Phytochemical screening and Antimicrobial activity of leaves of *Senna siamea*

By

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A thesis submitted to the School of Pharmacy in partial fulfillment of the requirements for the degree of Bachelor of Pharmacy (B. Pharm.)

School of Pharmacy
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Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

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Approval

The project titled "Phytochemical screening and antimicrobial activity of leaves of *Senna siamea"* submitted by Elma-Tun-Nisa (20146067) of Spring, 2021 has been accepted as satisfactory in partial fulfillment of the requirement of the degree of Bachelor of Pharmacy (Hons.) on May, 2025.

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Ethics Statement:

The study doesn't include any kind of animal or human trial.

Abstract:

Numerous medicinal plants have long been used in traditional medicine to treat a range of illnesses. The phytochemical components of medicinal plants and their biological properties, such as their antibacterial properties, have recently piqued the interest of numerous researchers.The present study was conducted to check the phytochemicals and antimicrobial activity of methanolic extract of *Senna siamea* leaf (SSLM). The standard phytochemical screening methods were utilized to investigate the presence of bioactive components, whereas the disk diffusion method was used to observe the antimicrobial activity of SSLM. During the qualitative phytochemical screening, several chemical compounds were found, including alkaloids, steroids, flavonoids, terpenoids, tannins, phenols and resins which have a variety of biological actions (e.g. anti-inflammatory, anticancer) rendering them beneficial for therapeutic purposes. Antimicrobial activity was assessed against two gram- positive bacteria and three gram-negative bacteria. SSLM showed smaller 'zone of inhibition' against *Escherichia coli, Klebsiella pneumoniae , Pseudomonas aeruginosa, Bacillus subtilis, Bacillus cereus.* Even though the experimental extract exhibited antibacterial activities, it has not been confirmed which bioactive components are accountable. Thus, our findings demonstrated that *S. siamea* leaf has antimicrobial properties. The study's encouraging results may also offer a foundation for future research in the development of novel drugs and antimicrobial agents.

Keywords: *Senna siamea*, phytochemical components, antibacterial activity, Methanol, Bioactive components.

Dedication:

This work is dedicated to my parents for their steadfast encouragement and unquestioning faith in me.

Acknowledgement

First and foremost, I want to express my gratitude to Almighty Allah for his unending blessings to me.

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List of Acronyms

WHO - World Health Organization.

AYUSH - Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homoeopathy.

S. siamea - Senna siamea.

ICDDR,B - International Centre for Diarrhoeal Disease Research, Bangladesh.

Chapter 1

Introduction

1.1 Background

Historically, medicinal plants have been an important source of compounds with potential therapeutic uses. They are still a great resource for the creation of new drugs. Plants' medicinal qualities are mostly due to the presence of active primary metabolites. Medicinal plants continue to be a major source of new therapeutic leads, but their scientific validation is still lacking due to a lack of adequate plant material, the selection and application of appropriate high-throughput screening biological assays, approval from regulatory bodies, and clinical trials. Although natural product-based drug discovery is inherently complex and requires coordinated research and protocols, the most recent scientific methodologies, systematic studies, as well as regulatory approvals, scientific advancements have made it apparent that plant-based products will be important future sources of novel therapeutic compounds(Miranda,2021).

In herbalism, the word "medicinal plant" refers to a wide variety of plants, which are used for their therapeutic benefits to cure or alleviate a variety of illnesses.The application of plants as medicine along with the research into these applications. The word "herb" comes from the Latin word "herb" and the Old French word "herb." People have been using plants for medicinal purposes since prehistoric times. Herbs are mentioned in ancient Greek writings, Egyptian papyri, and Chinese scriptures. There is evidence that medicinal herbs have been used for over 4000 years by Unani healers, Indian Vedas, European and Mediterranean cultures. In addition to indigenous civilisations like Rome, Egypt, Iran, Africa, and the Americas, other societies developed ancient medicinal systems like Unani, Ayurveda, and Chinese medicine that systematically used herbal therapy. In many different sectors, traditional medicine is still frequently used. Ancient civilisations acknowledged India's abundance of medicinal herbs. A large number of medicinal herbs, which are mostly gathered as raw materials for the manufacture of medications and aromatic items, are really primarily found in Indian woods. The AYUSH system in India codifies over 8,000 traditional remedies. These significant indigenous medical systems include Siddha, Ayurveda, Unani, as well as folk medicine. The most advanced and extensively used of these systems are Ayurveda along with Unani medicine.

The World Health Organisation (WHO) estimates that almost 80% of people worldwide rely on herbal remedies to meet some of their basic medical needs. The WHO estimates that some 21,000 plant genera have the potential to be used as medicines called medicinal plants. Approximately 75% of the world's population relies heavily on plants and their extracts for their medical requirements, according to the information currently available.Additionally, almost 30% of all plant species have at some point in their history been utilised medicinally.

In industrialised nations like the US, plant medicines may make up as much as 25% of all medications; in fast emerging nations like China and India, this percentage may reach 80%. Herbs were thought to be utilised to treat a variety of illnesses and health issues by ancient scholars. To get the correct conclusion on the effectiveness of different herbs, including their therapeutic capabilities, they have carried out a great deal of study and experiments. Most drugs manufactured in this manner have no adverse reactions or negative consequences. For this reason, herbal medicine is becoming more and more well-liked worldwide. This herbal remedy offers a cost-effective solution for a variety of inside illnesses that are typically thought to be incurable. Herbal plant treatments are thought to be quite safe because they rarely or never cause side effects. The main benefit of these medicines is that they are in tune with nature. The most crucial point is that anyone of any age or gender can use herbal medication (Vyshnavi N, 2021).

