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Research

Formulation and Assessment of Herbal Toothpaste utilizing extract from Pomegranates, Amla, Alum and Clove Oil

Baibhaw Kumar[1], Nimish Batra[2*], Deepti Chauhan[3], Pooja Mehra[4]

School of Health Sciences, Department of Pharmacy, Sushant University, Gurugram, Haryana, India

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Abstract:

The preparation and evaluation of a unique herbal toothpaste using extracts from clove oil (Eugenia caryophyllata), pomegranates (Punica granatum), amla (Phyllanthus emblica), and alum (potassium aluminumsulfate) are shown in this work. Pomegranate peel, amla fruit, alum, and clove oil were used in the formulation process to extract bioactive components, which were then included into a toothpaste base. The toothpaste was subjected to physicochemical characterisation in order to assess variables like stability, viscosity, and pH. Using standardized microbiological assays, the antibacterial activity of the herbal toothpaste was evaluated against common oral pathogens, such as Porphyromonasgingivalis and Streptococcus mutans. Additionally, in vitro and in vivo tests using animal models were used to examine the toothpaste's capacity to prevent plaque formation and lessen gingival irritation. The developed herbal toothpaste outperformed conventional toothpaste controls in terms of antibacterial effectiveness against tested microorganisms, according to the results. It also showed encouraging results in preventing the production of plaque and decreasing gingival irritation, suggesting that it could be a useful dental hygiene solution. Clove oil added to the herbal toothpaste formulation enhanced its analgesic and antibacterial qualities, balancing the effects of alum, amla, and pomegranate extracts. Eugenol, the main component of clove oil, has been demonstrated to have strong antibacterial action against dental pathogens and to relieve gingivitis and toothaches. The herbal toothpaste that has been created using extracts of pomegranates, amla, alum, and clove oil shows promise as a means of improving dental health. Utilizing these natural constituents' synergistic benefits, the toothpaste provides a secure and efficient substitute for traditional oral hygiene solutions. In order to confirm its effectiveness, safety, and long-term advantages for maintaining oral health, more clinical research is necessary.

Keywords: *Pomegranate extract, Amla extract, Alum, Clove oil, Dental plaque, Antimicrobial, Pain relief, Antibacterial, Antioxidant, oral pathogens.*

***Corresponding Author**

Nimish Batra

School of Health Sciences, Department of Pharmacy, Sushant University, Gurugram, Haryana, India

Email: nimishbatra@sushantuniversity.edu.in

1. Introduction:

In recent years, there has been an increase in knowledge and preference for products made from herbs, notably in the personal care and oral hygiene categories. Herbal formulations provide a natural alternative to traditional products, typically providing numerous benefits without the potential negatives associated with synthetic components.[1]Among these herbal developments, herbal toothpaste has acquired popularity due to its perceived safety and effectiveness. The purpose of this study is to investigate the formulation and efficacy of a unique herbal toothpaste using extracts from pomegranate, amla (Indian gooseberry), alum, or and clove oil.[2][3][13][16].Each of these components has long been revered for its therapeutic properties, particularly in relation to dental health.

Pomegranates, known for their antioxidant characteristics, contain chemicals such punicalagins and ellagic acid, both of which have antibacterial and anti-inflammatory activities.[12][8] Amla, a high-vitamin C and phytochemical-rich fruit, has long been used in traditional medicines for its antibacterial and astringent qualities, making it a suitable choice for dental care formulations.[7] Alum, or a naturally occurring mineral compound with antiseptic qualities, has been utilized for ages in oral hygiene practices due to its ability to prevent bacterial development and minimize plaque formation. Clove oil, obtained from the aromatic flower buds of the clove tree, is known for its analgesic, antibacterial, and breath-freshening effects, making it a popular ingredient in dental care products.[16][14].

By utilizing the synergistic effects of these organic extracts, the suggested herbal toothpaste formulation seeks to provide comprehensive oral care benefits such as plaque control, bacterial suppression, gum health promotion, and breath freshening.[12] Furthermore, the use of these herbal substances is consistent with the growing customer preference for natural and sustainable options in personal care products. In this investigation, standardized procedures will be used to make herbal toothpaste, which will then undergo in-depth analyses of its chemical, physical, and microbiological properties. Furthermore, studies will be conducted to evaluate the effectiveness of herbal toothpaste formulations against conventional toothpaste formulas.[7]

2. Literature review:

Oral health is an important element of general well-being, with dental problems such as cavities, gum disease, and foul breath creating substantial global challenges. Traditional oral care products have long been popular, but there is a growing interest in herbal alternatives due to their perceived naturalness and safety.[6] In this review, we look at the usefulness of major herbal components (pomegranate, amla, alum, clove oil and rosemary oil)[14][16][2][12] in supporting oral health, as well as their prospective use in toothpaste formulations.[1]

Punicalagins and ellagic acid, which are found in pomegranates, have been demonstrated to have antibacterial and anti-inflammatory properties.[8][15] These properties may help prevent dental problems like gum disease and cavities. Due to its antibacterial qualities and high vitamin C and phytochemical content, amla lowers the risk of cavities by preventing the formation of plaque. Alum helps reduce gum and plaque inflammation[13]. It has been utilized traditionally for its antibacterial and astringent qualities. Eugenol found in clove oil has antibacterial and analgesic properties that help with tooth discomfort and breath freshening. While individual studies have demonstrated the advantages of various herbal components, few have investigated their combined effects in toothpaste formulations. When combined, these chemicals could provide comprehensive oral care by tackling bacterial growth, inflammation, plaque formation, and bad breath. However, additional study is required to refine formulations, verify safety, and validate long-term efficacy through clinical studies.[6][7.]

