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BRAHMI (BcopaMonnieri): The Ancient Herb of Cognition and Calm

Investigating the Potential of Bacopa monnieri (Brahmi) in Combating Bacterial Skin Diseases

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BRAHMI (BcopaMonnieri): The Ancient Herb of Cognition and Calm Investigating the Potential of *Bacopa monnieri* (Brahmi) in Combating Bacterial Skin Diseases

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Abstract

Bacopa monnieri (Brahmi), a revered herb in traditional Ayurvedic medicine, is widely recognized for its adaptogenic, anxiolytic, and nootropic benefits. While its primary applications have historically centered on neurological and cognitive health, emerging interest in natural product-based antimicrobials warrants exploration into its broader therapeutic potential. Skin diseases, frequently exacerbated or caused by bacterial infections, pose a significant global health burden, driving the search for novel and effective antibacterial agents with minimal side effects. This abstract explores the current understanding of Brahmi's phytochemical composition, including bacosides, alkaloids, and flavonoids, which have demonstrated diverse pharmacological activities, including some reported general antimicrobial properties *in vitro*. However, direct scientific evidence specifically demonstrating Brahmi's efficacy in "curing skin diseases bacteria" remains scarce. While some traditional uses might allude to its application in various skin ailments, these often lack rigorous validation concerning specific bacterial pathogens. This paper hypothesizes that certain bioactive compounds within *Bacopa monnieri* may exhibit bactericidal or bacteriostatic effects against common dermatological pathogens, potentially offering a complementary or alternative approach to conventional treatments. Further comprehensive in vitro and in vivo studies are critically needed to elucidate the precise mechanisms of action, identify active antimicrobial constituents, and validate the therapeutic potential of Brahmi extracts against relevant skin disease-causing bacteria. Such research could pave the way for the development of novel, nature-derived interventions for dermatological infections.

INTRODUCTION

Brahmi (BaikopopaMonniera Linen) was important to improve memory and learning skills. First published in 1982 (Singh and Dhawan, 1982). Various studies have been done since then in animals to determine different properties shown by medical herbs. Brahmi capacity neuronal structure and/or function have also been evaluated several increasing evaluations in conservation Studies. Brahmi is a famous Ayurvedic medical herb, which retaliates as a repetition treatment of memory disorders. The medical power is informed in both Indians as well as both Indians. Chinese as traditional literature. However, many chemical compounds are separated Brahmi, active excerpts of this medicinal plant include Becoside-A and Becoside-B. a number Other phytochemicals such as alkaloids, glycosides, flavonoids, saponin etc. are components Brahmi (Dutta and Basu, 1963; Chatterjee et al., 1965; Basu et al., 1967). The survey done so far has revealed that Brahmi is many medical in addition to antiparkinson, antistroke and display, Alzheimer's disease and Alzheimer's disease and Shikhazophrenia treatment including memory increase effects , andanticonvalent potential. Current review discusses the chemical component of Brahmi together in vitro and VIVO studies based on molecular and medical effects.

Treatment skin diseases using Brahmi:

Brahmi (Bacopa monnieri) is a traditional Ayurvedic herb known for its use in skin conditions.Modern research supports its antimicrobial properties, particularly against bacteria causing skin diseases like *Staphylococcus aureus*, *E. coli*, and *Pseudomonas aeruginosa*. This is due to its active compounds like bacosides, alkaloids, and flavonoids, which can disrupt bacterial cell membranes and inhibit their growth. While promising, most evidence is from lab and animal studies; more human trials are needed. Brahmi can be used topically (pastes, oils) or internally for skin health.

MATERIAL REQUIRED

2.1 PROTOCOLS OF PHYTOCHEMICAL TEST IN BRAHMI:

2.1.1. SAPONIN TEST:- A saponin test is a phytochemical screening process designed to detect the presence of saponin in a plant sample or extracts. The test depends on the specific assets of saponin, which are glycosides that have a "soap -like" foamy ability when ampipatic (both hydrophilic and hydrophobic parts) are stimulated in water due to nature. They reduce the load on the water surface and cause frequent foam formation.

For green leaves- take 2ml of brahmi green leaf sample. add 8ml of water. shake it high. if froth is present it is positive. if froth is absent it is negative. in this froth is present it is positive.