1.2 Medicinal Plants around the Globe:

The idea of medicinal plants is used in healthcare systems across the globe because of its many advantages.Since ancient times, medicinal plants have been utilized to treat illnesses. Medicinal plants are those that are utilised as the basis for herbal remedies. According to US Forest Service estimates, plants represent the source of 40% of Western pharmaceuticals. According to the current pharmacopoeia, seven thousand therapeutic chemicals come from plants. Modern science and traditional empirical knowledge are combined in herbal medicine. A medicinal plant is thought to be a significant source of disease resistance. Various plant sections are used to extract essential therapeutic components. People in developing nations substitute therapeutic herbs for pharmaceuticals. The world is home to many different kinds of plants. Among them are herbs, which come in a variety of forms, hues, and foliage. These herb species are hard for the average person to identify. Over 50,000 plants are used medicinally by people worldwide. In India, there are 8,000 medicinal plants with proven therapeutic benefits. A list of some medicinal plants around the world are mentioned below (Borkatulla et al. , 2023).

Scientific Name	Family
Averrhoa carambola L.	Oxalidaceae
Alocasia indica (Roxb.) Schott.	Araceae
Bauhinia purpurea L.	Fabaceae
Coccinia cordifolia Wight & Arn.	Cucurbitaceae

Curcuma angustifolia Roxb.	Zingiberaceae
Delonix regia (Boj. ex Hook.) Raf.	Fabaceae
Erythrina variegata L.	Fabaceae
Ficus racemose L.	Moraceae
Garcinia mangostana L.	Clusiaceae
Justicia gendarussa Burm. f.	Acanthaceae
Leucas aspera (Willd.) Link	Lamiaceae
Mangifera indica L.	Anacardiaceae
Moringa oleifera Lam.	Moringaceae
Sesbania grandiflora (L.) Poiret	Fabaceae
Swietenia macrophylla King.	Meliaceae
Terminalia chebula Retz.	Combretaceae

Table 1: List of some medicinal plants around the world (Islam et al. , 2018).

1.3 Medicinal Plants of Bangladesh:

Bangladesh, a South Asian nation located in a tropical region, has the ideal climate and geographic setting for the abundant and luscious production of several medicinal plant species.With many species used to cure from simple colds and coughs to more serious disorders including fever, diabetes, and skin diseases, medicinal plants are an important part of traditional healthcare in Bangladesh. Snake Bites are common in Bangladesh, as they are in other tropical Southeast Asian nations. Four regions of the Chittagong Hill Tracts were the site of an anthropological study on the medicinal herbs used by indigenous people and traditional healers to cure snakebites. In Bangladesh, traditional healers have been used 116 plant species from 48 plant families to treat snakebite. Apocynaceae (8 species), Caesalpiniaceae (7 species), Euphorbiaceae (6 species), and Fabaceae (10 species) are the most abundant families.Seventy percent of the plants are wild, while eighteen percent are cultivated. Some species are both wild and cultivated. *Rauvolfia serpentina, Allium cepa,* *Costus speciosus, Emblica officinalis, Aristolochia indica, Leucas aspera, Vitex negundo, Hemidesmus indicus, and Emblica officinalis* are the species that are most frequently cited in the research area (Kadir et al. ,2015).

Scientific name	Bengali name	Family
Abrus precatorius L.	Kunch, Rati	Fabaceae
Abelmoschus moschatus Medic.	Latakasturi	Malvaceae
Acacia farnesiana (L.) Willd., Vachellia	Belati babul, Gokul	Mimosaceae
Abroma augusta Linn. f.	Ulatkambal	Sterculiaceae

Table 2: List of medicinal plants commonly used in Bangladesh.

1.4 Parts of Plants Used in Medicine:

There are numerous components of plants that can have medicinal benefits, such as leaves, roots, bark, fruit, seeds, and flowers. Within a single plant, distinct active compounds may be found in its various sections. Therefore, a piece of a plant may be hazardous while another part of the same plant is beneficial. Bark, flowers, bulbs, leaves, gum, fruits, resin, rhizomes, roots, seeds, along with tubers can all have medicinal properties. In this study, we have used the leaves of a sample plant for identifying the presence of phytochemicals.

1.5 Phytochemical screening :

Phytochemical screening helps look for bioactive compounds that can be used to make useful drugs by determining the components of plant extracts and which one is more common than the others.Medicinal plants include bioactive compounds that are used to cure a range of human ailments. They are also essential for healing. The therapeutic properties of plant species are attributed to phytochemicals. One crucial step in determining the bioactive substances found in a specific medicinal plant is phytochemical screening.Phytochemical screening is the process of finding different classes of phytoconstituents present in different plant sections. The chemical compounds found naturally in plants are known as phytochemicals.Numerous chemical components, such as phenols, flavonoids, alkaloids, terpenoids, saponins, etc., are found in plants. In addition to being high in phytochemicals, plant-based nutraceuticals also improve wellbeing and lower health risks. Because they are effective against a variety of physiological risks, their use is steadily growing. Phytochemical screening helps identify the constituents of plant extracts and which ones are predominant. It also helps find bioactive compounds that can be supplemented in food. Plant sample collection, extract preparation, and qualitative phytochemical analysis are all steps in the phytochemical screening process (Wachira et al. , 2024).

1.6 Antimicrobial Activity Testing Using the Disk Diffusion Method:

One of the most adaptable susceptibility testing techniques in terms of the antimicrobial agents which can be examined is the disc diffusion method. Paper disk soaked in antimicrobial agents are placed on a lawn of bacteria that has been seeded on the surface of an agar medium. The plate is then incubated for a whole night, and either the existence or absence of a zone of inhibition surrounding the discs is measured.

