Investigating the Antimicrobial Activity of the Sesquiterpene Lactone Laurenobiolide

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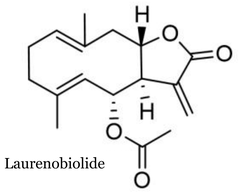
INTRODUCTION

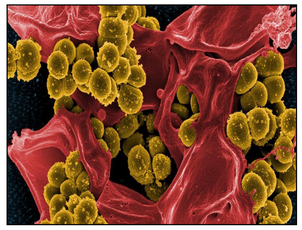
- Antibiotic resistance is a significant threat to public health
- Novel antimicrobials may be developed based on molecules derived from plants



Laurenobiolide

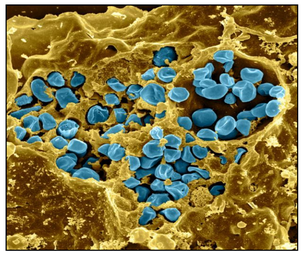
Laurenobiolide

- Sesquiterpene lactone
- Isolated from North American tulip tree *Liriodendron tulipifera*
- Used by indigenous tribes as a treatment for malaria
- Bioassay-guided approach identified laurenobiolide as effective against MRSA



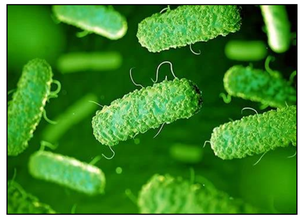
Staphylococcus aureus

- Gram-positive
- Causes skin infections
- Can be multi-drug resistant



Francisella tularensis

- Gram-negative
- Causes tularemia
- Potential bioweapon due to its highly infectious nature



Escherichia coli

- Gram-negative
- Causes foodborne illness

METHODS AND MATERIALS

Disc Diffusion Assay Workflow

- Plated bacteria at optimized concentration in triplicate
- Two discs per plate: control (methanol/CH_3OH) and disc impregnated with compound
- Incubated at 37°C
  - 24 hours for *E. coli* and *S. aureus*
  - 48 hours for *F. tularensis*

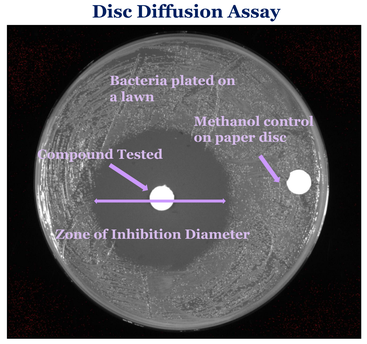
Compounds Tested

- Laurenobiolide
- Extracts from
  - *L. tulipifera*
  - *L. chinense*
  - *L. tulipifera* – *L. chinense* hybrid

Organisms Tested

Staphylococcus aureus - SA113
Escherichia coli - ATCC25922
Francisella tularensis – Live Vaccine Strain (LVS)

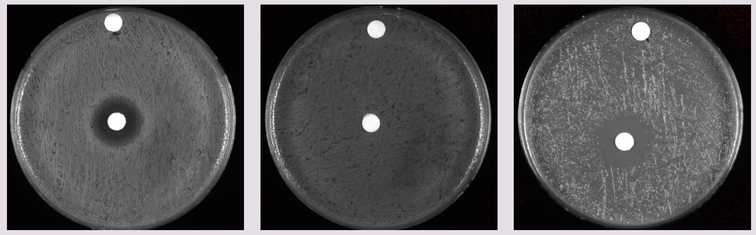
Disc Diffusion Assay



RESULTS

Antimicrobial Activity of Laurenobiolide

A.


S. aureus *E. coli* *F. tularensis*

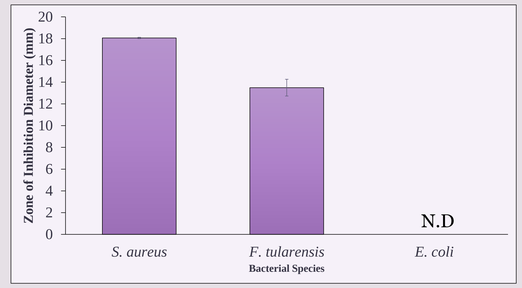
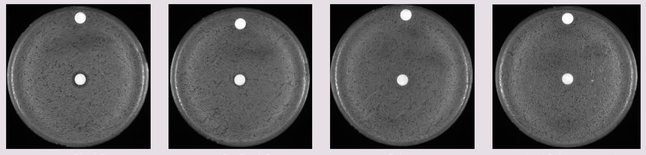


