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Formulation and evaluation of polyherbal mouthwash for the treatment of mouth ulcer

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Abstract:

This study aimed to investigate the effectiveness of a special gel composed of dried guava leaves for treating mouth ulcers. To formulate the herbal gel, different amounts of guava leaf powder were blended with a gel base made up of Carbopol 934 and propylene glycol to create a formulation for each concentration tested. After that, each formulated gel was evaluated for various characteristics. The compatibility between the components in the guava leaf powder and the polymer (the gel base) was verified with infrared spectroscopy. Furthermore, no chemical reaction occurred between the guava powder and the polymer component. The resulting gel was homogeneous and translucent with a pH value of 7-7.5. The gel was also easy to dispense when applied from its tube, which is a beneficial characteristic for any gel product. In addition, the gel formulation exhibited significant antifungal activity against the two fungal organisms tested (Aspergillus aures and Candida albicans). The flavonoids found in guava leaves help protect cells from oxidative stress caused by free radicals. Overall, the guava leaf gel was found to be superior to other commercial gels (in terms of tolerability) and was deemed both effective and successful for use in the preparation of an herbal formulation from dried guava leaves.

Keywords: Guava Leaves Powder, Gel, Mouth Ulcer, Mouthwash.

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1. Introduction

Recently, there has been a significant increase in the popularity of herbal mouthwashes. They provide great results in helping to eliminate bad bacteria from the mouth and in alleviating pain

quickly. They also have very few known side effects. On the other hand, traditional or chemical mouthwash products contain chemicals such as hydrogen peroxide, chlorine dioxide, and cetylpyridinium chloride that can help to whiten teeth, kill the bacteria that live in your mouth, and help alleviate pain. Therefore, herbal and chemical mouthwash formats are very different from each other; however, chemical mouthwash is relatively inexpensive[1]. They do not contain any alcohol, artificial colorants, or preservatives. Chemical mouthwashes use hydrogen peroxide or chlorhexidine for whitening, cleaning, and numbing toothache pain. They are cheap, but they can stain teeth and cause some side effects [2]. Chlorhexidine is a substance that binds to the surface of your teeth and gums, aiding in getting rid of the bad bacteria of your body. However, chlorhexidine does come with some adverse effects as well. For instance, it might be that you get more worried about your teeth looking yellow, brown due to coloring while you cannot eat normally or you experience the change of food taste in case of long, term usage of chlorhexidine [3]. Halitosis may result from the passage of air from the respiratory system to the exterior. If neglected, it can not only damage your health but also yourself, esteem and confidence. Breathing air has volatile sulphur compounds (VSCs) [4]. These compounds are a byproduct of the normal mouth bacteria, which cause 80% of halitosis cases. Besides oral bacteria and tooth decay which contribute up to 40% of halitosis cases, the most common bacteria associated with halitosis that include Strep [5]. mutans and Staph. aureus. Non, oral rinses contain antimicrobial agents, for example astringents demulcents, surfactants, and antibacterial substances, which can, through gargling, freshen breath and cleanse the mouth and upper respiratory tract [6]. One way to control halitosis is with mouthwash. Antibacterial mouthwash may be good at killing bacteria, reducing food debris in the mouth, and helping to loosen plaque [7.] To keep your bad breath under control, use an antibacterial mouthwash. It is beneficial in killing the bacteria, removing the food particles, and breaking down the plaque in the mouth [8]. The periodontium serves two functions because it protects the tooth from occlusal stresses and bacterial infiltration while helping to relieve stress. The periodontium of natural teeth undergoes common infections that manifest as gingivitis and periodontitis, which display symptoms of inflammation resulting from microbial activity [9]. The presence of multiple risk factors together with the development of dental plaque biofilm on the boundary between teeth and gums results in a powerful immune response which, in certain situations, can produce negative effects for the body[10]. The immune system responds to plaque at the boundary between the tooth and gingiva through two responses, but plaque functions as the primary element that enables both prevention and treatment of gum disease[11]. The rise of urban populations has resulted in higher rates of oral health problems [12]. Dental caries, or tooth decay, is one of the most common dental and oral disorders caused by the accumulation of biofilm or dental plaque [13]. Daily oral care routines benefit from mouthwash use because it reduces dental plaque and biofilm buildup, which leads to cavities, while it gives users fresh breath [14]. The two main categories of mouthwash products that exist in the market are chemical mouthwash and herbal mouthwash [15]. Users should recognize the effectiveness of chemical mouthwash, yet its usage can lead to specific dental problems. Compared to chemical mouthwash, herbal mouth rinse proves effective because it kills bacteria while providing instant pain relief and only causes minor side effects [16]. The mouthwash formulation requires all its components because each ingredient has a specific function which contributes to the final product[17]. Sodium benzoate and benzoic acid form from the combination of buffer solutions and preservatives[18,19] The active components of

