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FORMULATION AND ANTIMICROBIAL ASSESSMENT OF A NOVEL POLYHERBAL DENTIFRICE FOR ORAL CARE APPLICATIONS

Milap Choudhary[1], Ritika Gupta*, Kapil Kumar Verma[2]

[1]Department of Pharmacy, Minerva College of Pharmacy, Indora (H.P).

*Department of Quality Assurance, Minerva College of Pharmacy, Indora (H.P).

[2]Department of Pharmacology, Minerva College of Pharmacy, Indora (H.P).

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***Corresponding Author**

Ritika Gupta

Department of Quality Assurance, Minerva College of Pharmacy, Indora (H.P).

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ABSTRACT

The present investigation was undertaken to formulate and evaluate a novel polyherbal dentifrice containing medicinal plant extracts for oral care applications. The formulation was developed using extracts of neem, clove, babool and meshwak due to their established antimicrobial and oral protective properties. The prepared dentifrice was evaluated for physicochemical parameters including appearance, pH, spreadability, foamability, moisture content, stability and antimicrobial activity. Antimicrobial efficacy was assessed by agar well diffusion method against oral microbial strains. The developed polyherbal dentifrice demonstrated acceptable physicochemical characteristics and significant antimicrobial activity, suggesting its suitability as a natural oral care formulation.

KEYWORDS: Polyherbal dentifrice, antimicrobial activity, oral care, medicinal plants, herbal formulation.

1. INTRODUCTION

Oral diseases represent a major public health concern and include dental caries, gingivitis, plaque accumulation and periodontal infections. These conditions are mainly associated with microbial colonization within the oral cavity. Synthetic oral care products are extensively

used; however, prolonged exposure to chemical ingredients may lead to adverse effects including mucosal irritation and alteration of oral microflora.[1]

Medicinal plants have been widely utilized in traditional systems of medicine for maintenance of oral hygiene due to their antimicrobial, anti-inflammatory and antioxidant activities. Plant-derived preparations possess improved biocompatibility and reduced adverse effects compared with synthetic agents.[2]

- **Neem (Azadirachta indica)**

Azadirachta indica is a medicinal plant extensively employed in traditional medicine systems for the management of oral and dental disorders. The plant contains biologically active constituents such as nimbidin, azadirachtin and flavonoids which exhibit antimicrobial, anti-inflammatory and antioxidant properties. Neem has been reported to inhibit the growth of several oral microorganisms involved in plaque formation and periodontal diseases. Owing to these properties, neem is considered a valuable ingredient in herbal oral care formulations.[3]

- **Clove (Syzygium aromaticum)**

Syzygium aromaticum is widely recognized for its therapeutic value in oral healthcare. The dried flower buds contain eugenol as the principal phytoconstituent responsible for antimicrobial, analgesic and antiseptic activities. Clove has traditionally been used for the relief of dental pain and prevention of oral infections. Its antimicrobial potential against oral pathogens supports its incorporation into dentifrice formulations intended for maintenance of oral hygiene.[4]

- **Babool (Vachellia nilotica)**

Vachellia nilotica has been traditionally utilized for strengthening gums and maintaining oral cleanliness. The plant is rich in tannins, polyphenols and flavonoids which contribute to its astringent and antimicrobial activities. Babool bark and twigs have long been employed in indigenous dental practices due to their ability to reduce plaque accumulation and improve gingival health. The plant therefore represents an important component of herbal oral care preparations.[5]

- **Miswak (Salvadora persica**)

Salvadora persica, commonly known as miswak, has a long history of use as a natural oral hygiene aid. The plant contains alkaloids, fluoride, silica and sulfur compounds which

contribute to its antimicrobial and cleansing effects. Regular use of miswak has been associated with reduction of dental plaque and maintenance of oral health. Its traditional acceptance and therapeutic properties support its application in development of herbal dentifrice formulations.[6]

Fig 1: Neem leaves, Clove buds, Babool bark, Miswak Wood Stick.[7]

The present study focused on formulation and evaluation of a novel polyherbal dentifrice containing neem, clove, babool and meshwak extracts and assessment of its antimicrobial efficacy.[8]

2. AIM

To formulate and evaluate a novel polyherbal dentifrice containing medicinal plant extracts and assess its antimicrobial potential for oral care applications.

3. OBJECTIVES

1. To formulate a polyherbal dentifrice containing neem, clove, babool and miswak extracts.
2. To evaluate physicochemical properties of the prepared formulation.
3. To determine antimicrobial activity against oral microorganisms.
4. To assess formulation stability and oral suitability.
5. To establish the potential of herbal dentifrice for oral hygiene applications.

4. MATERIALS AND METHODS

4.1 Materials

Table 1: Composition of Polyherbal Dentifrice Formulation (100 g Batch).

