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Évaluation de l'efficacité antifongique des extraits de lavande en tant que biocides contre les champignons (Phoma sp et Colletotrichum sp)

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Introduction

For a long time, man has lived side by side with plants, and is used to consuming them for their medicinal and nutritional properties. Natural products are of great interest as raw materials for a range of industries, including cosmetics, pharmaceuticals, food, plant health and industry. Medicinal plants are in these different sectors in the form of active ingredients, oils, extracts, aqueous or organic solutions aqueous **(Selles, 2012).**

Plants are also used for their antibacterial and antifungal properties in the field of medical microbiology **(Mohammedi, 2013).** In fact, their therapeutic properties are due to the presence of hundreds of thousands of bioactive natural compounds called secondary metabolites. These secondary metabolites are then accumulated in the various organs and sometimes in specialised plant cells **(Boudjouref, 2011).**

medicinal herbs, have long been of interest in agricultural research due to their essential oil (**EO**) and water extracts as well and aromatic and medicinal properties. They are increasingly gaining attention as natural and environmentally friendly means of combating harmful weeds and plant diseases and phytopathogens. This scholarly introduction delves into the advantages provided by lavender plants and the diverse aqueous and oil extracts derived from them. The examination conducted scrutinizes the essential components present in lavender plants and the efficacy they exhibit in combatting a broad spectrum of detrimental weeds, fungi, and bacteria within agricultural settings. The primary objective of this research endeavor is to assess the efficiency of lavender extracts in confronting plant pathogens, encompassing a vast array of agricultural pests that pose a threat to crop yields. The intricate botanical makeup of lavender, which includes significant compounds such as linalool and linalyl acetate, presents promising opportunities for the implementation of sustainable pest control strategies in agricultural practices.

Biological control, a well-established concept with a rich historical background, has attracted significant attention in recent times due to its efficacy in the realm of integrated pest management strategies aimed at mitigating the impact of crop pests.

Over the last fifty years, the method most commonly used to control pathogens has been the use of chemical fungicides. The various components of these substances are harmful effects on humans and the environment, including the accumulation of residues, leading to soil pollution **(Hibar et al., 2007).**

Objectives

In our scholarly investigation, we aimed to meticulously explore and critically evaluate sustainable alternatives to synthetic chemical compounds commonly used in pest management and plant disease control. Our focus was directed toward enhancing the understanding of the efficacy of lavender derivatives in mitigating plant diseases caused by bacterial and fungal pathogens. Lavender extracts, as natural plant-based remedies, offer promising potential due to their bioactive properties and reduced environmental impact. This study endeavors to provide profound insights into the practical applications of lavender derivatives, emphasizing their role as sustainable, eco-friendly, and economically viable options in modern agricultural systems. Through this research, we aim to contribute to the development of holistic agricultural methodologies that align with the principles of integrated pest management (IPM) and ecological sustainability. Additionally, our investigation sheds light on the mechanisms through which lavender extracts exert antimicrobial and antifungal effects, highlighting their potential to replace or complement traditional chemical pesticides while addressing emerging concerns related to environmental pollution, soil degradation, and human health risks.

First part:

bibliographic section

Chapter one:

Medicinal plants

1 History of medicinal plants around the world

Throughout history, humans have relied on plants for sustenance and healing. Over time, they learned to distinguish between edible and poisonous plants, using some for various purposes such as warfare, magic, fishing, and hunting. This knowledge was initially transmitted orally and later recorded in writing, allowing us to find evidence of plant usage in ancient civilizations across the globe, including Sumerian, Babylonian, Egyptian, Chinese, Hindu, Aztec, and Inca cultures (Callery, 1988). The use of plants for medicinal purposes has evolved over time, with early records of medicinal plants found in cuneiform script on Sumerian and Babylonian documents (4,000 BC) and the Ebers Papyrus (Egypt) from around 1600 BC.

In ancient Greece, philosophers and physicians like Hippocrates (3rd century BC) and Dioscorides (60 AD) analyzed hundreds of herbs from various regions in their works, such as "De materia medica." During the same period, the Arab world expanded its knowledge of medicinal plants, with Ibn al-Baitar describing 1,500 drugs in the 13th century in his work "Corpus simplicium medicamentorum," which was later translated into Latin. The Crusades, the discovery of America, and interactions with other cultures led to the introduction of new drugs in Europe.

This rich history of using plants for medicinal purposes laid the foundation for phytotherapy, a term derived from the Greek words "phyton," meaning "plant," and "therapeia," meaning "treatment." Phytotherapy is a therapeutic approach that employs plants to address the root causes and symptoms of various ailments. As one of the oldest forms of therapy, it has been utilized for centuries to maintain and restore health by harnessing the natural healing properties of plants. Phytotherapy incorporates various techniques involving the use of plant extracts, essential oils, and other plant-derived substances to promote well-being and alleviate health issues (Farnsworth et al, 1986).

2. Medicinal Plants in Algeria

The utilization of medicinal plants for therapeutic purposes has been practiced for thousands of years, with the earliest documented evidence in Algeria and the Maghreb region dating back to the 9th century. Renowned scholar Ishâ-Ben-Amran contributed significantly to this field by

authoring various treatises on medicine and simple drugs **(Baba Aissa, 2000)** .During the French colonial period from 1830 to 1962, botanists made substantial progress in cataloging indigenous medicinal plant species, culminating in the publication of a comprehensive book by **(Fourment and Roques)** in 1942. This work featured 200 described and studied species, primarily found in northern Algeria, with only six species identified in the Sahara. In contemporary Algeria, as **Belkhodja, 2016** reported; phytotherapy remains a popular and widely used approach for managing various health conditions, including diabetes, rheumatism, weight loss, and even certain incurable diseases.

3. Definition of Medicinal Plants

A medicinal plant is a plant or plant part that possesses therapeutic properties due to the combined action of its active compounds, without causing harm at recommended doses. Plant-based medicines are scientifically named using the binomial system (genus, species, variety, and author). The scientific study of medicinal plants, including pharmacological and toxicological research, has enabled the understanding of their chemical composition, therapeutic effects, and safe dosages. In contrast to chemical drugs that target specific receptor sites with synthetic molecules, the therapeutic benefits of medicinal plants result from the synergistic action of all their components, making the effectiveness of phytotherapy dependent on the plant's composition. Medicinal plants offer both curative and preventive effects with primary metabolites such as sugars, fatty acids, and amino acids produced during photosynthesis, followed by the production of specialized metabolites with therapeutic properties **(Simon, 2001).**

4.Medicinal Plants applications

Medicinal plants have been used by humans for both food and healing since ancient times. These plants or their parts possess therapeutic properties due to the synergistic action of their active compounds, without causing harm at recommended doses. Plant-based medicines are scientifically named using the binomial system, which includes the genus, species, variety, and author. The study of medicinal plants, including pharmacological and toxicological research, has allowed for a better understanding of their chemical composition, therapeutic effects, and safe dosages.

In contrast to chemical drugs that target specific receptor sites with synthetic molecules, the therapeutic benefits of medicinal plants result from the combined action of all their components. This makes the effectiveness of phytotherapy dependent on the plant's composition. Medicinal plants offer both curative and preventive effects, with primary metabolites such as sugars, and amino acids produced during photosynthesis, followed by the production of specialized metabolites with therapeutic properties. Plant drugs are essentially whole, fragmented, or powdered plants or thallophytes used for medicinal purposes, either in a dried state or fresh. On the other hand, herbal medicinal products are medicinal products whose active ingredients are exclusively derived from plant drugs and/or plant drug preparations. These products have a long history of use and continue to be an essential part of traditional and modern medicine.

