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"Formulation and Characterization of the Oral Hygiene Efficacy of a Novel Herbal Toothpaste with Achyranthes aspera"

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Abstract:

The growing demand for safe, effective, and nature-derived oral care products has led to increased interest in herbal formulations. This study focuses on the formulation and evaluation of a novel herbal toothpaste incorporating Achyranthes aspera, a medicinal plant known for its antimicrobial, anti-inflammatory, and wound-healing properties. The formulation also includes conventional excipients such as sodium lauryl sulphate (as a foaming agent), glycerin (as a humectant), calcium carbonate (as an abrasive), methyl paraben (as a preservative), sodium saccharin (as a sweetener), and peppermint oil (as a flavoring and antimicrobial agent).

The toothpaste was tested for physicochemical qualities such as pH, spread-ability, foamability, abrasiveness, and microbial inhibition. Preliminary results show that the Achyranthes aspera-based product has acceptable organoleptic and functional properties. This study reveals that Achyranthes aspera can be effectively added to toothpaste formulations to improve oral hygiene efficacy. It also indicates that Achyranthes aspera has therapeutic characteristics that can help with oral hygiene and may serve as a helpful component in herbal dental care formulations.

Keywords: Antimicrobial, Toothpaste, Characterization, Anti-inflammatory, Humectant.

1. Introduction:

In the present era of drug development and discovery of newer drug molecules many plant products are evaluated on the basis of their traditional uses.[1] One of the many plants which are being evaluated for their therapeutic efficacies is Achyranthes aspera which is commonly known as Latjeera (Hindi) & Rough Chaff tree (English).[2] It is an erect or procumbent, annual or perennial herb, 1-2 meter in height, often with a woody base, commonly found as a weed of waysides, on roadsides Although it has many medicinal properties, it is particularly used spermicidal antipyretic & as a cardiovascular agent.[3]

Oral hygiene plays an important function in sustaining overall health.[4] Natural alternatives are gaining popularity as people become more aware of the adverse effects and limits of synthetic oral care products.[5] Medicinal plants, traditionally prized for their therapeutic powers, are becoming increasingly prevalent in dental care formulations.[6]

Achyranthes aspera, often known as prickly chaff flower, is a widely distributed medicinal plant used in traditional medical systems such as Ayurvedic and Unani traditions.[7,8] It has a wide range of pharmacological activity, including antibacterial, anti-inflammatory, astringent, and antioxidant properties, making it an attractive choice for oral health applications.[9,10]

Despite its traditional use, the inclusion of Achyranthes aspera into modern dental care formulations is still under investigation.[11] The purpose of this study is to create a toothpaste with Achyranthes aspera extracts and compare its physicochemical qualities and antibacterial efficacy to commercially available toothpastes.[12] The goal is to examine its potential as a safe, effective, and natural alternative for promoting oral hygiene in many different circumstances.[13]

The goal of this research is to use these natural components to develop toothpaste that not only enhances oral health but also serves as an alternative to traditional toothpaste formulations that may contain synthetic ingredients.[14] The development process entails meticulous formulation and standardization

to assure efficacy and safety. Achyranthes aspera is an essential medicinal herb that grows as a weed throughout India.[15] Though practically all of its parts are employed in traditional medicine, the seeds, roots, and shoots are the most essential medicinal components.[16]

2. Main Ingredients for Toothpaste:

2.1 Achyranthes aspera:[17-21]

- Scientific Name: Achyranthes aspera
- Family: Amaranthaceae
- Common Names: Prickly Chaff Flower
- Category: Medicinal herb
- Genus: Achyranthes
- Species: aspera

Fig. No 1 Achyranthes aspera powder

- Uses: Antibacterial and antifungal, Anti-inflammatory, used in treatment of dental issues such as gum inflammation, acts as astringent and wound healer, used in Ayurvedic formulations and herbal tooth powders.[23-28]

2.2 Sodium lauryl sulphate:[29]

- Sodium lauryl sulphate (also called Sodium dodecyl sulfate)
- Chemical Formula: C□□H□□NaO□S
- Common Names: SLS, Sodium dodecyl sulfate, Lauryl sulfate sodium salt, Monododecyl ester sodium salt of sulfuric acid.

Fig. No 2 Sodium lauryl sulphate

- Uses: Anionic surfactant, Detergent, Emulsifying agent, Wetting agent.

