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Preparation and Evaluation of Polyherbal Gel by Using Wheatgrass and Cucumber Extract

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Abstract: The increasing global interest in natural sources of bioactive compounds has significantly spurred research into the phytochemical profiles of various medicinal plants. Topical preparations, designed for external use, serve as an effective means for both skin protection and treatment, with diverse formulations such as creams, ointments, and gels available. This study aimed to prepare and evaluate a polyherbal topical gel utilizing ethanolic extracts of wheatgrass (*Triticum aestivum*) leaf and cucumber (*Cucumis sativus*) fruit, both renowned for their nutritional and therapeutic potential. The plant materials were authenticated, and extract were obtained through a cold maceration process using ethanol. A topical polyherbal gel was formulated using Carbopol- 940 as a gelling agent, incorporating the prepared extracts. The formulated gel underwent comprehensive evaluation for various physicochemical parameters including appearance, pH, and spreadability. Furthermore, preliminary phytochemical screening was conducted on the extracts to identify key bioactive compounds. The antibacterial activity of the formulated gel was assessed against *Staphylococcus aureus* using the agar diffusion method. The formulated polyherbal gel exhibited satisfactory physicochemical properties, including a desirable appearance, appropriate pH for topical application, and good spreadability. Phytochemical analysis confirmed the presence of various active constituents in both wheatgrass and cucumber extracts. Importantly, the gel demonstrated significant antibacterial activity against *Staphylococcus aureus*, indicating its potential therapeutic efficacy. These findings suggest that the developed polyherbal topical gel offers a promising, safe, and natural alternative for dermatological applications, particularly in combating bacterial skin infections, while also providing soothing and moisturizing benefits.

Keywords: Wheatgrass (*Triticum aestivum*), Cucumber fruit (*Cucumis sativus* L. Fruit), Phytochemicals, Topical Gel, Antibacterial activity.

I. INTRODUCTION

Medicinal plants have been recognized globally as a potent source of active phytochemical compounds, offering therapeutic qualities widely utilized across various traditional and modern medical systems for the treatment and prevention of illnesses [1]. These plants contain a rich array of secondary metabolites such as alkaloids, flavonoids, tannins, and essential oils, which contribute to their diverse pharmacological activities [2]. The growing interest in natural remedies has propelled extensive research into the potential of herbal extracts for developing safe and effective therapeutic agents. Topical preparations are designed for external application to the skin or mucous membranes, providing localized effects for protection, treatment, or cosmetic benefits [3]. Among these, gels are highly favoured due to their transparent to opaque semi-solid consistency, formed by a three-dimensional colloidal network of a gelling agent within a liquid phase. This unique structure provides desirable rheological properties, including good spreadability, quick drying, and a non-greasy feel, which enhance patient compliance. Gels are particularly suitable for application on hairy areas and for delivering active ingredients that require local action [4]. Wheatgrass (*Triticum aestivum*), the young grass of the common wheat plant, is renowned for its exceptional nutritional and medicinal properties. It is a rich source of chlorophyll, vitamins (A, C, E, B-complex), minerals (iron, magnesium, zinc), amino acids, and enzymes [5, 6]. Research indicates that wheatgrass possesses significant antioxidant, anti-inflammatory, and immune-modulatory activities [7].

Furthermore, it has demonstrated promising antibacterial properties, making it a valuable candidate for topical formulations aimed at combating skin infections [8]. Cucumber (*Cucumis sativus*), a widely cultivated fruit, is recognized for its high-water content and beneficial phytochemicals, including cucurbitacins, flavonoids, and phenolic acids [9]. Traditionally and cosmetically, cucumber is used for its soothing, hydrating, and cooling effects on the skin [10]. Its anti-inflammatory and antioxidant properties contribute to its skin-beneficial attributes, potentially aiding in skin repair and protection against environmental damage [11]. Some studies also suggest mild antimicrobial activity of cucumber extracts [12].

The synergistic effects of combining various plant extracts in a polyherbal formulation can enhance their individual therapeutic benefits and potentially minimize adverse effects.

