

Formulation and Evaluation of Antibacterial Gel Using Petroselinum Crispum

Christy Sunu¹, Hanna Johny², Semeera Parvin K S³, Shyma Beegum N A⁴,
Thansi C S⁵, Nishamol K S⁶

^{1,2,3,4,5}Students of Al Azhar College of Pharmacy, Thodupuzha, Kerala, India

⁶Assoc. Professor, Department of pharmacognosy, Al Azhar College of pharmacy, Thodupuzha, Kerala, India

Date of Submission: 25-01-2026

Date of Acceptance: 05-02-2026

ABSTRACT: Petroselinum crispum (parsley) is a medicinal herb rich in bioactive phytochemicals with known antimicrobial potential. Due to increasing antibiotic resistance and adverse effects of synthetic topical agents, safer herbal alternatives are being explored. This study aimed to formulate and evaluate an antibacterial herbal gel containing Petroselinum crispum leaf extract for topical use. Parsley leaves were collected, authenticated, shade-dried, powdered, and extracted using methanol and petroleum ether by the Soxhlet method. Phytochemical screening confirmed the presence of flavonoids, coumarins, tannins, phenolic compounds, alkaloids, and terpenoids associated with antibacterial activity. The formulated gel showed acceptable physicochemical properties, good stability, and effective antibacterial activity, suggesting its potential as a natural topical antibacterial formulation.

KEYWORDS: Petroselinum crispum, Herbal topical gel, Antibacterial activity, Plant-based topical therapy.

I. INTRODUCTION

Ayurveda is an ancient system of medicine originating in India, derived from the Sanskrit words Ayur (life) and Veda (knowledge), and it emphasizes a holistic approach to health by maintaining balance between the body, mind, and spirit. Rooted in traditional knowledge and natural healing practices, Ayurveda extensively relies on the use of plant-based remedies for the prevention and treatment of diseases[1]. Herbs, defined as plants or plant parts used wholly or partially for their medicinal, therapeutic, aromatic, or flavoring properties, form the core of Ayurvedic therapy and are also widely used in other traditional systems such as Unani and Traditional Chinese Medicine[2]. Medicinal plants including aloe, tulsi, turmeric, and ginger have been employed as home remedies for centuries across various cultures due to their proven therapeutic benefits[3]. Herbal

medicine refers to the use of these plant-derived materials in the form of herbal drugs and formulations intended for disease prevention and management. Owing to their natural origin, perceived safety, and fewer side effects, herbal medicines continue to play a vital role in traditional healthcare and are increasingly being integrated into modern medical and pharmaceutical practices[2].

HERBAL GEL DEFINITION

The term "gel" is derived from the word "gelatin," and both "gel" and "jelly" originate from the Latin words gelu, meaning "frost," and gelare, meaning "to freeze" or "to solidify"[4]. Gels are semisolid dosage forms that consist of dispersions containing either small inorganic particles or large organic molecules distributed within a liquid phase. Their characteristic semisolid consistency results from physical or chemical cross-linking within the system, which increases internal friction and contributes to enhanced viscosity[5].

PETROSELINUM CRISPUM

Petroselinum crispum is a green, biennial herbaceous plant belonging to the Apiaceae family[6]. It finds applications in the cosmetic industry, especially in regions such as China, Mexico, South America, India, and Southeast Asia[7]. Its foliage resembles that of coriander, yet it is distinguished by a unique flavor and aromatic profile. The essential oil derived from Petroselinum crispum seeds has been shown to suppress both humoral and cellular immune functions. In traditional medicinal practices, parsley has been associated with potential abortifacient properties. The plant contains a variety of phytochemical compounds, including coumarins, flavonoids, carbohydrates, and essential oil constituents.

Antibacterial Activity: The leaves and stems of Petroselinum crispum are known to possess

antibacterial properties against *Bacillus subtilis* and *Escherichia coli*. The antimicrobial furcoumarins include psoralen, 8-methoxypsoralen, 5-methoxypsoralen, oxypeucedanin, and isopimpinellin.

