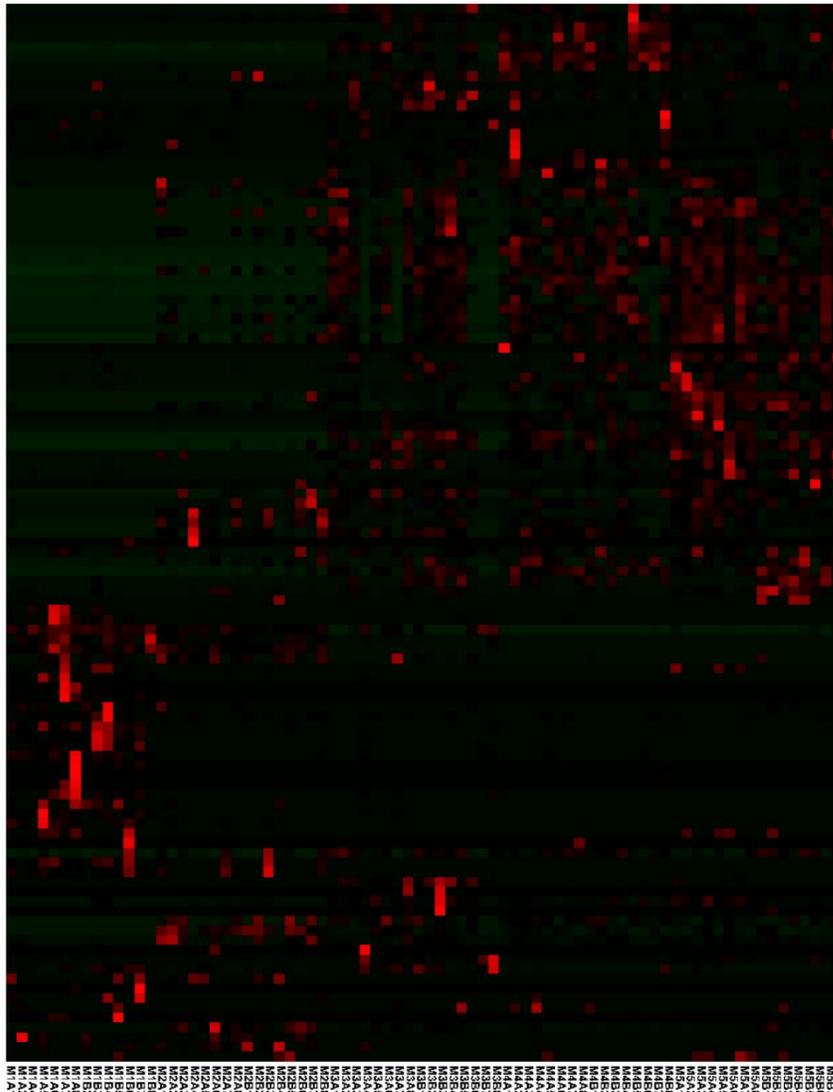


Supplementary Figure 2. Influences of maternal high sugar and fat diet on the alpha diversity and beta diversity of gut microbiota of offspring. (A) The alpha diversity of control, HSHF, *Hericium erinaceus*, *Ganoderma lucidum* treated samples at 28- and 56-day; (B) The beta diversity of control, HSHF, *Hericium erinaceus*, *Ganoderma lucidum* treated samples at 28- and 56-day; (C) The alpha diversity of control, HSHF, outdoor soil (T-) and from SAMP8 mice (S-) treated samples at 28- and 56-day; (D) The beta diversity of control, HSHF, outdoor soil (T-) and from SAMP8 mice (S-) treated samples at 28- and 56-day. The symbol of N1A is the 7-day control male samples, N1B is the 7-day control female samples, and N2A for 14-day, N3A for 21-day, N4A for 28-day, N5A for 56-day male samples, N2B for 14-day, N3B for 21-day, N4B for 28-day, N5B for 56-day female samples; M1A is the 7-day HSHF male samples, M1B is the 7-day HSHF female samples, and M2A for 14-day, M3A for 21-day, M4A for 28-day, M5A for 56-day male samples, M2B for 14-day, M3B for 21-day, M4B for 28-day, M5B for 56-day female samples. The symbol of N1 is the 28-day control samples, N2 is the 56-day control samples; M1 is the 28-day HSHF samples, M2 is the 56-day HSHF samples; HE1 is for *Hericium erinaceus* treated 28-day samples, HE2 is for *Hericium erinaceus* treated 56-day samples, LZ1 is for *Ganoderma lucidum* treated 28-day samples, LZ2 is for *Ganoderma lucidum* treated 56-day samples. Data are presented as the means \pm SD of 8 independent experiments. * $p < 0.05$ and ** $p < 0.01$ vs. the model group by one-way ANOVA test.



