Preparation and preliminary evaluation of a soothing gel containing Aloe vera and *Perilla frutescens* essential oil

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Abstract:

This article presents the process of developing an innovative skincare product derived from natural ingredients, specifically Aloe vera and perilla leaf essential oil (*Perilla frutescens*). The product is formulated in a gel-based form, making it lightweight, non-greasy, and suitable for a wide range of skin types, including normal, oily, combination, and especially sensitive skin. By combining clean, affordable, and easily accessible ingredients, the research has successfully created a high-quality skincare solution with excellent moisturising, protective, and regenerative properties at a relatively low production cost. The gel is rapidly absorbed into the skin, providing immediate hydration while delivering essential nutrients that help maintain healthy and balanced skin. Aloe vera extract is well known for its soothing, anti-inflammatory, and healing effects, whereas perilla leaf essential oil contributes antioxidant and skin-brightening benefits. Together, these ingredients help reduce irritation, improve skin texture, and support natural skin recovery. In addition, the product incorporates nanoparticles such as gold (Au) and titanium (Ti), which enhance skin regeneration, reduce dark spots, stimulate collagen production, and promote brighter, smoother, and healthier-looking skin with long-term use.

Keywords: **Aloe vera, *Perilla frutescens*, skincare gel.**

Classification numbers: **2.2, 3.3, 3.4**

1. Introduction

Organic cosmetic products have become a popular trend as consumers increasingly seek natural and eco-friendly alternatives, owing to a growing awareness of environmental protection. Plants are renewable resources; consequently, various companies are attempting to develop herbal products from plant materials. Natural ingredients are more biocompatible and healthier than synthetic materials [1]. Herbal cosmetics are products that contain one or more natural ingredients in their formulation to provide specific cosmetic benefits [2]. Many natural products are used for skincare and the improvement of damaged skin. Aloe vera gel is well known for its therapeutic, antiseptic, and anti-inflammatory properties, as well as its ability to facilitate tissue penetration. It contains many useful components, such as vitamins and amino acids [3]. *P. frutescens* is commonly used in daily life. Various inorganic components, phytosterols, antioxidant compounds, and vitamins (A, B, and C) are present in *P. frutescens* [4]. Aloe vera gel and the essential oil of *P. frutescens* are beneficial for human health due to their nutritional value. At present, there is no commercial gel available that is based on both Aloe vera and the essential oil of *P. frutescens* for herbal skin remedies [5]. Therefore, in this research, an herbal gel containing aloe vera gel and the essential oil of *P. frutescens* was prepared.

2. Materials and methods

2.1. Plant material

P. frutescens was collected in November 2025 in Hanoi, Vietnam. Aloe vera was purchased from the vegetable section of a supermarket in Hanoi, Vietnam.

Materials: limewater, dilute saltwater, lemon juice, nano-gold (Au), nano-titanium (Ti), hyaluronic acid (HA), collagen, vitamin B3, phenoxyethanol, polyethylene glycol, and Aloe vera.

2.2. Methods

Extraction of *P. frutescens* essential oils: A Clevenger-type apparatus was employed to isolate the essential oils from the leaves of *P. frutescens*. The hydro-distillation process commenced by adding 300-500 g of fresh plant material to distilled water at a ratio of 1:2, followed by boiling for 4 hours, starting from the appearance of the first essential oil drop in the collector (three batches were prepared). The products were dehydrated with Na_2SO_4 to yield essential oils. The essential oil was then stored in a dark bottle until analysis via gas chromatography [6]. Gas chromatography (GC) analysis: An Agilent Technologies HP7890A GC instrument was employed to perform GC-MS analysis of the essential oils. The instrument was equipped with an Agilent Technologies HP5975C mass spectrum detector and a DB-XLB column (60 m × 0.25 mm, film thickness 0.25 µm, Agilent

