Title:	Bioelectrocatalytic sulfide oxidation by a haloalkaliphilic electroactive microbial community dominated by Desulfobulbaceae
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Abstract:	Sulfide-oxidizing microorganisms (SOMs) play a vital role in biogeochemical sulfur cycling and are useful for the bioremediation of sulfide-rich wastewaters and environments. The electroactive SOMs remain poorly explored from extreme environments. This study presents the autotrophic electroactive microbial biofilm capable of sulfide oxidation under haloalkaline conditions (pH – 9.5; salinity – 20 g/L). It was obtained through electrochemical microbial enrichment from sub-surface sediments of the haloalkaline Lonar lake at an applied anode potential of -330 mV vs. Ag/AgCl in microbial electrolysis cells (MECs). The sulfide-oxidizing electroactive biofilm achieved a maximum average current density of 315±23 µA/cm2 with 87±10% coulombic efficiency and 34±8% sulfide oxidation to sulfate. The bioelectrocatalytic sulfide oxidation at the anode facilitated 0.16±0.02 mM/day hydrogen production at the cathode of MECs. Low current densities and neither sulfate nor hydrogen production were observed in abiotic electrochemical controls suggesting the bioelectrocatalytic role of anodic microbial biofilm in the sulfide to sulfate oxidation process. The sulfide oxidation process was faster in bioelectrochemical (0.94±0.2 mM/day) than the abiotic reactors (0.49±0.01 mM/day), confirming the microbial role in the enhanced sulfide oxidation bioelectrocatalysis. Sulfur was detected at the anode surface in both abiotic and biotic electrochemical experiments, suggesting the occurrence of electrochemical sulfide oxidation to sulfur process under here-tested conditions. The bio-anode analysis through scanning electron microscopic imaging confirmed the microbial growth at the anode surface, and 16S-rRNA based amplicon sequencing revealed the dominance of unclassified Desulfobulbaceace at a relative sequence abundance of 61.8 ± 9.9% in anodic biofilm. This work on electroactive SOMs from a natural haloalkaline habitat contributes to the limited understanding of extreme electroactive microorganisms and their role in sulfur cycling in such environments.
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