5.Components of Medicinal Plants

5.1. Definition of Active Principle

An active principle refers to a molecule found in a plant or vegetable drug that offers curative or preventive therapeutic benefits for humans or animals. This active principle can be present in a plant drug in its natural state or as part of a preparation based on a vegetable drug. The entire plant drug is considered an active principle, regardless of whether its therapeutic components are known or unknown. In other words, the active principle encompasses all the beneficial compounds found within the plant drug, working together to provide therapeutic effects **(Gayet, 2013, Pelt, 1980).**

5.2. Essential Oils

Essential oils are molecules with an aromatic nucleus and a volatile nature, which give plants a distinct odor. They are found in the secretory organs of plants **(Iseran et al, 2001).** These oils serve a protective role for plants against excessive light and help attract pollinating insects **(Dunstan et al, 2013).** In addition to their natural functions, essential oils are utilized in treating inflammatory conditions such as allergies, eczema, and intestinal issues **(Iseran et al, 2001).** Furthermore, they are widely used in the cosmetic and food industries **(Kunkele et Lobmeyer, 2007).**

6.Secondary Metabolites in Medicinal Plants

6.1. Flavonoids and Alkaloids

Flavonoids are responsible for the coloration of leaves, flowers, fruits, and other plant parts. They possess antibacterial properties **(Wichtl et Anton, 2009),** and some flavonoids also have anti-inflammatory and antiviral properties **(Iseran et al, 2001).** Alkaloids are natural nitrogenous substances with a frequent basic reaction derived from amino acids **(Kunkele et Lobmeyer, 2007).** All alkaloids have an intense physiological action, medicinal or toxic. Due to their high activity, alkaloids have given rise to many drugs **(Ali-Delille, 2013).**

6.2. Bitter Substances and Tannins

Bitter substances form a very diverse group of components with a common bitterness in their taste. This bitterness stimulates the secretions of the salivary glands, which in turn increase appetite and improve digestion and absorption of nutritive elements, thereby better nourishing the body **(Iseran et al, 2001)**. Tannins are amorphous substances contained in many plants and are used in the manufacture of leathers due to their ability to make skins imputrescible. They also possess antiseptic properties, as well as antibiotic, anti-inflammatory, anti-diarrheal, hemostatic, and vasoconstrictive (decrease in the caliber of blood vessels) properties **(Ali-Delille, 2013).** Plants containing tannin include oak **(Kunkele et Lobmeyer, 2007).**

6.3. The Mechanism Behind How Medicinal Plants Work

The therapeutic potential of medicinal plants has been increasingly understood in recent decades, thanks to advancements in pharmaceutical research. Scientists have deciphered the chemical composition of numerous medicinal plants, enabling the pharmaceutical industry to reproduce many of their components chemically and discover new combinations. This progress benefits both patients and the conservation of natural resources **(Kunkele et Lobmeyer, 2007).** Each medicinal plant contains thousands of active substances in varying quantities. When isolated, these active principles may not exhibit significant effectiveness. However, when combined with other substances within the plant, they reveal their pharmacological properties **(Cleur et Carillon, 2012).** This phenomenon is known as synergy, which distinguishes phytotherapeutic drugs from modern drugs that typically contain only one active principle **(Donald, 2000).** Medicinal plants offer both curative and preventive effects **(Simon, 2001).** The process of photosynthesis produces primary metabolites, such as sugars, fatty acids, and amino acids.

Subsequently, plants generate specialized metabolites, which possess therapeutic virtues **(Bruneton, 1999).** This intricate interplay of compounds within medicinal plants contributes to their overall healing potential.

Chapter two

Study of plant used

2.1 LAVUNDULA'S family:

The genus Lavandula, which belongs to the Lamiaceae family, **BSBI List 2007** encompasses approximately 39 distinct species, along with numerous hybrids and nearly 400 registered cultivars. Lavandula angustifolia serves as the primary source material for pharmacopoeia within this genus. USDA, **NRCS (n.d.) 2016.**

2.2. Classification:

Recent trends in the classification of *Lavandula stoechas* in the fields of botany and horticulture are characterized by a concentration on its bioactive constituents and therapeutic attributes, as delineated in various scholarly investigations **(Reyaz, Ahmad et al 2020).** *Lavandula stoechas*, found extensively across Africa, Europe, and Asia, is abundant in phytochemicals such as flavonoids, tannins, and sterols, while its leaves and flowers yield essential oil *lavandula stoechas* that are widely employed in pharmaceutical applications. Moreover, investigations have indicated the presence of ursolic acid in *Lavandula stoechas*, a compound demonstrating promising anti-diabetic characteristics, thus presenting itself as a potential option for managing postprandial glycemia and averting diabetes. Additionally, the genetic variability and morphological diversity inherent in *Lavandula stoechas* have been meticulously scrutinized, accentuating the imperative of conservation initiatives and the exploitation of genetic diversity for forthcoming horticultural pursuits. These advancements underscore the escalating fascination with *Lavandula stoechas* due to its multifaceted implications in the realms of botany and horticulture**. (Hanem, I., Eldeghedy et al 2022).**

2.3. Characterization:

Lavandula stoechas exhibits a distinctive floral configuration characterized by unique bracts in purple or pink hues. The plant is renowned for its aromatic attributes, possessing fragrant blossoms that allure pollinators like bees and butterflies. Thriving in arid, stony environments, *Lavandula stoechas* demonstrates a predilection for well-drained soil and sunny surroundings. Belonging to the Lamiaceae family, also known as the mint family, this species is recognized for its square stems and opposite leaves. The elongated, narrow leaves of *Lavandula stoechas*, often sporting a gray-green shade, significantly contribute to its overall aesthetic appeal and botanical categorization**.** This species is part of the Lamiaceae family, commonly referred to as the mint family, known for its square stems and opposite leaves the leaves of *Lavandula stoechas* are narrow, elongated, and often gray-green in color, contributing to its overall appearance and botanical classification. **(Sevim, Küçük et al 2019).**

2.4. Geographical breakdown:

Lavandula species can be located in different regions spanning from Europe to Asia, with Lavandula angustifolia being indigenous to Cape Town, the Canary Islands, Madeira, and southeast India. *Lavandula stoechas*, commonly observed in the Mediterranean area, specifically Algeria, is renowned for its abundant phytochemical composition, encompassing flavonoids, tannins, sterols, and essential oil *lavandula stoechas* derived from its foliage and blossoms. **(Hammiche et Maiza, 2006).**

another Lavandula species found in Algeria, is customarily employed in the alleviation of abdominal discomfort, migraines, and infections, with its essential oil distinguished by constituents like linalool and linalyl acetate. The Lavandula genus, inclusive of *L. stoechas*, showcases a broad spectrum of health advantages and utilities, extending from phytotherapy to skincare products and aromatherapy attributes. **(Moulsma et al., 2000).**

2.5. systematic classification:

Kimgdoom	**Plantae**
Division	**Magnoliophyta**

Classe	**Magnoliopsida**
Ordre	**Lamiales**
Family	**Lamiaceae**
Sous-famille	**Nepetoideae**
Gendre	***Lavandula***
Species	***Lavandula stoechas***

Figure 1**: Systematic classification**

2.6. toxicity

Lavandula stoechas presents challenges in terms of toxicity, specifically in relation to its cytotoxic properties. Studies have shown that the essential oil of this plant demonstrates noteworthy cytotoxicity against cancerous cells, whereas the ethanolic fraction exhibits anti-cancer properties attributed to constituents like Lupeol and Phytol. Furthermore, the chemical makeup of *Lavandula stoechas* essential oil varies depending on its geographical location, containing components such as camphor and cubebol, which contribute to its antibacterial, antifungal, and antioxidant effects. These results imply that despite the potential medicinal benefits of *Lavandula stoechas* in various applications, caution is warranted due to its possible adverse effects on specific organs and physiological systems. **(Abdel-Baki, A.-A.S et al 2023).**

2.7. chemical composition:

Lavandula stoechas stands as a valuable reservoir for bioactive compounds, there by playing a pivotal role in the pharmaceutical, aromatic, fragrance, and culinary sectors These particular species are highly valued for their aromatic and medicinal characteristics, with their essential oils derived from leaves and flowers recognized for their sedative, antibacterial, antifungal, and antidepressant properties**. (Aburjai et al 2007).**

The presence of chemical polymorphism among Lavandula species gives rise to variations in the bioactive compound composition, resulting in distinct chemotypes that exhibit a range of biological effects. It is imperative to comprehend the genetic diversity and epigenetic processes

that govern secondary metabolites in Lavandula species in order to manipulate biosynthetic pathways and elucidate genotypic distinctions in their content and variability. Furthermore, This particular botanical species is conventionally utilized for a diverse array of therapeutic objectives owing to its anti-inflammatory, antioxidant, antimicrobial, and anticonvulsant**(Sghir Taleb 2015).**

2.8. phytosanitary Problems:

The existence of *Lavandula stoechas*, a botanical specimen abundant in bioactive phytochemicals such as flavonoids and sterols, may exert a favorable influence on the overall well-being and efficiency of plants. Research has underscored the antimicrobial, antioxidant, and anti-inflammatory characteristics of *L. stoechas*, indicating its advantageous effects on plant development. **(Zhang X 1998).**

Moreover, both the plant itself and its primary metabolite, ursolic acid, have been recognized as potent agents against diabetes, regulating postprandial blood glucose *Lavandula stoechas* and improving glucose utilization, thus potentially enhancing plant vigor.

