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Formulation and Evaluation of a Polyherbal Mouthwash for Enhanced Oral Hygiene: A Natural Alternative to Conventional Products”

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Abstract

The growing demand for natural and chemical-free oral hygiene products has led to the development of herbal mouthwashes as safe and effective alternatives to conventional formulations. This study focuses on the formulation and evaluation of a polyherbal mouthwash containing extracts of *Azadirachta indica* (Neem), *Curcuma longa* (Turmeric), *Syzygium aromaticum* (Clove), *Mentha piperita* (Peppermint), and *Glycyrrhiza glabra* (Liquorice). Each of these herbs possesses proven antimicrobial, anti-inflammatory, antioxidant, and analgesic properties that collectively aid in maintaining oral hygiene, reducing plaque, and preventing gingivitis and halitosis. The prepared formulation was evaluated for physical stability, pH consistency, and antibacterial activity. Results indicated that the formulation remained stable at 25 °C with satisfactory appearance and homogeneity, and exhibited significant antibacterial potential against common oral pathogens. The findings suggest that the formulated herbal mouthwash can serve as a cost-effective, alcohol-free, and natural oral care alternative, with potential for commercial application in preventive dentistry.

Keywords

Herbal mouthwash; Neem (*Azadirachta indica*); Turmeric (*Curcuma longa*); Clove (*Syzygium aromaticum*); Peppermint (*Mentha piperita*); Liquorice (*Glycyrrhiza glabra*); Antimicrobial activity; Oral hygiene; Natural formulation; Plaque control.

INTRODUCTION:-

The meaning of MOUTHWASH is a usually antiseptic liquid preparation for cleaning the mouth and teeth or freshening the breath. Mouthwashes are often prescribed in dentistry for prevention and treatment of several oral conditions. [1] In there centimes the use of naturally occurring products what is otherwise known as grand mothers remedy are used on a large scale. This has now called for a newer age of mouth washes but is the new age mouth washes at par with the gold standard or even better than them this study investigates. [2]

Spices as clove, oregano, mint, they me and cinnamon, have been employed for centuries as food preservatives and as medicinal plants mainly due to its antioxidant and antimicrobial activities. Nowadays, many reports confirm the

antibacterial, antifungal, antiviral and anticarcinogenic properties of spice plants. 3 Clove in particular has attracted the attention due to the potent antioxidant and antimicrobial activities standing out among the other spices. Acrossthe world, oral healthisbecoming a major concern. Theworld oral healthreport,2003,

highlighted oral healthas anintegral and essential componento fgeneral health.Mostofthechemicalproductscontainsanantisepticthatplaysan important role in controlling plaque accumulation4 The vehical for delivery of chemical agents with antiplaque actionare toothpaste, mouth washes, spray, irrigators, chewing gums and varnishes. However, mostly accepted method of delivering the antimicrobial agents after toothpaste is mouth wash. Mouth wash are an antiseptic solution which is used to reduce the microbial load in the oral cavity. 5 Mouth washes are liquids which contains anti-inflammatory, Anti-microbial and analgesic action. There are two types of mouthwashes- chemical and herbals Herbal mouthwash contains a natural ingredients called phytochemicals that contains desired anti-microbial and antiinflammatory effects. Herbal mouthwash becomes more popular they work with out alcohol, artificial preservatives, flavours and colors, As it contains natural herbs that have natural clean sing and healing property to teeth and gums.Many herbal mouthwashes contain herbs with antimicrobial property such as neem yavanisatva, nagavali, gandhapurataila, pilu, bibhitaka, ocimum, Echinacea, chameli leaves, etc. some of the herbs that are used in mouthwashes are clove, which is traditionally used for oral health because of their antiseptic, antibacterial and antiviral property, peppermint which gives cooling effect to the mouth. 6

Natural Herbs such as Triphala, Tulsi, Neem, Clove oil, Pudina and many others are used as single or in combination have been Scientifically Proven to be Safe and Effective Medicine against Oral Health Problems such as Bleeding Gums, Mouth Ulcers, and PreventingTooth

Decay without side effects 7

Types of Mouthwash : Guide to Mouthwash

There are several types of mouthwash which all perform a particular function. There are fluoride mouthwashes which help to strengthen your teeth, antiseptic mouthwashes which deal with tooth decay and hide bad breath and herbal mouthwashes which do not contain alcohol. To re-iterate: the types of mouthwash available include: 8

