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Formulation and evaluation of *tinospora cordifolia* topical gel for antimicrobial activity

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Abstract

This study investigates the formulation and evaluation of agel extract of *Tinospora cordifolia*, aimed at addressing diabetes mellitus and antimicrobial resistance. *Tinospora cordifolia* is a widely recognized medicinal plant traditionally used for its antidiabetic and antimicrobial properties. The dried powder was extracted with ethanol using a mechanical shaker for 3 hours. A topical formulation like gel containing ethanolic extract was formulated using gelling agents in different concentration ratios. These gels were evaluated for physico-chemical parameters, viscosity, spreadability, pH, and antimicrobial activity. Agar well diffusion and broth microdilution methods were employed against common pathogens, including E.coli,candidaalbicans, and staphylococcus aureus, to evaluate antimicrobial efficacy. A topical gel formulation was successfully formulated containing ethanolic content of *Tinospora cordifolia*. The gel showed an effect on microbial activity, particularly against E.coli. The formulated *Tinospora cardifolia* gel extract is promising as a dual-action topical application for treating infections and managing blood glucose levels in diabetic patients. These findings support further investigation into the clinical applications of this formulation, highlighting its potential in interrogative medicines. Additional studies are needed to elucidate the underlying mechanisms and optimize the formulation for therapeutic use.

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INTRODUCTION

Microorganisms such as viruses, fungi, and bacteria can be killed or their growth inhibited by antimicrobial agents. They can be classified based on their target organisms, such as antibiotics for bacteria, fungi, antifungals, and viruses. The primary mechanisms of action include disrupting cell walls, inhibiting protein synthesis, or interfering with metabolic pathways. Antimicrobial activity is crucial in treating infections and preventing disease spread, making these agents essential in clinical and environmental settings. Research into natural

antimicrobials, like those derived from *Tinospora cordifolia*, highlights their potential to combat resistant pathogens effectively [1].

Tinospora cordifolia, commonly known as Guduchi or Giloy. *Tinospora cordifolia*, or the moonseed, is a genus Tinospora and family Menispermaceae member. This plant is home to India, Bangladesh, Myanmar, and Sri Lanka. A common medicinal herb in India is *Tinospora cordifolia*. It is frequently used to treat rheumatism, diabetes, skin conditions, wound infections, tooth infections, jaundice, hypertension, and the common cold. Ayurveda and other ancient texts refer to it. Recent studies have highlighted its bioactive compounds, such as alkaloids, glycosides, and polysaccharides, contributing to its therapeutic efficacy. The formulation of *Tinospora cordifolia* in gel form offers several advantages, including enhanced bioavailability, localized delivery, and ease of application, making it an attractive option for topical treatments. This study aims to formulate and evaluate a *Tinospora cordifolia* gel extract, investigating its potential antidiabetic and antimicrobial activities. By harnessing the therapeutic potential of this traditional herb, we aim to provide a dual-action formulation that could serve as a valuable addition to diabetes management and infection control strategies [2].

Herbal gels are topical preparations containing extracts of plants, herbs, or botanicals, always in a gel-like base, used for cosmetic, therapeutic, or medicinal purposes. Their less harmful impacts have made them popular. The fascination with studying the effects of plant-based medications is constantly growing. Many different topical therapy formulations are made for skin care and dermatological conditions. Clinicians and patients can now use semisolids, which are showing promising results for topical skin therapy. Transparent, oil-free gels with high molecular cross-linking are found in semisolid formulations. Thus, the need for gels in medicinal and cosmetic treatments is growing. A gel is a semi-rigid slab or cylinder of an organic polymer used as a medium for separating macromolecules [3].

Gels are thick, transparent, and slightly sticky, particularly those employed in cosmetic or pharmaceutical applications. Compared to ointments, gels offer a higher potential as a drug entrapment vehicle due to their non-stickiness, low energy requirements, ease of storage, and extended reagent shelf life. There are a lot of herbal gels that have been made, but none that contain the antibacterial properties of *Tinospora cordifolia* aqueous extract. So, the current work investigates the antibacterial activity of a gel containing ethanolic extract. Through rigorous formulation and evaluation processes, this research seeks to contribute to the growing body of evidence supporting the use of natural products in modern therapeutics, ultimately promoting holistic health approaches for individuals living with diabetes [4].

