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ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES OF STERCULIA FOETIDA RIND ALCOHOLIC EXTRACT AGAINST SOME MICROORGANISMS INCLUDING MDR BACTERIA

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ABSTRACT

Antibiotic resistance is one of the global health threats of our time. As microorganisms are developing resistance to antibiotics, some infectious diseases have become difficult and sometimes impossible to treat. This not only threatens the lives of those suffering from infection but also undermines the effectiveness of healthcare systems, worldwide. In this study, the antibacterial activity of the external peel or rind extract in 70% ethanol of *Sterculia foetida*, commonly known as Java olive, was investigated against *Staphylococcus aureus, Escherichia coli, Candida albicans, multidrug-resistant* (MDR) *E. coli, and* MDR *Klebsiella* spp. by broth microdilution method for determining MIC levels. The minimal inhibitory concentration (MIC) of the extract was tested against various types of bacteria and fungi, including MDR *E. coli*, and MDR *Klebsiella* spp. The results showed that the extract was effective against all strains tested, except MDR *E. coli*. These data suggest that *Sterculia foetida* can be an effective and alternative candidate for developing antimicrobial compounds.

KEYWORDS: *Sterculia foetida*, MDR bacteria, MIC level.

INTRODUCTION

Medicinal plants are a natural source of compounds that can be used to treat and control many diseases.[1] Numerous studies have been conducted exploring the medicinal properties of plants used in traditional medicine as well as the potential of antibacterial agents derived from plants. Some research was carried out that looked at the capacity of antimicrobial drugs derived from plants, as well as the medicinal properties of plants that were traditionally utilized in folk remedy.[2]

However, the variety of research performed is a long way from sufficient to cover the massive biodiversity and the numerous traditional uses of medicinal plants. By counting on natural substances, medicinal plants provide an important scope of opportunity by using natural treatments that are more secure and more effective than chemically synthesized drugs. The study conducted within this paper highlighted the significance of plant biodiversity, specifically regarding medicinal utilization.[3] Plant biodiversity plays an essential role in presenting us with necessary medicinal solutions, and we must hold such biodiversity to make certain stability and sustainability of such solutions.[4]

Sterculia foetida, commonly known as *sterculia* (Fig.1), is a species of flowering plant belonging to the family Sterculiaceae. It is found in all tropical areas including India, Vietnam, China, and parts of Southeast Asia. The family Sterculiaceae contains over 300 species and is found in tropical regions around the world. About 25-30 of these species, including *Sterculia foetida L.*, inhabit the Indian subcontinent., commonly known as Jungli Badam or Pinari in Hindi.[5] *Sterculia foetida* is a species of flowering plant native to East Asia, India, Sri Lanka, Myanmar, Thailand, Cambodia, Malaysia, the Philippines, and parts of Australia.[6] It is a medium-sized tree with a widely spreading crown and a short, curved trunk that can reach heights of 18 m. The bark is light gray to brown and covered with shallow grooves. The leaves are large, ovate, up to 10 cm long, and 7 cm wide. The flower is yellow-green and has five petals. The fruit (Fig. 1) is large, round, up to 6 cm in diameter, and contains seeds surrounded by a thick yellow-brown flesh with a distinctive nutty flavor.

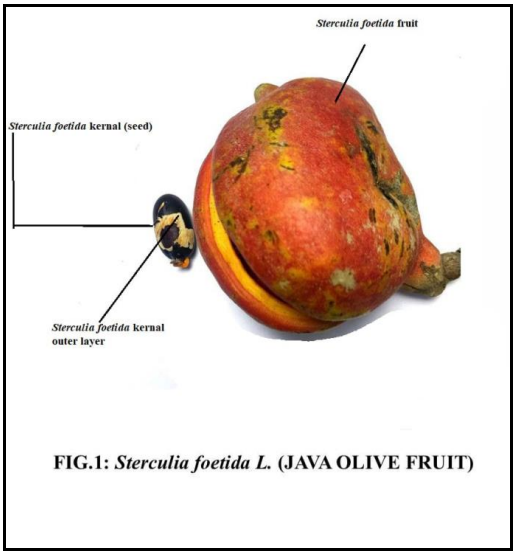

FIG.1: *Sterculia foetida L.* (JAVA OLIVE FRUIT)

Sterculia foetida has been found to have many medicinal properties. It is known for its anti-inflammatory and antibacterial properties and is used as an herbal remedy for different diseases such as wounds, infections, and burns. It can also be used as a digestive aid to relieve indigestion, bloating, and other digestive issues. The leaves can also be boiled in water and used as a tonic for fever, headache, and body aches. Additionally, the bark and leaves can be used to treat toothaches, eye infections, and intestinal worms.