2.3 Glycerin:[30]

- **Chemical Nature: Glycerin** is a simple polyol (sugar alcohol) compound with three hydroxyl (–OH) groups, making it highly water-soluble and hygroscopic (absorbs moisture from the air).
- Basic Description: (also known as glycerol) is a clear, odorless, sweet-tasting, and viscous liquid that is widely used in food, cosmetics, pharmaceuticals, and industry.
- Uses: Humectant, solvent, emollient, food additive, pharmaceutical agent.[31-32]

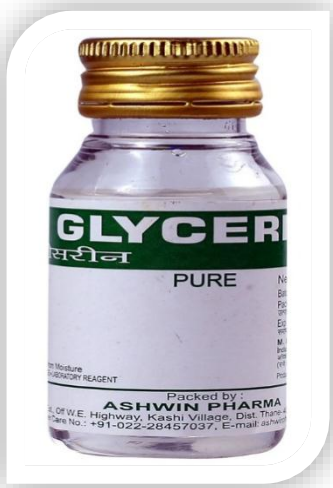

Fig. No 3 Glycerin

2.4 Methyl paraben:[33]

Methyl paraben (also written as methylparaben) is a type of paraben, which is commonly used as preservatives in cosmetics, pharmaceuticals, and food products to prevent the growth of harmful bacteria and mold.

Basic Information:

- Chemical Name: Methyl 4-hydroxybenzoate
- Chemical Formula: $C_8\ H_8\ O_3$
- Molar Mass: 152.15 g/mol
- Appearance: White crystalline powder

Fig. No 4 Methyl paraben

- Solubility: Slightly soluble in water; more soluble in alcohol and other organic solvents

Uses:[34]

- Cosmetics: Found in lotions, shampoos, deodorants, and makeup to prevent microbial growth.
- Pharmaceuticals: Used in creams, ointments, and oral medications.
- Food Industry: As an additive (E number E218) for preservation.

2.5 Calcium carbonate:[35]

Calcium carbonate is a chemical compound commonly found in rocks and naturally occurring substances like chalk, limestone, marble, and shells of marine organisms.

Basic Information:

- Chemical Formula: $CaCO_3$
- Appearance: White, odorless powder or colorless crystals.
- Solubility: Practically insoluble in water; reacts with acids to release carbon dioxide.
- Occurs Naturally As: Calcite, aragonite, limestone, chalk, marble.

Fig No 5 Calcium carbonate

Uses:[36]

- Antacid: Used to relieve heartburn and indigestion.
- Calcium Supplement: For bone health.
- Food Additive: E number E170, used as a firming agent or acidity regulator.

2.6 Peppermint oils:[37]

Scientific Name: Mentha piperita
Family: Lamiaceae (also known as the mint family)
Common Names: Peppermint, Brandy mint, Balm mint
Genus: Mentha
Species: piperita
Uses:[38]

- Used for antimicrobial and anti-inflammatory properties.

Fig. No 6 Peppermint oils

- Used as ingredient in toothpaste, mouthwash, shampoos, lotions, and lip balms.
- It also provides a cooling, refreshing effect due to menthol.
- Used as a flavoring agent in candies, chewing gum, teas, and desserts.
- Promotes alertness, focus, and can reduce nausea.
- Used to clear sinuses and improve respiratory function.

2.7 Sodium saccharine:[39]

Sodium Saccharin, a widely used artificial sweetener.
Common Name: Sodium saccharin
Chemical Formula: C□H□NNaO□S
Appearance: White crystalline powder.
Taste: Intensely sweet (about 300–700 times sweeter than sugar).
Used: Used in blends with other sweeteners to enhance flavor, Sweetens oral medications, chewable tablets.[40]

Fig. No 7 Sodium Saccharin

3. Formulation Profile of Toothpaste:

Table No. 1 Formulation Profile of Toothpaste.

Sr. No	Ingredients	Quantity
1.	Achyranthes aspera powder	3 gm
2.	sodium lauryl sulphate	3 ml
3.	glycerin	30 ml
4.	methyl paraben	0.5 ml
5.	Calcium carbonate	20 gm
6.	Sodium Saccharin	0.5 gm
7.	Peppermint oils	Q.s.

4. Procedure for Preparing of Toothpaste:

Step – 1 Preparation of Achyranthes aspera Extract:

- Take dried Achyranthes aspera leaves.
- Grind to a fine powder or extract using aqueous solvent (boiling and filtering).
- Dry the extract and use the powder directly.

