Phytochemical screening and antimicrobial activity of bark 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 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 thesis titled "Phytochemical screening and antimicrobial activity of bark of *Senna Siamea*." submitted by Faria Rashid Tisha (20346049), of Summer, 2020 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy.

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Ethics Statement

This project does not involve any kind of animal and human trial.

Abstract

Medicinal plants continue to be an important source for the development of novel medications and have historically been a good source of medicines with therapeutic activity. *Senna siamea* is a valuable source for pharmaceutical and natural medicine research because of its bioactive components, which have been extensively investigated. The focus of this research is to investigate the phytochemical constituent and the Antimicrobial activity of methanolic extract of *S.siamea* bark (MESSB) . Standard phytochemical screening tests were followed to check the phytochemicals and Disk diffusion method with concentrations of 1000µg/mL was used to check the antimicrobial activity. Phytochemical tests showed be the presence of various bio active compounds, including alkaloids, flavonoids, tannins, saponins, phenols, terpenoids, steroids, and glycosides. Antimicrobial test was conducted against five bacterial strains: *Escherichia coli, Bacillus subtilis, Klebsiella pneumoniae, Pseudomonas aeruginosa, Bacillus cereus.* MESSB exhibited moderate activity against all the tested bacteria. Although the extract showed antimicrobial activity, we don't know the actual responsible bio active component for this effect. Our future goal is to find out the responsible component and we can develop the new antimicrobial agent for this.

Keywords – *Senna siamea*; methanol extract; Phytochemical Screening; Disk Diffusion method; Antimicrobial activity.

Dedication

This research is dedicated to my family, teachers and friends

Acknowledgement

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ZOI - zone of inhibition

SSBM – *Senna siamea* bark methanol

ICDDR - International Centre for Diarrhoeal Disease Research, Bangladesh

Chapter 1

Introduction

The word "phytochemical" originates from Greek culture, where "phyton" means plant. Plant-based, cell-active compounds known as phytochemicals occur in plants and play biological roles in human beings and other organisms. These compounds provide plants with their own color, taste, and odor while shielding them from injury and harm. Phytochemicals are physiologically active chemical compounds that safeguard plant cells to environmental stressors such as the introduction of harmful substances, physical stress, deficiency, and microbial attack. The application of plant-derived chemical parts for therapy has increased tremendously over the years (Eloff; Saxena et al. in 2013). The basis of traditional medicine among rural residents across the globe can be traced back to plants of medicinal importance's. One of the earliest civilizations to use medicinal plants with their biological compounds is documented were Sumerian and Akkadian. Doughari et al. (2009) state that an ancient researcher with a biological application for naturally occurring plant material ranked around 400 herbal plants. Natural Egyptian and Ayurvedic products have been a central part of the classical Chinese system of cultural medicine (Sarkar and Nahar, 2007). About 3.4 billion humans on Earth are estimated to be heavily dependent on medicines derived from plants. According to this aspect, 88% of humans on earth rely on traditional, age-old medicines to remedy their underlying biological problems. (Doughari et all, 2009). The World Health Organization (WHO) has described a medicinal plant as any plant that includes compounds of possible therapeutic use or that are precursors to pharmacological semi-synthesis in one or more of its organs. According to the World Health Organization (WHO), a medicinal plant is any plant that contains chemicals that are therapeutically useful or that assist pharmacological semi-synthesis in one or more of its organs. The allowance of a degree of propensity to study species abundance characterizes the progressive formation of the discipline that deals with past

cases of diversity between and within animal and plant species; in the global environment diversity of plant species is apparent. Mittelbach et al. (2007) state that these data from various research are also highlighted within the field of geology history. Plants with a particular geographic distribution are examined in terms of the organisms that delineate time. The development of this level of tilt within groups is also both contemporary (the "cradle" model) and ancient (the "museum" model) (Birmingham & Dick, 2001; McKenna & Farrell, 2006). In the past few years, there has been a dramatic rise in the demand for natural therapies. Out of 250,000 known higher plant species, about 80,000 are used medicinally (Hossan, 2010). About 25% of medicines prescribed globally are derived from plants, and 11% of the World Health Organization's list of essential medicines are plant-derived (Jain, 2016). Over 60% of anti-microbial and anti-tumor drugs are either directly or indirectly derived from natural products (Rates, 2000).

