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Uncovering the Microbial Producers of branched Glycerol Dialkyl Glycerol Tetraethers

TOBY ANN HALAMKA, PHD CANDIDATE[1], JONATHAN RABERG[1], JAMIE MCFARLIN[1], ADAM YOUNKIN[1], CHRISTOPHER MULLIGAN[2], NADIA DILDAR[3], XIAO-LEI LIU[4] AND SEBASTIAN KOPF[1]

[1]University of Colorado Boulder
[2]University of California, Davis
[3]University of Colorado, Boulder
[4]University of Oklahoma

Presenting Author: toha6502@colorado.edu

Branched glycerol dialkyl glycerol tetraethers (brGDGTs) are ubiquitous and well-preserved sedimentary biomarkers. These compounds serve as important paleoenvironmental indicators due to inferred relationships between brGDGT distributions and past terrestrial climates. The relative abundances of structurally diverse brGDGTs have been empirically correlated with temperature and pH, such as the Methylation index of Branched Tetraethers (MBT) and the Cyclization index of Branched Tetraethers (CBT), respectively. However, the mechanistic link between temperature, pH, and brGDGT production has not been possible to ascertain thus far due to the absence of a clear biological source for brGDGTs in the environment. Despite some of the inherently archaeal structural attributes of brGDGTs, including their ether bonds and membrane-spanning nature, the domain Bacteria has been proposed as the likely candidate for their synthesis [1]. The widespread bacterial phylum Acidobacteria has been identified as a potential source for the biosynthesis of brGDGTs, with one brGDGT (structure Ia) previously detected in the membranes of two species of Acidobacteria [2]. Investigating the role of potential environmental growth constraints on Acidobacteria, we discovered that oxygen limitation triggers brGDGT production in *Edaphobacter aggregans* [3]. To further explore the relationship between oxygen concentration and brGDGT production, we expanded our investigation into the role that environmentally relevant energy stressors play in other soil bacteria and discuss the implications for the physiological function that brGDGTs may have in the cellular membrane. Recent findings from this work present a new perspective on the biosynthesis of brGDGTs in soil bacteria and provide nuance and new opportunities for the application of these enigmatic compounds in paleoenvironmental research.

[1] Membrane lipids of mesophilic anaerobic bacteria thriving in peats have typical archaeal traits, Weijers et al. (2006), *Environmental Microbiology* 8(4), 648 – 657.

[2] 13,16-Dimethyl Octacosanedioic Acid (iso-Diabolic Acid), a Common Membrane-Spanning Lipid of Acidobacteria Subdivisions 1 and 3, Sinninghe Damsté et al. (2011), *Applied and Environmental Microbiology* 77, 4147–4154.

[3] Oxygen limitation can trigger the production of branched GDGTs in culture, Halamka et al. (2021), *Geochemical Perspective Letters* 19, 36–39