

Abstract

In this experiment, fungal endophytes, from *Verbascum Thapsus*, or common mullein, were separated to examine for possible medicinal properties. There were thirty chemical compounds that showed possible medicinal properties, ranging from anti-cancer and anti-inflammatory to analgesics and more. These endophytes, from the leaf, were also tested against *Staphylococcus aureus*, *Escherichia coli*, *Vibrio parahaemolyticus*, and *Pseudomonas aeruginosa* to determine possible antibacterial properties. For both of the endophytes found in the leaf, there was inhibition observed in all the bacteria besides *Pseudomonas aeruginosa*.

Introduction

Verbascum Thapsus, more commonly known as common mullein or great mullein, is a plant part of the *Scrophulariaceae* family. This plant is native to Europe, Asia, and parts of Africa and was brought to America for medical purposes.¹ Common mullein has a long history of being used for respiratory treatment, but also has been shown to have other medicinal properties. Some of which including anti-inflammatory, anodyne, anticancer, antihistaminic, antioxidant, fungicide, hypnotic, sedative, and many more.²

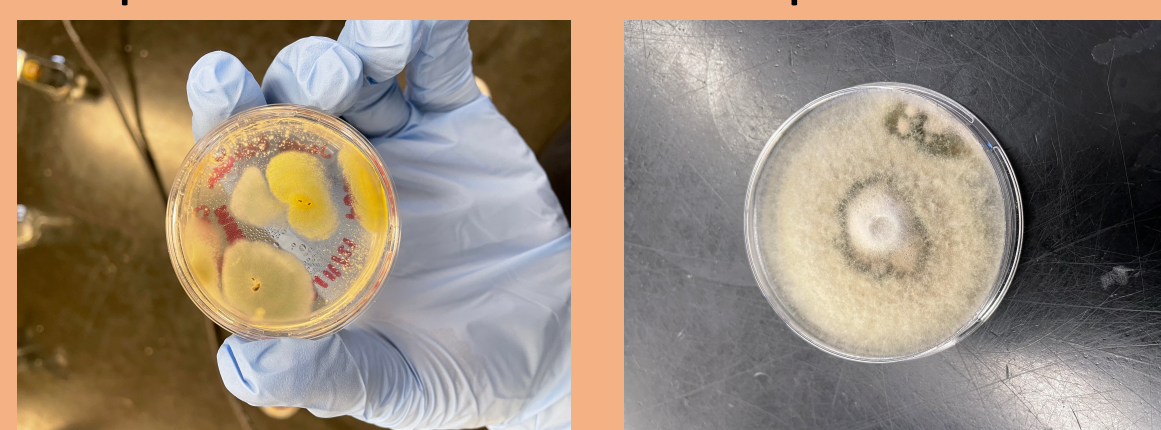
Endophytes are micro-organisms that live on the surface of the plant or within the tissue, but they don't cause any harm to the host plant.³ In this study endophytes were extracted from a common mullein sample to determine its chemical components and their possible medicinal properties. The bioactivity of these endophytes were also tested.

Experimental Design

- The plant sample was obtained from the salt marsh near Salem State University.
- Once obtained the sample was washed using soap and water, bleach, and ethanol and then put on a Potato Dextrose Agar to grow endophytes.



- The endophytes were then further separated onto their own plates.

