

Formulation and Evaluation of Herbal Toothpowder

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Abstract

Tooth powder, a traditional dentifrice, has been used for centuries to maintain oral hygiene and is experiencing renewed popularity as a natural and eco-friendly alternative to toothpaste. Available in powder form, it typically contains ingredients and herbs that aid in cleaning teeth, freshening breath. Herbal tooth powders, made from natural components such as neem, clove, and peppermint that offer antibacterial, cleansing, and freshening properties. The growing market for herbal products highlights the need for standardization to ensure the quality and purity of herbal formulations. Overall, herbal tooth powders offer a promising and sustainable alternative for maintaining optimal oral health.

KEYWORDS: Herbal Toothpowder; Oral hygiene; Neem; Anti-bacterial; Dental Caries; Tooth; Oral Care, etc.

1. INTRODUCTION

Tooth powder is a type of dentifrice, like toothpaste, used for cleaning teeth and maintaining oral hygiene. It comes in powder form and typically contains ingredients such as neem, turmeric, and cloves, which help clean the teeth, freshen breath, and possibly whiten the teeth. Users apply it to their toothbrush, often wetting the brush first to help the powder stick, and then brush their teeth in the same way they would with traditional toothpaste. Tooth powders have been used for many centuries and are experiencing a resurgence in popularity, particularly among those seeking natural or zero-waste alternatives to conventional toothpaste tubes[1].

Oral hygiene refers to the practice of maintaining the cleanliness of one's mouth and teeth to prevent dental problems such as cavities, gingivitis, and bad breath. This involves regular brushing and flossing to remove plaque and food particles, as well as routine dental check-ups for professional cleaning and examination. Good oral hygiene is crucial for overall health, as it can prevent oral infections and diseases that might affect other parts of the body.

The quality of life and overall well-being are significantly impacted by oral health. [2]

Herbal toothpowder is a type of tooth powder made using natural ingredients and herbs, without the synthetic chemicals found in many commercial toothpastes. These powders often

include components such as clove, turmeric, neem, and peppermint oil, among others, known for their cleansing, antibacterial, and freshening properties. Herbal toothpowders aim to clean teeth, freshen breath, and support overall oral health using traditional and natural remedies. They appeal to those seeking organic, eco-friendly, and potentially less abrasive alternatives to conventional tooth care products[3].

The market value of herbal products is steadily increasing. Due to the variability of phytoconstituents, substituents, and adulterants in crude drugs, these formulations must be standardized for their quality and purity. A wide range of herbal tooth powders, comprising various ingredients, is available on the market. In the identification and quantification of active compounds, several pharmacopeial monographs on plant materials are found lacking. Hence, for the standardization of herbs and their formulation, methods focusing on these aspects are considered useful. Using herbal tooth powder maintains oral hygiene in a reliable, safe, and cost-effective manner [4].

1.1 IDEAL PROPERTIES OF TOOTH POWDER[5]

Good abrasive effect

Calcium carbonate, primarily used as an abrasive, effectively removes stains and debris from teeth[6].

Non-irritant and non-toxic

When using tooth powder, it is essential to ensure that it does not irritate the teeth and does not contain any toxic substances that could harm them. Dentifrices contain many chemicals that maintain dental health and clean teeth. Chemicals such as triclosan may cause cancer, while sodium lauryl sulphate, used as a foaming agent, acts as a skin irritant and dries out the delicate skin, seeping into the blood. You should also avoid propylene glycol, fluoride, and diethanolamine (DEA) in dentifrice, as they are known to be harmful[7].

Prolonged effect

Tooth powder should maintain excellent dental health for a long time due to its long-lasting effects [6].

Impart no stain in the tooth

Dentifrice uses carbamide peroxide and hydrogen peroxide as whitening agents. Dentifrice uses natural ingredients, including baking soda, charcoal, and vinegar. Natural ingredients, however, take more time to yield good results. Thus, these stain removers help whiten and polish the teeth. Thus, they help remove tooth dislocation.