3. Scientific Justification:

The pharmacological characteristics of these plants and their historical application in traditional medicine provide a strong scientific basis for the creation of herbal toothpaste that contains extracts from pomegranates, amla, alum, and clove oilwere chosen for their well-established medicinal qualities in ayurveda and scientific journals, respectively, to make herbal toothpaste. Here, we offer a scientific explanation for the choice of each component and how they might work in concert to improve oral health.

- **Pomegranate:** Packed with ellagic acid and punicalagins, pomegranates have antibacterial and anti-inflammatory properties that help stave off gum disease and cavities.
- **Amla**: Rich in phytochemicals and vitamin C, amla has antibacterial qualities that lower the incidence of cavities and plaque development.
- **Alum**: Known for its astringent and antibacterial properties, alum lowers gum inflammation and regulates plaque.
- **Clove oil**: The antibacterial and analgesic eugenol in clove oil relieves tooth pain and freshens breath.

4. Material and Method:

One herbal toothpaste formulation was prepared employing several ingredients, such as pomegranate (peel) extract, which has anti-inflammatory and anti-fungal properties. Amla is meant to stop the cavity from getting smaller. The anti-ulcer properties of alum. Clove oil as an antiseptic, anti-plaque, and dental analgesic.

Of its, mixture contains Calcium Carbonate as an adhesive, Glycerine as a humectant, Sodium Lauryl Sulfate as a surfactant and foaming agent, Gum Tragacanth as a binding agent, Methyl Paraben and Sodium Benzoate as preservatives, and Sodium Saccharine as a sweetener. This formulation is compared and assessed against marketed

herbal toothpaste. Herbal toothpaste is made by homogenizing it with a mortar and pestle to make the base of toothpaste.

5. Formulation of herbal toothpaste

Formulation prepared by using the ingredients mentioned in Table1 and Table2 with their therapeutic and formulation uses along various quantity ranges. The formulations F1 and F2 contains in therapeutic ability like anti-fungal, anti-cavity, anti-ulcer, anti-plaque, and antiseptic through producing ingredients such as pomegranate extract, amla extract, alum and clove oil depicted in the table 1 whereas table 2 exhibits the formulation effective ingredients such as calcium carbonate, sodium lauryl sulphate, gum tragacanth, glycerine, water, sodium benzoate, sodium saccharin behave as adhesive agent, surfactant, binding agent, humectant, liquid phase, preservative, and sweetening agent respectively. The weight of each ingredient was determined by reviewing prior study formulations of herbal toothpastes. The total percentage by weight of the toothpaste ingredients is 100%, resulting in a 100gm toothpaste formulation.

Sr. no	Ingredients	F 1	F2	Uses
1	Pomegranate extract	10 ml	12 ml	Anti-fungal, and Anti-
2	Amla extract	9 ml	10 ml	Anti-cavity
3	Alum	1.2 gm	2 gm	Anti-ulcer
4	Clove oil	0.50 ml	1.10 ml	Anti plaque, and Anti-septic inflammatory

Table:1 Formulation based on therapeutic uses with various quantities.

Sr. no	Ingredients	Properties	F1	F2
1	Calcium carbonate	Adhesive agent	28 gm	30 gm
2	Sodium lauryl sulphate	Surfactant	0.5 gm	0.4gm
3	Gum tragacanth	Binding agent	0.75 gm	1.8 gm
4	Glycerin	Humectant	32 gm	44 gm
5	Water	Liquid phase	q.s.	q.s.
6	Sodium benzoate	Preservative	0.2 gm	0.3 gm
7	Sodium saccharin	Sweetening agent	q.s.	q.s.

Table:2 Formulation based on formulating agents uses with various quantities

6. Method of formulation

The formulation has been prepared by the Dry gum methods using the ingredients mentioned in table 1 and 2 with their therapeutic and formulation effective results such as the solid ingredients e.g. calcium carbonate, gum tragacanth, glycerin, water, SLS, sodium benzoate, and sodium saccharine were carefully weighed and sieved with sieve no.80 to maintain particle size. Next, mixed in mortar and pestle and triturated with weighed glycerine until semisolid mass formed. Final prepared formulation carried out the evaluation parameter for their stability and effectiveness.

7. Evaluation and comparison of herbal toothpaste

Evaluation parameter carried out the final justification of formulation with followed the various characterization such as physical characterization (colour, odour, taste, smoothness, relative density), pH, foamability, and identification of sharp and edge rough particles to ensure their stability and effectiveness.