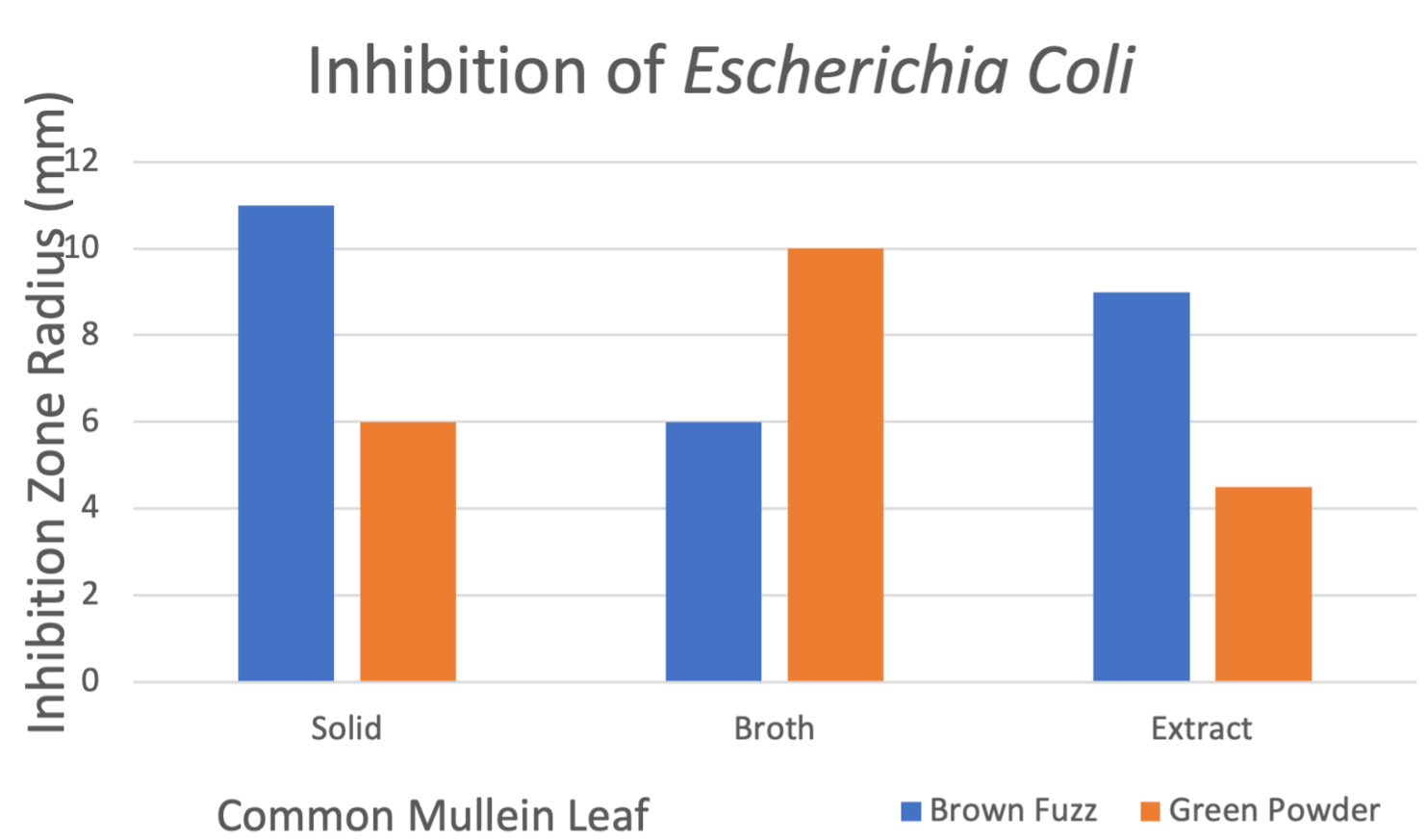