Additionally, the essential oil *lavandula stoechas* derived from *Lavandula stoechas* have exhibited antioxidant properties, which could aid in shielding plants from oxidative pressure and bolstering their capacity to withstand challenges. In summary, the varied pharmacological attributes of *Lavandula stoechas* propose that its presence could enrich the health and efficiency of neighboring plants through diverse mechanisms.

Chapter three

scholarly study about phoma and colletotrichum

The mycological genera Phoma and Colletotrichum play a significant role as plant pathogens that result in considerable financial losses in diverse agricultural crops on a global scale. Phoma varieties are recognized for their ability to invade a broad spectrum of plants, such as grains, oilseeds, veggies, and decorative plants, leading to ailments like stem lesions, leaf blemishes, and root decays. **ECHANDI, E. 1957** Similarly, Colletotrichum varieties act as the primary instigators of anthracnose ailments in numerous crops, encompassing fruits, vegetables, and decorative plants**. Huang, L 2013.**

3.1. Colletotrichum

The category Colletotrichum embodies a vast array of economically crucial Ascomycete fungi which collectively induce anthracnose ailment or leaf blights on all notable agricultural crops and decorative flora globally. Colletotrichum spp. frequently act as exemplars in investigations spanning from pathogenic evolution and differentiation to plant-microorganism connections. Throughout the establishment and colonization of host flora, individual of this category distinctly obtain nutrients through biotrophy and necrotrophy **(Hwang et al., 1995).**

The differentiation of Colletotrichum infection structures and the interactions between Colletotrichum and plant have been studied using several approaches. Examples of these approaches will be illustrated throughout this chapter. Genes that are differentially expressed during infection have been identified by subtractive hybridization, differential screening and differential display reverse transcriptase-PCR. For example, several genes expressed during appressorium formation by. gloeosporioides have been cloned using these techniques **(Hwang et al., 1995).** Differential screening of a cDNA library prepared from axenic cultures of gloeosporioides resulted in the isolation of a glutamine synthetase gene that is up-regulated during Stylosanthes infection. The gene is up-regulated during Stylosanthes guianensis infection **(Stephenson et aI., 1997**).

Gene complementation in model organisms is a powerful technique for characterizing the function of signaling proteins. the function of signaling proteins. Two notable signaling proteins from plant pathogenic fungi that complement defects in "tester" organisms are the protein kinase gene tb3 from C. trifolii (**Buhr et aI., 1996)** and the PMKl MAP kinase gene from M grisea (**Xu and Hamer,1996).** The TB3 kinase complemented the colonial phenotype of N crassa (due to disruption of the cot-l protein kinase).

3.2 phoma tracheiphilus

Plenodomus tracheiphilus (previously known as Phoma tracheiphilus) is an important fungal pathogen that causes a destructive vascular disease in citrus plants, particularly lemon, in parts of the Mediterranean region. Understanding its biology, epidemiology, and management strategies is crucial for the citrus industry in affected areas. **Berkman ND,2013** Phoma is a diverse genus of fungal organisms belonging to the division Ascomycota, category Dothideomycetes, order Pleosporales, and family Didymellaceae, as illustrated in Biodivers**.** Phoma species was originally proposed in the 19th century by Italian mycologist **Pier Andrea Saccardo (1880)**, and almost century later revisions were implemented to the description and categorization of the genus by **Gerhard Boerema and Gerrit Bollen (1975)** Over 220 species were officially acknowledged in the manual, "Phoma Identification Manual" by Boerema et al. with identification determined by morphological characteristics, such as the development of conidia (asexual spores), pycnidia (asexual fruiting bodies) Phoma tracheiphilus is a mitosporic fungus that causes a vascular disease called "mal secco" or "dry rot" in citrus plants **(Aziz ZAA. 2018)**.

The main host is lemon (Citrus limon), but it has also been reported on other Citrus species, as well as Fortunella, Poncirus, and Severinia. **(**In general, the categorization of fungi as a whole is undergoing dynamic revision due to the accessibility of modern molecular techniques for examination of fungi at the genomic, transcriptomic, and proteomic level. Present data indicates that all fungi may be classified within three divisions, henceforth further investigations are It can spread through water splash, wind-driven rain, and the movement of infected host plants for planting, especially asymptomatic plants **Cooke B2000** its necessary to accurately classify Phoma species within the realm fungi **(Choi, J.J.; Kim, S.H 2018).**

Chapter four

Host plant

4.1. General information on citrus fruit

According to **LOUSSERT (1985),** the term "citrus", of Italian origin, designates both edible fruits and the trees that bear them, belonging to the genus Citrus. These fruits play an essential role in the export and processing sectors, being transformed into various by-products such as juices, jams and essences, and thus contributing to job creation **(LOUSSERT, 1987).** According to **POLESE (2008),** citrus trees are small trees or shrubs that can reach heights of 2 to 10 m, with short trunks, dense branching and evergreen foliage. The partially thorny branches undergo several waves of growth, the most important of which takes place in spring. These plants are capable of producing fruit of various shapes and sizes.

4.2. Citrus decline diseases and symptoms

Citrus trees are vulnerable to a wide range of diseases, whether fungal, bacterial or viral. These diseases can cause significant damage to the tree. We refer to decline diseases as those that differ in nature, but are generally characterized by a slow progression, often leading to the death of the entire plant (SALIM, 2011).

Figure 2**: Citrus decline diseases and symptoms (original)**

4.3. Citrus decline diseases

Citrus is vulnerable to a wide range of diseases, whether fungal, bacterial or viral. These diseases can cause significant damage to the tree. We use the term "decline diseases" to refer to conditions that differ in nature, which are generally characterized by a slow progression, often leading to the death of the entire plant **(SALIM, 2011).**

4.4. Viral diseases

According to **TAHIRI (2007),** citrus virus diseases are a group of diseases that can be transmitted by grafting and by specific vectors represent the most serious and devastating threat to citrus worldwide not only In the Mediterranean basin.

4.5. Fungal diseases

According to **COSTERTON et al (1999**), a fungal disease, also known as mycosis, is a form of infection caused by the presence of fungi, Among the various fungal diseases that can affect citrus fruit.

4.6. Cryptogamic diseases

A number of fungal diseases can cause dieback to citrus trees, affecting leaves, roots and fruit, The damage caused by these diseases are significant, both in terms of their impact on the lifespan of the trees and the production losses**. (LOUSSERT, 1989).**

PART TWO: EXPERIMENTAL STUDY

Materials and methods

1. objective

The primary goal is to combat fungal pathogens affecting agricultural crops, which have always posed a major problem facing the spread of chemical pesticides, Biological control using aqueous extracts, essential oils, and hydroalcoholic extracts of lavender is one of the solutions to fight these pathogens while preserving the environment, Lavender essential oils have shown strong antibacterial activity against pathogenic strains such as Fusarium oxysporum and Phytophthora infestans, as well as Colletotrichum and Phoma. They can therefore be used as natural biopesticides to protect crops. Lavender aqueous extracts have also had a moderate effect against certain bacteria, thus constituting an alternative to chemical pesticides.