In detail, A paper disk or tablet containing a predetermined dose of an antimicrobial agent is placed on the surface of an agar plate that has already been inoculated with a standardized inoculum of the microbe. This process is known as diffusion. Diffusing the medication creates a gradient of concentration that leads to the formation of 'zone of inhibition', wherein the concentration is sufficiently high to stop the growth of the injected bacterium. The widths of the inhibitory zones are divided into susceptibility groups based on frequently updated clinical breakpoints.nBased on often revised clinical breakpoints, the 'zone of inhibition' diameters are categorised into susceptibility groups.Agar , incubation circumstances , microorganisms (growth rate, inoculum density), and the drug (disc content, diffusion rate, activity against the tested isolate) are some of the variables that affect the zone diameters (Drieux et al. , 2008).

1.7 Introduction and Taxonomic classification of sample plant: *Senna siamea*

S. siamea is Known by several names as the kassod tree or, yellow cassia, or "malga" in Hausa (FS et al. . ,2018). S. siamea is native to southern India, Sri Lanka, Cambodia, Malaysia, Thailand, and Myanmar, but it has spread far over several Indian states and tropical African nations.In Philippine cities and towns, this shade tree is often found. In taungya systems, it has been utilized to reforest degraded agricultural land. For coffee, it can serve as a shade tree (Heinsleigh and Holaway, 1988).

kingdom: Plantae
Phylum: Tracheophyta
class: Magnoliopsida
Order: Fabales
Family: Fabaceae
Genus: *Senna*
Species: *Senna siamea* (Rojas, 2022)

Figure 1: Leaves of S. siamea. (H.S. ,2018)

1.8 Literature review

Regardless of the subspecies, the leaves, stems, roots, flowers, and seeds of S. siamea have been used to treat a wide range of illnesses, including malaria, a tropical endemic disease that has a high rate of morbidity and mortality. Most often, the leaves of the plant are used to make herbal remedies, especially by Asian and African populations. In Burkina Faso, a mixture of dried and fresh leaves boiled for 20 minutes in one litre of water is used as a body wash or throughout the day with lemon juice to treat malaria and liver issues. Senna siamea has been used to treat a variety of conditions, including dieresis, typhoid fever, diabetes, hypotension, insomnia, constipation, and asthma. The leaves and bark of the plants have been used locally as antimalarial medications. Senna siamea has long been used to treat jaundice, menstrual discomfort, typhoid fever, and abdominal pain by lowering blood sugar levels. In ethnomedicine, S. siamea is used as a laxative, blood purifier, and treatment for rhinitis, herpes, genitourinary, and digestive disorders. In traditional medicine, the fruit is used to prevent intestinal worms and prevent convulsions in children (FS et al. ,2018). As the concentration of *S. siamea* extracts increases, so do their anti-inflammatory and antioxidant properties. Research on the antibacterial activity of several leaf extracts from Senna siamea indicates that these extracts exhibit varying degrees of sensitivity and broad-spectrum antibacterial activity against the examined bacterial species (Ogunniran et al. , 2024).

1.9 Morphology of *Senna siamea* :

S. siamea is a medium-sized tree that seldom grows taller than 20 meters, generally between 10 and 12 meters, however it can occasionally reach 30 meters. It has a short bole with smooth, grey bark that is slightly fissured longitudinally, and a dense, spherical, evergreen crown (Heinsleigh and Holaway, 1988).The leaves are dark green, 3–7 cm long, and 12–20 mm broad. The midrib ends in a bristle. Several enormous pyramidal panicles up to 60 cm long are produced at the ends of branches with bright yellow flowers (Heinsleigh and Holaway, 1988).The anthers are subequal, faintly beaked, and 5-8 mm long; the filaments are uneven, with the lateral abaxial ones being 7–12 mm long and the others 2.5–5.5 mm. Each pod contains 20–30 seeds and is flat, 15–25 cm long, silky and ribbon-like when young, and brown when ripe. The seeds are 8 mm long, bean-shaped, and glossy dark brown. A kilogramme of seeds contains between 35,000 and 41,000 seeds (Sosef et al., 1998).

1.10 Ecology:

S. siamea is native to Cambodia, southern India, Malaysia, Sri Lanka, Thailand, and Myanmar, but it has spread far over several Indian states and tropical African nations. *Senna siamea* thrives in lowland tropical locations with a seasonal climate, while it may grow in a range of climates. Senna siamea thrives in a variety of climates, but it thrives in the lowland tropics with mean annual rainfall between 500 and 2800 mm (ideally about 1000 mm), mean lowest temperature of 20° C, and mean peak temperatures of 31° C.Only if its roots are linked to groundwater will it be able to flourish, and the dry season shouldn't last longer than four to eight months. It does not thrive at elevations above 1300 meters and is susceptible to cold and frost. It needs a lot of light.

1.11 Rational of this study

S. siamea is commonly known as ‘Minjiri’ in Bangladesh. *S. siamea* (Minjiri) is a fast-growing, promising tree species that is native to Bangladesh and is part of the plantation initiative. Even though both earlier and more current research showed that the plants included a large number of active phytochemical elements, the trees are still often used as lumber. In Bangladesh's healthcare system, research into these chemical compounds including their innate capacity to endure in abiotic and biotic harsh conditions can lead to the expansion of new medications as well as important therapeutic advancements. Investigating the presence of these phytochemical components and the antibacterial activity of *S. siamea* against both Gram-positive as well as Gram-negative bacteria were the primary objectives of this study.

1.12 Aim of the study

The purpose of this research is to seek out the phytochemical components and investigate Senna siamea's antibacterial activity.

