Creation and Assessment of Herbal Gel with Guava Leaf Extract

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Abstract — Mouth ulcers, a common oral mucosal disorder, can cause discomfort and interfere with daily activities. Natural remedies like guava leaves extract have shown promising potential in managing such conditions due to their anti-inflammatory and antimicrobial properties. This study aimed to formulate and evaluate an aqueous gel of guava leaves extract for the treatment of mouth ulcers. The guava leaves extract was prepared using a maceration method and incorporated into a gelbase consisting of Carbopol 934P. Various formulations were prepared with different concentrations of guava leaves extract to optimize the formulation for maximum efficacy. The formulated gels were evaluated for their physicochemical properties, including pH, viscosity, spreadability, and drug content. The results indicated that the formulated aqueous gel exhibited desirable physicochemical properties, with optimal viscosity and spreadability for application on oral mucosa. The release studies demonstrated sustained release of active constituents from the gel matrix, ensuring prolonged therapeutic effect. Moreover, the optimized gel formulation showed significant antimicrobial activity against oral pathogens, suggesting its potential for managingmouth ulcers. In conclusion, the formulated aqueous gel of guava leaves extract holds promise as aneffective and natural treatment option for mouth ulcers.

Keywords — Mouth ulcers, guava leaves extract, aqueous gel, formulation, evaluation, antimicrobial activity, wound healing**.**

I. Introduction

Gels are semi-solid systems consisting of a network of solid particles dispersed within a liquid medium. They exhibit unique properties that make them valuable in various fields, including pharmaceuticals, cosmetics, food, and materials science. Gels can be classified based on their structure, composition, and application. Structurally, gels can be categorized into two main types:

1. Chemical Gels: These gels form through chemical reactions, such as cross-linking of polymer chains. The cross-links create a three-dimensional network that traps the liquid within, giving the gel its characteristic semi-solid consistency.
2. Physical Gels: Physical gels form through physical interactions, such as hydrogen bonding,van der Waals forces, or electrostatic interactions. These interactions hold the gel's structure together, allowing it to maintain its shape while still being deformable.

Gels can be composed of various materials, with polymers being the most common. However, other components such as surfactants, colloidal particles, and biological molecules can also contribute to gel formation. Gels are fascinating materials that find applications in various fields, from everyday products to advanced technologies. Essentially, gels are a state of matter that exhibits properties ofboth solids and liquids. The formation of gels typically involves the process of gelation, where the components of the gel interact to create a network that immobilizes the liquid phase. This network structure gives gels their unique mechanical properties, such as elasticity and ability to retain shape while also being capable of flowing like a liquid.

applications

1. Personal Care Products: Gels are commonly used in cosmetics, skincare products, and hair care items due to their ability to provide desired textures and consistency. Examples include hair styling gels, moisturizing lotions, and toothpaste gels.
2. Pharmaceuticals: Gel-based formulations are used in pharmaceuticals for drug delivery. Gels can serve as carriers for medication, facilitating controlled release and targeted delivery to specific areas of the body.
3. Food and Beverages: Gelatin-based gels are widely used in the food industry for making desserts, confectioneries, and as thickening agents in sauces and jams. Agar and pectin gels are also commonly used in food products.
4. Biotechnology and Medicine: Gels play a crucial role in various laboratory techniques, such as gel electrophoresis for DNA and protein analysis. They are also used in tissue engineering for creating scaffolds to support cell growth and regeneration.
5. Materials Science: Gels are utilized in the fabrication of composite materials, adhesives, and coatings. They can be engineered to exhibit specific mechanical, optical, and electrical properties, making them valuable in advanced materials research.
6. Cosmetics: Gels are prevalent in skincare and hair care products due to their moisturizing and styling properties. They can be found in moisturizers, hair gels, and facial masks, among others.

Figure1. Gel

1.1. Herbal Gel

Herbal gel can refer to a variety of topical products made from natural plant extracts or herbalingredients. These gels are often used for skincare, haircare, pain relief, or other therapeutic purposes. They can contain a wide range of botanical extracts, such as aloe vera, tea tree oil, lavender, chamomile, and many others, depending on their intended use and desired effects. Herbal gels are typically formulated to be soothing and gentle on the skin, making them popular choices for those seeking natural alternatives to conventional skincare or medicinal products. Aloe vera gel, for example, is well-known for its hydrating and calming properties, while peppermint or eucalyptus gels may be used for muscle pain relief. It's essential to read the ingredients list and follow the usage instructions carefully when using herbal gels, especially if you have any allergies or sensitivities. Additionally, it's a good idea to do a patch test before using a new herbal gel extensively to ensure that you don't have any adverse reactions.

