Galdieria sulphuraria Martin Seinturier - Uppsala University 2024

Figure 1 : Typical environment where *Galdieria sulphuraria* can be found

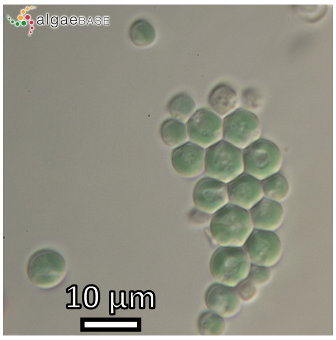

Figure 2 : Light microscope image of *Galderia sulphuraria*

The extremophile environments, present in many ecosystems, push back the limits of life on Earth. Due to the extreme acidity, high metal concentration, high temperature and other strong abiotic constraints, only a few lineages of highly specialized prokaryotes and eukaryotes can survive in these environments. The red algae *Galdieria sulphuraria* from the class of Cyanodiophyceae is the most commonly found species of eukaryotes and the one with the highest biomass in these conditions. It is a unicellular algae, of spherical shape reaching from 4 to 10 µm. Its intracellular content includes one plastid, up to 3 mitochondria, a vacuole for storing carbon production, a nucleus and a thick cell wall. It is ubiquitously found around the world, from hot springs to anthropogenic environments such as mine drainage areas to heavy metal polluted soils. Its preferred growth conditions are acidic conditions from pH 0 to 5 and temperature from 20 to 56°C. To survive in such inhospitable conditions with high constraints, they developed a set of adaptations. *G. sulphuraria* can for example sequester metal cations into vacuoles; in low light conditions it can grow endolithically, in rocks, and therefore turn its metabolism into partial heterotrophy. It reportedly can use up to 50 carbon sources to do so.

The unique set of metabolites and specialized enzymes of *G. sulphuraria* find several adaptations in biotechnologies. Its ability to sequester metal cations into vacuoles is used in the bioremediation of polluted soils. They produce valuable metabolites such as phycocyanin, pigments used in stains, anti-oxidative species, they contain high levels of proteins and carbohydrates but low levels of lipids.

One of their main advantages over other extremophiles is the ease of growing them in laboratory conditions, on several carbon sources, and in high densities.

Lastly, its genome underwent several reductions through evolution.

With this algae, scientists study the adaptation of eukaryotes in extremophile environments, as well as the mechanisms of life emergence in the early age of earth.

Resources :

Van Etten, Julia, et al. “Extremophilic red algae as models for understanding adaptation to hostile environments and the evolution of eukaryotic life on the early earth.” *Seminars in Cell and Developmental Biology*, vol. 134, Mar. 2022, pp. 4–13. https://doi.org/10.1016/j.semcdb.2022.03.007.

Johnson, D. Barrie, and Angeles Aguilera. “Extremophiles and Acidic Environments.” *Elsevier eBooks*, 2018, https://doi.org/10.1016/b978-0-12-809633-8.90687-3.

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Figure 1: Hot springs, A.Savin, Wikipedia (Dallol volcano, Afar Region, Ethiopia)

Figure 2: AlgaeBase, Khadijeh Mozaffari, Creative Commons