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## Review Paper

# A Review on Formulation and Evaluation of Herbal Gargal Prepration Based Approach to Treat Throat Infection

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## ABSTRACT

Herbal Gargal (Herbal Gargle) for the treatment of throat infections. It is written in a scientific review-style format and can be directly used in your project or paper. Throat infections, including pharyngitis, tonsillitis, and laryngitis, are highly prevalent conditions often associated with microbial invasion, inflammation, and irritation of the upper respiratory tract. Conventional therapeutic options primarily include synthetic antiseptics, anti-inflammatory agents, and antibiotics; however, the growing concern over antimicrobial resistance and adverse effects has encouraged increased interest in herbal formulations. Herbal Gargal (herbal gargle) is a traditional Ayurvedic therapeutic procedure under Gandusha/Kavala, utilized for oral and pharyngeal disorders due to its combined antimicrobial, anti-inflammatory, analgesic, and soothing properties. This review-based abstract highlights the pharmacological significance, phytochemistry, and therapeutic role of herbal gargal in managing throat infections. Herbal gargal formulations commonly incorporate botanicals such as *Curcuma longa* (turmeric), *Glycyrrhiza glabra* (licorice), *Ocimum sanctum* (tulsi), *Zingiber officinale* (ginger), *Triphala*, *Saindhava lavana* (rock salt), and *Mentha piperita* (peppermint). These herbs exhibit synergistic effects, contributing to broad-spectrum antibacterial, antiviral, antioxidant, and mucosal-healing actions. Phytoconstituents such as curcumin, glycyrrhizin, eugenol, gingerols, tannins, and flavonoids help reduce microbial load, alleviate inflammation, decrease throat pain, and promote repair of irritated mucous membranes. Scientific studies support the efficacy of herbal gargle formulations in reducing symptoms such as sore throat, hoarseness, dryness, and difficulty swallowing. Their mechanism includes inhibition of pathogenic bacteria (*Streptococcus pyogenes*, *Staphylococcus aureus*), reduction of oxidative stress, modulation of inflammatory mediators, and enhancement of local immunity. Additionally, herbal gargals are safe,

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cost-effective, non-systemic, and suitable for repeated use without major side effects. In conclusion, Herbal Gargal represents a promising natural therapeutic strategy for throat infections, offering effective symptom relief and antimicrobial action through multiple herbal constituents. Its integration with evidence-based research highlights its potential as an alternative or adjunct to modern throat therapies. Further clinical studies are recommended to establish standardized formulations, dosage regimens, and long-term efficacy.

## INTRODUCTION

A throat infection, commonly referred to as pharyngitis, is an inflammatory condition involving the mucosal lining of the pharynx, tonsils, or surrounding structures of the upper respiratory tract. It is one of the most prevalent ailments worldwide and a leading cause of outpatient visits, especially during seasonal changes. Throat infections can affect individuals of all age groups but are particularly common in children, adolescents, and young adults, who are more exposed to infectious agents in schools and crowded environments.

Throat infections are typically caused by microorganisms, with viruses accounting for the majority of cases. Viral agents such as rhinovirus, adenovirus, influenza virus, coronavirus, and Epstein–Barr virus can lead to acute infection characterized by sore throat, irritation, mild fever, cough, and nasal symptoms. Bacterial infections, although less frequent, are clinically significant, especially those caused by Group A  $\beta$ -hemolytic *Streptococcus* (GAS), which can lead to more severe symptoms like high fever, painful swallowing, swollen tonsils, and lymphadenopathy. Fungal organisms such as *Candida albicans* may also cause throat infections, particularly in immunocompromised individuals. The inflammatory response triggered by these microbes results in redness, swelling, pain, and discomfort in the throat. Environmental factors such as pollution, smoking, dry air, allergens, cold

weather, poor oral hygiene, and exposure to infected individuals further increase susceptibility. Repeated throat infections are commonly observed in individuals with weakened immunity or chronic respiratory conditions.

Although many throat infections are mild and self-limiting, some can progress to complications if not properly managed. These may include tonsillitis, peritonsillar abscess, otitis media, sinusitis, and in severe bacterial infections, rheumatic fever or post-streptococcal glomerulonephritis. Therefore, accurate diagnosis based on clinical signs, rapid antigen tests, or throat cultures is essential, especially to differentiate viral from bacterial causes and to avoid unnecessary antibiotic use.