1.13 Objective of the study

The objectives of this are

- To find out *Senna siamea's* phytochemical components.
- To assess *Senna siamea's* antimicrobial activity.
- To offer a foundation for future research in the development of novel drugs and antimicrobial agents.

Chapter 2

Materials and Methods

2.1 Preparation of plant extracts (*Senna siamea* leaf)

☐ **Collection and Identification of *S. siamea*:**

In October 2024, the leaves of a *Senna siamea* plant that was grown inside Sylhet Agricultural University in Sylhet, Bangladesh, were harvested. For identification and authentication, the aforementioned portion (leaf) of the plant was sent to the National Herbarium of Bangladesh (NHB), which is situated in Mirpur, Dhaka. They identified the leaf of *Senna siamea* and provided the ACCESSION NO. :JUH10267.

☐ **Preparation of the sample powder of the leaves of *S. siamea*:**

After being cleaned with fresh tap water, the leaves of *S. siamea* were allowed to air dry. After drying, the dried leaves were ground into a powder in an electric blender.Until they were needed, the samples in powder form were stored in a sterile bag.

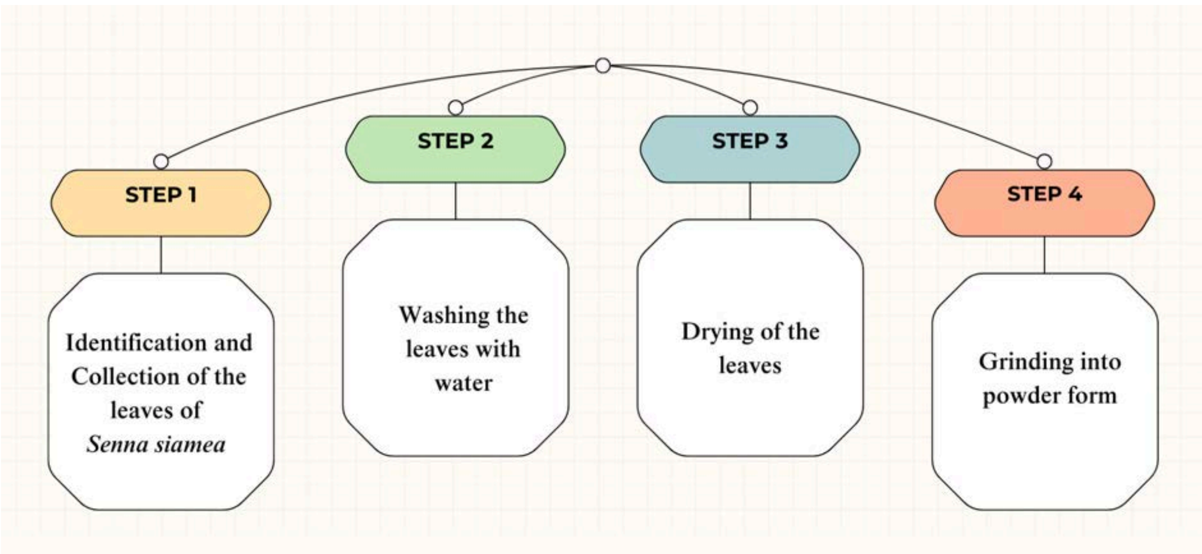

Figure 2: Preparation of the sample powder of S. siamea leaf.

☐ **Preparation of the extraction:**

1200 millilitres of methanol was used to extract 250 g of leaf powder of the sample plant, *S.siamea*. It was mixed and shaken occasionally while being left for two weeks.Following extraction, solid residues are eliminated by filtering the mixture first through a mesh screen and then through filter paper. After that, a rotary vacuum evaporator was used to concentrate the sample solution at 44.7°C. The resultant extract was stored until needed.

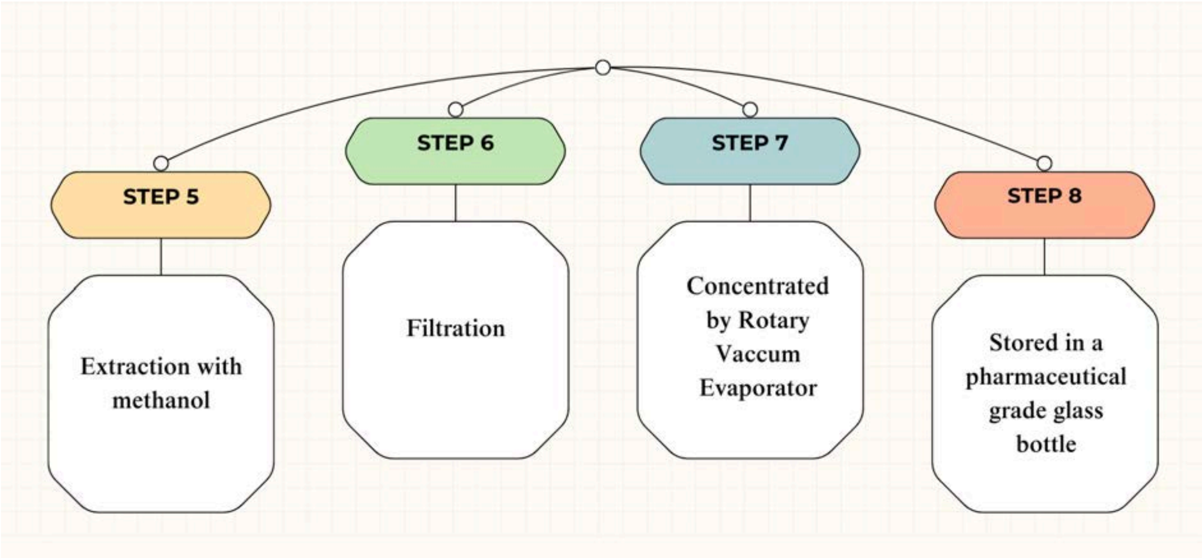

Figure 3: Preparation of the extraction of S. siamea leaf.

