Understanding Ginsenoside Mobility in Ginseng Garden Soil

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Ginseng and Ginseng Replant Disease

Image modified by Jessica Sinka

Panax quinquefolius (American Ginseng)

- A perennial, herbaceous plant prized for its roots
- It takes five years to grow
- Traditional Chinese Medicine

Ginseng Replant Disease (GRD)

- Proposed causes:
  - *Ilyonectria mors-panacis (Imp)*
  - Ginsenosides
- It can persist for decades in the soil

Ginsenosides

- Triterpene saponins
- Bioactive compound attributed to ginseng medical properties
- Biological properties:
  - Autotoxic
  - Selectively antimicrobial

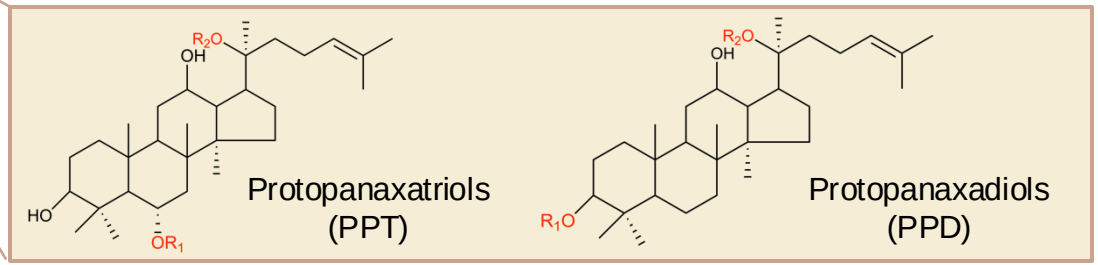
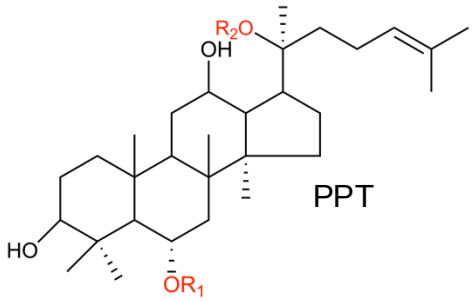
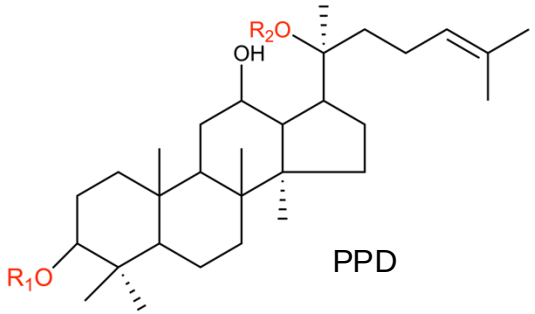


Image modified by Jessica Sinka

Why focus on ginsenosides?



Hinder development of pathogens



Stimulates growth of root rot pathogens

- *Ilyonectria* spp.

Better insight into:

- Persistence of ginsenosides
- Movement of ginsenosides
- How well ginsenosides binds to the soil

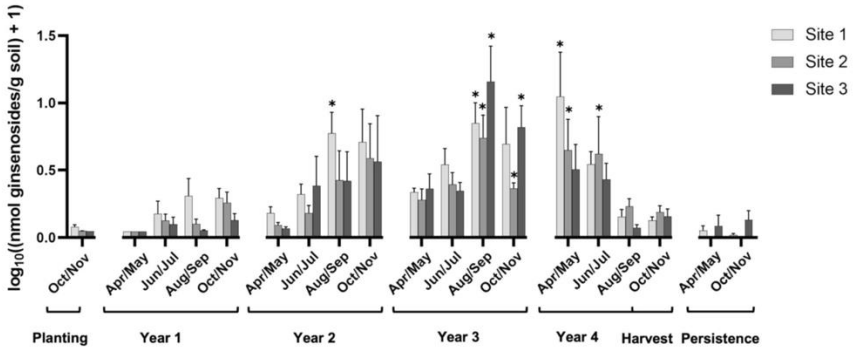


Figure created by Anka Colo

Research Question:

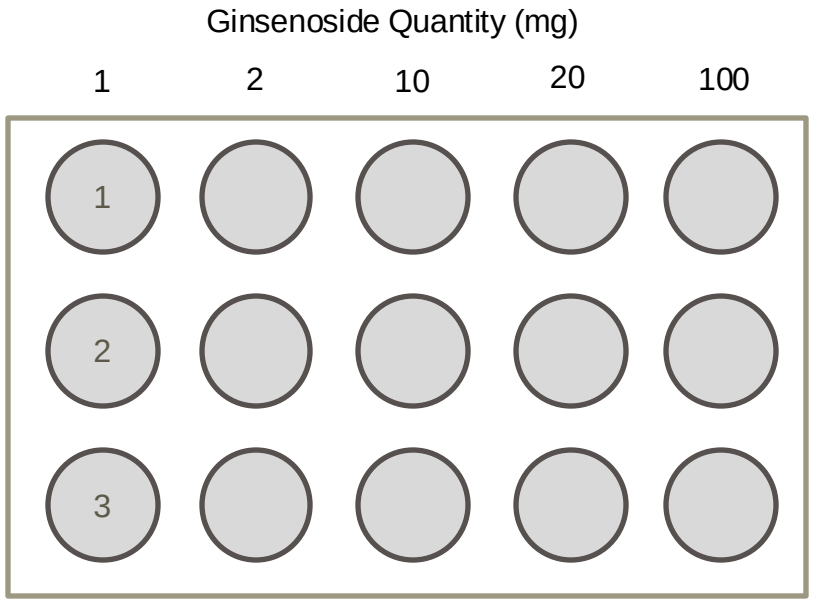
What are the properties of ginsenosides in ginseng garden soil?

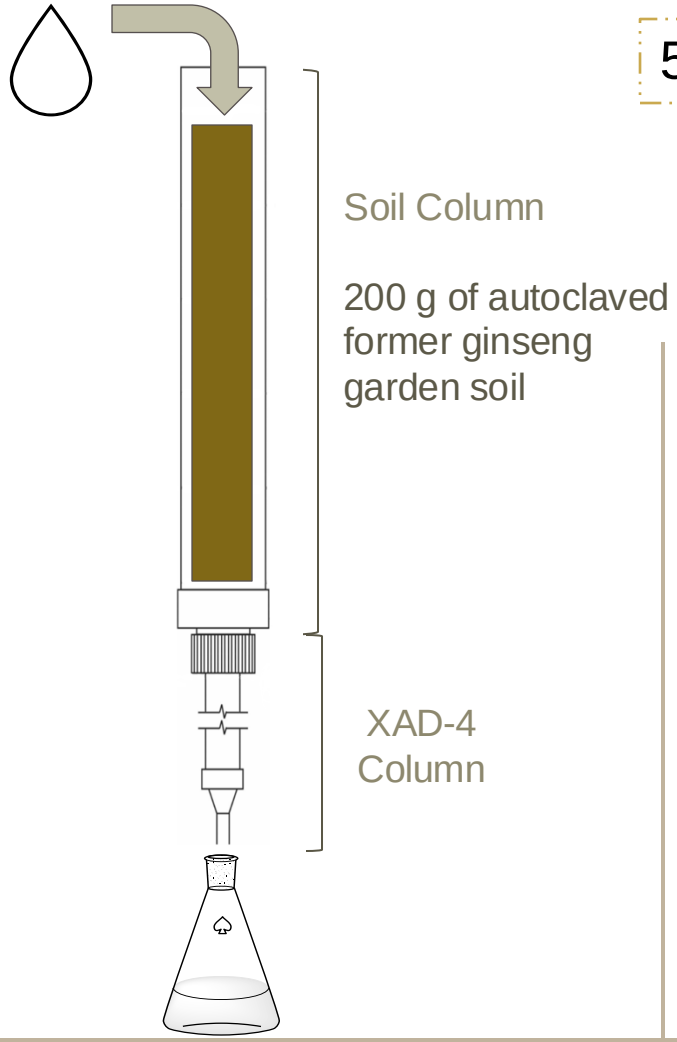
Objective:

1. Determine the movement and distribution of ginsenosides in soil

2. Determine the overall binding capacity of sandy-loam soils towards ginsenosides

Flowthrough Trapping System

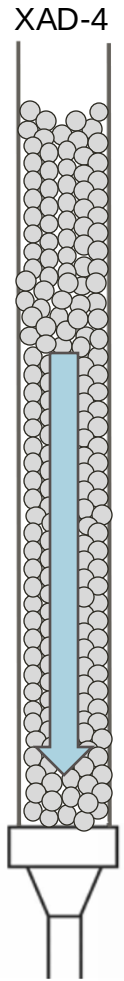




Ginsenoside Recovery

Flowthrough:

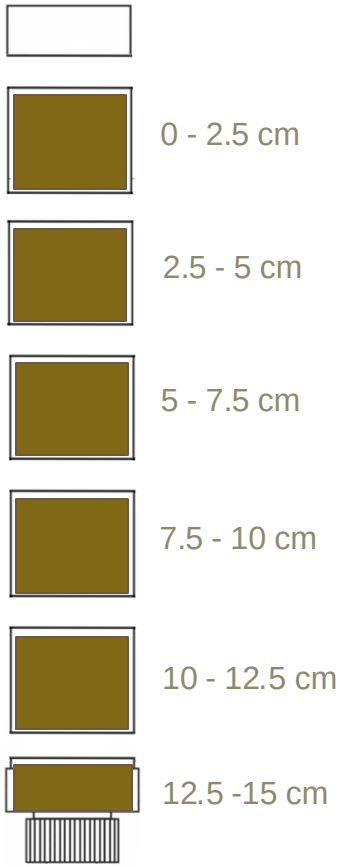
- Collected weekly for 10 weeks
- XAD-4 eluants were analyzed on LCMS



