

Formulation and Evaluation of Herbal Gargle

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Abstract

Oral hygiene is a key factor in maintaining systemic health. Synthetic mouthwashes often cause side effects such as staining and taste alteration. Herbal gargles formulated with medicinal plant extracts offer a natural, safe, and effective alternative for maintaining oral hygiene. This review focuses on the formulation and evaluation of a herbal gargle containing Neem (*Azadirachta indica*), Ginger (*Zingiber officinale*), Turmeric (*Curcuma longa*), and Mentha (*Mentha arvensis*). Each herb contributes unique pharmacological properties such as antibacterial, anti-inflammatory, antioxidant, and antiseptic effects. The paper also discusses evaluation parameters including pH, antimicrobial testing, and stability. Herbal gargles are emerging as promising formulations for preventing oral infections and maintaining fresh breath without the adverse effects of synthetic chemicals. Advantages (fewer side effects, acceptability) and challenges (standardization, stability, taste) are also discussed.

Keywords: Herbal gargles; Neem; Ginger; Turmeric; Mentha; Oral hygiene; Antimicrobial; Herbal formulation

1. Introduction

Maintaining oral hygiene is essential for preventing dental caries, gingivitis, and halitosis. Mouthwashes and gargles are commonly used for cleansing the oral cavity and reducing microbial load (Bhat et al., 2020). However, conventional mouthwashes containing alcohol and chlorhexidine can cause adverse effects such as tooth discoloration and mucosal irritation (Sharma et al., 2021).

Herbal formulations have gained attention as safe and effective alternatives due to their antimicrobial, anti-inflammatory, and antioxidant properties (Kumar et al., 2022). Medicinal plants such as Neem, Ginger, Turmeric, and Mentha possess well-documented oral therapeutic properties and can be combined to develop a synergistic herbal gargle for oral care. Oral hygiene is an essential component of overall health, as the oral cavity serves as a gateway to the body and a reservoir for numerous microorganisms (Rajesh et al., 2020). Poor oral hygiene can lead to dental caries, gingivitis, halitosis, and even systemic infections such as cardiovascular diseases and diabetes (Bhat et al., 2020). Mouthwashes and gargles are widely used as adjuncts to mechanical cleaning methods like brushing and flossing, helping to reduce microbial load, prevent plaque formation, and maintain fresh breath (Patel & Mehta, 2019).

Recent studies have also begun to evaluate combinations of these herbs in gargles or mouthwashes, assessing parameters like antimicrobial efficacy, irritation potential, pH, stability, and sensory acceptability. This review synthesizes current knowledge around these ingredients and outlines best practices in formulation and evaluation for herbal gargles.

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Gargling is an age-old, noninvasive therapeutic method used to deliver medicinal or cleansing agents directly to the pharyngeal and oropharyngeal mucosa. Gargling with liquid, and sometimes gargling, helps reduce microbial load, flush mucus, soothe inflammation, and deliver actives to the mucosal surface. In the context of oral and throat health, gargles act as adjuncts to mechanical hygiene (brushing, flossing) by targeting pathogens in hard-to-reach areas of the throat and tonsils.

Conventional synthetic mouthwashes typically contain alcohol, chlorhexidine, triclosan, or cetylpyridinium chloride as active ingredients. While effective, these formulations often cause adverse effects such as mucosal irritation, tooth and tongue staining, altered taste perception, and disruption of the natural oral microbiome (Sharma et al., 2021; Kaur et al., 2021). These limitations have prompted increasing interest in safer, plant-based alternatives.