1.1 Use of Medicinal Plants across the World

Natural products can be utilized as lead compounds in drug development. Help create new formulations, and enhance the action of other medications. The idea of medicinal plants in healthcare systems across the globe owing to its several benefits. Jain (2016) The herbal medicine sector is well established and popular in Eastern nations like China and India. European nations, like France and Germany, also have their own proportion of herbal remedies. Approximately half of the drugs that are prescribed by German physicians are phytochemical compounds. Approximately half of the drugs prescribed by doctors in Germany are phytochemical compounds. Natural products and phytochemicals, on the other hand, as "healthy foods" in North America. In line with European nations, Latin American nations are now emphasizing natural-sourced pharmaceuticals. (Rates,2000). About half of Germany's drugs consist of phytochemical drugs medications prescribed by physicians. Conversely, in North America, natural remedies and phytochemicals are being marketed as "healthy foods".

As in European countries, LatinU. S. countries are currently interested in drug formulations from natural products. (Rates, 2000).

1.2 Medicinal Plants of Bangladesh

Bangladesh, a tropical country in South Asia, offers the perfect climate and topography setting for the rich and widespread growth of several medicinal plant species. The nation boasts a rich tradition of employing medicinal plants to cure diseases as a consequence. (Uddin Shaikh Jamal, 2008). Within the sociocultural, medical, and spiritual realms Bangladesh's rural and tribal communities, the use of medicinal plants and herbal products are greatly sought after. About 500 of the 2000 medicinal plant species which are known to occur in this subcontinent have been utilized as "traditional/folk medicine" here. (Ghani, 1998). The local names for *Clerodendrum viscosum* (known as Bhant), *Dillenia indica* (known as Chalta), *Clitoria Ternate* (known as Aparajita), Diospyros peregrina (also called Gab), *Dipterocarpus turbinatus* (also called Garjan), *Ecbolium viride* (also known as Nilkhanta), *Glinus oppositifolius* (also known as Gima), *Saraca asoca* (also known as Ashok), *Glycosmisper taphylla* (also known as Dalton), and *Jasminum sambac* One of the most commonly used medicinal plants in Bangladesh, known as locally known as Beliphul, cures a number of diseases ranging from hypotension, ulcers, white leprosy, asthma, diarrhoea, gout, common cold, jaundice, and numerous others. In 2018, Snigdha Bardhan stated Usually, Kavirajes, the folk medicine practitioners of Bangladesh,ingest these medicinal plants in their raw form or transform them into delicious fluids. In order to cure common ailments, these Kavirajes typically have to resort to medicines prepared from medicinal herbs. (Mohammad Ali, 2011).

Figure-1: Utilizing medicinal plants for therapeutic purposes (Tanwar et al., 2023)

1.3 Phytochemical Screening of Medicinal Plants

The process of separating, characterizing, and testing the medicinally effective compounds usually present in plants is known as phytochemical screening of medicinal plants. Alkaloids, flavonoids, carotenoids, glycosides, tannins, antioxidants, and other phenolic compounds are just a few examples of bioactive molecules that come from plants. (N. Gandhiraja, 2009) Plants naturally contain a variety of phytochemicals, which possess a range of biological relevance since they offer a strong defense against many pathogenic microorganisms. These components are isolated and identified for the research of medicinal plants, using various separation techniques. (Lone, 2013)

1.4 *Senna siamea* – a widely used legume tree

A short guide to multi use trees of the world

Senna siamea Lamk., synonym *Cassia siamea* Lamk., *C. florida Vahl*., or *Senna sumatrana*, Roxb., is a non-nitrogen-fixing leguminous tree of the family Subfamily Caesalpinioideae of Leguminosae. South-east Asian countries have many planted it widely as polewood, fuelwood, shelterbelts, windbreaks, and erosion management. It is utilized for hedgerows, alley cropping, and intercropping and constitutes a good shade tree for planting along roadsides. In cocoa, it is utilized as a shade tree.plantations of tea and coffee. It has, as per Brandis 1906 and F/FRED 1994, has many local names and is most widely referred to as Thailand shower, minjiri, or kassod. (Brandis 1906, FRED 1994).

