INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Research Article

Formulation and Evaluation of Antimicrobial and Teeth Whitening Polyherbal Dentifrice

Karale Sanika Manoj*, Shubham Chandrakant Gadge

Department of Pharmacology, Samarth Institute of Pharmacy, Belhe, Pune – 412410.

ARTICLE INFO

Published: 13 June 2025
Keywords:
Dental, polyherbal, teeth, zone of inhibition, antimicrobial
DOI:
10.5281/zenodo.15655880

ABSTRACT

This research explores the development and assessment of a polyherbal dentifrice composed of natural ingredients including tamarind seed, walnut shell, activated charcoal, black seed oil, and clove oil. The objective is to create an effective toothpaste with both antimicrobial and teeth-whitening properties. The formulation was evaluated using standard physicochemical and microbiological tests and compared to commercially available products. The results suggest that the polyherbal dentifrice demonstrates significant antimicrobial efficacy and favorable physical properties, indicating its potential as a natural alternative for oral care.

INTRODUCTION

Maintaining oral hygiene is essential for overall health. Conventional toothpaste formulations often contain synthetic agents that may cause side effects. In recent years, the focus has shifted towards herbal and natural products due to their safety and therapeutic efficacy. Polyherbal formulations combine multiple plant-derived ingredients to enhance efficacy through synergistic effects. This study aims to formulate and evaluate a polyherbal toothpaste with antimicrobial and whitening properties using tamarind seed, walnut shell, activated charcoal, black seed oil, and clove oil. Oral hygiene plays a critical role in maintaining overall health, as poor oral care can lead to various systemic diseases. Toothpaste is a widely used oral hygiene product, designed to clean teeth, prevent cavities, and combat bad breath. While conventional toothpastes often contain chemical agents such as triclosan and fluoride, concerns about their long-term side effects have driven a growing demand for natural alternatives. In this context, polyherbal formulations have emerged as promising candidates due to their safety, efficacy, and holistic therapeutic properties.

2. MATERIALS AND METHODS

***Corresponding Author:** Karale Sanika Manoj
Address: *Department of Pharmacology, Samarth Institute of Pharmacy, Belhe, Pune – 412410.*
Email ✉: sanikakarale3@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Natural ingredients were selected based on their traditional and scientifically proven roles in oral care. Tamarind seed and walnut shell act as abrasives and antimicrobial agents. Activated charcoal is used for its whitening effect. Black seed oil and clove oil contribute anti-inflammatory and analgesic properties. Additional components such as calcium carbonate, glycerin, sodium lauryl sulphate, and peppermint oil were used for consistency and flavor. The formulation involved combining dry and liquid phases, homogenization, and stability assessment.

Figure: Tamarind Seeds

Formulation Table

The first step is to choose suitable herbal ingredients known for their dental benefits.

Ingredients	Quantity	Role
Tamarind seed	2g	Antimicrobial, teeth whitening
Walnut shell	2g	cleanser
Activated charcoal	0.5g	whitening effect
Black seed oil (kalonji)	0.5ml	Anti-inflammatory, anti-dental carries
Clove oil	0.5ml	Anaesthetic, antibacterial

The Second Step Is Base Selection:

Ingredients	Quantity	Role
Calcium carbonate	10g	Abrasive
Sodium saccharine	2g	Sweetening agent
Sodium lauryl sulphate	1g	Foaming agent
Methyl paraben	0.5	Preservative
Glycerine	2	Humectant
Sodium chloride	2g	Stain remover
Peppermint oil	q.s	Flavouring agent
Distilled water	q.s	vehicle

Formulation trial batches

Ingredients	F1	F2	F3
Tamarind seed	2g	2g	2g
Walnut shell	2g	2g	2g
Activated charcoal	0.5g	0.5g	0.5g
Black seed oil (kalonji)	0.5ml	0.5ml	0.5ml
Clove oil	0.5ml	0.5ml	0.5ml
Calcium carbonate	10g	10g	10g
Sodium saccharine	2g	2g	2g
Sodium lauryl sulphate	0.5g	0.7g	1g
Methyl paraben	0.5	0.5	0.5
Glycerin	2	2	2
Sodium chloride	2g	2g	2g
Peppermint oil	Q. S	Q. S	Q. S
Distilled water	Q. S	Q. S	Q. S

Evaluation test

1. Organoleptic evaluation

The organoleptic characteristics of the formulated toothpaste were evaluated using various parameters:

- **Color:** The visual color of the toothpaste was assessed to determine its appearance. This shows the brownish color.
- **Odour:** The scent of the toothpaste was examined by smelling the product. It has the refreshing and minty aroma.

