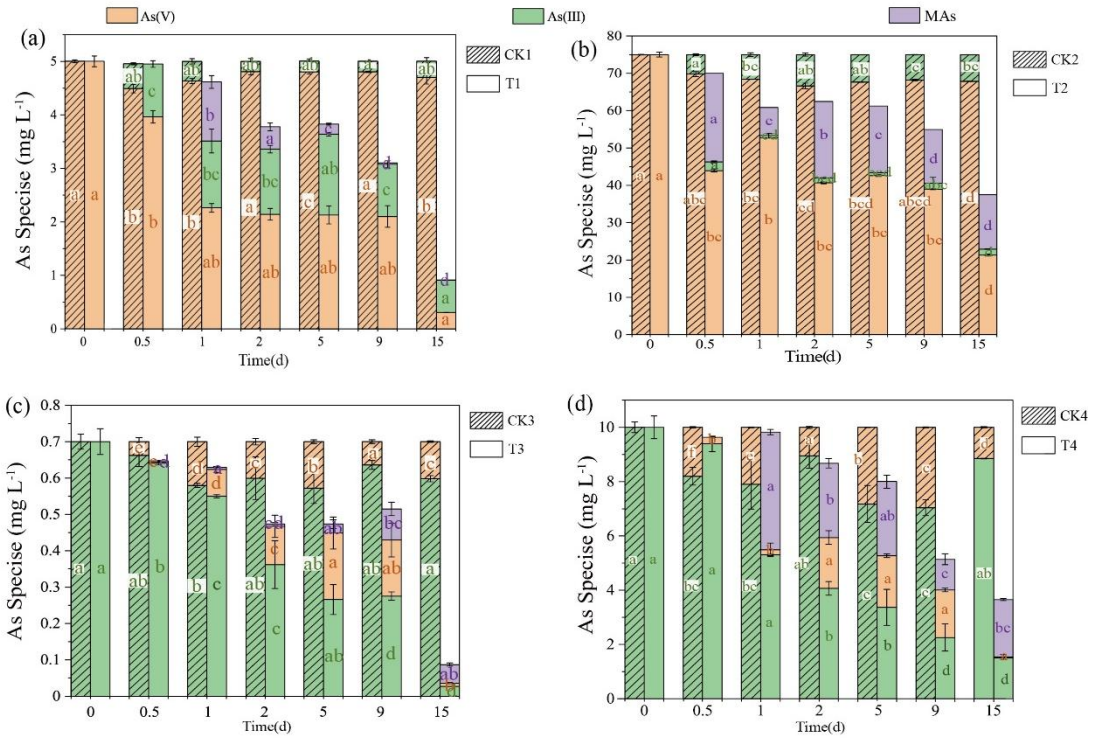

Figure S1 Distribution characteristics of As species in each reactor. Panel (a)~(d) show the distribution of aqueous As species in reactors with 5 mg L^{-1} As (V), 75 mg L^{-1} As (V), 0.7 mg L^{-1} As(III) and 10 mg L^{-1} As(III), respectively. Error bars indicate the standard deviation of three replicates. The lowercases denote significant differences at $p < 0.05$ as determined by Tukey's test. CK1, CK2, CK3 and CK4 represent the control groups with sterilized culture, responding to T1, T2, T3 and T4 reactors, respectively.