1.5 The scientific name of *Senna siamea* is as follows:

- Kingdom: Plantae
- Phylum: Tracheophyta
- Class: Magnoliopsida
- Order: Fabales
- Family: Fabaceae
- Genus: Senna

- Species: *Senna siamea* (Lam.) H.S. Irwin & Barneby

Figure 2 – S. siamea tree (Akor et al., 2021)

1.6 Morphology of *Senna siamea* bark

The bark of *Senna siamea* is dark brown to gray in color and presents a rough, faintly fissured appearance. The bark becomes more highly cracked and scaly as the tree matures. Upon cutting, the inner bark reveals a fibrous, pale brown to reddish-brown layer possessing a mild characteristic odor and bitter taste. The bark is quite dense and contains various bioactive molecules like tannins, flavonoids, and alkaloids that account for its application in herbal medicine (Orwa et al., 2009; Kamilah et al., 2022).

1.7 Antimicrobial Activity Test of medicinal plants

Medicinal plant antimicrobial activity assays are of a qualitative nature, which determine how effectively plant extracts are able to inhibit the growth of certain microorganisms and antibiotic resistance. Gandhiraja N. (2009) The severity of infection over a period higher, and the situation is getting worse due to emerging antibiotic resistance that is preventing the complete treatment solutions from being administered. As they already produce a range of secondary metabolites as part of their defense mechanisms against bacterial and fungal infections, plants can play a very important part in such conditions. Drugs that are plant-derived can therefore be used to identify new antibacterial drugs with new mechanisms of action and less side effects. (1908, Shaikh Jamal Uddin) In this research, the Kirby-Bauer Test, or the Zone of Inhibition Test, is worked.

1.8 Literature Review

Traditional medicine has also relied heavily on medicinal plants, and they remain vital in the discovery of novel therapeutic agents. There is a growing need to investigate natural products for possible antibacterial activity owing to the rise in antimicrobial resistance (Newman & Cragg, 2020). Nirmala et al. (2011) state that *Senna siamea*, a plant belonging to the family Fabaceae, has been in traditional use owing to its antimalarial, antibacterial, and anti-inflammatory activities. Researchers have investigated the bioactive compounds of the plant's leaves, bark, and seeds, among other components. *Senna siamea* was known to possess alkaloids, flavonoids, tannins, glycosides, and saponins, which have all been linked to antimicrobial activity in previous phytochemical studies (Akinmoladun et al., 2007). The disc diffusion method is a common and widely used technique employed for the assessment of antibacterial activity of plant extracts. The plant activity is compared with some standard

antibiotics like kanamycin (Bauer et al., 1966). In order to determine the susceptibility of *Senna siamea* bark extract on resistant and susceptible microbiological strains, kanamycin discs were used throughout this research. The plant extracts have been shown in a number of trials to be active against various drug-resistant organisms. Igbinosa et al. (2009), for example, illustrated that methanolic extracts of certain plants were active against antibiotic-resistant bacteria with remarkable zones of inhibition. This further emphasizes how crucial it is to screen Senna siamea as a possible source of antimicrobial agents, particularly in the wake of developing resistance patterns. Public health is facing a serious risk because of the prevalence of microorganisms with extremely high antibiotic resistance in both environmental and clinical niches. By offering sustainable and effective alternative treatments, the discovery of novel antibacterial chemicals from plants such as *Senna siamea* could go a long way in helping to surmount this problem (World Health Organisation, 2020).

1.9 Rationale for the study

S.siamea occurs naturally in Bangladesh's salty and humid areas, especially in the Sundarbans. The trees are used extensively as wood timber even though previous as well as current research indicated towards the presence of many active phytochemical constituents within the plants.Studies on these chemical entities and their natural tendency to exist within an abiotic and biotic stressful environment can extend the breadth of new drugs and significant therapeutic advancements in the health care sector of Bangladesh. This study was conducted to investigate and examine the prevalence of these phytochemical constituents and Antimicrobial Activity of *S.siamea* against both Gram Positive and Gram Negative Bacteria.

1.10 Aim of the Study

To evaluate the phytochemical constituents and antimicrobial activity of the bark of *S. siamea*

1.11 Objective of the Study

- To identify the major bioactive compounds in the Senna siamea bark through phytochemical screening.
- For the preparation of methanolic solvent extracts of *Senna siamea* bark for testing antimicrobial activity.
- To quantify the antimicrobial activity of the bark extracts against selected Gram-positive, Gram-negative bacteria and bacteria stain using disk diffusion method.