MATERIAL AND METHODS

Plants Collection:

The formulation of *Tinospora cordifolia* gel involved the collection of *Tinospora cordifolia* plants from the local region of Nellore in Andhra Pradesh, India, as well as from the neighboring areas surrounding Narayana Pharmacy College, also located in Nellore, Andhra Pradesh, India.

Chemicals and Solvents:

Analytical-grade chemicals and reagents were acquired from the New Himalaya Scientific Co shop, Rajaji Street, Nellore.

Preparation of Extract:

The collected plant materials had their stems removed and were subsequently washed with potable water, followed by two washes with distilled water. The stems were then shade-dried for one week. After the shade-drying process, the stems were ground into a powder using an electric blender. A sieve of No. 16 mesh size was used to remove leftover particles from the resultant powder. Next, ethanol was added to the powder at a 2:10 ratio to dissolve it. This mixture took three hours to be thoroughly mixed in a motorized shaker. The mixture was then filtered to make the gel, and the filtrate was collected [5].

Formulation of Gel:

A specified amount of Carbopol 940P was initially dissolved in distilled water. This solution was then homogenized using a high-speed homogenizer. A measured quantity of PEG 400 was added to the mixture and stirred for two minutes [6]. Subsequently, two drops of 50% triethanolamine were introduced to neutralize the gelling agent

and the necessary amount of water. The mixture was allowed to rest for 10 to 20 minutes to stabilize, after which the filtrate was incorporated while stirring for one to two hours (**Table 1**).

Figure 1 Tinospora cordifolia plant and Tinospora cordifolia powder

EVALUATION

Clarity, pH, viscosity, spread ability, antimicrobial activity, and UV visible spectrophotometric analysis were all assessed for the gels. Using standard techniques for both in vivo and in vitro diffusion investigations. Every study was conducted in triplicate, and average results were presented.

pH Measurement

The pH of the gel was measured using a calibrated pH meter [7] (Thermo Orion benchtop). The results are summarized in (**Table 2**).

Viscosity Determination

Figure 3 Determination of viscosity

Figure 2 Stirring, Homozinizing, and Extraction Equipment

The viscosity of the formulated gel was assessed using a Brookfield viscometer with a T-C spindle at a speed of 5 rpm (DV-1-PRIME, USA) [8]. This measurement is also detailed in (**Table 2**).

Spreadability Assessment

To evaluate spreadability, 1 gram of the gel was placed between two glass slides. A specific weight was applied to the top slide to exert pressure on the gel [9]. After a set period, the diameter of the spread gel was measured. The spreadability index (S) was calculated using the

formula:S=m·lt*S*=*tm*·*l*where:

- m*m* = weight applied to the upper slide (grams)
- l*l* = length of the glass slide (cm)
- t*t* = time taken for spreading (seconds)

This method provides insight into how well the gel can be spread over a surface.

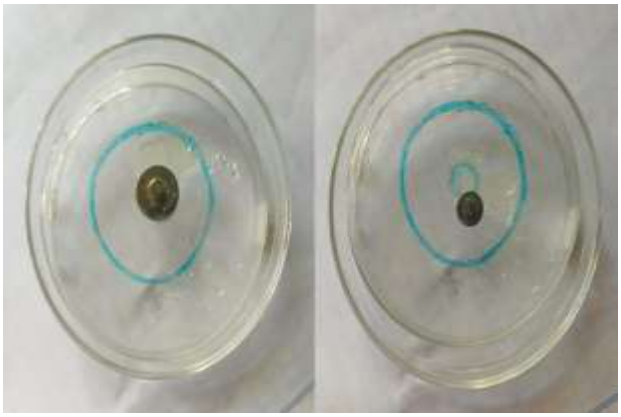

Figure 4 Samples A and B

Antimicrobial Activity Testing

Figure 5 Antimicrobial activity

For antimicrobial activity, LB broth was mixed with 100 ml of water and autoclaved for 30 minutes. The media was evenly distributed in Petri dishes within a laminar airflow cabinet. Following this, 100 µg of E. coli was introduced to the press. After allowing the dishes to sit in a refrigerator for 10 minutes, the drug under investigation was added under sterile conditions [10].

UV-Visible Spectrophotometric Analysis

To perform UV-visible spectrophotometric analysis, 1 gram of the gel was dissolved in up to 100 ml of water and scanned at a maximum wavelength of 228 nm using a Systronics 2201 UV-visible spectrophotometer [11]. The results can be found in (**Table 4**).

Figure 6 UV Visible spectrophotometric analysis

RESULTS AND DISCUSSION

Antimicrobial Activity

The F-2 batch was the most suitable in the zone of inhibition investigations of *S. aureus and E. coli* (**Table 3**).