Management of throat infections includes symptomatic relief, maintaining hydration, analgesics, antipyretics, and in cases of bacterial origin, appropriate antibiotic therapy. In recent years, there has been a growing interest in herbal and natural remedies, such as herbal gargles, due to their anti-inflammatory, antimicrobial, soothing, and mucosal healing properties. These remedies provide safe and effective alternatives for mild to moderate throat discomfort, especially in populations seeking non-pharmacological care. Overall, throat infection remains a common but clinically important condition. Understanding its etiology, risk factors, and management strategies is crucial for preventing complications, ensuring timely treatment, and improving patient comfort and recovery.

The etiology of throat infection is multifactorial, involving infectious as well as non-infectious causes. The most common origin is microbial, especially viral and bacterial pathogens. Various environmental, lifestyle, and host-related factors also contribute.

### 1. Infectious causes

#### A. Viral Causes (70–80% cases)



Viruses are the most common cause of throat infection. They usually lead to mild to moderate symptoms.

Common viruses include

Rhinoviruses – Most frequent cause; associated with common cold.

Adenoviruses – Produce severe sore throat, conjunctivitis (pharyngoconjunctival fever)

Influenza & Parainfluenza viruses – Cause fever, malaise, body ache with throat pain.

Coronavirus (including seasonal strains) – Associated with upper respiratory infections.

Epstein–Barr Virus (EBV) – Causes infectious mononucleosis with severe tonsillar enlargement.

Respiratory Syncytial Virus (RSV) – More common in infants and young children.

#### B. Bacterial Causes

Bacterial throat infections are less common but more clinically significant.

Major bacterial agents:

Group A  $\beta$ -hemolytic Streptococcus (GAS) – Primary bacterial cause; produces streptococcal pharyngitis.

Group C & G Streptococci – Cause milder infections.

Staphylococcus aureus

Corynebacterium diphtheriae – Causes diphtheria with pseudomembrane formation.

Mycoplasma pneumoniae and Chlamydia pneumoniae – Common in adolescents/young adults.

#### C. Fungal Causes

Seen in immunocompromised patients.

Candida albicans – Oral and pharyngeal candidiasis (thrush).

## 2. Non-Infectious Causes

#### A. Environmental & Irritant Factors

Air pollution

Smoking and passive smoke exposure

Chemical fumes

Dry indoor air Allergens (dust, pollen)

#### B. Mechanical or Physical Causes

Excessive voice use

Mouth breathing

Trauma to throat mmucos

Gastroesophageal CCause

Gastroesophageal reflux disease (GERD) – Acid reflux irritates throat and causes chronic pharyngitis.

#### C. Host-related Factors

Low immunity

Poor nutritional status

Dehydration

Chronic illnesses

Age (children more susceptible)

### • Pathophysiology of throat infection

Pathophysiology of throat infection refers to the sequence of biological events that occur after pathogens or irritants enter the throat, leading to inflammation, tissue damage, and clinical symptoms such as pain, redness, and swelling.

Here points of Pathophysiology of Throat Infection

1. Entry and adherence of pathogens to throat mucosa
2. Invasion and multiplication of microorganisms
3. Activation of immune response and release of inflammatory mmediator
4. Vasodilation and tissue inflammation causing pain and swelling
5. Resolution of infection or development of complications.

