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(RESEARCH ARTICLE)

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Formulation and evaluation of antimicrobial herbal gel

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Abstract

The aim of the current study to formulate and evaluate topical herbal gel of betel leaves and giloy. There is a potential market demand for natural and plant-based skin care products. The antimicrobial gel made from herbal plants works better than synthetic medications and has fewer side effects. The prepared extracts of betel piper leaves and giloy were added to prepared simple carbopol gel. The microorganisms *S. aureus, B. subtilis, E. coli and P. aeruginosa* have been used to determine antimicrobial activity. *Candida albicans* has been used to test its antifungal activity. This formulated gel was evaluated for physicochemical properties, pH determination, spreadability, viscosity, antimicrobial and antifungal activities. The results demonstrate that herbal gel containing betel leaves and giloy extract was successfully formulated. The gel was very effective as an antimicrobial and antifungal formulation. These formulations which are easy to use and have no side effects, have the potential to be very promising medications for wound healing.

Keywords: Topical gel; Betel leaves; Giloy; Antimicrobial and Antifungal

1. Introduction

Topical herbal gels represent a burgeoning area of research within the field of phytopharmacology and dermatological therapeutics. These formulations combine traditional herbal medicine with modern gel technology to offer targeted, effective treatments for various skin conditions while leveraging the therapeutic properties of natural plant extracts. The development and application of topical herbal gels are driven by the increasing demand for natural remedies and the growing recognition of the efficacy of plant-based treatments

Herbal gels are distinguished by their incorporation of active compounds derived from plants, which are formulated into a gel matrix that enhances their stability, penetration, and release. This matrix often includes gelling agents, water, and other excipients that work synergistically to provide a suitable environment for the active herbal ingredients. The choice of gelling agents and the concentration of herbal extracts are crucial in optimizing the gel's texture, absorption, and therapeutic efficacy.

Recent research has highlighted the benefits of herbal gels in managing a range of skin conditions, from inflammatory disorders such as eczema and psoriasis to antimicrobial and wound-healing application. For instance, extracts of plants like Aloe vera, Turmeric, giloy and Green Tea have been shown to possess anti-inflammatory, antioxidant, and antimicrobial properties making them valuable in the formulation of topical gels. These gels not only offer a more natural alternative to synthetic topical agents but also provide additional advantages such as reduced risk of adverse effects and improved patient compliance.

This research paper focuses on the formulation, characterization, and application of topical herbal gel. It examines the role of various herbal extracts, gelling agents, and formulation techniques in developing effective and safe topical

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treatments. By integrating traditional herbal knowledge with contemporary pharmaceutical practices, this study aims to contribute to the advancement of herbal medicine and its application in modern dermatology. [1-6]

2. Drug Profile

2.1. Betel Peper [7,9]:

Figure 1 Betel Leaves

Table 1 Betel peper leaves

Botanical Name : *Piper betle* L.			
Plant part used : Leaves			
Scientific classification	**Category**	**Chemical Constituents**	**Uses**
Kingdom – Plantae **Family**– Piperaceae **Genus** - *piper* L. **Species**- *piper betel* L.	anti-microbial, anticancer anti-inflammatory, anti-oxidant, anti- fungal, anti diabetic, gastroprotrctive.	Betel leaf extract contains: campene, f-pinene, u-limonene, 1-,9-cineol, methyl eugenol, phenol, chavicol, chavibetol, hydroxychavic, and caryophyllene	Boosting immunity, preventing infections, healing wounds, reducing inflammation, fighting fungal infections, and treating skin conditions

2.2. Giloy[10,11]:

Figure 2 Giloy Stem Powder

Table 2 Giloy Stem

Botanical Name: *Tinospora cordifolia*			
Plant part used : Stem			
Scientific classification	**Category**	**Chemical Constituents**	**Uses**
Kingdom - Plantae **Family** - Menispermaceae **Genus** - Tinospora **Species** - T. cordifolia	Anti-microbial, Anti-cancer, Anti-fungal, Anti-allergic, Anti-oxidant, Anti-inflammatory, Antipyretic, Blood-glucose-lowering activity, Antistress activity, Immunity booster, Wound-healing	Giloy leaf and stem extract contains: Flavonoids (Luteolin, kaempferol, quercetin), proteins, saponins, amino acids, sugars	Boosting immunity, preventing infections, healing wounds, reducing inflammation, helps in reducing fever, improves digestion and improves blood glucose level.