Analgesic and spasmolytic activity: The hydroalcoholic extract of *Petroselinum crispum* seeds demonstrated analgesic effects in mice. Various extracts from the aerial parts exhibited antispasmodic activity on both spontaneous and acetylcholine-induced contractions in isolated rat ileum.

Antioxidant activity: The essential oil extracted from the seeds showed in vitro antioxidant activity, with apiol and myristicin being the two active components responsible for this effect[8].

METHOD OF EXTRACTION

Soxhlet Extraction:

20g of powdered *Petroselinum crispum* were extracted using a Soxhlet apparatus with 300ml petroleum ether. The extraction was carried out continuously for 3 hours at 60 °C. The 250ml hot extract was filtered through Whatman filter paper to remove impurities, and the solvent was evaporated at room temperature. The resulting dried extract was collected and stored in an airtight container for future formulation and analysis[9].

Phytochemical Screening

It plays a crucial role in the process of isolating and identifying novel bioactive compounds derived from plants.

1. Test for Coumarins

- NaOH Test

2ml of extract was subjected to 3ml of 10% sodium hydroxide in a test tube. If the solution changes to a yellow colour, it indicates the presence of coumarins[10].

2. Tests for Flavonoids and Flavanones

- Aqueous Sodium Hydroxide Test

To a small portion of the extract, sodium hydroxide solution was added. A yellow colour that disappeared on acidification confirmed flavonoids.

- Shinoda Test

The alcoholic extract was treated with magnesium or zinc and dilute hydrochloric acid. The development of an orange-red or violet colour confirmed flavonoids.

3. Tests for Phenolic Compounds and Tannins

- Gelatin Test

The aqueous extract was filtered, and the filtrate was treated with 2% gelatin containing 10% sodium chloride. The formation of a milky white precipitate confirmed tannins.

- Lead Acetate Test

To the aqueous extract, 10% lead acetate was added. A bulky white precipitate indicated phenolic compounds or tannins.

- Decolorization Test

The aqueous extract was treated with dilute potassium permanganate solution. The disappearance of the purple colour confirmed phenolic compounds.

4. Test for Terpenoids

- Salkowski Test

The extract was dissolved in chloroform, and concentrated sulfuric acid was added. The red colour in the chloroform layer and greenish-yellow fluorescence in the acid layer indicated terpenoids.

5. Tests for Alkaloids

- Wagner's Test

To 2 ml of the filtrate, 1 ml of Wagner's reagent was added. The formation of a reddish-brown precipitate confirmed alkaloids.

- Hager's Test

To 2 ml of the filtrate, 1 ml of Hager's reagent was added. A yellow precipitate signified the presence of alkaloids.

- Dragendorff's Test

To 2 ml of the filtrate, 2 ml of Dragendorff's reagent was added. The formation of an orange-red precipitate indicated alkaloids[11].

FORMULATION OF HERBAL GEL

INGREDIENTS	QUANTITY(30gm)
Petroselinum crispum extract	0.3gm
Carbopol 940	0.3gm
Triethanolamine	0.12ml
Ethanol	7.28ml
Dimethyl sulfoxide	q.s
Distilled water	21.8ml

PROCEDURE

- The gel was created by mixing 0.3 gram of Petroselinum crispum extract, 0.3 gram of carbopol 940, 0.12 ml of triethanolamine, ethanol, and distilled water.
- Initially, the extract was dispersed in a combination of 7.1 ml distilled water and 5.38 ml ethanol, which was then gradually introduced to the hydrated carbopol 940, which contained 1.9 ml ethanol and 14.7 ml distilled water.
- The mixture was stirred continuously until the gel started to form. At this stage, dimethyl sulfoxide (DMSO) was added as a permeation enhancer.
- The gel was subsequently allowed to set until it reached the desired consistency[9].

EVALUATION OF GEL

1. Physical appearance

The visual assessment was used to evaluate the physical appearance of the prepared gels[12].

2. pH measurement

The gel's pH was measured using a digital pH meter. A 5 g sample was dissolved in 50 ml of water, and the glass electrode was fully immersed to record the pH. Additionally, 2.5 g of gel in 25 ml of distilled water was also tested, and the pH values were documented.