mouthwash products maintain their effectiveness because propylene glycol acts as a humectant that controls their evaporation rate [20].

NEEM LEAVES: (*Azadirachta indica*):

The Neem tree (*Azadirachta indica*) serves as a therapeutic source for both naturopathy and Ayurvedic medicine because its antibacterial and anti-inflammatory and wound healing properties enable its use in various herbal products which include multiple types of mouthwash and toothpaste and medicated mouthwash for treating oral infections and mucosal lesions [21].

Botanical Description:

Scientific name: *Azadirachta indica*
Family: Meliaceae
Common names: Neem, Indian lilac, Margosa
Plant type: Evergreen tree

Pudina leaves: (Mint) Leaves:

The fragrant herb mint serves as a component in various herbal remedies and multiple dental care products. The plant belongs to the mint family Lamiaceae and the Mentha genus which encompasses all mint species. Mentha piperita stands as the most widely used form of mint. The mint leaves contain essential oils which mouthwashes use for their antibacterial effects and because they provide quick relief from mouth ulcers while cooling oral tissues after consumption of spicy foods.[23,24]

Botanical Description:

Scientific name: *Mentha piperita*
Family: Lamiaceae
Common name: Pudina / Mint / Peppermint
Plant type: Aromatic perennial herb

Tulsi Leaves (Holy Basil**):**

Ocimum sanctum or *Ocimum tenuiflorum* are two different names for the herb, which also has several other alternatives depending on the region. Tulsi belongs to the family Lamiaceae. The health advantages of tulsi include antioxidant protection and its ability to reduce inflammation. Tulsi has antibacterial properties. People have used tulsi leaves since ancient times to treat various health conditions. The herbal mouthwash for treating mouth ulcers is made from tulsi leaf juice.[25'26]

Botanical Description

Scientific name: Mentha piperita
Family: Lamiaceae
Common name: Pudina / Mint / Peppermint
Plant type: Aromatic perennial herb

2. Literature Review:

- Bhoyar et al. (2026) formulated an herbal mouthwash having multiple herbs to maintain oral hygiene and impede the growth of harmful bacteria. They included ingredients such as neem, Tulsi, mints, honey, and salt for this mouthwash. To extract the valuable elements from these herbs, they performed a maceration procedure. Besides measuring the pH, viscosity, and foaming capacity of each mouthwash variant, they also investigated the mouthwash's ability to kill mouth bacteria such as Lactobacillus acidophilus, Candida

albicans, and Streptococcus mutans. According to their research, this herbal mouthwash is highly effective in killing bacteria and completely safe. It outperforms some chemical, based mouthwashes such as chlorhexidine ones. This is attributed to the polyherbal mouthwash having a harmonious set of ingredients and no negative effects. Polyherbal mouthwash formulation gives a good alternative, to those who strive for maintaining their oral cleanliness and health. [27]