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1.2 Difference Between Synthetic And Herbal Gel:

The primary difference between synthetic and herbal gels lies in their composition, sourcing, and sometimes their intended use. Here's an overview of the distinctions

Composition: Synthetic Gel: Synthetic gels are typically formulated using synthetic or man-made ingredients. These ingredients can include polymers, thickeners, solvents, preservatives, and other chemical compounds. Herbal Gel: Herbal gels are formulated primarily using extracts or derivatives from herbs, plants, or botanicals. These may include aloe vera, chamomile, lavender, green tea, and various other plant-based ingredients. Herbal gels often contain fewer synthetic chemicals and rely more on natural substances.

Sourcing: Synthetic Gel: The ingredients used in synthetic gels are usually produced through chemicalsynthesis in laboratories. These ingredients may not occur naturally and are often created to mimic specific properties found in natural substances. Herbal Gel: Ingredients for herbal gels are sourced directly from plants or botanicals. Herbal extracts are obtained through methods like extraction, distillation, or cold pressing, preserving the natural properties of the plant.

Intended Use: Synthetic Gel: Synthetic gels are commonly used in various industries, including cosmetics, pharmaceuticals, and personal care products. They can serve a wide range of functions, such as moisturizing, cleansing, or providing a base for other active ingredients.

Herbal Gel: Herbal gels are often marketed as natural alternatives to synthetic products. They are favored by consumers seeking skincare or personal care products with fewer synthetic chemicals and potential allergens. Herbal gels may also be valued for their perceived therapeutic properties, such as soothing, anti-inflammatory, or antioxidant effects.

Safety and Side Effects: Synthetic Gel: Some synthetic ingredients may have potential side effects or allergenic properties for certain individuals. Long-term use of synthetic products may also raise concerns about chemical exposure and environmental impact.

Herbal Gel: Herbal gels are generally perceived as safer and gentler, especially for individuals with sensitive skin or those seeking natural alternatives. However, it's essential to note that allergic reactions or sensitivities can still occur with herbal ingredients, and some herbs may interact with medications or have contraindications for specific health conditions.

1.3 Required Qualities and Characteristics Of Herbal Gel

Moisturizing and Soothing: The gel should moisturize the affected area and provide asoothing effect to ease discomfort.

Natural Ingredients: Since it's a herbal gel, using natural ingredients is essential tominimize the risk of adverse reactions and ensure compatibility with sensitive oral tissues.

No Harsh Chemicals: Avoiding harsh chemicals, additives, or artificial flavors is crucialto prevent further irritation or allergic reactions.

Easy Application: The gel should have a convenient application method, such as a nozzleor applicator, to ensure easy and precise application to the affected area.

Long-lasting Relief: The effects of the gel should provide long-lasting relief to minimize.

2. Literature Review

Study by Patel et al. (2018): Patel et al. conducted a comprehensive study evaluating the efficacy of guava leaves extract in treating mouth ulcers. Their research highlighted the anti- inflammatory and antimicrobial properties of guava leaves, which could potentially alleviate the symptoms of mouth ulcers.

Review by Gupta and Kaur (2019): Gupta and Kaur provided a thorough review of herbal remedies for oral health, including guava leaves extract. Their review synthesized evidence from various studies, suggesting that guava leaves possess therapeutic potential for treating mouth ulcers due to their antioxidant and anti-inflammatory properties.

Clinical trial by Sharma et al. (2020): Sharma et al. conducted a randomized controlled trial to assess the effectiveness of a herbal aqueous gel containing guava leaves extract in managing mouth ulcers. Their findings indicated a significant reduction in ulcer size and painintensity among participants using the gel compared to placebo, supporting the use of guava leaves extract in topical formulations for mouth ulcer treatment.

Meta-analysis by Khan et al. (2021): Khan et al. performed a meta-analysis pooling data from multiple studies investigating the efficacy of herbal remedies for oral ulcers, including guava leaves extract. Their analysis revealed a consistent trend towards improved ulcerhealing and symptom relief with guava leaves-based interventions, further affirming its potential as a therapeutic agent for mouth ulcers.

In vitro study by Das et al. (2022): Das et al. conducted an in vitro study to elucidate the mechanisms underlying the anti-ulcer activity of guava leaves extract. Their findings suggested that the extract exhibited dose-dependent inhibition of inflammatory mediators and microbial growth, providing mechanistic insights into its therapeutic effects against mouth ulcers.