- **Taste**: The taste of the formulation was manually checked by tasting it. which is sweet in taste

2. Physicochemical evaluation

a. pH Determination:

The pH determination of polyherbal toothpaste by using Auto pH Meter:

Procedure-

a. **Buffer Preparation:** Prepare 30 mL of buffer solution for each desired pH by mixing the appropriate volume of stock solutions.
b. **Equilibration:** Allow the prepared buffer solutions to stand for 15 minutes to reach equilibrium.
c. **Sample Preparation:** Dissolve the small amount of prepared polyherbal toothpaste in to distilled water for the pH measurement.
d. **pH Measurement:** Measure the pH of each solution using an auto pH meter according to standard operating procedures.

Figure: pH meter

b. Foamability

1. Weigh or measure 1 gram of the toothpaste using a clean spatula.
2. Transfer the toothpaste into a 10mL graduated cylinder**.**
3. Add 5mL of distilled water to the cylinder**.**
4. Mix gently by rotating or tapping the cylinder to ensure the toothpaste is dispersed but not vigorously shaken yet.
5. Allow the cylinder to stand undisturbed for 1 minute so that foam stabilizes

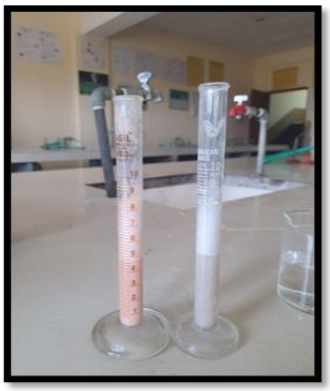


Figure: Foamability

c. Abrasiveness of particles-

The contents were placed on the finger and scratched on the butter paper for about 15-20cm to make sure there were no sharp or abrasive particles present. The same process was carried out for about 8-10 times which detected that there were few traces of small particles of walnut shells powder that were knowingly kept slightly larger than other particles for the good scrubbing of teeth when applied.

d. Grittiness-

Take a small amount of toothpaste (about 0.5–1 g) and spread it between two clean glass slides. Rub gently in a circular motion. Observe for any coarse or gritty particles.

e. Spread ability-

The spread ability test for paste involves assessing its slip and drag characteristics by sandwiching a formulated paste sample between two glass slides:

- 2g of the paste is placed on one glass slide and covered with another, allowing for the expulsion of air and the formation of a uniform film.
- Excess paste is removed, and an 80g weight is applied to the top slide, measuring the time in seconds for the slide to cover a 7.5cm distance.
- Shorter time intervals indicate better spread ability of the paste.

Calculation of spread ability is done using a specific formula, taking into account the time taken for the top slide to move the specified distance.

Calculation- S=M*L/T

Where, S - Spread ability, M - Weight tied to the upper slide

L - Length moved by the glass slide

T -Time (in sec) taken to separate the upper slide from the lower slide.

f. Moisture content

- To determine the amount of moisture and volatile matter in the toothpaste formulation, the researchers followed these steps:
- Placed 5 grams of the formulation in a porcelain dish of specific dimensions. The dish had a diameter of 6-8 cm and a depth of 2-4 cm.
- Dried the sample in an oven at a temperature of 105 degrees Celsius.