Chapter 2

Methodology

2.1 Collecting & identifying *Senna siamea* bark

Bark of *S. siamea* were collected from Sylhet Agricultural University, Bangladesh, on 10th October 2024, for the experiment study. The plant parts were individually brought and shown to the lab instructor for identification. Subsequently identified as *S. siamea*

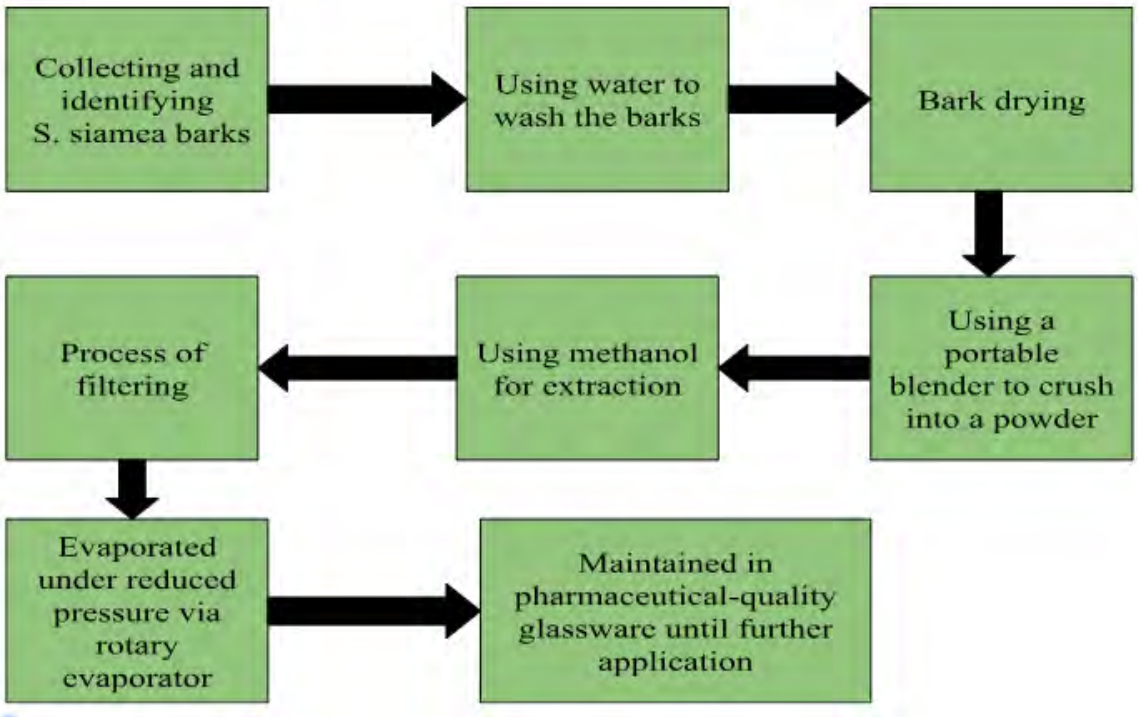

Figure 3: The entire procedure.

2.2 Process of Extraction

2.2.1 Drying of Plant parts

- Gather plant samples (such as bark from *S. siamea*) and identify it.
- Use fresh water to wash well. In the shade, let it air dry at room temperature.
- Grind in a blender until finely powdered.

2.2.2 Extracting and concentrating

A mixture of 1200 mL methanol and ethyl acetate is used to macerate 250 g of dried powder. After shaking, let it sit at room temperature for 14 days. Pass the cotton cloth through the filter, followed by the filter paper. Utilize a rotating evaporator to concentrate at lower pressure. Laminar Air Flow (LAF) further dries the area. After washing petri dishes with methanol, gather the dry extract. Keep in glass containers of the pharmaceutical type. The dried bark was first cut into small pieces (2–3 inches), then crushed into fine granules and measured. The powdered bark was placed in clean, labeled plastic jars, and methanol was added to fully cover the material (maceration). The jars were sealed and stored at room temperature (around 25°C) for seven days. After soaking, the mixture was filtered to separate the solid residue (marc) from the liquid extract (micelle). Finally, the liquid extract was evaporated to remove the solvent and concentrate the extract.