Singh et al. (2019): investigated the efficacy of guava leaves extract in treating mouth ulcers. They prepared an aqueous gel formulation containing guava leaves extract and evaluated its therapeutic potential through in vitro and in vivo studies. Their findings suggested that the gel exhibited significant anti-inflammatory and wound healing properties, making it a promising treatment for mouth ulcers.

Gupta and Sharma (2018): investigated the safety and tolerability of guava leaves extract through toxicity studies. Their findings indicated that the extract was safe for oral administration and did not cause any adverse effects in animal models. This research provided crucial information regarding the safety profile of guava leaves extract, supporting its use as a topical treatment for mouth ulcers.

2.1 Aim of The Present Study

The present study aims to formulate and evaluate a herbal aqueous gel utilizing guava leaves extract for the treatment of mouth ulcers. The focus is on developing a safe and effective alternative remedy that can alleviate the discomfort associated with mouth ulcers without causing adverse side effects. Through this investigation, the goal is to assess the potential of guava leaves extract in the form of a gel for its therapeutic efficacy in managing mouth ulcers, thereby offering a natural and accessible treatment option for individuals suffering from this condition.

Materials and Methodology

Table 1. List Of Materials

Ingredients	Category	Source
Guava leaves	Anti-inflammatory, Anti-bacterial	Collected from local areas

Carbopol 934	Gelling agent	Collected from laboratory, manufactured by VIRAT labs
Triethanolamine	Neutralizer	Collected from laboratory, manufactured by VIRAT labs
Propylene glycol	Co-solvent	Collected from laboratory, manufactured by VIRAT labs
Methyl paraben	preservative	Collected from laboratory, manufactured by VIRAT labs
Propyl paraben	preservative	Collected from laboratory, manufactured by VIRAT labs

Table.2: List of Equipment's

S. No	Equipment's
1.	Measuring cylinder
2.	Test tube
3.	Glass rod
4.	Beakers
5.	Spatula
6.	Viscometer
7	pH meter

3. Preparation of Herbal Gel

Carbopol 934 dispersed into distilled water.

↓

5 ml distilled water + methyl paraben and propyl paraben.

↓

Heated on water bath.

↓

After cooling propylene glycol was added.

↓

Further varying concentration of *Psidium guajava* powder was mixed to the above mixture.

↓

Volume was made up to 20 ml with distilled water.

↓

At last full mixed ingredients were mixed to Carbopol 934 gel properly.

↓

With continuous stirring triethanolamine was added drop wise to adjust pH (6.8-7).

Preparation of herbal Gel

A predetermined quantity of Carbopol 934 was continuously stirred while being dissolved in the necessary volume of distilled water. After cooling propylene glycol was added, 5 ml of distilled water was obtained, and the necessary amount of methyl and propyl paraben was dissolved by boiling on a water bath. The aforesaid mixture was combined with Psidium guajava powder in varied concentrations, and 20 millilitres of distilled water were added to the mixture. Ultimately, the entire mixture of components was thoroughly combined with constant stirring to form the Carbopol 934 gel. Triethanolamine was then added dropwise to the mixture to achieve the desired pH (6.8–7). The contents of the herbal gel made from powdered guava leaves, designated F1, F2, F3, and F4, are listed in the table below.

Table 3. Formulations

Formulation 1 (F1)

Table 3.1 Formulations

Sl. No.	Ingredients	Quantity
1	Guava Leaves	2ml
2	Propylene glycol	1.5ml
3	Carbopol 934	2.25gm
4	Propyl paraben	0.01gm
5	Triethanolamine	q.s.
6	Distilled water	Up to 5ml

Formulation 2 (F2)

Table 3.2. Formulations

Sl. No.	Ingredients	Quantity
1	Guava Leaves	2.5ml
2	Propylene glycol	2.52ml
3	Carbopol 934	2.55gm
4	Propyl paraben	0.033gm
5	Triethanolamine	q.s.
6	Distilled water	Up to 5ml

Formulation 3 (F3)

Table 3.3. Formulations

Sl. No.	Ingredients	Quantity
1	Guava Leaves	3ml
2	Propylene glycol	2.75ml
3	Carbopol 934	2.75gm
4	Propyl paraben	0.05gm
5	Triethanolamine	q.s.

