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Formulation and Evaluation of Moringa Oleifera Toothpaste for Diabetic Patients

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Abstract: Diabetes mellitus is a widespread metabolic disorder that often leads to complications affecting oral health, including gum disease, dry mouth, and delayed healing of oral wounds. Maintaining good oral hygiene is crucial for diabetic patients to prevent infections and manage overall health. Herbal remedies are gaining attention due to their natural origin, fewer side effects, and therapeutic benefits. Moringa oleifera, a medicinal plant known for its rich nutritional content and pharmacological properties, exhibits strong antibacterial, antioxidant, and anti-inflammatory effects, making it a suitable candidate for oral care products. This study aimed to formulate and evaluate an herbal toothpaste incorporating an aqueous extract of Moringa oleifera leaves, specifically designed for individuals with diabetes. The toothpaste was prepared using commonly accepted excipients and assessed for various quality parameters such as pH, texture, spreadability, foaming capacity, and stability. Antimicrobial activity was also evaluated against oral pathogens associated with dental problems in diabetic individuals, including Streptococcus mutans and Candida albicans. The findings revealed that the formulated toothpaste possessed desirable physical characteristics and showed promising antimicrobial properties. Its pH was found to be within a safe range for oral use, and it demonstrated good consistency and acceptable foaming ability. The antimicrobial tests indicated a significant inhibitory effect on the tested microorganisms, suggesting the potential of Moringa oleifera extract in promoting oral health among diabetic patients. Overall, the herbal toothpaste developed in this study offers a natural and effective alternative to conventional oral care products

Keywords: Herbal toothpaste, Moringa oleifera, diabetes, oral hygiene, antimicrobial activity, formulation, evaluation, natural oral care.

I. INTRODUCTION

Moringa oleifera has a rich history of utilization for medicinal, nutritional, and water treatment purposes dating back to ancient times. The plant is renowned for its abundance of vitamins, minerals, and various chemical constituents, making it a valuable resource. Among its notable pharmacological properties are its effectiveness as an anti-diabetic, anti-diarrheal, anti-fungal, anti-bacterial, anti-allergic, anti-cancer, anti-inflammatory, and anti-oxidant agent. Natural products have the advantages of causing minimum side effects, being biocompatible, available, and economical, with a wide array of biological activities. Reports have described the use of natural products with antimicrobial and anti-inflammatory properties to treat oral conditions and promote wound healing. Moringa oleifera, known as the "drumstick" or "horseradish" tree, is believed to have medicinal properties regarding a range of medical conditions, though there is limited information on its use in oral medicine.

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Properties of Moringa oleifera Herbal Toothpaste

Moringa-based herbal toothpaste exhibits various properties, including antibacterial, antifungal, anti-inflammatory, and antioxidant activities. Pharmacognostic evaluation ensures identity and purity, while microbial testing confirms its ability to inhibit oral pathogens.

Pharmacological Properties:

Antimicrobial: Inhibits bacterial growth Anti-inflammatory: Reduces gum inflammation Analgesic: Provides pain relief Antioxidant: Counteracts oxidative stress in gum tissues

Pharmacognostic Properties

- 1. Sourced from authenticated plants
- 2. Morphological and microscopic characters identified
- 3. Evaluated for ash value, extractive value, and moisture content

Microbial Properties

Demonstrates clear zones of inhibition in microbial tests Reduces overall oral microbial burden Limits biofilm and plaque formation.



Macroscopic Characteristics (Fresh Leaves)

| Feature | Description | |
|------------------|---|--|
| Colour | Dark green (fresh), dull green (dried) | |
| Odour | Mild characteristic | |
| Taste | Slightly bitter and grassy | |
| Shape | Pinnate compound leaves with ovate leaflets | |
| Size of leaflets | 1–2 cm long, 0.5–1 cm wide | |

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Surface

Smooth upper surface; slightly hairy lower side

Arrangement

Alternate arrangement of leaflets



Powder Characteristics (Moringa Leaf Powder)

| Observation | Description | |
|-----------------------|---|--|
| Colour | Green to dull green | |
| Odour | Earthy, characteristic | |
| Taste | Slightly bitter | |
| Microscopy of powder | Shows fragments of epidermis, xylem vessels, parenchyma cells, and calcium oxalate crystals | |
| Diagnostic Characters | Trichomes (unicellular), stomata, xylem vessels, and crystals | |

Composition

| Ingredient | Quantity | Properties |
|------------------|-------------|---|
| | | |
| Moringa oleifera | 1g | Antibacterial activity, Anti-inflammmatory, |
| | | |
| | | |
| Clove oil | 2 - 4 drops | Antioxidant |
| | | |
| | | |

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| Gum tragacanth | 2g | Viscous |
|---------------------------|-------|-----------------|
| Calcium carbonate | 10g | Abrasive agent |
| Methyl paraben | 0.5g | Antimicrobial |
| Menthol | 0.2g | Cooling agent |
| Titanium dioxide | 1g | Whitening agent |
| Sodium lauryl sulphate | 3g | Foaming agent |
| Distilled water | 10 ml | Vehicle |

Procedure

ALL THE REQUIRED MATERIALS FOR MAKING THE TOOTHPASTE WERE COLLECTED. EACH INGREDIENT WAS DRIED COMPLETELY AND POWDERED.

↓ THE POWDERED INGREDIENTS WERE WEIGHED ACCURATELY AS PER THE NEED.