For dry leaves - take 2ml of brahmi dry leaf sample .add 8ml of water. Shake it high. if froth is present it is present. if froth is absent negative. in this froth is absent it is negative

For dry – negative For wet – positive

Fig. 1 Saponin test

2.1.2 TANIN TEST OR BRAYMER TEST:A tannin test is a phytochemical screening method used to be qualitatively used to detect the presence of tannin in a plant extract. It is based on the principle that tannin, which is a polyphenolic compound, will respond to some reagents to produce specific color changes or precipitation, which is then seen as a positive sign. The most common reagent is the use of iron chloride (FECL3), usually a blue-black, blue or green color.

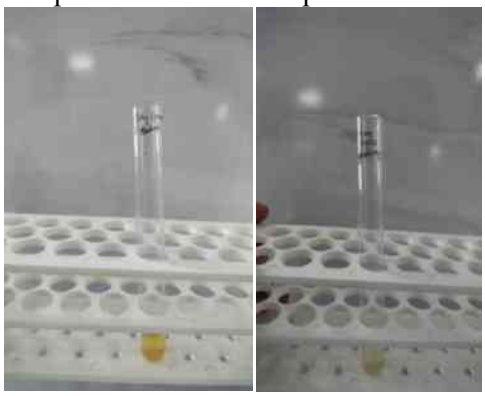
For green leaves – (**no water if sample is taken from saponin test).**take 1ml of sample green leaves - few drops of 10% ferric chloride. if blue /green color the its positive .if not then negative. in this blue and green color is not form it is negative.

For dry leaves – **(no water if sample is taken from saponin test) .**take 1ml of sample dry leaves .few drops of 10% ferric chloride .if blue /green color the its positive .if not then negative. in this blue green color is not form then it is negative.

For dry – positive For wet – negative

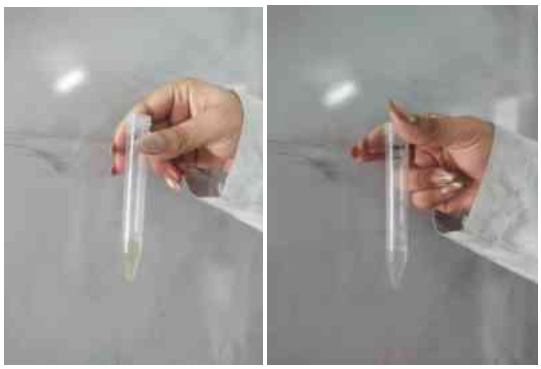
Fig. 2 : Tannin test

FLAVOID TEST:- A flavonoid test is a chemical method used to detect the presence of flavonoids in a sample, most commonly in plant extracts. Flavonoids are a large group of natural compounds found in various plants, fruits, and vegetables, known for their diverse biological activities.
For green leaves -take 1ml of sample green leaves. add 2ml of Noah (yellow color is form). add concentrate hcl 1drop **.**colorless the its positive . yellow color then it is negative. it is colorless it is positive.
For dry leaves-add 1ml of sample dry leaves .add 2ml of Noah (yellow color is form). add concentrate hcl 1drop.Colorless then it is positive. Yellowcolor then it is negative. it is yellow in color it is positive



For dry – negativeFor wet – positve
Fig. 3: Flavoid test

2.1.4ALKALOID TEST OR WANGER TEST: An alkaloid test is a common chemical method used to detect the presence of alkaloids in a sample, usually extracts of a plant. Alkaloid is a diverse group of naturally occurring organic compounds containing at least one nitrogen atom (usually in a heterocyclic ring) and shows significant physical activity in living organisms including humans, including humans.
For Green Leaves - add 1ml of sample green leave .add few drops of Wagner's reagent brown reddish ppt is form then it is positive if not then it is negative. Reddish brown ppt is form it is positive
For dry leaves - add 1ml of sample dry leaves .add few drops of Wagner's reagent . Brown reddish ppt is form then it is positive if not then it is negative. Reddish brown ppt is from it is positive

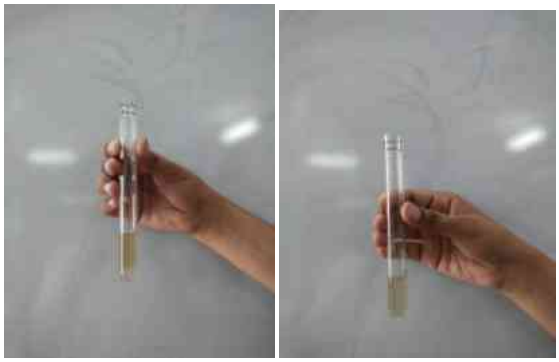


For dry- positive For wet – positive
Fig. 4: Alkaloid test

2.1.5TERPENOID TEST:A termoid test is a chemical method used to detect the presence of terpenoids in a sample, which is usually in plant extracts. Terpenoids (also known as isoprenoids) are a large and diverse class of natural organic compounds obtained from five-carbonisoprine units. They are known for their wide range of biological activities, including aromatic properties, medical properties and roles in protecting the plant

