Potential Medicinal Properties of Fungal Endophytes Isolated from *Salicornia depressa*

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Abstract

The fungal endophytes from the stem and roots of *Salicornia depressa*, commonly known as glassworts, were isolated and its medicinal properties were looked at. Both endophytes had a very similar strength of inhibition against *E. coli, P. aeruginosa*, *S. aureus*, and *V. parahaemolyticus*. Further analysis was done to obtain the chemical compounds of the endophytes on the liquid chromatography–mass spectrometry (LC–MS) machine.

Introduction

Salicornia depressa, also known as glassworts, are halophytes, which means that they have a high tolerance in salinity.[1] It is believed that the microorganisms that co-exist inside this plant's roots, known as endophytes, seem to have unique properties that allow for the plant to survive stressful conditions.[2]

Past studies have shown promising medicinal uses of this glasswort plant. It has been used to fight against oxidative stress, inflammation, diabetes, hypertension, hepatitis, depression, and gastroenteritis.[1,3] Another recent study has shown its possible usage to inhibit breast cancer stem cells.[4]

Experimental Design

Isolation & Extraction of Fungal Endophytes:

Different parts of the glasswort plant, collected at Pickman Salt Marsh in Salem, MA, were thoroughly washed before planting them on a potato dextrose agar (PDA) dish. After a week, the fungal endophytes grew and were plated on another PDA dish.

Figure 1: Fungal endophyte growth of root (L) and stem (R) after one week.

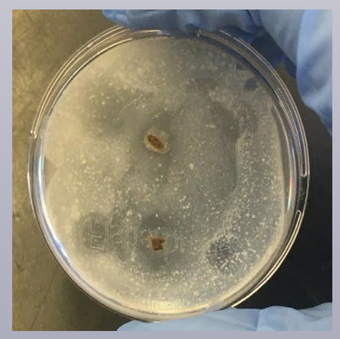
Experimental Design

The fuzz of the fungal endophytes were then put in broth and left for weeks. Then, the broths containing different fuzz were extracted to obtain the metabolites growing from the endophytes.

Bioactivity Test of the Endophytes:

The extract, broth, and solid fuzz of the endophytes were planted on four different agar plates, each containing four different bacteria: *E. coli, P. aeruginosa*, *S. aureus*, and *V. parahaemolyticus*.

Figure 2: Some bioactivity photos of the samples after 48 hours, measuring against (left to right): *S. aureus*, and *V. parahaemolyticus.* The clear spots show zones of inhibition.



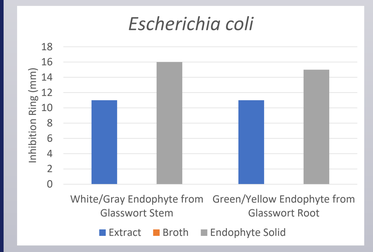
Identification of Compounds in Endophytes:

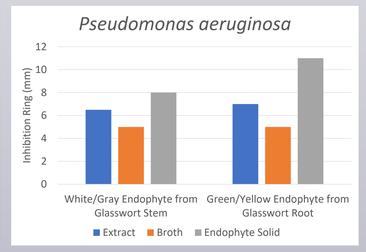
The endophyte extracts were run inside a liquid chromatography–mass spectrometry (LC–MS) machine to determine the composition of the endophytes.

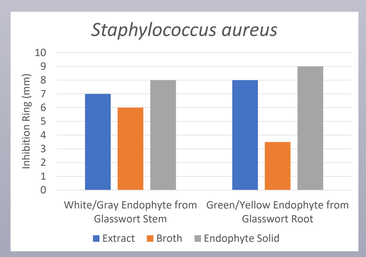
Results & Discussion

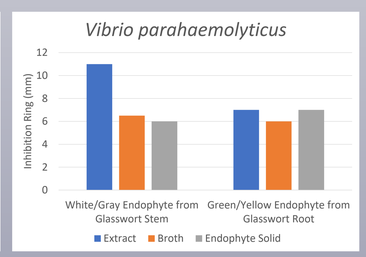
Bioactivity Results:

Figure 3: Bioactivity results depicting the size of the inhibition rings tested on the four bacteria.









Results & Discussion

LC-MS Analysis:*

Figure 4: Compounds seen in treatments for anxiety, depression, and sleep disorders.[5]

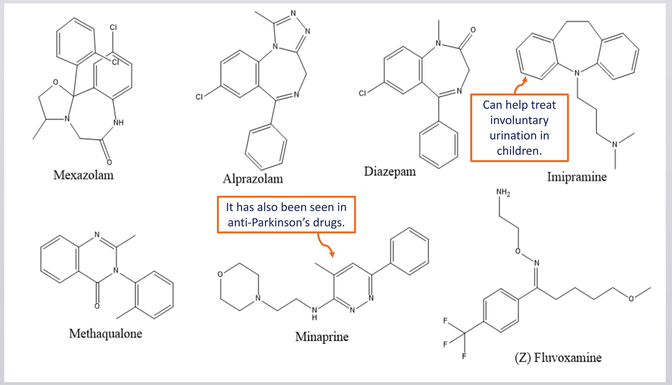


Figure 5: Compounds seen in glaucoma treatment. [5]

