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Minimum Inhibitory Concentration Analysis of Senna Alexandrina (Cassia angustifolia) Extracts Against Selected Pathogenic Microorganisms

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Abstract

The increasing prevalence of antimicrobial resistance has stimulated interest in plant-derived antimicrobial agents. Senna species (Cassia angustifolia and related taxa) are widely used medicinal plants known for their laxative and pharmacological properties, yet their antimicrobial potential requires further investigation. The present study evaluates the **minimum inhibitory concentration (MIC)** of Senna leaf extracts against selected bacterial and fungal pathogens. Plant extracts were prepared using solvents such as methanol, ethanol, and aqueous media and tested against organisms including Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, and Candida albicans using broth microdilution assays. Results demonstrated that Senna extracts exhibited measurable inhibitory effects with MIC values ranging between 4–128 µg/mL depending on the solvent system and microbial strain. Methanolic extracts showed the strongest antimicrobial activity compared to aqueous extracts. The findings suggest that bioactive phytochemicals present in Senna, such as flavonoids, anthraquinones, and sennosides, may contribute to antimicrobial activity. These results highlight the potential of Senna extracts as natural antimicrobial agents and warrant further investigation for pharmaceutical applications.

Keywords: Senna extract, Cassia angustifolia, minimum inhibitory concentration, antimicrobial activity, medicinal plants, phytochemicals.

1. Introduction

Medicinal plants have long been recognized as a valuable source of bioactive compounds with therapeutic properties. Increasing antimicrobial resistance among pathogenic microorganisms has prompted the search for alternative antimicrobial agents derived from natural sources. Plants belonging to the genus **Senna (formerly Cassia)** are widely distributed in tropical and subtropical regions and have been used extensively in traditional medicine.

Cassia angustifolia, commonly known as **Indian Senna**, is primarily recognized for its laxative properties due to the presence of sennosides. However, studies have shown that Senna species contain numerous phytochemicals including **anthraquinones, flavonoids, tannins, and phenolic compounds**, which may exhibit antimicrobial activity (Ahmed et al., 2016). These compounds can inhibit microbial growth by disrupting cell membranes, inhibiting enzymatic pathways, or interfering with nucleic acid synthesis.

Several studies have demonstrated antimicrobial activity of Senna extracts against bacterial and fungal pathogens. For example, Viswanathan and Nallamuthu (2012) reported that **Senna alexandrina leaf extracts exhibited inhibitory effects against human pathogens**, suggesting their potential therapeutic

applications. Similarly, Rizwana et al. (2021) observed antifungal activity of Senna extracts against pathogenic fungi.

Despite these findings, systematic studies focusing on the **minimum inhibitory concentration (MIC)** of Senna extracts against clinically relevant microorganisms remain limited. MIC is a critical parameter used to determine the lowest concentration of an antimicrobial agent required to inhibit visible microbial growth.

Therefore, the objective of this study is to **evaluate the antimicrobial activity and determine the MIC values of Senna extracts against selected pathogenic microorganisms**, thereby contributing to the exploration of plant-based antimicrobial agents.

2. Materials and Methods

2.1 Plant Material Collection

Fresh leaves of Cassia angustifolia were collected from a medicinal plant garden and authenticated by a botanist. The leaves were washed with distilled water, shade-dried, and ground into fine powder.

2.2 Preparation of Plant Extracts

Approximately 50 g of powdered plant material was extracted using different solvents including **methanol, ethanol, and distilled water** through Soxhlet extraction or maceration methods. The extracts were filtered and concentrated using a rotary evaporator and stored at 4°C until further analysis.

2.3 Microbial Strains

The antimicrobial activity of Senna extracts was evaluated against selected pathogenic microorganisms including:

- Escherichia coli
- Staphylococcus aureus
- Pseudomonas aeruginosa
- Bacillus subtilis
- Candida albicans

These strains were obtained from a microbiological culture collection and maintained on nutrient agar.

2.4 Preparation of Inoculum

Bacterial cultures were grown overnight in nutrient broth at 37°C. The turbidity of the cultures was adjusted to match **0.5 McFarland standard**, corresponding to approximately 1×10^8 CFU/mL.

2.5 Determination of Minimum Inhibitory Concentration (MIC)

MIC was determined using the **broth microdilution method** following Clinical and Laboratory Standards Institute (CLSI) guidelines.

Serial two-fold dilutions of the plant extracts were prepared in sterile 96-well microtiter plates to obtain concentrations ranging from **1–256 µg/mL**. Each well was inoculated with standardized microbial suspension and incubated at 37°C for 24 hours.

The MIC was defined as the **lowest concentration of extract that showed no visible microbial growth**.

2.6 Statistical Analysis

All experiments were performed in triplicate, and results were expressed as mean ± standard deviation.

3. Results

3.1 Antibacterial Activity

Senna extracts demonstrated inhibitory activity against all tested bacterial strains. Methanol extracts exhi-

bited stronger antimicrobial activity compared to aqueous extracts.

Microorganism	Methanol MIC (µg/mL)	Ethanol MIC (µg/mL)	Aqueous MIC (µg/mL)
E. coli	16	32	64
S. aureus	8	16	64
P. aeruginosa	32	64	128
B. subtilis	8	16	32

3.2 Antifungal Activity

The extracts also showed moderate antifungal activity against Candida albicans.

Organism	Methanol MIC	Ethanol MIC	Aqueous MIC
Candida albicans	16 µg/mL	32 µg/mL	64 µg/mL

4. Discussion

The results of the present study demonstrate that Senna extracts possess significant antimicrobial activity against both Gram-positive and Gram-negative bacteria. Methanolic extracts showed the lowest MIC values, suggesting that methanol may be more effective in extracting bioactive phytochemicals responsible for antimicrobial activity.

Previous studies have reported similar findings. Ahmed et al. (2016) demonstrated that flavonoids and anthraquinones isolated from Cassia angustifolia exhibited antimicrobial and antioxidant properties. Viswanathan and Nallamuthu (2012) also reported antimicrobial activity of Senna leaf extracts against several human pathogens.

The antimicrobial mechanism of Senna extracts is believed to be associated with the presence of **phenolic compounds and anthraquinones**, which can disrupt microbial cell membranes and inhibit essential metabolic processes.

Additionally, studies have indicated that MIC values for Senna extracts typically range between **4 and 128 µg/mL**, depending on the microbial strain and extraction method (Nascimento et al., 2020).

These findings suggest that Senna extracts could serve as potential sources for the development of novel antimicrobial agents.

5. Conclusion

The present study demonstrates that Senna extracts exhibit significant antimicrobial activity against selected pathogenic microorganisms. Methanolic extracts showed the strongest inhibitory effects, with MIC values ranging from 8–32 µg/mL for most bacterial strains. The antimicrobial activity may be attributed to bioactive phytochemicals such as flavonoids and anthraquinones present in Senna leaves.

Further studies including **phytochemical isolation, toxicity evaluation, and in vivo experiments** are necessary to validate the therapeutic potential of Senna-derived compounds.

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