Acidophiles

Life in Extremely Acidic Environments

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Cover design uses images © D. Barrie Johnson. Top image: Adit in an abandoned copper mine (Cantareras) in the Iberian Pyrite Belt, showing efflorescence of blue copper sulfate on the adit walls and metal-rich waters in the drainage channels. Middle image: An acidic geothermal site in São Miguel (an island in the Azores archipelago) with massive growths of acidophilic microorganisms. Bottom image: An extremely acidic ferruginous (iron-rich) pool in the Rio Tinto, Spain.

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Preface

This textbook provides a comprehensive account of different areas of acidophilic microbiology, ranging from fundamental to applied aspects of knowledge and research. It is subdivided into parts, each dealing with a specific area of the subject. Part II looks at the challenges faced by life forms that grow in extremely acidic environments and how they adapt to meet these challenges. Elevated concentrations of protons/hydronium ions, transition metals and, in many situations, stress induced by high osmotic potentials and redox potentials of the external solutions, are the major challenges faced by acidophilic microorganisms in natural and man-made environments. This part also includes a chapter describing how acidophiles obtain energy and the pathways involved in iron and sulfur oxidation at low pH. Part III includes chapters which describe the physiological and phylogenetic diversities of acidophilic microorganisms – the various genera and species of archaea, bacteria and eukaryotes that have documented thus far. Part IV covers acidophile community dynamics, describing ways in which different species of acidophiles interact with each other in terms of carbon and energy flows, and how these impact the geochemistry of acidic environments, an account of the distribution of acidophiles in both man-made and natural ecosystems, and how quorum sensing is used by acidophiles as a detection mechanism, and how this impacts the formation of biofilms, an important feature of biomining technologies. Part V deals with the various 'omics' that are used to study acidophiles and to answer fundamental question regarding the full breadth of their diversity, metabolisms and the molecular basis of their responses to stress factors. Genomic and metagenomic studies, and what has been and is being learned about acidophiles from proteomic-, mobilomic- and metabolomic-focused research, are described in detail. The final part, Part VI, considers the ways in which acidophiles are used in established and emerging biotechnologies, and describes why these fascinating microorganisms are considered potential candidates for life on other solar bodies, such as Mars, and beyond.

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Genus abbreviations

Genus name	Abbreviation
Acidianus	*Ad*.
Acidibacter	*Ab*.
Acidicaldus	*Acd*.
Acidiferrobacter	*Af*.
Acidilobus	*Al*.
Acidimicrobium	*Am*.
Acidiphilium	*A*.
Acidiplasma	*Ap*.
Acidisphaera	*As*.
Aciditerrimonas	*Atn*.
Acidithiobacillus	*At*.
'*Acidithiomicrobium*'	*Atm*.
'*Acidithrix*'	*Atx*.
Acidobacterium	*Abm*.
Acidocella	*Ac*.
Acidomonas	*Amn*.
Aciduliprofundum	*Acp*.
Alicyclobacillus	*Alb*.
Caldisphaera	*C*.
Caldivigra	*Cv*.
Desulfosporosinus	*D*.
Ferrimicrobium	*Fm*.
Ferrithrix	*Fx*.
Ferrobacillus	*F*.
Ferroplasma	*Fp*.
'*Ferrovum*'	*Fv*.
Frateuria	*Ft*.
Hydrogenobaculum	*H*.
Leptospirillum	*L*.
Metallosphaera	*M*.
Methylacidiphilium	*Mt*.
Nitrosotalea	*N*.
Picrophilus	*P*.

Genus name	Abbreviation
Stygiolobus	*Sg*.
Sulfobacillus	*Sb*.
Sulfolobus	*S*.
Sulfurisphaera	*Ss*.
Sulfurococcus	*Sc*.
Thermoplasma	*Tp*.
Thiobacillus	*T*.
Thermogymnomonas	*Tg*.
Thiomonas	*Tm*.
Vulcanisaeta	*V*.