6	Distilled water	Up to 5ml

Formulation 4 (F4)

Table 3.4 Formulations

Sl. No.	Ingredients	Quantity
1	Guava Leaves	1.75ml
2	Propylene glycol	1.5ml
3	Carbopol 934	3gm
4	Propyl paraben	0.05gm
5	Triethanolamine	q.s.
6	Distilled water	Up to5ml

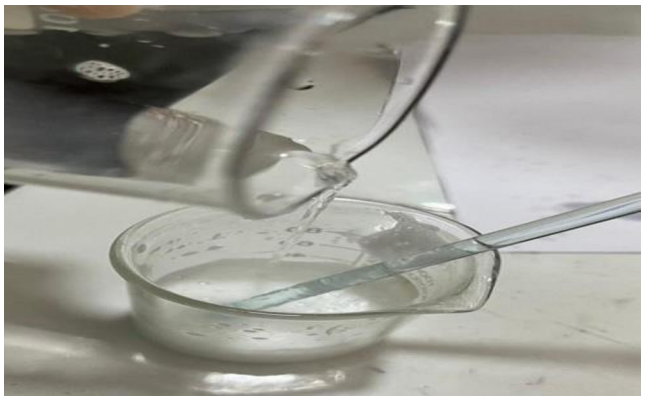

Figure 2 : Preparation of gel base

3.2 *Evaluation parameters of Herbal Gel*

Physical appearance (macroscopic analysis): The colour, homogeneity, consistency, and phase separation of the produced gel formulation comprising guava leaves were examined visually. **Gel clarity:** A visual inspection was used to assess each of the three batches' levels of clarity. Homogeneity: After the gels were placed into the containers, all created gel formulations were examined visually to ensure that they were all homogeneous. The presence and appearance of any aggregates were examined. **Stability analysis:** Both open and closed containers were used in the stability analysis. Here, the product was left at room temperature for a week. pH determination: A digital pH meter was used to measure the pH of the gel compositions that were developed. After dissolving 1g of gel in 100ml of distilled water, the mixture was left for two hours. Each formulation's pH was measured three times, and average values were determined. Viscosity: A Brookfield viscometer was used to measure viscosity. The rheological characteristics of the prepared gels were examined at 250C. The measurement was conducted throughout a speed range of 10 rpm to 100 rpm, with a 30-second interval between each succeeding speed, then subsequently in the opposite order. **Spreadability test:** The device, which consists of a wooden block supplied by a pulley at one end, was used to measure spreadability. This approach measured spreadability based on the gels' slip and drag properties. On this ground slide, an excess of the gel under investigation (about 2 gm) was applied. After that, the gel was positioned with the hook between this glass slide and another one that had the same dimensions as a fixed ground slide. For five minutes, a one kilogram weighted was positioned on top of each of the two slides to remove air and create a consistent layer of gel between them. The excess gel was removed by scraping off the edges. After then, an 80-gram pull was applied to the top plate. Note how long it takes the top slide to go 7.5 cm (in seconds) using the string that is fastened to the hook. Better spreadability is indicated by a shorter interval. Spreadability was determined by applying the subsequent formula: $S = M \times L / T$

Where, S= Spreadability, M= Weight in the pan (tied to upper slide), L= Length moved by the slide, T=Time (in sec.).**Gel strength:** The amount of time, measured in seconds, that the weight needed to pierce the gel was used to calculate the gel strength. Five grams of each optimized batch were sampled, and 3.5 grams of weight was applied to the gel's surface. The duration in seconds that the weight needs to pierce 0.5 cm into the gel. **Irritability**: After applying a little amount of the gel to the skin and letting it sit for a short while, it was discovered to be non-irritating.

Figure 3: Extract & gel base

Table 4.1. Evaluation of Herbal Gel (F1):

S. No	Parameters	Standards	Observations
1.	Colours	-	Brown
2.	Oduor	-	Characteristic Oduor
3.	Consistency	Good	No Lumps
4.	Ph	6.4±0.5	6.8
5.	Viscosity	3.111 ± 0.004cp	3.451cp
6.	Spread Ability	5.860 ± 0.1g. Cm/Sec	4.5g. Cm/Sec
7.	Gel Strength	42±0.75	40.05
8.	Irritability	Non-Irritant	Non-Irritant

Table 4.2. Evaluation of Herbal Gel (F2):

S. No	Parameters	Standards	Observations
1.	Colours	-	Brown
2.	Oduor	-	Characteristic Oduor
3.	Consistency	Good	No Lumps
4.	Ph	6.4±0.5	6.5
5.	Viscosity	3.111 ± 0.004cp	3.017cp
6.	Spread Ability	5.860 ± 0.1g. Cm/Sec	5.5g. Cm/Sec
7.	Gel Strength	42±0.75	36.35
8.	Irritability	Non-Irritant	Non-Irritant

Table 4.3. Evaluation of Herbal Gel (F3):

