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Full Length Research Article

Preparation and Evaluation of Herbal Tooth Powder Containing *Moringa oleifera* and *Phyllanthus niruri* for Oral Health

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Abstract

Oral health is an indicator of leading a healthy life. Herbal powder is a unique formulation that is made up of one or more herbs of different or the same types. Natural herbal powders are formulated without any harsh chemicals or toxic substances such as sulphates or silicone. Our tooth powder contains *Moringa oleifera* and *Phyllanthus niruri* as key ingredients. Other herbs used are *Phyllanthus retinus, Ficus benghalensis, Azadirachta indica, Elettaria cardamomum, Syzygium aromaticum, Cuminum cyminum, Zingiber officinale, Piper nigrum*, and *Terminalia chebula.* Plaques can be removed by toothpowder because herbs contain antimicrobial properties, and it also eliminates bad odours in the mouth. In the present work, the herbal toothpowder was formulated and standardized by analyzing necessary evaluation parameters such as physiochemical analysis, quantification of minerals such as calcium and phosphorous, and characterization of the powder by FTIR. This work was performed to prepare a tooth powder that can be used as a tool for proper oral hygiene and to overcome the side effects of the conventional tooth powder prepared with synthetic ingredients.

***Key words*:** Oral health, Antimicrobial, FTIR, Mineral, Physiochemical analysis

A vital requirement for good behaviour is oral health knowledge, which enables people to take precautions for their general health. Oral health encompasses much more than just having attractive, healthy teeth. It is essential to general health and has an impact on everyone's well-being and quality of life [9-10]. Due to variability of phytoconstituents, substituent and adulterants in crude drugs it is essential to standardize these formulations for their quality and purity. Herbal tooth powder is available in market in a wide range, consisting various ingredients.

The main risk factors for developing numerous oral diseases include an improper diet, smoking, drinking alcohol, and having poor dental hygiene habits. Diet influences the onset of several diseases of the mouth, including oral cancer, periodontitis, dental caries, and erosion. Herbal tooth powder is highly admired for its quality and longer shelf life. Baking soda, powdered chalk, and white clay are common in herbal toothpowder [1-2], [5-6], [8].

Ideal properties [2], [6]

- Good abrasive effect
- Non-irritant and non-toxic
- Prolonged effect
- Keep the mouth fresh and clean
- Impart no stain on tooth
- Cheap and easily available.

MATERIALS AND METHODS

Phyllanthus niruri, *Phyllanthus retinus*, *Ficus benghalensis*, *Azadirachta indica*, *Elettaria cardamom*, *Syzygium aromaticum*, *Cuminum cyminum*, *Zingiber officinale*, *Piper nigrum*, *Terminalia chebula*, calcium carbonate, baking soda, and sea salt were used to make a herbal tooth powder. The tooth powder was then sieved to create a fine powder after the herbal ingredients were all dried and processed in a home mixer [1], [6].

Evaluation

Identification of organoleptic properties [1-2], [6]

Colour: The prepared toothpowder was evaluated for its colour. The colour was checked visually.

Odour: The odour was found by smelling the product. Taste was checked manually by tasting the product.

Spread ability: Spread ability was assessed by manually spreading the powder.

Abrasiveness: It was evaluated manually.

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Table 1 Ingredients of Herbal Tooth powder [1], [6]

S. No	Constituents	Biological source	Family	Medicinal uses	Images
1.	Moringa leaves	*Moringa oleifera*	Moringaceae	Enhance the rebuilding of enamel surface lesions, antimicrobial effect [4]	
2.	Keelanelli leaves	*Phyllanthus niruri*	Phyllanthaceae	Anti-inflammatory property	
3.	Banyan bark	*Ficus benghalensis*	Moraceae	Helps in eradicating bad-breath, Reduce swelling and bleeding	
4.	Dry Amla	*Azadirachta indica*	Meliaceae	Cleanses the mouth, strengthens the teeth [10]	
5.	Cardamom	*Elettaria cardamom*	Zingiberaceae	Mouth freshener, anti-inflammatory and anti-oxidant property	
6.	Cloves	*Syzygium aromaticum*	Myrtaceae	Anti-inflammatory, anti-bacterial, antifungal and anaesthetic *properties* [12], [15]	
7.	Cumin	*Cuminum cyminum*	Apiaceae	Anti-microbial agent for oral hygiene and tooth whitening.	
8.	Dry ginger	*Zingiber officinale*	Zingiberaceae	It has antibacterial, antifungal, oral anticancer, anti-nausea, anti-carrier, and antiplaque capabilities. Because of its indirect re-mineralization property, it hardens the teeth	
9.	Myrobalan	*Terminalia chebula*	Combretaceae	Reduce plaque accumulation and gingival inflammation	
10	Black pepper	*Piper nigrum*	Piperaceae	Fights tooth decay and provide quick relief from a toothache [17]	
11	Himalayan salt	-	-	Flavoring, sweetening agent	
12	Baking soda	-	-	*Controls plaque formation and prevents tooth decay*, remineralize enamel	