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Technologies). The injector and detector temperatures were set at 250°C and 280°C, respectively. The column temperature program initiated at 40°C, followed by a 20°C/min increase to 140°C, and a subsequent increase to 270°C at 4°C/min. Helium was used as the carrier gas at a flow rate of 1 ml/min. Samples were injected via split injection with a volume of 1 µl and a split ratio of 100:1. The MSD conditions were as follows: ionisation voltage 70 eV, emission current 40 mA, and a mass scan range of 35-450 amu under full scan. A homologous n-alkane series was used as a reference, with its retention times used as a basis for the calculation of the retention indices of the constituents in the sample. The relative amounts of individual components were calculated based on the GC peak area (MSD response) without correction. Evaluation of antimicrobial activity testing: Evaluation of antimicrobial activity was performed on a 96-well microtiter plate using the methods of J.V. Berghe, et al. (1991) [7]. Bacterial strains included: *E. coli, P. aeruginosa, B. subtilis,* and *S. aureus*; moulds: *A. niger* and *F. oxysporum*; and yeasts: *S. cerevisiae* and *C. albicans* [8].

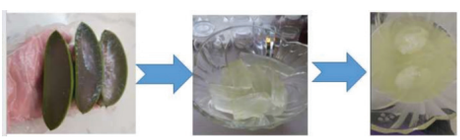
2.3. Experimental procedure

Phase 1. Extraction of Perilla essential oil.

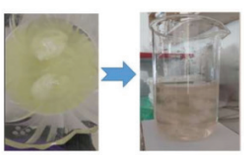
Fresh *P. frutescens* leaves were chopped and placed into a Clevenger-type apparatus. The hydro distillation process commenced by soaking the sample for 4 hours at boiling temperature. The obtained perilla essential oil was dried using anhydrous sodium sulfate (Na_2SO_4).

Phase 2. Preparation of Aloe vera gel.

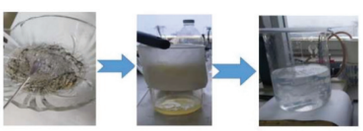
Stage 1: The green phloem of Aloe vera leaves was peeled to obtain the clear gel, which was then washed and homogenised (solution A). Calcium oxide was added to solution A and stirred until the pH reached 9-10. The residue was removed, and the clear liquid was collected (solution B).



Stage 2: A volume of 200 ml of solution B was transferred into a 1000 ml beaker. Fresh lemon juice (or citric acid) was added until the pH reached 6.5-7. The solution was filtered to obtain solution C.



Stage 3: To solution C, 3 g of activated carbon was added and stirred gently for 15 minutes. The solution was then filtered to obtain a clear liquid (solution D).



Stage 4: Cosmetic ingredients were added sequentially into solution D: collagen powder (0.4 g), vitamin B3 (2 g), propanediol (0.6 ml), polyethylene glycol (4 ml), and phenoxyethanol (1.5 ml). The mixture was placed on a magnetic stirrer until fully dissolved and adjust the gel to a pH = 7 (solution E).

Stage 5: A solution containing hyaluronic acid (HA) was slowly added to solution E. Continue stirring until a homogeneous gel is achieved.

Phase 3. Mixing gel with perilla essential oil and bottling.

To the gel base, the following were added: 2 g perilla essential oil, 0.2 ml nano gold (Au), 0.4 mL nano titanium (Ti), and a small amount of 24K gold flakes. The final product was poured into bottles and labeled.

3. Results and discussion

3.1. Perilla essential oil distillation results

A total of 1,190 g of fresh perilla leaves were distilled in three batches, yielding 2.38 g of essential oil, corresponding to an extraction efficiency of 0.2%. The concentration of each batch is provided in Table 1. Gas chromatography of Perilla essential oil is shown in Fig. 1, and the results of GC-MS analysis of the components in the essential oil of *P. frutescens* leaves are provided in Table 2 [6].

Table 1. Concentration of distilled perilla oil.