2. Presentation of the harvest area

Ath Mansour situates it within Greater Kabylia. The administrative hub of the commune is situated in Taourirt village, positioned at a distance of 4.7 km from the Daïra of M'chedallah, which itself is located 50 km away from the Wilaya of Bouira, and 150 km away from the capital Algiers. Ath Mansour commune's establishment stems from the most recent administrative restructuring conducted in 1984, initially named Taourirt; however, due to political considerations in 1990, it was renamed Ath Mansour. Encompassing a land expanse of 90 square kilometers, the territory of Ath Mansour commune is demarcated as follows: - Towards the north, it is bordered by Oued Sahel, with M'chedallah commune and Chorfa commune as adjacent areas, while the boundaries are defined by Oued Oumarigh. - On the eastern frontier lies the commune of Boudjlil, which is under the territorial jurisdiction of the wilaya of Bejaia. - The southern borders meet with the village of Ouled Sidi Brahim, where a separation from Bordj Bou Arreridj commune is marked by Oued Elkerma. - Towards the west, the commune's village is segregated from Ahnif commune by Oued Sidi Aissa (APC) as indicated by (Chabane, 2015).

Figure 3**: Presentation of the commune of Ath Mansour (google maps)**

2.1Climate

The climatic conditions in the Ath Mansour area are characterized by high temperatures and humidity during the summer season. Within this municipality, a variety of plant species have adapted to the prevailing hot climate, such as Eccih (Artemisia), tazeggart (Zizuphus spina), among others. This particular region experiences challenges from intense hot winds originating from the south, often accompanied by desert sand. Despite its geographical location on the plain (Bibans), facing the Djurdjura mountains, Ath Mansour encounters cold winter weather, as it is situated amidst a cluster of hills. The meteorological information cited in this text has been sourced from Meteoblue: http://www.meteoblue.com.

2.2Average temperature and precipitation

January exhibits the lowest temperatures, with an average daily maximum of 15°C and an average daily minimum of 8°C. Conversely, July experiences the highest temperatures, with an average daily maximum of 37°C and an average daily minimum of 23°C. The data depicted in the figure below highlights that March received the highest amount of rainfall at 57 mm, whereas July had the lowest recorded precipitation at 20 mm.

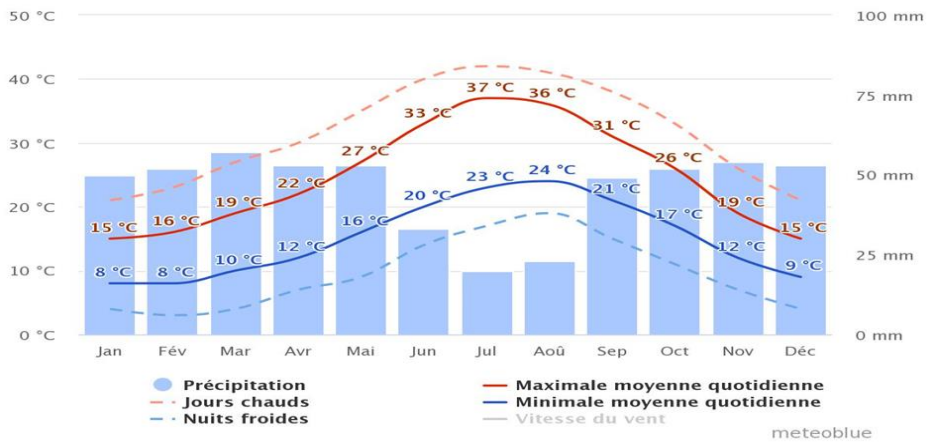

Figure 4**: Average temperature and precipitation in the Ath Mansour region (Meteoblue, 2022)**

2.3 Classification of Soil Types:

The assessment of soil quality is contingent upon its intended purpose and specific geographic location. The region of Ath Mansour exhibits distinct categories of soil, namely White earth (aremli): situated above the river in Ath Mansour, referred to as Iremliyen adjacent to tachemlit. Clay soil (akal alemssu): widespread across the region, exhibiting a viscous consistency during periods of precipitation.Sandy soil (armel n wassif): located along the Oud Sahel riverbanks, utilized by localavandula stoechas for residential construction purposes.Conclusively, the diverse soil composition in Ath Mansour can be attributed to its varied climatic conditions **(Chabane, 2015).**

3. phytochemical screening test:

The main purpose is to provide an overview of the classes of phytochemicals present in the plant, such as alkaloids, carbohydrates, proteins, phenolic compounds, flavonoids, tannins, saponins, steroids, terpenoids, and more. Phytochemical screening helps in the initial characterization of the plant's chemical composition, **Philipp, Blum. (2023).** which can then guide further research and development of potential biocide candidates from the plant The qualitative phytochemical tests provide information about the presence or absence of specific phytochemical classes, laying the foundation for quantitative analysis and isolation of individual compounds. **MARIANA, BASTOS. (2022).**

Figure 5**: phytochemical screening test (original 2024)**

Tannins

To prepare tannins test a quantity of 1.5 g of dry plant material was placed in 10 ml of 80% methanol, stirred for stirred for 15 min and then filtered. A few drops of 1% ferric chloride (FeCl3) were added to the methanoic extract already prepared. the methanoic extract already prepared. In the presence of tannins, a blue-black coloration is observed.black coloration. **(Alilou et al., 2014).**

Saponosides

The preparation of saponosides test requires 1 g of plant powder and 100 ml of distilled water placed in an Erlenmeyer flask, placed in a boiling water bath and boiled for 30 min while stirring regularly. After cooling, the mixture is filtered and shaken manually for 15 seconds. The persistence of foam indicates the presence of saponosides **(Najjaa et al., 2011).**

Polyphenols

To identify polyphenols, we need 2 ml of the infusion, one drop of 2% alcoholic ferric chloride solution (FeCl3). The appearance of a more or less dark blue-black or green color is a sign of the presence of polyphenol *lavandula stoechas* **(Alilou, H. et al., 2014).**

Glycosides:

The preparation of glycosides test requires to mix a few drops of H2SO4 with 2g of plant powder. The formation of a brick red then violet indicates the presence of glycosides **(Dohou et al., 2003).**

Lenco-anthocyanins;

A red colour develops in the presence of Leuco-anthocyanins after we Add 2g of plant powder to 20 ml of a mixture of propanol/hydrochloric acid (v/v), and heating the mixture in a boiling water bath for a few minutes. **(Najjaa et al., 2011).**

Irridoides

Their detection consists in treating 2ml of infusate in a beaker, with a few drops of; HCL, then heat using a hot plate. The formation of a blue colour indicates the presence of Irridoides **(karumi et al., 2004).**

Coumarins:

We can identify Coumarins by Boiling at reflux 2g of vegetable powder in 20 ml of ethyl alcohol for 15 minutes then filter, to 5 ml of filtrate add 10 drops of 10% KOH alcoholic solution, and a few drops of HCL to 10% (Appendix 02). The formation of a cloud indicates the presence of coumarins. **((Dohou et al.,2003).**

starches:

the preparation of starches test we Add a few drops of iodine (l2) to 2g of plant powder to form a violet-blue color, indicating the presence starches (**karumi et al., 2004).**

Mucilages:

The Identification of Mucilages In a beaker, starts by adding 1 ml of infused liquid and add 5 ml of absolute alcohol, stirred for 10 minutes.The appearance of a flaky precipitate indicates the presence of mucilage**. (karumi et al., 2004).**

4. Biological material

4.1. Plant Material

The plant parts used for the preparation of aqueous extracts are lavender flowers.

The plant was collected in 2024 from (mchedallah) Bouira located in northern Algeria

36° 21′ 59.98″ N, 3° 52′ 59.99″ E.