The plant is also known to have antioxidant properties and can be used to treat asthma and other respiratory ailments. The antibacterial activity of this extract is probably due to its high content of polyphenols with antibacterial properties. The results of these tests showed that the extract had significant pharmacological activity. Therefore, this study showed that *Sterculia foetida* extract can be used for the treatment and prevention of various diseases.

MATERIALS AND METHODS

Collection and preparation of *S. foetida* Extract

The *S. foetida* (Java olive) was collected from Jharkhali (22.0306° N, 88.7013° E), an area in Basanti block in 24 Paraganas, South District of West Bengal State, that borders the Sundarban National park, West Bengal.[7]

The fruit was washed and cleaned with tap water and the external peel was separated. 1 g of crushed peel was placed in 5 ml 70% ethanol for five days at room temperature, undisturbed. 5 days later, the extract (Fig. 2) was separated and preserved in the refrigerator for further experimentation.

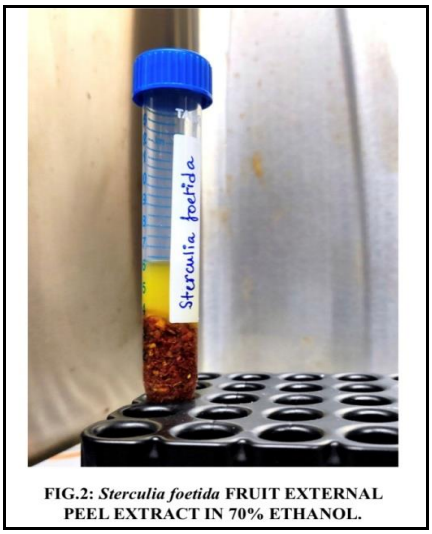

FIG.2: *Sterculia foetida* FRUIT EXTERNAL PEEL EXTRACT IN 70% ETHANOL.

Muller Hinton (MH) Broth

The broth was prepared by mixing 4.2 gram of Mueller Hinton broth powder (HiMedia)with 200 mL of distilled water and sterilized by autoclave.

Determination of MIC Values by Serial Dilution of the *S. foetida* Extract in a Microtiter Plate

A 96 well microtiter plate was used. All the wells were initially filled with 100 µL of MH broth. Five microbes were being used as test strains. For each microbe two

rows of the microtiter plate wells were assigned and marked accordingly. For each of strain suspension, first of the two rows was filled with 100µL of *S. foetida* extract. The extract was added in the first well and the rest 7 wells were diluted in 10^{-2} concentration in each step. In the second of the two rows 100µL 70% ethanol was added in the first well and the rest 7 wells were serially diluted in a similar fashion. This microwell dilution method is the main principle for determining the MIC (Minimal Inhibitory Concentration) value. 10 µL of test strain suspensions were added into each well, in different specified rows that are, *Staphylococcus aureus*, *Candida albicans*, *E. coli*, *E. coli MDR* isolates and two *Klebsiella MDR* isolates. A baseline reading of all the wells was taken at 620 nm in the Spectrophotometer. The microtiter plate was incubated overnight, and a second reading was taken of each well after 24 hrs. Subtractions of the first reading absorbance from the second reading were made for analysis.

RESULTS

In the study in microtiter plate with serial dilution of the extract starting from 10mg/mL, The general MIC of the extract for the organisms tested was found to be 78.1 µg/mL and the growth of *Staphylococcus aureus*, *Candida albicans*, *E. coli*, *and two Klebsiella* MDR isolates(Fig. 3, 4, 5, 7) was inhibited. This is a interesting result, as it means that the crude extract was able to inhibit the growth of these microorganisms and may have potential as a natural antibiotic. The growth of *E. coli* MDR, however, was not inhibited (Fig. 6).

