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Formulation & Evaluation of Toothpaste using Clove

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ABSTRACT

In today's oral care landscape, there's a prevailing preference for herbal toothpaste formulations over synthetic ones, driven by concerns for safety and effectiveness in combating dental issues such as caries. Our formulation incorporates a blend of natural ingredients, including aloe vera gel, clove oil, Neem powder, and pomegranate peel powder, which have not been previously explored in research. These constituents boast a range of therapeutic properties, from anti-ulcer and anti-bacterial to wound-healing and even potential anti-cancer and anti-fungal effects.

To create a toothpaste that meets both efficacy and stability standards, we conducted evaluations on various physical attributes such as pH, stability, extrudability, spreadability, foamability, and homogeneity. The objective of this project was to develop and assess a herbal toothpaste formulation. Our findings validate that our herbal-based toothpaste, enriched with natural ingredients, performs exceptionally well in terms of efficacy. Clove oil finds extensive application in dental hygiene and exhibits potent antibacterial properties against a broad spectrum of bacteria. The primary active component in clove oil is eugenol, accompanied by β-caryophyllene and eugenyl acetate. A comprehensive analysis of existing research underscores the promising potential of clove oil in treating periodontal disease. This study aims to compare the essential oil compositions extracted from the buds, leaves, and stems of S. aromaticum, examining their correlation with anatomical and geographical factors. Various commercial essential oils derived from clove buds, leaves, and stems were utilized for this investigation. Gas chromatography was employed to analyze the oils, and the constituents were subsequently identified. Eugenol emerged as the predominant compound across all oil types, with its concentration increasing progressively from buds (72.08% - 82.36%) to leaves (75.04% - 83.58%) and stems (87.52% - 96.65%). In clove bud essential oil, eugenyl acetate constituted the second major component (8.6% - 21.3%), whereas it was detected in significantly lower proportions in leaf (0% - 1.45%) and stem (0.07% - 2.53%) oils. β-caryophyllene (11.65% - 19.53%) and α-humulene (1.38% - 2.17%) emerged as the second primary compounds in leaf essential oil, exhibiting lower prevalence in bud (2.76% - 8.64% and 0.34% - 1.04%, respectively) and stem (1.66% - 9.7% and 0.22% - 1.31%, respectively) oils. Notably, the percentage of major constituents varied according to the geographical origin of each plant material.

Keywords : Medicated ,toothpaste ,Antimicrobial , Antifungal , antimalarial , cost effective , herbal formulation , Dental care , Plant extracts.

Introduction:

For centuries, herbal and natural toothpaste has been a cornerstone of oral healthcare, deeply rooted in ancient practices. India, with its rich tradition of employing local remedies for various ailments, exemplifies this legacy. With growing awareness about the drawbacks of commercial toothpaste, there's a notable shift towards non-alcoholic toothpaste and herbal formulations.

Natural toothpaste, devoid of fluorides, artificial flavors, or colors, is gaining traction among consumers seeking safer alternatives for oral hygiene. This trend reflects a renewed appreciation for traditional methods and a desire for products aligned with natural principles. Following advancements in the field of medicine, chalk and soap were incorporated into these formulations. Toothpaste, a dentifrice, serves the purpose of keeping teeth clean, maintaining their health, and enhancing their appearance. It's primarily used for oral hygiene, functioning as an abrasive to remove dental plaque and food debris, thereby assisting in preventing halitosis and releasing active chemicals like fluoride to prevent teeth and gum diseases such as gingivitis.

Polyherbal and natural formulations are particularly effective due to their inclusion of active chemical compounds like polyphenols, gums, alkaloids, and glycosides. These formulations have demonstrated diverse biological activities.