Figure: Moisture Content

g. Homogeneity

The section discusses the requirement for toothpaste to maintain homogeneity in its consistency and appearance under specific conditions. The toothpaste should extrude as a uniform mass from either a collapsible tube or another appropriate container when a normal force is applied at 27±2°C.Additionally, the bulk of the toothpaste should extrude smoothly from the container's crimp and then be dispensed steadily.

h. Extrudability

The extrudability of the formulated paste was assessed in the study using a specific method involving aluminum tubes and glass slides. Here is how the extrudability was evaluated: Formulated paste was filled into standard capped collapsible aluminum tubes and sealed by crimping the end. The weights of the tubes were recorded. The tubes were then placed between two glass slides and clamped. A weight of 50g was placed over the slides, following which the cap was removed. The amount of extruded paste was collected, weighed, and used to calculate the percentage of extruded paste.

i. Stability

- The stability study in the research adhered to the guidelines set by the International

Conference on Harmonization (ICH). Here are the key details of the stability study: Experimental Setup:

- The formulated paste was filled into collapsible tubes.
- It was then stored under different conditions of temperature and humidity

Table: Stability Evaluation

25ºC ± 2ºC / 60% ± 5% RH

Color	Appearance	Credibility	pH
Brownish	Homogeneous	2.5	7.2

30º C ± 2ºC/ 65% ± 5% RH

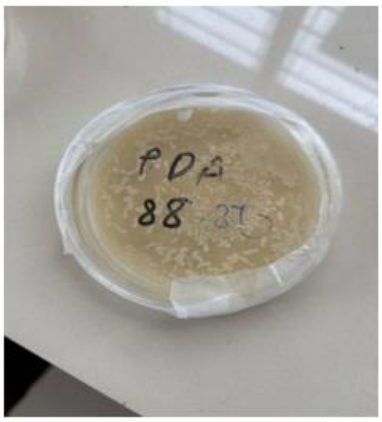
Color	Appearance	Credibility	pH
Brownish	Homogeneous	2.4	6.7

40ºC ± 2ºC / 75% ±5% RH

Color	Appearance	Credibility	pH
Brownish	Homogeneous	2.2	6.3

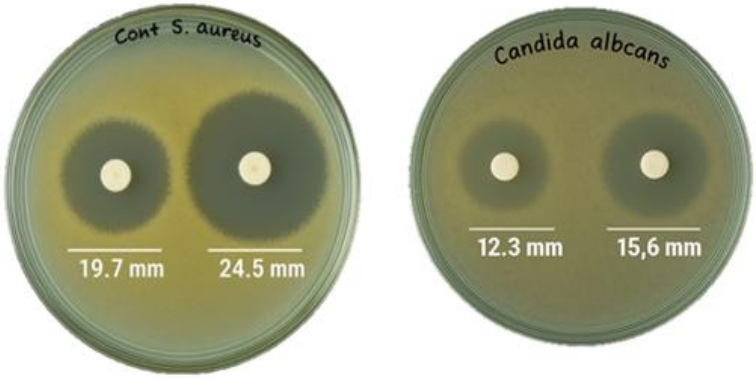
j. Microorganism and inoculation preparation

Gram-positive anaerobic bacteria were found to have antibacterial action. From the Samarth Institute of Pharmacy in Belhe, albicans strains were identified from individuals who had coughed and the S. aureus bacterium is collected from microbiology lab. To determine a concentration for fungal strains and a colony forming unit for bacterial strains, these samples were subcultured and subsequently diluted in a sterile normal saline solution (0.9%), with the turbidity of 0.5 McFarland being adjusted. Grow for 18 to 24 hours at 30 to 37°C in a saline solution while shaking to control turbidity. To inoculate your preferred medium using the cup plate method, use a calibrated pipette or loop.To prevent contamination, always use aseptic method. Label and incubate for up to 24 to 48 hours at the specified temperature, which is typically 30°C or 37°C.



candida albicans

S. aureus culture



Zone of Inhibition of S.aureus and C. albicans

RESULTS

The formulated dentifrice exhibited a brownish color with a smooth texture and characteristic odor. The pH was measured at 6.3, foamability was satisfactory, and moisture content was 15.6%. The toothpaste demonstrated a zone of inhibition of 19.7 mm against Staphylococcus aureus and 12.3 mm against Candida albicans, suggesting good antimicrobial activity. Stability testing confirmed that the formulation remained consistent across various storage conditions.

