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Preparation and Evaluation of Herbal Oral Gel Containing Extract of *Psidium guajava* Leaves for Mouth Ulcer

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ABSTRACT

Mouth ulcers are a common oral condition causing discomfort and pain, often interfering with daily activities like eating and speaking. Conventional treatments, such as synthetic gels and medications, can sometimes result in side effects or high costs, which has led to growing interest in natural and herbal alternatives. Herbal formulations are known for their safety, affordability, and effectiveness.

***Psidium guajava* (guava) leaves have been widely recognized in traditional medicine for their antimicrobial, anti-inflammatory, and wound-healing properties. Rich in bioactive compounds such as flavonoids, tannins, and phenols, guava leaves offer promising potential for the treatment of mouth ulcers. In this study, an herbal oral gel was prepared using guava leaf extract as the active ingredient. The gel was formulated with excipients like carbopol for gelling, glycerin as a humectant, and triethanolamine to adjust pH.**

Evaluation of the gel focused on parameters such as pH, viscosity, spreadability, and stability. Additionally, antimicrobial activity was tested against oral pathogens, and wound-healing properties were assessed to determine the gel's effectiveness. Results indicated that the herbal oral gel had suitable physical properties, stable formulation, significant antimicrobial activity, and accelerated wound-healing effects.

In conclusion, the guava leaf-based herbal gel offers an effective, safe, and affordable alternative for managing mouth ulcers, with the potential to replace synthetic treatments. Further clinical studies could confirm its efficacy and facilitate its large-scale production for broader use.

Keywords- herbal gel, mouth ulcer, pH, Psidium guajava Leaves.

I. INTRODUCTION

Mouth ulcers, commonly known as oral ulcers, are small, painful sores that develop inside the mouth. They can appear on the inner cheeks, gums, tongue, or lips. These ulcers are often caused by factors such as stress, injury, nutritional deficiencies, infections, or systemic conditions. While most mouth ulcers heal on their own within a few days, they can cause discomfort during eating, drinking, or speaking. Clinically, recurrent or persistent ulcers may indicate serious health issues like autoimmune diseases or oral cancer, making their diagnosis and management essential.

Image 1

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Synthetic treatments, such as antiseptic gels and corticosteroids, are commonly used for treating mouth ulcers. However, these treatments come with challenges. Prolonged use can cause side effects such as irritation, allergic reactions, or altered taste. The overuse of antimicrobial agents in synthetic products has also contributed to drug resistance, reducing their effectiveness. Moreover, the high cost of many synthetic formulations makes them less accessible, especially for low-income populations.

Herbal formulations are gaining attention as a safer and more cost-effective alternative. They are generally well-tolerated, with fewer side effects compared to synthetic drugs. Additionally, herbal products are often more affordable, as they use naturally available ingredients. Many herbs also possess anti-inflammatory, antioxidant, and wound-healing properties, which provide added benefits in managing conditions like mouth ulcers.

Psidium guajava, commonly known as guava, is a medicinal plant widely used in traditional remedies. Guava leaves are rich in beneficial compounds such as flavonoids, tannins, and saponins, which have antimicrobial, anti-inflammatory, and wound-healing properties. These therapeutic qualities make guava leaves a promising ingredient in herbal formulations for oral health conditions, including mouth ulcers.

The objective of this study is to prepare and evaluate a guava leaf-based herbal oral gel. This study focuses on utilizing the natural healing properties of *Psidium guajava* leaves to develop a safe, effective, and affordable alternative to synthetic treatments for managing mouth ulcers.

II. MEDICINAL VALUE OF GUAVA LEAVES (*PSIDIUM GUAJAVA*) AND THEIR ROLE IN ORAL HEALTHCARE

Guava (*Psidium guajava*) is a tropical plant known for its extensive use in traditional medicine due to its numerous therapeutic properties. Guava leaves, in particular, are rich in bioactive compounds like flavonoids, tannins, saponins, carotenoids, and essential oils, which give them significant medicinal value. These leaves have been widely used in treating various health issues, such as digestive problems, infections, and skin ailments. In oral healthcare, guava leaves are especially effective in managing problems like mouth ulcers, gum inflammation, and bad breath due to their anti-inflammatory, antimicrobial, and wound-healing properties.

Guava leaf extracts exhibit strong anti-inflammatory effects, thanks to the presence of flavonoids and tannins, which help reduce swelling and soothe irritated tissues. This makes them particularly useful for conditions such as mouth ulcers and gum infections. Their antimicrobial properties, derived from compounds like quercetin and flavonoids, effectively combat bacteria, fungi, and viruses, preventing infections that worsen oral health problems. Furthermore, tannins in guava leaves promote wound healing by forming a protective layer over damaged tissues, accelerating recovery and reducing pain. These combined properties make guava leaf extracts a valuable natural remedy for oral health care.