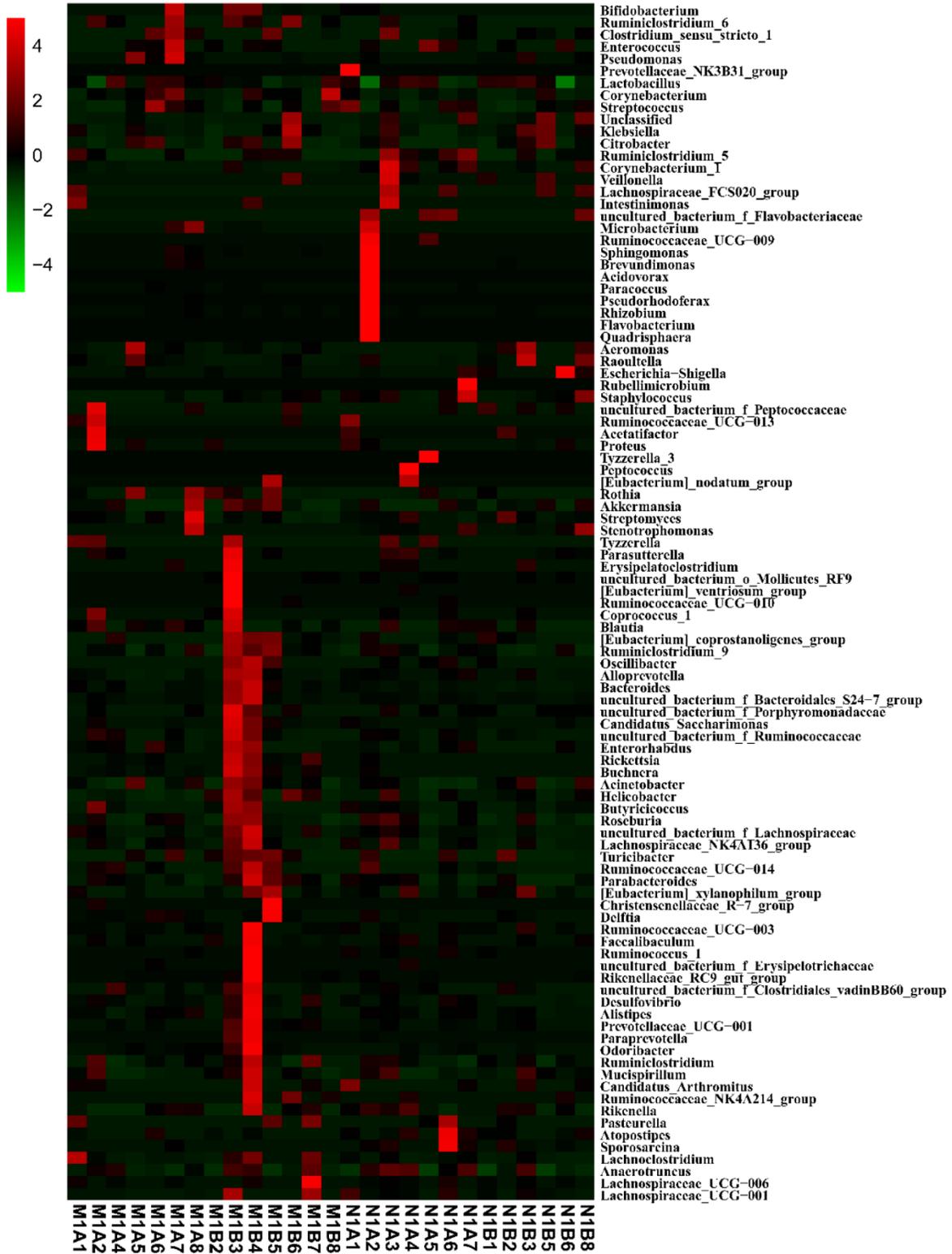
Supplementary Figure 3. Influences of maternal high sugar and fat diet on the gut microbiota of offspring. (A) All the samples; (B) All the control samples; (C) All the control male samples; (D) All the control female samples; (E) All the HSHF fed samples; (F) All HSHF male samples; (G) All HSHF female samples. The PCA analysis showed that the 7- (T1) and 14- (T2) days samples can successful distinguish of the 21- (T3), 28- (T4), 56- (T5) days samples, after 21 days, and the differences were decreased (Figure S2). The HSHF groups at different growth phase (7, 14, 21, 28, 56 days of age) showed the same variation tendency (Figure S2 and S4). The symbol of N1A is the 7-day control male samples, N1B is the 7-day control female samples, and N2A for 14-day, N3A for 21-day, N4A for 28-day, N5A for 56-day male