

Supplementary Figure.1 Animal model. Animal model and development. Male Wistar rats were divided into 4 groups ( $n=10$ ). Control group were on normal chow diet, while the other 3 groups were on HFD for 10 weeks. Two groups on HFD were demonstrated with different doses of SFN (10, 20 mg/kg) by oral gavage 3 times a week for 10 weeks and defined as SM and SH, respectively.

Supplementary Figure.2 (A) Body weight of rats along the whole experiment. TG (B) and TC (C) level of serum. (D) The AUC-glucose values for 0-120 min at week 8. Data were represented as mean  $\pm$  SD, significance was determined by one-way ANOVA corrected for multiple comparisons with Tukey's test. Compared to control group, \*\*\* $P < 0.01$ ; compared to HFD group, ### $P < 0.001$ .

Supplementary Figure.3 (A) Comparison of OTU Venn diagrams between groups. (B) Comparison of the number of OTUs between groups. (C) The relative abundance of bacteria between groups. Data were represented as mean  $\pm$  SD, significance was determined by one-way ANOVA corrected for multiple comparisons with Tukey's test. Compared to control group, \*\*\* $P < 0.01$ ; compared to HFD group, ### $P < 0.001$ .

Supplementary Figure.4 Characterization of intestinal flora in individuals at the phylum level (A), class level (B), order level (C), family level (D) and genus level (F).

Supplementary Figure.5 (A) D-Lac level in serum. The correlation analysis between *Bifidobacteria* (B), *Lactobacillus* (C) and LPS. (D) The correlation between *Bifidobacteria* and acetic acid, propionic acid and butyric acid.