3. Homogeneity

All formulated gels underwent visual inspection for homogeneity after being set in the container, assessing their appearance and checking for any aggregates[13].

4. Washability

The washability assessment involved applying a small amount of the prepared formulation to the skin, followed by washing it off with water. A small amount of the prepared formulations (gels) was massaged into the skin and then rinsed with warm water. The formulations should ideally possess good washability[14].

5. Skin irritation test

A small amount of herbal gel was applied to the dorsal side of the left hand and left for 24 hours. The site was monitored for irritation (redness, swelling, or itching) at intervals, and checked again after 24 hours before removing the gel[15].

6. Spreadability

Spreadability of the gel was measured using parallel plate method. 1g of sample prepared in 48 hours before the test is placed between two glass plates 20 x 20cm. A weight (50-500g) of 125g is placed on top for 1 minute. Then the diameter of the sample between the plates is measured.

$$S_i = d^2 \times \pi/4$$

S_i —spreading area (mm²) depending on mass.

d —spreading area[16].

7. Stability studies

Stability refers to the degree to which a product maintains its effectiveness within defined parameters over its shelf life. All chosen formulations underwent stability testing for a duration of 6 weeks at room temperature. Each formulation was evaluated for variations in pH, spreadability, homogeneity, or drug content according to the previously outlined procedures[13].

8. Antibacterial studies

The antimicrobial activity of Petroselinum crispum was evaluated using agar well diffusion method against Escherichia coli. Bacterial isolate were grown to log phase and adjusted to the 0.5 McFarland standard. Mueller-Hinton agar was used for antibacterial activity. Plates were lawn-inoculated using sterile swabs, and 6mm wells were aseptically made using a sterile cork borer. Each well was loaded with 50µL of the extract and allowed to pre-diffuse for 30 minutes. Bacterial plate was incubated at 37 °C for 24 h. After incubation, the diameters of inhibition zones were measured in millimetres. The presence of a clear inhibition zone was considered indicative of antimicrobial activity, whereas the absence of zone was interpreted as no antimicrobial activity[9].

II.RESULT AND DISCUSSION

SL. NO	EXPERIMENT	OBSERVATION	INFERENCE
1.	<p>TEST FOR COUMARINS</p> <p>a) NaOHTest : 2ml of extract was subjected to 3ml of 10% sodium hydroxide in a test tube.</p>	The solution changes to a yellow colour.	Presence of coumarins
2.	<p>TEST FOR FLAVANOIDS</p> <p>a) Aqueous Sodium Hydroxide Test: To a small portion of the extract, sodium hydroxide solution was added.</p> <p>b) Shinoda Test: The alcoholic extract was treated with magnesium or zinc and dilute hydrochloric acid confirmed flavonoids.</p>	<p>A yellow colour that disappeared on acidification.</p> <p>The development of an orange-red colour.</p>	<p>Presence of flavonoids</p> <p>Presence of flavonoids</p>
3.	<p>TEST FOR PHENOLIC COMPOUNDS AND TANNINS</p> <p>a) Gelatin Test: The aqueous extract was filtered, and the filtrate was treated with 2% gelatincontaining 10% sodium chloride.</p> <p>b) Lead Acetate Test: To the aqueous extract, 10% lead acetate was added.</p> <p>c) Decolorization Test: The aqueous extract was treated with dilute potassium permanganate solution.</p>	<p>The formation of a milky white precipitate</p> <p>A bulky white precipitate</p> <p>The disappearance of the purple colour</p>	<p>Presence of tannins</p> <p>Presence of phenolic compounds and tannins</p> <p>Presence of phenolic compounds</p>

4.	TEST FOR TERPENOIDS a)Salkowski Test: The extract was dissolved in chloroform, and concentrated sulfuric acid was added.	The red colour in the chloroform layer and greenish-yellow fluorescence in the acid layer	Presence of terpenoids
5.	TEST FOR ALKALOIDS a)Wagner’s Test: To 2 ml of the filtrate, 1 ml of Wagner’s reagent was added. b)Hager’s Test: To 2 ml of the filtrate, 1 ml of Hager’s reagent was added. c)Dragendorff’s Test: To 2 ml of the filtrate, 2 ml of Dragendorff’s reagent was added.	The formation of a reddish-brown precipitate. The formation of yellow precipitate. The formation of an orange-red precipitate.	Presence of alkaloids Presence of alkaloids Presence of alkaloids

EVALUATION

1.Physical appearance

- Colour: Olive green
- Odour: Characteristic
- Consistency: Thick viscous

2. pH

Using digital pH meter, pH was found to be 4.79.

