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Developing and Evaluating Polyherbal Mouthwash

Amandeep Kaur[1]; Rishabh[2]; Shruti Jaswal[3]; Rajneesh Kaur[4]; Brij Bhushan Sharma[5]; Sarbjot Singh[6]

[1]Associate Professor, Department Pharmacology, Himachal Pharmacy College, Majhuli (Nalagarh), Himachal Pradesh, 174101
[2]Himachal Pharmacy College, Majhuli (Nalagarh), Himachal Pradesh, 174101
[3]Associate Professor, Department Pharmaceutics, Himachal Pharmacy College, Majhuli (Nalagarh), Himachal Pradesh, 174101
[4]Associate Professor, Department Pharmaceutical Chemistry, Himachal Pharmacy College, Majhuli (Nalagarh), Himachal Pradesh, 174101
[5]Associate Professor, Department Pharmaceutical Chemistry, Himachal Pharmacy College, Majhuli (Nalagarh), Himachal Pradesh, 174101
[6]Associate Professor, Department Pharmacology, Himachal Pharmacy College, Majhuli (Nalagarh), Himachal Pradesh, 174101

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Abstract: Preventing dental caries, periodontal disorders, and halitosis is still a major global concern because oral health is essential to overall wellbeing. Despite their effectiveness, conventional mouthwashes frequently cause negative effects such tooth discolouration, changed taste perception, and irritation of the mucosa because of their artificial constituents. The creation of multipurpose mouthwashes, which blend extracts from several therapeutic herbs to produce synergistic therapeutic benefits, is therefore gaining popularity. The purpose, formulation techniques, and assessment criteria of polyherbal mouthwashes are highlighted in this review. The antibacterial, anti-inflammatory, antioxidant, and analgesic qualities of common herbal ingredients such Mentha piperita (peppermint), Syzygium aromaticum (clove), Glycyrrhiza glabra (liquorice), Ocimum sanctum (tulsi), and Azadirachta indica (neem) are examined. A summary of evaluation techniques is provided, including stability studies, physicochemical characterisation, antimicrobial testing, phytochemical screening, and clinical efficacy. The assessment also covers issues that must be resolved for effective commercialisation, including standardisation, formulation stability, and regulatory considerations. All things considered, polyherbal mouthwashes offer a viable, secure, and environmentally friendly substitute for artificial oral hygiene solutions, satisfying the rising desire for natural therapies in dental care.

Keywords: *Polyherbal Formulation, Mouthwash, Herbal Medicine, Antimicrobial Activity, Phytoconstituents.*

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I. INTRODUCTION

Dental wash is a water-based solution that is primarily used for deodorising, refreshing, and plaque control. Maintaining proper dental hygiene is crucial because plaque, a sticky layer of bacteria and food particles, can build up on teeth. Dentists commonly recommend mouthwash to prevent and cure a range of oral health conditions. (1)

Mouthwashes are usually antiseptic liquids that are intended to lower the quantity of oral bacteria. However, certain variations have further advantages including antifungal, anti-inflammatory, or pain-relieving properties. Most often, mouthwash is used at home as part of a consistent oral hygiene routine. Tooth decay can be avoided with the help of fluoride-containing anti-cavity rinses. Nonetheless, it is widely accepted that mouthwash should be used in addition to brushing and flossing, not in instead of them. (2)

Natural substances have drawn interest as useful additions to traditional oral hygiene regimens. Modern herbal mouthwashes have been developed as a result of the recent spike in popularity of natural treatments, sometimes

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known as "grandmother's remedies." This has sparked debate over whether these natural substitutes are superior to or on par with conventional goods (3). Interestingly, herbal mouthwashes don't have liquor or sugar.

Mouthwashes have two main purposes: they are antibacterial agents, especially before and during oral surgical procedures as prophylactics or the removal of teeth, and and they are a component of everyday home care. When used alone or in combination, natural herbs like neem, tulsi, and spinach have demonstrated efficacy and safety in treating oral illnesses like tooth decay, mouth ulcers, bleeding gums, and foul breath without producing negative side effects [(4)].