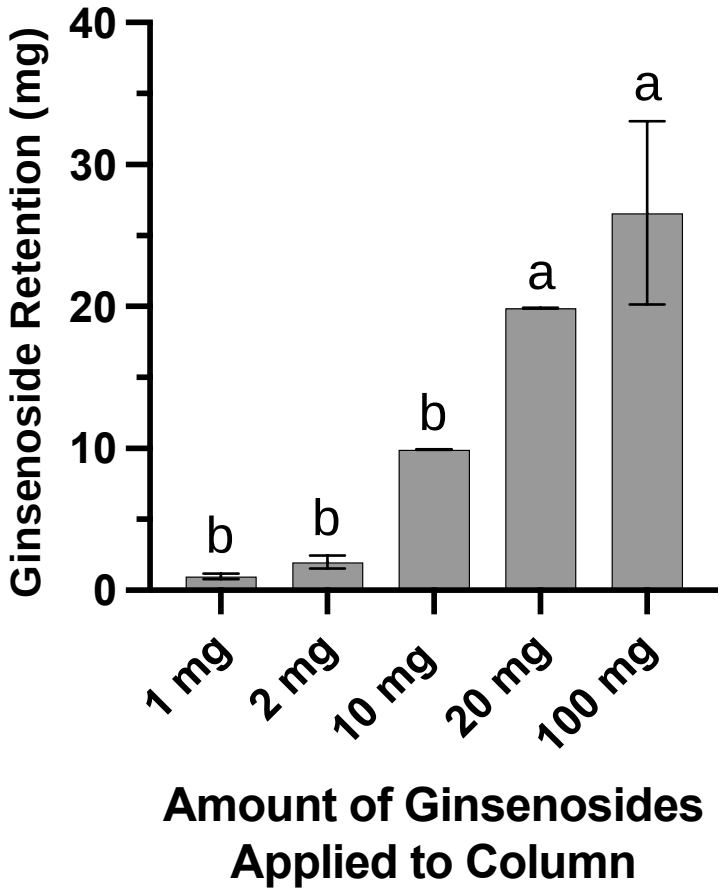
Ginsenoside Recovery

Soil Column:

- Columns were cut into 2.5 cm segments
- Ginsenosides were extracted from each segment
- Analyzed on LCMS



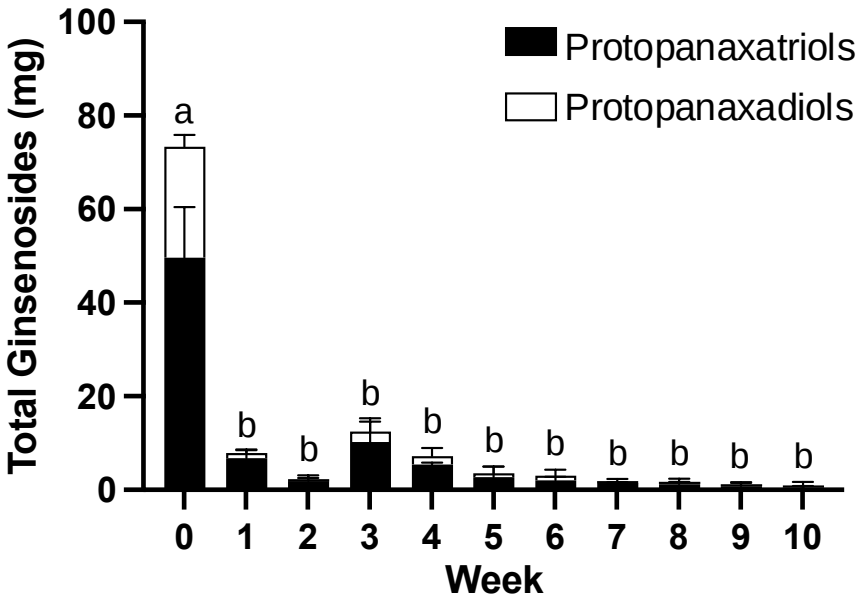
Initial Binding Capacity of Ginsenosides in Soil

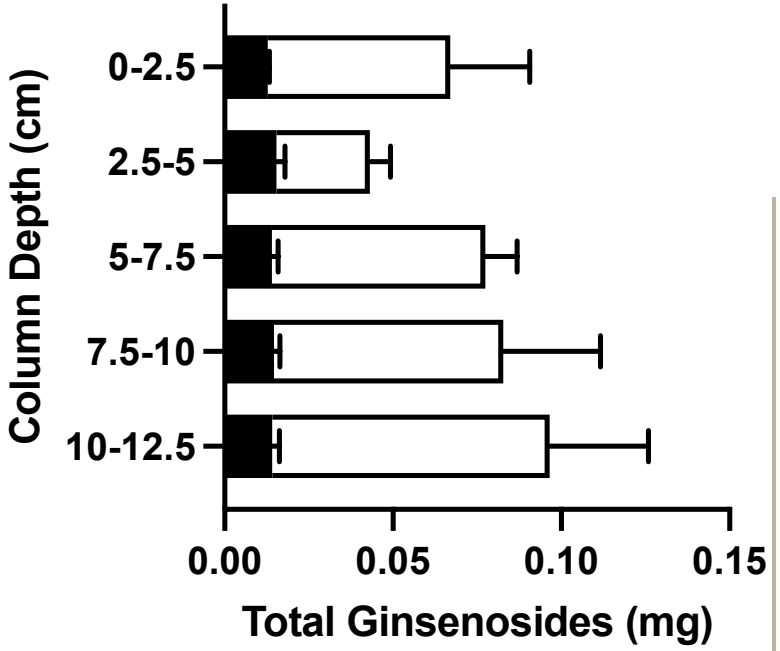


The degree of soil saturation in ginseng garden soil is between 20 - 25 mg / 200 g of soil