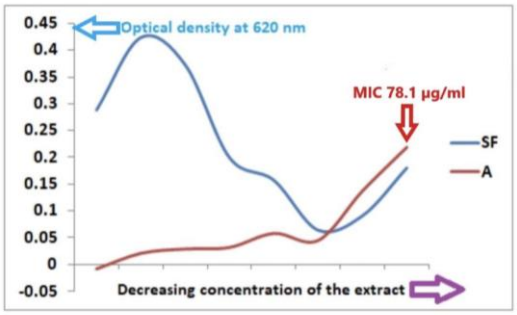

FIG. 3 : INHIBITION OF GROWTH OF *Staphylococcus aureus* (ATCC 25923) AT A VERY LOW CONCENTRATION OF THE EXTRACT (78.1 µg/ml) IN RELATION TO THE VEHICLE ETHANOL. (CONCENTRATION OF THE EXTRACT WAS SERIALLY DILUTED FROM 10 mg/ml to 78.1 µg/ml)

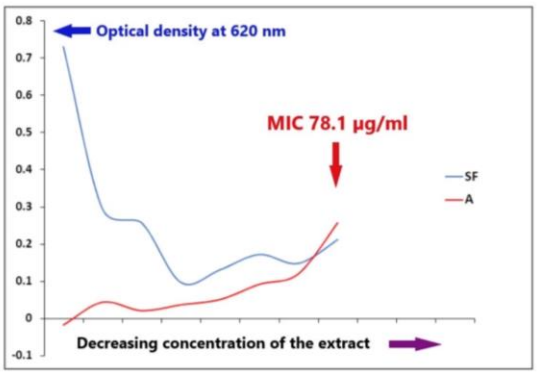

FIG. 4 : INHIBITION OF GROWTH OF *Candida albicans* (ATCC 10231) AT A VERY LOW CONCENTRATION OF THE EXTRACT (78.1 µg/ml) IN RELATION TO THE VEHICLE ETHANOL. (CONCENTRATION OF THE EXTRACT WAS SERIALLY DILUTED FROM 10 mg/ml to 78.1 µg/ml)

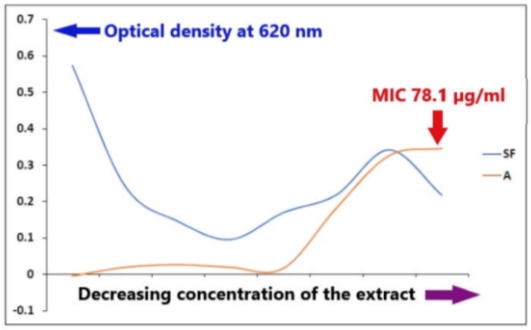

FIG. 5 : INHIBITION OF GROWTH OF *E.coli* (ATCC 25922) AT A VERY LOW CONCENTRATION OF THE EXTRACT (78.1 µg/ml) IN RELATION TO THE VEHICLE ETHANOL. (CONCENTRATION OF THE EXTRACT WAS SERIALLY DILUTED FROM 10 mg/ml to 78.1 µg/ml)

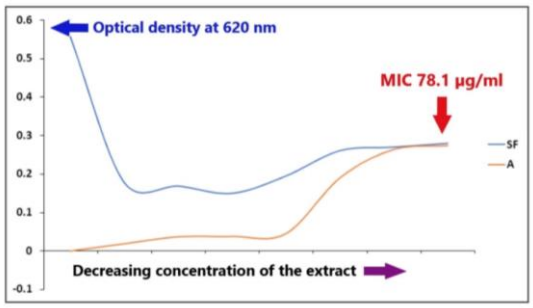

FIG. 6 : INHIBITION OF GROWTH OF *E.coli* MDR AT A VERY LOW CONCENTRATION OF THE EXTRACT (78.1 µg/ml) IN RELATION TO THE VEHICLE ETHANOL. (CONCENTRATION OF THE EXTRACT WAS SERIALLY DILUTED FROM 10 mg/ml to 78.1 µg/ml)