Because of their antibacterial and antioxidant properties, spices like basil, clove, mint, cardamom and neem have been used for centuries in traditional medicine and food preservation. These days, there is ample evidence of their antibacterial, antifungal, antiviral, and even anti-cancer qualities. [(2)]

Mouthwashes are liquid formulations with antibacterial, anti-inflammatory, and analgesic properties. Generally speaking, they can be divided into two categories: chemical and herbal. The antibacterial and anti-inflammatory features of natural plant-based molecules called phytochemicals are the source of the positive effects of herbal mouthwashes. [(5, 6)]

Herbal mouthwashes are becoming more and more popular because they lack alcohol and don't contain artificial flavours, dyes, or preservatives. Natural herbs that aid in gum and tooth cleansing and healing are added to these products. Neem, which has a potent antibacterial effect, is one of the substances found in many herbal rinses. Other often used herbs include clove, which has long been valued for its antiseptic, antibacterial, and antiviral properties in dental care, and menthol, which has a cooling effect. When taken alone or in combination, herbs like mint, neem, clove oil, and basil have been scientifically proven to be safe and helpful in treating oral health conditions like decaying teeth, mouth ulcers, and bleeding gums without having any negative side effects. [(7, 8)]

Traditional medicine has traditionally used neem bark and leaves to treat and prevent tooth problems. In addition to its well-known anti-inflammatory and analgesic effects, clove is frequently utilised to reduce oral irritation and provide short-term toothache relief. Cardamom has antibacterial and anti-inflammatory qualities that help to naturally refresh breath in addition to providing flavour to dental care products. Glycyrrhiza (licorice root) is known for its soothing, pain-relieving, and anti-inflammatory benefits, and is used to support oral health. [(9)]

➢ *Ocimum sanctum (Tulsi):*

Because of its broad-spectrum antibacterial qualities, this well-known plant in Ayurvedic medicine is used extensively to treat a range of systemic ailments, including dental disorders.

Additional chemicals in herbal mouthwash formulations include Tween 80 (also known as the polysorbate 80), a surfactant that is not ionic and is used as an emulsifier in pharmaceutical and food products.. Propylene glycol helps to keep products moist by acting as a thickening, sweetener, and humectant. Depending on the local geology, the water used in formulations may contain trace amounts of minerals, gases, and organic substances. Pure chemical water is therefore uncommon in nature. Nonetheless, to guarantee purity, deionised, distilled, and reverse osmosis-treated water are frequently utilised in commercial and scientific applications, such as the manufacturing of mouthwash. [(10, 11)]

The current study's objective is to develop a novel herbal toothbrush using neem, clove, tulsi, and peppermint leaves in order to assess its antibacterial qualities and lifespan.

Fig 1 Herbal Mouthwash

➢ *Types of Mouthwash*

Mouthwashes come in a variety of forms, each with a distinct function. For example, antibacterial mouthwashes fight bacteria that cause decay and foul breath, fluoride mouthwashes help to strengthen dental enamel, and herbal mouthwashes provide a natural substitute devoid of alcohol and artificial ingredients. [(12, 13)]

➢ *Types of Mouthwash:*

- Fluoride Mouthwash
- Cosmetic Mouthwash
- Antiseptic Mouthwash
- Natural (Herbal) Mouthwash
- Whitening Mouthwash

➢ *Cosmetic Mouthwash*

The main purposes of cosmetic mouthwashes are to temporarily cover up foul breath and give the mouth a new taste. They lack chemicals that effectively kill bacteria or treat underlying oral health issues, in contrast to therapeutic mouthwashes. Their primary goal is to improve mouth odour, and their effects are temporary. [(14)]

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➢ *Fluoride Mouthwash*

Mouthwash containing fluoride is crucial for strengthening tooth enamel and boosting its resistance to erosion and decay. It supports the maintenance of general oral wellness and reverses early cavities. Foods and the majority of water sources, including lakes and rivers, naturally contain fluoride, but the natural concentration is frequently insufficient to offer adequate protection. (15) You can successfully prevent cavities and enamel erosion by using fluoride-enriched rinses like Listerine Fluoride Defence, which contains fluoride, aromatic oils, and green tea extract. [(16)]