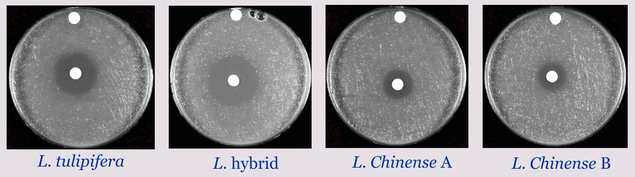
Figure 1. Multiple bacterial species are sensitive to laurenobiolide.
A. Representative image of disc diffusion assay results, using indicated bacteria
B. Quantification of disc diffusion results
Disc diffusion assays were performed with the indicated strains in biological triplicate using discs impregnated with 8 mg/mL laurenobiolide. Plates were incubated for 24 or 48 hours (strain dependent) and zones of inhibition were measured in mm. Error bars represent standard deviation. ND indicates no zone of inhibition detected

Antimicrobial Activity of Tree Extracts

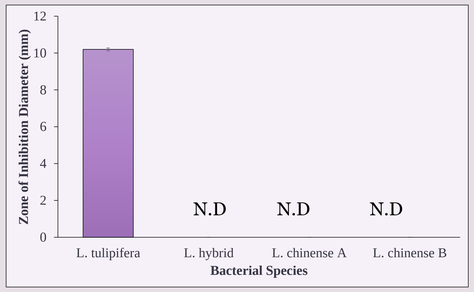
A. *S. aureus*


L. tulipifera *L.* hybrid *L. Chinense* A *L. Chinense* B

B. *F. tularensis*


L. tulipifera *L.* hybrid *L. Chinense* A *L. Chinense* B

C.



D.

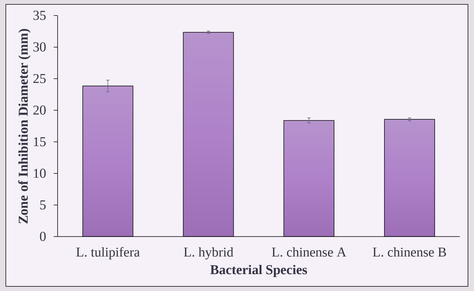
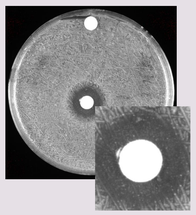
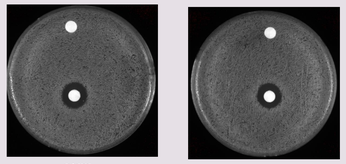


Figure 2.
A/B. Representative image of disc diffusion assay results, using indicated bacteria
C/D. Quantification of disc diffusion results
Disc diffusion assays were performed with the indicated strains in biological triplicate using discs impregnated with 10 mg/mL sample extract. Plates were incubated for 24 or 48 hours depending on strain, and zones of inhibition were measured in mm. Error bars represent standard deviation. ND indicates no zone of inhibition detected

Identification of Laurenobiolide Resistant Mutants


Selected potential mutants from laurenobiolide disc diffusion plates


Isolated single colonies of potential mutants and tested via disc diffusion


WT LR4A1

Potential mutants compared to Wild Type

Preliminary screening was performed with S. aureus with one biological replicate using discs impregnated with 8 mg/ml sample extract. Plates were incubated for 24 hours, and zones of inhibition were measured in mm. Replicates were compared against Wild Type to determine mutants of note to send for whole genome sequencing. Error bars represent standard deviation.

(waiting on more data, place holder(?) data

CONCLUSIONS AND FURTHER STEPS

Laurenobiolide Antimicrobial Activity

- *S. aureus* confirmed sensitive
- Laurenobiolide active against *F. tularensis,* a Gram-negative bacterium
  - Suggests possibility for broad spectrum antibiotic
- *E. coli* did not exhibit sensitivity at concentration of 8mg/mL

Antimicrobial Activity of Tree Extracts

- *S. aureus* determined only sensitive to *L. tulipifera* extract, consistent with presence of laurenobiolide.
- *F. tularensis* sensitive to all tested extracts, suggesting the presence of other inhibitory compounds

Isolated Laurenobiolide Resistant Mutants

- Next step into determining mode of action

References

Kirk, Riley D., "EVALUATING NATURAL PRODUCT LIBRARIES WITH EMPHASIS ON IN VITRO
PERMEABILITY WORKFLOWS" (2021). *Open Access Dissertations*. Paper 1294.
https://digitalcommons.uri.edu/oa_diss/1294

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