3. Materials and Methods

- **Collection of Materials:** Leaves of Betel Piper and stem of Giloy were collected from medicinal garden.
- **Preparation of Extracts**
- **Preparation of Betel Piper Leaves Extract**

Leaves of Betel Piper collected, wash and weigh it properly. Cut into small pieces and grind it. The paste of leaves taken into beaker and passes it through to muslin cloth to obtain the solution. This solution kept on water bath for heating till concentrated viscous solution is obtained.

Figure 3 Flow chart for process of preparing Betel Peper leaves extract

Preparation of Giloy Extract: Fine powder of giloy and water taken in beaker, boil for 1-2 hrs in water bath. Filter the solution using muslin cloth.

Figure 4 Flow chart for process of preparing Giloy Extract

3.1. Preparation of simple gel

1 gm Carbapol dissolved in 100ml of distilled water and kept it on magnetic stirrer to mix for 15 min. Add triethanolamine drop wise until transparent gel is formed.

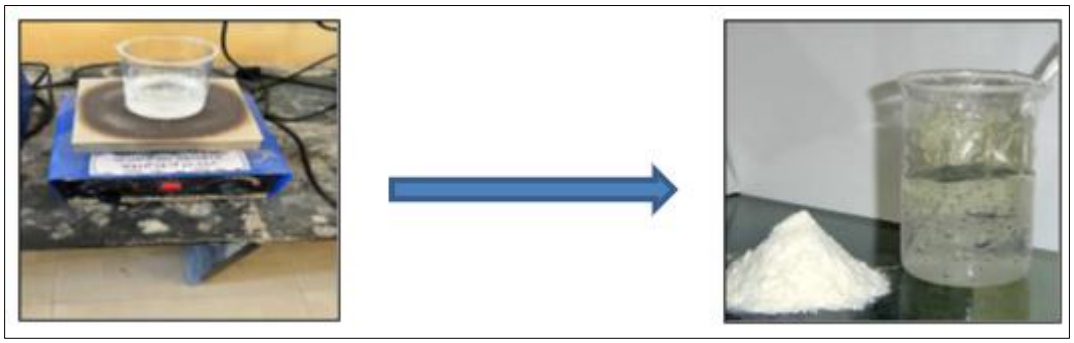

Figure 5 Process of preparing Simple Carbapol gel

3.2. Formulation of Topical Gel:

Take simple gel, add to it 1 ml of prepared betel piper leaf extract and 1 ml of giloy extract. Add rose water for fragrance. Mix it well and store it in air tight container.

Figure 6 Formulated topical herbal gel

4. Evaluation and characterization of formulated gel:

- **Physical appearance**: Physical parameter such as colour, appearance and consistency were checked visually.
- **pH Determination:** Prepared gel formulation's pH is measured using a digital pH meter. After dissolving 1 g of gel in 100 ml of distilled water, it was kept for 2 hours. In order to prevent any kind of skin irritation, the pH of the topical gel formulations was determined in the range of 6.8–7.1, which is close to the natural pH of the skin.
- **Viscosity Determination:** The Brookfield viscometer was used to measure the viscosity of the gel. Spindle number 64 was used to rotate the gels at 10 rpm, and the dial reading was recorded.
- **Spreadability:** Spreadability can be quantified by measuring the time in seconds taken for a given area to be covered or by assessing the ease with which the gel spreads over the skin. A small amount of gel was placed between the two glass slides, and a definite amount of weight was placed on these glass slides to compress the glass slides of uniform thickness. The movement of the slide across the gel simulates spreading. A weight of 70 g was added and the time required to separate the two slides was noted. Spreadability was calculated using the formula

$$S = \frac{ML}{T}$$

where,
M = Mass tied to upper slide,
L = Length of glass slides,

T = Time taken to separate the slides

- **Antimicrobial Activity:** Prepare an agar plate and inoculate it with the microorganism (*S. aureus, B. subtilis, E. coli, P. aeruginosa).* Apply a small quantity of the topical gel to a disk or directly to the agar. Incubate the plate under suitable conditions for a specified time. Measure the zone of inhibition around the sample.