One-way ANOVA with Tukey Post Hoc
($F_{4,10}$ = 14.95, p < 0.0001)

Distribution and Movement of Ginsenosides

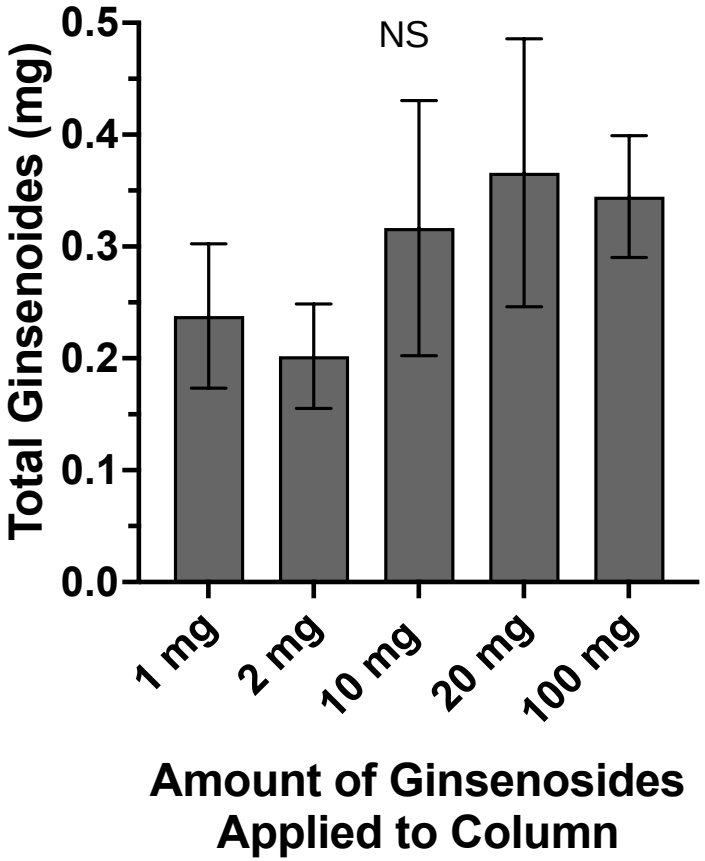




Protopanaxatriols move freely through the soil
Protopanaxadiols are more strongly bound to soil

One-way ANOVA with Tukey Post Hoc
($F_{10,22}$ = 61.63, p<0.0001)