Table 1 Gel formulation

Ingredients	A	B
Extract of alcohol	5%	10%
Carbopol 940P	4.5%	6.0%
Polyethylene glycol 400	15%	20%
50% Triethanolamine (5%)	0.6%	0.8%
Dist. water	q.s	q.s

Table 2 Evaluation criteria for the gel formulation

Parameters	Observations	
	A	B
Appearance	Transparent	Transparent
Color	Pale green yellow -white	Pale green yellow -white
pH	5.5 -5.6	5.6-5.8
Viscosity	8005cp	8905 cp
Spreadability	8.36	8.86

Table 3 The inhibitory zone

Organisms	Zone of inhibition for A	Zone of inhibition for B
E.coli	6mm	8mm
S.aureus	3mm	5mm

Table 4 Analysis using UV-visible spectrophotometry

Wavelength	Absorbance
228.0 nm	0.544

CONCLUSION

The method for formulating and assessing the antimicrobial activity of *Tinospora cordifolia* gel was developed successfully. This established method is straightforward and uncomplicated, making it easy to implement. It has demonstrated accuracy and reproducibility in its measurements. Overall, it provides a reliable approach for evaluating the antimicrobial properties of the gel.

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Author Contribution

All authors made substantial contributions to the conception, design, acquisition, analysis, or interpretation of data for the work. They were involved in drafting the manuscript or revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring its accuracy and integrity.

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REFERENCES

[1] Abhishek D Dorle, Kumar S Swami, Sujit K Nagar, And Supriya R Hyam. Design and evaluation of novel topical gel of Tinospora cordifolia as antimicrobial agent. Asian Journal of Pharmaceutical and Clinical Research, 8(6): 237-239, 2015.

[2] Vijay Kumar Singh, Praveen Kumar Singh, Purnendu Kumar Sharma, Peeyush Kumar Srivastava, and Ashutosh Mishra. Formulation and evaluation of topical gel of aceclofenac containing piperine. Indo American Journal of Pharmaceutical Research 3(7): 5266-5280, 2013.

[3] Patel Shamira, Changediya Bhavana, Gadhave MV, Jadhav S, and Gaikwad DD. Formulation and evaluation of diclofenac sodium gel by using carbopol. International Research Journal of Science and Engineering, 3:65-68, 2018.

[4] M Parthipan, V Aravindhan, and A Rajendran. Medico-botanical study of Yercaud hills in the Eastern Ghats of Tamil Nadu, India. Ancient Science of Life, 30(4):104-109, 2011.

[5] Upendra Sharma, Manju Bala, Neeraj Kumar, Bikram Singh, Renuka K Munshi, and Supriya Bhalerao. Immunomodulatory active compounds from Tinospora cordifolia. Journal of Ethnopharmacology, 141(3): 918-926, 2012.

[6] Upendra Sharma, Manju Bala, Neeraj Kumar, Bikram Singh, Renuka K Munshi, and Supriya Bhalerao. Immunomodulatory active compounds from Tinospora cordifolia. Journal of Ethanopharmacol, 141(3):918-926, 2012.

[7] AK Meena, Arjun Singh, P Panda, Sudip Mishra, and MM Rao. Tinospora cordifolia: its bioactivities & evaluation of physicochemical properties. IJPPR, 2(2):50–55, 2010.

[8] M Rajalakshmi, J Eliza, CE Priya, A Nirmala, and P Daisy. Anti-diabetic

properties of Tinospora cordifolia stem extracts on streptozotocin-induced diabetic rats. African Journal of Pharmacy and Pharmacology, 3(5):171-180, 2009.

[9] D H Tambekar, B S Khante, B R Chandak, A S Titare, S S Boralkar, and S N Aghadte. Screening of antibacterial potentials of some medicinal plants from Melghat forest in India. African Journal of Traditional Complementary Alternative Medicine, 6(3):228-232, 2009.

[10] Mayurkumar B Patel , and Shrihari Mishra. Hypoglycemic activity of alkaloidal fraction of Tinospora cordifolia. Phytomedicine, 18(12):1045-1052, 2011.

[11] P Stanely Mainzen Prince , and Venugopal P Menon. Hypoglycaemic and hypolipidaemic action of alcohol extract of Tinospora cordifolia roots in chemical induced diabetes in rats. Phytotherapy Research, 17(4):410-413, 2003.