Cheap and easily available

Tooth powder must contain ingredients that are cost-efficient and easily available in the market, ensuring no shortage of any material[5].

Keep the mouth fresh and clean

Tooth powder must include a flavouring agent that helps maintain good mouth Odor. Manufacturers add peppermint oil to tooth powder to freshen breath and mask the taste of other ingredients[6].

1.2 ADVANTAGES OF HERBAL TOOTH POWDER[8]

Maintenance of Oral Hygiene

Promotes a comprehensive cleaning for overall oral health.

Plaque Inhibition

Works to prevent the accumulation of plaque on tooth surfaces.

Gingivitis Relief

Soothes symptoms of gingivitis, including soreness, bleeding, and gum swelling.

Symptom Alleviation

Effectively reduces tooth sensitivity and associated pain.

Ease of Use

Features a user-friendly design for straightforward operation and seamless integration into any daily routine.

1.3 What is Tooth?

Human teeth consist of anatomical structures built up from successive layers of hard mineralized tissues: enamel, dentin, and root cement[10]. The light reflection patterns that

influence the overall tooth colour are generated by the tooth's dimensions, shape, and surface structure[11]. The tooth is composed of two parts: the crown and the roots. The crown is covered by an outer surface called enamel, which is the hardest tissue in the human body, not just in the tooth. The major composition of enamel is made up of hydroxyl apatite, while it also consists of water and keratin. The largest portion of a tooth consists of dentine[12]. Dentine, which lies beneath the enamel, is composed of hydroxyapatite in its passive form. Not only the tooth, but also saliva, which facilitates the consumption of food, is part of the oral composition. Saliva is proposed as the primary element for lubricating food and maintaining an optimal oral environment[13]. Saliva is produced by various glands, with the labial, lingual, buccal, and palatal glands being the larger and smaller glands that continuously produce saliva to maintain a dynamic state in the tooth environment. Teeth uniquely allow researchers to directly compare extant specimens with fossilized ones formed millions of years apart. Teeth uniquely allow researchers to directly compare extant specimens with fossilized ones formed millions of years apart[14]. The dental profession aspires to preserve and maintain healthy teeth throughout a person's lifetime[15].

1.4 Tooth-Related Problems

At the 2021 World Health Assembly, member states adopted a significant resolution aimed at advancing global oral health.[16] The WHO defines dental caries as a localized, post-eruptive pathological process of external origin that softens the hard tooth tissue, leading to the formation of cavities. Bacteria in plaque that accumulates on the teeth's surface interact during this process. Among all cariogens, *Streptococcus mutans* is the organism most frequently isolated from plaque colonies. *Streptococcus mutans* ferments sucrose, and acids are produced that demineralize tooth enamel[17].

Oral health is a fundamental aspect of overall health. Oral diseases create many problems for individuals and society. They are very commonly found all over the world. While effective methods and adequate information for preventing oral diseases exist, oral diseases remain one of the most prevalent health issues[18].

The population survey reveals that oral diseases, primarily dental caries and periodontal diseases, continue to be significant public health concerns. Dental caries and periodontal disease cause significant problems that impact the quality of life, often leading to tooth loss[19].

Dental caries (tooth decay)

In developing countries, dental caries poses the most important dental health problem. In the Indian subcontinent, the prevalence of dental caries is reported to be approximately 50%-60%[20]. Lifestyle choices significantly influence dental caries, making it the most prevalent human disease worldwide [21]. Dental caries occur when plaque forms on the surface of a tooth and converts the free sugars (all sugars added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices) in foods and drinks into acids that destroy the

tooth over time[22]. A continued high intake of free sugars, inadequate exposure to fluoride, and failure to remove plaque by tooth brushing can lead to caries, pain, and sometimes tooth loss and infection. Older adults frequently experience tooth loss, which impacts their quality of life, despite

considerable progress in dental treatment and the prevention of tooth decay [23]. The structure and properties of the individual tissue determine the durability of a tooth[24].