Order	Batch number	Perilla leaves (g)	Essential oil (g)	Concentration (%)
1	B1	390	0.81	0.21
2	B2	300	0.54	0.18
3	B3	500	1.03	0.21
Total		1190	2.38	0.2

The main components in the essential oil have been noted for their activities: perilla aldehyde (27.06%; exhibits antimicrobial and anti-inflammatory activity, supporting the gel's role in soothing irritated skin and reducing microbial growth) [9, 10]. Caryophyllene and humulene (15.44 and 2.94%; sesquiterpenes with strong anti-inflammatory properties, widely used to reduce redness, swelling, and

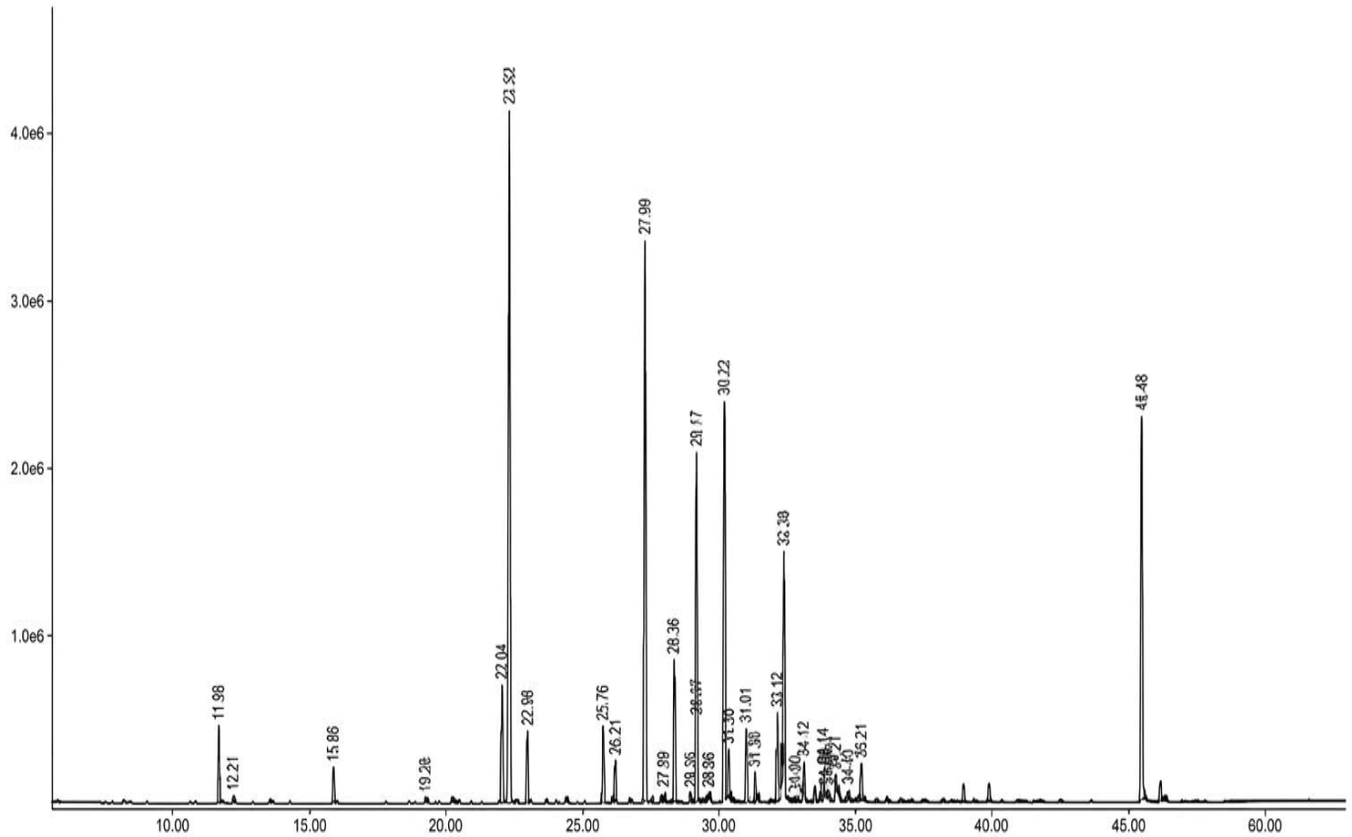


Fig. 1. Gas chromatography of perilla essential oil.