2.2 Phytochemical screening

The general approach of Harbone (1998) was used to perform a phytochemical analysis of the organic extract. Simple chemical assays were used for basic phytochemical screening in order to find secondary plant elements such alkaloids, tannins, flavonoids, saponins, steroids, phenols, glycoside, reducing sugar, and soluble carbohydrates in the sample.

Test for glycosides:
Keller-kilani Test : Two millilitres of glacial acetic acid containing one or two drops of a 2% FeCl3 solution were combined with crude extract. After that, the mixture was transferred to a second test tube that included two millilitres of concentrated H_2SO_4. The presence of cardiac glycosides was indicated by a brown ring at the interphase (Yadav et al. , 2011).

Test for alkaloids: Two millilitres of 1% HCl were combined with crude extract and heated gradually. The mixture was then supplemented with Mayer's and Wagner's reagents. The ensuing precipitate turbidity was seen as proof that alkaloids were present (Yadav et al. , 2011).

Test for terpenoids: Two millilitres of chloroform were used to dissolve the crude extract, which was then dried by evaporation. Two millilitres of concentrated H2SO4 were added, and the mixture was heated for approximately two minutes. Terpenoids were characterised by a greyish hue (Yadav et al. , 2011).

Test for steroid: Concentrated H_2SO_4 was incorporated sidewise to a mixture of crude extract and 2 millilitres of chloroform. Steroids were detected by the production of a red hue in the bottom chloroform layer.
Crude extract was combined with two millilitres of chloroform for an additional test. Next, two millilitres of strong acetic acid and H_2SO_4. were added to the mixture. Steroids were present because of their formation of a greenish tint (Yadav et al. , 2011).

Test for tannins: Crude extract was combined with two millilitres of a 2% FeCl3 solution. Tannin was indicated by a blue-green or black colouring
(Yadav et al. , 2011).

Test for flavonoids: Crude extract was combined with two millilitres of a 2% NaOH solution. When just a few drops of diluted acid were added, the strong yellow hue that had formed went colourless, indicating the presence of flavonoids (Yadav et al. , 2011).

Test for phenols: Crude extract was combined with two millilitres of a 2% FeCl3 solution. Phenol was indicated by a blue-green or black colouring (Yadav et al. , 2011).

Test for proteins: Crude extract when mixed with 2ml of Millon's reagent, white precipitate appeared which turned red upon gentle heating that confirmed the presence of protein (Yadav et al. , 2011).

Test for resin: 10 mL of distilled water was added to each plant extract, to which a few drops of 4% HCL were added. Appearance of turbidity in solution indicates presence of resin (Yadav et al. , 2011).

2.3 Antimicrobial Activity assessing

The Disk Diffusion Method was used to assess the antibacterial properties of S. siamea methanolic leaf extracts.

- ☐ **Microorganisms used for the test:**

To conduct the antimicrobial test, both gram-positive and gram-negative microorganisms were used.

Gram-Positive Bacteria	Gram-Negative Bacteria

B. subtilis BTCC 17 *B. cereus BTCC 19*	*E. coli (ATCC25922)* *K. pneumoniae CRL (ICDDR,B)* *P. aeruginosa (ATCC27853)*

Table 3: List of microorganisms used for the antimicrobial test of SSLM.

2.4 Procedure of antimicrobial activity test by Disk Diffusion Method.

Step 1:
The Mueller Hinton agar plates were taken out of the refrigerator. Before using, ensure that the medium's surface is dry and let it come to room temperature.The microbe that will be tested should be labelled on the agar plates.

Step 2:
Three to five comparable isolated colonies chosen from a non-selective agar plate that was left for 18 to 24 hours should be made into a direct broth suspension.The suspension should be adjusted to get a turbidity of 0.5 McFarland. As soon as the suspension is ready, the inoculum should ideally be added to the Mueller Hinton agar. Within fifteen minutes after preparation, the inoculum needs to be added to the Mueller Hinton agar.

Step 3:
Using a sterile cotton swab dipped in the 0.5 McFarland adjusted solution, inoculate the agar plates via the microbe.Repeatedly rotate the swab in the liquid, then press down hard on the tube's inner wall above the fluid level to drain the excess fluid.Finally, swab the agar's edge. A homogenous bacterial lawn culture will be created across the medium's surface using this injection technique.

Step 4:
Using an aseptic method, apply the antimicrobial discs to the inoculated agar plate's surface. The discs must be evenly spaced such that they are at least 24 millimetres apart, regardless of whether they are positioned separately or with a dispensing device. To prevent overlapping zones, position discs that generate consistently tiny zones next to those that generate bigger zones. Discs should not be positioned too near the plate's edge.To ensure full contact with the agar surface, press down on each disc. A disc should not be moved once it has made contact with the agar surface because the antimicrobial agents disperse nearly instantly.

Step 5:

Within 15 minutes of the discs being inserted, flip the plates over and put them in an incubator that is set to 35°C.The plates were incubated for 16 to 18 hours.