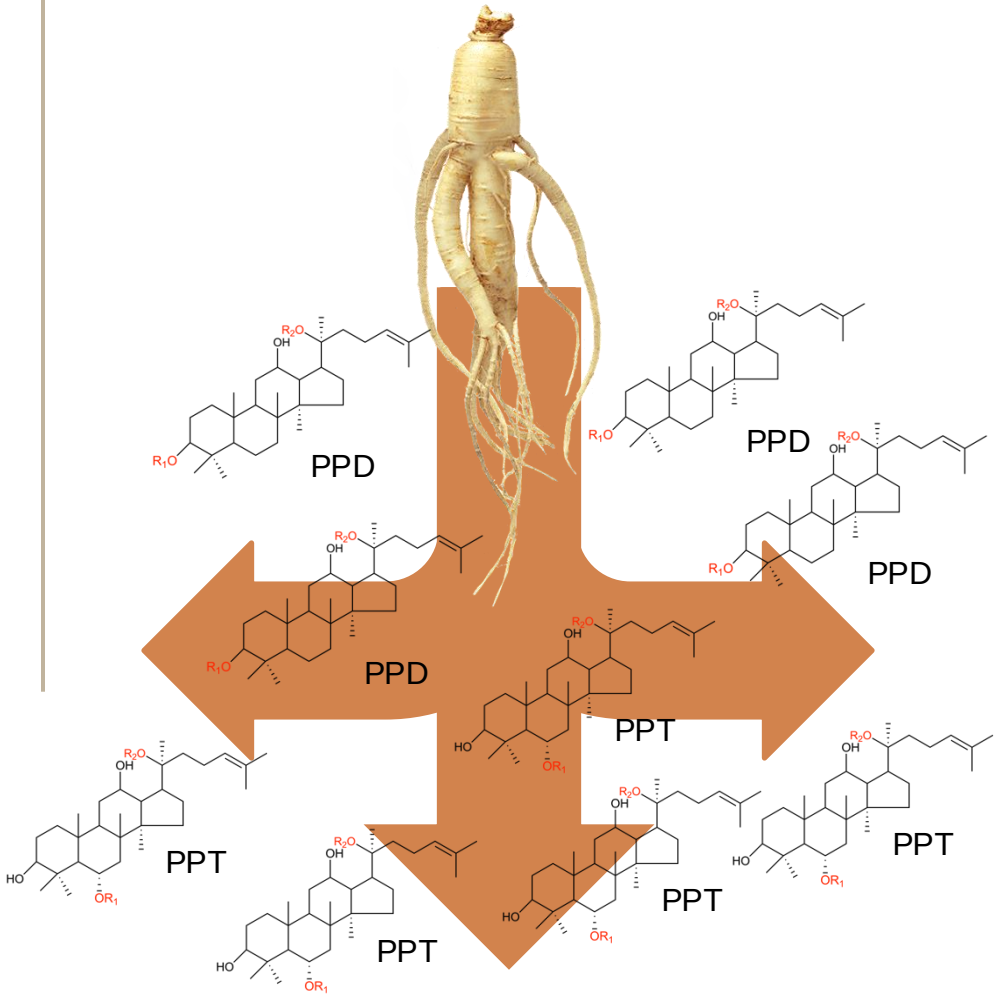
Uniform Distribution of Ginsenosides in the Soil



No matter how much water is added, there will always be between 0.25 - 0.35 mg/ 200 g of soil

One-way ANOVA with Tukey Post Hoc
($F_{4,10}$ = 0.677, p = 0.623)

What Does it All Mean?



Protopanaxadiols

- Effects on the development of pathogens in the microbiome
- More biologically active in GRD

Protopanaxatriols

- Reduces the antimicrobial protection around the roots
- Allowing GRD to occur more readily

