

#### Abstract and Introduction

The endophytic species of *Limonium* (Sea Lavender) was tested for its medicinal properties. Sea lavender was collected from the salt marsh located near Salem State University campus. Endophytes are often a bacterium or fungus that lives within a plant for at least part of its life without causing apparent harm.<sup>1</sup> Endophytes may benefit host plants by preventing pathogenic organisms from colonizing them. Endophytic fungi were derived from the harvested stem and roots of the plant. The endophytes were analyzed and displayed antibacterial properties for Gram-negative and Gram-positive bacteria. The stem samples from the plant were also analyzed via LC-MS to identify medicinal compounds within the endophytic species. As a result, twelve bioactive metabolites were identified with anticancer, antibacterial, anti-anxiety, anti-dysrhythmic, and anti-depressant properties. Sea lavender is a plant that grows in and can be found in salt marsh locations. They are long-lived perennials that will grow in many different climates. Sea lavender plants are most often planted in outdoor gardens for their attractive flowers. Sea lavender is known to have medicinal properties in its endophytic species. Different *Limonium* species are used in Chinese, European, Latin America and Arabian traditional medicines for the treatment of different health problems, such as cardiovascular and inflammatory problems. This research identifies which compounds are found and used from this plant.



#### Methods

The following materials were used and obtained from the Salem State University stock room: ethyl acetate, 70% ethanol, 10% bleach, and distilled water. The Hei-VAP Value "The Collegiate" rotating evaporator was used to purify the samples. The UPLC was used for LCMS instrumentation and the data was analyzed using MassLynx software. For antimicrobial testing the bacteria was supplied by the Salem State University Biology Department.



#### Experimental

Sea lavender was collected from the Forest River Salt Marsh located on Salem State University campus. Pieces of the stem and root of the plant were cut and placed in PDA plates. Before plating the plants were thoroughly cleaned with soap and distilled water and 70% ethanol. The samples were left at room temperature for a week. After noticeable growth of the endophytic fungi, the samples were examined for any contamination before replating on new plates.



Two samples were taken from each plate containing black and white fuzz. The samples were left at room temperature for two weeks. New fungi growth was observed. Small pieces of the endophytic fungi (including the gel) were placed in potato broth one month. Then the metabolites from the broth were extracted to test their bioactivity.



BEFORE



AFTER

The antibacterial properties were tested by adding 2  $\mu$ L broth and extracted samples to a plate smeared in bacteria. The samples were left at room temperature for two days. The extracted samples were also ran on the LCMS to identify compounds of interest.

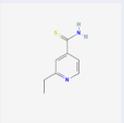
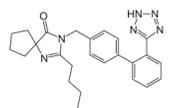
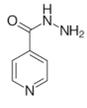
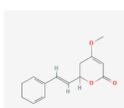
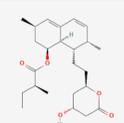
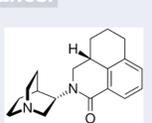
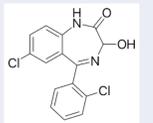
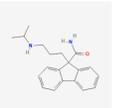
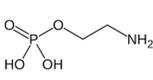
#### Results

##### BIOACTIVITY:

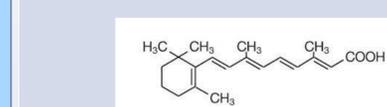
All samples were tested against four bacteria, including *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Vibrio parahaemolyticus*. The plates were left for about one week. The following chart shows activity of inhibition which indicates that the plant has antibacterial properties.



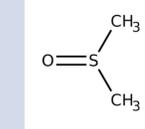
##### LC-MS DATA:

| Cardiovascular  | Anti-bacterial  | Anti-depressant  |
|---|---|--|
|  <p><b>Furazabol</b><br/>Anabolic steroid, treatment of atherosclerosis and hypercholesterolemia</p>                     |  <p><b>Ethionamide</b><br/>Antibiotic used to treat tuberculosis</p>                                 |  <p><b>Lisuride</b><br/>Treatment of migraine disorders</p>     |
|  <p><b>Irbesartan</b><br/>Treatment of hypertension</p>  |  <p><b>Isoniazid</b><br/>Medicine for prevention and treatment of tuberculosis</p>                   |  <p><b>Kava</b><br/>Treatment for anxiety and stress</p>        |
|  <p><b>Lovastatin</b><br/>Used to lower cholesterol and triglyceride levels in the blood</p>                             |  <p><b>Lorazepam</b><br/>Antisemitic, used to prevent nausea and vomiting caused by chemotherapy</p> |  <p><b>Lorazepam</b><br/>Used for short term anxiety relief</p> |
|  <p><b>Indecainide</b><br/>Used in antidysrhythmic therapy, relieving symptom and reducing the risk of cardiac death</p> |  <p><b>Phosphoethanolamine</b><br/>Biosynthesis of cell membranes and anticancer</p>                 |  |

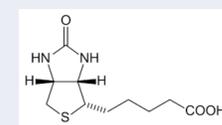
#### Miscellaneous



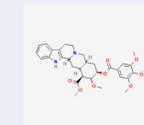
**Tretinoin**  
Topical treatment for acne, wrinkles, and discoloration



**Dimethyl sulfoxide**  
Used to reduce inflammation and pain



**Biotin**  
Vitamin used for skin, hair, and nails



**Deserpidine**  
Used for the control of high blood pressure and relief of psychotic behavior

#### Discussion

The endophytes of sea lavender were tested against four different types of bacteria. From the results of the bioactivity, it supports the findings of the endophytic species having antibacterial properties as well as medicinal properties. The LCMS data identified compounds of interest that are used for medicinal reasons. Most of the identified compounds are used for cardiovascular applications such as furazabol, irbesartan, lovastatin, and indecainide. The compounds dimethyl sulfoxide and anileridine are used to treat pain and inflammation. Traditional uses for *Limonium* include cardiovascular and inflammatory issues. These results show why the plant may be effective in these areas. Some of these compounds can be found in common medications, skin care products, and vitamins such as biotin. The common medicinal uses that has been previously discovered for sea lavender were to help treat gastrointestinal issues, pulmonary hemorrhage, and chronic laryngitis and bronchorrhea. These results are interesting because they show the need for further research into the medicinal properties of endophytes from *Limonium*.

#### References

- [1] Endophytes and Plants <https://bio.libretexts.org/@go/page/12371> (accessed Apr 26, 2022).
- [2] Dhanya N. Nair, S. Padmavathy, "Impact of Endophytic Microorganisms on Plants, Environment and Humans", *The Scientific World Journal*, vol. 2014, Article ID 250693, 11 pages, 2014. <https://doi.org/10.1155/2014/250693>
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- [5] Knox C, Law V, Jewison T, Liu P, Ly S, Frolkis A, Pon A, Banco K, Mak C, Neveu V, Djoumbou Y, Eisner R, Guo AC, Wishart DS. DrugBank 3.0: a comprehensive resource for 'omics' research on drugs. *Nucleic Acids Res.* 2011 Jan;39(Database issue):D1035-41.