Step 6:

Holding sliding callipers or a ruler a few inches above a black, nonreflecting background that is lit by reflected light, the zones of inhibition were measured on the inverted Petri plate (Hardy Diagnostics,2024)

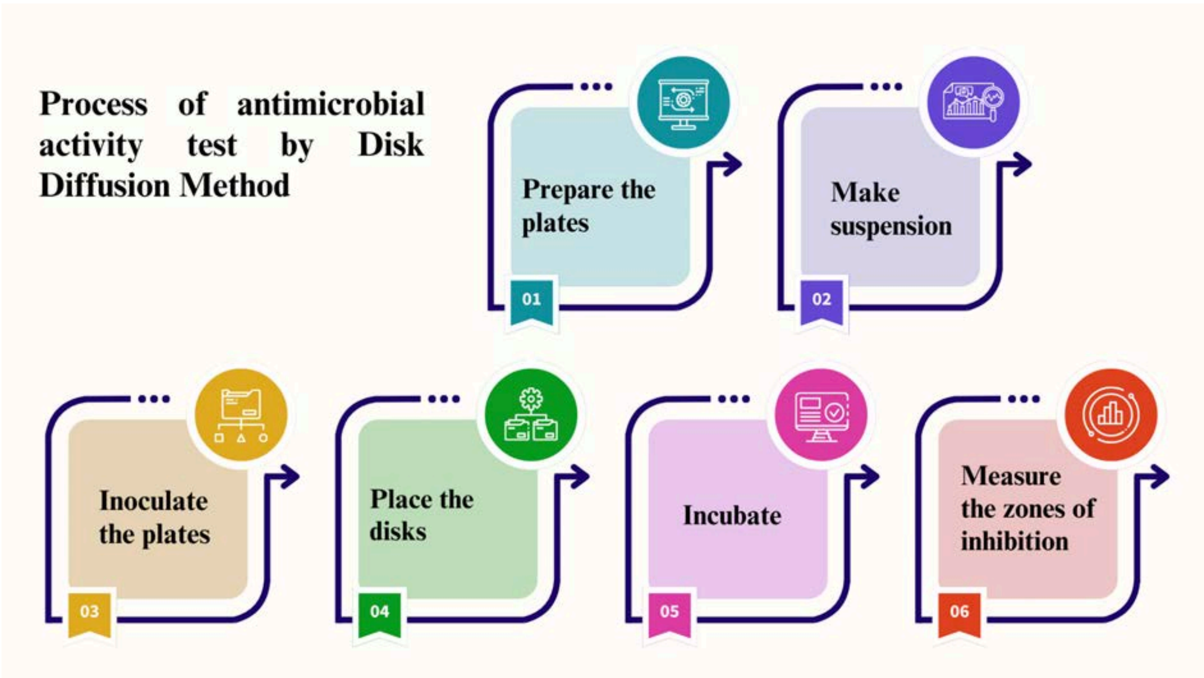

Figure 4: Procedure of antimicrobial activity test of SSLM.

Chapter 3

Result

3.1 Result of phytochemical screening

Here, SSLM has shown positive results for some bioactive compounds. Tannin, terpenoid, flavonoid, steroid, alkaloid, cardiac glycoside, phenol and resin have tested positive except protein.

Class of Compounds	Name of the Test	Present(+)/Absent(-)
Alkaloids	Wagner's Test Mayer's Test	+
Terpenoids		+
Phenols	Milon's Test	+
Tannins	Ferric Chloride Test	+
Flavonoids	Alkaline reagent Test	+
Glycoside	Keller-kilani Test	+
Protein	Millon's Test	-
Resin	Acetic Anhydride Test	+
Steroid	Lieberman-Burchard	+

Here, Present (+) and Absent(-).

Table 4: Result of Phytochemical Screening of SSLM.

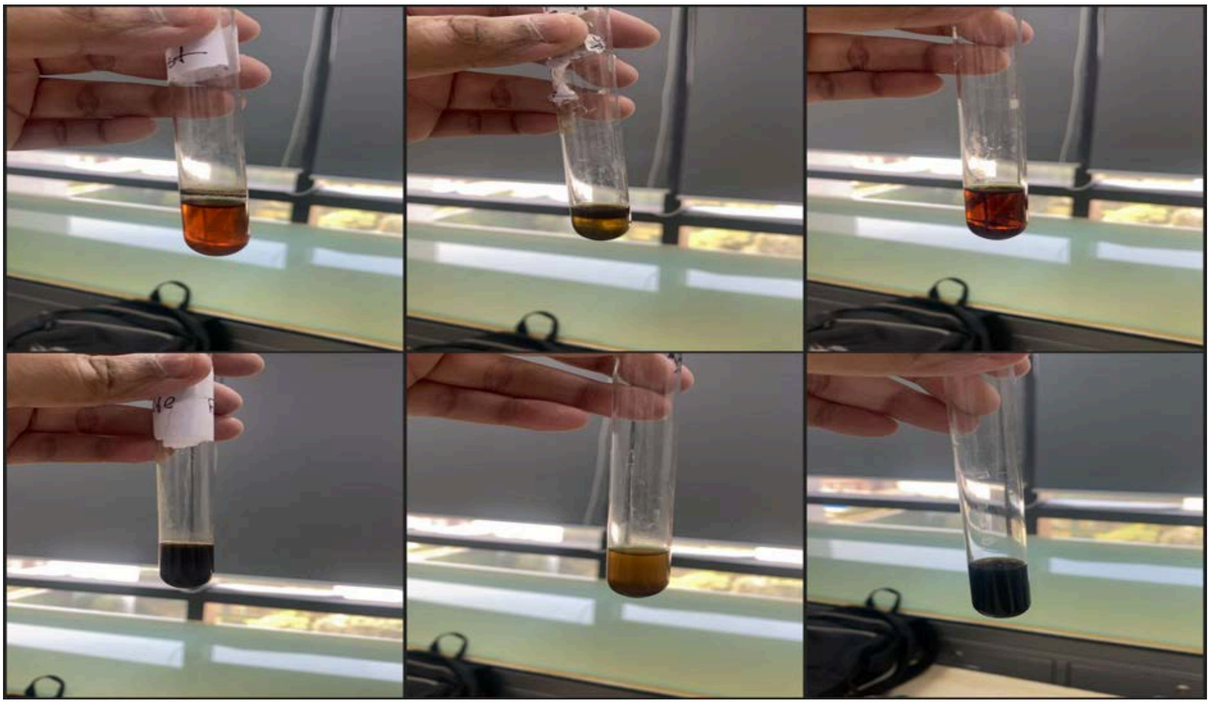

Figure 5: Phytochemical Test of SSLM.