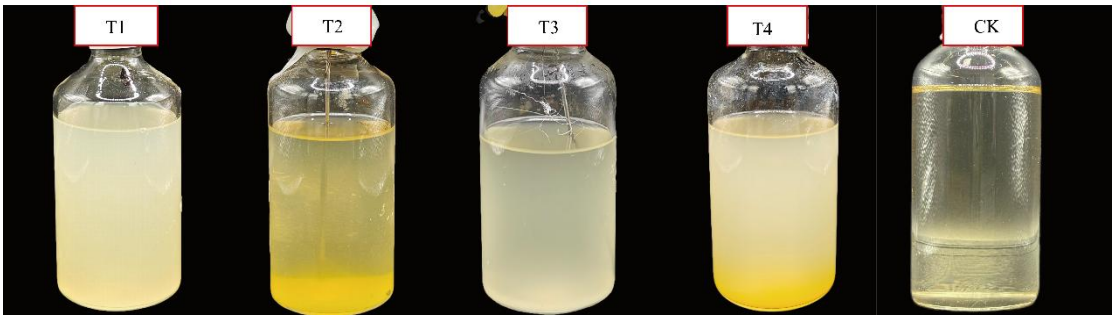

Figure S2 Experimental phenomena of cultures under different As contaminants during incubation. T1, T2, T3 and T4 reactors contain 5 mg L^{-1} As (V), 75 mg L^{-1} As (V), 0.7 mg L^{-1} As(III) and 10 mg L^{-1} As(III), respectively, and CK represents the control groups with sterilized culture.

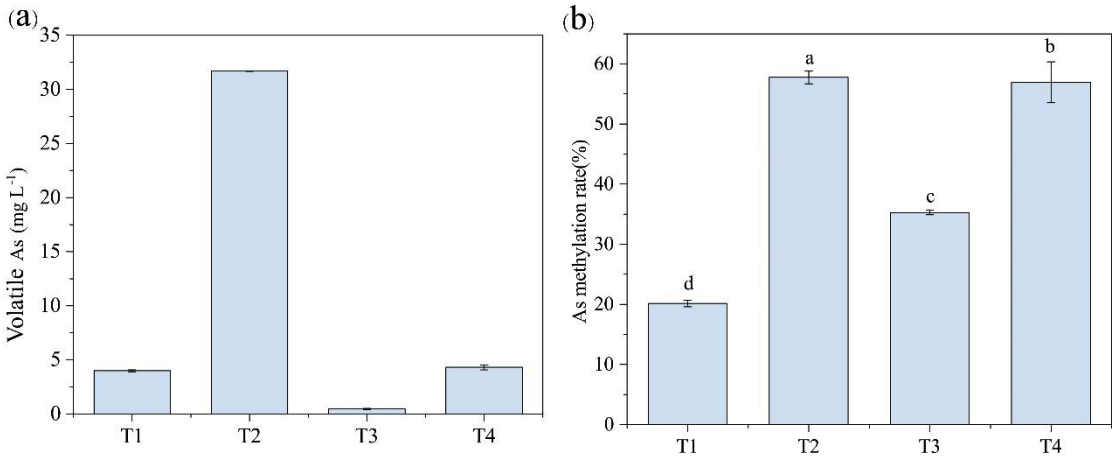

Figure S3 The Volatile As content in different reactors. Error bars indicate the standard deviation of three replicates. The different lowercase letters indicate a significant difference at $p < 0.05$, as assessed by Waller-Duncan's test.