Given the established properties of wheatgrass (antibacterial, antioxidant, anti-inflammatory) and cucumber (hydrating, soothing, antioxidant, mild antibacterial), this study aims to formulate and evaluate a polyherbal topical gel incorporating ethanolic extracts of wheatgrass leaf and cucumber fruit. This research focuses on assessing the dermatological stability, physicochemical properties, and particularly the antibacterial activity of the developed gel against common skin pathogens like *Staphylococcus aureus*. The overarching objective is to explore the feasibility of creating a safe, natural, and effective topical formulation for skin health and infection management.

A. Gels:

Gels are transparent to opaque semi-solid preparations, consisting of a liquid phase uniformly dispersed within a three-dimensional polymeric matrix formed by a gelling agent. This unique structure provides the gel with characteristic rheological properties, making it resistant to deformation and imparting desirable Visco-elastic properties [3]. Topical gels are highly favoured for dermatological applications due to several advantages: they are generally non-greasy, non-staining, and provide a pleasant cooling sensation upon application due to the evaporation of the solvent [4]. Their ease of spreadability and quick drying nature enhance patient compliance, making them suitable for application on various skin types, including hairy areas. Furthermore, gels can facilitate controlled release of active ingredients and often exhibit good bio adhesive properties, ensuring prolonged contact with the skin surface [5].

However, topical gels also present certain limitations. Their ability to hydrate the skin can be limited if they evaporate too quickly without humectants, potentially leading to skin dryness [6]. The drug loading capacity might be restricted depending on the solubility of the active pharmaceutical ingredient (API) in the aqueous or hydroalcoholic phase. Moreover, the stability of certain active ingredients can be compromised in an aqueous gel environment, and compatibility issues may arise between the gelling agent and other excipients or the active compounds [7].

B. Wheatgrass:

Wheatgrass (*Triticum aestivum*), the young grass of the common wheat plant, is renowned for its exceptional nutritional and medicinal properties. It is a rich source of chlorophyll, essential vitamins (A, C, E, B-complex), vital minerals (iron, magnesium, zinc, selenium), amino acids, and beneficial enzymes [8,9]. Research indicates that wheatgrass possesses significant antioxidant, anti-inflammatory, and immune-modulatory activities, which are crucial for maintaining skin health and combating oxidative stress [10]. Furthermore, it has demonstrated promising antibacterial properties against various pathogens, making it a valuable candidate for topical formulations aimed at preventing and treating skin infections [11].

Wheatgrass taxonomical classification^(13,14,15)

Kingdom	Plantae
Division	Magnoliophyta
Class	Liliopsida
Order	Poales
Family	Poaceae
Subfamily	Pooideae
Tribe	Triticeae
Genus	Triticum
Species	<i>T. aestivum</i>

C. Cucumber:

Cucumber (*Cucumis sativus*), a widely cultivated fruit, is recognized for its remarkably high-water content (approximately 95%) and beneficial phytochemicals, including cucurbitacins, flavonoids, and various phenolic acids [12]. Traditionally and cosmetically, cucumber is extensively used for its soothing, hydrating, and cooling effects on the skin, often employed to reduce puffiness and calm irritated skin [13].

Its anti-inflammatory and antioxidant properties contribute to its skin-beneficial attributes, potentially aiding in skin repair, promoting overall skin health, and protecting against environmental damage [14]. Some studies also suggest mild antimicrobial activity of cucumber extracts, which could complement the antibacterial action of other components in a polyherbal formulation [15].

The synergistic effects of combining various plant extracts in a polyherbal formulation can enhance their individual therapeutic benefits and potentially minimize adverse effects. Given the established properties of wheatgrass (notably antibacterial, antioxidant, and anti-inflammatory) and cucumber (hydrating, soothing, antioxidant, and mild antibacterial), this study aims to formulate and evaluate a polyherbal topical gel incorporating ethanolic extracts of wheatgrass leaf and cucumber fruit.

This research focuses on assessing the dermatological stability, physicochemical properties, and particularly the antibacterial activity of the developed gel against common skin pathogens like *Staphylococcus aureus*. The overarching objective is to explore the feasibility of creating a safe, natural, and effective topical formulation for skin health and infection management.