Periodontal disease

A chronic oral bacterial infection characterizes periodontal disease, which inflames the gums and gradually destroys the periodontal tissues and alveolar bone that support the teeth[25]. Periodontal disease, a gum infection, results from poor oral hygiene. When plaque remains on the teeth, it leads to gum disease. If left untreated, this condition can deteriorate the jawbone and, in severe cases, lead to tooth loss[26]. Our periodontist in Bellevue can detect many signs of periodontal disease during a dental exam. At Premier Periodontics, we specialize in treating patients at any stage of gum disease. To prevent and treat periodontal disease, one primarily controls plaque deposits through mechanical methods, such as scaling and root planning, to achieve optimal plaque control[27].

Sensitive teeth

A short and sharp sensation of pain in response to thermal, tactile, osmotic, evaporative, or chemical stimuli characterizes dental hypersensitivity (DH), a common oral disease[28]. Your teeth become sensitive to hot and cold foods and drinks when the enamel wears away, exposing the dentin. Tubes in the dentin lead to the nerve deeper inside the tooth, allowing hot or cold substances to travel along the tubes to the nerve and cause intense pain. Tooth decay, gum disease, root infection, a cracked or broken tooth, worn-down crowns or fillings, enamel erosion, and receding gums can all cause tooth sensitivity, also known as dentin hypersensitivity. The naturally thin enamel layer of your teeth can also make them sensitive [29].

Toothpaste and mouthwashes specifically meant for sensitive teeth are available, and your dentist might also recommend treatments such as fluoride treatments, crowns, gum grafts, or root canals, depending on the severity of your case[31].

1.5 Herbal Ingredient used in Toothpowder[32]

- Turmeric
- Neem
- Ash (Cow dung)
- Pippali
- Black Pepper
- Rock Salt
- Fennel Powder
- Clove
- Cardamom
- Calcium Carbonate
- Peppermint Oil
- Tomar
- Magnesium Carbonate

Despite the advancements in public policies so far, dental caries is still considered by authorities and dental professionals to be the most prevalent and costly oral infectious disease worldwide, representing a significant global public health problem that needs to be managed. In the last decades, effective caries-preventive methods have been developed and amended[29]. It is well known that the chemical control of plaque can effectively prevent the development of Dental caries[36].

In this context, novel therapeutic agents against Dental caries, aimed at minimizing the adverse effects of synthetics (altered taste, mucosal desquamation, and tooth staining), have been proposed in the form of natural products (plant extracts, essential oils, and isolated compounds)[30].

2. Materials and Methods[32, 41]

2.1 Material

All the herbal ingredients were collected from the local Market. All other ingredients, such as Calcium Carbonate [37] and Magnesium Carbonate, were obtained from the Laboratory. All the ingredients are of analytical grade[34].

Table No. 1: List of Ingredients

S.No.	Ingredients	Formulation Code				
		F1	F2	F3	F4	F5
1.	Clove (gm)	5	5	5	-	5
2.	Turmeric (gm)	2.9	4	2.6	3.2	5
3.	Neem (gm)	3.1	3.8	5.8	6.4	-
4.	Fennel (gm)	3.2	3.2	3.2	3.2	3.2
5.	Cardamom (gm)	4.2	4.2	4.2	4.2	4.2
6.	Rock Salt (gm)	4	5.6	5	-	3.6
7.	Black Pepper (gm)	0.2	2	1	2.8	0.8
8.	Pippali (gm)	0.4	0.4	0.4	0.4	0.4
9.	Tomar (gm)	0.6	0.6	0.6	0.6	0.6
10.	Ash (Cow dung) (gm)	62	60	58	56	59
11.	Calcium Carbonate (gm)	10	7	11	9	11
12.	Magnesium Carbonate (gm)	4.2	4	3	5	7
13.	Peppermint oil (ml)	0.2	0.2	0.2	0.2	0.2

2.2 Method of Preparation

Grind ingredients

Grind all the hard and whole ingredients, such as cloves, cardamom, black pepper, and fennel seeds, to make a fine powder using a mortar and pestle.