- Jadhav et al., (2025) I prepared a mouthwash using Ocimum sanctum, which people call Tulsi, and *Azadirachta indica*, which people call Neem. I tested the mouthwash to determine its shelf life while I also studied its physical characteristics and its ability to taste and destroy harmful microorganisms. The research about Tulsi and Neem showed that these plants contain antibacterial properties and they provide anti-inflammatory effects and they help the body develop immunity. [28]
- Arthi et al., prepared a polyherbal mouth rinse using neem, basil (Tulsi), white tea, and cinnamon extracts. The antimicrobial and anti-inflammatory activities were evaluated against oral pathogens responsible for plaque and oral infections. The study demonstrated that herbal combinations effectively reduce bacterial growth and oral inflammation, making them suitable for managing oral disorders including mouth ulcers. [29]
- Pranita et al., (2022) herbal mouthwash which used menthe neem tulsi and pomegranate extract as its main ingredients. The main purpose of their research was to test the herbal mouthwash's power to kill Staphylococcus aureus and Escherichia coli which are common oral bacteria. The herbal mouthwash proved successful in preventing the development of these dangerous bacteria. So, herbal mouthwash serves as an effective instrument for people who want to sustain their dental cleanliness and well-being. Herbal mouthwash merits a mention in oral hygiene as it contains herbal extracts capable of controlling the growth of oral bacteria. The products maintain mouth cleanliness while providing fresh breath. [30]
- Jasrotia et al., (2024) created a mouthwash using neem and mint and Tulsi. They conducted tests on the mouthwash to determine its effects on microorganisms. The tests demonstrate that the mouthwash effectively kills all tested pathogens. The product can be used to treat both skin irritation and bacterial infections. The mouthwash contains three main ingredients which are neem (*Azadirachta indica*), mint (Mentha longifolia), and tulsi (Ocimum sanctum). The research proved that the mouthwash demonstrates effective results. The solution helps to treat various health problems. The mouthwash consists of various ingredients. The mouthwash contains neem and mint and tulsi as its components. The method provides highly effective results for treating various problems. [31]
- Prasanth et al., (2021) First, I developed a mouthwash using Neem, Tulsi, and Mint as main ingredients. Scientists conducted tests on this mouthwash to evaluate its effectiveness against bacteria that cause infections including Streptococcus mutans and Candida albicans. The results showed that the mouthwash could prevent these microorganisms from multiplying. The herbal mouthwash shows potential to serve as an effective method for stopping infections and treating mouth ulcers. The herbal mouthwash that was made from Neem, Tulsi, and Mint is very promising. The substance can block the development of both Streptococcus mutans and Candida albicans. The mouthwash provides protection

against mouth ulcers and infections that result from these microorganisms through its use. [32]