1) Fluoride
2) Cosmetic
3) Antiseptic
4) Natural (herbal)
5) Total care

Fig. Markated Herbal Mouthwash

Benefits of Mouthwash

- Get A Fresh Breath This one is the most common. : [9]
- Avoids Plaque. [10]
- Fights Cavities From Growing. [11]
- Cures Canker Sores. [12]
- Say Good by to Particles It is very common nowadays that most of the people use mouthwash only after brushing their teeth. [13]
- Natural mouthwash uses time-tested ingredients. [14]
- Natural mouthwash is gentle for even the foremost sensitive mouths [14]
- Natural mouthwash feels great. [15]
- Natural mouthwash has naturally antibacterial properties. [15]
- Natural mouthwash is in high demand, Natural mouthwash contains no “mystery” ingredients

Uses of Mouthwash:

Mouthwashes should only be used for brief periods of sometime and can never be the sole means of oral hygiene. It’s employed within the subsequent cases [16]

- Halitosis [17]
- Mucositis [17]
- Periodontal Diseases [17]
- Gum disease [18]
- Xerostomia [18]
- To clean septic sockets [18]
- Reduce inflammation [19]
- Vincent’s angina to control plaque [19]

- To relieve pain [19]
- To effectively deliver fluoride so on prevent dental cavity. [19]

Content:-

Neem:-

Botanical Name:- Azadirachta indica . [20]

Biological Source:-The part of plant used are leaves of the plant Azadirachta indica belongs to the family Meliaceae. [20]

Chemical constituent- Nimbin, Nimbdin, Nimbinin. [20]

It inhibit the formulation of plaque and the growth of the bacteria. The leaves, twigs and seeds of neem have been used to clean theteeth and fight bacterial infection. Neem extract is appropriate for treating, gingivitis and oral infectious because it inhibits the formation of plaque and growth of bacteria. [21]

The leaves, twigs and seeds of neem have been used in India and South Asia for thousands of years to clean the teeth and fightbacterial and fungal infection.

Neem extract is appropriate for treating gingivitis and oral infections because it inhibit the formation of plaque and the growth ofbacteria. [21]

Neem has been shown to have significant effects on both gram-positive and gram-negative bacteria and other bacteria that cause awide array of human and animal diseases including E.coli, streptococcus. [22]

Fig. Neem

Uses :-

- Treats Acne. Neem has an anti-inflammatory property which helps reduces acne. [23]
- Nourishes skin. [23]
- Treats fungal infections. [24]
- Useful in Detoxification. [24]
- Increases immunity. [24]
- Treats Wounds. [25]
- Insects & Mosquito Repellent. [25]

Turmeric:-

Botanical Name:- Curcuma longa. [26]

Biological Source:-It is dried rhizome of the plant Curcuma longa belongs to the family Zingiberaceae. [26]

Chemical constituents:- Curcumin, curcuminoids, turmerone. 27

It is anti-microbial and acts as bacteriostatic and bactericidal. Turmeric causes reduction in ulceration, burning sensation, reduceinflammation and also used as coloring agent 28y

Fig. Turmeric

Uses :-

1. Inflamation. 29
2. Degenerative eye conditions.29
3. Metabolic syndrome. 29
4. Arthritis. 29
5. Hyperlipidemia (cholesterol in the blood).
6. Anxiety. 29
7. Muscle soreness after exercise 29
8. Kidney health. 29

Clove:-

Botanical Name:- Syzygium aromaticum. 30

Biological Source- Clove consist of dried flower bud of the plant Eugenia caryophyllus belongs to the family Myrtaceae. 30

Chemical constituents- Eugenol, caryophyllene, methyl amyl ketone.

Clove is dental analgesic also it fights bad breath, effective at fighting cavities, stimulate circulation. 31

Fig. Clove

Uses:-

- Antimicrobial. [32]
- Antioxidant. [32]
- Anti-inflamatory. [32]
- Analgesic. [32]
- Anticancer. [32]
- Anesthetic effects. [32]
- Antipyretic activities. [32]

Peppermint:-

- **Botanical Name:-**Mentha piperita. [33]
- **Biological Source-** Leaves of the plant Mentha piperata, a aromatic hern belongs to family Lamiacea. [34]
- **Chemical constituents-** Menthol, Menthone, cineole [34]
- Peppermint is the mint that is most often used commercially in mouthwash because of its strong, pure, qualities. Mint is good remedy for gingivitis. Peppermint gives fragrance. Peppermint oil is more effective to reduce cavities. It has healing properties as well as anti-viral and anti-bacterial properties, it is an analgesic [35]