Mix dry Ingredients

In a large mixing bowl, combine equal parts of each powdered herb and spice. Typical proportions might be about 1 tablespoon each for a small batch, but adjust according to your preference and the potency desired. Include rock salt, tomor, ash, calcium carbonate, and magnesium carbonate in this mixture[39].

Sieve

Pass the mixture through a fine-mesh sieve to ensure that all components are finely ground and to remove any large particles. This step is crucial for achieving a smooth texture in the final product[31].

Add essential oil

Add a few drops of peppermint oil to the mixture. Use a dropper for precision and mix thoroughly with a spatula or spoon. Peppermint oil not only Flavors the powder but also has antibacterial properties and provides a refreshing aftertaste.

Mix thoroughly

Ensure that all ingredients are well combined. The consistency should be even and homogenous, without clumping. If the mixture is too dry, a few more drops of peppermint oil can be added; mix well after each addition.

Store

Transfer the prepared tooth powder into an airtight container to keep it dry and to maintain its aromatic freshness. Label the container with the date it was prepared.

Usage

To use, wet your toothbrush, dip it into the tooth powder, and brush as you normally would. Rinse thoroughly after brushing. We collect all drugs from the local market. We dried the standardized herbal material in the shade and tested its moisture content until it reached a level of six percent or below. We tested them according to the standards outlined in the Ayurvedic Pharmacopoeia of India. The material was powdered and utilized in the formulation of herbal tooth powder. The powdered herbal material was sifted using a mesh with an opening size of 0.085 mm. The composition of the developed formulation is summarized in the table above.

2.3 Evaluation of herbal Toothpowder

The prepared herbal tooth powder was evaluated for its various parameters, including organoleptic, physical-chemical, and rheological properties.

Organoleptic Evaluation

Organoleptic characteristics for various sensory characters, such as colour, odour, and taste, were carefully noted down

as illustrated. The organoleptic and morphological characteristics, including color, odor, texture, and appearance, were separately studied for the raw drugs and powder[46].

Colour

The prepared tooth powder was evaluated for its colour. The colour was checked visually under normal lighting conditions.

Odour

The product's odour was checked by smelling it.

Taste: Taste was manually checked by tasting the product[49].

2.4 Physicochemical Evaluation

The physical and chemical features of the herbal tooth powder were evaluated to determine its pH, moisture content, ash value, and the amount of inorganic matter present.

pH

The pH of the formulated herbal toothpaste was measured using a pH meter. 5 g of tooth powder was placed in a 100 mL beaker. Allow 10ml of boiled water to cool. Stir vigorously to form a suspension, and then measure the pH [45].

Moisture Content

To determine the moisture content, we accurately weighed 5g (W_0) of each formulation into an evaporating dish measuring 6-8cm in diameter and 2-4 cm in depth. We then dried the formulation in an oven at $105^\circ\text{C} \pm 2^\circ\text{C}$ until the weight remained constant, and noted it as $W_{1.25}$. Tooth powder (10 g) was weighed and dried in an oven at 105°C , then cooled. The loss of weight is recorded as percentage moisture content and calculated by the given formula: % Moisture content = Original sample weight - Dry sample weight / Original sample weight X 100[26].

Ash value

Weigh accurately about 3 g of the powdered drug in a silica crucible. Incinerate the powdered drug by gradually increasing the heat until the sample is free from carbon, and then cool it. Please keep it in a desiccator. Weigh the ash and calculate the percentage of total ash in contrast to the air-dried sample[48].

Rheological Evaluation

Physical parameters, such as bulk density, foaming test, and angle of repose, were observed and calculated for the formulation[44].

Bulk Density

The bulk density of the powder is the ratio of the mass of an untapped powder sample and its volume, including the contribution of the inter-particulate void volume. It is expressed in grams/mL[34].

$$\text{Bulk density} = \text{Untapped density} - \text{tapped density}$$

Foam Test

The foamability of the product was evaluated by taking 2 g of tooth powder with water in a measuring cylinder. The initial volume was noted as v1, and then the mixture was shaken ten times. The final volume of foam was noted as v2[50].