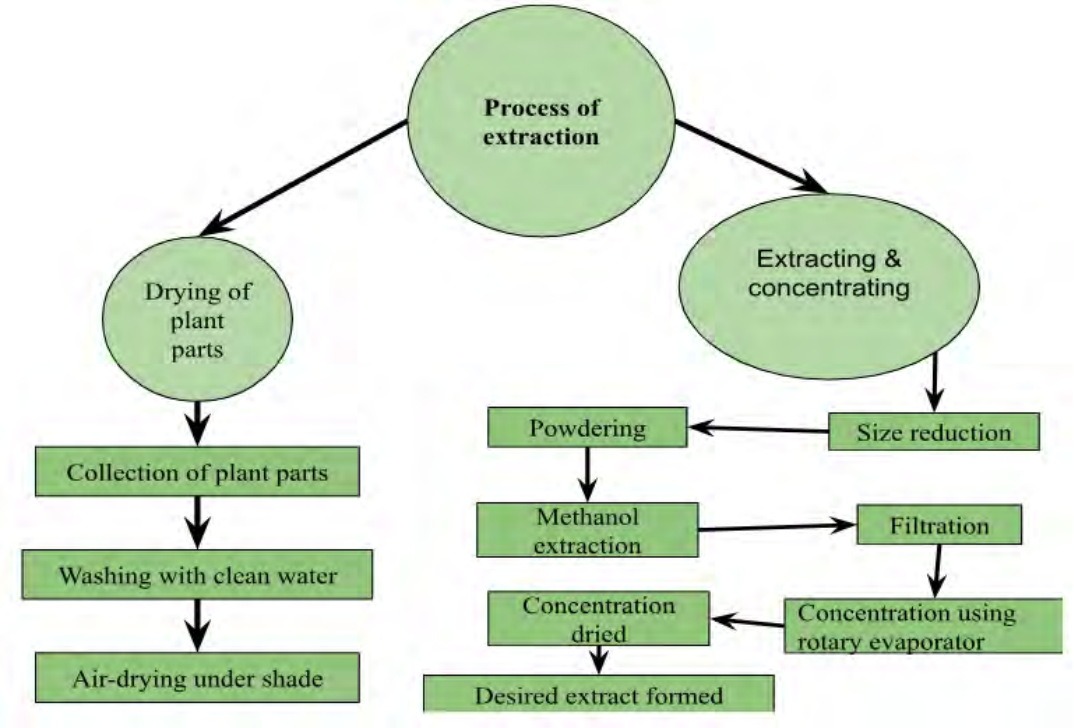

Figure-4: Extraction process

2.2.3 Filtration

To get a clear solution with the crude extract, the methanol-soaked solutions were then filtered first with a fresh cotton washcloth and then with filtration papers.

2.2.4 Concentration (Using Rotary Evaporator)

The objective is to remove the solvent from the filtrate and produce a thick or semi-solid extract. Method: The filtrate is poured into the evaporation flask. Vacuum pump, water bath—which is usually between 40 and 60°C, depending on the solvent—and condenser make up the rotary evaporator. Low pressure turns the flask, protecting heat-labile chemicals by permitting evaporation of the solvent at low temperatures. Separately collected and condensed, the evaporated solvent yields a concentrated extract.