Table 2. Results of GC-MS analysis of the components in the essential oil of *P. frutescens* leaves.

No.	Component name	RI	%
1	Octen-3-ol < 1- >	11.68	1.47
2	Octanol < 3- >	12.21	0.11
3	Linalool	15.86	0.71
4	Terpineol < a- >	19.26	0.11
5	Shisool < trans- >	22.04	3.15
6	Perilla aldehyde	22.32	27.06
7	Perill alcohol	22.98	1.68
8	Copaene < a- >	25.76	1.41
9	Elemene < cis-b- >	26.21	1.07
10	Caryophyllene < E- >	27.30	15.44
11	Farnesene < (Z)-b- >	27.99	0.28
12	Humulene < a- >	28.36	2.94
13	Muurolene < g- >	28.95	0.21
14	Zingiberene < a- >	29.17	5.20
15	Germacrene D	29.21	2.83
16	Farnesene < (E,E)-a- >	29.60	0.13

No.	Component name	RI	%
17	Muurolene < a- >	29.64	0.13
18	Myristicine	30.22	9.44
19	Cadinene < d- >	30.35	1.09
20	Elemicine	31.01	1.29
21	Nerolidol < E- >	31.30	0.48
22	Spathulenol	32.14	2.28
23	Caryophyllene oxide	32.38	7.50
24	Bisabol-11-ol < Z- >	32.80	0.22
25	Humulene Epoxide II	33.12	0.95
26	Caryophylla-3 (15),7 (14)-dien-6-ol	33.84	0.70
27	Muurolol < epi-a- > (= T-Muurolol)	33.89	0.25
28	Muurolol < a- > (= Cadinol < d- >)	34.00	0.25
29	Cadinol < a- >	34.27	0.51
30	Caryophylla <14-Hydroxy-9-epi-(E)- >	34.73	0.24
31	Unknown (159, 220, RI 1707)	35.75	1.02
32	Phytol	45.46	5.93
Total (%)			**96.07**

irritation in dermatological applications) [11]. Myristicine (9.44%; antioxidant and antifungal effects, enhancing the gel's protective capacity against oxidative stress and fungal colonisation) [12, 13]. Caryophyllene oxide and spathulenol (7.50% and 2.28%; oxygenated sesquiterpenes with antibacterial and antifungal activity, strengthening skin defence) [14]. *trans*-shisool (3.15%; antimicrobial activity). Zingiberene and germacrene D (5.20% and 2.83%; provide antioxidant and soothing effects, synergising with aloe's hydrating polysaccharides to promote skin comfort and resilience) [15, 16].

P. frutescens essential oil was evaluated for its activity against eight microbial test strains. The results showed that the oil demonstrated inhibitory activity against the growth of *Saccharomyces cerevisiae* at a concentration of 400 µg/ml, and against *Aspergillus niger*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* at 200 µg/ml. This antimicrobial effect is attributed to the active component groups present in the oil.

Five batches of gel mixtures containing Aloe vera solution and the components were prepared using the method described above. The results are summarised in Table 3.

Table 3. Properties of Aloe vera - Perilla soothing gel batches.

No.	Aloe vera solution (D* solution)	Gel mixture (ml)	Observations	pH value
1	200	210	Transparent and homogenous	7.3
2	200	211	Transparent and homogenous	7.2
3	200	210	Transparent and homogenous	7.4
4	200	210	Transparent and homogenous	7.5
5	200	210	Transparent and homogenous	7.3

Nanoparticles of gold (Au) and titanium (Ti) were incorporated into the gel formulations to enhance UV protection, antimicrobial activity, and skin regeneration [17].

The soothing gel exhibited a pleasant scent of perilla essential oil with an attractive colour and rapid absorption, providing the skin with hydration, minerals, brightening, softening, and revitalisation (Fig. 2). The product can be used on all skin types: normal, oily, or combination, and for all age groups. The perilla scent provides relaxation and comfort during application.