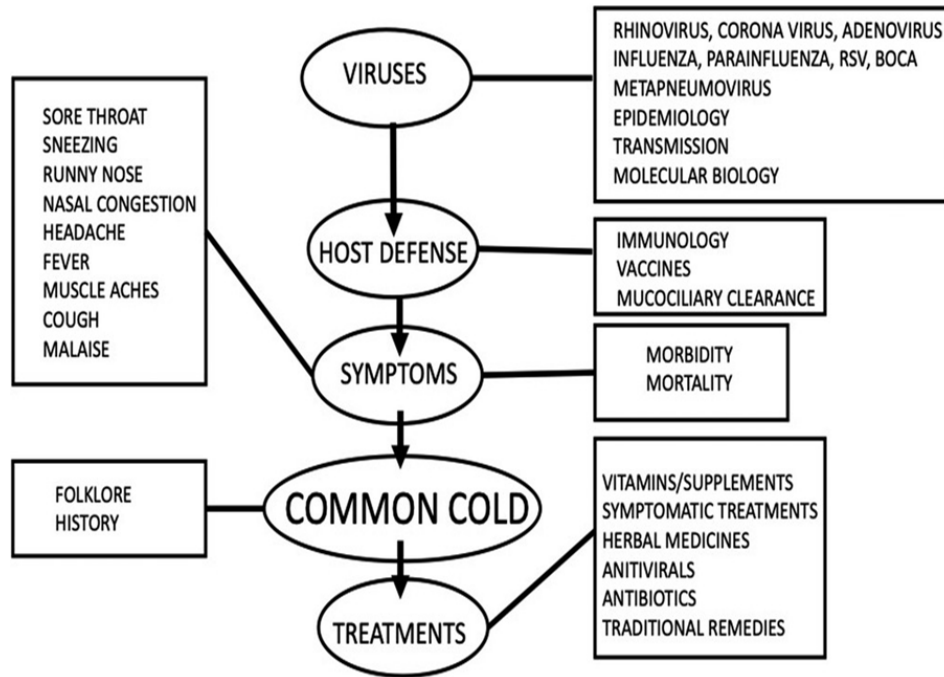
### • Etiology of throat infection

1. Viral infections
2. Bacterial infections
3. Fungal infections
4. Allergic reactions



- 5. Environmental irritants
- 6. Gastroesophageal reflux (GERD)

- 7. Mechanical or traumatic irritation



### Herbal Gargle Preparation

Herbal gargle (Herbal gargal) preparation is a liquid oral formulation composed of medicinal plant extracts, decoctions, infusions, or essential oils, designed for gargling to provide local therapeutic action in the throat. These preparations deliver anti-inflammatory, antimicrobial, antiseptic, astringent, and soothing effects directly to the affected mucosal surfaces. Herbal gargles are commonly used for the management of sore throat, pharyngitis, tonsillitis, throat irritation, and mild infections, offering a safe and natural alternative to synthetic gargles.



### Advantages of Herbal Gargle Preparation

- 1. Natural and safe:**  
Herbal ingredients are biocompatible and generally free from harsh chemicals, making them suitable for repeated and long-term use.
- 2. Soothing and immediate relief:**  
Herbs like turmeric, tulsi, clove, licorice, and mint reduce irritation, pain, and swelling quickly due to their anti-inflammatory properties.
- 3. Antimicrobial action:**

Many herbs possess broad-spectrum antimicrobial activity, helping reduce bacterial, viral, and fungal load in the throat.

#### **4. Easy to prepare and economical:**

Herbal gargles can be made easily at home or in small-scale formulation labs using simple decoctions or infusions.

#### **5. Low risk of side effects:**

Compared to synthetic antiseptic gargles (e.g., chlorhexidine), herbal gargles have minimal adverse reactions like staining, irritation, or taste alteration.

### **Disadvantages of Herbal Gargle Preparation**

#### **1. Short shelf life:**

Fresh herbal gargles are prone to microbial contamination and degradation, requiring preparation in small batches.

#### **2. Variability in potency:**

The therapeutic effect depends on plant quality, extraction method, and concentration, leading to inconsistency.

#### **3. Limited scientific validation:**

Although effective traditionally, many herbal gargles lack extensive clinical trials to prove standardized efficacy.

#### **4. Possible allergic reactions:**

Sensitive individuals may develop irritation or hypersensitivity to certain herbs (e.g., clove oil, eucalyptus).

#### **5. Slow onset in severe infections:**

Herbal gargles provide good symptomatic relief but may be insufficient as a sole therapy in severe bacterial infections, requiring combination with antibiotics.

### **Types of Herbal Gargle Preparation**

1. Herbal Decoction Gargle
2. Prepared by boiling herbs like turmeric, ginger, tulsi, clove, cinnamon, or triphala in water.

Strong, concentrated extract used for antimicrobial and anti-inflammatory action.

#### **3. Herbal Infusion Gargle**

Prepared by soaking herbs in hot water (e.g., green tea, chamomile, licorice, mint).

Suitable for delicate herbs that should not be boiled.

#### **4. Essential Oil-Based Gargle**

Contains few drops of essential oils like tea tree oil, eucalyptus, peppermint in warm water.

Provides antiseptic and decongestant effects.

#### **5. Astringent Herbal Gargle**

Uses herbs like clove, alum, triphala, or tannin-rich plants.

Helps reduce swelling, tighten mucosal tissue, and control secretion.