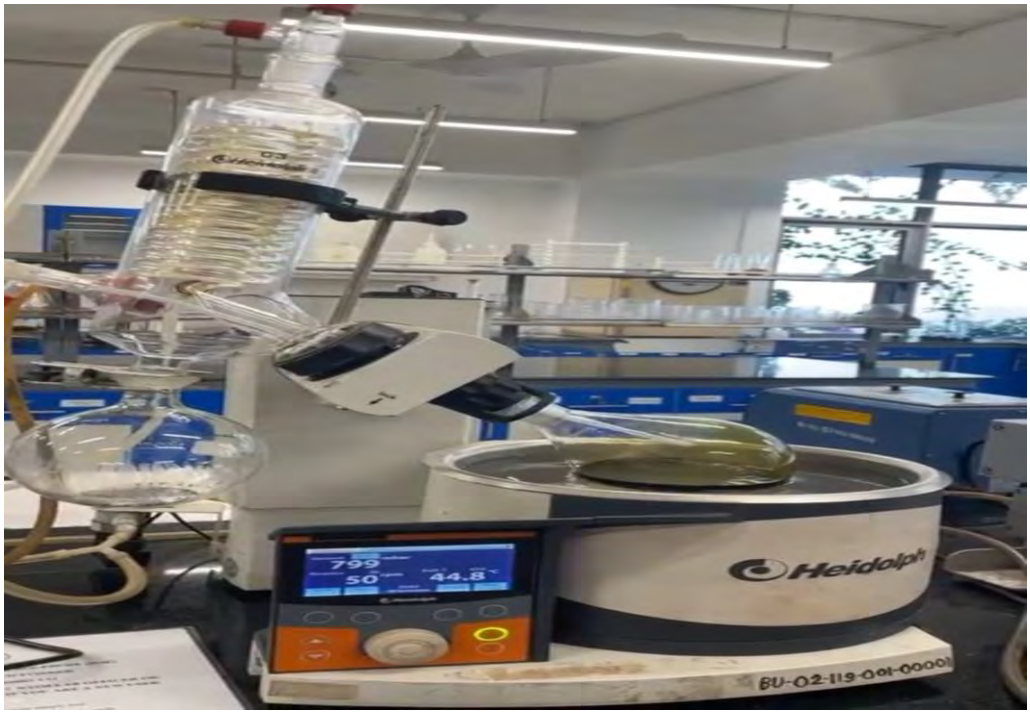

Figure-5: Evaporation through rotary evaporator in lab

2.3 Screening of *S. siamea* bark using phytochemicals

In order to determine the qualitative chemical composition of *S. siamea*, the crude extracts were screened for alkaloids, steroids, tannins, saponins, resin, terpenoid, and glycoside phytochemicals.

2.3.1 Detection of Alkaloid

Two milliliters of 1% HCl was added to crude extract and heated slowly. The mixture was then added to Mayer's and Wagner's reagents. The turbidity of the resulting precipitate was taken as evidence that alkaloids were present in MSSB (Nandagoapalan et al., 2016).

2.3.2 Detection of Tannin

A milliliter of the barks purified solution was combined with two milliliters of distilled water in separate test tubes. Presence of tannin was then demonstrated by adding two to three drops of ferric chloride to the mixture, which changed the color of the test tube of leaves to green or blue-black.

There a dark blue to bluish black color found in the bark confirming that Tannin was clearly present. (Mane & Shaikh, 2021).

2.3.3 Flavonoid detection

200 mg of plant extract was combined with ethanol and filtered. Two mL of the filtrate was subjected to concentrated HCl and magnesium ribbon; a pink or red color confirmed flavonoids.(Nandagoapalan et al., 2016).

2.3.4 Glycoside Detection

The Keller-Killiani Test detected the glycosides by taking four milliliters of filtered ethanol extracts of roots, bark, and leaves and putting them in three test tubes. In small amounts, glacial acetic acid and ferric chloride were added to the test tubes containing the extract. A few drops of the concentrate of sulfuric acid were added. It gave a reddish-brown. coloring where two layers overlap, and the topmost contained a bluish-green color layer (Nandagoapalan et al., 2016).

2.3.5 Steroid Detection

Libermann-Burchard reagent was prepared by combining 5 milliliters of concentrated sulfuric acid and acetic anhydride, and 50 milliliters of ethanol and cooled in ice water. The mixture was then heated to 100°C for 5 to 10 minutes. Ten milligrams of the ethanol concentrate of the leaves, barks, and roots were then withdrawn and diluted using test tubes and 0.5 milliliters of hot acetic anhydride. Then, a test tube in each was given 0.5 mL of chloroform filtrate. There was a blue-green ring formation around root and bark extracts' test tubes on the drop-by-drop addition of the freshly prepared Libermann-Burchard reagent after well mixing of the extracts (Nandagoapalan et al., 2016).

2.3.6 Phenol Detection

Liebermann's test: 1 milliliter of sodium nitrite, a few drops of diluted sulfuric acid and 2 milliliters of diluted NaOH were added to three milliliters of the various extracts that were portioned out into three

test tubes. As a result, phenol was detected from the solutions due to the bright red, blue, or green color produced (Nandagoapalan et al., 2016).

2.3.7 Resin Detection

After the extraction of leaves, barks, and roots into an ethanol solution, 1 millilitre was achieved and a few drops of acetic anhydride were incorporated to check for the resin. Pure sulfuric acid was included in the 1 mL form. The test tubes were all orange to yellow in color and indicated that there was resin from the H. fomes plant extracts (Nandagoapalan et al., 2016).

2.3.8 Protein detection

Raw extract when mixed with 2ml of Millon's reagent, white precipitate that results in red when mildly heated that confirms the presence of protein.

2.4 Antimicrobial Activity Test

The purpose of this study was to ascertain the zone of inhibition of the bacterial isolates to determine antibacterial activity of kanamycin by disc diffusion method. From the presence or absence of clear zones of growth around the kanamycin disc, indicative of microbial resistance, this test sought to confirm the presence of antibiotic-resistant bacteria (Bauer et al., 1966).