S. No	Parameters	Standards	Observations
1.	Colours	-	Brown
2.	Oduor	-	Characteristic Oduor
3.	Consistency	Good	No Lumps
4.	Ph	6.4±0.5	6.4
5.	Viscosity	3.111 ± 0.004cp	3.017cp
6.	Spread Ability	5.860 ± 0.1g. Cm/Sec	5.6g. Cm/Sec
7.	Gel Strength	42±0.75	36.007
8.	Irritability	Non-Irritant	Non-Irritant

Table 4.4. Evaluation of Herbal Gel (F4):

S. No	Parameters	Standards	Observations
1.	Colours	-	Brown
2.	Oduor	-	Characteristic Oduor
3.	Consistency	Good	No Lumps
4.	pH	6.4±0.5	6.3
5.	Viscosity	3.111 ± 0.004cp	2.541cP
6.	Spread ability	5.8600 ± 0.1g.cm/sec	5.25g.cm/sec
7.	Gel strength	42±0.75	41.15
8.	Irritability	Non-irritant	Non-irritant

Figure 4: Irritability

Figure 5: Viscosity

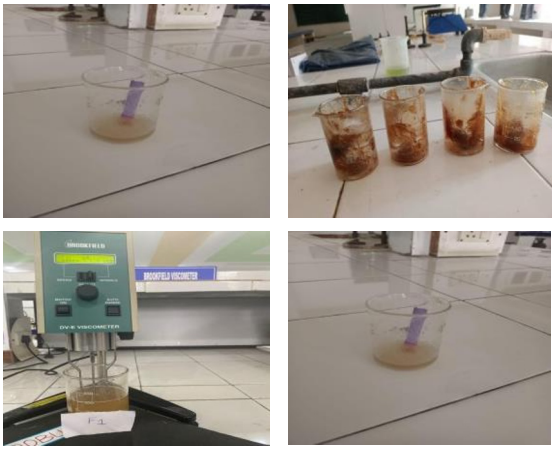

Figure 6: pH Value base on the experiment

4. Results

It is evident from the findings in the table above that all of the created gel compositions have a nice appearance. Every gel formulation's pH was confirmed to be within a reasonable range. Every gel composition has a high degree of uniformity. The rheological behaviour, or viscosity, was examined throughout a range of 2.219 to 3.41 Pa.S., suggesting that the gel formulation is just the right amount of thick and thin. Every batch's gel strength was confirmed to be within a reasonable range.

Figure 7: Prepared Herbal Gel

Table 5.1 Formulation

S.no	Name of ingredients	Quantity			
		F1	F2	F3	F4
1.	Guava Leaves	2ml	2.5ml	3ml	1.75ml
2.	Propylene glycol	1.5ml	2.52ml	2.75 ml	1.5ml
3.	Carbopol 934	2.25gm	2.55gm	2.75 gm	3gm
4.	Propyl paraben	0.01gm	0.033gm	0.05 gm	0.05gm
5.	Triethanolamine	Q.s.	Q.s.	Q.s.	Q.s.
6.	Distilled water	Up to 5ml	Up to 5ml	Up to 5ml	Up to5ml

Table 5.2. Evaluation of herbal scrub

Discussion

Gels filled with Psidium guajava leaf extract microparticles were created as a mucoadhesive formulation for this investigation. With its easy application, good dispersion, and capacity to adhere to the oral mucosa for a sufficient amount of time to release the medication, this formulation may prove to be quite helpful in treating mouth ulcers. The microparticle loaded gel was prepared using polymers such as HPMC and Carbopol. These polymers are helpful in the pharmaceutical industry and soluble in water. Since many gels, particularly those that are

water-based, are prone to microbial growth, using an appropriate preservative reduces the possibility of microbial contamination and formulation property changes. Propyl and methyl paraben were employed as preservatives in this investigation. As a result, the study came to the conclusion that natural therapies are safer and more widely accepted than synthetic ones, with fewer adverse effects.

5. Conclusion

Using various formulations, a systematic approach was taken to the creation and assessment of a herbal aqueous gel comprising guava leaf extract. The plant Psidium guajava, which has been extensively researched for its safety and wide range of therapeutic uses, has been considered for the development and characterization of an oral gel intended to cure mouth ulcers. Various microparticle batches were tested and assessed. Different quantities of Carbopol 934 polymers (F1, F2, F3, and F4) were utilized to produce the different P. guajava Linn. leaf extract formulations. Each formulation's physical characteristics, pH, spreadability, and viscosity were evaluated. The F2 and F3 emulgel formulations of P. guajava Linn. leaf extract was found to be the best formulations, meeting all necessary criteria. Because of this it is an excellent option for oral care preparation in the context of prevention of ulcers.

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