Physical Examination

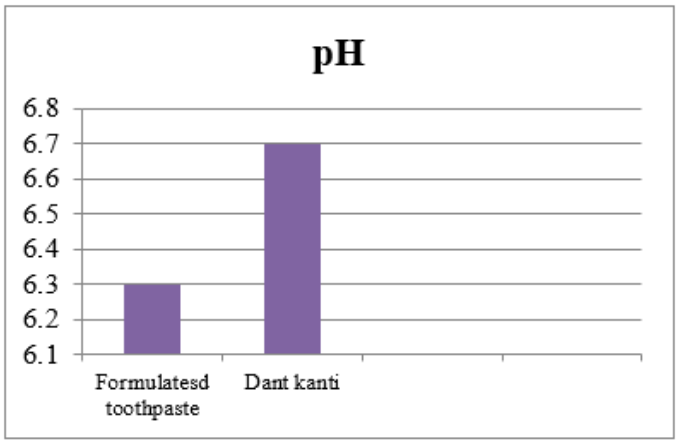
Sr. No	Parameter	Observation
1	Color	brownish
2	Odour	Characteristic
3	Taste	sweet
4	Smoothness	Smooth

Evaluation Results

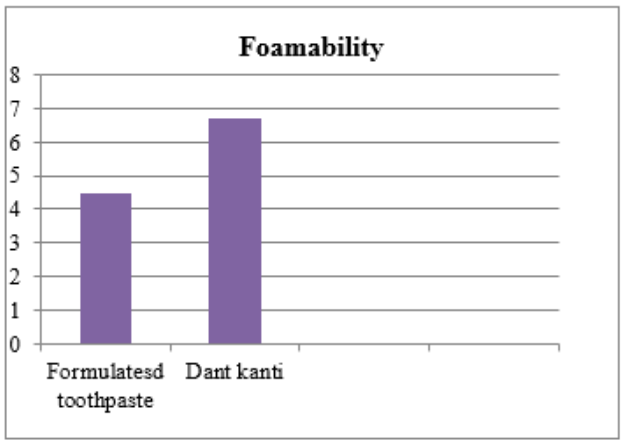
Sr. No	Parameter	Observations
1	Ph	6.3
2	Homogeneity	Good
3	Foamability	4
4	Moisture Content	15.6%
5	Spread ability	2.5
6	Stability	Stable

Comparative study

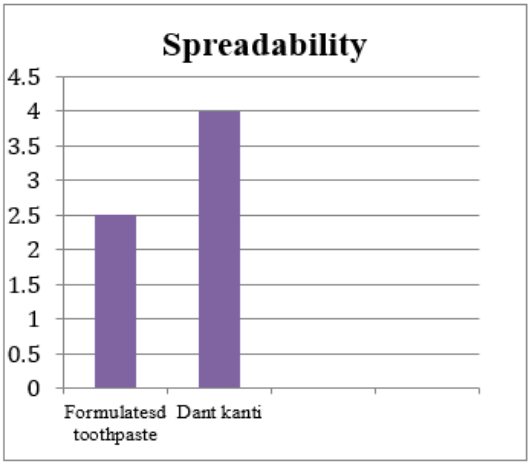
pH of the formulated toothpaste is compared to the marketed toothpaste (Dant Kanti)



Foamability of the formulated toothpaste is compared to the marketed toothpaste (Dant Kanti)



Spreadability of the formulated toothpaste is compared to the marketed toothpaste (Dant Kanti)



DISCUSSION

The polyherbal formulation showed favorable physicochemical and antimicrobial characteristics. Tamarind seed and walnut shell provided abrasive and cleansing actions, while activated charcoal enhanced the whitening effect. The antimicrobial efficacy was on par with commercial formulations. The use of natural components supports a growing trend toward sustainable and safer oral care products.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Samarth institute of pharmacy, Belhe. Department of pharmacology for providing the necessary resources and support throughout the course of this research. We also extend our appreciation to prof. Shubham Gadge sir for their valuable feedback, guidance, and insightful discussions that significantly contributed to the development of this work.

CONCLUSION

The polyherbal dentifrice developed in this study proved to be a promising alternative to synthetic toothpaste. It offers dual benefits of teeth whitening and antimicrobial action without the risks associated with synthetic ingredients. This

formulation holds potential for further development and commercialization.