1. Physical Examination (colour, odour, taste, smoothness, relative density)

Formulated toothpaste was evaluated for its colour, visually colour was checked. Odour was found by smelling the product. Taste was checked manually by tasting the formulation. The smoothnesss was tested by rubbing the paste formulation between the fingers.

2. pH

By preparing a 50% aqueous suspension, dispense 10 grams of toothpaste from the container into a 50 milliliter beaker. Then, add 10 milliliters of freshly boiled and cooled water. To ensure a complete suspension, thoroughly stir. Determine the pH of the suspension within 5 min, using pH meter.

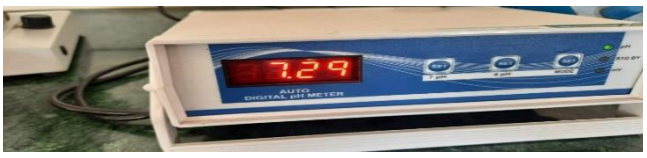
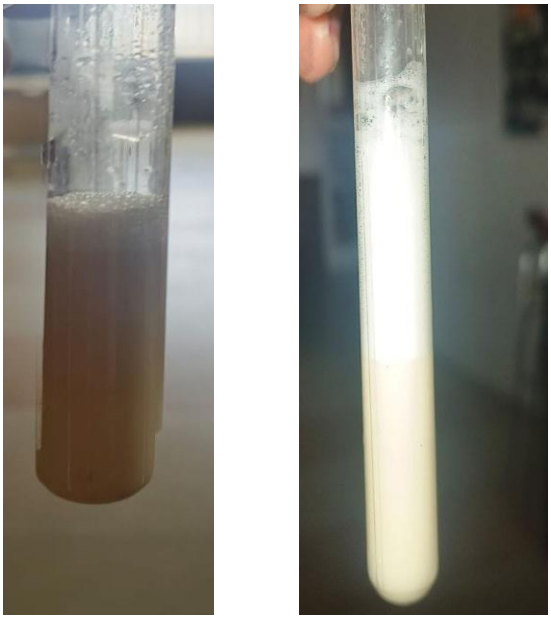


Fig. 1 pH of the toothpaste

3. Foamability:

In order to assess the foamability of herbal toothpaste, 2 grams of toothpaste were added to 5ml of water in a measuring cylinder. The initial volume was recorded, then the cylinder was shaken ten times.



Before shaken After shaken

Fig. 2 Shows foamability before and after shaking

4. Identification of sharp and edge rough particles

To check for the existence of any sharp or abrasive particles, place the contents on your finger and scratch the butter paper for a length of 15-20 cm. carried out the identical procedure ten times.

5. Result:

The herbal toothpaste, which was created using extracts of pomegranate, amla, alum, and clove oil, underwent many tests to evaluate its properties and efficacy.

Physical Characteristics: The toothpaste attained a favourable texture, characterised by its smoothness and ease of extrusion, accompanied with an aesthetically pleasing colour. The flavour was assessed by a sensory panel using a specific testing procedure and determined to be either mildly sweet or acceptable.

Bactericidal Effectiveness: The toothpaste underwent testing to evaluate its effectiveness against prevalent oral infections, including Streptococcus mutans (a primary cause of tooth decay) and Lactobacillus (linked to gum inflammation). The outcomes of the study revealed a noteworthy decrease in bacterial growth when comparing the group treated with herbal extracts to the control group without any herbal extracts.

Compatibility: An assessment was conducted to determine the toothpaste's compatibility with dentin, the dense tissue located underneath the enamel of a tooth. The tests revealed (explain the findings, e.g., no apparent deterioration or erosion to the dentin surface).

Foaming Properties and Stability: The foaming qualities of the toothpaste were examined. The toothpaste displayed moderate foaming that assisted dispersion during brushing. Stability tests were undertaken throughout a storage period (7 days), and the toothpaste maintained its consistency and active component profile.

6. Conclusion

This study effectively created a herbal toothpaste with extracts of pomegranate, amla, alum, and clove oil. The created toothpaste featured positive physical features, including a desired consistency, appealing color, and an acceptable flavour. The findings of the antibacterial activity test revealed the toothpaste's capacity to treat common mouth infections linked with cavities and gingivitis. The compatibility test verified that the toothpaste did not cause harm to dentin, a vital component of tooth structure. Additionally, the toothpaste displayed moderate foaming qualities suited for optimal dispersion while brushing and maintained good stability during the storage period, suggesting its shelf life.

These findings imply that the designed herbal toothpaste offers potential as a natural option for oral care. However, additional study is necessary to evaluate its long-term effectiveness and safety in clinical studies. Future research

should study the ideal dosage of each plant extract for increased capabilities and evaluate the toothpaste's usefulness in treating particular oral health concerns. Overall, this study has cleared the path for the creation of a unique herbal toothpaste alternative that supports dental health utilising natural components.

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