The method of determining the content of protein, fat, moisture, ash, titratable acid, dietary fiber (soluble and insoluble) and carbohydrates (non-dietary fiber):

According to GB5009.5-2016 (National Standard of the People's Republic of China), the FBP (2 g), $CuSO_4$ (0.4 g), K_2SO_4 (6 g) and sulfuric acid (20 mL) were added into the digestive tube. Then the digestive tube was transferred to the digestion oven. The digestion will still continue for 1 h when the temperature of the digesting oven reached at 420°C. The 50 mL of distilled water was added to the cooled reaction solution. The protein content was detected by using kjeldahl apparatus, subsequently.

According to GB5009.5-2016 (National Standard of the People's Republic of China), the fat of FBP was extracted by petroleum ether for 10 h (8 times/h). After removing the organic phase, the FBP sample was dried and weighed to calculate the fat content.

The content of moisture, ash, titratable acid and dietary fiber (soluble and insoluble) was respectively determined according to GB5009.3-2016, GB5009.4-2016, GB5009.239-2016 and GB5009.88-2014 (National Standard of the People's Republic of China) without any modification.

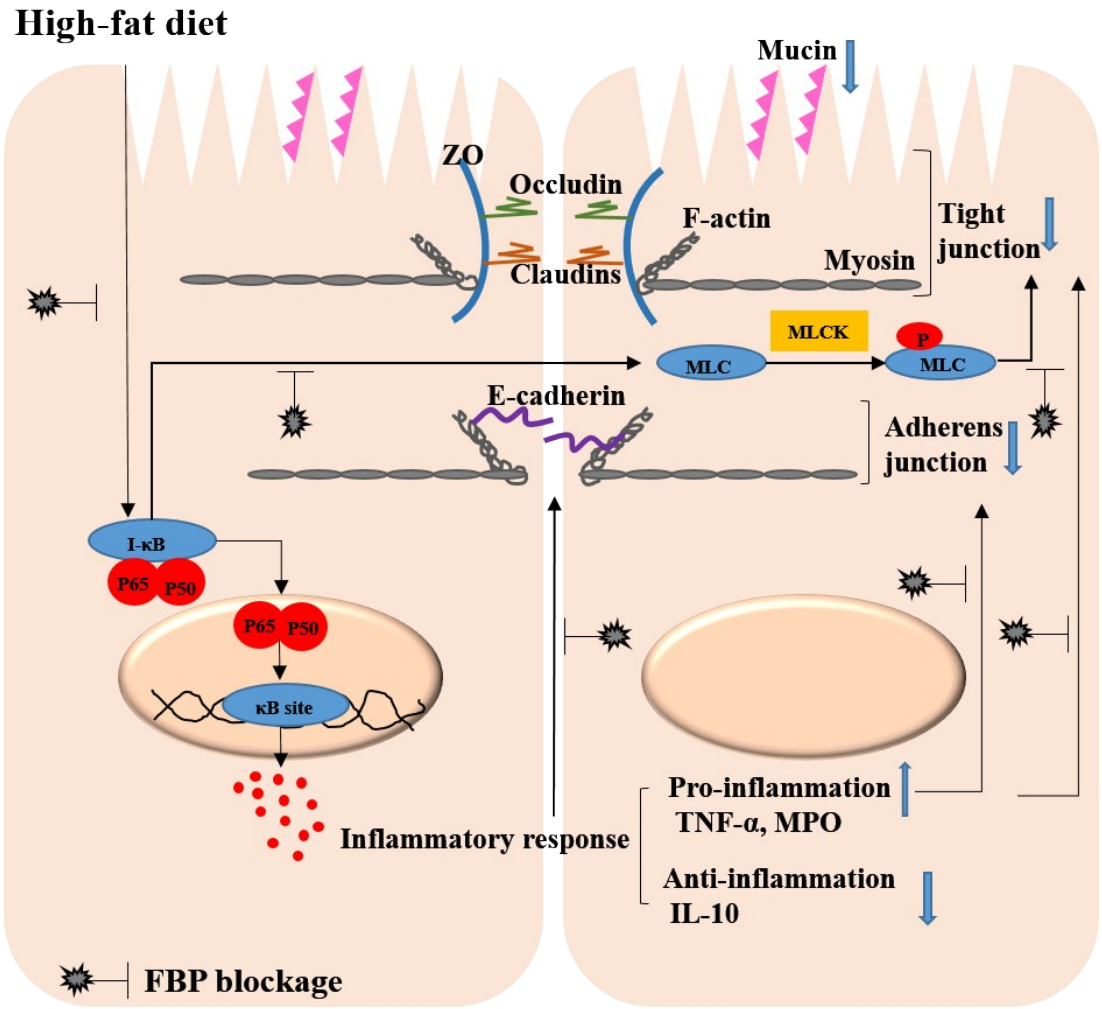
According to previous studies [1-3], the remaining difference to 100% was considered as being carbohydrates (non-dietary fiber).

The method of phenolic compounds determination by using UPLC-MS:

The FBP (500 mg) was dissolved in 400 mL of 60% ethanol. The phenolic extraction of FBP were subsequently extracted through ultrasound (480 W, 25°C, 1 h) and concentrated through evaporation. Then concentrated extraction (5 mL) were

applied to the C18 Sep-Pak cartridges (Waters, USA) to purify and collect the polyphenols. The phenolic extraction was obtained after the purify.