THE INGREDIENTS WERE MIXED WITH CHEMICALS, SUCH AS GLYCERIN IS USED AS A HUMECTANT AND SODA SOLVENT, TO FORM A BASE FOR THE PREPARATION.

> ↓ THE CHEMICAL-BASED POWDER INGREDIENTS WERE ADDED TO THE MORTAR PESTLE AND SLS POWDER WAS ADDED (FOAMING AGENT).

> > \downarrow

THE CHEMICAL INGREDIENTS, WELL, A PASTE CONSISTENCY IS FORMED.

Trituration method

The binder is premixed with solid abrasives and triturate, which are then mixed with the liquid phase containing humectants and oils. Then, add preservatives and sweeteners to the mixer. After the formation of a homogeneous paste, the flavour and the detergent were added last at a slow speed. Agitation to minimize foaming, mixed, milled, and tubed.

Evaluation Parameters of Toothpaste

The quality and performance of herbal toothpaste are assessed using the following parameters:

pH:

The pH should ideally be between 6.5 and 7.5 to maintain oral tissue compatibility. A pH meter is used to evaluate a 10% toothpaste solution in distilled water.

Foaming Ability:

Indicates the cleaning efficiency. Determined by shaking a toothpaste solution and measuring foam volume.

Spreadability:

Evaluated by placing a small amount of toothpaste between two glass slides and measuring the spread diameter under a given weight.

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Abrasiveness:

Assessed to ensure that the paste does not erode dental enamel. Performed using enamel blocks or standard methods like radioactive dentin abrasion.

Organoleptic Properties:

Taste, odour, texture, and appearance are evaluated by human volunteers for acceptability.

Microbial Load Test:

Total bacterial and fungal counts are checked to ensure microbial safety using standard plate count methods.

Stability Testing:

Carried out under accelerated conditions ($40^{\circ}C \pm 2^{\circ}C$, 75% RH) for 3–6 months to assess phase separation, colour, odour, and microbial growth.

Extrudability and Tube Collapse Test:

Ensures the ease with which toothpaste can be squeezed from the tube and maintains its form after extrusion.

Results

Phytochemical Analysis of Moringa oleifera

| Sr. No. | Test | Specific Test | Methanol Extract | Aqueous Extract |
|---------|------------------------|--------------------------|-------------------------|------------------------|
| | | | | |
| 1 | Carbohydrate | Molisch Test | +ve | +ve |
| | | | | |
| | | Benedict Test | +ve | +ve |
| 2 | Alkaloids | Dragendorff Test | +ve | +ve |
| | | Mayer's Test | +ve | -ve |
| | | Hager's Test | +ve | +ve |
| | | Wagner's Test | +ve | -ve |
| 3 | Saponins | Foam Test | -ve | -ve |
| 4 | Glycosides | Borntrager's Test | +ve | -ve |
| | | Legal's Test | +ve | +ve |
| 5 | Steroids (Phytosterol) | Salkowski Test | -ve | -ve |
| | | Liebermann–Burchard Test | -ve | -ve |
| 6 | Fixed Oils and Fats | Stain Test | +ve | +ve |
| 7 | Phenol | Ferric Chloride Test | -ve | -ve |
| 8 | Tannins | Gelatin Test | +ve | +ve |

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|-------|------------------------------|-----------------------|-----|--------------|
| 9 | Flavonoids | Alkaline Reagent Test | +ve | +ve |
| | | Lead Acetate Test | +ve | +ve |
| | | Shinoda Test | +ve | -ve |
| 10 | IO Protein and Amino Acids | a) Biuret Test | +ve | +ve |
| | | b) Xanthoproteic Test | -ve | -ve |
| | | c) Ninhydrin Test | -ve | -ve |

| Sr.no | Parameters | Observation |
|-------|------------------|-------------|
| 01 | Ph | 6.8 |
| 02 | Foamability | 5.5 |
| 03 | Viscosity (pa-s) | 50 pa-s |
| 04 | Excludability | Good |

pH test



Spreadiability



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Toothpaste



Discussion

The present study focused on the development of an herbal toothpaste using aqueous extract of Moringa oleifera leaves, targeting the specific oral care needs of diabetic patients. The formulated toothpaste exhibited acceptable organoleptic properties such as smooth texture, mild herbal aroma, and natural green colour, enhancing its user acceptability. Physicochemical parameters, including pH, spreadability, and foaming ability, were within acceptable limits, ensuring safety and efficacy for daily oral hygiene use.

The pH of the formulation was near neutral, which is essential to avoid enamel erosion and maintain oral tissue health in diabetic patients. Antimicrobial testing revealed that the toothpaste demonstrated notable activity against common oral pathogens, particularly Streptococcus mutans and Candida albicans, which are often responsible for dental caries and oral thrush.

This suggests that the phytoconstituents present in Moringa oleifera extract contributed significantly to the antimicrobial action, potentially reducing the risk of oral infections in diabetic individuals.

II. CONCLUSION

The study successfully formulated an herbal toothpaste incorporating aqueous extract of Moringa oleifera leaves, specifically designed to meet the oral care needs of diabetic patients. The formulation met all standard quality parameters and exhibited strong antimicrobial activity, particularly against organisms commonly found in diabetic oral infections. The current design has good organoleptic, spreading, foaming, abrasive, and in vitro antimicrobial properties. It also has the advantage of not having harmful substances, chemicals, and the presence of herbal powders, a wide range of natural compounds good for teeth and the oral cavity toothpastes. Because design has prospects for such design and widespread use.

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