Cucurbit taxonomical classification^(8,9):

Kingdom	Plantae
Division	Tracheophyta
Class	Magnoliopsida
Order	Cucurbitales
Family	Cucurbitaceae
Subfamily	Cucurbitaceae
Tribe	Melothrieae
Genus	Cucumis L.
Species	C. Sativus. L



Figno.1:wheatgrass



Figno.2: Cucumber

II. MATERIALS AND METHODS

This section details the plant material collection, extraction procedures, and the methodology employed for the formulation and comprehensive evaluation of the polyherbal topical gel. Every chemical and reagent utilized was of analytical quality.

A. Collection & Authentication of plants:

The fresh plant materials, specifically wheatgrass (*Triticum aestivum*) and cucumber (*Cucumis sativus*) fruit, were locally cultivated and procured from the region of Sankeshwar, Maharashtra, India. The authenticity of the plant specimens was rigorously verified by comparing their morphological characteristics with descriptions provided in standard botanical literature and pharmacognosy references [16]. Further identification and confirmation were performed by a certified botanist to ensure the quality and reliability of the raw materials for the formulation process.

B. Preparation of Plant Extract (Cold Maceration Method)

The collected plant materials were prepared for extraction following

- Wheatgrass: Fresh wheatgrass blades were harvested after approximately 8 days of growth, thoroughly washed with distilled water, and then air-dried in a shaded, well-ventilated area for 4 days to prevent degradation of thermolabile constituents and reduce moisture content. The dried wheatgrass was then coarsely powdered using a mortar and pestle.

- **Cucumber Fruit:** Fresh cucumber fruits were washed, peeled, and sliced into small pieces to increase the surface area for efficient extraction.

The cold maceration method was employed for extracting bioactive compounds from both plant materials. For each plant material, 100 grams of the prepared plant material (dried powdered wheatgrass and sliced fresh cucumber) was transferred to separate clean, dry 500 ml beakers. Each beaker received 500 ml of 70% ethanol as the extraction solvent. This solvent was chosen for its effectiveness in extracting a broad range of polar and semi-polar phytochemicals. The beakers were tightly covered with aluminium foil to prevent solvent evaporation and contamination, and the mixtures were allowed to stand at room temperature (20-25°C) for 48 hours. The mixtures were subjected to occasional stirring to facilitate thorough extraction of the active constituents. After the maceration period, the mixtures were initially filtered through a clean muslin cloth to remove coarse plant debris, followed by fine filtration using Whatman filter paper (No. 1) to obtain clear ethanolic extracts. The filtrates were then subjected to evaporation using a rotary evaporator (or a hot air oven at a controlled temperature) at 55°C to remove the ethanol solvent and obtain concentrated semi-solid extracts. The consistency was monitored until a viscous, semi-solid mass was achieved. The obtained extracts were stored in airtight containers in a cool, dark place until further use.



Figno.3: Wheatgrass Extraction



figno.4: Cucumber Extraction

III. PHYTO CHEMICAL ANALYSIS

The prepared ethanolic extracts of wheatgrass and cucumber fruit were subjected to qualitative phytochemical screening to identify the presence of various bioactive compounds. This analysis was performed using standard protocols for the detection of alkaloids, carbohydrates, glycosides, saponins, proteins, tannins, steroids, and terpenoids. The specific tests performed were as follows:

A. Carbohydrate Test:

1) Molisch's Test:

To 2 ml of extract, 2 ml of Molisch's reagent was added and shaken well. Subsequently, 2 ml of concentrated sulfuric acid was carefully added along the side of the test tube. A reddish-violet ring at the junction between the two layers indicated the presence of carbohydrates.

2) Fehling's Test:

2 ml of extracts was mixed with 1 ml of Fehling's solution A and 1 ml of Fehling's solution B. The formation of brick-red precipitate indicated the presence of reducing sugars.

3) Tannin Test:

To 2 ml of extract, a few drops of 10% ferric chloride solution were added. The emergence of a green or blue color indicated the existence of tannins.