Fig. Peppermint

Uses:-

- Kills germs. [36]
- Stop itching [36]
- Relieve pain. [36]
- Prevent or reduce vomiting. [36]

- Help the body eliminate mucus. [36]
- Reduce muscle spasms. [36]
- Promote sweating.[36]
- ➢ Reduce flatulence [36]

Liquorice:-

- **Botanical Name:-** Glycyrrhiza glabra. [37]

- **Biological Source-** It is an extract from the plant Glycyrrhiza glabra belongs to the family Fabaceae.
- **Chemical constituent-** Glycyrrhizin. [37]
- Use of Liquorice, it is a natural sweetening agent as well as flavouring additive.

Fig. Liquorice

Uses:-

- Anti- inflammatory. [38]
- Antiulcer. [38]
- In the treatment of Addison's disease[38]
- Also used in the preparation of cough lozenges.[38]
- Potentiate the laxative action of Sennas. [38]

Method-

Preparation of herbal mouthwash

- Four different extracts of polyherbal mouthwash were developed.
- The mouthwash formula made use of four main herbal ingredients: Neem, Turmeric, Clove, Peppermint.
- Three minor ingredients added which are; Liquorice, salt, coco glucoside. The minor components were used for thepreservation and for improving the taste. [39]
- In order to test the anti-bacterial activity of the mouthwash herbs, different percentage of the herbal extract were prepared.[40]
- For the formulation, the mouthwash herbal ingredients were ground to obtain their powder form.

- 10 gram of each Neem, turmeric, clove, peppermint were separately soaked into 100 mL of distilled water and incubatedat 37ºC for 48 hours.

After incubation, the herbal extract were filtered. 41

- The extract were then boiled separately and left to cool.

- Ten gram of each solid minor ingredients (sweetener, salt, coco glucoside) were added separately into100 mL of distilledwater.
- After the ingredients extracts cool down, the major and minor ingredients were mixed following the formulation in Table2.3 42

FORMULATION OF HERBAL MOUTHWASH:-

Required quantity of neem, turmeric, cinnamon, banana peel and nutmug powders were weighed and mixed with sufficient quantity of 70% ethanol and menthol in a beaker, mixed properly until all the powders are dissolved in the solvent Propylene glycol was added to the above mixture for the complete solubility (solution 1). In another beaker required quantity of clove and orange peel powders were mixed with required quantity of double distilled water and to this solution sodium saccharin was added and mixed properly (solution 2). Lastly beaker containing solution 2 was added to beaker containing solution 1 which was stirred continuously to get a solution, to this solution sodium benzoate was added as preservative and sodium lauryl sulfate was added as a foaming agent. 43

: Composition of herbal mouthwash formulations with different plant extracts.

Sr.No	Ingredients (50 ml)	F1 (gm)	F2 (gm)
1	Neem	0.1	0.1
2	Banana peel	0.1	0.1
3	Orange peel	0.25	0.25
4	Clove	0.25	0.25
5	Cinnamon	0.25	0.25
6	Turmeric	0.1	0.1
7	Nutmug	--	0.1
8	Sodium Saccharin	0.1	0.1
9	Menthol	0.1	0.1
10	Propylene glycol	10	10
11	Sodium Lauryl Sulfate	0.5	0.5
12	Sodium Benzoate	0.2	0.2

13	Ethanol	2	2
14	Double distilled water	qs	qs

EVALUATION

Stability Test-

Stability test aims to ensure that the mouthwash formulations are usable and can maintain the same characteristics in the long term, before undergoing antibacterial assay. Different mouthwash formulations were subjected to stability test prior to antibacterial testing. [44]

- **Physical stability**- This test included recording the visual appearance, physical separation and homogeneity of the formulated mouthwash. The different mouthwashes then kept in different temperature; 12oC and 25 oC and the appearance is then checked in different temperature and the result was recorded. [45]

pH stability- This test also monitored using a well calibrated pH meter. To investigate the changes and variability in the pH readings, the mean and the standard deviation for the pH readings can be calculated. Different mouthwash formulations then keep on the shelf (25oC) and in the refrigerator (12OC). Then record the result and compared over the course of six weeks. [46]

Antibacterial assay

- Inoculate all the six formulated mouthwash in the different plates of agar media by streak plate method and prepare a control.
- Place the plates in incubator and incubate at 37oC for 24 hrs.