2.4.1 Materials and Apparatuses

a. Nutrient Agar Medium

b. Filter paper discs

c. Petri-dishes

d. Micropipette

e. Sterile forceps

f. Mueller-Hinton agar

g. Screw cap test-tube

h. Autoclave

i. Spirit burner

j. Incubator

k. Laminar air flow hood

l. Nose mask and hand gloves

2.4.2 Microorganisms used for the test

Antimicrobial property test was also performed on gram positive as well as gram negative bacteria.

Gram positive	Gram negative
• *Bacillus subtilis BTCC 17* • *Bacillus cereus BTCC 19*	• *Escherichia coli (ATCC25922)* • *Klebsiella pneumoniae (ICDDR,B)* • *Pseudomonas aeruginosa (ATCC27853)*

Table-1: Names of the gram positive and gram-negative bacteria used during the test

2.4.3 Experimental Procedure

For inoculation of the bacteria, 100 ml distilled water was used to dissolve 2.5 g of nutrient broth. Ten conical flasks were provided 10 ml of the broth, and ten bacterial strains were inoculated and incubated at 37 °C for 24 hours with shaking. Meanwhile, Mueller-Hinton agar was melted in distilled water to prepare the agar medium, which was filled into petri dishes and left to solidify. When incubated, the bacterial cultures were seeded on the solid agar using sterile cotton swab. Standard discs of kanamycin, sample discs, and blanks were placed on the plates, which were then incubated at 37 °C for 24 hours. Finally, the inhibition zones on disc were measured to quantify antimicrobial activity.

Chapter 3

Result

3.1 Phytochemical results of the MESSB extract showed the presence of a number of bioactive compounds.

Phytochemical	Test Performed	Observation	Inference
Alkaloids	Mayer's and Wagner's test	Turbidity or cloudiness	(+)
Flavonoids	Alkaline reagent test	yellow color	(+)
Tannin	Ferric chloride test	Blue -black or green color	(+)
Resin		turbidity	(+)
Phenol	Millon's test	Bluish-green or black	(+)
Terpinoid		Reddish-brown inference	(+)
steroid		Green ring	(+)
glycoside	keller-killani test	blue or bluish-green	(+)
protein	Millon's test	brick red or deep red.	(-)

Note: Here + (positive) and - (negative)

Table-2: Screening of MESSB

Figure-6: Flavonoids Test

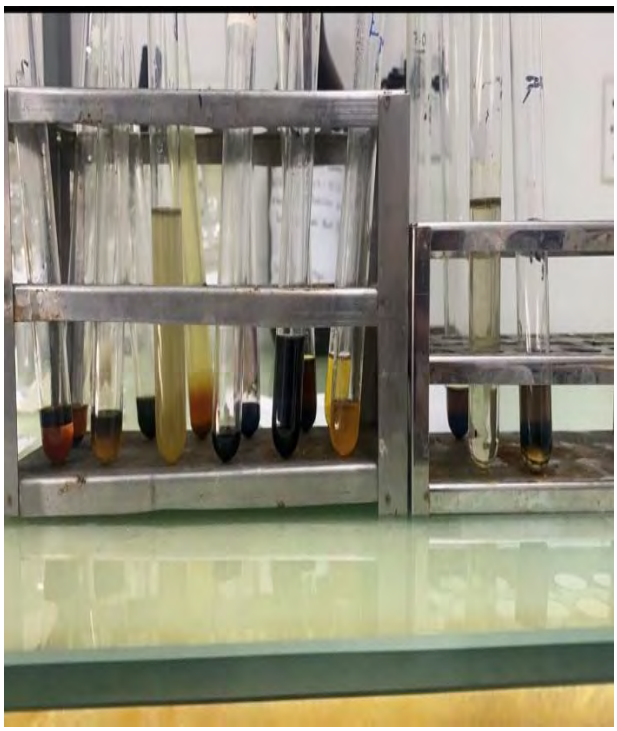

Figure-7: Screening of alkaloid, tannin, saponin, phenol, terpenoid, steroid, glycoside accordingly

3.2 Antimicrobial Activity of Senna siamea bark

The extract showed moderate activities against the tested pathogens (Table-03)

Pathogenic bacteria	Zone of inhibition Kanamycin 30µg/Disk (mm)	Zone of inhibition of MESSB extract (1000 µg) in mm
Escherichia coli (ATCC25922)	25 ± 2 mm	14±2 mm
Bacillus subtilis BTCC 17	27.67 ±1.527 mm	12±2 mm
Klebsiella pneumoniae (ICDDR,B)	30±2 mm	12±2 mm
Pseudomonas aeruginosa (ATCC27853)	28 ± 2 mm	2±2 mm
Bacillus cereus BTCC 19	26± 2 mm	10±2 mm

Table 3: Outcome of the antimicrobial test using the disk diffusion technique.