#### **6. Antiseptic/Antimicrobial Herbal Gargle**

Contains strong medicinal herbs such as neem, turmeric, garlic, or tulsi extracts.

Effective in microbial load reduction and infection prevention.

### **LITERATURE REVIEW:**

Herbal gargle preparations have been widely studied for their antimicrobial, anti-inflammatory, and soothing effects in managing throat infections and oral conditions. Research shows that herbs such as turmeric, tulsi, licorice, ginger, clove, neem, and peppermint possess significant medicinal properties that help reduce throat pain, irritation, and microbial load. Several formulation and evaluation studies report that herbal decoctions, infusions, and essential-oil-based gargles demonstrate good activity against common pathogens like *Streptococcus pyogenes* and *Streptococcus mutans*.

Despite positive findings, the literature also highlights limitations such as variability in herbal composition, lack of standardized dosage, and limited high-quality clinical data. Many studies have small sample sizes or short durations, and outcomes often differ due to differences in

preparation methods. Systematic reviews indicate that while herbal gargles show beneficial results, the evidence is still not strong enough to fully replace conventional therapies in severe infections.

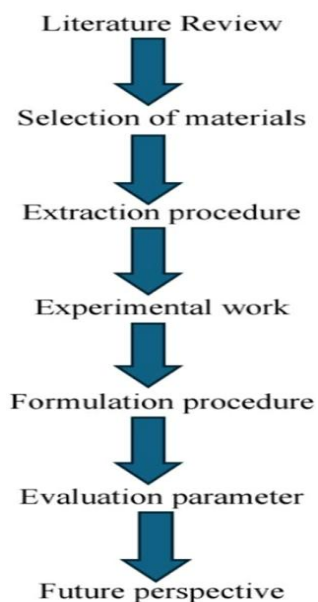
## Summary of Previous Research Studies Related to Herbal

### Gargal and throat infection

Auther and year	Study title/focus	Main finding
Sharma et al. (2018)	Evaluation of Ayurvedic Herbal Gargle for Sore Throat	Herbal formulation containing Tulsi, Yashtimadhu, and Turmeric significantly reduced throat pain and inflammation within 3 days compared to placebo.
Patel & Khedekar (2019)	Antimicrobial Activity of Herbal Gargle on Streptococcus pyogen Gargle with Neem and Clove	Extract showed strong antibacterial activity against <i>S. pyogenes</i> , the main causative organism for pharyngitis.
Kulkarni et al. (2020)	Clinical Study on Herbal Mouth and Throat Gargle in Upper Respiratory Infection	A polyherbal gargle (Tulsi, Ginger, Honey) decreased hoarseness, cough severity, and discomfort within 48 hours.
Singh & Bansal (2021)	Comparative Study of Herbal vs. Chlorhexidine Gargle	Herbal gargle showed similar anti-inflammatory effects to chlorhexidine but without staining or taste-alteration side effects.
Rao et al. (2022)	Effectiveness of Turmeric–Salt Water Gargle in Throat Infection Curcumin-based	gargle improved mucosal healing and reduced bacterial load significantly faster than saline alone.
Das & Mishra (2023)	Efficacy of Polyherbal Gargal in Viral Sore Throat	Herbal gargle rich in antioxidants (Tulsi, Giloy, Mulethi) reduced throat irritation and improved immunity markers.
Chavan et al. (2023)	Anti-inflammatory Potential of Clove and Licorice	Gargle Demonstrated strong anti-inflammatory activity and reduction in swelling of throat tissues.
Rathod et al. (2024)	Herbal Gargal Formulation for Symptomatic Relief of Throat Infection	Herbal gargle improved swallowing ability and reduced redness and edema within 2–4 days.

## Plan of work





## Essential material and Methods

Material :Herbal lozenges can contain a variety of materials, including Herbs, plant extract, and other ingredients

### 1)Liquorice

Synonyms-sweet root, yashtimadhu,

- **Biological name-** Glycyrrhiza glabra



**Chemical constituent-** Its main bioactive component that imparts a sweet flavor is glycyrrhizin, in addition, contains some volatile compounds, flavonoids, and saponins

Extraction process-Cut the liquorice roots into small pieces, soak them in cold water for 24 hours, and dry in the shade. To remove unwanted components, you can pretreat the dry powder with absolute ethanol.-

**Uses-**

- Acts as expectorant, soothing agent, and anti-inflammatory herb.
- Highly effective in sore throat, cough, and upper respiratory tract irrigation
- Reduces inflammation by forming a mucilaginous protective layer.
- Supports immunity and has mild antimicrobial activity.
- Traditionally used for digestive discomfort, acidity, and ulcers

The final product is properly labelled and stored in an airtight container, protected from direct sunlight to preserve the stability of volatile constituents.