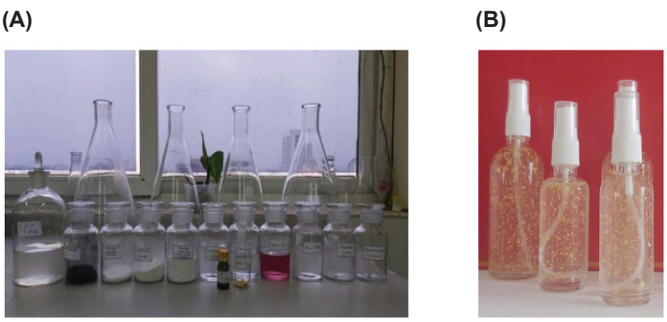


Fig. 2. (A) Components of the soothing gel product; (B) The final Aloe vera - Perilla soothing gel product.

Stability was assessed using two parameters: pH and homogeneity. Measurements were taken at time zero and after a one-week interval at two different temperature ranges: room temperature and below 10°C (refrigerated). All formulations passed the homogeneity test across the selected temperature ranges over the one-week period.

3.2. Weaknesses and limitations

The inclusion of nano-Au and nano-Ti in the aloe-Perilla gel was intended to provide multifunctional benefits: UV protection, antimicrobial support, and skin regeneration. The concentrations used (X mg/ml Au, Y mg/ml Ti) were selected based on published cosmetic formulations and maintained within ranges reported as safe for topical use. Nano-Ti is an established UV filter in sunscreens, while nano-Au has been investigated for wound healing and anti-ageing effects. Dispersion stability was achieved through homogenisation in the aloe gel matrix, which prevented visible aggregation. However, regulatory frameworks such as the EU Cosmetics Regulation require explicit labelling of nanoscale Ti and further toxicological evaluation of nano-Au. Therefore, while our formulation demonstrates proof-of-concept, additional studies on long-term safety, dermal penetration, and regulatory compliance are essential before commercialisation. Acknowledging the current limitations, we are committed to systematically addressing them in the near future. Our next phase of work will include expanding production batches to ensure reproducibility, conducting comprehensive analytical studies, and implementing controlled clinical trials to evaluate both efficacy and safety. Furthermore, we will pursue long-term investigations into dermal penetration, biocompatibility, and regulatory compliance. These efforts will generate the robust dataset required to advance the formulation from laboratory proof-of-concept toward a commercially viable cosmetic product. In fact, the trend toward using natural cosmetic products is becoming increasingly popular, attracting consumer attention for various reasons, such as safety, gentleness, environmental friendliness, and reduced irritation compared to synthetic cosmetics.

4. Conclusions and recommendations

The homogeneity test of the gel batches showed that the prepared gel had a uniform composition. All gels had a characteristic, acceptable odour and a moderate, non-viscous consistency. The smear test confirmed that all formulations were non-greasy and had good moisturising effects. The prepared gel batches were easily removed with tap water, indicating that the herbal gel is easy to use. The irritancy test confirmed that the prepared gel caused no allergic reactions or skin irritation, indicating that the formulations are safe for use. The pH of the prepared herbal formulations was in the range of 7.3-7.6 [3]. In this project, we developed a handmade soothing gel formulated from a mixture of aloe vera extract and *P. frutescens* essential oil. The outcome of the project is a cosmetic product composed of natural ingredients, including Aloe vera gel, nano-gold (Au), nano-titanium (Ti), and the distinctive addition of *P. frutescens* essential oil. It regenerates the skin, fades dark spots, and leaves the skin bright and smooth. This gel product is safe for all skin types, including normal, oily, and especially sensitive skin. The scent of Perilla essential oil provides a soothing effect and a pleasant sensation. The safe production process, combined with clean and readily available raw materials, resulted in a high-quality skincare product with unique ingredients that enhance moisturisation, protection, and skin regeneration at a low cost.

CRediT author statement

Linh Tran Vu Phuong: Methodology, Investigation, Writing, Editing; Nga Nguyen Linh: Data analysis, Validation, Editing; Linh Phung Phuong: Data analysis, Editing; Inh Cam Thi: Conceptualisation, Supervision, Validation.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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