Chapter 4

Discussion

Medicinal plants have been commonly recognized as sources of an extensive variety of phytochemicals screening and antimicrobial activity (Newman & Cragg, 2020). *S. siamea* bark is such a plant, with a high level of bioactive constituents and identified pharmacological activities (Kanchanapoom et al., 2002). Successful use of plant material relies upon effective purification and extraction to isolate bioactive compounds for therapeutic intents (Jain, 2016). Phytochemical screening is necessary in early studies to detect major constituents. Preliminary phytochemical screening of the MESSB confirmed the presence of various bio active plant compounds, including alkaloids, flavonoids, tannins, saponins, phenols, terpenoids, steroids, and glycosides. These bioactive compounds contribute to the plant's medicinal value and are associated with potential antimicrobial effects. The phytochemicals present are very much impressive in their pharmacological activities. Alkaloids, indicated by the appearance of turbidity, exhibit analgesic, antimalarial, and antispasmodic activities, mainly on the nervous system (Newman & Cragg, 2020). Flavonoids, indicated by yellow coloration when in alkaline reagent tests, exhibit antioxidant, antibacterial, anticancer, and cardioprotective activities (Jain, 2016). Tannins, indicated by bluish or reddish coloration upon treatment with ferric chloride, exhibit astringent, antimicrobial, antioxidant, anti-inflammatory, and wound healing activities (Ugboko et al., 2020). Resins and phenols are responsible for antimicrobial, anti-inflammatory, anticancer, and antioxidant activities (Newman & Cragg, 2020). Terpenoids and steroids exhibit strong anti-inflammatory and anticancer activities, whereas glycosides show cardiotonic and antimicrobial activities (Jain, 2016). The protein test was negative since either they lack proteins or have them in concentrations too low to be detectable by Millon's reagent or present in undetectable concentrations.

Antimicrobial screening was conducted against bacteria like *E. coli, B. subtilis, K. pneumoniae, P. aeruginosa, and B. cereus*. *S. siamea* bark extract (MESSB) indicated moderate activity against all the aforementioned bacteria compared to that of standard Kanamycin (30 µg/disc). The extract was moderately active against the bacteria with a zone of inhibition of 14± 2 mm against *E. coli*, 12± 2 mm against *B. subtilis* and *K. pneumoniae*, 10± 2 mm against *B. cereus*, and 2± 2 mm against *P. aeruginosa*. Kanamycin yielded greater zones of (25 to 30) ± 2 mm. Decreased activity of the extract may be due to resistance of the bacteria, especially in *P. aeruginosa*, which was least sensitive. In general, the extract has moderate antibacterial activities but is less effective compared to traditional antibiotics. The results provided tiny inhibition zones, most likely because the extract was in small quantity and the strains used were highly resistant to antibiotics. In case the bacteria are not resistant, the bark extract of *S. siamea* would produce bigger inhibition zones since non-resistant strains tend to be susceptible to the bioactive compounds present in the extract. This suggests that bacterial resistance has the capability to significantly limit the visible antibacterial effect of plant-based therapies.

Chapter 5

Conclusion & Future works

Senna siamea is a highly effective traditional plant in Bangladesh with untapped medicinal potential. Phytochemical test of S.siamea bark established the presence of bioactive compounds, such as flavonoids, tannins, and alkaloids, which are known to have medicinal significance. Antimicrobial assay revealed weak but meaningful activity against some bacterial strains, validating its age-old use in traditional medicine. This finding suggests that the bark of *S. siamea* possesses potential as a source of natural antimicrobial compounds and warrants further investigation for drug discovery (Balouiri et al., 2016).

Further studies on *Senna siamea* bark can be conducted on the isolation and identification of bioactive compounds accountable for its antimicrobial activity using chromatography and spectroscopy techniques. Further *in vitro* and *in vivo* studies should be carried out to ascertain their effectiveness and safety, particularly against drug-resistant and chronic infections. Its antiviral and other pharmacological activities should also be investigated to further enhance its potential application in medicine (Cowan, 1999).

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