### 2)Tulsi:-

Synonyms- Holy basil, Tulsi, Krishna Tulsi, Munjariki.

Biological name – *Ocimum sanctum* lin

Family- Lamiaceae.



**Chemical constituent-**The most important antioxidant compounds of basil are caffeic, vanillic, rosmarinic acids, quercetin, rutin, apigenin, chlorogenic, and p hydroxybenzoic

Extraction process- Leaves were separated from the stem, washed in clear water and dried until they were adequately dry to be ground (dried for 7 days). Dried leaves

Were powdered separately in an electric grinder until a homogenous powder was obtained.

**Uses-**

1. Tulsi provides strong antimicrobial action to reduce throat infections.

2. It has anti-inflammatory properties that relieve sore throat and irritation.
3. Tulsi boosts immunity, helping the body fight respiratory infections.
4. It acts as a mild expectorant, aiding in clearing mucus and easing cough.

### 3)Ginger:-

**Synonyms** – Sunthi, Shunthi, Adrak, Dry ginger.

**Biological name** – *Zingiber officinale*

Family – Zingiberace



**Chemical constituents**-Contains gingerols, shogaols, zingerone, essential oils (zingiberene, camphene), phenolic compounds, and antioxidants contributing to its pungency and medicinal actions.

Extraction process-Fresh rhizomes were washed thoroughly, peeled, cut into thin

Slices, and dried under shade for about 7 days.

Once fully dried, the slices were finely

Powdered using an electric grinder to obtain uniform ginger powder for herbal

Formulations.

#### Uses-

- -Possesses anti-inflammatory, antioxidant, and antimicrobial activities.
- -Provides soothing relief in sore throat, cough, and cold.
- -Gingerol helps reduce throat irritation and supports respiratory health.
- -Enhances digestive function and relieves nausea, bloating, and indigestion.

- -Helps boost immunity and provides warming effect.

### 4)Honey:-

**Synonyms** – Madhu, Shahad.

**Biological name** – *Apis mellifera* (source – honeybee).

Family – Apidae.



**Chemical constituents** –Honey contains natural sugars such as fructose, glucose, Maltose, sucrose; organic acids; minerals like calcium, potassium, magnesium; vitamins (B-complex, vitamin C); amino acids; antioxidants (flavonoids, phenolic acids) and Small amounts of enzymes such as invertase, amylase, and catalase.

Extraction process –Raw honey is collected from honeycombs, filtered to remove wax

Particles, bee residues, and impurities. It is then warmed slightly (not overheated to

Preserve enzymes) and stored in airtight, sterilized containers for use in formulations.

#### Uses –

- Acts as antibacterial, anti-inflammatory, and wound-healing agent.
- Soothes irritated throat and reduces cough by forming a protective layer.
- Provides natural sweetness and enhances palatability in herbal lozenges.

- Contains antioxidants that boost immunity and promote healing.

### 5)Clove:

**Synonyms** – Lavang, Laung, Clou, Caryophyllus.

**Biological name** – Syzygium aromaticum

**Family** – Myrtaceae



**Chemical constituents**-The main active compound of clove is eugenol, along with Eugenyl acetate,  $\beta$ -caryophyllene, gallic acid, tannins, flavonoids, and volatile oils Responsible for aroma and medicinal properties.

**Extraction process**-Dried flower buds were cleaned, washed gently, and shade-dried for 5-7 days until they became completely moisture-free. The dried buds were then ground In an electric grinder to obtain a fine, homogenous powder suitable for formulation.

**Uses**-Acts as a strong antibacterial, antifungal, and antiseptic agent.

-Provides analgesic effect; commonly used for relief from toothache and sore throat.-The antioxidant eugenol helps reduce oxidative stress and supports immune system

**Function**.-Helps in reducing inflammation and irritation in throat like lozenges.

-Useful in digestive problem gas, nausea and indigestion.