➢ *Antiseptic Mouthwash*

Antimicrobial compounds found in antiseptic mouthwashes aid in the removal of microorganisms that cause plaque and foul breath. The Eucalyptus globulus tree yields eucalyptus oil, a potent antibacterial that has long been utilised in traditional medicine for its disinfecting qualities. An excellent illustration of an antiseptic rinse that lowers plaque and guards against dental infections is The product Cool Mint. [(14, 17)]

➢ *Whitening Mouthwash*

Aesthetics is another important aspect of modern dental treatment, as seen by the rising demand for items that improve the appearance of smiles. The purpose of whitening mouthwashes is to progressively whiten discoloured teeth by removing surface stains. They help keep a bright smile and go well with at-home whitening procedures. By lowering the microbial load left behind after brushing, they frequently aid in maintaining general oral hygiene in addition to their cosmetic advantages. [(18)]

➢ *Natural (Herbal) Mouthwash*

Anyone searching for oral hygiene solutions without alcohol might consider natural or herbal mouthwashes. Although these rinses have a milder smell and content, they provide benefits that are comparable to those provided by their chemical alternatives. Herbal mouthwashes are appropriate for supportive periodontal therapy since they effectively lower plaque and inflammation. Usually, they don't contain artificial flavours, colours, alcohol, or preservatives. (19)

Herbal formulations can be a good substitute for chemical mouthwashes in terms of maintaining oral hygiene because of their additional advantages. However, for best outcomes, a complete comprehension of the product and an accurate diagnosis of the patient's oral condition are necessary. When selecting a mouthwash, one should evaluate the user's ability to maintain good oral hygiene habits, the mouthwash's effectiveness and safety, as well as their oral health and vulnerability to dental disorders. [(20)]

II. ADVANTAGES OF HERBAL MOUTHWASH

➢ *Comprehensive Antimicrobial Activity*

- Targets and inhibits a variety of oral infections, such as bacteria, viruses, and fungi, with effectiveness.
- Helps avoid dental cavities, gingivitis, plaque accumulation, and other oral infections.

➢ *Anti-Inflammatory and Healing Benefits*

- Helps reduce gum inflammation, bleeding, and irritation—commonly supported by ingredients like neem, tulsi, clove, and liquorice.
- Promotes faster recovery of oral wounds such as ulcers, sores, and soft tissue injuries.

➢ *Natural Analgesic Effect*

- Clove oil, known for its numbing properties, provides relief from toothaches and gum pain.

➢ *Breath Freshening and Flavor Improvement*

- Mint and tulsi offer a refreshing taste and help maintain long-lasting fresh breath.
- Possess natural deodorizing effects that help combat halitosis (bad breath).

➢ *Support for Oral Immune Function*

- Herbal ingredients such as tulsi and liquorice enhance the mouth’s natural defense mechanisms, helping to prevent frequent infections.

➢ *Safe for Prolonged use*

- Does not contain synthetic substances such as alcohol or chlorhexidine, lowering the risk of side effects like staining, mucosal irritation, or taste disturbances.

➢ *Antioxidant Defense*

- Offers protection against oxidative stress in oral tissues, contributing to long-term gum and mucosal health.

➢ *Prevention of Tooth Decay*

- Inhibits bacterial growth and plaque accumulation, both key contributors to the development of dental caries.

III. HERBS USED

➢ *Neem* [(27)]

- Synonyms: Indica Azadirachta
- Genesis in Biology: Neem consists of the fresh or dried leaves of Indica *Azadirachta* .
- Family: Meliaceae

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Fig 2 Neem


Fig 3 Tulsi

- Active constituents - Azadirachtin, Numbing, Numbing, Nimbinin.

➢ *Properties:*

- *Neem (Azadirachta Indica)* [28]

✓ Neem possesses potent antimicrobial and anti-plaque properties. It is crucial because it prevents the development of plaque and the growth of oral germs.
✓ For many years, neem leaves, twigs, and seeds have been used to clean teeth and treat bacterial illnesses in order to practise good oral hygiene.
✓ Due to its demonstrated efficacy in treating a range of infectious oral diseases, neem extract is a beneficial component of natural mouthwash formulations.