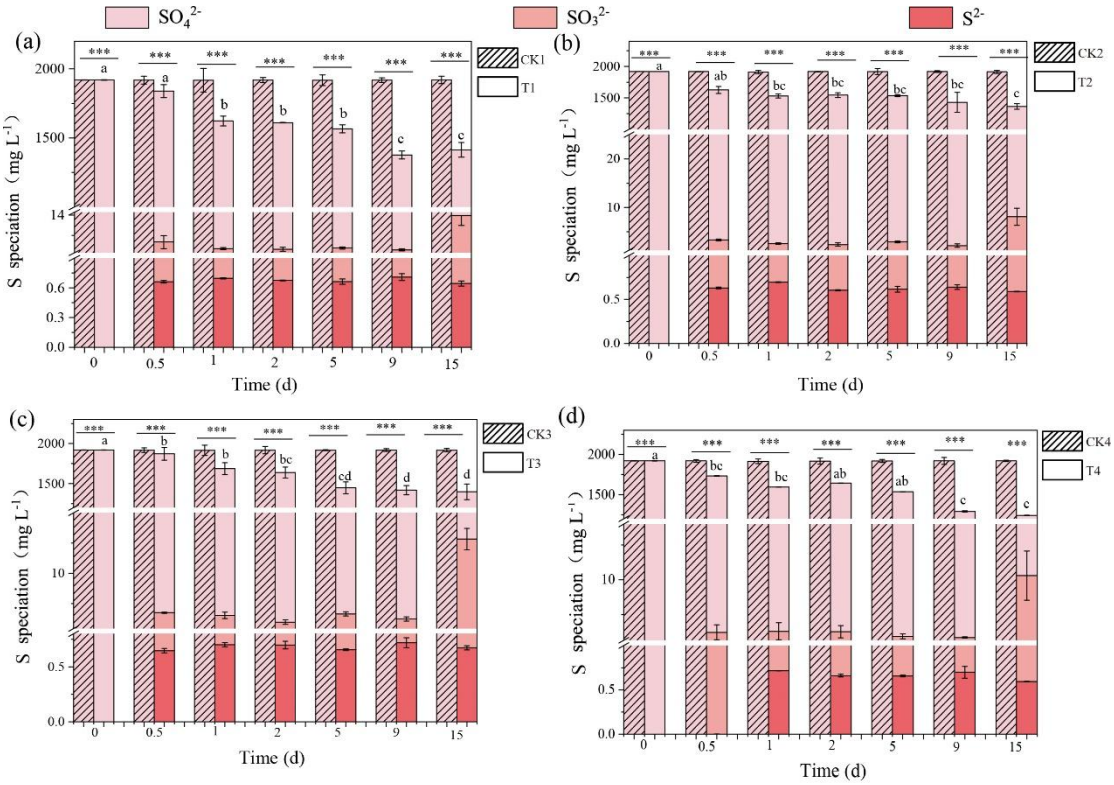

Figure S4 Distribution of S speciation in different reactors. Panel (a)~(d) display distribution of S species in reactors with 5 mg L^{-1} As (V), 75 mg L^{-1} As (V), 0.7 mg L^{-1} As(III) and 10 mg L^{-1} As(III), respectively. CK1, CK2, CK3 and CK4 represent the control groups with sterilized culture, responding to T1, T2, T3 and T4 reactors, respectively. Error bars indicate the standard deviation of three replicates. Lowercases denote significant difference at $p < 0.05$, as determined by Waller-Duncan's test. The asterisk represents the difference in TAs between T group and its corresponding CK group.

