Ecological Functions and Biotechnological Potential of Biological Soil Crusts in Arid and Semi-Arid Ecosystems

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Abstract:
Biological soil crusts (BSCs) are complex communities of microorganisms and cryptogamic organisms that colonize the uppermost layers of soil, particularly in arid and semi-arid ecosystems. This study investigated Moroccan BSCs through a comprehensive sampling campaign conducted across 13 sites representing four distinct climatic zones. Physicochemical and enzymatic analyses were performed, with particular emphasis on dehydrogenase activity (DHA) and acid phosphatase activity (APase) as key indicators of microbial activity and the potential of BSCs to improve soil fertility through phosphorus mobilization. The results revealed substantial variability among sampling sites, largely driven by differences in edaphic and climatic conditions. Most BSC samples exhibited high DHA and APase activities, indicating a metabolically active microbial biomass and a strong capacity for phosphorus solubilization and nutrient cycling. Furthermore, the considerable concentrations of polyphenols and flavonoids highlight the potential of BSCs as reservoirs of bioactive compounds. Collectively, these findings emphasize the ecological importance of BSCs in maintaining soil fertility and ecosystem functioning, while also demonstrating their promise as a source of valuable biomolecules for future biotechnological applications.