Herbal gargles, formulated using medicinal plant extracts, have gained significant attention in recent years due to their multifunctional therapeutic properties, including antimicrobial, anti-inflammatory, antioxidant, and wound-healing activities (Dwivedi et al., 2020; Kumar et al., 2022). Plants such as Neem (*Azadirachta indica*), Ginger (*Zingiber officinale*), Turmeric (*Curcuma longa*), and Mentha (*Mentha arvensis*) have long been recognized for their oral health benefits in traditional medicine systems such as Ayurveda (Subapriya & Nagini, 2005; Aggarwal & Harikumar, 2009). Mechanical cleaning methods, such as tooth brushing and flossing, are effective but often insufficient for complete microbial control. Mouthwashes and gargles serve as important adjuncts to mechanical oral care by reducing microbial load, preventing plaque formation, and maintaining oral freshness (Patel & Mehta, 2019). Synthetic mouthwashes, including chlorhexidine and alcohol-based formulations, have demonstrated strong antimicrobial activity. However, their prolonged use is associated with several limitations, including mucosal irritation, altered taste perception, tooth and tongue staining, and disruption of the natural oral microbiome (Sharma et al., 2021; Kaur et al., 2021).

In recent decades, there has been growing interest in herbal oral care products due to their safety, biocompatibility, and multifunctional therapeutic properties. Herbal gargles contain bioactive phytochemicals—such as flavonoids, terpenoids, alkaloids, tannins, and curcuminoids—that exhibit antibacterial, anti-inflammatory, antioxidant, and wound-healing activities (Dwivedi et al., 2020; Kumar et al., 2022). Medicinal plants such as Neem (*Azadirachta indica*), Ginger (*Zingiber officinale*), Turmeric (*Curcuma longa*), and Mentha (*Mentha arvensis*) have been traditionally used for oral health in Ayurveda, demonstrating significant efficacy in plaque reduction, gingivitis management, and halitosis control (Subapriya & Nagini, 2005; Aggarwal & Harikumar, 2009). pH compatibility, preservative strategy, and sensory acceptability. Evaluation must cover physicochemical parameters, antimicrobial and anti-inflammatory performance, safety (irritation potential), and user compliance. Some recent studies have begun to explore herbal gargles and mouthwashes combining these or similar herbs, showing promising results in antimicrobial efficacy and acceptability (et al., ArpitaNandy2023)

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2. Ingredients:

Table 1 Traditional Uses & Phytochemistry

Ingredient	Major Chemical Constituents	Part of Plant Used	Traditional / Medicinal Uses
Neem (<i>Azadirachta indica</i>)	Nimbidin, Azadirachtin, Nimbolide, Gedunin, tannins, flavonoids, essential oils, fatty acids	 Seeds, seed oil; Leaves; Bark; Flowers	Antibacterial, antifungal, anti-inflammatory; antipyretic used for skin infections; oral hygiene; insecticidal uses.
Ginger (<i>Zingiber officinale</i>)	Gingerols, Shogaols, Zingiberene, α -zingiberene, β -bisabolene, monoterpenes & sesquiterpenes; volatile oils; phenolic ketones; oleoresins.	 Rhizome (fresh or dried)	Used as anti-inflammatory, analgesic (pain relief), for sore throat, digestive aid, carminative, flavouring; also antimicrobial.
Turmeric (<i>Curcuma longa</i>)	Curcuminoids (curcumin, demethoxycurcumin, bis-demethoxycurcumin), volatile oils (α -, β -termerone, zingiberene, sesquiterpenes), polysaccharides, phenolic compounds.	 Rhizome (underground stem)	Anti-inflammatory; antioxidant; antimicrobial; used to treat throat infections, wounds, skin disorders; also used as spice and colourant.
Mentha (Mint, e.g., Mentha piperita, spearmint etc.)	Essential oils: Menthol, Menthone, Carvone, limonene, esters, ketones; also flavonoids (luteolin, apigenin etc.), phenolic acids.	 Leaves; occasionally stems / aerial parts	Used to freshen breath; soothing throat; mild antiseptic; flavouring; digestive aid; cooling sensation; relief of irritation.

3. Oral Hygiene and Role of Gargles

3.1. Importance of Oral Care

The oral cavity serves as a reservoir for numerous microorganisms. Poor oral hygiene leads to plaque accumulation, periodontal diseases, and systemic infections (Rajesh et al., 2020). Maintaining an optimal microbial balance through regular gargling is crucial for oral health.

3.2. Mechanism of Gargles in Oral Hygiene

Gargles act by physically dislodging debris and chemically inhibiting bacterial growth. Antimicrobial components penetrate biofilms and reduce inflammation of the mucosal surface (Patel & Mehta, 2019).