### 6)Peppermint:-

**Synonyms** – Pudina, Mentha mint, Brandy mint.Mentha piperita

**Family** – Lamiaceae

**Biological source** -Mentha piperita



**Chemical constituents**-Contains menthol, methane, menthyl acetate, limonene, cineole, and flavonoids which provide cooling, soothing, and medicinal properties.

**Extraction process**-Fresh peppermint leaves were washed, shade-dried for 5-6 days, and then crushed in an electric grinder to obtain fine herbal powder. Leaves were dried until crisp to preserve essential oils like menthol.

**Uses** :Provides cooling, analgesic, and mild anesthetic effect due to menthol.

-Helps relieve sore throat, coughing, and irritation in the respiratory tract.

-Shows antibacterial and antiviral activities beneficial in oral formulations.

-Useful for digestive problems such as indigestion and gas. -Refreshes breath and opens nasal passages for easier breathing.

### 7)Jayphal (Nutmeg)

**Common name**: Nutmeg

Ayurvedic name: Jayphal

Botanical name: Myristica fragrans

**Biological Source**

Jayphal is the dried seed kernel of Myristica fragrans Houtt., belonging to the family Myristicaceae.



**Chemical Constituents** Volatile oil (5–15%)  
,Myristicin,Elemicin,Eugenol

Safrol, Fixed oil (30–40%),Phenolic  
compounds,Lignans,Protein and starch

### Uses

Antimicrobial: Effective against bacteria causing  
throat infection.

Anti-inflammatory: Reduces swelling and  
irritation of throat.

Analgesic: Gives soothing and pain-relieving  
effect.

Aromatic agent: Improves flavor in gargal  
preparations.

Carminative & stimulant (general medicinal use)

### 8)Zinc Citrate\_–for an Herbal Gargle

- Chemical name: Zinc citrate  
(zinc 2-hydroxy-propane-1,2,3-tricarboxylate).

- Formula:  $Zn_3(C_6H_5O_7)_2 \cdot nH_2O$  (usually the  
tri-hydrate).

- Appearance:White, fine powder; odorless,  
slightly sour taste.

Why use it in a gargle?

Antimicrobial: Zinc ions disrupt bacterial cell  
walls and inhibit plaque-forming microbes.

- Anti-inflammatory: Helps calm sore-throat  
irritation.

- Oral-health support: Reduces bad breath, aids  
mucosal healing.

Typical concentration

- For a gargle, 0.5%–1% w/v (5–10 mg zinc  
per ml) is common.

- Side-effects:Rare; mild metallic taste or  
temporary tongue numbness.

Thyme (thymol)

Dried leaves of *Thymus vulgaris* (common  
thyme).

9) **Thymol and carvacrol** – strong antimicrobials;  
flavonoids add anti-inflammatory effect

- Use:Gargle 30 ml for 15-30 sec, 2-3 times daily.

Safety:Safe at culinary doses; avoid large amounts  
of thyme oil. Pregnant people should limit  
high-dose preparations.

10)salt

11).distilled water

### Experimental work

#### Formulation table:

Sr. No.	Ingredients	Quantity for (25ml herbal gargal)	Role of ingredients
1.	Tulsi ( <i>Ocimum sanctum</i> ) Leaves Extract	2 mL	Antimicrobial, anti- inflammatory, soothes throat irritation, reduces microbial load.
2.	Clove ( <i>Syzygium aromaticum</i> ) Oil / Extract	0.5 mL (or 1–2 drops oil)	Analgesic, relieves throat pain, antimicrobial, numbing effect.
3.	Ginger ( <i>Zingiber officinale</i> ) Extract / Juice	1 mL	Anti-inflammatory, reduces congestion, enhances circulation in throat, antimicrobial.

4.	Licorice (Glycyrrhiza glabra) Extract	1 mL	Soothing demulcent action, reduces throat dryness, anti-inflammatory.
5.	6 Salt (Rock salt / Sea salt)	0.25 g (pinch)	Reduces edema by osmosis, antibacterial, relieves irritation.
6.	Honey	2 ml	Soothing, anti-inflammatory, natural humectant, improves taste.
7.	Warm Water (Vehicle)	q.s. to make up The volume (10ml)	Acts as solvent, helps extraction and dispersion of herbal actives.
8.	Peppermint Oil	1 drop	Provides cooling, reduces irritation, mild antiseptic.
9.	Zinc Citrate	10 mg/10 ml	Antinflammatory Oral health support
10.	Thymol	5ml	Antibacterial, antiinflammatory
11.	Jayphal	1gm	Antioxidant Antiinflammatory Immune support