For Green Leaves – add 2ml of sample green leaves. add 800microliter of chloroform. 1ml of concentrate sulphuric acid (Place test tube in water while add sulphuric acid.grey color solution positive. if not then it is negative. It have grey color it is positive

For dry leaves - 1ml of sample dry leaves. add 800microliter of chloroform. 1ml of concentrate sulphuric acid. (Place test tube in water while add sulphuric acid) grey color solution positive. If not then it is negative. It do not have grey color it is negative



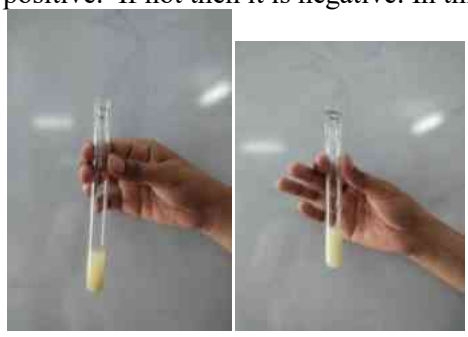
For dry – negative **For wet – positive**

Fig. 5: Terpenoid test

2.1.6 PHENOLIC OR LEAD ACETATE TEST: A phenolic test refers to any chemical method used to detect the presence of phenol compounds in a sample, usually a plant extract or other organic matrix. Phenol connection is a large group of aromatic organic compounds, characterized by the presence of one or more hydroxyl (Offoh) groups directly associated with a fragrant ring (like a benzene ring). They are widely distributed in plants and are known for their antioxidants, antimicrobial and other biological activities

FOR GREEN LEAVES -Add 2ml Of Sample Green Leaves. Add 10% Of Lead Acetate (Make 2ml). If White Ppt Positive. If Not Then It Is Negative. In this white ppt is form it is positive

FOR DRY LEAVES - Add 2ml of sample dry leaves. add 10% of lead acetate (make 2ml).If white ppt positive. If not then it is negative. In this white ppt is not form it is negative.



For dry – negative **For wet – positive**

FIG. 6: Phenolic test

2.1.7 DRAGENDROFF'S TEST:A chemical test used to detect alkaloids. The reagent (containing potassium bismuth iodide) reacts with alkaloids to form an orange or reddish-brown precipitate.

For green leaves - Add 2ml of sample green leaves. add 1 – 2ml of dragendroff's reagent. If reddish brown ppt positive. if not then it is negative. In this reddish brown ppt is form it is positive.

For dry leaves – Add 2ml of sample dry leaves. add 1 – 2ml dragendroff's reagent. If reddish brown ppt positive. If not then it is negative. In this reddish brown ppt is not form it is negative

For dry – negative For wet – positive

Fig. 7: Dragendroff's test

FLAVANOID TEST:

CYANIDIN TEST: Cyanidin test **is a** chemical test used to detect the presence of anthocyanin pigments**,** particularlyCyanidin, in plant extract

For green leaves - add 2ml of sample green leaves. dissolved in 1-2ml 50%methanol by heating. Add metal magnesium . 6drop of concentrate hcl. **I**f red color/orange color positive. If not then it is negative. In this orange color is not form it is negative

For dry leaves - Add 2ml of sample dry leaves. dissolved in 1-2ml 50%methanol by heating. Add metal magnesium. 6drop of concentrate hcl. If red color / orange color positive. if not then it is negative. In this orange color is form it is positive

For dry – posiitiveFor wet – negative

Fig. 8: Cyanidin test

AMMONIA TEST : Ammonia test **is a** chemical test used to detect the presence of anthraquinone glycosidesin plant extracts

For green leaves -Add 2ml of sample green leaves. Add 2ml of ammonia (yellow color form). Add 1ml of concentrate h2so4. **If** color disappear positive. If not then it is negative. In this color is not disappear properly it is negative

For dry leaves - Add 2ml of sample dry leaves. Add 2ml of ammonia (yellow color form). add 1ml of concentrate h2so4. If color disappear positive. If not then it is negative. Inthis color is not disappear properly it is negative.