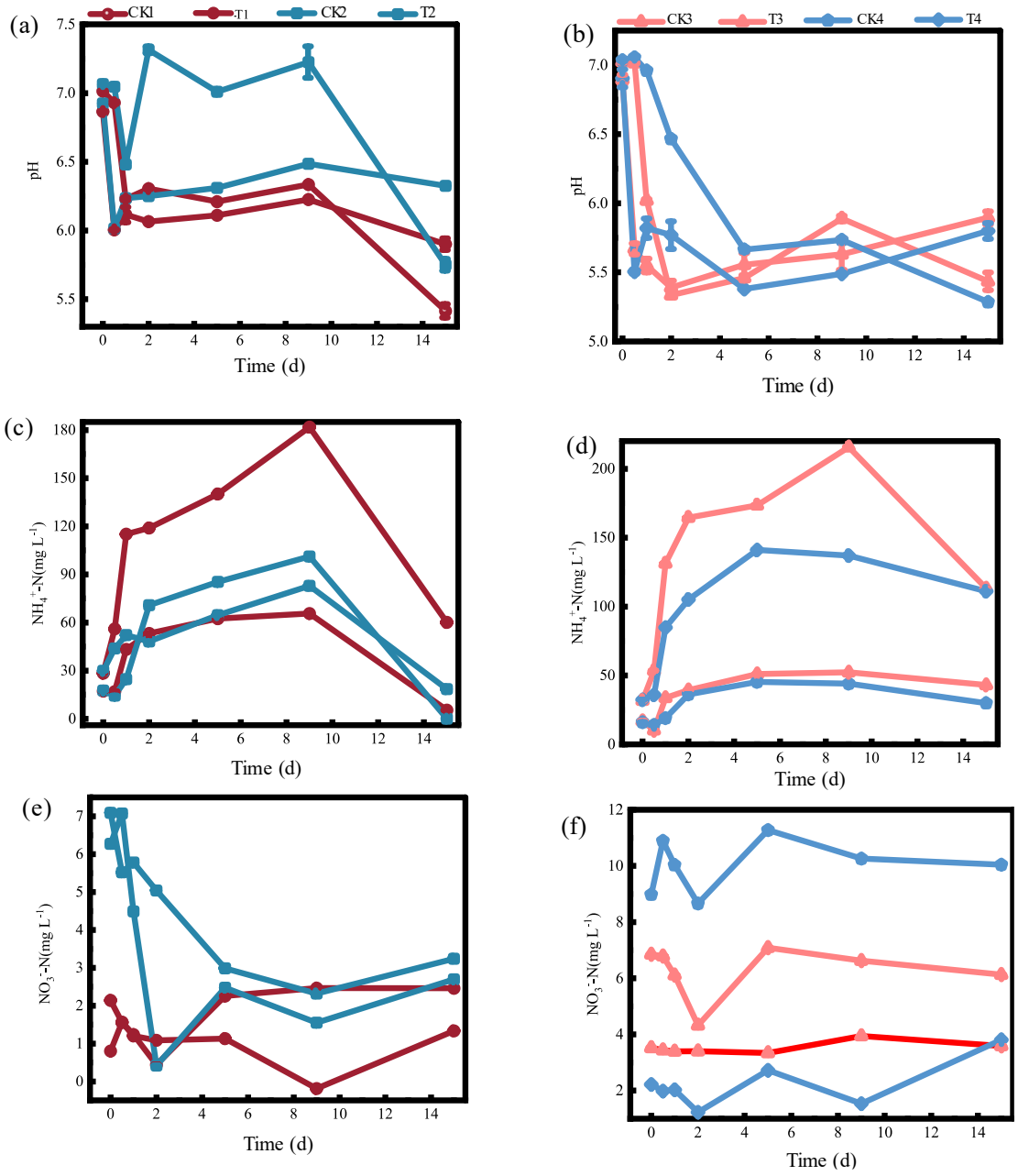

Figure S5 Changes of environmental factors in each reactor during incubation. Panel (a), (c), and (e) display the distribution of pH, NH_4^+-N, and NO_3^--N in reactors containing 5 mg L^{-1} As(V), 75 mg L^{-1} As(V), respectively. Panel (b), (d), and (f) show the same environmental factors in reactors with 0.7 mg L^{-1} As(III) and 10 mg L^{-1} As(III), respectively. CK1, CK2, CK3, and CK4 represent the control groups with sterilized culture, corresponding to T1, T2, T3, and T4 reactors, respectively. Error bars indicate the standard deviation of three replicates.