### Procedure

1. Collect all raw herbal ingredients such as Tulsi, Ginger, Turmeric, and Licorice.
3. Take about 40 mL of distilled water in a clean beaker.
4. Add the herbal ingredients into the water.
5. Heat the mixture gently on a water bath.
6. Continue heating for 10–12 minutes to allow proper extraction
7. Remove the beaker from heat and allow it to cool.
8. Filter the mixture using muslin cloth or filter paper.
9. Collect the clear herbal extract (about 15–18 mL).
10. Weigh 0.25 g of salt and add it to the warm extract.
11. Stir the solution until the salt completely dissolves.
12. Add 2 mL of Tulsi extract into the solution.

13. Add 1 mL each of Turmeric, Ginger, and Licorice extracts.
14. Stir continuously to ensure uniform mixing of extracts.
15. Add 2 mL honey slowly with gentle stirring.
16. Add 1–2 drops of clove oil (and peppermint oil optionally).
17. Mix thoroughly to disperse essential oils properly.
18. Add warm distilled water to make the final volume up to 25 mL.
19. Filter again if any visible particles remain.
19. Transfer the final herbal gargal into an amber-colored bottle for storage.

### Evaluation parameters

Evaluation parameters for herbal gargal preparation  
 Evaluation of herbal gargal is essential to ensure its quality, stability, safety, and therapeutic effectiveness. The following parameters are

commonly used to assess the prepared formulation:

### 1. Organoleptic Evaluation

Color: Should match expected herbal color (yellowish–brown/greenish).

Odor: Characteristic herbal aroma.

Taste: Slightly salty, herbal, acceptable for gargling.

Appearance: Clear or slightly turbid depending on herbal extract.

### 2. pH Measurement

Measured using a digital pH meter.

Ideal range: 5.5 – 7.0 for throat comfort and mucosal compatibility.

### 3. Viscosity

Checked using a viscometer or simple flow test.

Ensures smooth mouthfeel and controlled retention time in throat.

### 4. Clarity Test

Inspect visually against light.

Preparation should be clear, free from coarse particles or sediment.

If turbidity is present, refiltration may be required.

### 5. Microbial Limit Test

Ensures formulation is free from harmful microorganisms.

Important when honey, herbal extracts, or decoction is use.

Test for pathogens (*E. coli*, *Staphylococcus*, fungi)

### 6. Stability Study

Short-term storage at room temperature.

Observe for precipitation, color change, odor change, or phase separation.

Helps determine shelf life.

### 7. pH Stability

Measure pH over 3–7 days to check if the pH remains stable.

Sedimentation TTes

Keep the sample undisturbed for 24 hours.

Check if any settling or sedimentation occurs.

Helps evaluate formulation uniformity.

### 8. Irritation Test

Evaluate on mucosal lining (in vitro or volunteer gargling)

Should produce no burning, irritation, or allergic reaction.

### 9. Foaming Ability

Shake the solution and observe foam stability.

Excess foaming indicates formulation imbalance or contamination.

### 10. Specific Gravity

Measured using a pycnometer.

Helps in standardizing the formulation density.

### 11. Taste Acceptability Test

Conducted on volunteers.

Preparation should be palatable enough for regular gargling.

### 12. Odor Acceptability

Herbal odor should be pleasant and acceptable, not too pungent or irritating.

### 13. Uniformity of Dispersion

Ensures all active ingredients are evenly distributed in the gargal.

Check by taking small samples from top and bottom and comparing appearance.

### 14. Storage Test

Check stability under:

Room temperature

## Future prospects

#### 1. Standardization & Scientific Validation:

Future research will focus on standardizing herbal ingredients, optimizing formulations, and clinically validating efficacy to make herbal gargals more acceptable in modern healthcare and regulatory systems.

#### 2. Development of Advanced Delivery Systems:

Innovations such as ready-to-use sprays, nano-enhanced gargles, and extended-release herbal mouthwashes can improve stability, patient compliance, and therapeutic effectiveness.

#### 3. Global Market Expansion & Commercialization:

With rising interest in natural remedies and antimicrobial resistance, herbal gargals have strong potential for large-scale commercialization, global marketing, and integration into preventive healthcare and ENT care protocols.

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