FOR DRY - NEGATIVEFOR WET - NEGATIVE

Fig. 9: Ammonia test

CARBOHYDRATES TEST(MOLISH TEST): A carbohydrates test **is a** chemical test used to detect the presence of carbohydrates (sugars and polysaccharides) in a sample, typically by observing a color change or precipitate formation upon reaction with specific reagents.

For green leaves - add 2ml of sample green leaves. add 2drops of alcoholic napthol. Add 1ml of concentrate h2so4.If violet ring positive. if not then it is negative. In this violet ring is not form it is negative.

For dry leaves - Add 2ml of sample dry leaves. Add 2drops of alcoholic napthol. Add 1ml of concentrate h2so4. If violet ring positive. If not then it is negative. In this violet ring is not form it is negative

FOR DRY – NEGATIVE FOR WET – NEGATIVE

Fig. 10: Carbohydrate test

2.1.10REDUCING SUGAR:

2.1.10.1 BENEDICT'S TEST: Benedict's test **is a** qualitative chemical testused **to** detect the presence of reducing sugars**, such as** glucose, fructose, lactose, and maltose**,** in a sample.

For green leaves - Add 2ml of sample green leaves. Add 0.5ml Benedict's reagent. boil for 2min. If yellow /green/red positive. If not then it is negative

For dry leaves - Add 2ML OF SAMPLE DRY LEAVES. Add 0.5ml Benedict's reagents. Boil for 2min.if yellow /green/red positive. If not then it is negative

FOR WET – POSITVE **FOR DRY – POSTIVE**

Fig. 11: Benedict test

2.1.10.2 FEHLING TEST: Fehling's test **is a** chemical test used to detect the presence of reducing sugars**,** especiallyaldehydes-containing sugarslikeglucose**.**

For green leaves -Add 2ml Of Sample Green Leaves.Add 0.5ml Benedict's Reagents. Boil For 2min. If Yellow /Green/Red Positive. If Not Then It Is Negative. In this it form green color it is positive.

For dry leaves - Add 2ml Of Sample Dry Leaves. Add 0.5ml Benedict's Reagents. Boil For 2min.If Yellow /Green/Red Positive. If Not Then It Is Negative. In this it form blue color it is negative

FOR DRY - NEGATIVE (BLUE) **FOR WET – POSITIVE (GREEN)**

Fig. 12: Fehling test

2.1.11 PHENOLIC TEST -

2.1.11.1 HOT WATER TEST: The "Hot Water Test" is a quality control process used to evaluate the durability, resistance, and performance of a product when exposed to high temperatures, typically through immersion in hot water for a specified period.

For Green Leaves - Hot Water In A Beaker. Motor Plant Part Is Dipped. Warmed For A Min (Black/Brown Ring). [0.1gm Sample +5ml H2o] (Heat). If Black /Brown Ring Positive. If Not Then It Is Negative. In this black / brown ring is not form it is negative

For Dry Leaves - Hot Water In A Beaker. Motor Plant Part Is Dipped. Warmed For A Min (Black/Brown Ring).[0.1gm Sample +5ml H2o] (Heat)If Black /Brown Ring Positive. If Not Then It Is Negative. In this black ring is form it is positive.

For dry – positive **For wet – negative**

Fig.13: Hot water test

2.1.11.2POTASSIUM DICHROMATE TEST: The "Potassium Dichromate Test" is a chemical test that utilizes the strong oxidizing properties of potassium dichromate (K2Cr2O7), typically in an acidic medium, to detect the presence of reducing agents by observing a characteristic color change**.**

For Green Leaves - Add Green Plant Extract.Add Few Drops Of Potassium Dichromate. If Dark Color Positive. If Not Then It Is Negative. It does not show dark color it is negative

For Dry Leaves - Add Dry Plant Extract. Add Few Drops Of Potassium Dichromate. If Dark Color Positive. If Not Then It Is Negative. It does not show dark color it is negative

FOR WET – NEGATIVE **FOR DRY – NEGATIVE**

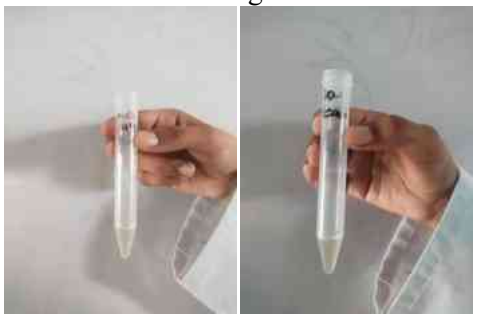
Fig.14: Potassium Dichromate test

2.1.12 PROTEIN TEST-

2.1.12.1 NINHYDRIN TEST: The "Ninhydrin Test" is a chemical test used to detect the presence of primary amines, secondary amines, and ammonia, but it is most famously known for detecting α-amino acids, peptides, and proteins, yielding a characteristic deep blue-purple color.