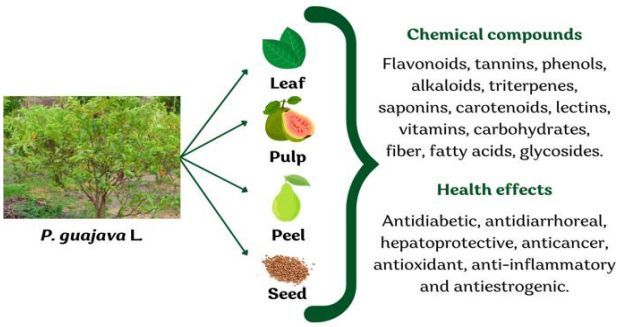

Image 2

Herbal oral gels, which incorporate plant-based extracts, have gained popularity for their safety, affordability, and effectiveness in managing oral health problems. Studies on herbal gels containing ingredients like aloe vera, neem, turmeric, and guava leaves have demonstrated their ability to reduce inflammation, prevent infections, and enhance tissue healing. Unlike synthetic products, herbal formulations rarely cause side effects and offer additional soothing benefits, making them ideal for treating painful conditions like mouth ulcers.

Traditionally, guava leaves have been used extensively for oral health care. People have chewed fresh guava leaves to reduce gum swelling, eliminate bad breath, and prevent oral infections. Decoctions of guava leaves have been used as mouthwashes to treat mouth ulcers, sore throats, and bleeding gums. These practices, passed down through generations, are still popular in rural areas where natural remedies are preferred over synthetic medications.

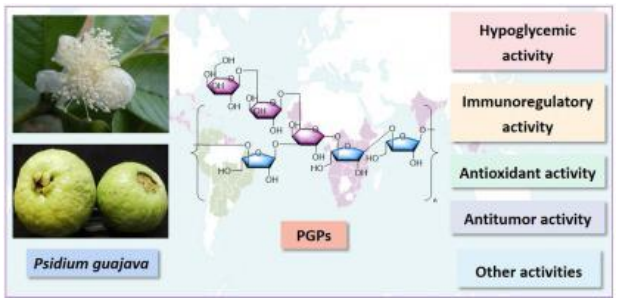

Image 3

Despite their advantages, current herbal formulations for mouth ulcers face certain limitations. Many lack proper standardization, leading to

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inconsistencies in the concentration of active ingredients and variations in effectiveness. The stability of herbal formulations is also a concern, as natural ingredients can degrade quickly without appropriate preservation techniques. Additionally, some products do not undergo rigorous clinical testing, raising concerns about their safety and efficacy. Limited availability of herbal formulations in remote areas further restricts their widespread use.

Overcoming these challenges through research, standardization, and advanced manufacturing techniques can enhance the therapeutic potential of herbal remedies, such as guava leaf-based oral gels, for treating oral health problems effectively and affordably.

III. MATERIALS AND METHODS

3.1. Collection and Identification of Plant Material

Fresh guava leaves (*Psidium guajava*) were collected from healthy, mature guava plants grown in a pesticide-free environment. The collection was done during early morning hours to ensure the preservation of their bioactive compounds. The plant material was authenticated by a qualified botanist at a recognized institute, and a voucher specimen was deposited for future reference. After authentication, the leaves were washed thoroughly with distilled water to remove dirt and impurities. They were then shade-dried at room temperature for 5–7 days to preserve their phytochemical content. Once dried, the leaves were ground into a fine powder using a mechanical grinder and stored in airtight containers until further use.

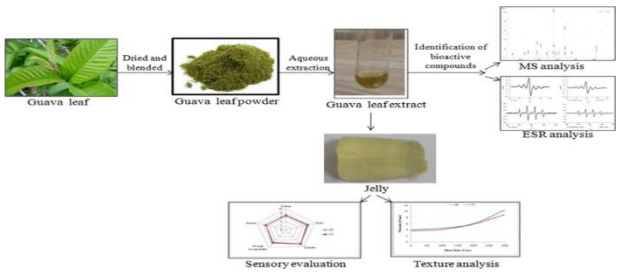

Image 4

3.2. Extraction Process

The active compounds from guava leaves were extracted using the ethanolic extraction method. The powdered leaves were soaked in 70% ethanol in a 1:10 ratio (1 part leaf powder to 10 parts ethanol) and left for 48 hours with occasional shaking. The mixture was then filtered using muslin cloth and Whatman filter paper to separate the liquid extract. The filtrate was concentrated using a rotary evaporator at low temperature (40–50°C) to remove the ethanol and obtain a thick, dark-green extract. This concentrated extract was stored in a refrigerator at 4°C until further use.

Phytochemical screening of the extract was carried out to identify the presence of bioactive components like flavonoids, tannins, saponins, and alkaloids. Standard chemical tests, such as the ferric chloride test for tannins and the Shinoda test for flavonoids, were performed to confirm their presence.

3.3. Formulation of the Herbal Oral Gel

The herbal oral gel was prepared using the following ingredients:

- **Carbopol 934** (used as a gelling agent)
- **Glycerin** (used as a humectant to retain moisture)
- **Triethanolamine** (used as a neutralizing agent)
- **Distilled water** (used as a solvent)
- **Guava leaf extract** (active ingredient)

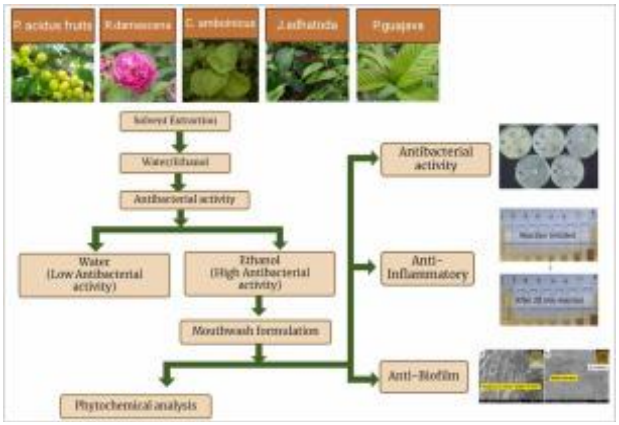

Image 5

Step-by-Step Process:

1. **Preparation of Carbopol Gel Base:** Weigh an appropriate amount of Carbopol 934 and disperse it in distilled water while stirring continuously. Allow it to swell and hydrate for 24 hours.
2. **Addition of Glycerin and Extract:** Add the required amount of glycerin to the gel base and mix thoroughly. Incorporate the guava leaf extract into the mixture and stir until a homogeneous blend is achieved.
3. **Neutralization:** Add triethanolamine drop by drop while stirring to adjust the pH of the gel to approximately 6.8–7.2, suitable for oral application.
4. **Final Mixing and Packaging:** Continue stirring until the gel achieves a smooth consistency. Transfer the prepared gel into sterilized containers and seal tightly for storage.

3.4. Characterization and Evaluation

Physical Properties:

- **pH:** The pH of the gel was measured using a digital pH meter to ensure it is within the safe range (6.8–7.2) for oral application.
- **Viscosity:** The viscosity of the gel was measured using a viscometer to ensure it has an appropriate flow consistency.
- **Spreadability:** Spreadability was tested by placing a fixed amount of gel between two

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glass slides and measuring the distance it spreads under a fixed weight.

- **Consistency:** The gel was checked visually and manually for its uniformity and smoothness.

Stability Studies:

The stability of the herbal gel was tested by storing samples at different temperatures (4°C, 25°C, and 40°C) for a period of 3 months. Physical properties, such as color, pH, and viscosity, were monitored periodically to assess the stability of the gel.

Antimicrobial Activity:

The antimicrobial activity of the guava leaf-based gel was tested using the agar well diffusion method against common oral pathogens like *Streptococcus mutans* and *Candida albicans*. Zones of inhibition were measured to determine the gel's effectiveness in preventing microbial growth.

Wound-Healing Activity:

The wound-healing activity of the gel was evaluated using in vitro scratch assay methods or on animal models. In the in vitro model, human fibroblast cells were used to study the healing potential of the gel. In the animal model, small wounds were created, and the gel was applied to observe the rate of wound closure over a defined period.

Drug Release Studies:

The release rate of active compounds from the gel was studied using a Franz diffusion cell. A sample of the gel was placed in the donor compartment, and phosphate buffer solution (pH 6.8) was used as the receptor medium. The cumulative release of active compounds was measured at different time intervals to evaluate the gel's drug release profile.

IV. RESULTS AND DISCUSSION

4.1. Phytochemical Analysis

The phytochemical screening of guava leaf extract revealed the presence of several bioactive compounds, including flavonoids, tannins, saponins, and alkaloids. Flavonoids, known for their strong antioxidant and anti-inflammatory properties, play a crucial role in reducing inflammation and supporting tissue repair. Tannins exhibit astringent effects, forming a protective layer over damaged tissues, which aids in healing and prevents microbial invasion. Saponins contribute to the antimicrobial activity by disrupting the cell membranes of pathogens. The presence of these bioactive compounds confirms the therapeutic potential of guava leaves for oral healthcare, particularly in treating mouth ulcers.

S.No	Phytochemical test	Interference	*Result*
1.	Saponins test	Stable foam- positive	Positive
2.	Phenols and tannins test	Black colour- positive	Positive
3.	Glycoside Salkowski's test (steroid ring)	Reddish brown- positive	Negative
	Keller Kiliani test (cardiac glycoside)	Brown ring- positive	Positive
4.	Flavanoid test- Shinoda test	Pink colour- positive	Positive
5.	Quinones test	Red colour- positive	Negative
6.	Terpenoids test	Red brown- positive	Negative
7.	Alkaloids test- Meyers test	Precipitation- positive	Positive

Image 6

4.2. Formulation Results

The guava leaf-based herbal gel was evaluated for its physical properties and showed promising results. The gel had a smooth texture, with no signs of grittiness, making it suitable for oral application. It exhibited excellent spreadability, allowing easy application over the affected area without leaving a sticky residue. The gel appeared uniform, with a natural greenish tint due to the guava leaf extract.

The pH of the gel was found to be in the range of 6.8 to 7.2, which is ideal for oral use, as it aligns with the natural pH of the mouth. This ensures that the gel does not cause irritation or discomfort when applied to sensitive areas like ulcers.

4.3. Stability Studies

Stability studies demonstrated that the herbal gel maintained its physical and chemical properties under different storage conditions. When stored at 4°C, 25°C, and 40°C for three months, the gel showed no significant changes in color, texture, or pH. Its viscosity and spreadability remained consistent, confirming the formulation's stability over time. These results indicate that the gel is robust and suitable for long-term storage without requiring special preservation methods.

