

Microbial Resilience: Navigating Growth Challenges in Cold Environments

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Antarctic yeast, *Glaciozyma antarctica* PI12 and Antarctic bacterium, *Cryobacterium* sp. SO1 have evolved strategies to survive and grow in extreme cold environments although they have optimal growth temperatures above freezing temperatures. Therefore, it would be interesting to determine the mechanisms by which these microorganisms adapted to temperatures above 10 °C while simultaneously thriving in very cold and subzero environments. Hence, this project set out to examine how these microbes respond to colder temperatures at the molecular level. Comparative transcriptome analyses were performed to determine the gene expression patterns of *G. antarctica* PI12 and *Cryobacterium* sp. SO1 at optimum and sub-optimal cold temperatures. The results showed that the gene expression patterns of *G. antarctica* PI12 were dependent on the severity of the cold, with more genes differentially expressed at -12°C than at 0°C than its optimal growth temperature at 12°C. Interestingly, it used nitrite as an alternative terminal acceptor of electrons to minimize disruption of energy production in the cell when oxygen was absent. In contrast, *Cryobacterium* sp. SO1 upregulated six ribosomal genes, four hydrolases, a *clp* protease, and a novel *YraN* family endonuclease related to the programmed cell death (PCD) pathway at 10°C lower than its optimal growth temperature of 20°C, suggesting that the temperature drop was likely lethal to some cells. Three highly upregulated transcriptional regulators were likely key components to regulate genome-wide expression to adapt to the cold among others. Overall, both *G. antarctica* PI12 and *Cryobacterium* sp. SO1 had all the necessary genes and well-coordinated mechanisms to adapt to sub-optimal colder or freezing growth temperatures. Their adaptability to cold environments, combined with their preference for growth at temperatures above 10°C, demonstrates their versatility and suggests they will be well-suited to cope with future warming in Antarctica.

References

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