- Patil et al., (2020) We developed a mouthwash product which used tulsi and neem and clove extracts as its main ingredients. The researchers conducted tests to determine various characteristics of the mouthwash which included testing its pH and viscosity and stability and antimicrobial effectiveness. The study results showed that the herbal mouthwash successfully killed both Staphylococcus aureus and Streptococcus mutans bacteria. The substance may serve as a natural treatment option for mouth ulcer conditions. The mouthwash formulation which includes Tulsi and neem and clove extracts shows promising results. The substance successfully prevented Staphylococcus aureus and Streptococcus mutans from growing. [33]
- Gupta et al., (2018) We developed a mouthwash solution through the combination of medicinal herbs which contained Mentha piperita, *Azadirachta indica* and Ocimum sanctum. The study investigated how well the mouthwash could prevent bacteria from growing in dental areas. We conducted an agar diffusion assay test to examine the effectiveness of the mouthwash. The test results showed that the herbal mouthwash successfully prevented pathogens from growing. The herbal mouthwash provided significant assistance in treating both inflammation and oral ulcers. The herbal mouthwash made from Mentha piperita, *Azadirachta indica* and Ocimum sanctum demonstrates strong effectiveness.[34]
- Prabu et al., (2017) The scientists investigated how effective these extracts were at fighting bacteria which cause problems with human hygiene. The research showed that the extracts achieve complete antibacterial effectiveness against the bacteria which cause plaque and gingivitis and oral ulcers. The two extracts demonstrate effective protection against the bacteria which cause dental problems in humans. The extracts serve as an effective preventive measure against oral health problems which include plaque and gingivitis and mouth ulcers. The two extracts show their value by maintaining oral hygiene while fighting the bacteria that create different dental issues.[35]
- Kaur et al., (2016) I discovered a mouthwash which included herbal ingredients of mint and neem and tulsi. The combination of mint, neem, and tulsi is very effective in combating microbes and inflammation in the mouth, thereby reducing their presence. Mint and neem and tulsi work together to stop plaque buildup and mouth ulcer development.[36]
- Haffajee et al., (2008) I conducted research to determine how herbal mouthwash affects oral bacteria and its ability to prevent plaque development. Research has shown that the utilization of mouthwash containing plant extracts significantly reduces harmful bacteria responsible for oral diseases and inflammation.[37]
- Blumberg et al., (2006) The peppermint plant which scientists name Mentha piperita contains several effective medicinal components because it contains menthol and flavonoids. The substances exhibit antibacterial properties while also providing anti-inflammatory effects and calming effects to the skin. The combination of peppermint with oral care products which include mouthwashes establishes peppermint as an ideal ingredient. The peppermint plant helps maintain our mouth cleanliness while delivering fresh breath.[38]

3. AIM AND OBJECTIVES:

Aim: The aim of this study is to come up with and assess a polyherbal mouthwash made up of medicinal plant extracts for effectively treating oral ulcers and maintaining oral hygiene with respect to the incidence of Aphthous Ulcer.

Objectives:

1.To select suitable medicinal plants:

The research aims to discover plant species which will provide antimicrobial, anti-inflammatory, antioxidant, and wound-healing effects to treat oral ulcers. *Azadirachta indica*, *Ocimum sanctum*, and Mentha piperita were chosen as study subjects because of their ability to decrease oral bacteria, which leads to better dental health.

2.To collect and prepare plant materials:

The second stage requires people to gather specific parts of the medicinal plants azadirachta indiclarre *Ocimum sanctum* and mentha piperita and then wash them with clean water to eliminate all dirt before they start drying in a shaded location. After all items reach complete dryness, the team will use a grinder to produce very fine powder from every material. The extraction process will become simpler because all powdered plant parts will have identical particle dimensions.

3.To formulate a polyherbal mouthwash:

To make a mouthwash with a few herbs. The research aims to create a mouthwash which combines herbal extracts with glycerine and flavouring agents and preservatives and distilled water as additional components. The mouthwash needs to be stable, safe, and pleasant for oral administration.

4.To evaluate the physicochemical properties of the formulation:

Physico, chemical Testing of the Mouthwashes The physico, chemical testing of the mouthwash involves the same set of tests as listed for physical properties. The mouthwash was evaluated for colour and odor, taste and viscosity, pH level clarity etc. A mouthwash would be deemed safe and stable for use if the above, listed properties are satisfactory.

5: To evaluate antimicrobial activity

Antimicrobial Testing of Mouthwashes The study tests the ability of the polyherbal mouthwash to kill the two pathogenic organisms Streptococcus mutans and Candida albicans which cause oral infections and create tongue lesions.

4. Material and Method:

Collection and Authentication of Plant Materials: Obtained neem leaves and tulsi leaves and mint from a nearby herbal garden or market. I used distilled water to wash the leaves which helped in cleaning them by removing both dust and pollutants. I sun dried the leaves by leaving them in the shade during a period that lasted between 7 and 10 days. I used a grinding machine to convert the dried leaves into powder form. I stored the product in air tight jars to create conditions for later usage. The powder production process needed neem leaves and tulsi leaves and mint leaves as the main materials. I was able to create the powder by using only neem leaves and tulsi leaves and mint leaves. [39]

Preparation of Plant Extracts: The dried powdered plant materials were extracted using the maceration method.