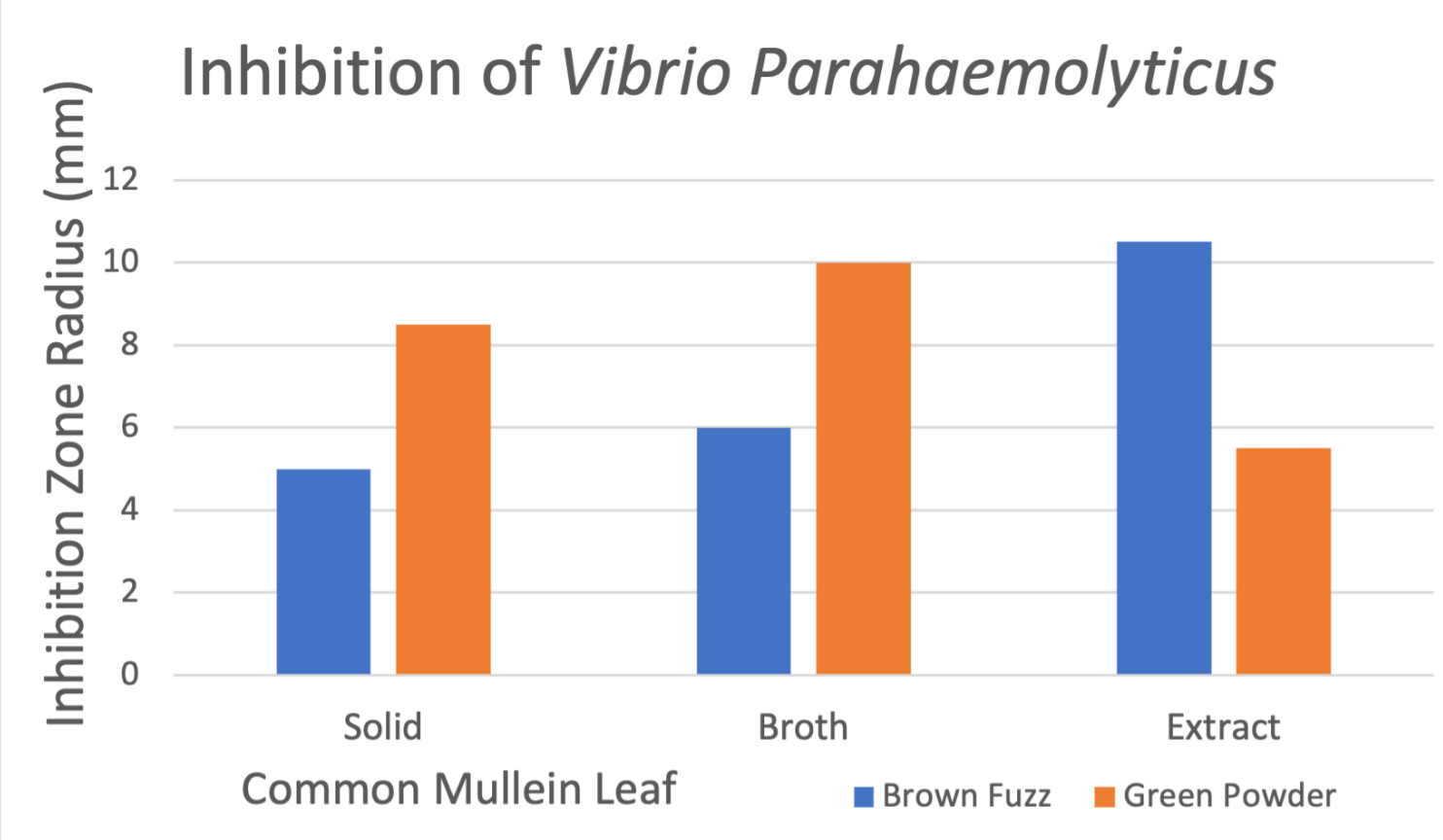
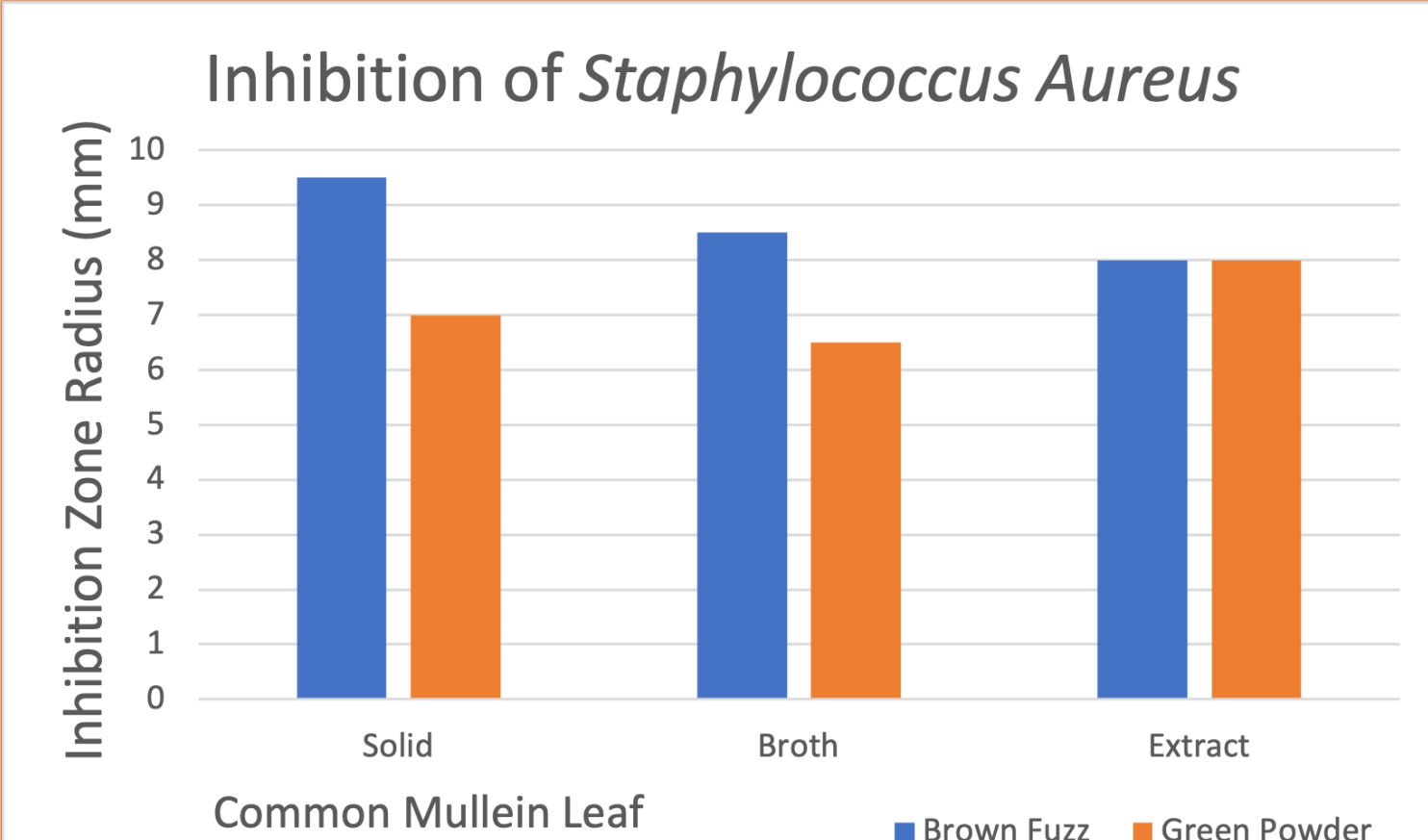