samples, N2B for 14-day, N3B for 21-day, N4B for 28-day, N5B for 56-day female samples; M1A is the 7-day HSHF male samples, M1B is the 7-day HSHF female samples, and M2A for 14-day, M3A for 21-day, M4A for 28-day, M5A for 56-day male samples, M2B for 14-day, M3B for 21-day, M4B for 28-day, M5B for 56-day female samples. Data are presented as the means \pm SD of 8 independent experiments. * p < 0.05 and ** p < 0.01 vs. the model group by one-way ANOVA test.

B

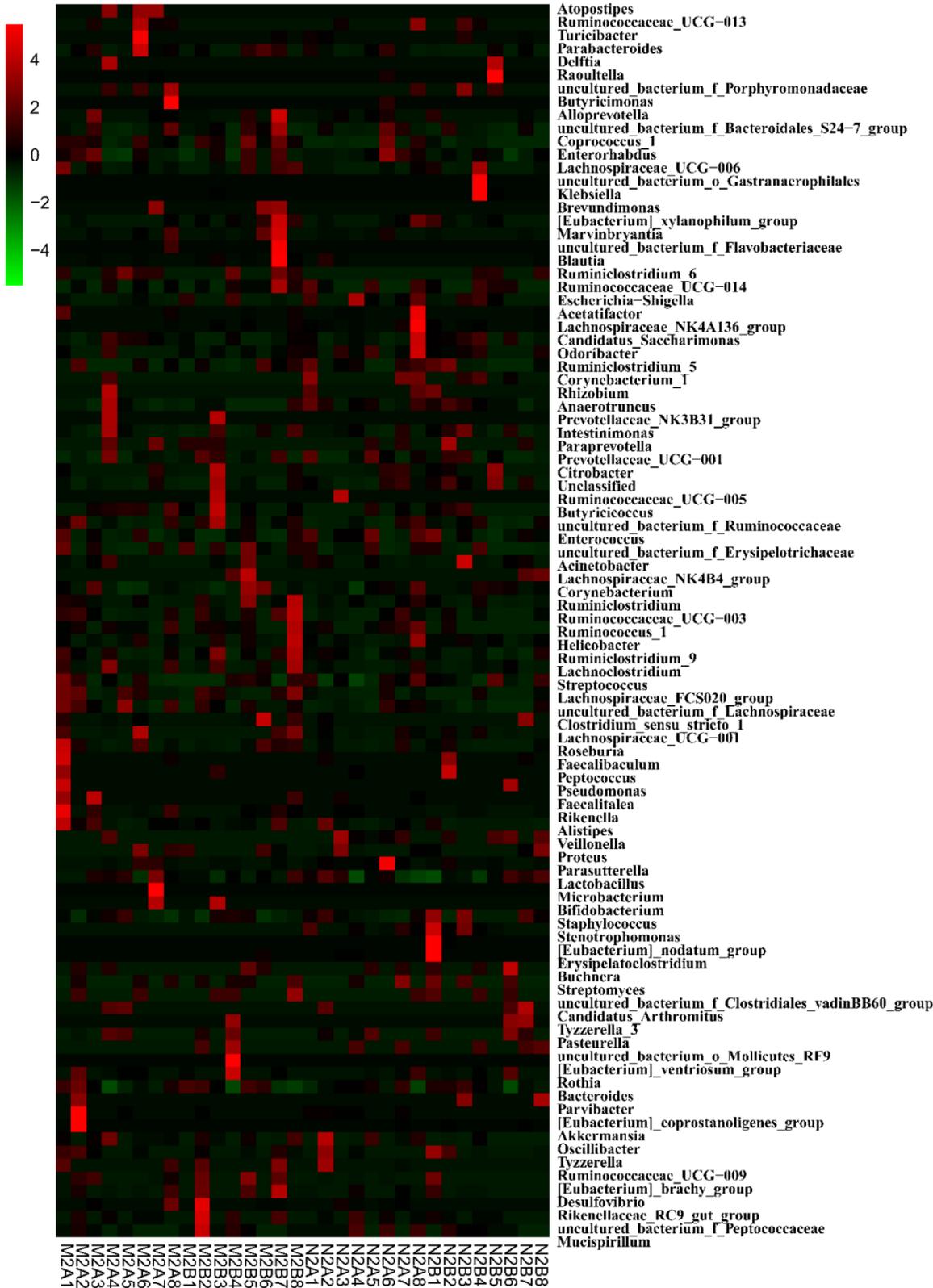


- Parvibacter
- uncultured bacterium f. Erysipelotrichaceae
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- Rikenellaceae
- Rikenellaceae RC9 gut group
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- Ruminococcaceae_UCG_005
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- Roseburia
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- Ruminococcaceae_UCG-003
