Corrinoids, a Class of Model Metabolites, Differentially Impact Isolation of Soil Bacteria

Zoila I. Alvarez-Aponte[1*] (zoila.alvarez@berkeley.edu), Zachary F. Hallberg,[1] Alexa M. Nicolas,[1] Myka A. Green,[1] Eoin L. Brodie,[2] Mary K. Firestone,[1]Hans K. Carlson,[1,2] and **Michiko E. Taga[1]**

[1] University of California, Berkeley; [2] Lawrence Berkeley National Laboratory, Berkeley, CA

https://tagalab.berkeley.edu

Project Goals: The overall goal of this project is to gain a deeper understanding of the microbial interactions that drive soil community structure. This research leverages a model group of metabolites related to vitamin B_{12}, known as corrinoids, to investigate microbial interactions. Corrinoids are a structurally diverse nutrient class shared among microbes, as they are produced by only a subset of the bacteria that require them. Based on the inherent preferences that bacteria display for specific corrinoids, the hypothesis driving this work is that corrinoids are keystone nutrients and can shape soil microbial communities. To test this hypothesis, we are examining the effects of corrinoid addition on community composition and function across multiple levels of complexity. By investigating the impact of a key nutrient in soil at levels spanning the whole community to individual isolates, this work will reveal an unprecedented view of metabolic interactions in soil microbial communities.

Soil microbial communities impact numerous global processes, from the global carbon cycle to agriculture and human health. The effect of microbes on the processes they modulate is greatly dependent on the composition of microbial communities and nutrient availability. Thus, to understand the global role of microbes, we must take a closer look at the interactions that determine community structure, function, and dynamics. However, the physicochemical and taxonomic complexity of the soil microbiome poses a challenge to disentangling these interactions. By focusing on corrinoids as model metabolites, we aim to mechanistically study complex metabolic interactions between soil microbes.

In this work, we isolated bacteria from soil on media amended with different corrinoids to address two hypotheses. First, because bacteria are known to have distinct preferences for specific corrinoids, we hypothesize that corrinoids influence culturability, and we expect to isolate distinct taxa on each corrinoid condition. Second, because corrinoids other than B_{12} have never been used in growth media, species that prefer them have likely remained uncultured, leading to a pervasive bias across microbiology.

By using seven different corrinoid conditions, we have isolated an even and diverse collection of 243 isolates, including representatives from seven phyla. We predict at least 21 of these isolates to be novel based on full 16S rRNA amplicon sequence similarity, and are in the process of characterizing these isolates further. Preliminary data suggest that one of the novel isolates prefers [5-OHBza]Cba, a corrinoid known for being produced by methanogens, over B_{12}. This preference has rarely been observed in bacteria. This observation is part of the diversity of corrinoid metabolisms we have observed in this set of isolates, which include corrinoid production, auxotrophy, and independence. This isolate collection and the methods we are developing will be crucial for future steps in this research, which include testing corrinoid sharing interactions in co-cultures.

This research is funded by the DOE Genomic Sciences Program Grant DE-SC0020155 (to MET).