3.2.1. Mechanical Cleansing:

Gargling generates a hydrodynamic force that physically dislodges food particles, plaque deposits, and microbial biofilms from the teeth, gums, and oral mucosa. This reduces the overall microbial load and prevents the establishment of pathogenic colonies (Patel & Mehta, 2019).

3.2.2. Antimicrobial Action:

Active ingredients in gargles, such as phytochemicals in herbal formulations or chlorhexidine in synthetic ones, interact with microbial cell membranes. They can cause cell wall disruption, protein denaturation, and inhibition of microbial adhesion to oral surfaces, ultimately leading to bacterial death or growth inhibition (Dwivedi et al., 2020; Gopinath et al., 2013).

3.2.3. Anti-inflammatory and Healing Effects:

Herbal gargles containing compounds such as curcumin, gingerols, and nimbidin reduce the production of pro-inflammatory cytokines and modulate the inflammatory response in gingival tissues. This helps alleviate gum inflammation and promotes tissue healing (Aggarwal & Harikumar, 2009; Singh et al., 2020).

4. Limitations of Synthetic Mouthwashes

Commercial mouthwashes containing chlorhexidine, triclosan, and alcohol provide temporary relief but often cause side effects such as staining of enamel, altered taste, burning sensation, and dryness (Kaur et al., 2021). Overuse may disturb the oral microbiota balance. Thus, a shift toward herbal-based formulations is both logical and beneficial.

Oral Mucosal Irritation: Alcohol-based mouthwashes and chlorhexidine-containing products can cause burning sensations, irritation, or dryness of the oral mucosa (Sharma et al., 2021). Chronic exposure may exacerbate oral discomfort, particularly in sensitive individuals.

Tooth and Tongue Staining: Chlorhexidine, a common antiseptic in synthetic mouthwashes, is associated with brown staining of teeth and tongue surfaces upon prolonged use, reducing cosmetic acceptability (Kaur et al., 2021).

Alteration of Taste Perception: Synthetic mouthwashes may cause temporary taste disturbances, such as a metallic or bitter aftertaste, affecting patient compliance (Patel et al., 2020).

Disruption of Oral Microbiota: Overuse of antimicrobial synthetic agents can disturb the natural balance of oral microbiota, potentially leading to opportunistic infections or reduced colonization of beneficial bacteria (Verma et al., 2022).

Chemical Toxicity and Side Effects: Long-term use of certain synthetic formulations containing triclosan, cetylpyridinium chloride, or alcohol may have cytotoxic effects on oral epithelial cells and could contribute to systemic toxicity (Dwivedi et al., 2020).

5. Herbal Approach in Oral Hygiene

5.1. Advantages of Herbal Gargles

Herbal gargles offer multiple advantages over synthetic formulations:

- **Safety and Biocompatibility:** Herbal extracts are generally non-toxic and cause minimal irritation, making them suitable for long-term use across age groups (Dwivedi et al., 2020).
- **Multifunctional Activity:** Many plant extracts possess antibacterial, antifungal, anti-inflammatory, and antioxidant properties, which collectively contribute to oral health maintenance (Kumar et al., 2022).

- **Preservation of Oral Microbiome:** Unlike broad-spectrum synthetic antimicrobials, herbal gargles selectively inhibit pathogenic microorganisms while preserving beneficial oral flora, supporting overall microbial balance (Verma et al., 2022).
- **Reduced Side Effects:** Herbal formulations avoid common issues associated with synthetic mouthwashes, such as tooth staining, taste alteration, and mucosal dryness (Sharma et al., 2021).
- **Eco-Friendly and Sustainable:** Herbal ingredients are biodegradable and environmentally friendly, aligning with global trends in sustainable healthcare (Kamatou et al., 2013).

