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Research Article

Preparation & Development of a Topical Gel Containing *Bauhinia purpurea* Leaf Extract

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ABSTRACT

The research aimed to explore the antibacterial properties of Bauhinia purpurea leaf extracts and assess their potential for medical applications. Specifically, the study focused on evaluating the efficacy of both aqueous and methanol extracts against S. aureus and E. coli bacterial strains using the agar well diffusion method on Muller-Hinton Agar medium. Results indicated that the methanolic extract exhibited significant inhibition against Staphylococcus aureus, while the aqueous extract did not demonstrate observable activity against the tested microorganisms. This suggests that the antibacterial activity of Bauhinia purpurea leaf extracts may be solvent-dependent, with methanol being more effective in extracting the bioactive compounds responsible for antibacterial properties. Moreover, the research involved the development and assessment of eight different formulations derived from these extracts. Various parameters such as physical characteristics, pH, spreadability, viscosity, antibacterial effectiveness, and in-vitro cell diffusion were evaluated to determine the suitability of these formulations for potential applications. Overall, the study highlights the potential of Bauhinia purpurea leaf extracts, particularly the methanol extract, as a source of antibacterial agents. Further research could focus on identifying and isolating the specific bioactive compounds responsible for the observed antibacterial activity and optimizing formulations for practical applications in medicine or healthcare.

INTRODUCTION

For centuries, plants have served as remedies for human ailments owing to their therapeutic components. Their richness in antimicrobial agents stems from the diverse array of microorganisms they harbor and the abundance of metabolites extractable from them[1]. This recognition of traditional medicines as viable healthcare alternatives has spurred scientific exploration into the antimicrobial potential of medicinal plants. Contemporary research has

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pinpointed numerous secondary metabolites within various plant species possessing antimicrobial properties. Given the severity of human infections, particularly those caused by bacteria and fungi, the quest for novel antimicrobial agents remains imperative. This drive fuels ongoing investigations into the medicinal properties of plants, aiming to unearth new chemotherapeutic options[2-3].

Bauhinia purpurea Linn (Fabaceae), mostly referred to as the butterfly plant, is a deciduous tree of average size, found sparsely in India. It boasts a range of gastrointestinal applications, including serving as a laxative (flowers), a carminative agent (roots), and a remedy for diarrhea (bark). This plant has been used traditionally to cure a number of ailments, including septicemia, dropsy, discomfort, rheumatism, convulsions, and delirium.[4]

The aerial parts of the plant reportedly contain flavone glycosides, dimeric flavonoids, 6-butyl-3-hydroxy flavanone, amino acids, phenyl fatty esters, lutein, and β-sitosterol[5]. Notably, *Bauhinia purpurea* has found utility as a novel paraffin section marker for identifying Reed–Sternberg cells in Hodgkin's lymphoma[6].

Furthermore, *Bauhinia purpurea* lectin (BPA), isolated from the seeds of *Bauhinia purpurea* alba, exhibits specificity for Galβ1-3GalNAc (T) and has been extensively utilized in various cytochemical and immunological studies of cells and tissues under pathological or malignant conditions[7]. BPA serves as a marker in hyperplastic human tonsils and peripheral blood mononuclear cells, employed in immune histological, immune electron microscopic, and flow cytometric techniques[8].

Herbs Used in Indian traditional medicine marks the inception of disease healing, owing to their rich reservoir of antioxidants capable of mitigating or delaying various diseased conditions. Among these, the stem bark of *Bauhinia purpurea* has been historically employed by Indian, Sri Lankan, and Pakistani communities to address a spectrum of ailments including ulcers, wounds, glandular swellings, stomach tumors, poison antidotes, diarrhea treatment, antihelminthic applications, leprosy, menstrual disorders, and rectal disorders.