4.2. Collection and Identification of Plant Material

Several outings were organized during the year 2024 in different regions of Bouira, in search of wild lavender plants collected from the Upper Tell Atlas area "Bouira". The collected samples were identified by myself and the laboratory team of the Faculty of agronomy in Bouira, Under suoervision of dr mabdoua samira referring to the systematic floristic manual**.(Fennane et al., 2007).**

4.3 Fungal Material

I was provided with isolates of Colletotrichum sp. and Phoma by Ms. Mabdoua, a member of the Plant Protection Laboratory **(bouira)** The isolates were initially isolated from citrus fruits. After purification and identification, the isolates were preserved on PDA. Before use, they were re-cultured on PDA.

4.4 Macroscopic and microscopic identification of isolates

According to **(BOTTONET et al., 1990),** the identification of fungi relies mainly on two methods: the observation of cultural characters, also known as macroscopic identification, and the examination of their morphology under the microscope, known as microscopic identification. Macroscopic identification is carried out with the naked eye, based on a number of distinctive features. These include observation of morphological appearance, pigmentation, colony color, growth rate, mycelial texture, colony reverse color, as well as fungal odor and color **(BOTTONET et al., 1990).**

For microscopic identification, we use the scotch-tape method. A drop of Methylene Blue is placed on a glass slide, then the mycelium is removed directly from the Petri dish using a piece of transparent tape. This piece of tape is then placed on the glass slide for microscopic observation, using x40 and x100 objectives **(BOTTONET et al., 1990).**

5 Methodes

5.1 Defenition of Plant water extract:

Plant water extract can be defined as a liquid solution derived from the process of immersing or heating plant matter (such as leaves, stems, flowers, or roots) in water to separate and obtain their various bioactive components. **(J.B. Harborne)** This particular technique enables the extraction of a diverse array of advantageous phytochemical substances, which may encompass alkaloids, flavonoids, tannins, and essential oils, contingent upon the specific botanical species utilized for the extraction process. The utilization of plant water extracts is prevalent in a variety of applications, including traditional medicinal practices, herbal treatments, and as organic agents for pest control or soil enrichment within the realm of agricultural practices. **Bancha, Yingngam. (2022).**

5.2Defenition of hydrethanolic extract:

Hydroethanolic extract is frequently derived from botanical material *lavandula stoechas* through a variety of extraction methodologies like maceration, soxhlet extraction, microwave, ultrasound, and other advanced approaches**. (Salhi, 2012)** The extraction procedure entail *lavandula stoechas* briefly exposing ground plant material to a solvent such as methanol, ethanol, or other alcohols, regulating solubility through solvent temperature adjustments, and exerting a force to expedite solvent permeation through the plant substance.

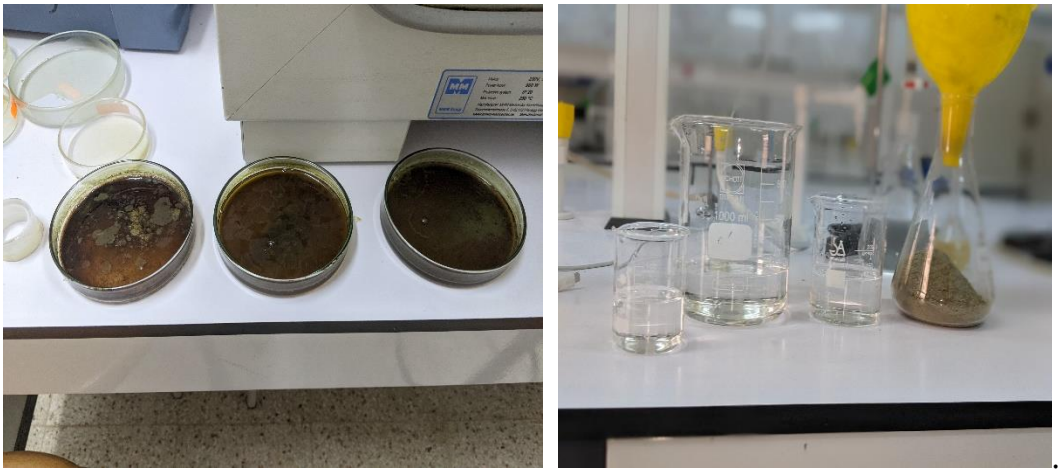

Figure 6**: preparation of hydroethanolic extract (original 2024)**

5.3Definition of essential oil:

Essential oils with a distinct attribute (comprising chemical characteristics and physiological effects) are commonly derived from a singular botanical origin when the maturity of the flora, the weather conditions, and the soil composition and collection time are closely similar **(Sirousmehr A , Arbabi J 2014)** EOs are comprised of terpenes, terpenoids, and aromatic compounds as primary constituents, in addition to minor components which collectively determine their biological activity These oil *lavandula stoechas* are categorized into oxygenated compounds (esters, aldehydes, ketones, alcohols, phenols, and oxides) and hydrocarbons (monoterpenes, sesquiterpenes, and diterpenes). Typically containing 20 to 60 compounds, EOs comprise both volatile and nonvolatile elements, with the volatile compounds dominating the mixture. The chemical makeup of EOs varies significantly depending on factors such as plant species, geographical location, and growth stage, all of which impact their therapeutic potential and applications across various industries. Despite their complex nature, EOs have become increasingly popular due to their versatile bioactivity, which has spurred research efforts aimed at unraveling their chemistry and investigating their pharmacological properties. Essential oils (EOs) are clear, seldom pigmented, and capable of being dissolved in nonpolar or slightly polar organic solvents. They typically possess a lower density (less dense) than water, with minimal deviations from this characteristic**. (Gupta V 2010).**

Figure 7**: preparation of essential oil (original 2024)**

5.3.1 The hydroethanolic extraction

The extraction was carried out in the laboratories of the Faculty of Agronomic Sciences of the Akli Mohand Oulhadj University (Bouira). The extraction stage is crucial in the process of analysing and identifying bioactive molecules. Typically, natural products are extracted using the solid-liquid principle, as outlined by **MENDIOLA et al (2007).** In order to extract the active ingredients from the plant tested, a solid/liquid type extraction (maceration and ultrasound-assisted extraction) was carried out using pure ethanol solvent.

5.3.2Extraction by maceration

Ethanol extraction was carried out according to the protocol of **RAJA (2012),** with a few modifications. 40 g of powder from each sample was macerated in 400 ml of 96% pure ethanol in a sterile Erlenmeyer flask lined with aluminium foil. The mixture was mechanically stirred at room temperature for 24 hours. At the end of maceration, filtration was carried out using Whatman filter paper to separate the solid from the liquid. The solutions obtained were then evaporated in an oven at 40°C, and the pure extract was collected in Eppendorf tubes and stored at 4°C until use.

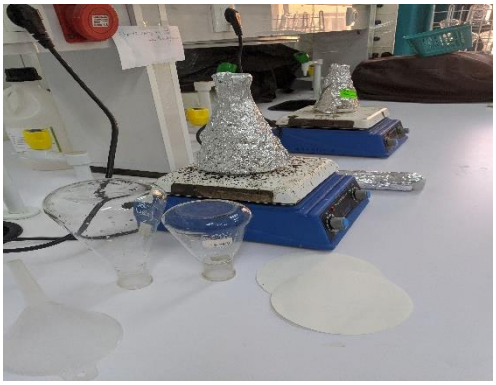

Figure 8**: hydroethanolic extraction method for Lavandula stoechas (original 2024)**

5.3.3 Determination of moisture content

The moisture content of the plants was determined by the oven-drying process at 120°C **(Twidwell et al., 2002).** For *Lavandula stoechas*, 40 g of fresh material was oven-dried for one hour, with three replicates were carried out for each sample, the average of which would represent the moisture content.