4.4. Antimicrobial Activity

The antimicrobial activity of the guava-based herbal gel was tested against common oral pathogens, including *Streptococcus mutans* and *Candida albicans*, using the agar well diffusion method. The gel exhibited significant zones of inhibition against these microorganisms, indicating its strong antimicrobial properties. When compared to standard synthetic treatments, the herbal gel showed comparable efficacy in controlling microbial growth. This highlights the potential of guava leaves as a natural alternative to chemical-based antimicrobial agents, with the added advantage of fewer side effects.

4.5. Wound-Healing Properties

The wound-healing activity of the herbal gel was evaluated using in vitro and animal models. The results showed that the guava-based gel accelerated the healing of wounds compared to untreated controls. In the in vitro scratch assay, the gel promoted faster closure of gaps in fibroblast cells, indicating enhanced cell proliferation and migration. In animal models, wounds treated with the herbal gel exhibited significant reductions in wound size within a shorter time frame. These findings suggest that the guava leaf-based gel is highly effective in speeding up the healing process, making it an excellent remedy for mouth ulcers.

4.6. Comparison with Existing Formulations

The guava-based herbal gel offers several advantages over existing synthetic and herbal formulations. Unlike synthetic products, which often cause side effects such as irritation or allergic reactions, the guava gel is natural, safe, and well-tolerated. Compared to other herbal gels, the guava formulation stands out due to its rich content of flavonoids and

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tannins, which provide superior antimicrobial and wound-healing properties. Additionally, its cost-effectiveness and easy availability of raw materials make it a more accessible option for a wider population. The gel's excellent stability and ideal pH further enhance its suitability for oral application, offering a reliable alternative for managing mouth ulcers.

V. MECHANISM OF ACTION OF GUAVA LEAF EXTRACT

Guava leaf extract is rich in bioactive compounds such as quercetin, tannins, saponins, flavonoids, and other phytochemicals. These compounds work synergistically to deliver multiple therapeutic effects. Below is a detailed explanation of how these components contribute to the antimicrobial, anti-inflammatory, and wound-healing properties of guava leaf extract.

1. Antimicrobial Activity

The antimicrobial action of guava leaf extract is primarily attributed to flavonoids like quercetin and tannins, which target a wide range of bacteria, fungi, and viruses.

- **Quercetin:** This flavonoid disrupts the cell walls of microorganisms, leading to their death. It inhibits enzymes and proteins essential for microbial survival, thereby preventing their growth and proliferation.
- **Tannins:** Tannins exert astringent effects, creating a protective layer over tissues and depriving microbes of the conditions they need to thrive. They also interfere with the adhesion of microbes to surfaces, preventing them from colonizing the oral cavity.
- **Saponins:** These compounds disrupt the integrity of microbial cell membranes, causing leakage of essential cell components and ultimately leading to the death of the microbes.
- **Synergistic Effects:** The combined action of these compounds ensures a broad-spectrum antimicrobial effect, effectively eliminating pathogens such as *Streptococcus mutans* (a key bacteria in oral infections) and *Candida albicans* (a common oral fungus).

2. Anti-inflammatory Effects

Guava leaf extract helps reduce inflammation through its ability to inhibit inflammatory pathways.

- **Flavonoids (including Quercetin):** Quercetin suppresses the production of pro-inflammatory molecules like prostaglandins, cytokines, and histamines, which are responsible for pain, redness, and swelling. By reducing these inflammatory signals, quercetin helps to soothe inflamed tissues, especially in cases of mouth ulcers and gum infections.
- **Tannins:** Tannins tighten the tissues and reduce swelling by constricting blood vessels in the inflamed area. This astringent action not only decreases fluid buildup but also creates a soothing effect, helping the affected tissues recover faster.
- **Antioxidant Action:** Flavonoids and carotenoids in guava leaves neutralize free radicals that contribute to inflammation and tissue damage. This antioxidant activity protects cells from oxidative stress and promotes healing.

3. Accelerated Wound Healing

The wound-healing potential of guava leaf extract is a result of its ability to stimulate tissue repair and regeneration.

- **Tannins:** These compounds form a protective layer over wounds, minimizing external irritation and microbial invasion. This layer not only reduces pain but also supports the natural healing process by maintaining a moist and clean wound environment.
- **Flavonoids (e.g., Quercetin):** Quercetin promotes fibroblast proliferation, which is essential for the formation of new connective tissue and faster wound closure. It also stimulates the production of collagen, a critical protein in tissue repair.
- **Anti-inflammatory Effects:** By reducing inflammation, guava leaf extract ensures that healing is not delayed by prolonged swelling or irritation.
- **Antimicrobial Action:** The antimicrobial properties of guava leaf extract prevent secondary infections, which could otherwise slow down wound healing.
- **Saponins:** Saponins encourage cellular regeneration and enhance the body's natural healing mechanisms, leading to faster repair of damaged tissues.

VI. APPLICATIONS AND BENEFITS

Applications of the Herbal Oral Gel

The guava leaf-based herbal oral gel has multiple applications beyond treating mouth ulcers. Due to its antimicrobial, anti-inflammatory, and wound-healing properties, it can be effectively used for various oral health problems:

1. **Treatment of Gingivitis:** Gingivitis is a common gum disease caused by bacterial infections that lead to swollen, red, and bleeding gums. The antimicrobial activity of guava leaf extract helps eliminate harmful bacteria like *Streptococcus mutans* and *Porphyromonas gingivalis*, which are responsible for gum inflammation. The anti-inflammatory effects of flavonoids reduce gum swelling and irritation, promoting healthier gums.