Reports suggest that Bauhinia species contain steroidal glycosides, terpenoids, lactones, and flavonoids. *Bauhinia purpurea* has been documented to exhibit diverse pharmacological activities such as antioxidant, hepatoprotective, hypoglycemic, antiproliferative, and anti-inflammatory effects. Thus, the current study endeavors to evaluate the secondary metabolites, antibacterial activity, and in-vitro drug release profiles of gels prepared from extracts of *Bauhinia purpurea.*

The current study set out to determine the active ingredients in *Bauhinia purpurea* that possessed antibacterial activity in order to determine any potential therapeutic benefits. Agar well diffusion was used to test the *Bauhinia purpurea* leaf extract's antibacterial properties.

Fig.1: Image of *Bauhinia purpurea* plant

MATERIALS AND METHODS

Sample collection

The leaves of *Bauhinia purpurea* were collected from Solapur District of Maharashtra, India. After being carefully cleaned with water, the gathered leaves were dried in the shade. After drying, the dried leaves were ground into a powder using a blender so they could be used again.

Extraction of plant material

Aqueous Extract Preparation

The *Bauhinia purpurea* leaf powder of 160 gm was dispersed in approximately 2600 ml of distilled water and allowed to undergo maceration. The macerated mixture was filtered using muslin cloth to remove larger particles. This process was repeated thrice to ensure thorough filtration. Subsequently, the filtrate was passed through whatman filter paper for finer filtration. This step helps to remove smaller particles and debris, yielding a clearer solution. The filtrate obtained from the previous step was subjected to evaporation using a hot water bath at a controlled temperature. The purpose of evaporation is to remove the solvent (water) from the extract, leaving behind the concentrated extract. And extract was stored at a temperature range of 5-10°C to maintain its stability.

Methanolic Extract Preparation

The *Bauhinia purpurea* leaf powder of 70 gm was dispersed in approximately 500 ml of methanol and allowed to undergo maceration. The macerated mixture was filtered using muslin cloth to remove larger particles. This process was repeated thrice to ensure thorough filtration. Subsequently, the filtrate was passed through whatman filter paper for finer filtration. This step helps to remove smaller particles and debris, yielding a clearer solution. The filtrate obtained from the previous step was subjected to evaporation using a hot water bath at a controlled temperature. The purpose of evaporation is to remove the solvent (water) from the extract, leaving behind the concentrated extract. And extract was stored at a temperature range of 5-10°C to maintain its stability.

Phytochemical analysis

Qualitative analysis was done for the existence of alkaloid, carbohydrate, glycoside, saponins, phenols and tannins, Flavonoids, Amino acids, proteins, steroids[9].

Table 1: Preliminary phytochemical screening of extracts of *Bauhinia purpurea* leaves

Sr. No.	Plant constituents	Methanol extract	Aqueous extract
1	Alkaloids	-	-
2	Carbohydrates	-	-
3	Glycosides	+	-
4	Saponins	+	+
5	Phenolic compounds &Tannins	+	+
6	Flavonoids	+	+
7	Amino Acids	+	+
8	Protein	-	-
9	Steroid	-	-

PREPARATION OF GEL

Table 2: Formulation of Herbal Gel Containing *Bauhinia purpurea* Aqueous Leaves Extract

Sr. No	INGREDIENTS	A1	A2	A3	A4
1	Carbopol 940 (%)	1.5	1.5	1.5	1.5
2	BPL Aq Extract (gm)	0.05	0.1gm	0.15gm	0.2
3	BPL Aq Ext./ml of gel base (gm/ml)	0.005	0.01	0.015	0.02
4	Propylene Glycol (ml)	3	3	3	3
5	Methyl Paraben (gm)	0.3	0.3	0.3	0.3

6	Propyl Paraben (gm)	0.15	0.15	0.15	0.15
7	Triethanolamine	q.s	q.s	q.s	q.s

Table 3: Formulation of Herbal Gel Containing Table For *Bauhinia purpurea* Methanolic leaves Extract

Sr. No.	INGREDIENTS	M1	M2	M3	M4
1	Carbopol 940(%)	1.5	1.5	1.5	1.5
2	BPL Me Extract (gm)	0.05	0.1	0.15	0.2
3	BPL Me Ext./ml of gel base(gm/ml)	0.005	0.01	0.015	0.02
4	Propylene Glycol (ml)	3	3	3	3
5	Methyl Paraben (gm)	0.3	0.3	0.3	0.3
6	Propyl Paraben (gm)	0.15	0.15	0.15	0.15
7	Triethanolamine	q.s	q.s	q.s	q.s

