

Supplementary Table S1. Mice growth and reproduction feed compositions (units: g/kg)

Crude protein	≥200 g	Vitamin A	≥14000 IU	Na	≥2 g
Crude fat	≥40 g	Vitamin D	≥1500 IU	K	≥5 g
Crude fiber	≤50 g	Vitamin E	≥120 IU	Mg	≥2 g
Crude ash	≤80 g	Vitamin K	≥5 mg	Cu	≥10 mg
Moisture	≤100 g	Vitamin B1	≥13 mg	Fe	≥120 mg
Lysine	≥13.2 g	Vitamin B2	≥12 mg	Zn	≥30 mg
methionine+cystine	≥7.8 g	Vitamin B6	≥12 mg	Mn	≥75 mg
Vitamin B12	≥0.022 mg	Se	0.1-0.2 mg	I	≥0.5 mg
Total phosphorus	6-12 g	Ca	10-18g		

Supplementary Table S2. Detailed recipes of HFD and HFD+PP04 diet (w/w %)

ingredients	HFD	HFD+PP04
Water	10.00	10-X
<i>P. pentosaceus</i> PP04	0.00	X
Mice growth and reproduction feed	68.80	68.80
Cholesterol	1.00	1.00
Bile salt	0.20	0.20
Lard	10.00	10.00
Egg yolk	10.00	10.00

Note: X is the amount of PP04 broth added to diet based on food intake data recorded the day before to ensure that the consumption was 10⁹ CFU/mouse.

Supplementary Table S3. A list of primer sequences used in this study.

Mouse Gene	Forward primer sequence (5'-3')	Reverse primer sequence (5'-3')
Occludin	TGGCTATGGAGGCGGCTATGG	AAGGAAGCGATGAAGCAGAAGGC
Claudin-1	GCTGGGTTTCATCCTGGCTTCTC	CCTGAGCGGTCACGATGTTGTC
ZO-1	GCGAACAGAAGGAGCGAGAAGAG	GCTTTGCGGGCTGACTGGAG
Muc-2	TGCTGACGAGTGGTTGGTGAATG	TGATGAGGTGGCAGACAGGAGAC
IL-6	ACTTCCAGCCAGTTGCCTTCTTG	TGGTCTGTTGTGGGTGGTATCCTC
IL-1 β	TCGCAGCAGCACATCAACAAGAG	AGGTCCACGGGAAAGACACAGG
TNF- α	GGACTAGCCAGGAGGGAGAACAG	GCCAGTGAGTGAAAGGGACAGAAC
Nrf2	CAGCCATGACTGATTTAAGCAG	CAGCTGCTTGTTTTTCGGTATTA
HO-1	ACCGCCTTCCTGCTCAACATTG	CTCTGACGAAGTGACGCCATCTG
CYP2E1	CCAACTCTGGACTCCCTTTTAT	ACGCCTTGAAATAGTCACTGTA
NQO1	GCGAGAAGAGCCCTGATTGTACTG	AGCCTCTACAGCAGCCTCCTTC
β -actin	GGCTGTATTCCCCTCCATCG	CCAGTTGGTAACAATGCCATGT