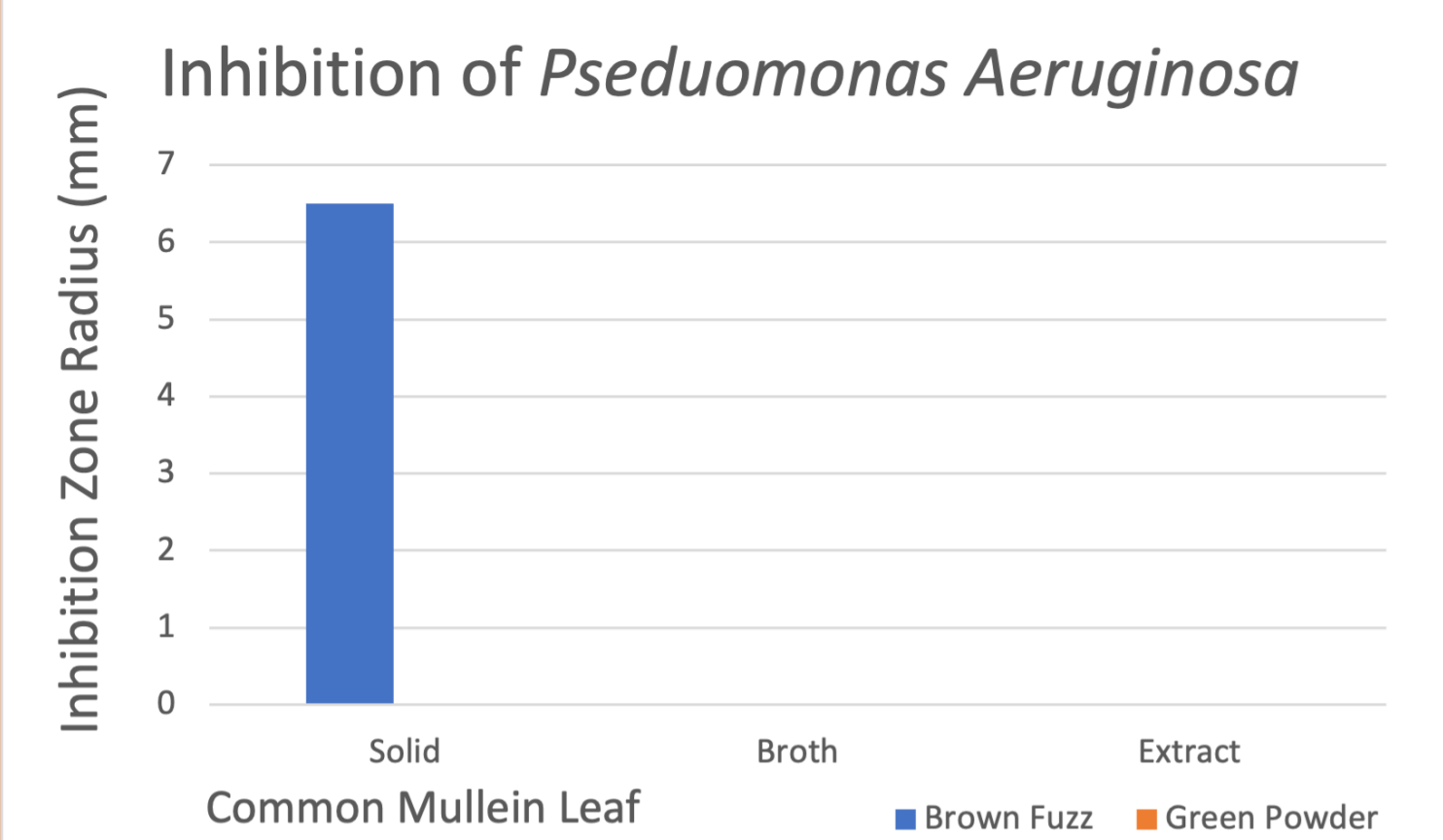


