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FORMULATION AND EVALUATION OF POLYHERBAL MOUTH DISSOLVING STRIP FOR HALITOSIS MANAGEMENT

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ABSTRACT

The oral cavity's odor-producing bacteria are the primary cause of halitosis, a common oral ailment. For the treatment of oral odor, herbal formulations are becoming more popular as safer substitutes for synthetic ones. In order to treat halitosis, this review focuses on the creation and assessment of a polyherbal mouth dissolving strip that contains extracts of neem (Azadirachta indica), tulsi (Ocimum sanctum), and green tea (Camellia sinensis). These herbs have strong antibacterial, antioxidant, and anti-inflammatory qualities that help suppress microorganisms that cause odors and lower the volatile sulfur compounds that cause foul breath. These extracts offer benefits such immediate therapeutic effect, greater patient compliance, portability, and rapid disintegration when included into a mouth dissolving strip. Appropriate polymers, formulation techniques, and evaluation metrics like thickness, folding endurance, surface pH, disintegration time, and antibacterial activity are also highlighted in the paper. Therefore, polyherbal mouth dissolving strips offer a viable and practical method of managing halitosis.

KEYWORDS: Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Green tea (Camellia sinensis), oral thin film, antimicrobial action, polyherbal formulation, mouth dissolving strip, halitosis, and herbal medication administration.

INTRODUCTION

Bad breath, often known as halitosis, is a prevalent oral health issue that is frequently disregarded in society. The primary sign of halitosis is the development of an unpleasant mouth odor brought on by bacterial activity, food residue decomposition, or inadequate oral care. Since halitosis is rarely fatal, the public and government pay little attention to this oral health issue. However, comfort and interpersonal communication are severely hampered by poor breath. Compared to clove flowers, which are used more frequently, tulsi, neem, and green tea leaves are parts of the clove plant that are rarely used. According to the study's findings, antibacterial substances such flavonoids, phenolics, triterpenoids, tannins, eucalyptol compounds, caryophyllene, and limonene are also present in the leaves of tulsi, neem, and green tea. Active substances called flavonoids have antimicrobial properties. By preventing the formation of bacteria like S. mutans, which causes bad breath, tulsi, neem, and green tea leaves work as antibacterials. Furthermore, another study found that gargling with clove mouthwash significantly reduced the amount of hydrogen sulfide in the mouth. This suggests that clove mouthwash is useful in lowering the amount of hydrogen sulfide in the mouth, which in turn helps lessen foul breath. The creation of pharmacological preparations in the form of thin solid preparations intended for oral drug usage is known as oral thin film strip (OTFS). Due to its many benefits over other preparations, including ease of use and convenience, this preparation has been widely developed. Cloves have been widely used in the production of pharmaceutical preparations for a variety of therapeutic uses, including nanoemulsion and oral gel. OTFS has not, however, been studied using ethanol

extract from clove leaves. According to the aforementioned explanation, researchers are interested in creating OTFS preparations that incorporate ethanol extract of clove leaves as a mouth refreshing preparation using the solvent casting method with a mixture of gelatin and hydroxy propyl methyl celluloses (HPMC).

Advantages of mouth dissolving strips

- Water is not required for its administration.
- Quick action.
- Transportable and manageable.
- Increases certain active compounds' bioavailability.
- Provides increased stability.
- Successfully covers up offensive flavors.

Disadvantages of mouth dissolving strips

- In saliva, the formulation should be well soluble in water.
- It is difficult to distribute drugs uniformly throughout the strips.
- It is not possible to successfully combine high medication doses.

To guarantee stability and safety, specialized packaging is needed.

Ideal characteristics of mouth dissolving strips

The medication should taste well.
It should be water soluble and stable in saliva, have a modest molecular size and weight, be resistant to external variables like temperature and humidity, and effectively permeate the oral mucosa.

Plant profile

1. Neem (*Azadirachta indica*)

Fig. No. 1: Neem plant.