Acknowledgements

NSERC CRSNG

CANADIAN AGRICULTURAL PARTNERSHIP
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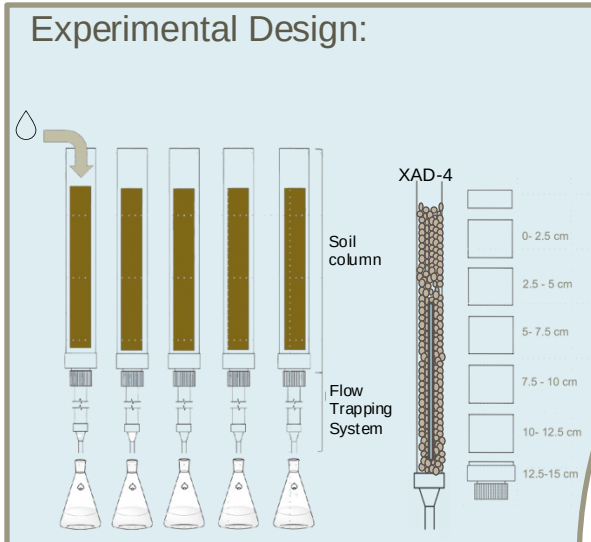
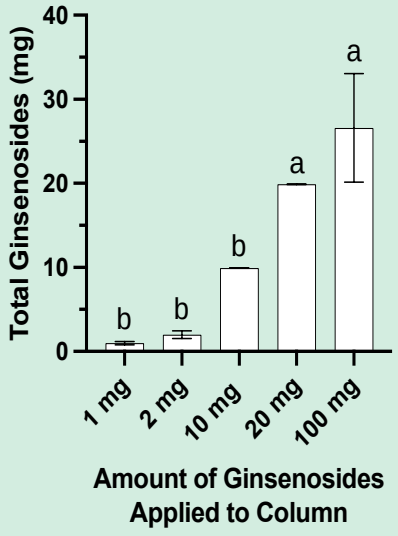
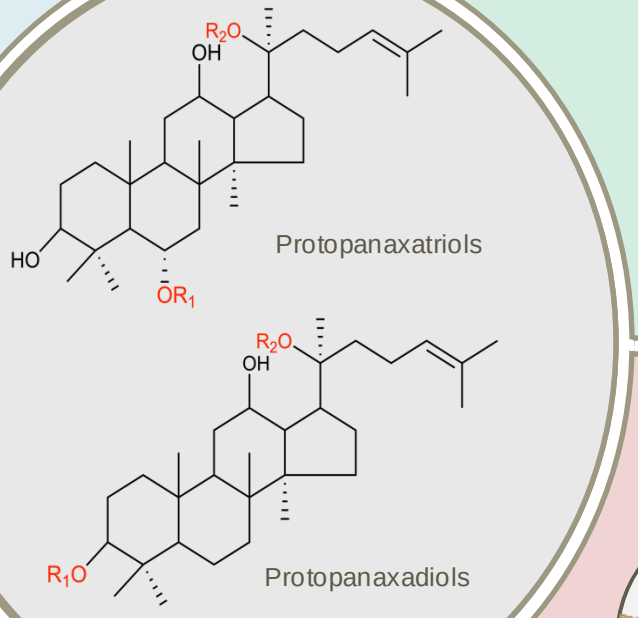
Experimental Design:

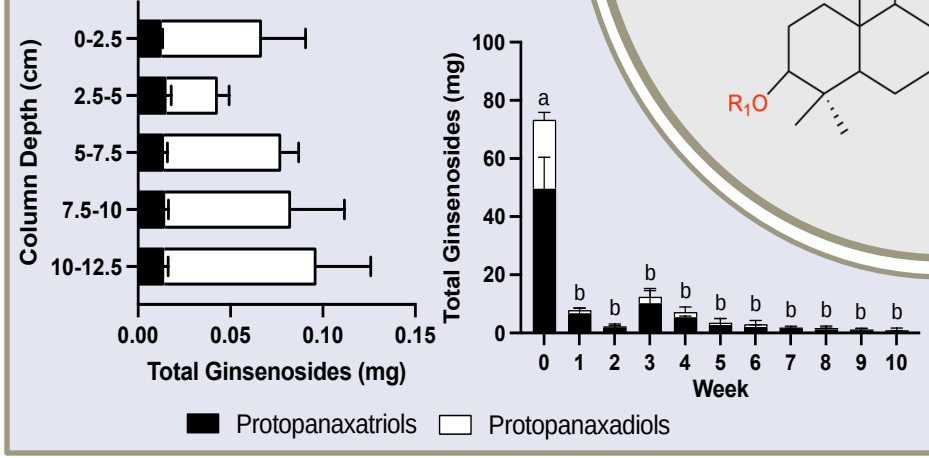


Initial Binding Capacity:





Ginsenoside Movement:



What Does it All Mean:

PPD enhances the growth of pathogens in the microbiome
Antimicrobial protection is reduced with the movement of PPT