3.2 Result of Antimicrobial activity Test

Here, SSLM has shown intermediate activity against some selected gram-positive and gram-negative bacteria.

Bacteria Strain	Zone of inhibition Kanamycin 30µg/Disk (mm)	Zone of inhibition of SSLM -1000 µg/Disk (mm)
E. coli (ATCC25922)	24.67±1.53	9±1
B. subtilis BTCC 17	26±1	10.67±1.53

K. pneumoniae CRL (ICDDR,B)	27.67±1.53	10±1
P. aeruginosa (ATCC27853)	26.33±1.53	9.33±2.52
B. cereus BTCC 19	24±1	8.33±1.53

Table 5: Result of Antimicrobial activity test of SSLM by disk diffusion method.

Chapter 4

Discussion:

Medicinal plants are significant for a variety of reasons, including their usage in folklore, which can inform the development of contemporary medicine, and their ability to treat illnesses.

Around the world, *S. siamea* is a medicinal herb that offers several therapeutic benefits. Table 4 displays the findings of the different phytochemical screening tests that were conducted during the study from leaves of *S. siamea* . Tannin, terpenoid, flavonoid, steroid, alkaloid, cardiac glycoside, phenol and resin were the phytoconstituents found in plants. Flavonoids reduced risk primarily from cancer and cardiovascular disorders (Ballard & Marostica, 2019).As tannins react irreversibly with proteins and combine within bacterial membranes to neutralise their action, they are known as bactericides.Moreover, it can be said that because of tannins, SSLM shows antibacterial activity. As a result, medications based on tannins have been sold for a long time to treat intestinal infections. Other physiological effects of tannins have also been documented, including the reduction of blood pressure, the acceleration of blood coagulation, the reduction of serum cholesterol levels, and the modulation of immune responses. Therapeutically, The anaesthetic, cardioprotective, and anti-inflammatory qualities of alkaloids are particularly well-known. Terpenes' antimicrobial qualities, or their capacity to eradicate or inhibit the growth of microorganisms, are frequently employed in both conventional and modern medication (Himejima et al. 1992). It has been demonstrated that terpenes exhibit advantageous antiplasmodial action. Terpenes' antiplasmodial efficacy has drawn increased attention to malaria due to the rise in infections as well as drug resistance (Nogueira and Lopes 2011). Phenolics are well recognised as the biggest phytochemical compounds possessing antioxidant properties. Humans use phenolic phytochemicals to treat a variety of illnesses, such as bacterial, fungal, viral infections, inflammation, as well as cancer (Giovanni Ribaudo,2023). They are highly valued for their ongoing effectiveness as anti-arrhythmic medicines and in the treatment of congestive heart failure.In the last five years, new research has shown that these phenolics are involved in selectively controlling human tumours while impairing normal cellular proliferation (Newman et al. , 2008). The term "steroid therapy" describes the application of corticosteroids to treat a range of illnesses. Asthma, a number of autoimmune illnesses, immune system suppression to prevent transplant rejection (liver, kidney, heart, lung, and hand), along with cancer symptom treatment are all made possible by its anti-inflammatory properties (Encyclopedia of Body Image and Human Appearance, 2012). In case of antimicrobial activity test, we know, Larger zone of inhibition show that the test organism is vulnerable to the tested antibiotic. SSLM possesses a moderate antibacterial action, as indicated by the small zone of inhibition we obtain from the antimicrobial test result. Higher concentrations can boost the antibacterial action.

Chapter 5

Conclusion

The world is abundant in natural and medicinal plants. Because of its potential to assist in the fields of medicine and pharmacology, medicinal plants are receiving more attention than ever before. Photochemical components that have specific pharmacological effects on the human body are derived from the medicinal plant .Nowadays, *S. siamea* is becoming more widely recognised and receiving financial and medical assistance for its several medicinal advantages.

In conclusion, this phytochemical analysis of *S. siamea* leaf shows that they contain a wide variety of phytochemical elements that can significantly contribute to therapeutic needs. Additionally, the antimicrobial activity investigation indicates that S. siamea leaf might contain antimicrobial compounds that combat a variety of microorganisms. This study offers important insights into the possible applications of *S. siamea* leaves in the pharmaceutical industry.

Future

The study established an essential framework for future investigations into the separation as well as characterisation of phytoconstituents from the selected plant component for development of novel drug and antimicrobial agents.The study's sole basis was screening and qualitative analysis. It would be preferable if the different phytochemicals' IR spectra, bioactivity, and quantitative detection could be carried out. If the phytoconstituents could be identified, analysed, and separated, the study would be more advantageous.

Reference

Maldonado Miranda, J. J. (2021, January 1). Chapter 7 - Medicinal plants and their traditional uses in different locations (R. A. Bhat, K. R. Hakeem, & M. A. Dervash, Eds.). ScienceDirect; Academic Press.

N, V. (2021). Importance of Medicinal Plants in Medicine. Journal of Medicinal and Organic Chemistry, 1(1), 01.