- Ruminiclostridium
- Ruminococcaceae_NK4A214_group
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- uncultured bacterium f. Lachnospiraceae
- family XIII_U41_001
- Lachnospiraceae_NK4A136_group
- Coproccoccus_1
- Ruminiclostridium_5
- uncultured bacterium f. Ruminococcaceae
- Oscillospira
- Ruminiclostridium_9
- uncultured bacterium o. Mollicutes_RF9
- Candidatus_Saccharimonas
- Ruminococcus_1
- Ruminiclostridium_6
- uncultured bacterium f. Clostridiales_vadinBB60_group
- Blautia
- Lachnospiraceae_FT5020_group
- Lachnospiraceae_UCG-007
- Lachnospiraceae_UCG-006
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- Ruminococcaceae_UCG-014
- Erysipelotrichaceae
- Alloprevotella
- Nasutisphaera
- Intestinimonas
- Lachnospiraceae
- Ancientobacter
- Veillonella
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- Corynebacterium
- Streptococcus
- Enterococcus
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- Pseudomonas
- Breviflavimonas
- Sphingomonas
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- Odoribacter
- Acetivibrio
- Buchnera
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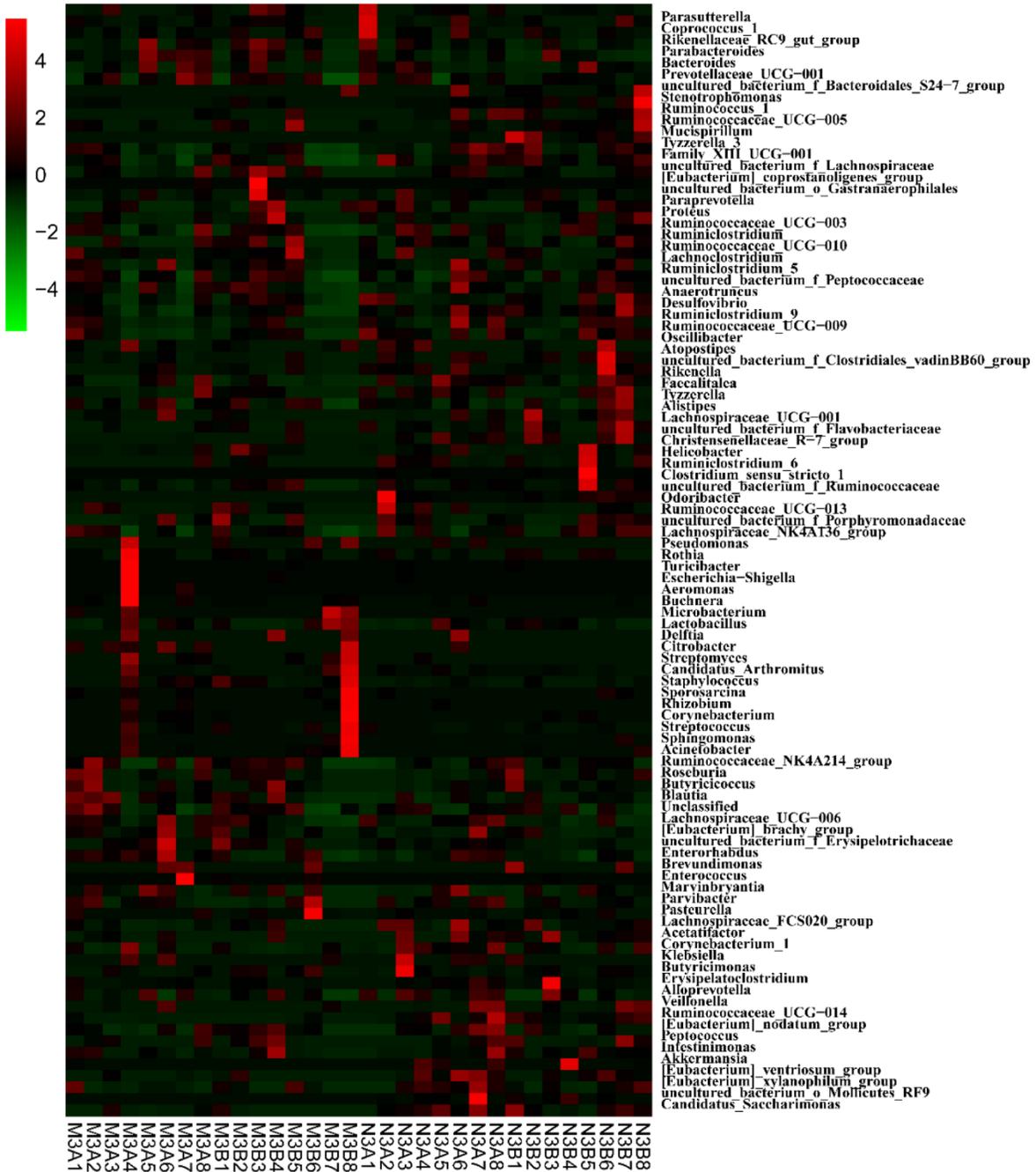
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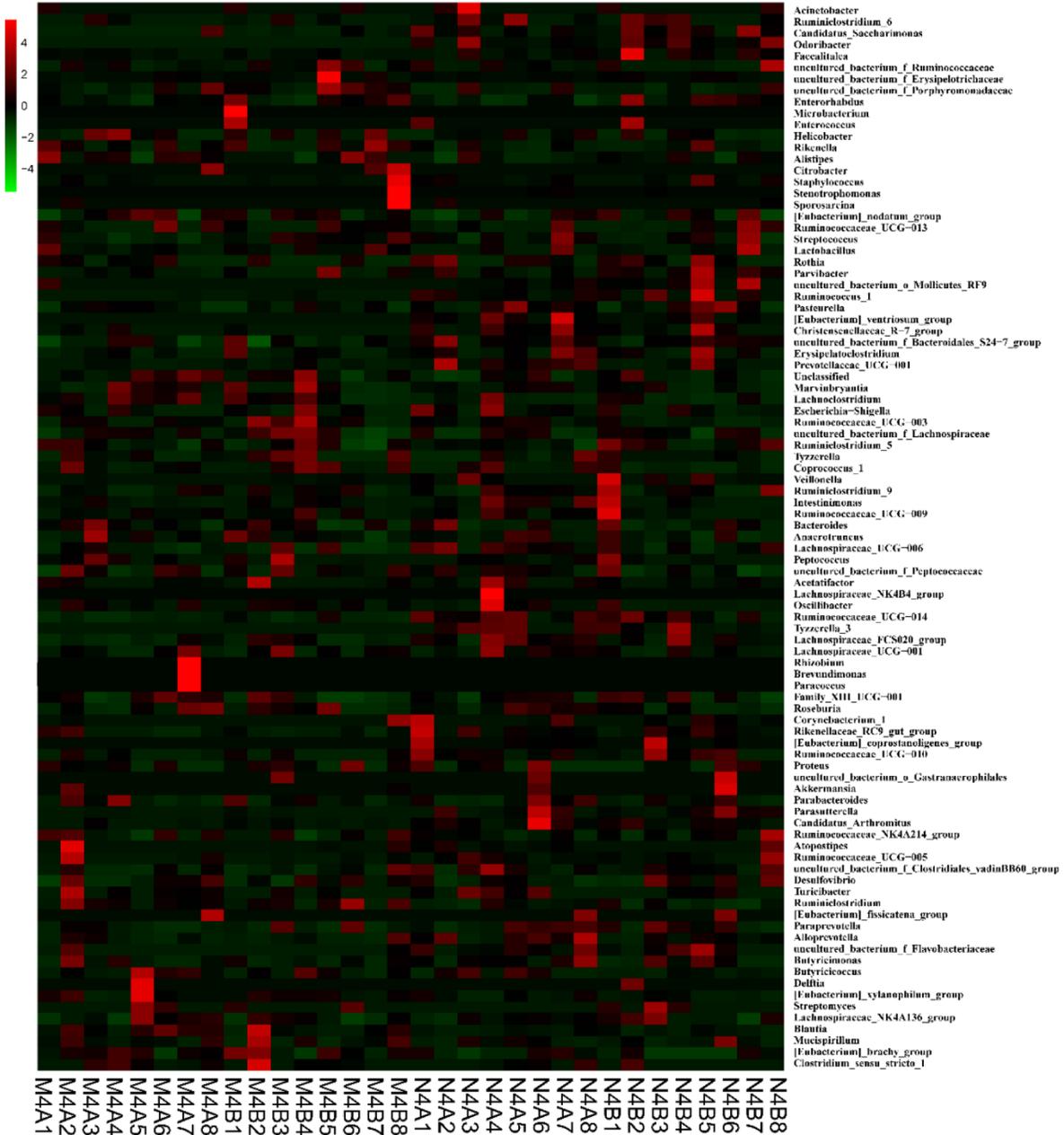
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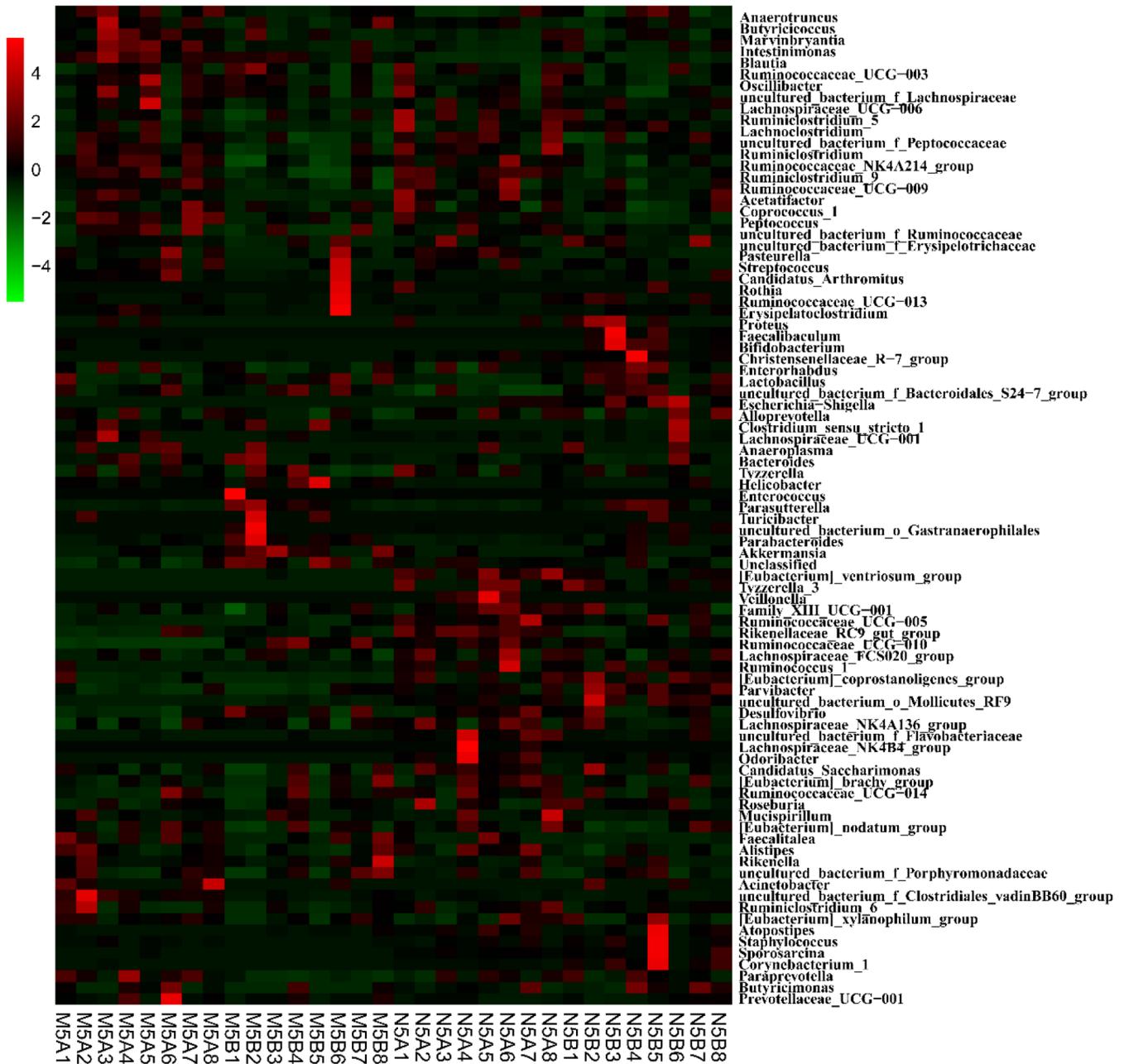
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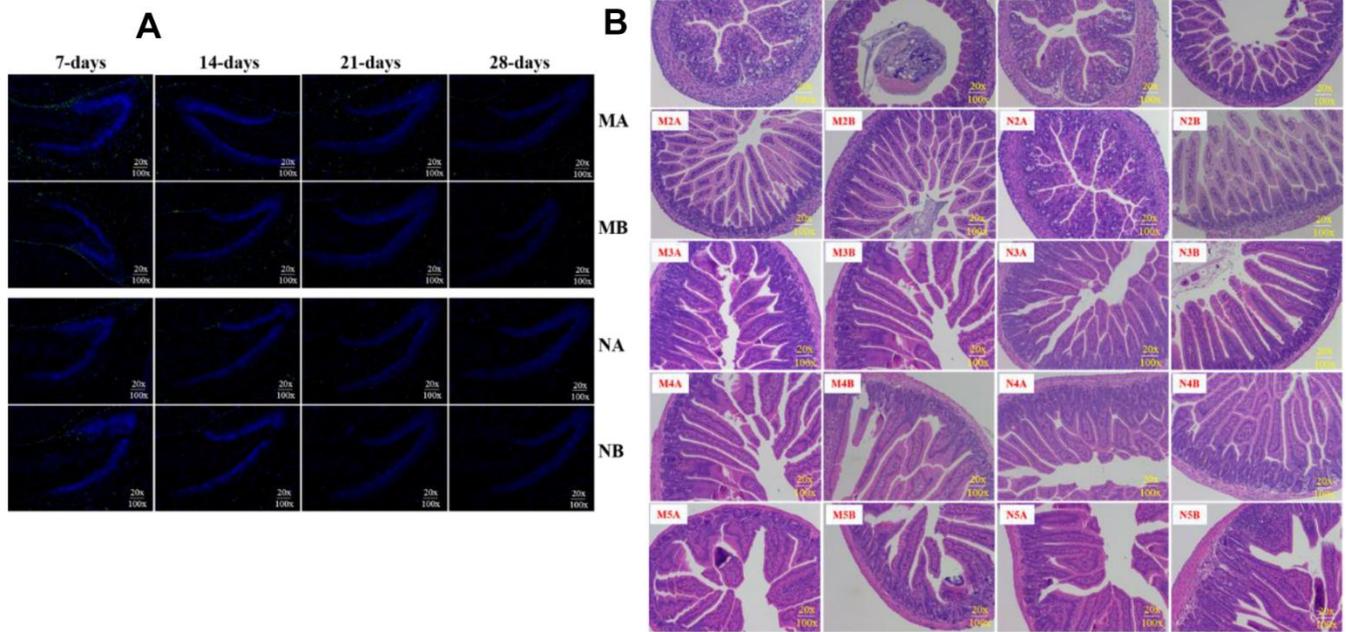
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G



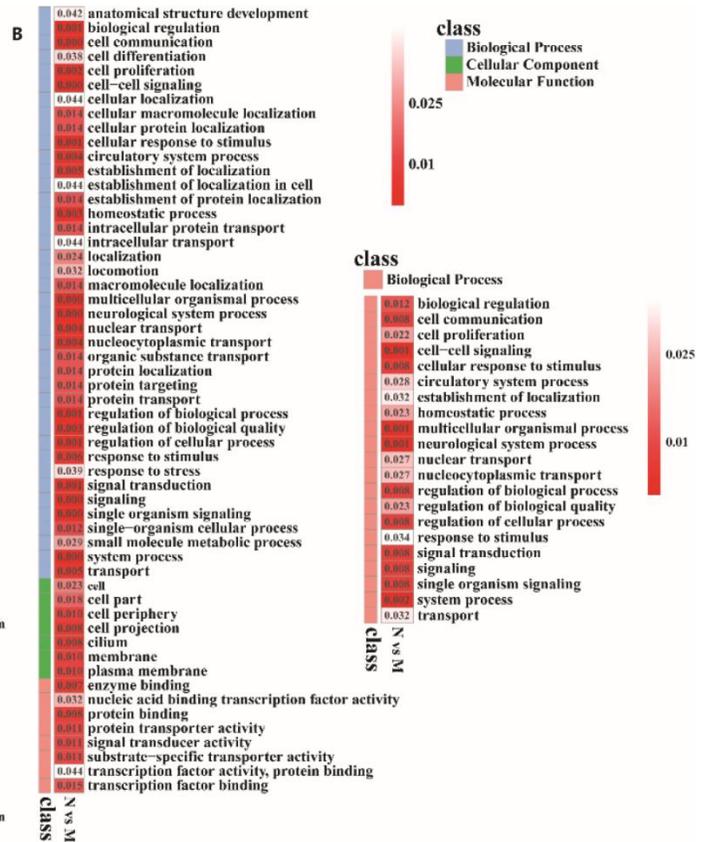
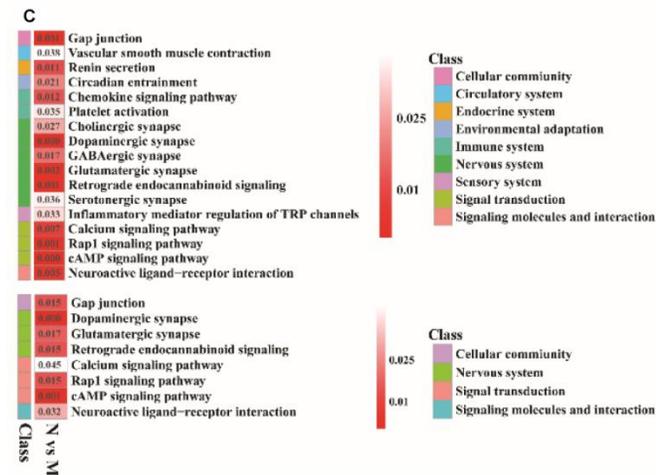
Supplementary Figure 4. Influences of maternal high sugar and fat diet on the genus of gut microbiota of offspring. (A) All the control samples; (B) All the HSHF fed samples; (C) All the samples at 7-day; (D) All the samples at 14-day; (E) All the samples at 21-day; (F) All the samples at 28-day; (G) All the samples at 56-day. The symbol of N1A is the 7-day control male samples, N1B is the 7-day control female samples, and N2A for 14-day, N3A for 21-day, N4A for 28-day, N5A for 56-day male samples, N2B for 14-day, N3B for 21-day, N4B for 28-day, N5B for 56-day female samples; M1A is the 7-day HSHF male samples, M1B is the 7-day HSHF female samples, and M2A for 14-day, M3A for 21-day, M4A for 28-day, M5A for 56-day male samples, M2B for 14-day, M3B for 21-day, M4B for 28-day, M5B for 56-day female samples. Data are presented as the means \pm SD of 8 independent experiments. * p < 0.05 and ** p < 0.01 vs. the model group by one-way ANOVA, followed by the one-way ANOVA test.