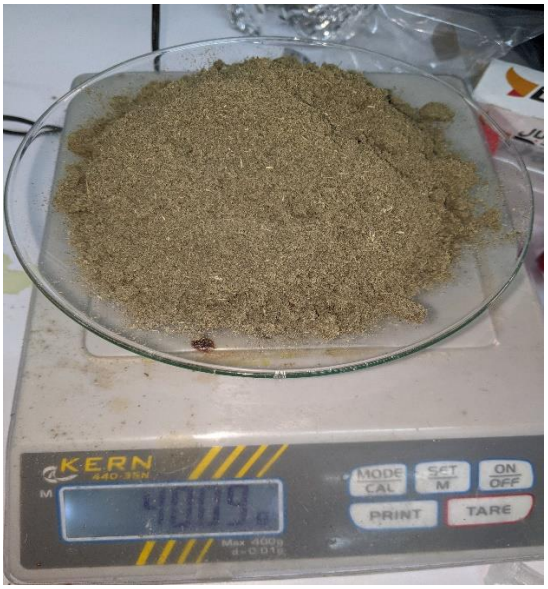

Figure 9**: Determination of moisture content (original 2024)**

5.3.4 Preparation of aqueous extracts

To prepare the aqueous extracts we must use Infused, decocted and macerated extract that were prepared according to the method adopted by **Sqalli and al (2007),** using 10 g of powder per 100 ml of water The yield of the different extract is calculated by the formula:

Yield ext % = M ext /M ech × 100, where

M ext: Mass of extract after solvent evaporation in g

M ech: Mass of plant sample in g

Figure 10**: Preparation of aqueous extracts (original 2024)**

5.3.5 Essential oils

Essential oils were extracted by hydro distillation using a Clevenger-type apparatus **(Clevenger, 1928).** Distillation was carried out in a flask, by boiling for four hours 40 g of fresh plant material with 400 ml of distilled water., where: $\text{EO yield} = \frac{M'}{M} \times 100$

M': Mass of essential oil obtained in g

M: Mass of plant material used in g.

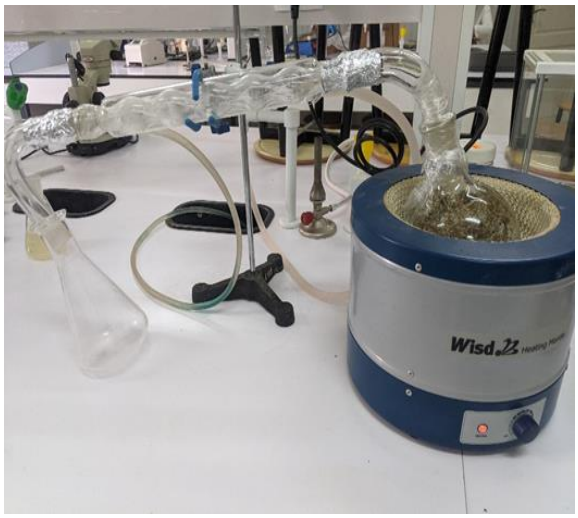

Figure 11**: Essential oil avandula stoechas Extraction (original 2024)**

Essential oil Extraction yield

Extraction yield is expressed as a percentage of the weight of dry starting material. It is determined by the following equation:

$$\text{Yield } (\%) = \frac{\text{M ext dry}}{\text{M ext}} \text{ X } 100$$

M ext : mass of extract before evaporation (in g).

M ext dry: the mass of extract after evaporation (in g).

5.3.4 Preparation of culture medium

Nutritional requirements vary from one microorganism to another and this determines the culture medium for each of them. PDA (potato dextrose-agar medium) has been used for the growth of fungi **(RAPPILY, 1968).**

Commercial PDA was prepared by first calculating the amount needed for 150 ml, which is equivalent to 5.85 g of PDA powder. Then 150 ml of distilled water was mixed in suitable flasks. The culture medium was sterilized in an autoclave at 121°C for two hours. The vial *lavandula stoechas* are then allowed to cool to room temperature. Pour the mixture into Petri dishes with a sterilized lid.

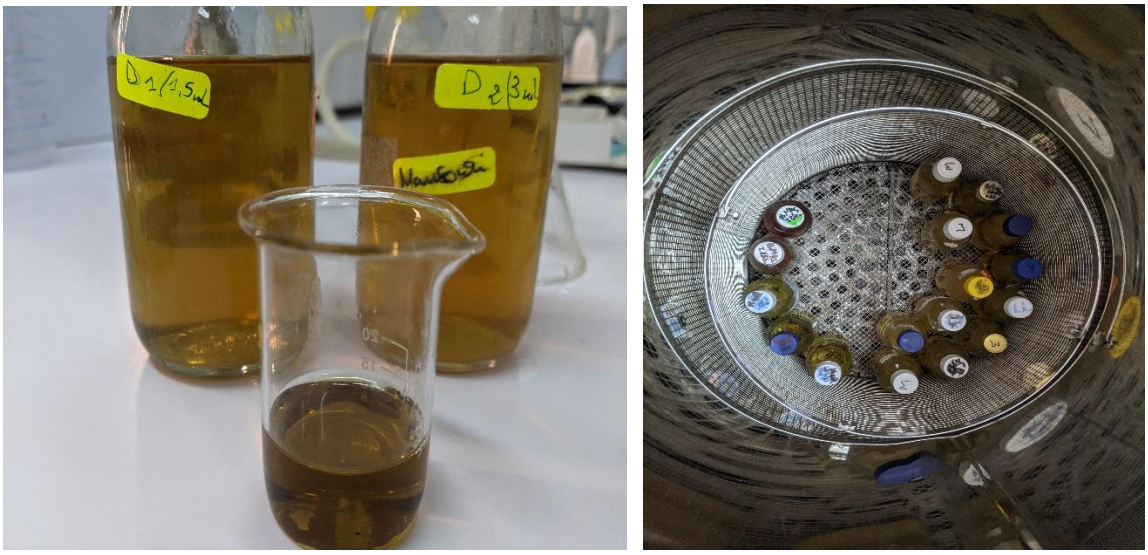

Figure 12**: Preparation of culture medium (original 2024)**

5.3.5 Transplanting and purification

To obtain pure strains, each developed strain is seeded into the center of a petri dish containing PDA medium using a sterile Pasteur pipette. The incubation process is carried out for 10 days at 27°C, and then the code and date of each strain are written on each petri dish. This method is repeated until pure colonies are obtained **(BOTTONET al., 1990).**

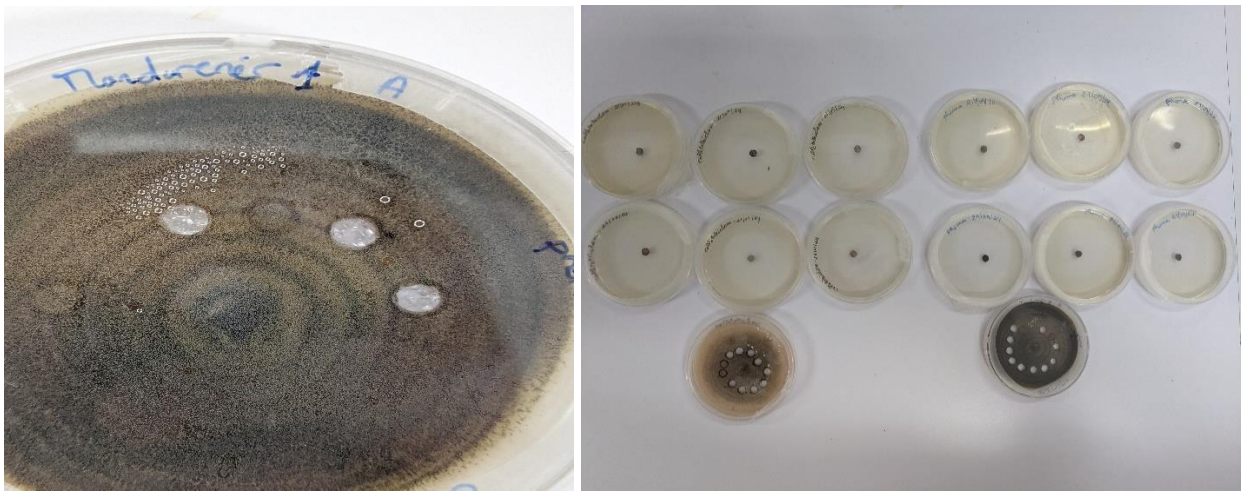

Figure 13**: Transplanting and purification (original 2024)**

5.3.6 Preparation of dilutions of the extracts

essential oil extracts were dissolved in dimethyl sulfoxide (DMSO) and which has been shown to have no observable effect on microbial organisms.