For Green Leaves - Add 2ml of Sample Green Leaves. Add 2drops Of Ninhydrin Solution.If Purple Positive. If Not Then It Is Negative. It does not show purple color it is negative

For Dry Leaves -Add 2ml Of Sample Green Leaves. Add 2drops Of Ninhydrin Solution. If Purple Positive . If Not Then It Is Negative. It does not show purple color



FOR WET – NEGATIVE **FOR DRY – NEGATIVE**

Fig. 15: Ninhydrin test

2.1.13 XANTHOPROTEIC TEST -The "Xanthoproteic Test" is a chemical test used to detect the presence of proteins containing aromatic amino acids, specifically tyrosine, tryptophan, and phenylalanine, by observing a characteristic yellow coloration upon heating with concentrated nitric acid, which turns orange upon basification.

For Green Leaves - Add 2ml Of Sample Green Leaves. Add Fes Drops Of Concentrate Nitric Test.If Yellow Positive. If Not Then It Is Negative. It does not show yellow color it is negative

For Dry Leaves - Add 2ml Of Dry Green Leaves. Add Fes Drops Of Concentrate Nitric Test. If Yellow Positive. If Not Then It Is Negative. It show yellow color it is positive

For wet – negative **For dry – positive**

Fig.16: Xanthoproteic test

TABLE OF PHYTOCHEMICAL

TEST NAME	DRY EXTRACT (BEFORE IMAGE)	DRY EXTRACT	DRY EXTRACT (AFTER IMAGE)	WET EXTRACT (BEFORE IMAGE)	WET EXTRACT	WET EXTRACT (AFTER IMAGE)
SAPONIN TEST		NEGATIVE			POSITIVE	
TANIN TEST		POSITIVE			NEGATIVE	
FLAVOID TEST		POSITIVE			POSITIVE	
ALKALOID TEST		POSITIVE			POSITIVE	
TERPENOID TEST		NEGATIVE			POSITIVE	
PHENOLIC &LEAD ACETATE TEST		NEGATIVE			POSITIVE	
DRAGENDOFF TEST		NEGATIVE			NEGATIVE	

FLAVOID TEST:-						
• CYANIDIN TEST		POSITIVE			NEGATIVE	
• AMMONIA TEST		NEGATIVE			NEGATIVE	
CARBOHYDRATE TEST(MOLISH TEST)		NEGATIVE			NEGATIVE	
REDUCING SUGAR TEST:-						
• BENEDICT'S TEST		POSITIVE			POSITIVE	
• FEHLING TEST		NEGATIVE (GREEN)			POSITIVE (BLUE)	
PHENOLIC TEST:-						
• HOT WATER TEST		POSITIVE			NEGATIVE	

• POTASSIUM DICHROMATE TEST		NEGATIVE			NEGATIVE		
PROTEIN TEST:-							
NINHYDRIN TEST:-		NEGATIVE			NEGATIVE		
XANTHOPROTEIC TEST :-		POSITIVE			NEGATIVE		

ISOLATION OF BACTERIA –

ISOLATION OF BACTERIA – Staphylococcus aureus

This process aims to isolate a pure culture of *S. aureus* from a mixed sample and then perform initial characterization.

1. Collection of Sample

Purpose: To obtain a biological sample likely to contain *S. aureus*.

Details for *S. aureus*:*S. aureus* is a common commensal on human skin and mucous membranes (especially the nasal passages), and a frequent cause of skin infections, wound infections, and food poisoning. Therefore, samples often include:

Clinical Swabs: skin lesion swabs

2. Serial Dilution

Purpose: To reduce the concentration of bacteria in the sample to a manageable level, allowing for the formation of isolated colonies on solid media.

Details for *S. aureus*: Applicable to any bacterial isolation.

Procedure:

Prepare a series of sterile dilution blanks (e.g., tubes containing 9 mL of sterile saline or peptone water).

Add 1 mL of the initial sample to the first dilution blank (1:10 dilution). Mix thoroughly.

