**Supplementary information**

**Additional file 1: Figure S1-S2**

**Figure S1.** The timeline of treatments and data collection.

**Figure S2.** Effects of cold stress on physiological indexes.

**Additional file 2: Table S1-S8**

**Table S1.** Composition and nutrient levels of the sheep diet (air-dry basis).

**Table S2.** Effects of wind velocity on diversity indexes of sheep under low temperature.

**Table S3.** The standard curve, PCR efficiency and linear correlation coefficient (R2).

**Table S4.** Influence of temperature on the microbiota analyzed via qPCR.

**Table S5.** The function prediction at level 1 (%).

**Table S6.** The function prediction at level 2 (%).

**Table S7.** The function prediction at level 3 (%).

**Table S8.** Effects of cold and wind chill level on the VFA content of rumen fluid.

**Additional file 3: Table S9**

**Table S9.** Correlation analysis of rumen microbiota and host phenotype.