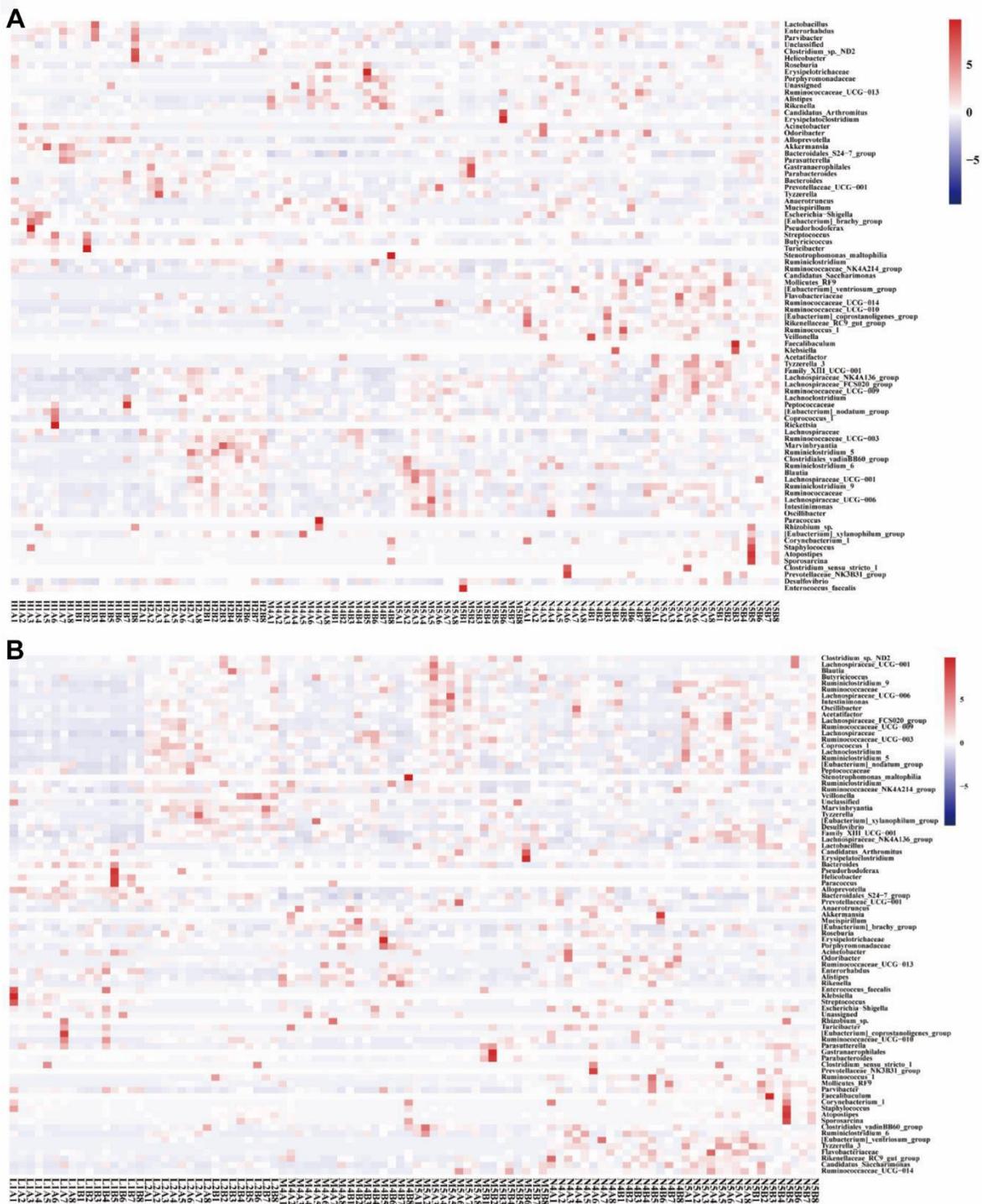
Supplementary Figure 5. The pathological structure of brain and small intestine. IBA1 for microglia (A); H&E staining showed the pathological structure of the small intestine (B). The symbol of N1A is the 7-day control male samples, N1B is the 7-day control female samples, and N2A for 14-day, N3A for 21-day, N4A for 28-day, N5A for 56-day male samples, N2B for 14-day, N3B for 21-day, N4B for 28-day, N5B for 56-day female samples; M1A is the 7-day HSHF male samples, M1B is the 7-day HSHF female samples, and M2A for 14-day, M3A for 21-day, M4A for 28-day, M5A for 56-day male samples, M2B for 14-day, M3B for 21-day, M4B for 28-day, M5B for 56-day female samples.

A KEGG pathway analysis of colonic contents from the HSHF-diet mice

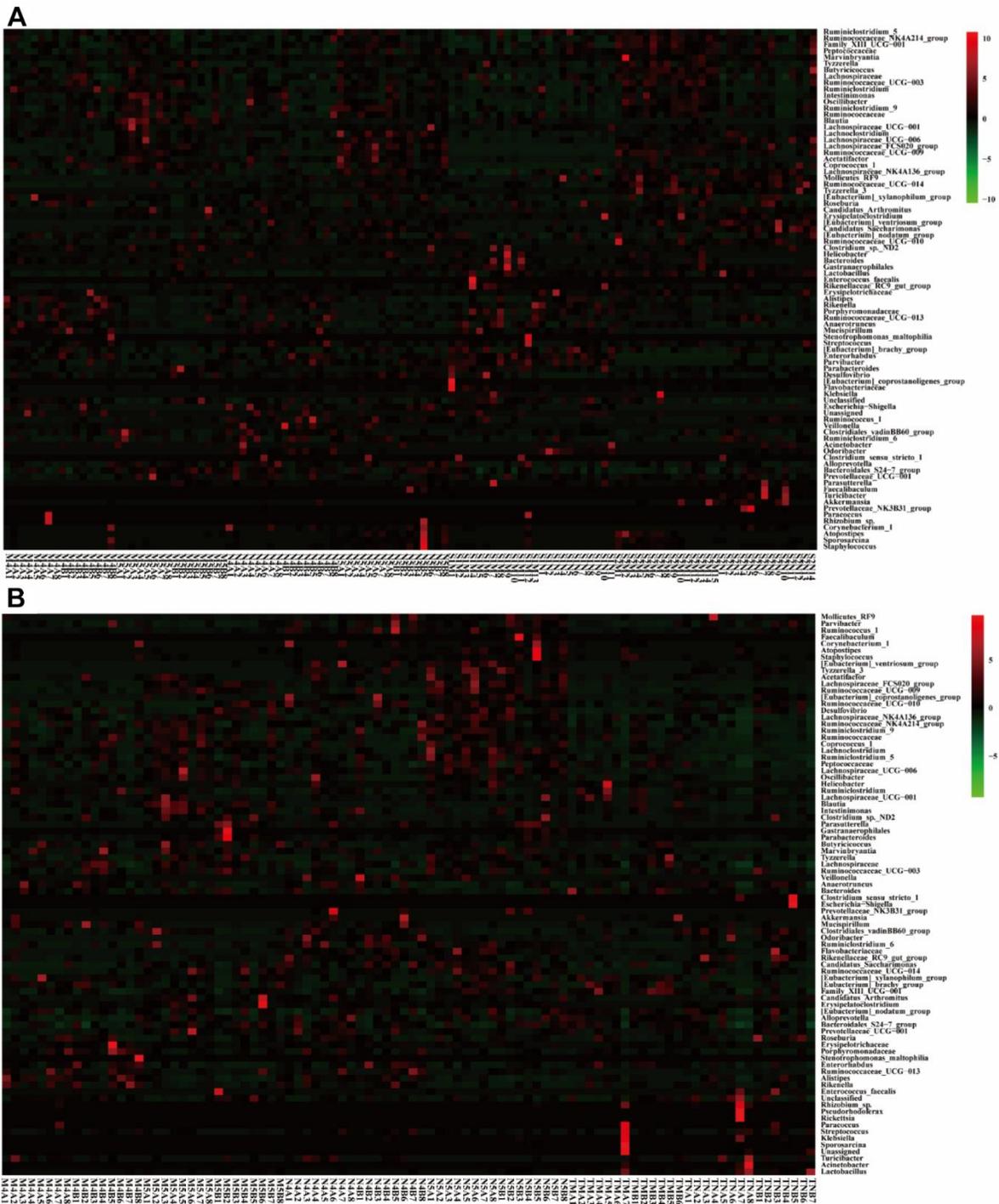
KEGG pathway	Total Cmpd	Raw p	FDR
Pyrimidine metabolism	39	3.96E-05	0.000149
Cysteine and methionine metabolism	33	4.14E-05	0.000149
Sphingolipid metabolism	21	4.14E-05	0.000149
Aminoacyl-tRNA biosynthesis	48	5.01E-05	0.000149
Arginine biosynthesis	14	6.32E-05	0.000149
Purine metabolism	66	6.32E-05	0.000149
D-Glutamine and D-glutamate metabolism	6	6.32E-05	0.000149
Nitrogen metabolism	6	6.32E-05	0.000149
Glycine, serine and threonine metabolism	34	6.72E-05	0.000149
Glutathione metabolism	28	9.17E-05	0.000183
Amino sugar and nucleotide sugar metabolism	37	0.000139	0.000253
Glycerolipid metabolism	16	0.000403	0.000620
Pentose phosphate pathway	22	0.000403	0.000620
Ether lipid metabolism	20	0.001653	0.002362
Phenylalanine metabolism	12	0.008923	0.011897
Glyoxylate and dicarboxylate metabolism	32	0.019477	0.024067
Steroid hormone biosynthesis	77	0.020457	0.024067
Alanine, aspartate and glutamate metabolism	28	0.028938	0.032154
Glycerophospholipid metabolism	36	0.032177	0.033871
Citrate cycle (TCA cycle)	20	0.045320	0.045320



Supplementary Figure 6. Pathway analysis of the different metabolites in colonic contents from the HSHF-diet mice using MetaboAnalyst 4.0 (A); The cholinergic neurons and GABA neurons were increased by up-regulated the LHX8 in the HSHF diet offspring when they getting old (B, C). The KEGG analysis showed that the significant pathways including Dopaminergic synapse, cAMP signaling pathway, Gap junction, Rap1 signaling pathway, Retrograde endocannabinoid signaling, Glutamatergic synapse, Neuroactive ligand-receptor interaction, Calcium signaling pathway.