5.2. Therapeutic Role of Plant-Based Extracts

Phytochemicals such as flavonoids, terpenoids, alkaloids, tannins, and curcuminoids in herbal extracts contribute to their oral therapeutic effects:

- **Antimicrobial Action:** Active compounds inhibit oral pathogens responsible for dental caries, gingivitis, and halitosis (Gopinath et al., 2013).
- **Anti-inflammatory and Analgesic Effects:** Reducing gum inflammation and discomfort associated with periodontal diseases (Chrubasik et al., 2005).
- **Antioxidant Activity:** Neutralizing reactive oxygen species (ROS) in oral tissues, thereby reducing oxidative stress and tissue damage (Singh et al., 2020).
- **Wound Healing and Tissue Protection:** Certain phytochemicals promote mucosal healing and protect oral epithelial cells (Aggarwal & Harikumar, 2009).

6. Major Herbal Ingredients and Their Pharmacological Importance

6.1. Neem (*Azadirachta indica*)

Neem is known for its potent antibacterial, antifungal, and anti-inflammatory properties. Its active constituents—azadirachtin, nimbidin, and quercetin—are effective against *Streptococcus mutans* and *Lactobacillus acidophilus* (Subapriya & Nagini, 2005). Neem-based mouthwashes have shown efficacy comparable to chlorhexidine without side effects (Nayak et al., 2011).

6.2. Ginger (*Zingiber officinale*)

Ginger contains gingerols and shogaols, which exhibit strong anti-inflammatory and antimicrobial actions. It reduces plaque formation and alleviates gingival inflammation (Chrubasik et al., 2005). Its antioxidant activity helps protect oral tissues from oxidative stress (Singh et al., 2020).

6.3. Turmeric (*Curcuma longa*)

The main bioactive compound curcumin possesses anti-inflammatory, antibacterial, and wound-healing properties (Aggarwal & Harikumar, 2009). Turmeric-based gargles can reduce gingivitis and inhibit bacterial colonization (Gopinath et al., 2013).

6.4. Mentha (*Mentha arvensis*)

Mentha contains menthol and essential oils that provide a cooling, refreshing effect and act as natural antiseptics (Kamatou et al., 2013). It also helps mask unpleasant breath odor and provides soothing action to oral tissues.

7. Formulation of Herbal Gargle

Table 2 Ingredients and Composition

Sr. No	Ingredient	Botanical Name	Function	Quantity (%)
1	Neem extract	<i>Azadirachta indica</i>	Antibacterial	10
2	Ginger extract	<i>Zingiber officinale</i>	Anti-inflammatory	5
3	Turmeric extract	<i>Curcuma longa</i>	Antiseptic / Healing	5
4	Mentha oil	<i>Mentha arvensis</i>	Flavor / Cooling	2
5	Black salt	-	flavor	1
6	honey	-	Sweetener	2
7	Distilled Water	-	Vehicle	q.s. to 100

7.1. Method of Preparation

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Neem leaves, ginger, menthol and turmeric are extracted the process of decoction.

Extraction of neem

- Take 8-10 dried neem leaves.
- Grind them coarsely. III. Take 30 ml of water.
- After boiling the water add powdered neem
- Boil it for 15-20 minutes on medium to low flame.
- Let it cool down for 30 minutes
- Strain the solution with the help of filter paper.
- Neem extract is obtained.

Extraction of ginger

- Take dried ginger. Grind them coarsely Take 30 ml of water.
- After boiling the water add powdered ginger.
- Boil it for 15-20 minutes on medium to low flame.
- Let it cool down for 30 minutes.
- Strain the solution with the help of filter paper. ginger extract is obtained.

Extraction of turmeric

- Take dried turmeric.
- Grind them coarsely.
- Take 30 ml of water.
- After boiling the water add powdered turmeric Boil it for
- 15-20 minutes on medium to low flame.
- Let it cool down for 30 minutes.
- Strain the solution with the help of filter
- turmeric extract is obtained.

Extracton of menthol

- Take 10 gm mint leaves.
- Add it into 30ml water.
- Boil it for 15-30 min.
- Let it cool down.
- Filter it on filter paper.
- Mint extract is obtained.

- Take 20 ml water
- Add above extract on it and mix it well.
- Then add black salt into it and mixed it well.
- Filter the solution.
- Add honey into it and mixed well.
- Herbal gargle are well prepared.