The specific phenolic compounds of phenolic extraction were detected through UPLC-MS system (Thermo Scientific Q Exactive, USA) with the 3200 V of appropriate spray voltage and 300℃ of capillary temperature. ZORBAX Eclipse XDB-C18 column (50 mm×2.1 mm, 1.8 μm) was used with the 0.2 mL/min of flow rate and 30°C of the column temperature. Phase A (0.1% formic acid-acetonitrile) and phase B (0.1% formic acid-water) were used as the binary gradient. Gradient was as follows: 5% A at 0 min, 20% A at 6 min, 35% A at 15 min, 40% A at 20 min, 95% A at 24 min, 95% A at 27 min, 5% A at 35 min. Both positive and negative electrospray ionization modes were collected at the mass ranges of 80-1200 m/z. Standards (gallic acid, catechin, epicatechin, caffeic acid, protocatechuate, syringic acid, ferulic acid, quercetin, kaempferol, and malvidin), purchased from Yuanye Biotech Co., Ltd. (Shanghai, China), were used to quantify the phenolic compounds. Quercetin and malvidin were separately used as the equivalent of quercetin glycosides and anthocyanins. Results were analyzed by the Xcalibur software (Thermo Scientific, USA).



Supplementary Figure S1. Possible mechanism of FBP on small intestinal barrier function in HFD mice.

Supplementary Table S1. Ingredients of maintenance purified diet.

	Feed ratio (g/kg)	
Ingredient	TP23522	TP23520
Casein	190	258
Corn Starch	480	0
Maltodextrin	118	162
Sucrose	65	89
Soybean Oil	24	32
Lard	19	317
Cellulose	47	65
Mineral Mix, M1022	43	58
Vitamin Mix, V1000	9	13
L-Cystine	3	4
Choline Bitartrate	2	3
TBHQ	0.01	0.07
	Total: 1000	Total: 1000
	Feed heat ratio (%)	
	TP23522	TP23520
Protein	20	20
Carbohydrate	70	20
fat	10	60
	Total: 100	Total: 100
	Feed heat (Kcal/g)	
	TP23522	TP23520
	3.9	5.3

Supplementary Table S2. Primers used in this research.

Gene	Primers	Gene Bank ID/References
β-actin	F: GGCTGTATTCCCTCCATCG R: CCAGTTGGTAACAATGCCATG	[4]
ZO-1	F: CGGAACTATGACCATCGCCTAC R: CTTCGGGATGTTGTCTGGAGTC	NM-001163574.1
Claudin-1	F: GGGCTGATCGCAATCTTTGTGT R: CCACTAATGTCGCCAGACCTGA	NM-016674.4
Claudin-4	F: GGCTGAGCGATGGCGTCTAT R: CGATGTTGCTGCCGATGAAGG	NM-009903.2
Occludin	F: TTCCACACTTGCTTGGGACAGA R: TCCGCCATAGCCATAGCCATAG	NM-0088756.2
E-cadherin	F: GCCATCGCCTACACCATCGT R: GCAGCCTGAACCACCAGAGT	NM-009864.3
Muc 2	F: ACGCCTGTGACCTCTCAATCC R: CCGCTGATGAAGTGACGAATGG	NM-023566.3
NF-κB	F: GAGGTCTCTGGGGGTACCAT R: TTGCGGAAGGATGTCTCCAC	[5]
MLCK	F: CCCTTCCTTCTCTAGTGTTCTGA R: AGCCTCACAGATGGATCGAG	[6]

Supplementary Table S3. The approximate composition of FBP powder.

Component	Content (g/kg)
Moisture	23.6 ± 0.7
Fat	5.0 ± 0.2
Protein	114.5 ± 1.5
Ash	22.7 ± 0.5
Titratable acid	2.7 ± 0.1
Soluble dietary fiber	48.0 ± 0.1
Insoluble dietary fiber	360.3 ± 2.2
Carbohydrates (non-dietary fiber)	423

Data expressed as mean ± standard deviation (n = 3). The content of carbohydrate (non-dietary fiber) was calculated by difference.

Supplementary Table S4. Body weight of mice during the five-week-feed.

Group	Body weight (g)					
	Initial	1 Week	2 Week	3 Week	4 Week	5 Week
C	21.59 ±1.25 [a]	23.61±1.93 [ab]	23.74±0.65 [a]	23.84±0.57 [a]	24.49±0.77 [a]	25.10±0.54 [a]
CL	21.46 ±0.51 [a]	23.31±1.55 [a]	23.58±1.52 [a]	23.81±0.81 [a]	24.43±0.49 [a]	25.32±0.32 [a]
CH	21.62 ±0.68 [a]	22.88±0.47 [a]	23.29±0.46 [a]	23.94±0.65 [a]	24.36±0.62 [a]	25.23±0.56 [a]
HFD	21.97 ±1.14 [a]	25.89±1.25 [c]	27.48±0.80 [bc]	28.99±0.65 [c]	31.94±2.14 [c]	33.89±1.39 [c]
HFDL	21.90 ±0.91 [a]	25.26±0.73 [bc]	27.59±1.16 [c]	28.42±0.77 [c]	30.01±0.42 [b]	31.20±0.95 [b]
HFDH	21.83 ±0.63 [a]	24.87±0.77 [bc]	26.50±0.63 [b]	27.53±0.58 [b]	29.52±0.66 [b]	30.45±0.74 [b]

Data expressed as mean ± standard deviation (n = 7). Means with different letters in each column were significantly different at $p < 0.05$.

References for supplementary information

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