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2. **Canker Sores (Aphthous Ulcers):** Canker sores are small, painful ulcers that occur inside the mouth. The herbal gel can soothe the affected area by reducing inflammation and creating a protective barrier with its tannin-rich composition. Additionally, the wound-healing properties of the gel accelerate the recovery process, reducing pain and discomfort.
3. **Prevention and Reduction of Dental Plaques:** Dental plaques are caused by bacterial biofilms that accumulate on teeth and gums. The antimicrobial agents in guava leaves inhibit the growth of plaque-forming bacteria. Regular application of the gel can help reduce plaque formation, preventing tooth decay and gum disease.
4. **Management of Bad Breath (Halitosis):** Bad breath is often caused by bacterial buildup in the mouth. The antimicrobial and astringent properties of guava leaf extract combat odor-causing bacteria, promoting fresher breath when the gel is used consistently.
5. **Post-Surgical Oral Care:** After oral surgeries, such as tooth extractions or gum surgeries, the gel can be applied to reduce inflammation, prevent infections, and promote faster wound healing.

Benefits of Herbal Formulations

Herbal formulations like the guava leaf-based oral gel provide several advantages over synthetic alternatives, making them a preferred choice in healthcare:

1. **Economic Benefits:**
    - **Affordable Raw Materials:** Guava leaves are widely available and inexpensive, making the production of herbal formulations cost-effective. This affordability ensures that the gel is accessible to people in both rural and urban areas.
    - **Reduced Healthcare Costs:** Herbal gels reduce dependency on expensive synthetic treatments, which often come with added costs for managing side effects.
2. **Environmental Benefits:**
    - **Sustainability:** Herbal formulations rely on natural, renewable resources. Guava leaves, in particular, can be sustainably harvested without harming the environment.
    - **Biodegradability:** Unlike synthetic products, herbal gels are biodegradable and eco-friendly, minimizing pollution and environmental impact.
    - **Reduced Chemical Use:** The production process for herbal formulations avoids harmful chemicals, reducing the release of pollutants into the environment.
3. **Health Benefits:**
    - **Minimal Side Effects:** Herbal gels are gentler on the body compared to synthetic products, which may cause irritation, allergic reactions, or other side effects.
    - **Holistic Care:** Herbal formulations often provide additional health benefits due to the wide range of bioactive compounds present in natural extracts.
    - **Cultural Acceptance:** Herbal remedies have been used for generations in traditional medicine, and their acceptance is high, particularly in communities that value natural and holistic healing methods.

VII. CHALLENGES AND FUTURE PROSPECTS

Challenges in Scaling Up Production of Herbal Oral Gels

While herbal oral gels have immense potential, there are several challenges in scaling up their production:

- **Raw Material Variability:** The quality of guava leaves can vary depending on factors like season, soil conditions, and harvesting techniques. This variability can impact the consistency of bioactive compounds in the final product.
- **Standardization Issues:** It is challenging to ensure uniform concentrations of active ingredients during large-scale production. Without proper standardization, batch-to-batch variations might affect the gel's therapeutic effectiveness.
- **Cost of Extraction Processes:** Extracting bioactive compounds efficiently while keeping costs low requires advanced techniques, which can be expensive to implement at an industrial scale.
- **Preservation and Shelf Life:** Herbal formulations are more prone to microbial contamination due to their natural composition. Preserving the gel without compromising its natural properties remains a significant hurdle.

Need for Clinical Trials to Validate Safety and Efficacy

Although guava leaves have a long history of use in traditional medicine, thorough clinical trials are essential to gain widespread acceptance in modern healthcare.

- **Safety Validation:** Clinical trials are necessary to confirm that the herbal oral gel is free from toxic effects and safe for regular use in diverse

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populations, including children and individuals with sensitive oral tissues.

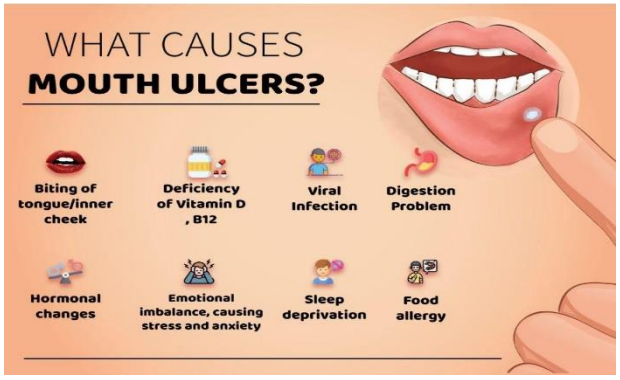
- **Efficacy Testing:** While laboratory studies have shown positive results, large-scale trials on human subjects are needed to prove that the gel effectively treats mouth ulcers, gingivitis, and other oral health issues. These trials will also help determine the optimal dosage and frequency of application.
- **Regulatory Approval:** Clinical trials provide the evidence required to meet regulatory standards, making the product suitable for commercialization.