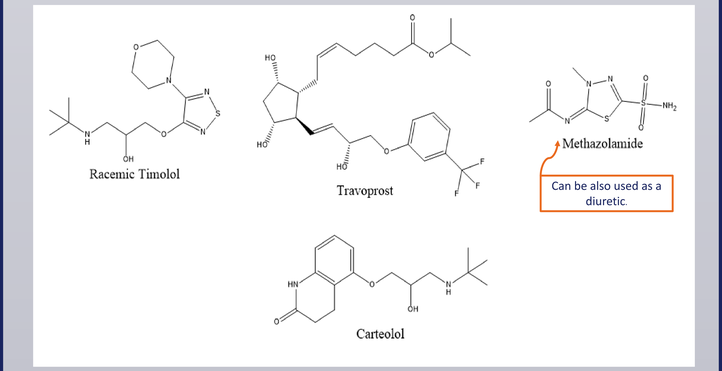


Figure 6: Compounds related to hormones. [5]

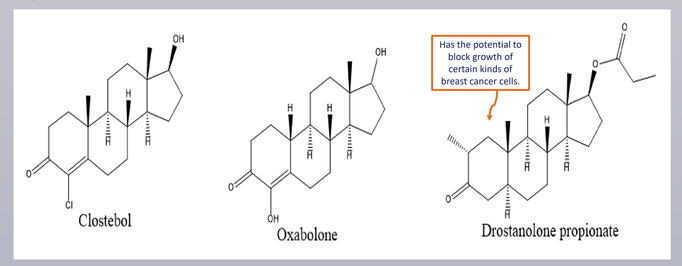


Figure 7: Compounds with anti-inflammatory, pain reliever, and anesthetic properties. [5]

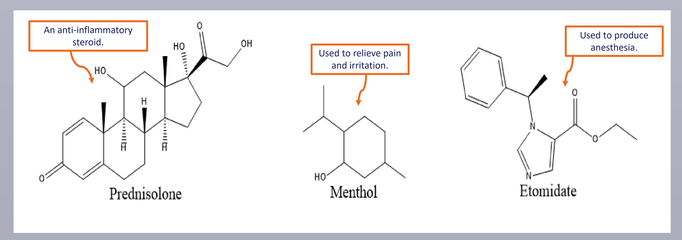
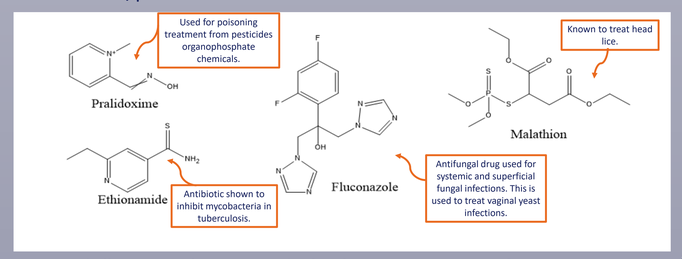


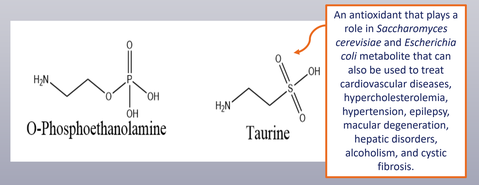
Figure 8: Compounds seen in treating bacteria, yeasts, and insecticides/pesticides. [5]



***All compounds were seen in the glasswort roots except for Methaqualone, which was only seen in the stem.**

Results & Discussion

Figure 9: Compounds seen for Alzheimer's treatment. [5]



Conclusion

Findings from this Study:

- Compounds found to treat depression, hypertension, oxidative stress, diuretics, inflammation, breast cancer, and bacteria seem to be consistent with the past studies found on *Salicornia* species.

Further Investigations:

- Look into potential uses of the plant for sleep and anxiety disorders, since many of the compounds found were used as treatments for them.
- Potential Alzheimer's treatment should be looked at further, even though a previous study has shown no significant effectiveness in it.[6]

References

1. Patel, S. Salicornia: evaluating the halophytic extremophile as a food and a pharmaceutical candidate. *3 Biotech* **2016,** *6* (104), 1–5.
2. Furtado, B. U.; Gołębiewski, M.; Skurupaa, M.; Hulisz, P.; Hrynkiewicz, K. Bacterial and Fungal Endophytic Microbiomes of Salicornia europaea. Appl. Environ. Microbiol. 2019, 85 (13), 1–2.
3. Kim, S.; Lee, E. Y.; Hillman, P. F.; Ko, J.; Yang, I.; Nam, S. J. Chemical Structure and Biological Activities of Secondary Metabolites from *Salicornia europaea* L. *Molecules* **2021,** *26* (2252), 1–26.
4. Ko, Y. C.; Choi, H. S.; Kim, J. H.; Kim, S. L.; Yun, B. S.; Lee, D. S. Coriolic Acid (13-(S)-Hydroxy-9Z, 11E-octadecadienoic Acid) from Glasswort (Salicornia herbacea L.) Suppresses Breast Cancer Stem Cell through the Regulation of c-Myc. *Molecules* **2020,** *25* (4950), 1–11.
5. National Library of Medicine PubChem Use and Manufacturing. https://pubchem.ncbi.nlm.nih.gov (accessed April 19, 2021).
6. Lee, W. J.; Shin, Y. W.; Kim, D. E.; Kweon, M. H.; Kim, M. Efect of desalted Salicornia europaea L. ethanol extract (PM-EE) on the subjects complaining memory dysfunction without dementia: a 12 week, randomized, double-blind, placebo-controlled clinical trial. *Nature* **2020,** *10,* 1.

Acknowledgements

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