REFERENCES

1. Jadhav JG, Khan ZK. Formulation and evaluation of herbal toothpaste. Int J Res Publ Rev. 2024 Apr;5(4):7695–701.
2. Shahidullah, Sultana N, Samreen S, Begum S, Saleh M. Herbal toothpaste: an overview. IJRAR. 2023 May;10(2). P-ISSN: 2349-5138.
3. Sharma R. A review on four medicinal plants in dentistry. Int J Contemp Pediatr. 2024 Jan;11(1):83–93. P-ISSN: 2349-3283; E-ISSN: 2349-3291.
4. Gangurde GP, Shinde AD. Formulation development and evaluation of herbal tooth powder. JETIR. 2023 May. ISSN: 2349-5162
5. Purkar SR, Sancheti NS, Joshi SS. Preparation and evaluation of herbal toothpaste. Int J Adv Res Sci Commun Technol. 2023 Mar;3(1). ISSN (Online): 2581-9429.
6. Rathi NM, Sirsat SV, Toshniwal SS, Zagare NT, Shaikh FS. Formulation and evaluation study on herbal toothpaste: a review. Int J Sci Healthc Res. 2022 Apr;7(4). ISSN: 2456-4184.
7. Gautam D, Palkar P, Maule K, Singh S, Sawant G, Kuvalekar C, et al. Preparation, evaluation and comparison of herbal toothpaste with marketed herbal toothpaste. Asian J Pharm Technol. 2020 Jul–Sep;10(3). ISSN: 2231–5705.
8. Shaikh AA. Comparative evaluation of herbal toothpaste formulations: a preliminary in-vitro study. Indian J Pharm Pharmacol. 2023:172–6.
9. Parveena A, Ahmad QZ. Study of antimicrobial activity of Unani polyherbal toothpaste “Sunoon Zard”. Int J Unani Med. 2021 Feb;10(21). ISSN: 2405-8440.
10. Akotakar AM, Thenge RR, Patil AV, Ghonge AB, Bhaltadak MB. Formulation and comparative standardization of toothpaste. Int J Pharm Sci Res. 2018 Oct;3(4):12–5.
11. Sadeghi-Nejad B, Moghimipour E, Yusef Naanaie S, Nezarat S. Antifungal and antibacterial activities of polyherbal toothpaste against oral pathogens, in vitro. Curr Med Mycol. 2018 Jun;4(2):21–6. doi: 10.18502/cmm.4.2.65. PMID: 30324153; PMCID: PMC6181064.
12. Mohan Maruga Raja MK. A scientific evidence-based review of tamarind usage in Indian folklore medicine. J Nat Remedies. 2022 Oct 8;22:347–62. doi: 10.18311/jnr/2022/30123.
13. Mahajan K, Kunte SS. Formulation and physicochemical evaluation of a herbal dentifrice formulated with Myristica fragrans (nutmeg): an in vitro study. Int J Ayurvedic Med. 2023;14(4):1106–10. ISSN: 0976-5921.
14. Al-Rawi R, AL-Rawi N, Bashir Y, Saeed M, Mustafa A, Omar M, et al. Teeth whitening and antibacterial effects of Juglans regia bark: a preliminary study. Int J Dent. 2021;2021:6685437. doi: 10.1155/2021/6685437.
15. Pirwani DC, Rasala TM, Bhede KJ, Gupta SS, Ittadwar AM. Natural excipients as teeth whitening agents: a review. Int J Pharm Sci Rev Res. 2023 Mar–Apr;79(2):102–7. ISSN: 0976-044X.
16. Mude G, Pise S, Thombare G. Formulation and evaluation of polyherbal toothpaste and comparative study with marketed formulations. International journal of creative research thought vol 8. 2020 Jun 21;:3796.

HOW TO CITE: Karale Sanika Manoj*, Shubham Chandrakant Gadge, Formulation and Evaluation of Antimicrobial and Teeth Whitening Polyherbal Dentifrice, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 6, 2690-2697. https://doi.org/10.5281/zenodo.15655880