Table S1 Composition of experimental diets

Ingredient (g/kg)	NCD	HFD	Intervention group diet	
			HFD-UB	HFD-FB
UB	0.00	0.00	150.00	0.00
FB	0.00	0.00	0.00	150.00
Casein	189.56	258.45	227.65	224.10
L-Cystine	2.84	3.88	3.88	3.88
Corn Starch	479.79	0.00	0.00	0.00
Maltodextrin 10	118.48	161.53	114.91	111.31
Sucrose	65.21	88.91	88.91	88.91
Cellulose, BW200	47.39	64.61	0.00	7.08
Soybean Oil	23.70	32.31	24.28	24.41
Lard	18.96	316.60	316.60	316.60
Mineral Mix	9.48	12.92	12.92	12.92
DiCalcium Phosphate	12.32	16.80	16.80	16.80
Calcium Carbonate	5.21	7.11	7.11	7.11
Potassium Citrate, 1 H_2O	15.64	21.32	21.32	21.32
Vitamin Mix, V10001	9.48	12.92	12.92	12.92
Choline Bitartrate	1.90	2.58	2.58	2.58
FD&C Yellow Dye #5	0.04	0.00	0.00	0.00
FD&C Blue Dye #1	0.01	0.07	0.07	0.07
Total	1000	1000	1000	1000
Energy and their source (%)				
Protein	20	20	20	20
Carbohydrate	70	20	20	20
Fat	10	60	60	60
Total	100	100	100	100

UB: untreated highland barley bran; FB: fermented highland barley bran; NCD: normal control diet; HFD: high-fat diet; HFD-UB: high-fat diet supplemented with 15% UB; HFD-FB: high-fat diet supplemented with 15% FB. To equalize carbohydrate, protein, fat, sucrose and fiber content (g/kg diet) among the HFD, HFD-UB, and HFD-FB diets, casein, maltodextrin, soybean oil, and cellulose were reduced in the HFD-UB and HFD-FB diet, respectively. The proximate nutritional composition of UB was as follows (g/100 g dry weight basis): total dietary fiber 48.87, starch 23.52, protein 15.34, fat 5.36, ash 4.02; The proximate nutritional composition of FB was as follows (g/100 g dry weight basis): total dietary fiber 38.36, starch 18.29, protein 16.58, fat 5.27, ash 4.83.

Table S2 Primers sequences

Gene	Forward sequence (5'-3')	Reverse sequence (5'-3')
GAPDH	GTTTCCTCGTCCCGTAG	AATCTCCACTTTGCCACT
PPARα	GTCATCACAGACACCCTC	GGGTTGTTGCTGGTCT
PPARγ	GATTTCTCCAGCATTTC	ATCGCACTTTGGTATT
AMPKα-1	CATAAAGTGGCTGTGAA	GTGAGGGTGCCTGAAC
CPT-1	TGTCCAAGTATCTGGCAGTC	AGCCGTCATCAGCAACC
SREBP1c	AGGCACAGATGTGTCTATGG	TCACCTGGTTATCCTCAAAGG
ACC	GGCAGCAGTTACACCACATAC	TCATTACCTCAATCTCAGCATAGC
LKB1	AACCTGCTACTCACCACC	ATGTCCACCTTGAAACCT
SREBP2	CTACCGCAAGGTGTTCC	TTGGTGTTCTGAGTGGG
HMGCR	GTCTGGACGAAGATGTG	GGCTAAACTCAGGGTAAT
Cd36	AGTCCTGGCTGTGTTTGGAG	CTGTACACAGTGGTGCCTGT
FAS	GCCTCTGGTGCTTGCT	TTCACGAACCCGCCTC