S. No.	Ingredients	Quantity	Function
1	Neem extract	2 g	Antimicrobial agent
2	Clove extract	2 g	Antiseptic and antimicrobial agent
3	Babool extract	2 g	Anti-plaque and astringent agent
4	Miswak extract	2 g	Oral cleansing agent
5	Calcium carbonate	34 g	Abrasive agent
6	Glycerin	20 g	Humectant
7	Tragacanth gum	2 g	Binder and thickening agent
8	Sodium lauryl sulphate	1.5 g	Foaming agent
9	Sodium benzoate	0.5 g	Preservative
10	Peppermint oil	0.5 mL	Flavouring agent
11	Distilled water	q.s. to 100 g (≈34 g)	Vehicle

4.2 Methods

- **Step 1: Preparation of Herbal Extract Blend**

Accurately weighed quantities of neem extract, clove extract, babool extract and meshwak extract were taken separately and mixed thoroughly in a mortar to obtain a uniform polyherbal blend.[9]

- **Step 2: Preparation of Base Material**

Calcium carbonate was accurately weighed and transferred into a clean mortar. The powder was triturated to break agglomerates and obtain a fine uniform consistency.[10]

- **Step 3: Addition of Humectant**

Glycerin was incorporated gradually into the powdered base with continuous trituration to produce a smooth and homogeneous mass. Glycerin was added slowly to avoid lump formation.[2]

- **Step 4: Incorporation of Binding Agent**

Tragacanth gum was added to the prepared mixture and blended uniformly to improve viscosity and consistency of the dentifrice formulation.[11]

- **Step 5: Addition of Herbal Extracts**

The prepared polyherbal extract blend containing neem, clove, babool and meshwak was incorporated into the base mixture with continuous mixing to ensure uniform distribution of active constituents.[9]

➢ **Step 6: Addition of Foaming and Preservative Agents**

Sodium lauryl sulphate was added as a foaming agent followed by incorporation of sodium benzoate as preservative. The mixture was triturated until a uniform consistency was achieved.[12]

➢ **Step 7: Addition of Flavouring Agent**

Peppermint oil was added gradually to enhance organoleptic properties and provide a pleasant flavour.[13]

➢ **Step 8: Adjustment of Final Volume**

Distilled water was added slowly in small portions with continuous mixing until a smooth and homogeneous dentifrice with suitable consistency was obtained.[14]

Fig. 2: Polyherbal toothpaste containing clove, neem, babool and miswak extracts.

➢ **Step 9: Homogenization**

The prepared dentifrice was mixed thoroughly to ensure uniform distribution of ingredients and absence of lumps.[15]

➢ **Step 10: Packaging and Storage**

The prepared polyherbal dentifrice was transferred into suitable airtight containers and stored at room temperature for further evaluation studies.[2]

4.2 Evaluation Parameters

4.2.1 Organoleptic Evaluation

Colour, odour, appearance and consistency were visually examined.

4.2.2 pH Determination

One gram of formulation was dispersed in 10 mL distilled water and pH was measured using a digital pH meter.

4.2.3 Spreadability Test

Spreadability was determined by measuring spreading diameter between glass slides.

4.2.4 Foamability Test

Foam volume was recorded after shaking a known quantity of dentifrice suspension.

4.2.5 Moisture Content

Formula

Moisture Content (%) =\frac{Initial\ weight - Final\ weight} \{Initial\ weight}\times100

4.2.6 Stability Study

Formulation was stored at room temperature and observed periodically for changes in appearance and consistency.

4.2.7 Antimicrobial Activity

Antimicrobial activity was assessed by agar well diffusion method against oral microbial strains and zone of inhibition was measured.

6. RESULTS AND DISCUSSION

Table 2: Evaluation Results of Polyherbal Dentifrice.

Sr. No	Parameter	Result	Discussion
1.	Appearance	Smooth homogeneous paste	Uniform mixing and acceptable consistency observed
2.	Colour	Brownish green	Due to incorporation of herbal extracts
3.	Odour	Pleasant aromatic	Acceptable sensory characteristic
4.	pH	6.9 ± 0.1	Compatible with oral environment
5.	Spreadability	Good	Suitable application characteristics
6.	Foamability	Moderate	Adequate cleansing performance
7.	Moisture content	5.24 ± 0.18 %	Within acceptable range
8.	Stability	Stable	No phase separation or colour change observed
9.	Antimicrobial activity	Zone of inhibition = 19 ± 1.1 mm	Significant inhibitory activity against oral microorganisms

6.1 DISCUSSION

The developed polyherbal dentifrice exhibited satisfactory physicochemical characteristics suitable for oral application. The pH remained within the physiological range indicating compatibility with oral tissues. Good spreadability and moderate foamability confirmed acceptable formulation performance.

The antimicrobial evaluation demonstrated considerable inhibitory activity against oral microorganisms. The observed activity may be attributed to phytoconstituents present in neem, clove, babool and meshwak extracts. The formulation-maintained stability throughout the study period without any visible changes.

7. CONCLUSION

The present study demonstrated the successful formulation and evaluation of a novel polyherbal dentifrice containing neem, clove, babool and mishwak extracts for oral care applications. The developed formulation exhibited satisfactory physicochemical characteristics including acceptable appearance, pH, spreadability, foamability and stability. Antimicrobial assessment revealed considerable inhibitory activity against oral microorganisms, indicating the therapeutic potential of the formulation in oral hygiene management. The combined action of herbal constituents may contribute to plaque control, reduction of microbial load and maintenance of gingival health. Therefore, the developed polyherbal dentifrice may serve as a promising natural alternative to conventional oral care products and warrants further clinical investigation for evaluation of long-term efficacy and safety.

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