Transfer 1 mL from the first dilution to the second blank (1:100 dilution). Mix.

Continue this process to create further dilutions (e.g., 1:1000, 1:10,000, 1:100,000, etc.) until a desired dilution range is achieved (often 10^{-4} to 10^{-6} for typical samples). The goal is to get 30-300 colonies on the plate.

3. Spread Plate - Incubation 24hr

Purpose: To spread a diluted bacterial sample over the surface of an agar medium, allowing individual cells to grow into distinct colonies.

Details for *S. aureus*:

Agar Medium:

General Purpose: Nutrient Agar, Tryptic Soy Agar (TSA) can be used for initial growth. *S. aureus* grows well on these.
Selective/Differential Media (Recommended for *S. aureus* isolation):
Mannitol Salt Agar (MSA): This is highly recommended for isolating *S. aureus*.
Selective: Contains 7.5% NaCl, which inhibits the growth of most bacteria except halotolerant organisms like *Staphylococci*.
Differential: Contains mannitol and a pH indicator (phenol red). *S. aureus* ferments mannitol, producing acid which turns the phenol red indicator from red to yellow around the colonies. Most other *Staphylococci* (e.g., *S. epidermidis*) do not ferment mannitol, so their colonies appear red/pink.
Procedure:
Pipette 0.1 mL of selected dilutions (e.g., 10$^{-4},10^{-5},10^{-6}$) onto the surface of separate sterile agar plates (e.g., MSA plates).
Using a sterile bent glass rod (hockey stick) or spreader, evenly distribute the inoculum over the entire agar surface until absorbed.
Invert the plates and incubate at 37°C for 24 hours.
Expected Results for *S. aureus* on MSA: Yellow colonies with a yellow halo around them, indicating mannitol fermentation.

4. Streaking - Incubation 24hr

- Purpose: To obtain a pure culture from a single, isolated colony grown on the spread plate. This is crucial for accurate identification.

Details for *S. aureus*:

- Procedure (Quadrant Streaking Method is common):

1. Using a sterile inoculating loop, touch the top of a well-isolated colony (preferably a yellow colony from the MSA plate if used for initial isolation).
2. Gently streak the loop across approximately one-quarter of a new sterile agar plate (e.g., Nutrient Agar or TSA, or another MSA plate if further confirmation is desired) in a back-and-forth motion (Quadrant 1).
3. Sterilize the loop.
4. Rotate the plate slightly. Drag the sterile loop once or twice through the edge of Quadrant 1 and then streak into Quadrant.
5. Sterilize the loop.
6. Rotate the plate. Drag the sterile loop once or twice through the edge of Quadrant 2 and then streak into Quadrant.
7. Sterilize the loop.
8. Rotate the plate. Drag the sterile loop once or twice through the edge of Quadrant 3 and then streak into Quadrant 4 (the final quadrant, often with less dense streaking).
9. Invert the plate and incubate at 37°C for 24 hours.
10. Expected Results for *S. aureus*: After 24 hours, you should observe individual, well-isolated colonies. On TSA or Nutrient Agar, *S. aureus* colonies are typically round, smooth, convex, opaque, and often golden-yellow (though some strains can be white).

5. Gram Staining (Classification / Identification) (Catalase, Motility, Carbohydrate Tests)
This step involves a series of tests to characterize the isolated pure culture and confirm it as *S. aureus*.
Gram Staining

- Purpose: A differential staining technique that classifies bacteria based on their cell wall composition.
- Procedure:

1. Prepare a thin smear of bacterial culture (from a well-isolated colony) on a clean glass slide. Air dry and heat fix.
2. Flood the smear with Crystal Violet (primary stain) for 1 minute. Rinse with water.
3. Flood with Gram's Iodine (mordant) for 1 minute. Rinse with water.

4. Decolorize with Alcohol or Acetone (decolorizer) for 10-20 seconds (until no more violet runs off). Rinse immediately with water.
5. Flood with Safranin (counterstain) for 30-60 seconds. Rinse with water.
6. Blot dry and examine under oil immersion microscopy.