Fig. S1

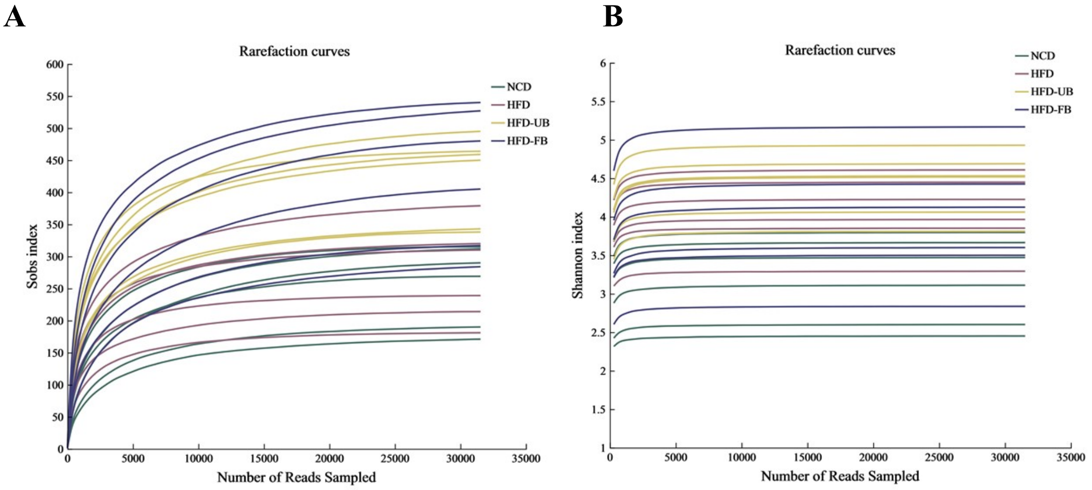


Fig. S2

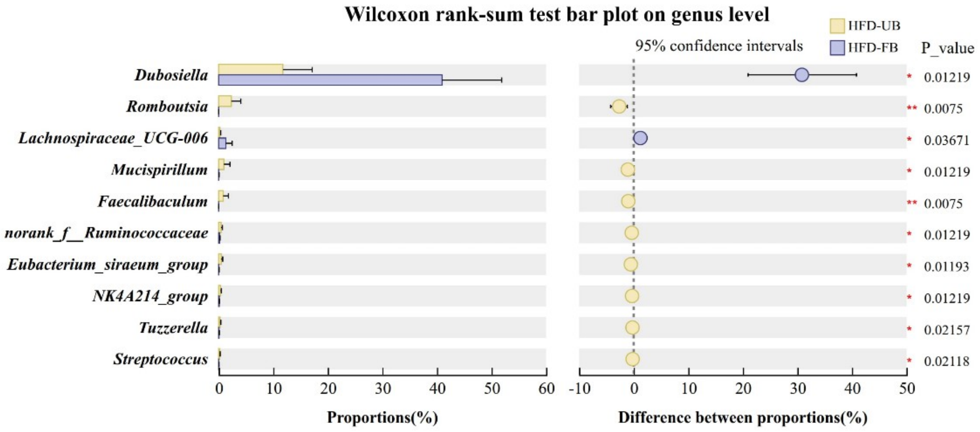
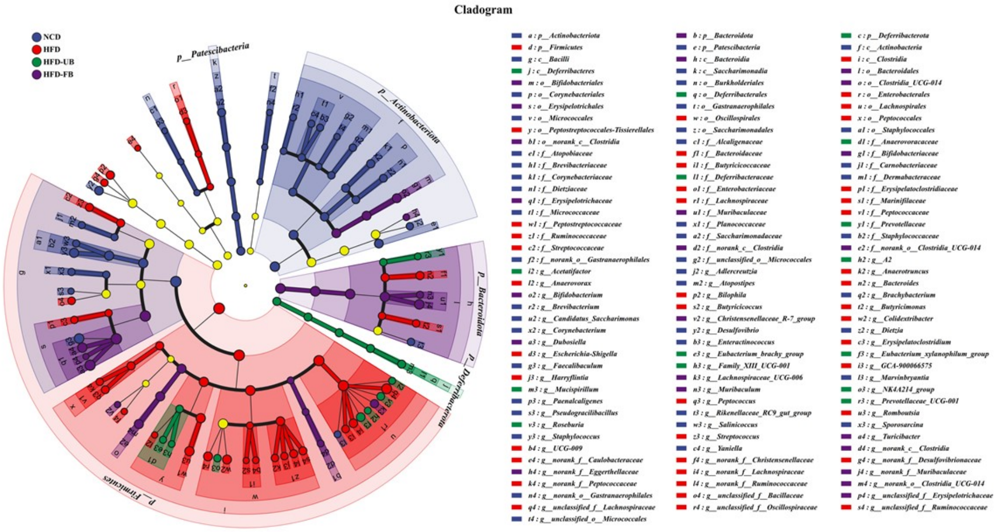


Fig. S3



Method S1

Total polyphenol content was determined as follows: 125 μL of the extract was mixed with 500 μL of distilled water. Subsequently, 125 μL of Folin-Ciocalteu reagent was added, and the mixture was allowed to stand for 6 min. Then, 1.25 mL of a 7% (w/v) Na_2CO_3 solution and 1.0 mL of deionized water were added. After thorough mixing, the mixture was incubated in the dark for 90 min. Absorbance was measured at 760 nm. The results were expressed as milligrams of gallic acid equivalent per gram of dry weight (mg GAE/g DW).

Total flavonoid content was determined as follows: 0.5 mL of the extract was mixed with 2.25 mL of distilled water, followed by the addition of 0.15 mL of a 5% (w/v) $NaNO_2$ solution. After 6 min of reaction, 0.3 mL of 10% (w/v) $AlCl_3$ was added and the mixture was allowed to stand for 5 min. Subsequently, 1 mL of NaOH solution (1 mol/L) was added and mixed thoroughly. The absorbance was measured immediately at 510 nm. The results were expressed as milligrams of rutin equivalent per gram of dry weight (mg RE/g DW).

The phenolic acids and flavonoids were quantified using liquid chromatography-mass spectrometry (AB 6600LC-MS, Milwaukee, WI, USA). Reversed-phase high-performance liquid chromatography separation was carried out using a Waters HSS T3 column (50×2.1 mm, 1.8 μm). The mobile phase components were mobile phase A (water with 0.1% formic acid) and mobile phase B (acetonitrile with 0.1% formic acid). The mobile phase gradient was: 0-2 min, 10% B; 2-9 min, 60% B; 9-12 min, 10% B. The injection volume was 2 μL and the column temperature was 40 °C. The mass spectrometer was operated in negative ion mode with the following parameters: Sheath gas, 40 arb; auxiliary gas, 10 arb; ion spray voltage, -2800 V; temperature, 350 ℃, ion transfer tube temperature: 320 ℃. For quantitative determination, the standard curve was made by known concentrations of standard compounds.