Determining Degradation of Phenethyl Isothiocyanate Across Different Insect Species

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Introduction:

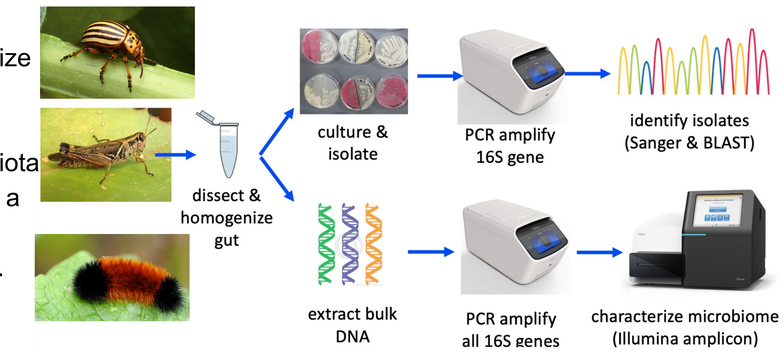
- Microbes associated in the guts of insects have been seen to degrade plant defense chemicals[1] . *Pantoea* in flea beetles was found to degrade isothiocyanates[2] . Additionally, a species of *Pseudomonas* was identified as a degrader of caffeine in Coffee Berry Borer Beetles[3].
- Brassicaceous plants house Phenethyl Isothiocyanates (PEI).
- Specialized diets, like those found in Colorado Potato Beetles, Yellow Margined Leaf Beetle, and Spotted Cucumber Beetles are more commonly exposed to specific plant toxins associated with their dietary preference. Grasshoppers with generalized diets are exposed to a variety of plants, often limiting their intake of more specific plant chemicals.
- We sought to identify the degradation ability of symbionts present in beetles, grasshoppers, and caterpillars when exposed to PEI.

Hypothesis:

Bacteria found in brassicaceous specialists will be better at degrading PEI than generalists and solanaceous specialists.

Methods:

(1) Characterize the wild herbivorous insect microbiota and generate a gut bacterial isolate library.



(2) Screen isolates for ability to detoxify plant allelochemicals *in vitro*:

Solanaceae	**Brassicaceae**
chlorogenic acid	sulforaphane
rutin	phenethyl isothiocyanate
tomatine	allyl isothiocyanate

(3) Measure impacts of toxin degraders on insect growth, survival, and plant tissue consumption via inoculation and toxin challenge experiments.

Results:

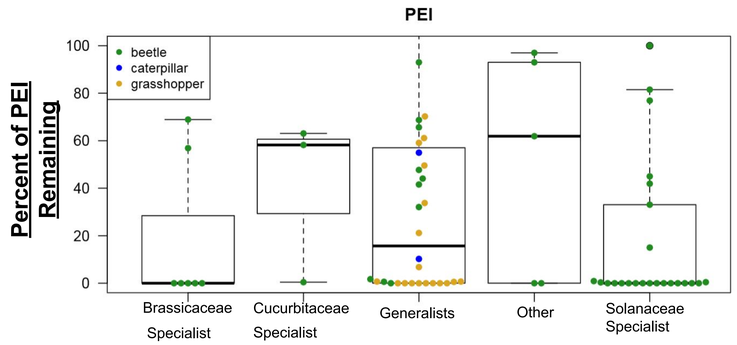


Figure 1: Box Plot of Bacterial Isolates Labeled as Degraders Grouped by Insects. This figure shows the percent of PEI remaining compared to the insects dietary preferences. (other represents the specialists that aren't brassicaceous or solanaceous).

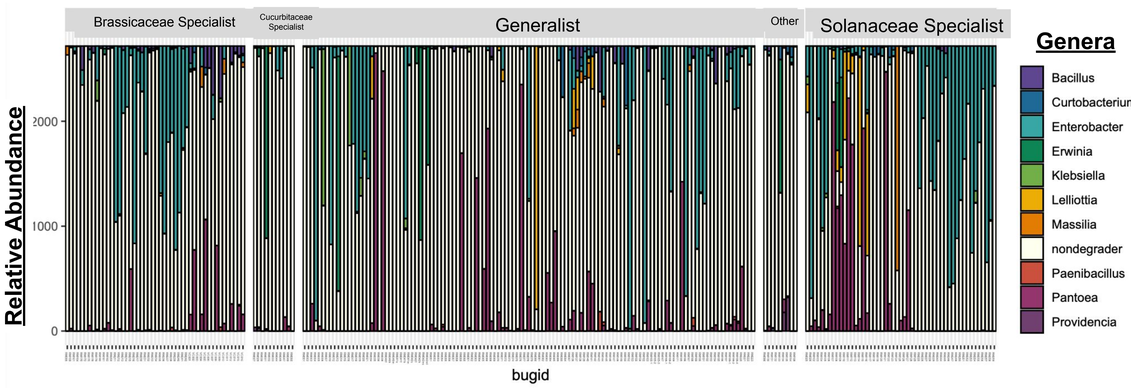


Figure 2: Illumina Stacked Bar plot Colored by Isolates Labeled as PEI Degraders. This figure shows the illumina data of specific degrading bacteria present in specialists and generalists insect species.

Summary:

In the results we see that bacteria found in brassicaceae specialists are better degraders of PEI. We can also see that most of the bacterial degraders were found in beetles. Bacteria found in generalists species had a wide range of degraders and non degraders.

Conclusion:

- It was found that 44 of the 96 isolates that were analyzed were found to be degraders.
- My hypothesis was supported by my results. It was shown that brassicaceous specialists were better at degrading PEI.

Future Research: These species of insect have been shown to degrade PEI, so our plan is to begin in-vivo experiments. We will also begin to analyze solanaceous plant toxins, and do a similar experiment to this one.

Acknowledgments:

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Citations:

1.Kikuchi, Y., T. Hosokawa, and T. Fukatsu. 2011.
2. Shukla, S. and Beran, F., 2020
3.Ceja-Navarro, J. et al, 2015