Supplementary Figure 7. Special maternal diet changes the gut microbiome trace. (A) The dietary supplement of *Hericium erinaceus* group (A); the dietary supplement of *Ganoderma lucidum* (B). The symbol of N1A is the 7-day control male samples, N1B is the 7-day control female samples, and N2A for 14-day, N3A for 21-day, N4A for 28-day, N5A for 56-day male samples, N2B for 14-day, N3B for 21-day, N4B for 28-day, N5B for 56-day female samples; M1A is the 7-day HSHF male samples, M1B is the 7-day HSHF female samples, and M2A for 14-day, M3A for 21-day, M4A for 28-day, M5A for 56-day male samples, M2B for 14-day, M3B for 21-day, M4B for 28-day, M5B for 56-day female samples. The symbol of N1 is the 28-day control samples, N2 is the 56-day control samples; M1 is the 28-day HSHF samples, M2 is the 56-day HSHF samples; HE1 is for *Hericium erinaceus* treated 28-day samples, HE2 is for *Hericium erinaceus* treated 56-day samples, LZ1 is for *Ganoderma lucidum* treated 28-day samples, LZ2 is for *Ganoderma lucidum* treated 56-day samples. Data are presented as the means \pm SD of 8 independent experiments. * $p < 0.05$ and ** $p < 0.01$ vs. the model group by one-way ANOVA, followed by the one-way ANOVA test.



Supplementary Figure 8. Special maternal diet changes the gut microbiome trace. The exposure to different microbe in early life (microbe from the outdoor soil (T-, A) and SAMP8 mice (S-, B) also could change the inherent species abundance (Figure S3). The symbol of N1A is the 7-day control male samples, N1B is the 7-day control female samples, and N2A for 14-day, N3A for 21-day, N4A for 28-day, N5A for 56-day male samples, N2B for 14-day, N3B for 21-day, N4B for 28-day, N5B for 56-day female samples; M1A is the 7-day HSHF male samples, M1B is the 7-day HSHF female samples, and M2A for 14-day, M3A for 21-day, M4A for 28-day, M5A for 56-day male samples, M2B for 14-day, M3B for 21-day, M4B for 28-day, M5B for 56-day female samples. The symbol of N1 is the 28-day control samples, N2 is the 56-day control samples; M1 is the 28-day HSHF samples, M2 is the 56-day HSHF samples; HE1 is for *Hericium erinaceus* treated 28-day samples, HE2 is for *Hericium erinaceus* treated 56-day samples, LZ1 is for *Ganoderma lucidum* treated 28-day samples, LZ2 is for *Ganoderma lucidum* treated 56-day samples. Data are presented as the means \pm SD of 8 independent experiments. * $p < 0.05$ and ** $p < 0.01$ vs. the model group by one-way ANOVA, followed by the one-way ANOVA test.