- *Tulsi (Ocimum Sanctum Linn.)* [29, 30]

✓ Biological Source: The herb Ocimum sanctum, which is a member of the Labiatae (Lamiaceae) family, yields tulsi whether its leaves are fresh or dried.

- *Key Active Constituents:*

✓ Eugenol (~70%) – known for its antiseptic and anti-inflammatory properties.
✓ Carvacrol (~3%) – exhibits antibacterial effects.
✓ Eugenol-methyl-ether (~20%) – adds to the aromatic and therapeutic qualities.
✓ Linalool – contributes to fragrance and antimicrobial action.
✓ Standard Requirement: The dry-weight content of eugenol in Tulsi leaves must be at least 0.40%.

Tulsi's rich composition of essential oils makes it highly effective in managing oral health issues such as gum inflammation, bad breath, and microbial infections.

➢ *Characteristics of Tulsi (Ocimum Sanctum Linn.)* [31]

- *Rich in Nutrients*

✓ Tulsi contains substantial amounts of zinc and vitamin C, which contribute to boosting the immune system naturally and help ward off infections.

- *Potent Antimicrobial Agent*

✓ The plant's phytochemicals, distributed throughout its parts, exhibit strong antibacterial, antiviral, and antifungal activity. This makes Tulsi effective in protecting against a wide range of microbial infections.

- *Traditional use in Oral and Respiratory Health*

✓ Tulsi leaf extracts are traditionally used to maintain oral hygiene and are also beneficial in relieving symptoms of cough and cold, due to their soothing and antimicrobial effects.

- *Liquorice (Glycyrrhiza Glabra)* [32, 33]

✓ Biological Source: The root extract of the plant Glycyrrhiza glabra, a member of the Leguminosae family, is used to make liquorice.

- *Active Constituents:*

✓ Glycyrrhizin – known for its sweet taste and anti-inflammatory properties.
✓ Glucuronic Acid – involved in detoxification processes.
✓ Glycyrrhetinic Acid – possesses anti-inflammatory and antimicrobial activity.
✓ Resins and Volatile Oils – contribute to the herb's therapeutic effects.

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Liquorice is widely used in herbal medicine, particularly for its anti-inflammatory soothing, and demulcent properties, making it beneficial in managing gum inflammation oral ulcers, and other dental conditions.

Fig 4 Liquorice

➢ *Therapeutic Properties of Liquorice (Glycyrrhiza Glabra)*

- *Potent Antifungal Compounds*

✓ Research has identified glycyrrhizic acid, glabridin, and lichochalcone-A as the key active compounds in liquorice that exhibit significant antifungal effects against a variety of pathogens.

- *Lichochalcone-A as a Targeted Antifungal Agent*

✓ Scientific evaluations have specifically highlighted lichochalcone-A for its strong antifungal activity, supporting its inclusion in herbal formulations for treating fungal infections.

- *Relief for Aphthous Ulcers*

✓ Liquorice has been found to effectively reduce pain, decrease inflammation, and shrink the necrotic center and inflammatory halo associated with aphthous ulcers, promoting faster healing and comfort.

➢ *Clove* [34, 35]

- Biological Source- It is obtained from the Dried flower buds of Eugenia *caryophyllus*.
- Family – Myrtaceae.

Fig 5 Clove

- Active constituents- Eugenol, caryophyllene, methyl amyl ketone, volatile oil, tannins.

➢ *Properties-*

- It was discovered that clove oil had potent antifungal properties against opportunistic fungal infections.
- The clove's eugenol is the key component that gives it its antifungal properties.
- Also possess antioxidative, antiviral, and anti-inflammatory qualities.
- It is frequently utilised in toothpaste and mouthwash formulations because of its antibacterial and antifungal qualities.