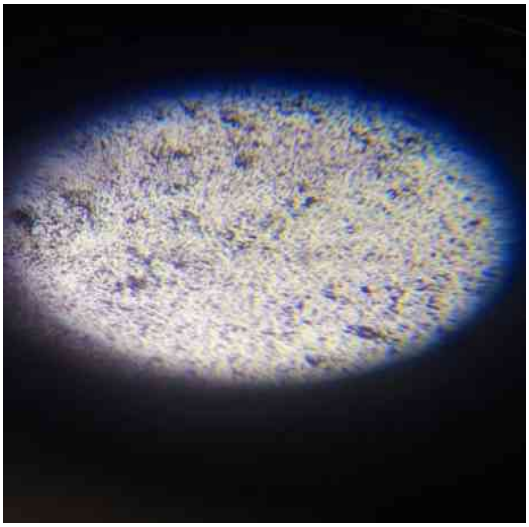


Fig. 17: Microscopic view of bacteria after gram staining

Characterization / Biochemical:

A. Indole test:

Fig. 18: Indole test

- Tryplone – 10g/l
- Nacl -5g/l
- Ph – 68

Procedure-
Autoclave this for 1hr. Then inoculate 100ul N.B into it.
Then incubate for 24hrs and add kovac'sreagent. red color ring is form it is positive.

B. Starch hydrolysis test (Amylase):

Beef extract/yeast – 3g/l
Starch -1.5g/l
Agar – 15g/l
Autoclave for 1hr. Then pour in plate immediately it will solidify . Streaking through s aures bacteria (straight line). Incubate for 24hrs.Add iodine direct .Clear zone at degradated form.

It is positive.

Fig. 19: Starch hydrolysis test

C. Nitrate Reduction Test:

- Peptone -5g/l
- Yeast extract – 3g/l
- Potassium nitrate -1g/l
- Autoclave for 1hr. Inoculation bacteria for 24hr. Then add first sulphonilic acid (200ul). And then add alpha- napthylamine(200ul). Red ppt positive. If colorless its negative.
- The red ppt is formed its positive.

Fig. 20 Nitrate reduction test

3. Antimicrobial Activity –

The Minimum Inhibitory Concentration (MIC) test depicted in **Figure 21** evaluates the **antibacterial efficacy of Brahmi (Bacopa monnieri) extracts** against *Staphylococcus aureus*, a common skin disease-causing pathogen. MIC testing is a standard method to determine the **lowest concentration of an antimicrobial agent** that can inhibit the visible growth of a microorganism after incubation.

In this study, different concentrations of Brahmi extract were applied to wells or tubes inoculated with *S. aureus*. After 24 hours of incubation at 37°C, the **growth of bacteria was assessed visually or via turbidity**. The well showing **no visible bacterial growth** indicates the MIC—i.e., the concentration at which Brahmi effectively halted bacterial proliferation.

Based on the MIC plate image (Fig. 21), it is evident that **Brahmi extract exhibits a dose-dependent antimicrobial effect**, with higher concentrations significantly inhibiting bacterial growth. This suggests the **presence of potent phytochemicals** such as **bacosides, flavonoids, and alkaloids**, which contribute to membrane disruption or enzyme inhibition in the bacterial cell.

These findings support Brahmi's potential as a **natural antibacterial agent** in the treatment of skin infections, although further **quantitative MIC value determination**, **comparison with standard antibiotics**, and **clinical validation** are required for therapeutic application.

Fig. 21:MIC PLATE

Conclusion

The study highlights the promising antimicrobial potential of *Bacopa monnieri* (Brahmi) extract, particularly against *Staphylococcus aureus*, a major pathogen responsible for bacterial skin infections. Through a combination of phytochemical screening and antimicrobial assays, including the Minimum Inhibitory Concentration (MIC) test, Brahmi was found to contain several bioactive compounds such as bacosides, alkaloids, flavonoids, and phenolic compounds that are likely responsible for its bacteriostatic and bactericidal effects. The MIC plate (Fig. 21) demonstrated clear zones of inhibition at specific concentrations of Brahmi extract, indicating its efficacy in inhibiting bacterial growth.

This antimicrobial effect can be attributed to the phytochemicals' ability to disrupt bacterial cell membranes, interfere with protein synthesis, or inhibit metabolic enzymes. Particularly, flavonoids and

alkaloids are known for their role in increasing membrane permeability, leading to cell lysis in gram-positive bacteria like *S. aureus*. Additionally, the results from the phytochemical tests showed that the fresh (wet) extract of Brahmi was richer in bioactive components compared to the dry form, which may explain the more potent antimicrobial activity observed.

The findings support the traditional Ayurvedic use of Brahmi in treating skin conditions and open up new possibilities for using its extract as a natural alternative or complementary approach to conventional antibiotics. Given the rising global challenge of antibiotic resistance, plant-based therapies like Brahmi hold significant promise due to their multi-targeted action and lower tendency to induce resistance.