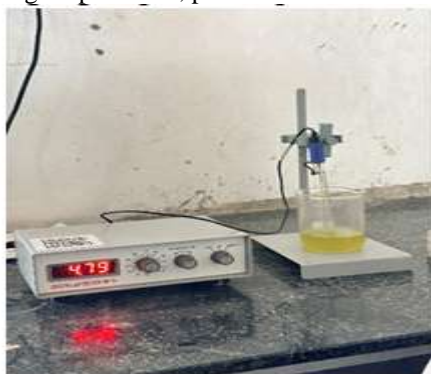


Fig.21

3. Homogeneity test

The developed gel showed good uniformity and consistency, with no visible lumps, flocculates, or aggregates on visual inspection.



Fig.22

4. Washability

No greasiness or skin discomfort was observed after washing.

5. Skin irritation

No notable irritation or inflammation on skin.



Fig.23

6. Spreadability

The formulation shows optimum spreadability.

$$S_i = d^2 \times \pi/4$$

$$= (2.7)^2 \times 3.14/4$$

$$= 5.7$$



Fig.24

7. Stability study-

SINO.	PARAMETERS	DURING PREPARATION	AFTER STABILITY STUDY
1	Colour	Olive green	Olive green
2	Odor	Characterisitic	Characterisitic
3	pH	4.79	4.77
4	Texture	Smooth	Smooth
5	Consistency	Thick viscous	Thick viscous

9. Antimicrobial study

The antibacterial activity of the test sample was evaluated against *Escherichia coli* using the agar well diffusion method. After incubation, a zone of inhibition measuring 10 mm in diameter was observed around the well. This result indicates that the test sample exhibited mild antibacterial activity against *E. coli*. The formation of a measurable inhibition zone confirms the inhibitory potential of the sample, though the activity was relatively low compared to standard antibacterial agents.



Sample

Control

Fig.25

Antibiotic/sample	Zone of inhibition(mm) <i>Escherichia coli</i>
Amikacin	17
Piperacillin-Tazobactam	11
Gentamicin	20
Meropenem	26
Cefepime	27
Petroselinum crispum	10

PACKAGING

- Antibacterial gel is packed in a wide-mouthed container for easy removal and application.
- Container must be airtight and leak-proof to prevent contamination.
- The container is usually kept inside a printed cardboard box for protection.

LABELLING

- "FOR EXTERNAL USE ONLY".
- Patch test recommended.
- Discontinue use if irritation occurs.

DIRECTION TO USE

Clean and dry the affected area thoroughly before application and apply a thin layer of the gel to the affected area.

STORAGE

- Store in a cool and dry place.
- Keep away from direct sunlight and heat.
- Keep the container tightly closed after use.

III. CONCLUSION

The present study successfully formulated and evaluated a topical antibacterial herbal gel containing *Petroselinum crispum* leaf extract using a systematic pharmaceutical approach. Bioactive constituents were efficiently extracted by Soxhlet extraction using petroleum ether. The gel was prepared using Carbopol 940, triethanolamine, ethanol, distilled water, and dimethyl sulfoxide, resulting in a smooth and stable formulation. Phytochemical screening confirmed the presence of flavonoids, tannins, phenolic compounds, terpenoids, and alkaloids. Evaluation studies including pH, spreadability, homogeneity, stability, washability, and skin irritation demonstrated good physicochemical stability and patient acceptability. Antibacterial activity assessed by the agar well diffusion method showed significant inhibition of bacterial growth, supporting the therapeutic potential of the formulation. Overall, the findings

highlight *Petroselinum crispum* as a promising natural antibacterial agent for topical pharmaceutical applications.