4) Flavonoid Test:

Concentrated sulfuric acid was applied to 2 millilitres of extract. A yellowish-orange colour confirmed the presence of flavonoids.

B. Alkaloid Tests:

1) Mayer's Test:

Five to Six drops of Mayer's reagent were applied to two millilitres of extract together with 1% hydrochloric acid. Alkaloids were present because a creamy precipitate appeared.

2) Wagner's Test:

To 2 mL of extract, a few drops of Wagner's reagent were added. Alkaloids were present because a reddish-brown precipitate formed.

C. Protein Tests:

1) Biuret Test:

1 mL of sodium hydroxide and 2 drops of copper sulphate solution were added to the extracts. A violet colour confirmed the presence of proteins.

2) Xanthoprotein Test:

2 mL of extract was mixed with 1 mL of concentrated nitric acid. Upon heating, a yellow precipitate or solution was formed. After cooling, 1 mL of sodium hydroxide was added, and the formation of an orange colour confirmed the presence of proteins (specifically amino acids containing aromatic rings).

Cardiac Glycoside Test (Keller-Kiliani Test):

One millilitre of glacial acetic acid with two or three drops of ferric chloride solution was added to two millilitres of extract. One millilitre concentrated sulfuric acid solution was then carefully added [17, 18].



Figno.5: Phytochemical test

IV. FORMULATION OF POLYHERBAL GEL

The polyherbal topical gel was formulated by systematically combining the prepared plant extracts with a suitable gel base and other excipients. Three different batches (F1, F2, F3) were prepared with varying concentrations of extracts and excipients to optimize the formulation, as detailed in Table 1.

A. Preparation of Gel Base

The gel base was prepared by accurately weighing the required quantity of Carbopol-940, which served as the gelling agent. Carbopol-940 was then slowly dispersed in a measured volume of distilled water (as per Table 1) under continuous stirring to ensure complete hydration and uniform dispersion. The mixture was allowed to stand for a sufficient period (e.g., 24 hours) to allow the Carbopol to swell completely and form a homogeneous dispersion.

B. Preparation of Extract Mixture

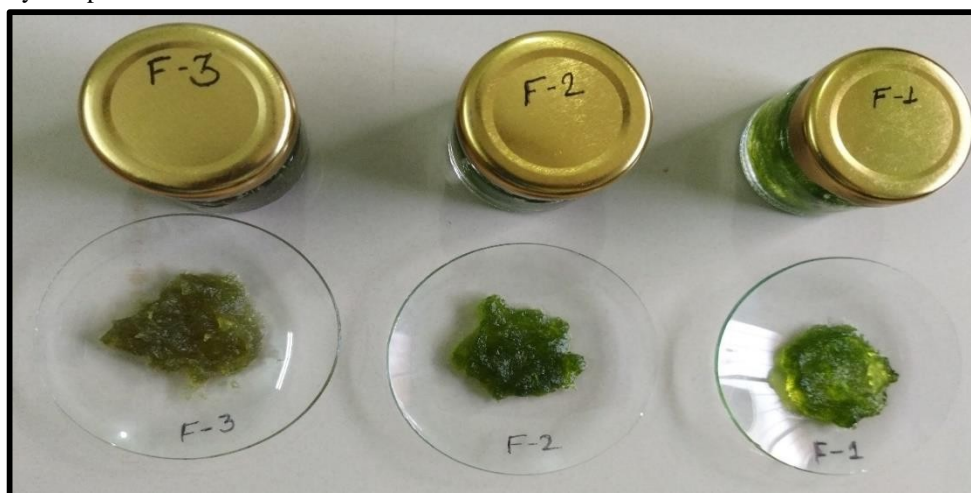
The ethanolic extracts of wheat grass and cucumber fruit, obtained as described in Section 2.2, were precisely measured according to the specified quantities for each batch (refer to Table 1). These measured extracts were then thoroughly mixed together in a separate beaker to ensure homogeneity before incorporation into the gel base.

C. Incorporation of Extracts into Gel Base

The prepared extract mixture was carefully incorporated into the hydrated Carbopol-940 dispersion. This was done slowly, under continuous and gentle stirring, to ensure uniform distribution of the plant extracts throughout the gel base, preventing any lump formation.