Scientific Name: *Azadirachta indica*

Family Meliaceae
Common Name: Neem

Biological Source
Neem consists of dried **leaves, bark, seeds, and oil** obtained from *Azadirachta indica*.

Geographical Source
Widely found in **India and other tropical regions**.

Parts Used
Leaves, bark, seeds, flowers, and oil.

Major Chemical Constituents
Azadirachtin, Nimbin, Nimbidin, Nimbolide, Flavonoids, Tannins.

Pharmacological Activities
Antibacterial, antifungal, anti-inflammatory, antioxidant.

Uses
Used in **oral care, treatment of halitosis, dental infections, and skin disorders**.

2. Tulsi (*Ocimum sanctum*)

Fig. No. 2: Tulsi plant.

Scientific Name: *Ocimum sanctum* (Holy Basil)

Family Lamiacea
Common Name: Tulsi / Holy Basil
Marathi Name: □ □ □ □

Biological Source
Tulsi consists of **fresh or dried leaves and flowering tops** of *Ocimum sanctum*.

Geographical Source
Native to **India** and widely grown in tropical regions.

Parts Used
Leaves, seeds, and whole plant.

Major Chemical Constituents
Eugenol, Ursolic acid, Rosmarinic acid, Flavonoids.

Pharmacological Activities
Antibacterial, antifungal, anti-inflammatory, antioxidant.

Uses
Used for **oral care, cough, cold, infections, and bad breath (halitosis)**.

3. Green tea (*Camellia sinensis*)

Fig. No. 3: green tea plant.

Scientific Name: *Camellia sinensis*

Family Theaceae
Common Name: Green Tea

Biological Source
Green tea consists of dried leaves and leaf buds of *Camellia sinensis*.

Geographical Source
Native to China and India and widely cultivated in Asia.

Parts Used
Young leaves and buds.

Major Chemical Constituents
Catechins, Polyphenols, Caffeine, Tannins, Flavonoids.

Pharmacological Activities
Antioxidant, antibacterial, anti-inflammatory.

Uses
Used for oral hygiene, prevention of bad breath (halitosis), and as a health beverage.

Extraction Procedure (Maceration Method)
Preparation of Polyherbal Extract by Maceration
The hydroalcoholic extracts of Neem (*Azadirachta indica*), Tulsi (*Ocimum sanctum*), and green tea (*Camellia sinensis*) were used for the formulation of mouth dissolving strips. Since the extract powders were coarse in nature, the maceration method was employed to obtain smooth liquid extracts.

Procedure

1. Preparation of hydroalcoholic solvent
A hydroalcoholic solvent was prepared using **distilled water and ethanol in the ratio of 70:30 (v/v)**.

2. Dispersion of extract powders
The weighed quantities of each herbal extract powder were taken separately in clean beakers:
- Neem extract (**400 mg**)
- Tulsi extract (**400 mg**)
- Green tea extract (**200 mg**)

Fig. No. 4: Extract powder of neem tulsi and green tea.

3. Addition of solvent
The hydroalcoholic solvent was added to each extract in sufficient quantity:
- Neem + **5 mL solvent**
- Tulsi + **5 mL solvent**
- Green tea + **3 mL solvent**

4. Magnetic stirring
Each mixture was placed on a **magnetic stirrer** and stirred for **30–45 minutes** at room temperature or with mild heating (**not exceeding 40°C**) to ensure proper dispersion and extraction.

Fig. No. 5: Magnetic stirring of neem tulsi and green tea.

5. Maceration

The beakers were covered with aluminum foil and kept undisturbed for **12–24 hours** at room temperature to allow complete maceration and extraction of active constituents.

Fig. No. 6: neem tulsi and green tea ectract kept for maceration.

6. Filtration

After maceration, the mixtures were filtered separately using **Whatman No. 1 filter paper** to remove any undissolved coarse particles.