Table 3 Evaluation Parameters

Sr. No	Evaluation Parameter	Purpose / Importance	Method / Description
1	Organoleptic Evaluation	Assess color, odor, taste, and clarity; ensures acceptability to users	Visual inspection and sensory evaluation
2	pH Measurement	Ensure compatibility with oral cavity (pH 5.5–7.5) and avoid irritation	Using digital pH meter
3	Viscosity / Flow Behavior	Determine thickness, spreadability, and uniformity of solution	Brookfield viscometer or Ostwald viscometer
4	Stability Studies	Assess changes in color, odor, pH, and efficacy over time	Store at 4°C, 25°C, 40°C for 30 days
5	Organoleptic Stability	Check for precipitation, turbidity, or phase separation during storage	Visual observation
6	Antioxidant Activity	Optional: Evaluate free radical scavenging to support anti-inflammatory action	DPPH assay or ABTS assay
7	Shelf-life Estimation	Predict product longevity under normal storage conditions	Accelerated stability testing

8. Future Perspectives

herbal gargles offer a safe and eco-friendly approach to oral care. Combining neem, ginger, turmeric, and mentha provides multi-targeted activity—antibacterial, antioxidant, and soothing. Unlike alcohol-based products, these herbal gargles are non-irritating and suitable for all age groups (Patel et al., 2020).

Future studies should focus on standardization, clinical trials, and nano formulation-based delivery to enhance bioavailability and efficacy (Das & Roy, 2019). Herbal gargles can play a vital role in managing common oral conditions like gingivitis, stomatitis, and halitosis, as well as preventing plaque formation (Kaur et al., 2021). Unlike synthetic mouthwashes containing alcohol or chlorhexidine, polyherbal gargles are biocompatible and suitable for long-term use without causing mucosal irritation or tooth staining (Sharma et al., 2021). Moreover, they can help restore the natural oral microbiome, supporting beneficial bacteria essential for oral and gut health (Verma et al., 2022).

Standardization and quality control remain significant challenges for herbal formulations. Variations in plant source, harvest season, and extraction method can influence phytochemical composition (Mukherjee et al., 2018). Hence, future research should focus on establishing validated methods for standardization, such as chromatographic fingerprinting and quantification of marker compounds (Rajesh et al., 2020)

9. Applications

Herbal gargles are widely used for maintaining oral hygiene and treating minor throat and mouth ailments. Their natural ingredients make them suitable for regular and therapeutic use without harmful side effects.

- Treatment of Sore Throat and Throat Infections
 - Provide relief from pain, irritation, and inflammation of the throat.
 - Help in managing conditions like pharyngitis and tonsillitis.

- Prevention of Dental Plaque and Gingivitis
 - The antimicrobial action of herbs such as neem, tulsi, and clove helps reduce bacterial growth and plaque formation on teeth and gums.
 - Prevents gum bleeding and bad breath.
- Mouth Ulcer and Oral Wound Healing
 - Ingredients like honey, licorice, and rose water soothe and promote healing of small oral wounds and ulcers.
- Post-Dental or Oral Surgery Care
 - Used as a mild antiseptic rinse to maintain cleanliness and prevent infection after dental procedures.
- Daily Oral Hygiene and Fresh Breath
 - Regular use keeps the mouth clean, maintains pH balance, and provides a fresh and pleasant taste

10. Conclusion

From the above project we can conclude that the prepared herbal gargle shows various properties. That show its effectiveness. The neem content shows anti- microbial Activity. The turmeric show healing properties for the various infection like mouth ulcer. The honey provides sweetness to the preparation. Ginger to used to relieve that throat infection. The black salt increases its shelf life. The preparation and formulation of the herbal Gargle we were able to discuss stability, clarity, viscosity anti-microbial activity and pH of the gargle. In which we came to know that the sample has passed all the above tests.

Result

- Formulation of herbal gargle was prepared successfully .
- Evaluation test of herbal gargle are performed successfully.
- The formulation showed the good organoleptic properties such as colour and taste.

Compliance with ethical standards

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