Unlike synthetic toothpaste made from various chemical components, which can harm sensitive parts of the teeth such as enamel, crown, dentin, roots, and the blood supply to the nerves, herbal toothpaste utilizes herbs derived from natural plants like Babul, Aloe Vera extract, Clove oil, peppermint oil, and Eucalyptus oil. Toothpaste has been an integral part of oral health care since ancient times, dating back to as early as 300-500 BC in China and India. During this period, abrasives like squashed bone, pulverized egg, and clam shells were used for tooth cleaning. Modern toothpaste formulations emerged in the 19th century, with later additions of chalk and soap. Advancements in formulations continued after 1945, with the introduction of various detergents,

notably sodium lauryl sulfate, serving as a foaming/emulsifying agent.In recent years, there has been a shift in focus towards the incorporation of active ingredients in toothpaste formulations to prevent and/or treat oral illnesses. Toothpaste, available in gel or paste form, is applied with a toothbrush to clean and maintain oral hygiene. Oral hygiene practices aim to keep the mouth and teeth clean, preventing common dental issues such as cavities, gingivitis, periodontal diseases, and bad breath. These oral infections are often caused by plaque-forming bacteria and yeast, including species such as actinomyces, actinobacillus, streptococcus, and candida.While mechanical cleaning with a toothbrush plays a significant role, toothpaste excipients also contribute to effective cleaning. Toothpaste, whether in paste or gel form, is a crucial dentifrice utilized alongside a toothbrush to uphold the aesthetic appeal and well-being of teeth. Serving as an abrasive, toothpaste aids in the removal of dental plaque and food residue from the teeth, while also combating halitosis. Furthermore, it incorporates active ingredients like fluoride or xylitol, which play a vital role in preventing tooth and gum diseases. Dental plaque buildup on teeth is particularly concerning due to its cosmetic implications and pathogenic nature.

MATERIAL & METHODOLOGY

Plant profile: Clove (Lavang)

Botanical name: *Syzigium aromaticum*

Common name:

- Marathi –Lavang
- Hindi – Laung
- Tamil - கிராம்பு

Kingdom: Plantae

Class*:* *Dicotyledons*

Order: *Myrtales*

Family: *Myrtaceae*

Genus: *Syzigium*

Species: aromaticum

Popular name: Lavang

Habitats: Clove has been successfully introduced and cultivated in subtropical regions around the world. Subtropical climates with mild winters and hot summers provide suitable conditions for clove cultivation. It can tolerate occasional frosts, but prolonged exposure to freezing temperatures can damage the plant.

Cultivation:

- **Site Selection**: Choose a location with a tropical climate characterized by warm temperatures, high humidity, and well-distributed rainfall. Clove plants thrive in partial shade and require protection from strong winds.
- **Soil Preparation**: Prepare the soil by ensuring it is well-draining, fertile, and slightly acidic (pH 5.5 to 6.5). Conduct a soil test to determine nutrient levels and amend the soil with organic matter or appropriate fertilizers if needed.
- **Propagation**: Clove plants can be propagated from seeds or cuttings. Seeds are sown in nursery beds filled with well-draining soil and germinated under controlled conditions. Seedlings are transplanted to the field when they are about 6-12 months old.
- **Planting**: Plant clove trees at a spacing of 6-8 meters apart to allow for adequate growth and airflow. Dig planting holes large enough to accommodate the root ball of the seedling. Backfill the holes with soil and water thoroughly after planting.

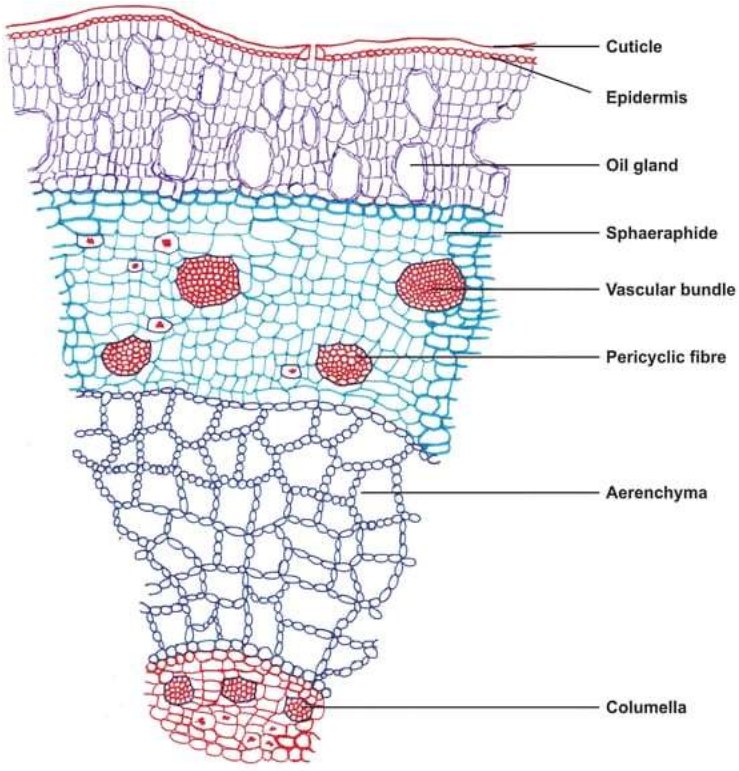
Cultural Practices:

Weed Control: Keep the area around clove trees free from weeds to minimize competition for nutrients and water. Mulching can help suppress weed growth and retain soil moisture.

Pruning: Regular pruning is necessary to shape the trees, remove dead or diseased branches, and promote airflow within the canopy.

Fertilization: Apply organic fertilizers such as compost or well-rotted manure annually to provide essential nutrients for clove tree growth. Additionally, apply balanced chemical fertilizers based on soil nutrient analysis.

- **Pest and Disease Management**: Monitor clove trees regularly for signs of pests and diseases such as clove bud borer, scale insects, and root rot. Implement integrated pest management strategies, including cultural, biological, and chemical control methods, as needed.
- **Harvesting**: Clove trees typically start flowering and producing flower buds within 5-7 years of planting. Harvest the flower buds when they reach the desired size and color (usually pink or red) but before they fully open. Buds are carefully handpicked to avoid damage to the tree.
- **Post-Harvest Processing**: After harvesting, dry the clove buds in the sun or using specialized drying methods until they reach the desired moisture content. Sort and grade the dried cloves based on size, color, and quality. Pack the cloves in suitable containers for storage or distribution.



T. S. of Clove flower bud

Medicinal uses:

- Antiinflammatory
- Antioxidant
- Antifungal

- Reduce blood sugar
- Antimicrobial
- Dental analgesic

Chemical constituents of clove leaves:

Flavonoids, Hydroxybenzoic acid, Hydroxycinnamic acid, Hydroxyphenyl propenes, Eugenol, Phenolic acids, Gallic acid, Kaempferol, Quercetin, Caffeic acid, Ferulic acid, Ellagic acid, Salicylic acid. Clove is a significant botanical reservoir of phenolic compounds such as flavonoids, hydroxybenzoic acids, hydroxycinnamic acids, and hydroxyphenyl propenes. Eugenol stands out as the primary bioactive compound in clove, present in concentrations ranging from 9,381.70 to 14,650.00 mg per 100 g of fresh plant material.

Methodology:

Method:Dry gum method

Sr.no.	Ingredient	Formula 1	Formula 2	Formula 3
1	Gaur gum	0.3	0.2	0.1
2	Clove oil	0.1	0.2	0.3
3	Calcium carbomnate	25	27	23
4	Sodium benzoate	0.1	0.2	0.2
5	Peppermint oil	0.4	0.3	0.6
6	Sodium lauryl sulphate	1.5	2.5	2.7
7	Glycerine	15	13	17
8	Sodium saccharin	2	1	3
9	Water	q.s.	q.s.	q.s.

Procedure

Dry Gum Method

The dry components, including calcium carbonate, sodium lauryl sulfate, glycerin, sodium benzoate, and sodium saccharin, were precisely measured according to the provided formula.

The ingredients were further combined in a mortar and pestle, and subsequently triturated with accurately measured glycerin until forming a semi-solid substance.

Upon completion, peppermint oil was introduced to impart a refreshing flavor to the mixture.

Fig.No.2 formulation of toothpaste

Evaluation parameter

1.