REFERENCES

- [1]. Alex Hankey. The scientific value of Ayurveda. *The Journal Of Alternative And Complementary Medicine*. 2005;11(2):221.
- [2]. A textbook by PratapChauban (2007). *Ayurvedic Pharmacognosy*:15.
- [3]. GhongadeGovind, ApteMadhavi. Review of herbal drug formulations and its evolutions. *Mintage Journal of Pharmaceutical and Medical Sciences*. 2019;8(1):1.
- [4]. NaziyaPathan, Salman Pathan, VarsharaniAvhad. Formulation and evaluation of herbal gel using lemongrass oil. *International Journal of Novel Research and Development*. 2024;9(6):691.
- [5]. Aditi Sanjay Kumavt, Pathan N Hakimkhan, Punam B Mahanor, Mayur R Mandlik. Evaluation and formulation of topical herbal gel for skin. *World Journal Pharmaceutical Research*. 2025;14(2):372-4.
- [6]. Punosevac M, Radovic J, Lekovic A, Kundakovic-Vasovic T. A review of botanical characteristics, chemical composition, pharmacological activity and use of parsley. *Archives of Pharmacy*. 2021;71:177-196.
- [7]. Chauhan ES, Aishwaya J. Nutraceuticals potential of *Petroselinum crispum*: a review. *Journal of Complementary Medicine & Alternative Healthcare*. 2018;7(2).
- [8]. Farzaei MH, Abbasabadi Z, Shams Ardekani MR, Rahimi R, Farzaei F. Parsley: A review of ethnopharmacology, phytochemistry and biological activities. *Journal of Traditional Chinese Medicine*. 2013;33(6):816-824.
- [9]. Divyaparvathi R, Manivannan R, Karthick M, Nivetha M, Dinesh B, Dineshkumar VS, Elavarasan V, Karunya J, Ravikumar P. Formulation and evaluation of anti-acne topical gel from petroleum ether and methanol extract of *Bougainvillea glabra*. *International Journal of Pharmacy and Pharmaceutical Research*. 2025;31(3):186.
- [10]. Muniyandi MJ, Lakshman K. Preliminary studies of phytochemical investigation on coastal medicinal plants of Bolor, Mangalore. *Indo American Journal of Pharmaceutical Sciences*. 2018;5(2):1311.
- [11]. Sebastin V, Gopalakrishnan G, Sreejith M, Anoop Kumar K. Preliminary phytochemical evaluation and spectral characterization of active constituents in the dried extracts of the whole plant *Argyreiainmbicata* (Rox) Sant& Patel. *Asian Journal of Pharmaceutical and Clinical Research*. 2019;12(11):57-58.
- [12]. Aiyalu R, Govindarjan A, Ramasamy A. Formulation and evaluation of topical herbalgel for the treatment of arthritis in animal model. *Brazilian Journal of Pharmaceutical Sciences*. 2016;52(3):495.
- [13]. Rakesh P, Amid Y, Krishna G, Sujit P. Formulation and evaluation of herbal gelcontaining extract of *Hibiscus syriacus*. *Research Journal of Pharmacy and Technology*. 2014;7(3):296-300.
- [14]. Upadhyay C, Vibha, Pathak D, Kulshreshtha M. Preparation and evaluation of different herbal gels synthesized from Chinese medicinal plants as antimicrobial agents. *Pharmacological Research – Modern Chinese Medicine*. 2023;9.
- [15]. kumar R, Soni H, Sagar, Gulia D, Kumar N. Formulation and evaluation of antibacterial herbal gel. *Journal of Pharmaceutical Research International* 2025;37(10):114.
- [16]. Bakhrushina EO, Anurova MN, Zavalniy MS, Demina NB, Bardakov AI, Krasnyuk II. Dermatologic gels spreadability measuring methods: comparative study. *International Journal of Applied Pharmaceutics*. 2022;14(1):164–165. doi:10.22159/ijap.2022v14i1.41267.