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Relationship Between Protein and Secondary Metabolite Content in Congeneric Tropical Shrubs

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Introduction

- Fruits contain nutritional rewards for dispersers such as sugars, lipids, minerals, and proteins.
- Secondary metabolites are chemicals with no known primary physiological function in the plants that produce them. They are important in interactions with herbivores, pathogens, pollinators, and seed dispersers most often acting as defenses.
- Sugars are the most abundant type of award and exhibit a positive correlation with secondary metabolites.
- Unlike sugars, protein levels are generally low in fruits.

Fruits from the genus *Psychotria* (in the coffee family) collected in Panama.

Objectives

1. Examine the relationship between protein content and secondary metabolites in plant samples.
2. Determine if there is a significant difference in different parts of the plant.

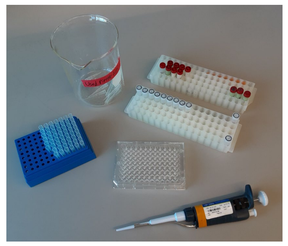
Hypotheses

There are two basic models of the defense trade off hypothesis which deals with secondary metabolites in fruits:

1. The removal rate and relative risk model: nutritious fruits are rewarding for frugivores and are thus removed quickly from the plant; these fruits should require little chemical defense.
2. The nutrient/toxin titration model: nutritious fruits are beneficial enough to frugivores that higher defense concentrations can be held in the fruits and dispersers will still disperse them.

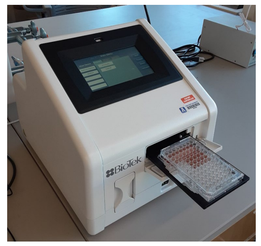
Methods

- Leaf and fruit tissue samples were collected on Barro Colorado Island, Panama.
- After secondary metabolite extractions, proteins were extracted from the samples with protein extraction solution.
- 10µL of each protein extraction was pipetted into microplate wells and 300µL of Coomassie Plus Reagent was added to each well. Protein absorbances were measured in triplicate.
- The microplate was placed into the microplate reader which measured the absorbance and calculated protein concentration based on standard solution absorbances placed in the microplate.
- Data analysis was performed using basic linear regression and ANOVA functions in R.

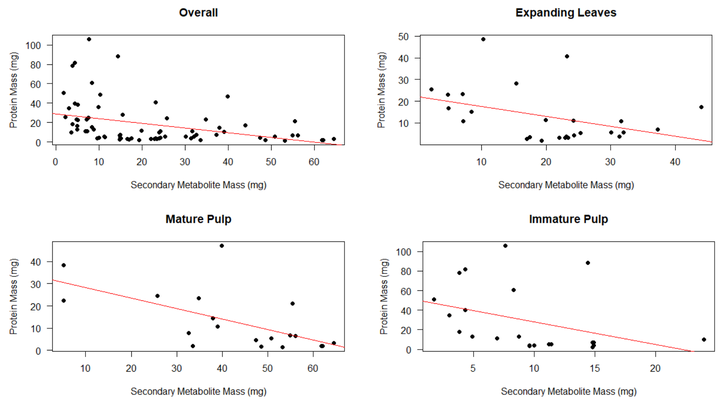


Left: Pipetting of samples into microplate.

Right: Microplate reader.



Results



All tissue types exhibited a negative relationship between protein content and secondary metabolite content.

Results

Tissue Type	Adjusted R^2	P-value
Expanding leaves	0.125	0.0428
Immature Pulp	0.0984	0.0847
Mature Pulp	0.334	0.00565
All tissues	0.128	0.00111

Adjusted R-squared and P-values for linear regressions.

Mature fruit pulp had the strongest correlation with an R-squared value of 0.334 and the smallest p-value of the 3 separate tissues. Immature pulp had the weakest correlation between secondary metabolite and protein content. Significance between species using a pairwise test (TukeyHSD) was found for 2 of the 15 *Psychotria* species: *P. capitata* and *P. hoffmannseggiana.*

Conclusion

The consistent negative relationship between proteins and secondary metabolites supports the removal rate and relative risk models of the defense trade-off hypothesis. Nutritionally rewarding fruits are probably removed quickly from the plant and thus do not require extensive chemical defenses. Our laboratory is currently collecting data on the removal rates in order to confirm this inference.

Red capped manakin, a common disperser of *Psychotria* fruits.

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