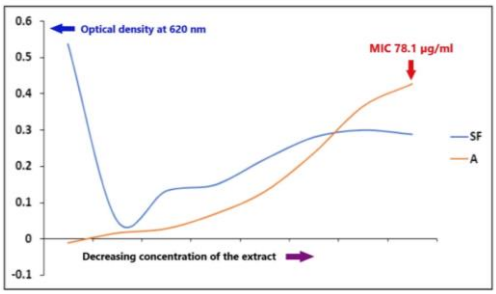

FIG. 7 : INHIBITION OF GROWTH OF *Klebsiella* MDR AT A VERY LOW CONCENTRATION OF THE EXTRACT (78.1 µg/ml) IN RELATION TO THE VEHICLE ETHANOL. (CONCENTRATION OF THE EXTRACT WAS SERIALLY DILUTED FROM 10 mg/ml to 78.1 µg/ml)

DISCUSSION

In this experiment, we observed that the alcoholic extract of *Sterculia foetida* integument had good antibacterial and antifungal activity against *Staphylococcus aureus, Candida albicans, Escherichia coli,* MDR *Escherichia coli and* MDR *Klebsiella* spp.. The antibacterial activity of *Sterculia foetida* was evaluated against several bacteria, including *Escherichia coli, Staphylococcus aureus, Bacillus subtilis and Pseudomonas aeruginosa*, and the results showed that the extract inhibited the growth of all bacteria tested, with the greatest inhibition observed against *E. coli. and S. aureus* suggest that the antibacterial activity of the extract is due to the presence of polyphenols, flavonoids, terpenoids and other secondary metabolites.[8] [9]

Sterculia foetida was able to inhibit the growth of all the test microorganisms, except MDR *E. coli***.** In evalution to antifungal properties of the plant, the growth of *C. albicans* was well inhibited by the extract. **(Fig. 4)** *C. albicans* is opportunistic yeast that can cause vaginal, oral and pulmonary infections. The use of this plant may provide a new source of antifungal agents against pathogenic *C. albicans*. This is because the fungus is difficult to control with other drugs.[12] Moreover, the use of *S. foetida* as an antimicrobial agent has not been much investigated in scientific studies. Due to reports of the development of resistance in bacteria and fungi to various commercially available antimicrobial agents, extract of this plants are a potential source of new compounds whose specific

chemical constituents can be developed as effective drugs against microorganisms.[10] Thus, further research on the plant is needed to explore its potential therapeutic benefits.

Fatty acids are isolated from the seeds and seed oil of *Sterculia foetida Linn.* These fatty acids have been found to have antioxidant activity, antibiotic, antifungal, insecticidal and antitumor properties. The fatty acids found in the oil of this plant are tetradecanoic acid (1.65%), hexadecanoic acid (11.87%), and octanoic acid (steculic acid) (6.76%), 9-10-methylene-heptadec-9-enoate (malbalic acid).[11][12][13]

The leaves of *Sterculia foetida* are known to be composed of 5,7,8-tetrahydroxy-4-methoxyflavone-8-O-beta-D-glucoside and 5,7,8-tetrahydroxy-4-methoxyflavone-7-O-beta. there is. -D-glucoside., puerarin and 5,7,8-tetrahydroxy-4-methoxyflavone were isolated.[13][14]

Fruit extract of *Sterculia foetida Linn.* It was developed for silver nanoparticles and its antibacterial activity was evaluated. The silver nanoparticles showed antibacterial activity against human pathogenic bacteria such as *Escherichia coli, Pseudomonas putida and Klebsiella pneumoniae*.[13][15]

The antibacterial and antifungal activity of *Sterculia foetida* makes it a potential source of new natural antibiotics. This plant can be used to develop new and more effective drugs for the treatment of bacterial and fungal infections. Besides, the presence of other biologically active compounds in *Sterculia foetida* suggests that it can also be used for drug development for other diseases. Therefore, further studies are needed to explore the medicinal application potential of this plant.

CONCLUSION

The ethanolic extract of the external peel of *Sterculia foetida* have shown both antibacterial and antifungal properties by inhibiting the growth of *Staphylococcus aureus, Candida albicans, E. coli and* MDR *Klebsiella*. It can be used as a natural remedy for treating bacterial and fungal infections. Further studies are needed to isolate and characterize the active components responsible for its medicinal properties.

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CONFLICTS OF INTEREST

There is no conflict of interest of any Author.

AUTHORS ATTRIBUTION

AS performed the experiment, collected the data and prepared the manuscript; BNC, PG and SD prepared the research design, corrected the manuscript and interpret the results.

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