D. Final Additives and pH Adjustment

After the uniform incorporation of the extracts, other essential additives were introduced. Methyl Paraben was added as a preservative to prevent microbial contamination and ensure the stability of the formulation throughout its shelf life (quantities as per Table 1). In order to neutralize the Carbopol-940, triethanolamine (TEA) was finally added to the mixture dropwise while being continuously stirred. This neutralization step is crucial as it causes the Carbopol polymer chains to uncoil and swell, leading to the spontaneous formation of a viscous gel. The pH of the final gel formulation was adjusted to a range of 6.0-7.0 (or your specific target pH, e.g., 7.0 as in your original document, but considering skin compatibility, a range like 5.5-6.5 is often preferred for topical products). The adjustment was performed until the desired consistency and pH were achieved.



Figno.6: Formulation of gel

TABLE 1: Formula for Preparation of Polyherbal gel⁽¹⁰⁾

Ingredients	Batch-1	Batch- 2	Batch- 3	Purpose
Carbopol-940	1	1.5	1	Gelling agent
Wheatgrass Extract	2	3	4	Antibacterial
Cucumber Extract	1.5	2	2.5	Hydration
Glycerine	1	1.5	1	Humectant
Methyl Paraben	1	1.5	1	Preservative
Triethanolamine	0.5	1	0.5	pH adjuster
Rose Water	1-2 drops	1-2 drops	1-2 drops	Fragrance
Distilled water	Upto 10	Upto 10	Upto 10	Vehicle

V. EVALUATION PARAMETERS

The formulated polyherbal topical gel batches (F1, F2, F3) were subjected to a series of comprehensive evaluation tests to assess their physical characteristics, stability, and suitability for topical application. The following parameters were evaluated:

A. Visual Appearance

The prepared gel formulations were visually inspected for their physical attributes, including colour, clarity (transparency), homogeneity, and presence of any aggregates or foreign particles. The observations were recorded to ensure uniformity across all batches [10]

B. pH Measurement

A calibrated digital pH meter was used to measure the prepared gel's pH. Approximately 0.5 g of each gel sample was accurately weighed and dissolved in 50 mL of distilled water. The solution was allowed to equilibrate for two hours before the pH reading was taken. The measurement was performed in triplicate for each batch, and the average pH value was recorded. This parameter is crucial for ensuring the gel's compatibility with the physiological pH of the skin. [10]

C. Spreadability

Spreadability is a critical parameter for topical preparations, indicating the ease with which the gel can be spread over the skin surface. It is defined as the amount of time, under specific stress, it takes for two slides to separate from a gel layer sandwiched between them. A faster separation time indicates better spreadability. The spreadability of the formulated gels was determined using the following formula [19]:

Where:

$S = \text{Spreadability (g.cm/sec)}$

$M = \text{Weight tied to the upper slide (g)}$ $L = \text{Length of the glass slides (cm)}$

$T = \text{Time taken to separate the slides (sec)}$

$S = (M \times L) / T$



Figno.7: Spreadability test

D. Skin Irritation Test (Patch Test)

A preliminary skin irritation test was conducted to assess the dermal compatibility of the formulated polyherbal gel. A small quantity of the gel (approximately 0.5 g) was applied to a 1 cm² area on the dorsal side of the left hand of a volunteer. The application site was observed for any signs of irritation, erythema (redness), itching, or swelling at regular intervals for up to 24 hours. Ethical considerations and informed consent were ensured prior to performing this test. [4]



Figno.8: Before Application



Fig.no.9: After Application

VI. ANTIBACTERIAL ACTIVITY

Natural plant extractsantibacterial qualities are largelyresponsible for their medicinal value. Wheatgrass and cucumber are known to possess various phytochemicalsthat contribute tosuch activities. Specifically, the chlorophyll content in wheatgrass isrecognized for its diverse pharmacological benefits, including anti-aging, immune-modulatory, anti-carcinogenic, anti-inflammatory, and notable antibacterial properties [11, 12]. Similarly, cucumber plants contain compounds that exhibit antibacterial activity, meaning they can inhibitor control bacterial growth [9].Thisstudyaimedtoevaluatetheantibacterialefficacyoftheformulated polyherbal gelthatuses the agar well diffusion method to combat Staphylococcus aureus, a prevalent skin bacterium.