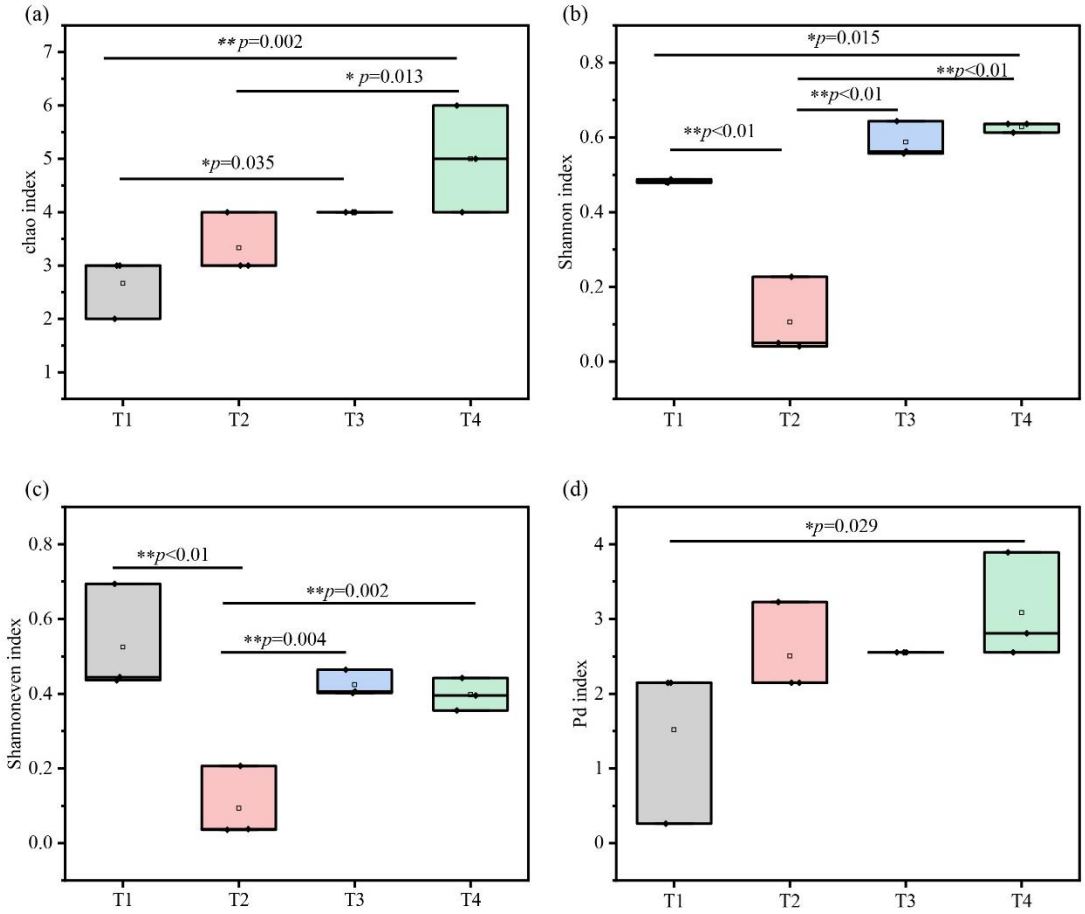

Figure S6 Changes of microbial alpha-diversity at different temperature fields during various operation periods, including Chao 1, Shannon, Shannoneven and Pd indices. Error bars indicate the standard deviation of three replicates. According to Pearson correlation coefficient, symbols '*, **, ***' indicate $p<0.05$, $p<0.01$, and $p<0.001$, respectively.

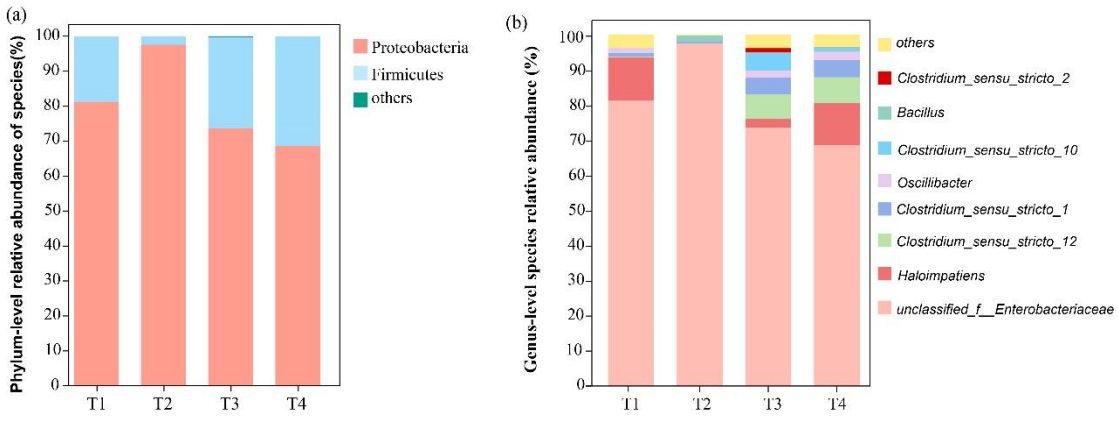

Figure S7 Changes of microbial community structure in different treatment groups. Panel (a) and (b) show relative abundance microbial phyla and genera, respectively.