Sr.no.	Test	Observation	Inference
1	To conduct a protein test, mix 3 grams of the powder with 5 milliliters of Millon's reagent.	Black red ppt	Protein is present
2	Perform the lead acetate test for tannins by combining 0.5 grams of the powder with a 1% solution of lead acetate.	White is present	Tannins is present
3	To conduct the Benedict's test for carbohydrates, mix equal volumes of the powder solution and Benedict's reagent, then heat the mixture for 5 minutes in a water bath.	Red colour solution observed	Presence of carbohydrate
4	For the Wagner's test to detect alkaloids, combine 2.3 milliliters of the powder solution with a few drops of Wagner's reagent.	Brownish red colour obtained	Presence of alkaloids

Abrasiveness

Extrude the content onto butter paper, forming a length between 15 to 20 centimeters. Repeat this procedure for at least ten collapsible tubes. To check for any sharp or hard-edged abrasive particles, gently press the contents of the length with the tip of your finger. Toothpaste should not contain such particles.

2. pH measurement

Weigh 10 grams of toothpaste into a 150 ml beaker. Add 10 ml of boiled and chilled water to the beaker and stir the mixture thoroughly to form a suspension. Use a pH meter to measure the pH of the suspension.

3. Foaming ability

Prepare a suspension of the substance by adding 5 grams of toothpaste to a glass beaker containing 100 ml of water. Allow 30 minutes to pass after adding an additional 10 ml of water and covering the beaker with a watch glass. If detergent is present in the suspension, gently warm it to remove it. Transfer

the suspension to a 250 ml measuring cylinder after stirring with glass rods. Check for the generation of foam (more than 2 mL). Transfer any residue left in the beaker to the measuring cylinder by adding 5–6 ml of water, then fill the cylinder to 50 ml with water. Stir the mixture with up-and-down motions at 30°C until a homogeneous suspension is achieved. After shaking, let the cylinder stand for five minutes. Finally, note the volume of foam and water produced.

4. Loss of drying

Weigh 5 grams of the sample into a porcelain dish with a diameter of 6 to 8 cm and a depth of 2 to 4 cm. Place the sample in an oven and keep it there for 24 hours at 105°C. After 24 hours, remove the sample from the oven and take a new weight to determine the overall moisture content of the sample.

5. Antimicrobial activity

A sterile nutrient agar medium was prepared and applied aseptically onto petri dishes. The skin around the teeth of a volunteer with distinct dental features was cleansed with distilled water and allowed to dry. A cotton swab saturated with 5 cc of distilled water was then used to gently rub the area until it fully reached the skin around the teeth. This mixture was evenly spread onto the prepared agar surface. After solidification, wells were created in the agar plates containing the inoculums using a sterile cork borer (6 mm in diameter). An indentation was made by excluding the herbal toothpaste before inoculating onto the agar media petri plates. The plates were chilled for 30 minutes to facilitate proper diffusion of the toothpaste into the agar.

Result & Discussion

Phytochemical screening

Phytochemical	Syzigium aromaticum
Glycosides	Present
Alkaloids	Present
Tannins	Present
Volatile oils	Present

Evaluation parameter of Medicated Toothpaste

Sr.no	**Parameters**	**Observation**
1	Colour	white
2	Odour	Characteristic
3	Taste	Sweet
4	Stability	Stable
5	Spredіblity	Easily spreadable
6	Abrasiveness	Good abrasive
7	Foam ability	good

Conclusion

Clove is renowned for its therapeutic properties, making it a versatile remedy for various health issues such as intestinal parasites, migraine headaches, colds, impotence, and gastrointestinal discomforts like nausea, vomiting, diarrhea, and gas. Clove oil, with its antimicrobial, antifungal, antiseptic, antiviral, aphrodisiac, and stimulating qualities, offers a wide range of health benefits. It is employed in the treatment of toothaches, indigestion, coughs, asthma, headaches, stress, and blood impurities.

Rich in essential minerals like calcium, iron, phosphorus, sodium, potassium, as well as vitamins A and C, clove provides a holistic health boost. Notably, its application in dental care stands out due to its potent germicidal properties, effectively alleviating dental pain, toothaches, sore gums, and mouth ulcers. Eugenol, a compound found in clove oil, has been a staple in dentistry for years. Diluted clove oil gargles provide relief for throat discomforts, while its distinct aroma combats bad breath. Consequently, clove oil is a common ingredient in various dental products and medications, including mouthwashes and toothpaste. Dentists often combine clove oil with zinc oxide to create a temporary white filling material, offering an alternative to root canal procedures.

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