A concentration of 100 mg/ml was prepared for each extract used. Dilutions of the extracts were then made and analyzed using the following methods **(Rowe et al., 2009)**

- SS: 400 mg of extract with 4 ml of DMSO [100%]. For hydroethanolic extract
- SS :1g of essential oil with 10 ml of DMSO [100%]. For essential oil extract
- D1: 0,75 ml of SS extract with 0.25 ml of DMSO [75%].
- D2: 0.5 ml of SS extract with 0.5 ml of DMSO [50%].
- D3: 0.25 ml of SS extract with 0.75 ml of DMSO [25%].

Same methode was adopted for the water extracts with replacing the DMSO with desttilled water

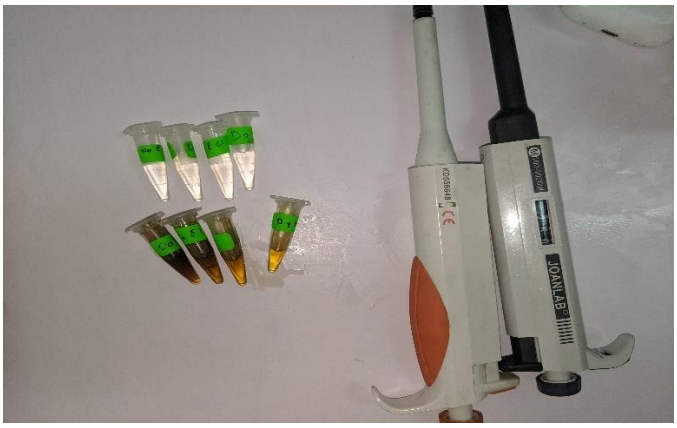

Figure 14**: Preparation of dilutions of the extracts (original 2024)**

5.3.7 Disk deposition and extract injection

The disk diffusion method is a widely used technique for evaluating the antimicrobial activity of plant extracts and other compounds. In this method, sterile paper disks impregnated with the test substance are placed on agar plates inoculated with the target microorganisms. The test substance diffuses from the disk into the agar, creating a concentration gradient. If the test substance is effective against the microorganism, a clear zone of inhibition will form around the disk where microbial growth is prevented.

Using sterilized tweezers with a flame, 6 mm diameter Whatman paper discs were gently placed on the surface of PDA agar. Then, 10 µL of each dilution of the different extracts (SS/D1/D2/D3) was added to the disks using tweezers. DMSO alone was also added without any dosage to the witness disc**. Smith, A. B., & Johnson, C. D. (2020).**

5.3.8 Reproducing fungal strains

In the experiment described, the researchers aimed to reproduce fungal strains and assess their interactions with aromatogram discs under controlled conditions. The mane steps are Preparation of Petri dishes containing Potato Dextrose Agar (PDA) medium. Aseptically placing a 5 mm-diameter disc from a prepared fungal culture in the center of the PDA-containing Petri dish. Placing aromatogram discs (containing plant extracts) around the central fungal disc on the agar plate. Repeating the experiment three times for each treatment, using different concentrations of the aromatogram discs. Sealing the Petri dishes with plastic film to maintain sterile conditions. Incubating the inoculated Petri dishes at 28°C for 7 days. **Brown, R. T., & Green, M. L. (2018**) all of the working experience was within fume hood all the time.

Figure 15**: Reproducing fungal strains (original 2024)**

Part three

Results and discussion

Results and discussion

1. phytochemical screening results

The qualitative chemical analysis tests offer insights into the existence or lack of certain chemical groups, establishing the groundwork for quantitative examination and separation of distinct substances. The subsequent assessment of chemical components through screening tests

showcases the constituents. The results of the chemical characterization are classified according to the different observation criteria we have as follows:

+++: Positive reaction; ++: Moderately positive reaction; -: Negative reaction

Table 1:**phytochemical screening results**

Phytochemicals	Lavandula stoechas
Polyphenols	**+++**
Terpenoids	**-**
Saponosids	**-**
Coumarins	**-**
Free quinones	**-**
Tannins	**+++**
Glucosides	**+++**
Anthocyanins	**+++**
Leuco anthocyanins	**-**
Mucilage	**+**
Starch	**-**
Irridoides	**++**
Anthraquinones	**-**

phytochemical screening results

the analysis of *Lavandula stoechas* reveals a notable concentration of polyphenols, glucosides, and mucilage, along with a moderate level of tannins and iridoides.

Absence of terpenoids, saponosids, coumarins, free quinones, leuco anthocyanins, starch, and anthraquinones is observed. A high abundance of anthocyanins is particularly noted in an alkaline environment. These findings suggest that *Lavandula stoechas* harbors substantial quantities of polyphenols and glucosides, recognized for their antioxidative characteristics. The

presence of tannins hints at potential astringent attributes, while iridoides may contribute to anti-inflammatory and antimicrobial effects. The non-existence of various other phytochemicals may limit the potential applications of the plant to those associated with its identified compounds.

2.Comparison of Phytochemical Profiles across Different Lavandula Species

The phytochemical examination of *Lavandula stoechas* illustrates a remarkable concentration of polyphenols, glucosides, and mucilage, accompanied by a moderate level of tannins and iridoids. Nevertheless, the lack of terpenoids, saponins, coumarins, free quinones, leucoanthocyanins, starch, and anthraquinones is noted. A substantial presence of anthocyanins is especially highlighted in an alkaline setting. These results indicate that *Lavandula stoechas* contains significant amounts of polyphenols and glucosides, acknowledged for their antioxidative properties. The existence of tannins suggests potential astringent qualities, while iridoids could contribute to anti-inflammatory and antimicrobial effects. The absence of various other phytochemicals may restrict the potential uses of the plant to those linked with its identified compounds. When juxtaposed with other Lavandula varieties, certain resemblances and disparities become apparent.

Zengin, G., Aumeeruddy, M. Z., Mahomoodally, M. F., & Sarikurkcu, C. (2019)

Lavandula angustifolia (English lavender) is recognized for its flavonoids, tannins, and coumarins, which are either missing or found in lower levels in *Lavandula stoechas* Lavandula dentata has been shown to generate flavonoids and tannins Lavandula luisieri (Lusitanian lavender) has been documented to contain phenolic acids, flavonoids, and iridoids, which are also evident in *Lavandula stoechas*. Lavandula viridis (green lavender) has been identified to produce iridoids, a feature also found in *Lavandula stoechas***. Figueiredo, A. C., Barroso, J. G., Pedro, L. G., & Scheffer, J. J. (2008).**

3. extracts Yield

3.1 aqueous extracts Yield

After calculating the extraction yield according to the formula given previously in section Material and methods. The results of the dry crude extracts obtained are shown in the following

form: The Initial weight of fresh material (before drying) was 40 g and the Weight after drying it was 35 g to calculate the yield, we can use the following formula:

Yield % = M ext /M ech × 100, where: $\text{Yield } (\%) = \frac{(40\text{ g} - 35\text{ g})}{40\text{ g}} \times 100 = 12.5\%$

Therefore, the Yield of the *Lavandula stoechas* sample is 12.5%That indicates the efficiency of the aqueous extraction method in extracting the desired compounds from the plant material. A higher yield would suggest a more efficient extraction process. **Johnson, Lawerance, Lincoln. (2020).** The yield can be used to compare the performance of different extraction methods or to optimize the extraction conditions to obtain a higher yield of the desired compounds. **Lubenova. (2010).**