- The endophytes were then put into a potato dextrose broth to start extracting metabolites.



- The broth from each sample then got rotovapped to obtain an extract from each sample.
- The extract, broth, and solids were tested against *Staphylococcus aureus*, *Escherichia coli*, *Vibrio parahaemolyticus*, and *Pseudomonas aeruginosa* to determine the Bioactivity.
- The extract was used to ID chemical components using the LC-MS.

Bioactivity



LC-MS Data

Anti-Cancer			
Common Name	Structure	Uses:	Sample:
Phosphoryl-ethanolamine	<chem>NCOP(=O)(O)O</chem>	Possible usage for anti Cancer purposes	Both Samples
Tandutinib	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treats Glioblastoma Multiforme	Green Powder
Halo-cynthiaxanthin	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Inhibits growth of certain tumor cells	Both Samples

Heart and Blood			
Common Name	Structure	Uses:	Sample:
Taurine	<chem>NCSC(=O)(=O)O</chem>	Lowers blood pressure and calms the nervous system	Both Samples
Calcium Diacetate	<chem>CC(=O)OC[Ca+2]OC(=O)C</chem>	Lowers phosphate in the blood stream	Both Samples
D-Vinylglycine	<chem>NC(C=C)C(=O)O</chem>	Irreversible inhibitor of aspartate aminotransferase	Both Samples
Metyrosine	<chem>NC(O)C[C@H](O)c1ccc(O)cc1</chem>	Used for high blood pressure treatment	Both Samples

Anti-Inflammatory			
Common Name	Structure	Uses:	Sample:
Nabumetone	<chem>COC1=CC=C(C=C1)C(=O)OCC</chem>	Chronic Arthritis and as a long lasting anti-inflammatory	Both Samples
L-Cysteine	<chem>NC(CS)C(=O)O</chem>	Anti-inflammatory, Arthritis, Bronchitis, Diabetes, flu symptoms, cardiovascular disease.	Both Samples
Niflumic Acid	<chem>O=C(O)c1ccc2c(c1)nc(F)c2</chem>	Used for joint and muscular pain. Used for chronic arthritis as an anti-inflammatory	Both Samples