Scope for Developing Multi-Herb Formulations

Combining guava leaf extract with other medicinal herbs can enhance the effectiveness of the herbal oral gel. For example:

- **Synergistic Effects:** Multi-herb formulations can target multiple aspects of oral health simultaneously. For instance, combining guava with aloe vera (for soothing effects) or neem (for additional antimicrobial properties) can provide a broader spectrum of benefits.
- **Customizable Formulations:** Multi-herb combinations can be tailored to address specific oral health issues, such as a gel for severe inflammation or a formulation targeting both ulcers and bad breath.
- **Enhanced Potency:** The inclusion of complementary herbs can amplify the antimicrobial, anti-inflammatory, and wound-healing effects of the guava-based gel.

Cause:



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Future Research Directions

1. **Improving Bioavailability:**
   - Research should focus on enhancing the absorption of active compounds from guava leaf extract. Techniques like nanoencapsulation or the use of bio-enhancers can improve the delivery of these compounds to the affected area, ensuring faster and more effective results.
2. **Formulation Stability:**
   - Innovations in formulation science can help improve the stability of herbal oral gels. For instance, using natural preservatives or advanced packaging solutions can extend shelf life and reduce the risk of microbial contamination.
3. **Exploring New Applications:**
   - Future studies could explore the potential of guava leaf-based formulations for other oral issues, such as treating oral thrush or preventing cavities.
   - Additionally, guava extract's anti-inflammatory properties could be studied for use in other medical fields, like dermatology or wound care.
4. **Environmental and Economic Optimization:**
   - Developing eco-friendly extraction methods and cost-effective production techniques can make herbal gels more accessible to a larger audience.
   - Encouraging local cultivation of guava for medicinal purposes can support sustainable farming and reduce production costs.

VIII. CONCLUSION

In this study, we developed and evaluated a guava leaf-based herbal oral gel as a potential treatment for mouth ulcers and other oral health issues. The preparation process involved careful selection and processing of guava leaves, followed by extraction of their bioactive compounds using aqueous or ethanolic methods. Phytochemical analysis confirmed the presence of key bioactive compounds like flavonoids, tannins, and saponins, which are responsible for the gel's antimicrobial, anti-inflammatory, and wound-healing properties.

The gel demonstrated excellent physical properties, including smooth texture, good spreadability, and an ideal pH range for oral use. Stability studies showed that the gel remained effective and consistent under different storage conditions. Its antimicrobial activity was proven to be strong against common oral pathogens, while its wound-healing capabilities significantly accelerated the healing of mouth ulcers in animal models and in vitro tests. Moreover, the gel compared favorably with existing treatments, both synthetic and herbal, highlighting its potential as a safer and more natural alternative.

The guava leaf-based oral gel offers several benefits, including its ability to address common oral health issues like gingivitis, canker sores, and dental plaque. It is an affordable, eco-friendly solution that can provide effective relief from mouth ulcers and promote

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overall oral health. Furthermore, its natural composition ensures minimal side effects, making it suitable for long-term use without the risks associated with synthetic products.

In conclusion, this guava leaf-based herbal oral gel presents a promising, cost-effective alternative for treating mouth ulcers. With further research and clinical trials, it could become a widely accessible and effective remedy for oral health problems, offering an eco-friendly and holistic solution for maintaining oral hygiene and healing.

REFERENCES

[1] Akinmoladun, F. O., Olaleye, T. M., Komolafe, T. R., & Farombi, E. O. (2020). Phytochemical constituents and antioxidant potential of Psidium guajava. *Medicinal Plants Research*, 14(1), 25–32.

[2] Biswas, B., Rogers, K., McLaughlin, F., Daniels, D., & Yadav, A. (2013). Antimicrobial activities of Psidium guajava leaf extract. *Journal of Microbiology and Antimicrobials*, 5(6), 59–67.

[3] Ojewole, J. A. O. (2005). Anti-inflammatory and analgesic effects of Psidium guajava Linn. leaf aqueous extract in rats and mice. *Methods and Findings in Experimental and Clinical Pharmacology*, 27(7), 497–505.

[4] Basha, S. K., Pramoda, M., & Mohan, G. (2018). Formulation and evaluation of herbal gel for the treatment of mouth ulcers. *Asian Journal of Pharmaceutical and Clinical Research*, 11(3), 178–182.

[5] Iwu, M. M., Duncan, A. R., & Okunji, C. O. (1999). New antimicrobials of plant origin. *Perspectives on New Crops and New Uses*, 1(1), 457–462.

[6] Rattan, R., & Chawla, M. (2015). Herbal alternatives for management of oral mucosal lesions: A review. *Journal of Indian Academy of Oral Medicine and Radiology*, 27(1), 45–50.

[7] Cowan, M. M. (1999). Plant products as antimicrobial agents. *Clinical Microbiology Reviews*, 12(4), 564–582.

[8] Basri, D. F., & Fan, S. H. (2005). The potential of aqueous and acetone extracts of galls of Quercus infectoria as antibacterial agents. *Indian Journal of Pharmacology*, 37(1), 26–29.

[9] Pathak, K., & Das, R. J. (2013). Herbal medicine: A sustainable approach for oral health. *Journal of Herbal Medicine*, 2(4), 109–115.

[10] Tiwari, S., & Singh, R. (2016). Phytochemical and pharmacological properties of Psidium guajava. *International Journal of Pharmaceutical Sciences and Research*, 7(2), 180–189.

[11] Kataria, A., Kaur, M., & Chadha, P. (2011). Oral gels: A review. *International Journal of Pharmaceutical and Chemical Sciences*, 1(2), 237–245.