Flow Property[8]

A funnel was taken and fixed with a clamp to the sand. A graph paper was placed below the funnel, and the height between the graph paper and the bottom of the funnel was measured. Then 50 g of powder was weighed and poured into a funnel by blocking the orifice of the funnel with the thumb, and the thumb was removed. The powder began to flow down onto the graph paper, forming a cone-shaped pile until the peak of the pile reached the bottom of the funnel stem. Then, the angle of repose was calculated using the following formula.

$$\tan \theta = H/R$$

Where,

θ = Angle of repose

H = Height of powder,

R = Radius of graph paper

4. Results and Discussion

Organoleptic evaluation

The organoleptic evaluation assessed the sensory properties of the herbal tooth powder, including color, Odor, and taste.

The F2 formulation showed a more aesthetically pleasing greyish colour, compared to F1, F3, F4, and F5, which were either too bright or too strong. The F2 formulation had a milder herbal scent, making it more favourable compared to the stronger or very low Odor of F1, F3, F4, and F5 formulations. The F2 formulation had a neutral taste, which was preferred over the bitterness of the F3 and F4 formulation and the sweetness of the F1 and F5 formulation.

Table No. 2: Evaluation of Organoleptic Properties of Toothpowder

Code	Colour	Odour	Taste
F1	like Ash	Dark Gray	Burning smell/ smoky
F2	Ideal/neutral taste	Greyish/ideal	Mild odour/ideal
F3	Salty taste	Black	Smoky
F4	Bitter taste	Dark olive Green	Pungent
F5	Bitter taste	Dark yellow	spicy and floral smell

Physio-Chemical Evaluation

The physicochemical characteristics were evaluated to determine the pH, moisture content, and ash value, which are crucial in determining the stability and performance of the product. The pH of the F2 formulation was 7.5, which is slightly more neutral than that of the F1, F3, F4, and F5 formulations. This pH is optimal for maintaining oral health and preventing irritation, making F2 the best option. The moisture content of F2 was found to be lowest (1.4%), indicating better shelf stability and reduced chances of microbial growth compared to F1, F3, F4, and F5 formulations. The ash value of the F2 formulation was lower (70.5%), indicating that it contains fewer inorganic

impurities, which is beneficial for the product's better handling and packing.

Rheological Evaluation

The F2 formulation exhibited the lowest bulk density (4.1 g/mL), which is desirable for improved handling and packaging of the product. F2 exhibited the highest foamability, indicating superior spreading and cleaning action, making it more effective than the formulations of F1, F3, F4, and F5. The F2 formulation had the lowest angle of repose, indicating the best flowability, which makes it easier to dispense and apply during use.

Table No. 3: Formulation of all Evaluations

Formulation Code	Angle of Repose (θ)	Bulk Density (g/ml)	pH	Moisture Content	Ash Value
F1	14.4 \pm 0.21	3.0	5	1.84	72.6
F2	16.1 \pm 0.25	4.1	7.5	1.4	70.5
F3	13.5 \pm 0.20	2.5	9.5	2.5	74.8
F4	10.6 \pm 0.34	5.2	4.5	3.5	66.6
F5	17.5 \pm 0.18	6.1	8	5.2	69.7

3. Conclusions

Based on the evaluation results, the F2 formulation consistently performed better across all parameters, including organoleptic properties, physicochemical characteristics, and rheological properties. It exhibited the most desirable colour, Odor, and taste, optimal pH, low moisture content, and

minimal ash value. Additionally, F2 showed superior foamability, flow properties, and bulk density, making it the most stable and effective formulation for use. Therefore, F2 is the preferred formulation for further development and commercial use in herbal tooth powder products.

You can safely use our herbal powder twice daily without experiencing any adverse effects[51].

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Conflicts of Interest

The authors declare that they have no conflict of interest.

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