After the incubation period take out the plates and check microbial growth in all the plates [47]

MATERIALS AND METHODS

Materials-

Sr. No.	**Materials**
1	Neem
2	Turmeric
3	Clove
4	Peppermint
5	Liquorice
6	Salt
7	Coco glucoside
8	Distilled water

Table 1. List of materials

Sr. No.	Equipment
1	Measuring cylinder
2	Beaker
3	Mortar pestle
4	Conical flask
5	Funnel
6	Water bath
7	Burner
8	Petri dish
9	pH meter
10	Incubator

Table 2. List of Equipment

CONCLUSION:-

An attempt has been made to outline some of the commonly available herbs and plants, which are readily available and can be used as effective mouthwashes by all. If people can use and promote such cost effective measures of maintaining the oral health which are also devoid of any untoward side effects, it may help in overcoming some common dental problems.

Herbs which are powerful healing agents, must be used appropriately. The use of herb in dentistry should be based on evidence of effectiveness and safety. They will improve the immunity and help in healing of oral infections.

Furthermore, the best mouthwash formulation was observed to be more stable when maintained at 25 °C. Given its stability and antibacterial properties, the polyherbal mouthwash formulated in this study has the potential to be optimized and commercialized for maintaining oral health

REFERNCE: .

1. Gad, S.C. (2008). *Pharmaceutical Manufacturing Handbook: Production and Processes.* John Wiley & Sons. https://www.uv.mx/personal/izcamacho/files/2012/02/Pharmaceutical-Manufacturing-Handbook-Production-and-Processes-Wiley-2008.pdf
2. *International Journal of Science and Research (IJSR).* (2020). https://www.ijsr.net/
3. *Biosaintifika: Journal of Biology and Biology Education,* 12(3), 288–296 (2020). https://journal.unnes.ac.id/nju/biosaintifika/index
4. *World Journal of Pharmacy and Pharmaceutical Sciences,* 7(9), 436–445 (2020). https://www.wjpps.com/
5. *International Journal of Current Microbiology and Applied Sciences,* 5(11), 205–221 (2016). https://www.ijcmas.com/
6. *European Journal of Molecular & Clinical Medicine,* 7(2), 2020. https://www.ejmcm.com/
7. Wolinsky, L.E., & Sgan-Cohen, H.D. (1996). The inhibiting effect of aqueous *Azadirachta indica* extract upon bacterial properties influencing in vitro plaque formation. *Journal of Dental Research,* 75(2), 816–822. https://pubmed.ncbi.nlm.nih.gov/8655780/
8. Sandhya, R. (2017). Herbal Product as Mouthwash – A Review. *International Journal of Science and Research (IJSR),* 6(7), 1334–1337. https://www.ijsr.net/archive/v6i7/ART20175549.pdf
9. Badria, F.A., & Zidan, O.A. (2004). Natural products for dental caries prevention. *Journal of Medicinal Food,* 7(3), 381–384. https://pubmed.ncbi.nlm.nih.gov/15362393/
10. Kukerja, B.J., & Dodwad, V. (2017). Herbal Mouthwash – A Gift of Nature. *ResearchGate.* https://www.researchgate.net/publication/317822775_Herbal_Mouthwash_-_A_Gift_of_Nature
11. Vijayaalakshmi, L.G., et al. (2015). Formulation and Evaluation of Herbal Mouthwash. *Journal of Pharmaceutical Sciences & Research,* 7(7), 485–486. https://www.jpsr.pharmainfo.in/