Table 1: Formulation of herbal mouthwash

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Ingredient	Function	Role	Quantity
Neem leaves	Active drug	Anti-bacterial	5g
Tulsi leaves	Active drug	Anti-inflamatory	5g
Pudina leaves	Active drug	Cooling analgesic	5g
Salt	….	flavoured	0.5
Honey	Sweetener	flavoured	2 ml

Procedure:

1. About 50 g of each powdered plant material was weighed accurately.
2. The powder was soaked in 200 ml of ethanol or distilled water in separate conical flasks.
3. The mixtures were kept for 48 hours with occasional shaking.
4. After extraction, the mixtures were filtered using Whatman filter paper.
5. The filtrates were concentrated using a water bath at 40–50°C to obtain crude extracts.[40]

Evaluation of Polyherbal Mouthwash: [41]

Organoleptic Evaluation: The prepared mouthwash was evaluated for

Colour - **Taste-.**

Odor-

pH Determination:

The pH of the mouthwash was determined using a digital pH meter at room temperature. Mouthwash pH should be between 5.5–7 to maintain oral compatibility.

Viscosity:

The viscosity of the mouthwash was measured using a Brookfield viscometer to determine the flow property.

Antimicrobial Activity:[42]

The antimicrobial activity was evaluated by the agar well diffusion method against oral pathogens such as:

- Streptococcus mutans
- Staphylococcus aureus
- Candida albicans

Stability Study: ICH Guidelines Q1A (R2). Stability Testing of New Drug Substances and Products.

6. Result and Discussion:

The polyherbal mouthwash was successfully formulated using extracts of neem (*Azadirachta indica*), tulsi (*Ocimum sanctum*), and mint (Mentha piperita). The prepared formulation was evaluated for various physicochemical parameters and antimicrobial activity.

The prepared polyherbal mouthwash containing neem, tulsi, and mint extracts showed acceptable physicochemical properties and good antimicrobial activity against common oral pathogens. The formulation maintained a suitable pH and stability, making it safe for oral use. The herbal ingredients contribute antibacterial, anti-inflammatory, and soothing properties which help reduce infection and promote healing of mouth ulcers.

Therefore, the formulated polyherbal mouthwash can be considered an effective and natural alternative to synthetic mouthwashes for the treatment of mouth ulcers.

Future Prospect:

The polyherbal mouthwash formulated with neem, tulsi, and mint extracts showed promising antimicrobial and anti-inflammatory properties for the treatment of mouth ulcers. However, further research and development can enhance its therapeutic potential and commercial applicability. The following future prospects can be considered:

1. **Clinical Trials**
   The formulation can be evaluated through large-scale clinical trials in patients with mouth ulcers to confirm its safety, efficacy, and therapeutic benefits.
2. **Standardization of Herbal Extracts**
   Further studies can focus on standardizing the active phytoconstituents present in neem, tulsi, and mint to ensure consistent quality and effectiveness of the mouthwash.
3. **Advanced Formulation Development**
   The mouthwash formulation can be improved by incorporating additional herbal ingredients with wound-healing and analgesic properties to enhance its therapeutic action.
4. **Long-Term Stability Studies**
   Extended stability studies can be conducted under different environmental conditions to determine the shelf life of the formulation.
5. **Commercial Production**
   With further optimization and regulatory approval, the polyherbal mouthwash can be developed into a commercial product as a natural alternative to synthetic mouthwashes.
6. **Comparative Studies**
   Future research may compare the effectiveness of this polyherbal mouthwash with commercially available mouthwashes such as chlorhexidine to determine its relative efficacy.
7. **Toxicological Studies**
   Additional studies can be carried out to evaluate the safety profile and possible side effects of long-term use of the herbal formulation.

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