Fig. No. 7: Filtration of neem tulsi and green tea extract.

7. Concentration of filtrate

The obtained filtrates were concentrated using a **water bath at 40–45°C** until the desired volume and consistency were achieved.

Fig. No. 8; Concentration of filtrate.

8. Collection of liquid extracts

The final concentrated liquid extracts obtained were:

- Neem liquid extract – **5 mL**
- Tulsi liquid extract – **5 mL**
- Green tea liquid extract – **3 mL**

These liquid extracts were then incorporated into the mouth dissolving strip formulation.

Phytochemical Screening of Polyherbal Extracts

Table No. 1: Phytochemical screening of neem, tulsi, and green tea.

Sr. No.	Phytochemical Constituent	Neem Extract	Tulsi Extract	Green Tea Extract
1	Alkaloids	Present (+)	Present (+)	Present (+)
2	Flavonoids	Present (+)	Present (+)	Present (+)
3	Tannins	Present (+)	Present (+)	Present (+)
4	Saponins	Present (+)	Present (+)	Present (+)
5	Glycosides	Present (+)	Present (+)	Present (+)
6	Terpenoids	Present (+)	Present (+)	Present (+)
7	Phenols	Present (+)	Present (+)	Present (+)

METHODOLOGY

Table No. 2: Formulation table.

Sr. No.	Ingredient	Quantity	Role
1	Neem liquid extract	5 mL	Antibacterial
2	Tulsi liquid extract	5 mL	Antimicrobial
3	Green tea liquid extract	3 mL	Antioxidant
4	Sodium alginate	1.5 g	Primary film former
5	Guar gum	0.5 g	Natural co-film former
6	Glycerin	1–1.5 mL	Plasticizer
7	Honey	1 mL	Natural sweetener
8	Clove oil	0.2 mL	Flavoring
9	Citric acid	100 mg	Saliva stimulant
10	Purified water	q.s. to 30–40 mL	Solvent

Preparation of Polymer Solution

Step 1: Dissolution of Sodium Alginate

1. Take **30 mL purified water** in a clean beaker.
2. Add **1.5 g sodium alginate slowly** with continuous stirring.
3. Place on **magnetic stirrer with mild heating (40–50°C)**.
4. Stir until smooth and lump-free (**30–45 minutes**).

Fig. No. 9: Dissoltion of sodium alginate.

Step 2: Addition of Guar Gum

1. Add **0.5 g guar gum slowly**.
2. Continue stirring for **15–20 minutes**.
3. Ensure homogeneous viscous solution.

Fig. No. 10: addition of excipients.

Step 3: Addition of Excipients

1. Add **1–1.5 mL glycerin**.
2. Add **1 mL honey**.
3. Add **100 mg citric acid**.
4. Add **0.2 mL clove oil**.
5. Stir for **10–15 minutes**.

Step 4: Addition of Herbal Extracts

After cooling polymer solution to **lukewarm temperature**:

1. Add:
   - **5 mL Neem liquid extract**
   - **5 mL Tulsi liquid extract**

- **3 mL green tea liquid extract**

2. Stir continuously for **15–20 minutes**.
3. Make final volume with purified water if necessary.

Step 5: Deaeration
1. Keep solution undisturbed for **20–30 minutes**.
2. Remove air bubbles.

Step 6: Casting of Mouth Dissolving Strip
1. Take clean **petri plate or glass mould**.
2. Apply a thin layer of glycerin.
3. Pour the prepared film solution.
4. Spread uniformly.

Fig. No. 11: casting of mouth dissolving strip.