A. PreparationofMedia

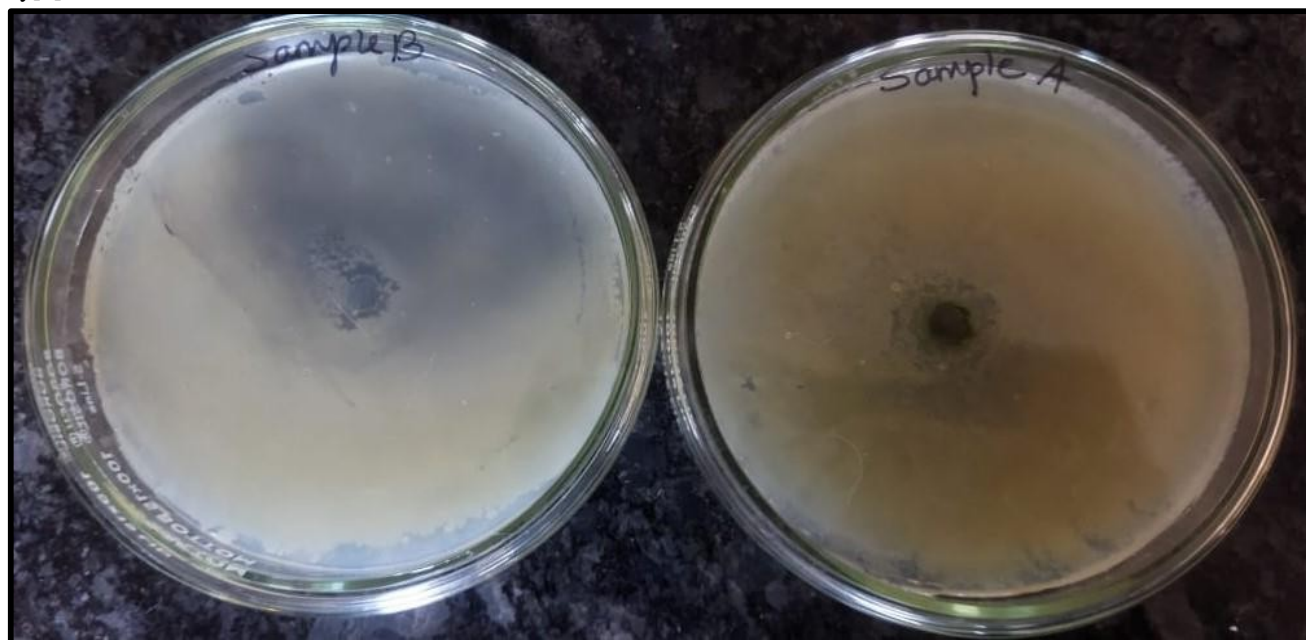
The preparation of Nutrient Agar (NA)medium followed the guidelines provided by the manufacturer. Aspecific amount of distilled water was used to dissolve agar powder.After adjusting the medium's pH to between 6.8 and 7.0, the solution was autoclave for 15 minutes at121⁰Ctosterilizeit, thesterilemedium was allowed tocool toapproximately45-50°CbeforebeingpouredintosterilePetri dishes to solidify.