Table 1 Composition of Herbal Mouthwash

Ingredients	Scientific Name	Chemical Constituents	Activity
CLOVE	Eugenia caryophyllus	Eugenol	Dental analgesic, Anti-microbial agent.
NEEM	Azadirachta indica	Nimbin, Nimdin, Azadirachtin	Antiseptic, inhibit plague formation.
TULSI	Ocimum sanctum	Eugenol, carvacrol, and eugenol-methyl-ether	Anti-microbial activity against various bacterial strains
LIQUORICE	Glycyrrhiza glabra	Glycyrrhizin	Sweetening agent
PEPPERMINT OIL	Mentha pippereta	Menthol	Local anesthetic, cooling agent
TWEEN 80	-		Non-ionic emulsifier
SODIUM BENZOATE	-		Preservative
PROPYLENE GLYCOL	-		Humectant
DISTILLED WATER	-		Vehicle

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IV. MATERIALS AND METHODS [36, 37]

➢ *Neem Collection, Acquisition, and Extraction*

Azadirachta indica, or neem, leaves are collected and left to dry. The sequential extraction was carried out using the Soxhlet apparatus. Following its passage through Whatman filter paper, the extract was kept in a cool, sealed container.

Fig 6 Extraction of Neem by Soxhlet Apparatus

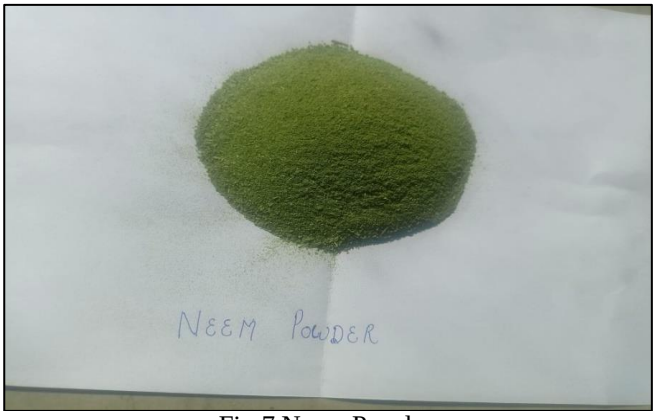

Fig 7 Neem Powder

➢ *Collection, Procurement & Extraction of Tulsi*

The leaves of tulsi (Ocimum santum) are collected and allowed to dry. The dried material was taken out to make a tulsi extract. The extraction was done using the decoction method. Prior to being sealed in a container, the extract was filtered via filter paper.

Fig 8 Filteration Process of Tulsi

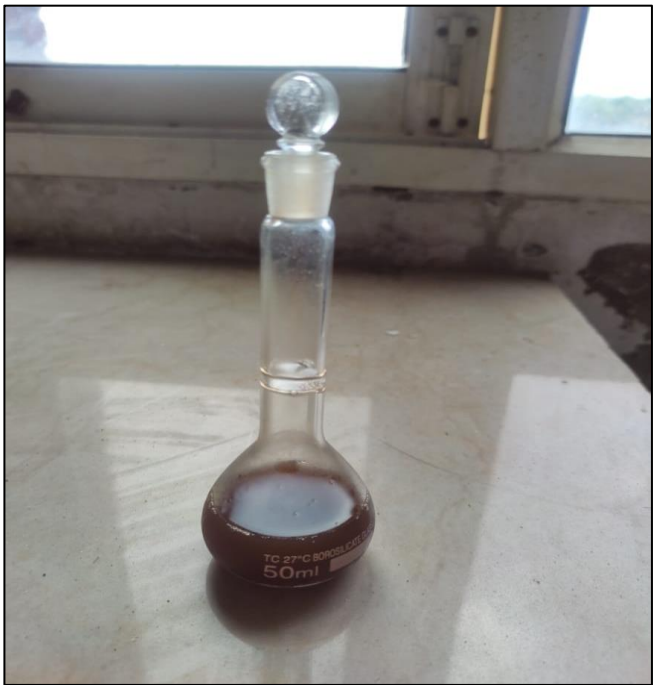

Fig 9 Tulsi Extract

➢ *Collection, Procurement & Extraction of Liquorice*

Liquorice powder helps relieve coughing, sore throats, and the respiratory tract's overproduction of mucus. Additionally, it facilitates coughing up mucus. Liquorice has beneficial qualities.

Glycyrrhiza glabra dried roots are gathered at the neighbourhood market. After that, a mixer was used to grind it into a fine powder. The decoction method was then used for extraction. After filtering, the extract was stored in a cool location.