Analgesics			
Common Name	Structure	Uses	Sample
Alphame-prodine	<chem>CN1CC[C@H](C1)C(=O)O</chem>	Exerts physiological effects such as: Analgesia, euphoria, sedation to help relieve itching, nausea etc.	Both Samples
Niflumic Acid	<chem>O=C(O)c1ccc2c(c1)nc(F)c2</chem>	Used for joint and muscular pain. Used for chronic arthritis as an anti-inflammatory	Both Samples
Fentanyl	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Used for opioid anesthetic, management of severe pain.	Both Samples
Menthol	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Used to relieve minor joint and muscle aches/pains	Both Samples

Mental Health and Brain			
Common Name	Structure	Uses:	Sample:
Imipramine	<chem>CN1CC[C@H](C1)c2ccc3c2cnc3</chem>	Used as an antidepressant. Can treat anxiety and panic disorder	Both Samples
Alprazolam	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treats anxiety and panic disorder	Both Samples
Diazepam	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Anxiety, muscle spasms, and seizures	Both Samples
L-Glutamine	<chem>NC(CCC)C(=O)O</chem>	Anxiety, Depression, Bipolar Disorder, Insomnia, IBS, Schizophrenia.	Brown Fuzz
Ethchlorvynol	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treats insomnia	Both Samples
Zonisamide	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Seizures/Epilepsy	Both Samples
Amantadine	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Used to treat Parkinson's Disease and other uncontrolled movements.	Both samples

Miscellaneous			
Common Name	Structure	Uses	Sample
Vildagliptin	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treats type II diabetes	Both Samples
Becomethasone	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Used to prevent difficulty breathing, chest tightness, and asthma	Both Samples
Biotin	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Helps metabolize fats, carbohydrates, and protein. Improves keratin infrastructure.	Both Samples
Masoprocol	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treatment of skin growths by sun exposure	Both Samples
Nore-thindrone	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Used as a progesterone to regulate ovulation and menstruation	Both Samples
Ascorbic Acid (Vitamin C)	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Antioxidant that fights bacterial infections, detoxifies reactions, and in formation of collagen	Both Samples
Succimer	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treats lead poisoning	Both Samples
Praloxidine	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treat poisoning caused by organic phosphorus pesticides	Both Samples

Antibiotics			
Common Name	Structure	Uses	Sample
Ethianomide	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Treats tuberculosis and leprosy. Inhibits mycolic acid synthesis.	Both Samples
Rifamycin W	<chem>Cc1ccc2c(c1)nc3c2cnc3</chem>	Antibiotic used to treat diarrhea caused by E. Coli	Both Samples



Discussion and Conclusions

Overall, the thirty constituents that were obtained using the LC-MS showed a large range of possible medicinal properties. Although research has shown a lot of usage for possible respiratory issues, this experiment didn't provide information to back those sources up. This study found many chemical constituents that had medicinal properties ranging from mental health, to the heart, anticancer, and analgesics. This study was able to confirm that there are constituents with anti-inflammatory properties.² Although it was not able to confirm things like the possible respiratory properties, it does give room for growth and for future studies. For future studies, looking into further usage for the plants constituents to be used for possible mental health treatments or the heart and blood would be interesting. These two properties showed up a repeatedly throughout this study but didn't have any literature to back these findings up.

The endophytes within this study were tested for their bioactivity against four bacteria: *Staphylococcus aureus*, *Escherichia coli*, *Vibrio parahaemolyticus*, and *Pseudomonas aeruginosa*. They successfully showed inhibition against all of them except for the *Pseudomonas aeruginosa* which only showed inhibition for brown fuzz solid. This lines up with previous studies that have conducted similar experiments that show common mullein has antibacterial properties.⁴ This may be a potential source for future antibiotics.

References

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- Riaz, M.; Zia-Ul-Haq, M.; Jaafar, H. Z. E. Common Mullein, Pharmacological and Chemical Aspects. *Revista Brasileira de Farmacognosia* **2013**, 23 (6), 948-959.