Step -2 Mixing the Base Abrasives:

- In a clean bowl, weigh and mix Calcium carbonate with Achyranthes aspera powder.

- Ensure a uniform blend using a mortar and pestle or mechanical mixer.

Step – 3 Preparation of Liquid Phase:

- In a separate container, mix Glycerin, Sodium saccharin, and Methyl paraben.
- Stir until completely dissolved.
- Add Sodium lauryl sulfate to the mixture slowly while stirring continuously.

Step – 4 Combining Phases:

- Slowly add the liquid phase to the dry mix Calcium carbonate blending well to form a smooth paste.
- If needed, add purified water gradually to adjust consistency.

Step -5 Add Flavoring Agent:

- Add Peppermint oil at the end and mix thoroughly to ensure uniform distribution.

Step – 6 Final Mixing & Packaging:

- Homogenize the paste using a hand blender.
- Transfer the finished toothpaste into sterilized toothpaste containers.
- Label it and store in dry place.

5. Finally Formulated paste:

Fig. No 8 Finally Formulated paste.

6. Physical Evaluation Parameter and Results of Toothpaste:

The following physical parameters have been studied for the formulation of Herbal Toothpaste. Color, odor, and appearance. Texture, Ph, homogenecity, stability, consistency, spreadable capacity, Foamability and Smoothness.

Table No. 2 Physical Evaluation Parameter of Toothpaste.

Sr. No	Parameter	Observation
1.	Color	Light Brown
2.	Oduors	Fragrant
3.	Appearance	Soft
4.	Texture	Smooth
5.	pH	7.7
6.	Taste	Sweet
7.	Spread ability	Uniform
8.	Stability	Stable at Room Temp.
9.	Consistency	Semisolid
10.	Homogenecity	Good
11.	Smoothness	Smooth
12.	Foamability	Good
13.	Weight Test	11.82 gm
14.	Solubility	Soluble in water

7. Weight Test of Toothpaste:

Fig. No 9 Weight Test sample of Toothpaste.

8. Solubility Test of Toothpaste:

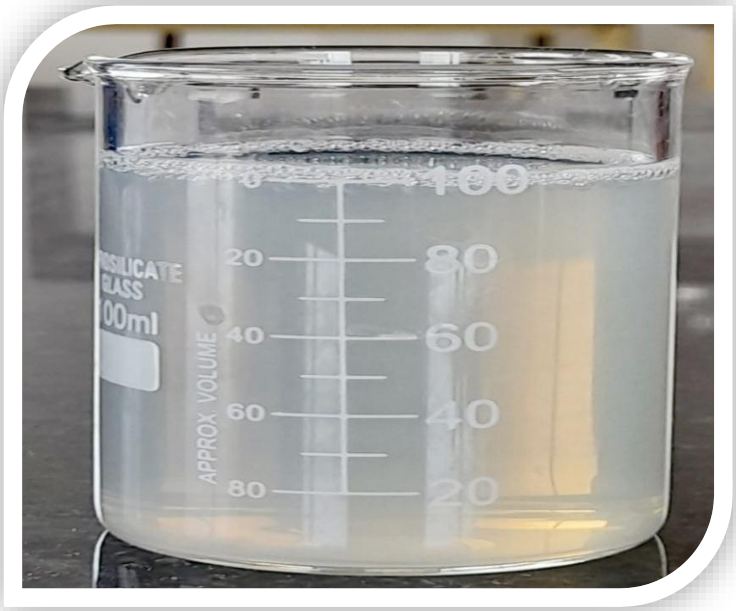

Fig. No 10 Weight Test sample of Toothpaste.

9. Formulated sample of Toothpaste:

Fig. No 11 Formulated sample of Toothpaste.

10. Conclusion:

As a result, an effective herbal toothpaste formulation was successfully prepared using Achyranthes aspera as the primary active herbal ingredient, supported by appropriate excipients such as calcium carbonate (abrasive), glycerin (humectant), sodium lauryl sulfate (foaming agent), and preservatives such as methyl paraben. The inclusion of peppermint oil created a pleasant flavor and refreshing sensation, while sodium saccharin served as a non-caloric sweetener. The finished product had good consistency, stability, and desirable physical qualities, showing its potential as a natural and effective alternative to commercial toothpastes.

11. Conflict of Interests:

- The authors declare that they have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this paper.

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