However, while in vitro results are encouraging, further research is essential to validate these findings through in vivo models and clinical trials. Standardization of extract preparation, dose optimization, and safety profiling will also be necessary before considering therapeutic application. In conclusion, this investigation provides preliminary but meaningful evidence that *Bacopa monnieri* possesses notable antibacterial properties and could be developed into a plant-based antimicrobial agent for treating bacterial skin infections, especially those caused by *Staphylococcus aureus*.

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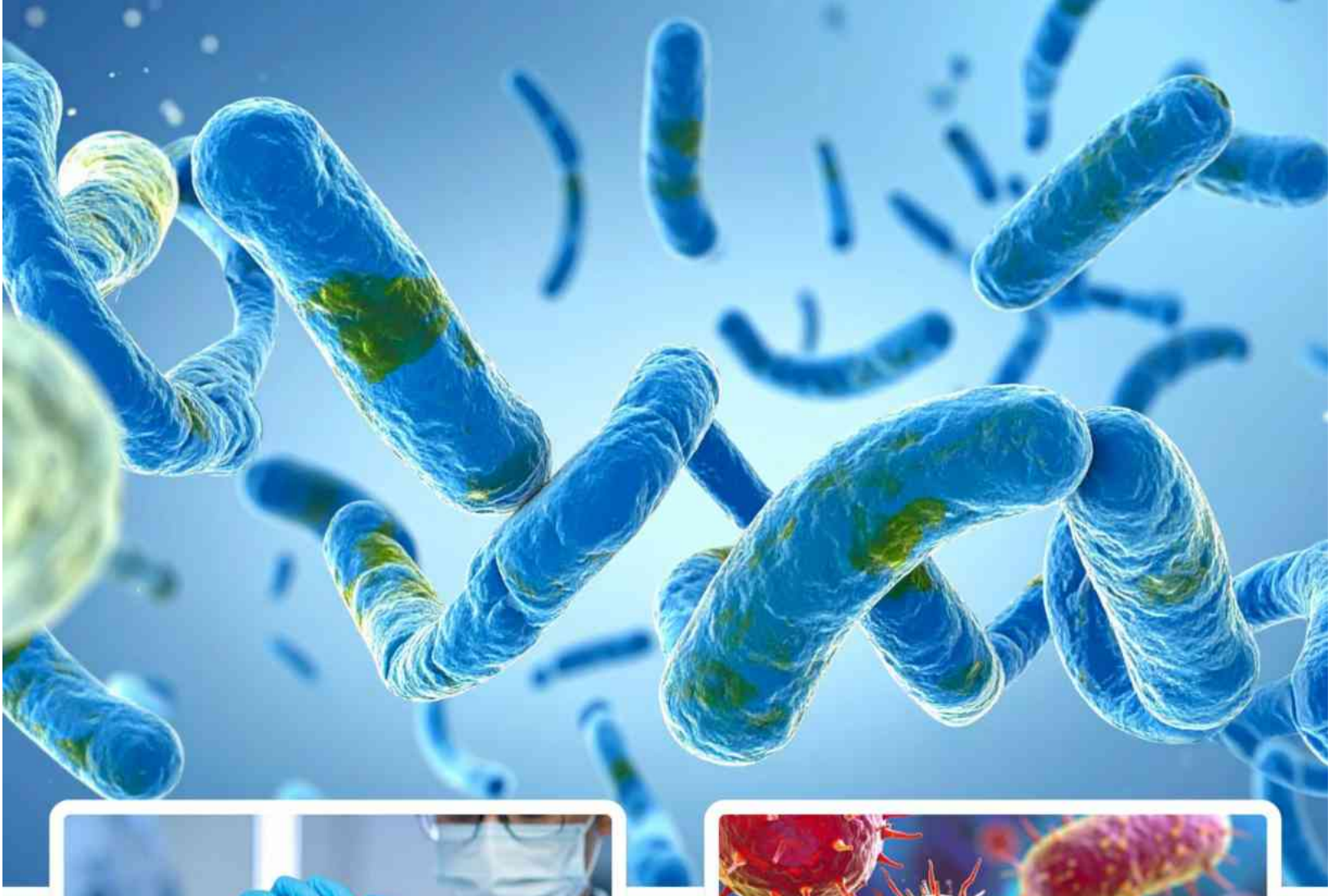

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