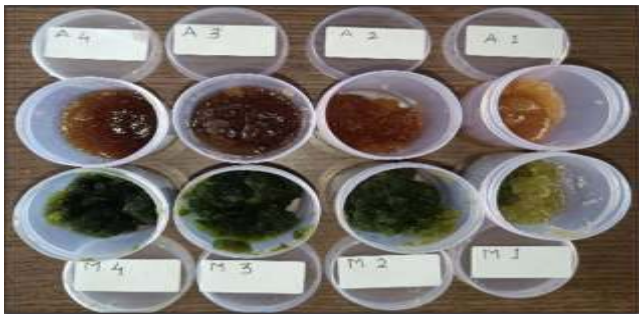

Fig. 2: Formulation of gel from *Bahuinia purpurea* Aqueous and Methanol Extract

RESULT & DISCUSSION

Evaluation of gel

1. Physical appearance

The physical appearance of *Bauhinia purpurea* gel, such as color and consistency, was visually checked shown in table 4 and 5. The pH value of the gel formulation is shown in table 3 gel was found to be in the range of 5.7 – 6.3 slightly alkaline pH, which is similar to normal skin.

Table 4: Physical Evaluation of *Bauhinia purpurea* Aqueous leaf Extract

Formulation code	Color	Consistency
A1	Light brown	Semi-solid
A2	Brown	Semi-solid
A3	Brown	Semi-solid
A4	Dark brown	Semi-solid

Table 5: Physical evaluation of BPL Methanol Extract

Formulation code	Color	Consistency
M1	Green	Semi-solid
M2	Green	Semi-solid
M3	Green	Semi-solid
M4	Dark Green	Semi-solid

2. pH

The pH value of the gel formulation is shown in table 7&8, gel was found to be in the range of 5.7 – 6.3 slightly alkaline pH, which is similar to normal skin.

Table 6: Determination of pH Aqueous Extract

Formulation code	pH
A1	5.7 ± 0.2
A2	5.5 ± 0.2
A3	5.9 ± 0.2
A4	6.1 ± 0.2

Table 7: Determination of pH Methanol Extract

Formulation code	pH
M1	6.2± 0.2
M2	5.9 ± 0.2
M3	6.3 ± 0.2
M4	5.8 ± 0.2

3. Viscosity

The viscosity of the herbal gel formulations was assessed using a Brookfield rotational viscometer with spindle number 64, operated at a rotational speed of 100 rpm.

Table 8: The viscosity of formulation ranged from 1878-5408 cps

Formulation containing Aqueous extract		Formulation containing Methanol extract	
Formulation code	Viscosity (cps)	Formulation code	Viscosity (cps)
A1	4482	M1	3158
A2	2646	M2	3876
A3	2632	M3	5408
A4	1878	M4	3690

4. Antibacterial activity

The in vitro antibacterial activities of both aqueous and organic extracts of *Bauhinia purpurea* were determined using the standard agar well diffusion assay. Petri dishes with a diameter of 100 mm containing 25 ml of Mueller-Hinton Agar (MHA) were inoculated with 100µl of the test strain. After allowing the inoculum to solidify, wells with a diameter of 6 mm were created in the solidified agar using a sterilized cork-borer. Subsequently, 100µl of each extract was dispensed into its respective well, and the plates were then incubated at 37°C for 24 hours. Negative controls included dimethyl sulfoxide (DMSO), while tetracycline antibiotic served as the positive control. The experiment was conducted under strict aseptic conditions, and the antibacterial activity of each extract was quantified by measuring the mean diameter of the zone of inhibition (mm) produced by the respective plant extract[10].