Fig 10 Decoction Process of Liquorice Extract

➢ *Peppermint Oil*

For the polyherbal preparation, peppermint oil was gathered from the neighbourhood market. When administered orally (by mouth) or topically at the usual dosages, it seems to be safe. Numerous clinical research have shown peppermint oil to be safe.

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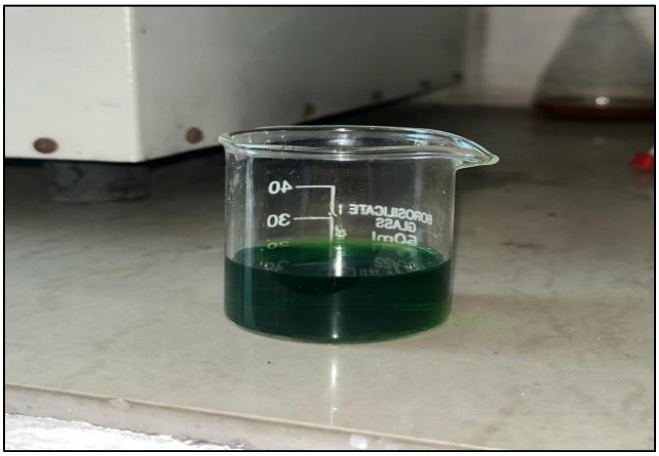

Fig 11 Peppermint Oil

➢ *Clove Oil*

The local medical store is where clove oil is gathered. It functions as an analgesic for teeth. provide momentary toothache relief. The clove's eugenol component contains anti-inflammatory qualities that may benefit the tooth that isn't feeling well.

Fig 12 Clove Oil

➢ *Tween 80*

The non-ionic surfactant Tween 80, also known as polysorbate 80 or polyoxyethylene sorbitan monooleate, is frequently used as an emulsifying agent in food goods, medications, and cosmetics.

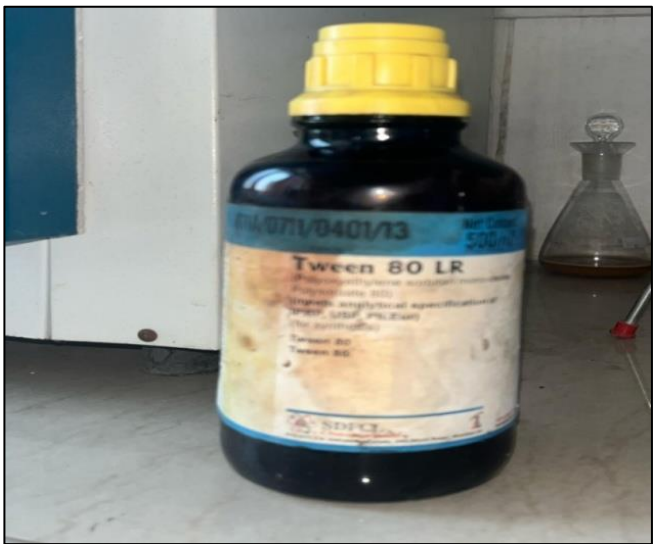

Fig 13 Tween 80

Table 2 Formulation of Polyherbal Mouthwash

Sr.no.	Ingredients	Quantity
1	CLOVE	2 ml
2	NEEM	4 ml
3	TULSI	4 ml
4	LIQUORICE	5 ml
5	PEPPERMINT OIL	2 ml
6	PROPYLENE GLYCOL	10 ml
7	TWEEN-80	5 ml
8	SODIUM BENZOATE	1 gm
9	DISTILLED WATER	q.s.

V. PROCEDURE

➢ *Materials Used:*

Tulsi extract, clove oil, neem extract, licorice extract, Tween-80, sodium benzoate, peppermint oil, and distilled water. [38, 39, 40]

➢ *Formulation Procedure*

- A 100 ml mouthwash formulation comprising the active herbal components liquorice, tulsi, neem, and clove was made. Table 2 presents the comprehensive formulation.In a glass beaker, propylene glycol was mixed with the designated herbal extracts.
- After heating the liquid to 60°C, Tween-80 and peppermint oil were added gradually while being constantly stirred with a magnetic stirrer set to 300 rpm.