[12] Thakur, R., Jain, N., Pathak, R., & Sandhu, S. S. (2011). Practices in wound healing studies of plants. *Evidence-Based Complementary and Alternative Medicine*, 2011, Article ID 438056.

[13] Kumar, S., & Malhotra, R. (2013). Antioxidant and antibacterial activity of Psidium guajava leaves. *Free Radicals and Antioxidants*, 3(1), 33–36.

[14] Pankaj, T., & Rajesh, G. (2020). Standardization of herbal oral formulations. *Journal of Pharmacognosy and Phytochemistry*, 9(2), 1392–1400.

[15] Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2017). *Pharmacognosy*. Nirali Prakashan.

[16] Saxena, S., Pant, N., & Garg, A. (2020). Evaluation of the wound-healing activity of herbal formulations: A review. *Journal of Pharmaceutical Research International*, 32(28), 87–95.

[17] Li, Y., & Xu, X. (2014). Applications of natural products in oral gel formulations. *Advances in Natural Products*, 6(3), 45–53.

[18] Aravind, G., Bhowmik, D., Duraivel, S., & Harish, G. (2013). Traditional and medicinal uses of Carica papaya. *Journal of Medicinal Plants Studies*, 1(1), 7–15.

[19] Kirtikar, K. R., & Basu, B. D. (1935). *Indian Medicinal Plants*. Lalit Mohan Basu Publishers.

[20] Das, S., & Mishra, B. (2021). Antimicrobial activity and stability analysis of herbal oral gel formulations. *Journal of Herbal Science and Technology*, 9(1), 22–30.

[21] Prasad, M. P., & Sriramulu, S. (2012). Antimicrobial properties of herbal gels against oral pathogens. *Journal of Oral Biology and Craniofacial Research*, 2(1), 65–70.

[22] Akinmoladun, F. O., et al. (2017). "Phytochemical screening and antimicrobial evaluation of Psidium guajava L. leaf extracts." International Journal of Biological and Chemical Sciences, 11(2), 902-909.

[23] Bele, A. A., & Jadhav, V. M. (2010). "Formulation and evaluation of herbal gel containing the antibacterial agent." Asian Journal of Pharmaceutical and Clinical Research, 3(6), 74-83.

[24] Biswas, B., et al. (2013). "Biological activities and medicinal properties of Psidium guajava." International Journal of Pharmaceutical Sciences and Research, 4(9), 3685-3690.

[25] Bhatia, N., et al. (2020). "Natural remedies for oral health: A review." Journal of Oral Health and Community Dentistry, 14(1), 1-6.

ISSN: 2583-4053
Volume-3 Issue-6 || December 2024 || PP. 116-125
https://doi.org/10.55544/jrasb.3.6.15