Step 7: Drying
1. Dry at **room temperature for 24–36 hours**

OR

2. Dry in **hot air oven at 40°C for 4–6 hours**.

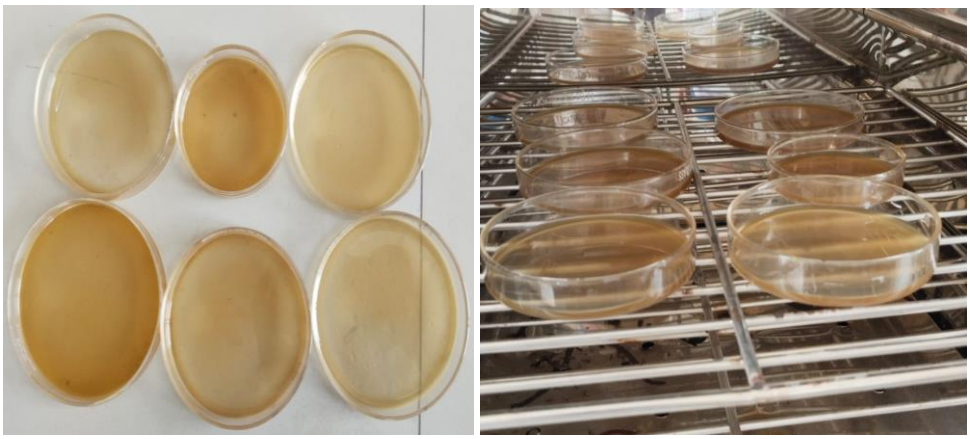

Fig. No. 12: Drying strips on room temp or hot air oven.

Step 8: Cutting and Storage
1. Peel dried strip carefully.
2. Cut into **2 × 2 cm strips**.
3. Store in **aluminum foil or airtight container**.

Fig. No. 13: Mouth dissolving strips.

Evaluation Results of Prepared Mouth Dissolving Strip

Sr.No.	Evaluation Parameter	Observation / Result
1	Appearance / Organoleptic Properties	Light brown to Amber colored strips, smooth surface, semi-transparent, flexible, slightly glossy, non-sticky, characteristic herbal odor
2	Shape and Uniformity	Square-shaped strips with mostly uniform size; slight variation at edges due to manual cutting
3	Texture	Smooth and soft with slight wrinkles/folds visible on some strips
4	Thickness	Approximately 0.20 ± 0.03 mm *(measure with vernier caliper to confirm)*
5	Weight Variation	Approximately 140–160 mg per strip *(measure on digital balance to confirm)*
6	Folding Endurance	Good flexibility; estimated >180 folds before breaking *(perform actual test)*
7	Surface pH	Expected near neutral (6.5–7.0) *(measure experimentally)*
8	Disintegration Time	Estimated 40–60 seconds *(test in 10 mL water/simulated saliva)*

RESULT

According to the reviewed research, polyherbal mouth dissolving strips that comprise herbal extracts such green tea, tulsi, and neem have encouraging outcomes for halitosis treatment. The produced strips showed appropriate surface pH, good folding endurance, and consistent thickness, among other satisfactory physical attributes. The active ingredients were released quickly since the strips broke down quickly in simulated saliva, typically in a short amount of time. Effective antibacterial action against oral bacteria that cause bad breath has been reported in in vitro experiments.

DISCUSSION

Mouth dissolving strips are a cutting-edge oral medication delivery method that increases patient compliance because they dissolve quickly, are convenient, and don't require water. Additional therapeutic benefits, such as antibacterial, antioxidant, and deodorizing actions, can be obtained by using polyherbal extracts. The oral cavity's odor-producing bacteria are known to be inhibited by herbs including neem, tulsi, and green tea. These herbal components combined in a quick-dissolving strip could offer a safe and natural substitute for traditional mouthwashes and fresheners.

CONCLUSION

A new and efficient method for treating halitosis is provided by polyherbal mouth dissolving strips. The formulation offers better patient acceptance, quick disintegration, and convenience of administration. This dosage form is a natural and safe way to maintain dental hygiene because it contains herbal extracts with antibacterial and revitalizing qualities. The development of commercially viable herbal oral strips for the treatment of halitosis may be aided by additional research and clinical testing.

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