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- Sodium benzoate was added to the main mixture after being separately dissolved in distilled water. The magnetic stirrer was used to thoroughly homogenise the entire solution. Lastly, 100 millilitres of distilled water were added, and the mixture was stirred until it became transparent and clear.

Fig 14 Herbal Extract on Magnetic Stirrer

➢ *Evaluation Test of Herbal Mouthwash*

- *Physical Assessment*

Visual inspection and sensory evaluation were used to evaluate the prepared herbal mouthwash's physical attributes, including colour, odour, taste, and consistency.

- *pH Determination*

A digital pH meter was used to measure the herbal mouthwash's pH. First, standard buffer solutions were used to calibrate the equipment. The pH was measured after around 1 millilitre of the mouthwash was diluted in 50 millilitres of distilled water.

- *Stability Studies*

Any pharmaceutical formulation must undergo stability testing in order to guarantee the product's long-term chemical and physical integrity, consequently verifying its efficacy and safety.

A three-month accelerated stability study was carried out in accordance with ICH criteria. The mouthwash samples were kept in the following controlled humidity and temperature conditions:

✓ 3°C
✓ 60% relative humidity and 25°C ± 2°C
✓ At 75% relative humidity, 40°C ± 2°C

Throughout the trial period, samples were taken out for analysis once a month to track any changes in the product's characteristics.

➢ *Outcomes and Conversation*

- Physical Parameter: Visual inspection was used to assess physical parameters like colour, odour, taste, and consistency.

Table 3 Result of Physical Evaluation

Sr.no.	Obeservation	Formulation
1	COLOR	LIGHT BROWN
2	ODOUR	MINT SMELL
3	TASTE	REFRESHING MINT
4	FORM	LIQUID

- *pH Testing*

✓ A digital pH meter was used to measure the produced herbal mouthwash's pH.
✓ The formulation's pH was determined to be 6.1; as the skin has an acidic pH of about 5.5, this pH range is appropriate for oral disorders.

Fig 15 Result of pH Testing of Herbal Mouthwash

- *Stability Study*

✓ The stability of the herbal mouthwash formulation was evaluated using both open and closed containers over a period of one month at room temperature.
✓ As the formulation is purely herbal and alcohol-free, the stability assessment focused on identifying any physical and chemical changes that might occur during storage.
✓ The study confirmed that the product maintained its physical integrity (appearance, odor, consistency) and showed no significant chemical degradation, indicating that the herbal mouthwash remains stable under standard storage conditions.

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Table 4 Result of Stability Study of Herbal Mouthwash

Sr. No.	Temperature	Evaluation Parameters	Observation (Month)	
	3 – 5 ^{0}C	VISUAL APPEARANCE	LIGHT BROWN	LIGHT BROWN
		PHASE SEPARATION	NIL	NIL
		HOMOGENEITY	GOOD	GOOD
	ROOM TEMPERATURE (25^{0}C RH=60%)	VISUAL APPEARANCE	LIGHT BROWN	LIGHT BROWN
		PHASE SEPARATION	NIL	NIL
		HOMOGENEITY	GOOD	GOOD
	40^{0}C±2^{0}C RH=75%	VISUAL APPEARANCE	LIGHT BROWN	LIGHT BROWN
		PHASE SEPARATION	NIL	NIL
		HOMOGENEITY	GOOD	GOOD

VI. CONCLUSION

The developed herbal mouthwash showed significant therapeutic efficacy and functions as an affordable yet promising medication delivery mechanism, according to the study's findings. However, more thorough research is needed to confirm its efficacy and safety. This involves extensive laboratory testing and long-term clinical assessments to evaluate the product's advantages and potential drawbacks, especially given that it is meant for medical use.

In contrast to mouthwashes that are based on chemicals and sold commercially, the herbal composition has strong action with few side effects. Thus, encouraging the use of herbal mouthwashes may provide a safer option for oral hygiene. Thus, encouraging the use of herbal mouthwashes may provide a safer option for oral hygiene. Raising public and healthcare professional knowledge of the benefits of herbal formulations is obviously necessary. The use of such natural items in routine dental care should be supported and expanded through further research and larger trials.

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