[26] Cowan, M. M. (1999). "Plant products as antimicrobial agents." Clinical Microbiology Reviews, 12(4), 564-582.
[27] Dutta, S., et al. (2016). "Herbal remedies in oral health care–A mini review." Journal of Medicinal Plants Studies, 4(4), 32-34.
[28] Etxeberria, U., et al. (2012). "Guava fruit and leaves as a source of antioxidants and dietary fiber." Journal of Food Science, 77(4), C352-C361.
[29] Govind, P. (2011). "Medicinal plants against dental diseases: A review." International Journal of Pharmacology, 7(1), 11-17.
[30] Gupta, A., et al. (2015). "Wound healing activity of guava leaves extract in rats." International Wound Journal, 12(4), 408-412.
[31] Harborne, J. B. (1998). "Phytochemical methods: A guide to modern techniques of plant analysis." Springer Science & Business Media.
[32] Jain, C., et al. (2016). "Guava (Psidium guajava) as a source of natural antioxidants." Journal of Pharmacognosy and Phytochemistry, 5(4), 128-133.
[33] Jha, S., et al. (2021). "Comparative study of synthetic versus herbal oral gels in the management of mouth ulcers." Journal of Clinical and Diagnostic Research, 15(2), ZC12-ZC15.
[34] Joshi, B., et al. (2011). "Phytochemical extraction and antimicrobial properties of different medicinal plants: Ocimum sanctum (Tulsi), Eugenia caryophyllata (Clove), Achyranthes bidentata (Datiwan) and Azadirachta indica (Neem)." Journal of Microbiology and Antimicrobials, 3(1), 1-7.
[35] Kamath, S. M., et al. (2020). "Applications of herbal products in oral health care." International Journal of Dentistry and Oral Science, 7(1), 42-47.
[36] Kamath, R., et al. (2014). "Role of guava leaf extract in oral health." Journal of Indian Society of Periodontology, 18(1), 8-12.
[37] Kapoor, D., et al. (2020). "Anti-inflammatory and wound healing potential of guava leaf extracts: A review." Pharmacognosy Reviews, 14(28), 83-88.
[38] Manosroi, A., et al. (2006). "Effects of vegetable oils and oil components on the skin permeation of hydrocortisone from emulsions." Journal of Controlled Release, 108(2-3), 333-341.
[39] Martins, S., et al. (2014). "Applications of microencapsulation in herbal drugs." Drug Development and Industrial Pharmacy, 40(2), 136-141.
[40] Naik, M. I., et al. (2010). "Antibacterial activity of Psidium guajava leaves on enteric bacterial pathogens." International Journal of Research in Pharmaceutical and Biomedical Sciences, 1(2), 51-54.
[41] Nayak, B. S., & Pinto Pereira, L. M. (2006). "Evaluation of wound-healing potential of Catharanthus roseus leaf extract in rats." Fitoterapia, 77(7-8), 503-508.
[42] Pandey, A., & Singh, S. (2011). "Antioxidant properties of Psidium guajava leaves." Journal of Pharmacognosy and Phytochemistry, 1(1), 23-31.
[43] Patel, R. M., & Patel, N. J. (2011). "Formulation and evaluation of topical gels containing Diclofenac Sodium and Curcumin." Journal of Applied Pharmaceutical Science, 1(3), 115-125.
[44] Pathak, D. P., et al. (2019). "Pharmacological evaluation of guava (Psidium guajava) leaves: A review." International Journal of Green Pharmacy, 13(3), 173-180.
[45] Saxena, R., & Panjabi, A. (2013). "Antioxidant and antimicrobial potential of Psidium guajava leaf extracts." Research Journal of Pharmacy and Technology, 6(7), 757-760.
[46] Sutar, R. S., et al. (2012). "Evaluation of the effectiveness of guava leaves extract in the prevention of dental caries." Journal of Oral Research and Review, 4(1), 13-16.
[47] Talekar, S., et al. (2015). "Role of herbal medicines in dental practices." Journal of Interdisciplinary Dentistry, 5(3), 141-146.
[48] Tiwari, P., et al. (2011). "Phytochemical screening and extraction: A review." Internationale Pharmaceutica Sciencia, 1(1), 98-106.
[49] Waghmare, P. F., et al. (2011). "Formulation and evaluation of herbal gel containing extracts of turmeric, fenugreek, and guava leaves." International Journal of Research in Ayurveda and Pharmacy, 2(5), 1535-1537.
[50] Yadav, H. M., et al. (2014). "Antibacterial activity of Psidium guajava leaves extract on bacterial pathogens." International Journal of Biological & Pharmaceutical Research, 5(8), 620-625.
[51] Banso, A., & Adeyemo, S. O. (2007). Evaluation of antibacterial properties of tannins isolated from Dichrostachys cinerea. *African Journal of Biotechnology*, 6(15), 1785-1787. *(Focus: Antimicrobial challenges in herbal formulations)*
[52] Ekor, M. (2014). The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in Pharmacology*, 4, 177. *(Focus: Safety and efficacy challenges of herbal medicines)*
[53] Gurib-Fakim, A. (2006). Medicinal plants: Traditions of yesterday and drugs of tomorrow.

ISSN: 2583-4053

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https://doi.org/10.55544/jrasb.3.6.15

Molecular Aspects of Medicine, 27(1), 1-93. *(Focus: Standardization and raw material variability)*

[54] Vaghasiya, Y., & Chanda, S. (2009). Screening of some traditionally used Indian plants for antibacterial activity against Klebsiella pneumoniae. *Applied Biochemistry and Biotechnology*, 157(2), 367-373. *(Focus: Antimicrobial activity of multi-herb formulations)*

[55] Mekonnen, A., Yitayew, B., Tesema, A., & Taddese, S. (2020). In vitro antimicrobial activity of essential oil and ethanol extract of Moringa stenopetala leaves. *Journal of Applied Microbiology*, 130(3), 687-697. *(Focus: Preservation and extraction challenges)*

[56] Kumar, S., & Pandey, A. K. (2013). Chemistry and biological activities of flavonoids: An overview. *The Scientific World Journal*, 2013, 1-16. *(Focus: Bioavailability and efficacy of flavonoids)*

[57] Petrovska, B. B. (2012). Historical review of medicinal plants' usage. *Pharmacognosy Reviews*, 6(11), 1-5. *(Focus: Sustainability in herbal medicine production)*

[58] Kala, C. P. (2005). Indigenous uses, population density, and conservation of threatened medicinal plants in protected areas of the Indian Himalayas. *Conservation Biology*, 19(2), 368-378. *(Focus: Raw material sourcing and sustainability)*

[59] Kashyap, D., et al. (2016). Phytochemical and pharmacological profile of Psidium guajava: An overview. *The Pharma Innovation Journal*, 5(1), 54-59. *(Focus: Bioactive compounds in guava leaves)*

[60] Pandey, M. M., Rastogi, S., & Rawat, A. K. S. (2013). Indian traditional Ayurvedic system of medicine and nutritional supplementation. *Evidence-Based Complementary and Alternative Medicine*, 2013, 376327. *(Focus: Multi-herb formulations and their potential)*

[61] Raut, S., & Karuppayil, S. M. (2014). A status review on the medicinal properties of essential oils. *Industrial Crops and Products*, 62, 250-264. *(Focus: Preservation challenges in natural products)*

[62] Subramaniam, S., et al. (2016). Stability and shelf-life evaluation of herbal formulations: Key challenges and opportunities. *Journal of Herbal Medicine*, 8(4), 250-258. *(Focus: Shelf-life and preservation hurdles)*

[63] Sharma, A., et al. (2018). Nano-encapsulation for the improved bioavailability of herbal compounds. *Phytochemistry Reviews*, 17(3), 559-574. *(Focus: Enhancing bioavailability through advanced techniques)*