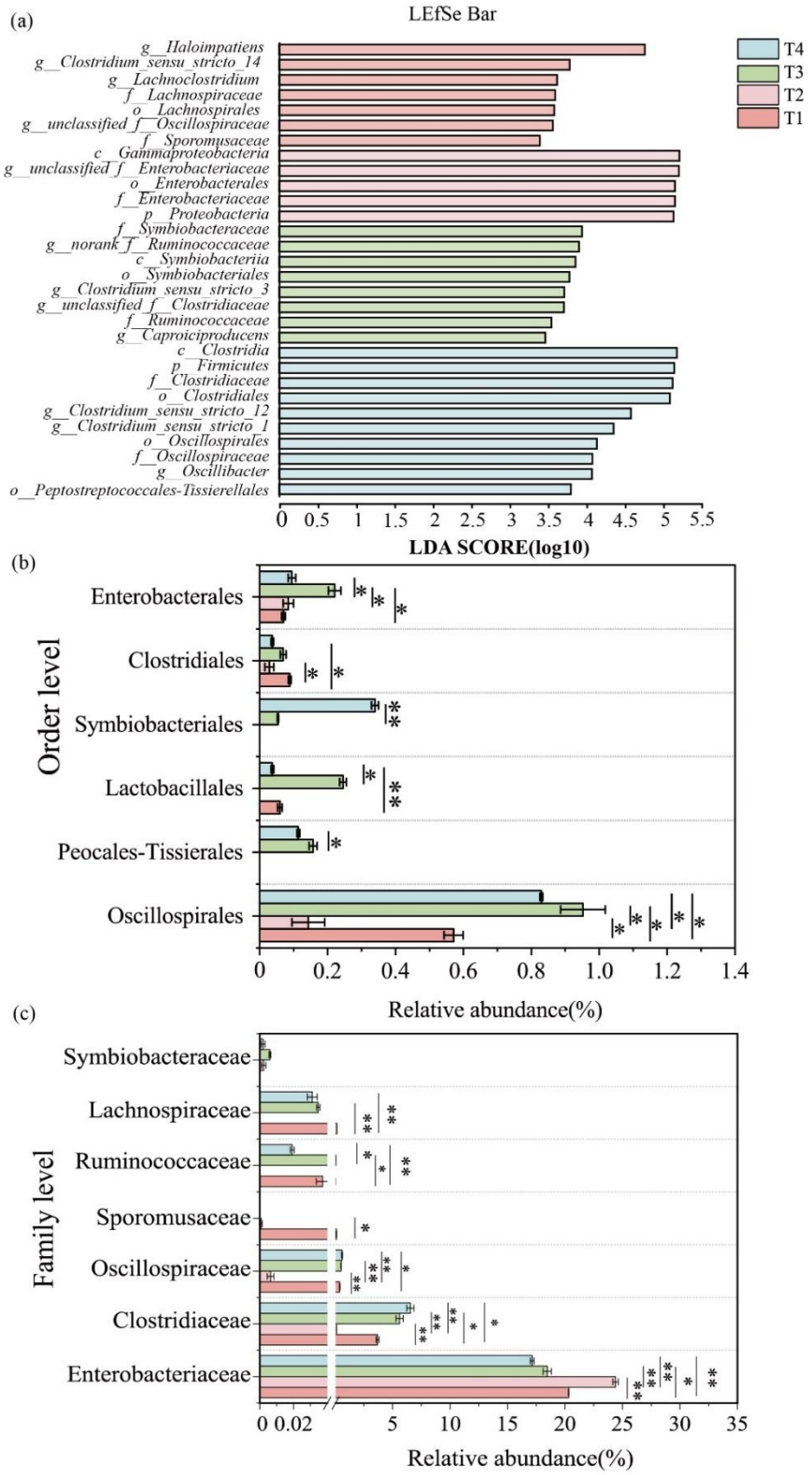

Figure S8 LEfSe analysis identifies different clades in different reactors. Panel (a) illustrates the species with a LDA score greater than 3.0, indicating their significant differential abundance across the reactors. Panel (b) and (c) showed the distribution of biomarkers in different reactors at order level and family level, respectively. According to Pearson correlation coefficient, symbols '*, **, ***' indicate $p<0.05$, $p<0.01$, and $p<0.001$, respectively.