Bacteria-clay and social interactions control biofilms formation and ecological functions in soils

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Microbial biofilms, sessile microbial communities enveloped in a self-produced extracellular polymeric substance (EPS), are ubiquitous in the natural environment. In soil systems, the sessile state dominates in microorganisms and protects them physically, chemically, and biologically. Soil microbial biofilms play a vital role in the formation and stability of soil aggregates, weathering of minerals, degradation and sequestration of organic carbon, and controlling bacterial pathogens invade. Therefore, there is a critical need to understand the progressive formation of microbial biofilms and their ecological functions in soils. Firstly, we will report the growth, biofilm formation, and virulence gene expression of the pathogenic bacteria *Escherichia coli* O157:H7 after exposure to montmorillonite, kaolinite, and goethite, three common soil minerals in the clay size fraction. Our results showed that montmorillonite could stimulate the rapid growth of *E. coli* O157:H7, but inhibit biofilm formation through decreasing CA production and increasing bacterial motility. Kaolinite is preferential for *E. coli* O157:H7 attachment and colonization. Goethite, detrimental for *E. coli* O157:H7, not only promoted the development of biofilm primarily through triggering the CA production to encase cells, but also decreased the production of toxins. Secondly, we will present the social interactions between pathogen *V. parahaemolyticus* and two representative soil isolates, e.g., *B. subtilis* and *P. putida* through transcriptomic analysis. Our results showed that the different influences on a pathogen by different types of interactions can be modulated by chemicals and medium fluidity. Finally, artificial soil was employed to investigate the soil biofilm formation and corresponding impacts on microbial activities and community structure. The results showed that soil biofilm sustained 40-times more active microbes than that without biofilm, which contributed to increased organic turnover rate. Meanwhile, the diversity and evenness of soil with biofilm was significantly higher than that without biofilm. The above findings provide novel insights about the environmental prerequisite for soil biofilm formation which sustain a diverse and robust community to drive soil biogeochemical and ecological processes.