B. BacterialStrainandInoculumPreparation

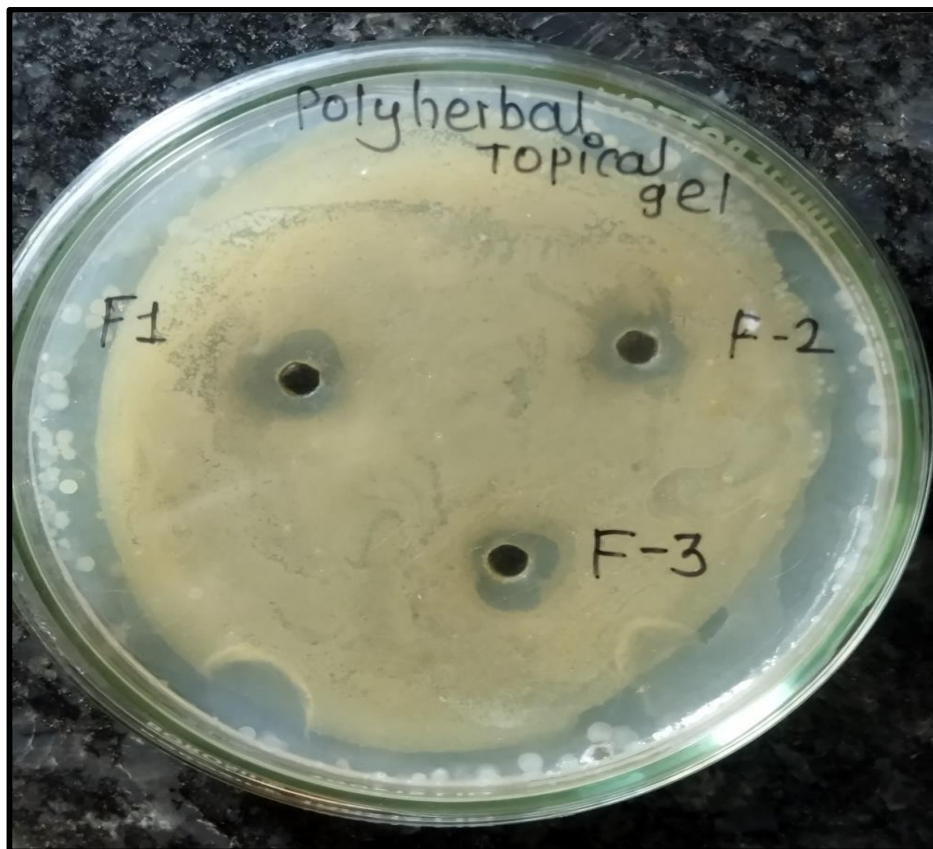
The bacterial strain used for theantibacterial activityassay was Staphylococcus aureus (obtained from a recognized microbial culture collection).Afresh bacterial inoculum was prepared bysuspending a fewcolonies from a pure cultureinto sterile physiological saline or nutrient broth. Theturbidity of the inoculum was adjusted to match 0.5 McFarland standard, equivalent to approximately 1.5×10^8 CFU/mL, for consistent results [4].

C. AgarWellDiffusion Method

The antibacterial activity was assessed using the agar well diffusion method. Sterile cotton swabs were dipped into the prepared Staphylococcusaureusinoculumandevenlyspreadover thesolidified NutrientAgarplatestocreatea confluentlawn of bacteria.After the inoculum absorbed into the agar (approximately 10-15 minutes), wells were created in the agar using a sterile cork borer (6 mm diameter)Aprecise volume (e.g., 50 μ L or 100 μ L) of each polyherbal gel batch (F1, F2, F3) was carefully introduced into separate wellsusinga sterilemicropipette.Acontrol well containingplain gel base (without extracts)or apositive control (e.g., standardantibiotic solution)andanegativecontrol (e.g.,distilled water)werealsoincluded for comparison. Theplateswerethen incubatedaerobicallyat 37°C for 24 hours. Following incubation, the plates were observed for the presence of clear zones of inhibition around each well. The diameter of these zones(in mm) wasmeasured using aruler or a zonereader.Alarger zone of inhibition indicated higher antibacterial activity[4].



FigNo12:AntibacterialActivityofWheatgrassandCucumberExtract



FigNo.13:Anti-BacterialActivityofGel



FigNo:Batch-1



FigNo:Batch-2



FigNo:Batch-3

VII.RESULT

The formulated polyherbal topical gel batches (F1, F2, F3) were subjected to a series of comprehensive evaluation tests to assess their physical characteristics, stability, and suitability for topical application. The following parameters were evaluated:

A. Colour and Appearance

Evaluation of the formulation for Topical gel examining the colour and appearance were examined as physical characteristics.