3.2. essential oil Yield

We obtained the oil essential yield by following the formula shown on pervious part The yield of the essential oil was calculated using the formula:

EO yield (%) = (M' / M) × 100 Therefor: $\text{EO yield } (\%) = \frac{1\text{ g}}{40\text{ g}} \times 100 = 2.5\%$

So, the essential oil yield is 2.5% of the dry plant material. The yield *Lavandula stoechas* essential oil calculated on the basis of fresh plant mass is 2.5%. This quantity is considerable compared to other values obtained on the same plant species with essential oil yields varying between 1% and 2.5% **(Brieskorn, 1991).**

The Variations in yield can be attributed not only to the geographical origin of the plant to the geographical origin of the plant, the type (dry or fresh) and the extraction technique, but also to the harvesting period. the time of harvesting of the plant material, as well as environmental and climatic factors climatic factors **(Burt, 2003).**

3.3. hydroethanoic extract Yield

The formula to calculate the yield is: Yield (%) = (M ext / M ech) × 100 Where Mass of extract after solvent evaporation = 8g and = Mass of plant sample = 40 g

The ethanolic extract yield of 20% means that for every 100 grams of dried plant material used in the extraction process, 20 grams of extract were obtained after solvent evaporation. This yield can be interpreted as follows:

1/Extraction efficiency: The 20% yield indicates that the ethanolic extraction method was able to extract and recover 20% of the total extractable compounds present in the plant material. A higher yield would suggest a more efficient extraction process.

2/Concentration of bioactive compounds: Assuming the extracted compounds have biological activity, the 20% yield provides an estimate of the concentration of these compounds in the plant material. a higher yield may indicate a higher concentration of bioactive compounds. **Bolouri, A., et al. (2022).**

4.In vitro" evaluation of the effectiveness of different extracts of *lavandula stoechas* on Phoma and Colletotrichum

The experiment described in this query focuses on evaluating the antifungal activity of various biofungicidal agents against two important plant pathogenic fungi, Phoma and Colletotrichum, using the disk diffusion method.

Fungal Cultures the Petri dishes used in this experiment contain fungal cultures of Phoma and Colletotrichum species. These are known to be significant plant pathogens that can cause diseases in a wide range of agricultural crops.

Biofungicidal Agent Doses The experiment utilizes a series of discs labeled from dose 0 to dose 3, representing different concentrations of the bio fungicidal agents being tested. Dose 0 corresponds to the highest concentration, while dose 3 represents the lowest concentration. Additionally, a witness disc (T) is included as a control.

Extraction Methods Three different extraction methods were used to prepare the bio fungicidal agents: Hydroethanoic Extract (**EOH** or similar) Essential Oil (**EO** or similar) Water Extract (**WE** or similar) The use of these diverse extraction methods aims to capture the potential antifungal properties of different classes of compounds present in the plant materials.

Figure 16**: the effectiveness of the different extracts (original 2024)**

5.disscution

after several observations we noted that phoma progresses very poorly when treated with **EO** and **EH** However, when treated with **WE** we observe that it grows to discs the inhibition zones is larger at higher concentrations of **WE**. These results do not include Colletotrichum where treatment with **WE** was more effective compared to phoma moreover, when treated with **EO** and **EH** we note a normal development to it this raises the question of colletotrichum's resistance to biopesticides.

6.Comparison with Other Research

1/Phoma:

A research conducted by **Sharma et al. (2017)** revealed that Phoma was prone to essential oils, with clove oil displaying the highest antifungal properties. **Katooli et al. (2012)** observed that

Phoma was suppressed by watery extracts of different plants, with garlic extract proving to be the most efficient.

2/Colletotrichum:

Alvindia (2013) illustrated that Colletotrichum exhibited resilience to various botanical extracts, such as neem, garlic, and ginger.**Bautista-Baños et al. (2014)** stated that Colletotrichum displayed decreased sensitivity to essential oils in comparison to other fungal pathogens.

In general, the presence of the chemical families detected for Lavandula stoechas in our study is confirmed by the work of **Baptista et al,** concerning polyphenols and flavonoids , by **Ezzoubi et al** for tannins, catechic tannins, Flavonoids and sterols Teixeira et al for polyphenols, flavonoids and terpenes **Jeffrey et al** These results are comparable to those obtained in studies on Lavandula officinalis by **Shafaghat et al** ,who confirmed the presence of tannins, flavonoids, the same on Lavandula dentata and Lavandula angustifolia by **Abdelhady et al** which marked the presence of polyphenols. The phytochemical study carried out for this plant demonstrates results which are validated by other research substantiated the presence of specific chemical groupings, and the nonexistence of other groupings can be accounted for by a difference at the level of several geographic, physicochemical or biological parameters such as; The difference of the harvesting site including the environment of the plant or the genetic aspect between the plants or alterations at the level of the genes for a genetic adjustment.

7.Implications

Several studies have evaluated the antifungal activity of *Lavandula stoechas* essential oils and confirmed the presence of antifungal activity against filamentous fungi (Colletotrichum and phoma tracheiphilia) **Benabdelkader et al**. Similarly, Lavandula stoechas essential oils tested on filamentous fungi and molds had antifungal activity on various strains of clinical origin and on clinical dermatophytes with inhibition zones between 0.32 µl/ml and 5 µl/ml **[Zuzarte 2013].** *Lavandula stoechas* essential oils also demonstrated antifungal activity against Rhizoctonia solani and Fusarium oxysporum, but had less effect on Aspergillus flavus (Angioni et al. 2006) The antifungal activity of *Lavandula stoechas* essential oils has been reported to be specifically related to the presence of antifungal compounds such as camphor, 1,6-cineole, and fenchone, and the synergistic effect of the major and minor constituents of this oil.

The varying reaction of Phoma and Colletotrichum to biopesticides implies that their susceptibility fluctuates based on the specific pathogen and the nature of the extract utilized.The insusceptibility of Colletotrichum to biopesticides emphasizes the necessity for additional investigation to formulate more potent control tactics considering the doses that we made my not be efficient comparing with other dosses applied on other plants or we can simply say that the fungus resistance against the doses of *lavandula stoechas* components or the methodes are not essentially efficient and does not develop am adaptation either with type of extract or with fungus we can say as well that maybe the time length needed so a reaction could happen between fungus and extracts is not enough so the active molecules did not engage due to evaporation or other conditions.

8.Conclusion

In ending this examination provides valuable insights into the distinctive reactions of plant pathogens to various biocides. These conclusions highlight that biocides can be considered effective alternative solutions to chemical pesticides, thus avoiding the harm the latter cause to

human health and the ecosystem. Therefore, this field requires further exploration to uncover the mechanisms underlying the resilience of pathogens and to devise more effective and sustainable control measures for these economically significant fungal pathogens.

furthermore, the comparative examination of the reactions of phoma and Colletotrichum to various biopesticides, encompassing essential oils, ethanol extracts and water extracts uncovered some intriguing observations: phoma exhibited substandard growth when subjected to essential oils, ethanol extracts and water (**EO**), but thrived when exposed to water extracts (**WE**). The areas of restriction were more extensive when utilizing higher concentrations of **WE**, signifying the effectiveness of the aqueous extract against this pathogen. On the contrary, Colletotrichum demonstrated a dissimilar reaction. When managed with **WE**, it displayed greater sensitivity in comparison to phoma. Nevertheless, when treated with **EO** and **HE**, Colletotrichum displayed typical growth, indicating resilience to these agents. The distinct reaction of these two pathogens prompts inquiries about their resilience mechanisms. Colletotrichum's resilience to biopesticides underscores the necessity for additional investigation to formulate more potent control tactics. Correlation with alternative investigations corroborates these discoveries. phoma has been documented to be prone to essential oils and aqueous extracts, whereas Colletotrichum displayed resilience to diverse plant extracts and essential oils. The outcomes underscore the significance of comprehending the specific susceptibility of each pathogen to distinct biopesticides. uniform approach may prove ineffective and tailored control methodologies are indispensable.

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