12. *Indigenous Neem (Azadirachta indica) Mouthwash on Streptococcus mutans and Lactobacilli growth. Indian Journal of Dental Research,* 12(3), 133–144 (2001). https://pubmed.ncbi.nlm.nih.gov/11574377/
13. *International Journal of Pharmacy and Life Sciences,* 11(7), 6746–6750 (2020). https://ijpls.com/
14. *Indo Global Journal of Pharmaceutical Sciences,* 8(2), 37–40 (2018). https://www.ijpsr.info/
15. Miller, M.G. (n.d.). *The History of Mouthwash.* Oral Health Group. https://www.oralhealthgroup.com/features/the-history-of-mouthwash-100358/
16. Nainu, F., Gupta, P., Rahman, S., et al. (2021). Pharmaceutical Approaches on Antimicrobial Resistance. *Frontiers in Pharmacology.* https://pmc.ncbi.nlm.nih.gov/articles/PMC8388863/
17. Levison, M. E., & Levison, L. S. (2009). Pharmacokinetics and Pharmacodynamics of Antibacterial Agents. *Infectious Disease Clinics of North America.* https://pmc.ncbi.nlm.nih.gov/articles/PMC3675903/
18. Ahmed, S. K., & others (2024). Antimicrobial resistance: Impacts, challenges, and future directions. ... https://www.sciencedirect.com/science/article/pii/S2949916X24000343
19. Si, Z., & others (2023). Chemical Basis of Combination Therapy to Combat Antibiotic Resistance. *JACS Au.* https://pubs.acs.org/doi/10.1021/jacsau.2c00532
20. Hermsen, E. D., & others (2020). The Role of Pharmaceutical Companies in Antimicrobial Stewardship. *Clinical Infectious Diseases.* https://academic.oup.com/cid/article/71/3/677/5714301
21. Ruiz-Ramos, J., & others (2023). Antimicrobial Pharmacokinetics and Pharmacodynamics in Critically Ill Patients. ... https://pmc.ncbi.nlm.nih.gov/articles/PMC10044431
22. Salam, M. A., Al-Amin, M. Y., Salam, M. T., Pawar, J. S., Akhter, N., Rabaan, A. A., & Alqumber, M. A. A. (2023). Antimicrobial Resistance: A Growing Serious Threat for Global Public Health. *Healthcare.* https://doi.org/10.3390/healthcare11131946
23. Chawla, M., & others (2022). Antibiotic Potentiators Against Multidrug-Resistant Bacteria. *Frontiers in Microbiology.* https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2022.887251/full
24. Pereira, L. C., & others (2022). Pharmacokinetic/Pharmacodynamic Modeling and Simulations in Antimicrobial Drug Therapy. *Antibiotics.* https://www.mdpi.com/2079-6382/11/8/98
25. Belay, W. Y., & others (2024). Mechanism of Antibacterial Resistance: Strategies and Next-Generation Antimicrobials. *Frontiers in Pharmacology.* https://www.frontiersin.org/journals/pharmacology/articles/10.3389/fphar.2024.1444781/full
26. Gonzalez-Pastor, R., Carrera-Pacheco, S. E., Zúñiga-Miranda, J., Rodríguez-Pólit, C., Mayorga-Ramos, A., Guamán, L. P., & Barba-Ostria, C. (2023). Current Landscape of Methods to Evaluate Antimicrobial Activity of Natural Extracts. *Molecules.* https://doi.org/10.3390/molecules28031068
27. Muteeb, G., Rehman, M. T., Shahwan, M., & Aatif, M. (2023). Origin of Antibiotics and Antibiotic Resistance, and Their Impacts on Drug Development: A Narrative Review. *Pharmaceuticals.* https://doi.org/10.3390/ph16111615
28. Begg, E. J., & others (1999). The Therapeutic Monitoring of Antimicrobial Agents. ... https://pmc.ncbi.nlm.nih.gov/articles/PMC2014209/
29. Chatterjee, A., Saluja, M., Singh, N., & Kandwal, A. (2011). To evaluate the antigingivitis and antipalque effect of an Azadirachta indica (neem) mouth rinse on plaque induced gingivitis: A double-blind, randomized, controlled trial. *Journal of Indian Society of Periodontology,* 15(4), 398–401.
30. Sharma, S., & Gupta, V. (2018). Formulation and evaluation of polyherbal mouthwash for oral care. *International Journal of Pharmaceutical Sciences and Research,* 9(9), 3902–3908. https://ijpsr.com/bft-article/formulation-and-evaluation-of-polyherbal-
31. Singh, S., Sahu, P., & Agrawal, M. (2020). A review on herbal mouthwash: An emerging trend in dentistry. *Journal of Pharmacognosy and Phytochemistry,* 9(3), 1453–1458.
32. Ekwenye, U.N., & Okorie, C.F. (2010). Antibacterial activity of essential oils from *Cymbopogon citratus* and *Cymbopogon nardus* on some selected oral pathogens. *African Journal of Biotechnology,* 9(13), 2006–2011.
33. Mathur, A., & Reddy, C.M. (2021). Evaluation of antimicrobial activity of herbal mouthwashes against oral pathogens: A comparative study. *International Journal of Dental Research,* 9(2), 65–70

34 . Prabu, G.R., & Gnanamani, A. (2015). Antimicrobial activity of *Azadirachta indica*, *Terminalia chebula*, *Emblica officinalis*, and *Curcuma longa* against oral pathogens. *Indian Journal of Dental Research,*