4.1. *In-vitro* Antifungal Activity [17]

In a 250 ml conical flask, dissolve the Sabouraud's dextrose agar medium with 100 ml of distilled water. After adjusting the pH to 5.6 to 0.2, the medium was autoclaved for 15 minutes at 121 °C. After cooling to ambient temperature, it was transferred onto sterile petri plate plates that were placed under a laminar air flow unit. Once the medium-filled petri dishes were placed in a laminar airflow unit to solidify, a diluted suspension culture loop (*C. albicans*) was added to the surface of the solidified agar and evenly distributed with the aid of a spreader culture. The culture was then sterilized, and cups were punched using sterile cork borer, betel pepper and giloy gel. Mixture: 0.5 ml of 1% Clotrimazole gel, as sold in the market, was added to each cup individually. After that, the zone of inhibition was evaluated in petri dishes that had been cultured for 24 hours at 37 °C

5. Results and Discussion

The topical herbal gel was prepared and evaluated for the various parameters. The herbal gel was light brown in colour and translucent in appearance and had a cool and smooth feeling on application. pH also maintained constant throughout the study which was found to be 6.5 to 7.0 and the gel was non-irritant upon application on the skin. Spreadability were also measured and found to be less variant.

Table 3 Evaluating Parameters of Formulated Herbal Gel

Sr. No.	Parameters	Results
1	Colour	Brown
2	Odour	Smoky
3	Clarity	Clear
4	Spradabilty	3.12 cm^2
5	Non-irritancy	Non-irritant
6	pH	6.87
7	Viscosity	3162 ±0.22

Antimicrobial Activity: In antimicrobial study, the herbal gel shows antimicrobial activity against the various strains of microorganisms. Gel shows highest zone of inhibition for *P. aeruginosa* than other stains of microorganisms.

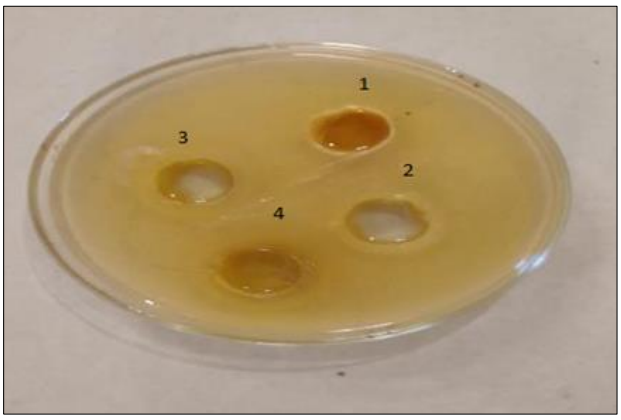

Figure 7 Zone of inhibition for different microorganisms

Table 4 Antimicrobial study of formulated herbal gel

Sr. No.	Organisms	Zone of Inhibition in mm
1	*E. coli*	8.2
2	*B. subtilis*	9.3
3	*S. aureus*	10.4
4	*P. aeruginosa*	10.6

E. coli: Escherichia coli, B. subtilis: Bacillus subtilis, S. aureus: Staphylococcus aureus, P. aeruginosa: Pseudomonas aeruginosa.

Antifungal Activity: The antifungal properties of marketed 1% clotrimazole gel and herbal gel made from betel leaves and giloy were tested using the cup plate technique, as illustrated. As indicated the zones of inhibition for the marketed 1% clotrimazole gel and formulated gel was found to be 23 mm and 21 mm respectively (Table No.5). Thus, from the zone of inhibition, formulated gel is also efficient against *candida albicans*. Hence it has been demonstrated that topical gel of betel pepper and giloy shows an antifungal activity.

Table 5 Zone of inhibition shown by formulated topical gel compared with marketed 1% Clotrimazole gel against *C.albicans.*

Sample	Zone of inhibition in mm	Fungal Culture
1% Clotrimazole	23	*Candida albicans*
Formulated gel	21	

6. Conclusion

The plant betel pepper and giloy selected for the study. Both the plants are very useful in wound healing. Literature survey revealed that both plants are used traditionally for various ailments as an antifungal and antimicrobial agent. In this study, the attempt was made to increase the antifungal and antimicrobial activity by incorporating the extract of both plants in simple carbopol gel. In antifungal activity study, the formulated gel was shown 21 mm of zone of inhibition which comparatively near to zone of inhibition shown by 1% Clotrimazole gel (23 mm) against *C. albicans*. The phytoconstituents and phytochemicals present in betel peper and giloy are responsible for antimicrobial and antifungal activity. Thus it has been concluded that topical gel containing betel peper and giloy extract might be used as an alternative to commercial synthetic formulations.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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