Borkatulla B, Ferdous J, Uddin AH, Mahmud P. Bangladeshi medicinal plant dataset. Data Brief. 2023 May 7;48:109211. doi: 10.1016/j.dib.2023.109211. PMID: 37383807; PMCID: PMC10294007.

Mominul Islam, A. K. M., Hasan, M., Musha, Md. M. H., Uddin, Md. K., Juraimi, A. S., & Anwar, Md. P. (2018). Exploring 55 tropical medicinal plant species available in Bangladesh for their possible allelopathic potentiality. Annals of Agricultural Sciences, 63(1), 99–107. https://doi.org/10.1016/j.aoas.2018.05.005

Kadir, M. F., Karmoker, J. R., Alam, Md. R., Jahan, S. R., Mahbub, S., & Mia, M. M. K. (2015). Ethnopharmacological Survey of Medicinal Plants Used by Traditional Healers and Indigenous People in Chittagong Hill Tracts, Bangladesh, for the Treatment of Snakebite. Evidence-Based Complementary and Alternative Medicine, 2015, 1–23. https://doi.org/10.1155/2015/871675

Wachira, S. W. (2024, January 1). Chapter 33 - Factors to consider in development of nutraceutical and dietary supplements☆☆In the previous edition, P.K. Mukherjee, R.K. Harwansh, S. Bahadur, V. Duraipandiyan, and N.A. Al-Dhabi contributed to this chapter. (S. B. McCreath & Y. N. Clement, Eds.). ScienceDirect; Academic Press. https://www.sciencedirect.com/science/article/abs/pii/B9780443186578000323

Drieux, L., Brossier, F., Sougakoff, W., & Jarlier, V. (2008). Phenotypic detection of extended-spectrum β-lactamase production in Enterobacteriaceae: review and bench guide. Clinical Microbiology and Infection, 14, 90–103. https://doi.org/10.1111/j.1469-0691.2007.01846.x

M, A., FS, N., & TI, O. (2018). Antibacterial efficacy and phytochemical screening of Senna siamea leaves extracts on some pathogenic bacteria. Journal of Microbiology & Experimentation, 6(3). https://doi.org/10.15406/jmen.2018.06.00208

Yadav, R., & Agarwala, M. (2011). Phytochemical analysis of some medicinal plants. Journal of Phytology, 3(12), 10–14. https://core.ac.uk/download/pdf/236018626.pdf

Pizzi, A. (2021). Tannins medical / pharmacological and related applications: A critical review. Sustainable Chemistry and Pharmacy, 22, 100481. https://doi.org/10.1016/j.scp.2021.100481

Chung, K.-T., Wong, T. Y., Wei, C.-I., Huang, Y.-W., & Lin, Y. (1998). Tannins and Human Health: A Review. Critical Reviews in Food Science and Nutrition, 38(6), 421–464. https://doi.org/10.1080/10408699891274273

Heinrich, M., Mah, J., & Amirkia, V. (2021). Alkaloids Used as Medicines: Structural Phytochemistry Meets Biodiversity—An Update and Forward Look. Molecules, 26(7), 1836. https://doi.org/10.3390/molecules26071836

Sun, W., & Shahrajabian, M. H. (2023). Therapeutic Potential of Phenolic Compounds in Medicinal Plants—Natural Health Products for Human Health. Molecules, 28(4), 1845. https://doi.org/10.3390/molecules28041845

Newman, R. A., Yang, P., Pawlus, A. D., & Block, K. I. (2008). Cardiac Glycosides as Novel Cancer Therapeutic Agents. Molecular Interventions, 8(1), 36–49. https://doi.org/10.1124/mi.8.1.8

Fawkner, H. J. (2016). Encyclopedia of Body Image and Human Appearance | ScienceDirect. Sciencedirect.com. https://www.sciencedirect.com/book/9780123849250/encyclopedia-of-body-image-and-human-appearance

Nogueira CR, Lopes LMX. Antiplasmodial Natural Products. Molecules. 2011;16(12):2146–2190. doi: 10.3390/molecules16032146. [DOI] [Google Scholar]

Himejima M, et al. Antimicrobial terpenes from oleoresin of ponderosa pine tree Pinus Ponderosa: a defense mechanism against microbial invasion. J Chem Ecol. 1992;18(10):1809–1818. doi: 10.1007/BF02751105. [DOI] [PubMed] [Google Scholar]

Ballard, C.R., & Marostica, M.R. (2019). Health benefits of flavonoid., in book Bioactive Compounds, 185-201. https://doi.org/10.1016/ b978-0-12-814774-0.00010-4, Accessed: 04.11.2020

Heinsleigh TE, Holaway BK, 1988. Agroforestry species for the Philippines. Metro Manila Philippines: US Peace Corps, AJA Printers.

Heinsleigh TE, Holaway BK, 1988. Agroforestry species for the Philippines. Metro Manila Philippines: US Peace Corps, AJA Printers.

Sosef MSM, Hong LT, Prawirohatmodjo S, eds, 1998. Plant resources of southeast Asia. Timber trees: lesser-known timbers. Leiden, The Netherlands: Backhuys Publishers, 5(3).

Rojas-Sandoval, J., & Acevedo-Rodríguez, P. (2022). Senna siamea (yellow cassia). CABI Compendium, CABI Compendium.

Senna siamea (Lam.) H.S.Irwin & Barneby | Plants of the World Online | Kew Science. (2018). Plants of the World Online.

Sharma, R. (2022, May 18). Kirby Bauer Disc Diffusion Method for Antibiotic Susceptibility Testing. Microbe Notes.

Hardy Diagnostics. (2024, February 5). From Zones of Inhibition to Accurate Results: Mastering the Kirby-Bauer Technique. Hardydiagnostics.com.