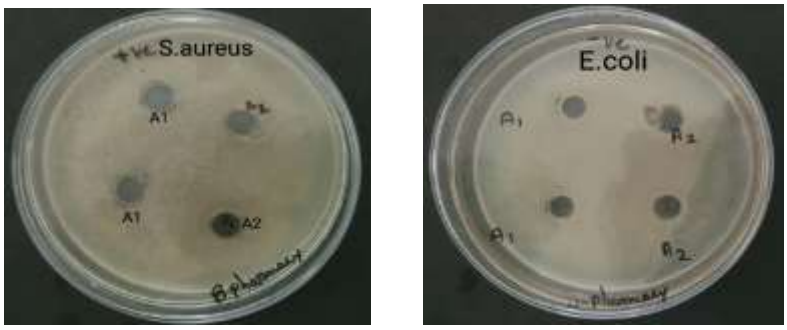

Fig. 3: Zone of inhibition of Aqueous Extract formulation on *S. aureus* & *E. coli*

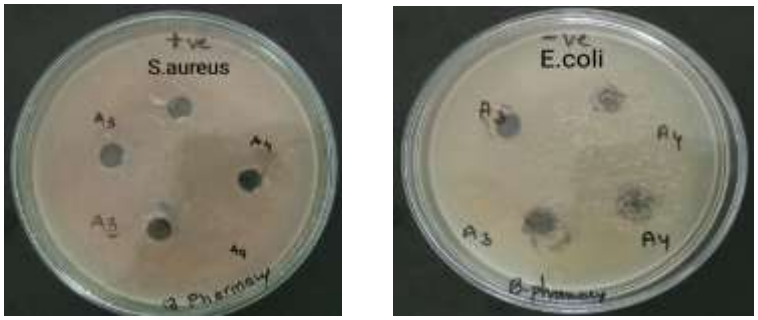

Fig. 4: Zone of inhibition of Aqueous Extract formulation on *S. aureus* & *E.coli*

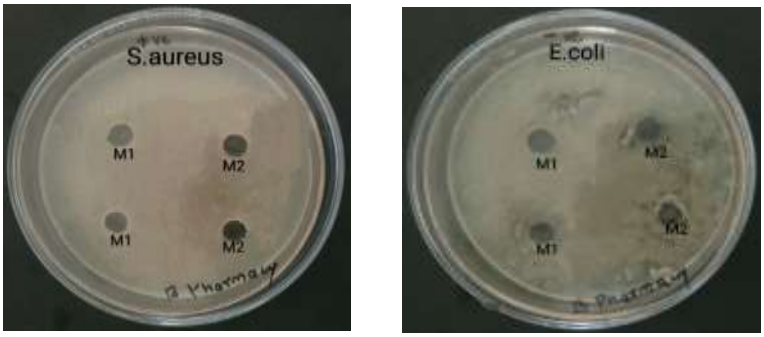

Fig. 5: Zone of inhibition of Methanol Extract formulation on *S. aureus* & *E. coli*

Fig 6: Zone of inhibition of Methanol Extract formulation on *S.aureus* & *E.coli.*

Table 9: Results of antimicrobial screening of aqueous and organic plant extracts determined by agar diffusion method

Zone of inhibition (in mm diameter)																
Bacterial strains	***S. aureus***								***E.coli***							
Extraction type (mg/ml)	**Aqueous**				**Methanol**				**Aqueous**				**Methanol**			
Formulation code	A1	A2	A3	A4	M1	M2	M3	M4	A1	A2	A3	A4	M1	M2	M3	M4
Diameter (mm)	0	0	0	0	0	0	20	26	0	0	0	0	0	0	18	22
Tetracycline	35				35				30				30			
DMSO	NA				NA				NA				NA			

CONCLUSION

The formulation and evaluation of a herbal gel containing *Bauhinia purpurea* leaves extract, along with the study of its antimicrobial activities, have been successfully completed. Phytochemical screening studies of the crude drug, identification of chemical compounds, and various evaluation parameters were conducted. The results demonstrate that the *Bauhinia purpurea* herbal gel formulations exhibit favorable appearance, ease of spreadability, improved release profile, and stability. Among all gel formulations, formulation M4 containing *B. purpurea* along with showed better spreadability, promising anti-microbial action against gram positive and gram negative micro-organism, and formulation A4 shows the maximum drug release as compared to other formulation.

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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