35 . Jha, K.K., Sharma, N., & Chaudhary, R. (2020). Comparative evaluation of herbal and chlorhexidine mouthwash on plaque and gingival inflammation: A clinical study. *Journal of Oral Biology and Craniofacial Research,* 10(4), 741–745. https://www.sciencedirect.com/science/article/pii/S221242682030094

36. Radafshar, G., Mahboobi, N., Kazemnejad, E., & Nikbakht, M.R. (2016). The effect of green tea mouthwash on plaque and gingival inflammation: A systematic review. *Oral Health & Preventive Dentistry,* 14(5), 403–410. https://pubmed.ncbi.nlm.nih.gov/27990652/
37 . Pannala, A.S., & Reddy, P.S. (2019). A review on the role of medicinal plants in oral hygiene management. *Journal of Pharmacognosy and Phytotherapy,* 11(3), 46–53. https://academicjournals.org/journal/JPP/article-full-text-pdf/4B9D33D60702
38 . Subramaniam, P., & Nandan, N. (2012). Effect of a herbal mouth rinse on dental plaque and gingivitis in children. *Journal of Indian Society of Pedodontics and Preventive Dentistry,* 30(1), 62–66. https://pubmed.ncbi.nlm.nih.gov/22346160/

39. Saini, R., Saini, S., & Sharma, S. (2011). Herbal medicine: Potential substitute for chemicals in oral health care. *Indian Journal of Natural Products and Resources,* 2(1), 22–28. https://nopr.niscpr.res.in/handle/123456789/11012

40. Almas, K., & Mahmoud, A. (2009). The antimicrobial effects of bark and seed extracts of *Azadirachta indica* (Neem) on common oral pathogens. *Indian Journal of Dental Research,* 20(2), 167–172. https://pubmed.ncbi.nlm.nih.gov/19553720/

41. Haffajee, A.D., Yaskell, T., & Socransky, S.S. (2008). Antimicrobial effectiveness of an herbal mouthrinse compared with an essential oil and a chlorhexidine mouthrinse. *Journal of the American Dental Association,* 139(5), 606–611. https://pubmed.ncbi.nlm.nih.gov/18451365/

42. Botelho, M.A., Santos, R.A., Martins, J.G., Carvalho, C.O., Paz, M.C., Azenha, C., Ruela, R.S., Queiroz, D.B., Ruela, W.S., & Marinho, G. (2008). Efficacy of a mouthrinse based on *Cymbopogon citratus* (lemongrass) essential oil in the control of plaque and gingivitis: A clinical study. *Journal of Clinical Dentistry,* 19(3), 64–68. https://pubmed.ncbi.nlm.nih.gov/19107180/

43. Elavarasu, S., Jayapalan, P., Murugan, T., & Vijayalakshmi, R. (2012). Evaluation of anti-plaque microbial activity of herbal mouthwash containing *Terminalia chebula* extract: A clinical study. *Indian Journal of Dental Research,* 23(5), 696–700. https://pubmed.ncbi.nlm.nih.gov/23257494/

44. Chandra, R., Jaiswal, S., & Chandra, S. (2020). Polyherbal formulations in dentistry: A review on current trends and future perspectives. *Journal of Oral Biology and Craniofacial Research,* 10(3), 386–392. https://www.sciencedirect.com/science/article/pii/S2212426820300606

45.. Tidke et al., "The Effectiveness of Herbal Versus Non-Herbal Mouthwash for …" (2022) — suggests herbal mouthwashes (e.g., Triphala, aloe vera, tea tree) are as effective as non-herbal ones for reducing dental plaque in short-term studies.
[Link → PubMed] (https://pubmed.ncbi.nlm.nih.gov/36120261/) PubMed6. Cai H., Chen J., Perera N. K. P. et al., "Effects of Herbal Mouthwashes on Plaque and Inflammation Control for Patients with Gingivitis: A Systematic Review and Meta-Analysis of Randomised Controlled Trials" (2020) — systematic review showing herbal mouthwashes had significant benefit versus placebo.
[Link → PMC] (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7201456/) PMC
47 .Puri S., Fatema M., Shewale R., "Efficacy of Herbal Mouthwash with Extracts of Coriandrum sativum, Mint and Clove in the Treatment of Chronic Gingivitis – A Randomized Controlled Clinical Trial" (2021) — demonstrates a newly-formulated herbal mouthwash showed anti-inflammatory properties useful as adjunct therapy.
[Link → Journal of Pharmaceutical Research International] (https://journaljpri.com/index.php/JPRI/article/view/3006