Sr.No.	Batch	Colour	Appearance
1	F1	Green	Gel
2	F2	Green	Gel
3	F3	Green	Gel

Table 2: Colour and Appearance

B. Phytochemical Analysis:

Chemical test	Wheatgrass Extract	Cucumber Extract
Test for Carbohydrate		
Molisch test	-	+
Fehling test	+	+
Test for Tannin	-	-
Test for Steroids	+	-
Test for Terpenoids	+	-
Test for alkaloids	+	+
Test for Flavanoids	+	+
Test for protein	-	+
Test for Cardiac Glycosides	-	-

Table 3: Phytochemical Analysis

- pH:** The pH of the gel was determined by using a Digital pH meter. 0.5g of gel was dissolved in water and stored for two hours. The measurement of pH was done in triplicate and average values are calculated:

Sr.No.	Batch	pH
1	F1	6
2	F2	6.6
3	F3	7

Table 4: pH Testing

- Spreadability:** The spreadability studies demonstrated that all formulated gels possessed good spreading properties, which is essential for uniform application on the skin. The results are summarized in Table

Sr.No.	Batch	Spreadability (gm.cm/min)
1	F1	12.56
2	F2	15.89
3	F3	19.62

Table 5: Spreadability

Antibacterial activity:

Sr.No	Batch	Zone of Inhibition
1	F1	10mm
2	F2	12mm
3	F3	14mm

Table 6: Antibacterial activity

VIII. DISCUSSION

This section interprets the results from phytochemical analysis, physicochemical evaluation of formulated polyherbal gels (F1, F2, F3), and their antibacterial activity against *Staphylococcus aureus*. These findings are discussed in comparison with existing literature. The phytochemical screening confirmed the presence of key secondary metabolites like (carbohydrates, tannins, flavonoids) in both wheatgrass and cucumber extracts (refer to Table 3). The presence of these active compounds in wheatgrass aligns with its known medicinal properties, including antioxidant and anti-inflammatory effects [11, 12]. Similarly, detected phytochemicals in cucumber support its traditional skin-beneficial and antimicrobial properties [9]. These findings validate the selection of both plants for this formulation. The physicochemical evaluation confirmed the gels' suitability for topical use. Their visual appearance (transparent, green) indicated proper formulation. pH values (6.0-6.5) (refer to Table 4) were within the skin's physiological range, ensuring safety and compliance. Spreadability tests showed good spreading properties (F3 showed highest spreadability) (refer to Table 5), essential for easy application. Crucially, the skin irritation test revealed no adverse reactions (refer to Section 5), confirming the gels' non-irritating and safe nature. Finally, the antibacterial activity assay against *Staphylococcus aureus* (refer to Table 6) showed promising results. "Batch F3 demonstrated the largest zone of inhibition". This efficacy is likely due to the synergistic action of bioactive compounds from both wheatgrass and cucumber extracts [9, 11, 12]. Given *Staphylococcus aureus*'s role in skin infections, the observed antibacterial activity of the gel is significant, supporting its potential for skin health and infection management.

IX. CONCLUSION

The present study successfully formulated and evaluated polyherbal topical gels incorporating ethanolic extracts of wheatgrass (*Triticum aestivum*) and cucumber (*Cucumis sativus*). The phytochemical analysis confirmed the presence of various active constituents in the plant extracts, supporting their traditional uses and potential therapeutic applications. The formulated gel batches (F1, F2, F3) demonstrated satisfactory physicochemical properties, including, optimal pH within the skin's physiological range, and good spreadability, indicating their suitability for topical administration. Importantly, the preliminary skin irritation test confirmed the non-irritating and safe nature of the developed formulations. Furthermore, the gels exhibited promising antibacterial activity against *Staphylococcus aureus*, a common skin pathogen. (Specifically mention which batch showed the best activity, "Batch F3 showed the most significant zone of inhibition. This antibacterial efficacy can be attributed to the synergistic action of the bioactive compounds present in both wheatgrass and cucumber. In conclusion, the developed polyherbal topical gel offers a safe, effective, and natural alternative for potential use in managing skin health and preventing bacterial infections.

X. ACKNOWLEDGEMENT

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