Fouriertransform Infrared Spectroscopy (FTIR) Analysis

Fourier transforms infrared (FTIR) spectroscopy Probes the vibrational properties of amino acids and cofactors, which are sensitive to minute structural changes. The lack of specificity of this technique, on the one hand, permits us to probe directly the vibrational properties of almost all the cofactors, amino acid side chains, and of water molecules. On the other hand, we can use reaction-induced FTIR difference spectroscopy to select vibrations corresponding to single chemical groups invo Fourier transform infrared (FTIR) spectroscopy probes the vibrational properties of amino acids and cofactors, which are sensitive to minute structural changes. The lack of specificity of this technique, on the one hand, permits us to probe directly the vibrational properties of almost all the cofactors, amino acid side chains, and of water molecules. On the other hand, we can use reaction-induced FTIR difference spectroscopy to select vibrations corresponding to single chemical groups invo Fourier transform infrared (FTIR) spectroscopy probes the vibrational properties of amino acids and cofactors, which are sensitive to minute structural changes. The lack of specificity of this technique, on the one hand, permits us to probe directly the vibrational properties of almost all the cofactors, amino acid side chains, and of water molecules. On the other hand, we can use reaction-induced FTIR difference spectroscopy to select vibrations corresponding to single chemical groups involved in a specific reaction. Various strategies are used to identify the IR signatures of each residue of interest in the resulting reaction-induced FTIR difference spectra. (Specific) Isotope labeling, site directed mutagenesis, hydrogen/deuterium exchange are often used to identify the chemical groups. Studies on model compounds and the increasing use of theoretical chemistry for normal modes calculations allow us to interpret the IR frequencies in terms of specific structural characteristics of the chemical group or molecule of interest [19].

Quantification method

Determination of calcium

In a conical flask, 5 mL of oxalic acid and 1 mL of sulfuric acid were gently warmed. In a burette, potassium permanganate was taken, and then the condensate from a conical flask was titrated. A pink colour developed at the end point. The titre value and repeated the titration for the concordant value. 5 ml of sulphuric acid was taken in a conical flask and titrated against the standard potassium permanganate. This serves as a blank. 2 mL of herbal solution was taken in a centrifuged tube, along with 1 mL of 4% ammonium oxalate, and mixed thoroughly. It was kept overnight for complete precipitation. The next day, the contents were centrifuged for 5 minutes, and the supernatant was discarded. Then add 3 ml of diluted ammonia to ensure complete removal of ammonium oxalate. Then the precipitate was dissolved in 5 ml of 1N sulfuric acid. It was compared to 0.01N potassium permanganate. The appearance of pink was the titration's end point for the concordant value.

Determination of inorganic phosphorus

0.5 to 2.5 ml of the working standard was pipetted out into the series of test tubes and marked accordingly. The given unknown solution was diluted to 100 mL, and then 1 mL and 2 mL were placed in test tubes and labelled T_1 and T_2, respectively. The volume was made up to 9 ml with distilled water, and they served as the blank. 1ml of ammonium molybdate and 0.4 ml of aminonaphthol sulphonic acid were added to each test tube and allowed to stand at room temperature for 10 minutes. From the standard graph, the amount of intensity of the blue colour was formed and read calorimetrically at 640 nm.

RESULTS AND DISCUSSION

Table 2 Evaluation of herbal dentifrice [1], [6]

Parameters	Observation
Colour	Ash colour
Odour	Characteristic
Taste	Good
Spreadability	Easily spreadable
Abrasiveness	Good abrasive

Table 3 Mean and standard value of calcium

Variety of tooth powder	Mean and standard value
Herbal powder	6.4 ± 3.7
Synthetic powder	2.8 ± 1.8

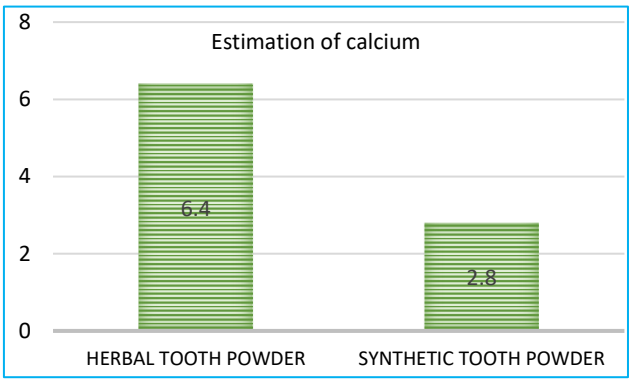

Fig 1 Shows the mean and standard value of calcium

The results show that the mean and standard values of calcium in natural tooth powder and synthetic tooth powder are 6.4% and 2.8%, respectively [Table 3, Fig 1]. Hence, natural tooth powder contains a higher level of calcium when compared to synthetic tooth powder.

Table 3 Mean and standard value of inorganic phosphorous

Variety of tooth powder	Mean and standard value
Herbal powder	3.6 ± 0.55
Synthetic powder	2.5 ± 0.45

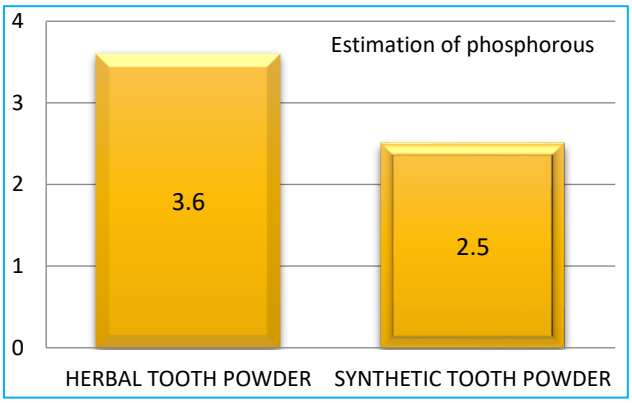

Fig 2 Shows the mean and standard value of inorganic phosphorous

The result shows that (Table 4, Fig 2) show the mean value and standard value of phosphorous in herbal tooth powder. Natural tooth powder contains 3.6% phosphorous, while synthetic tooth powder contains 2.5% phosphorous, giving natural tooth powder a higher phosphorous content than synthetic tooth powder.

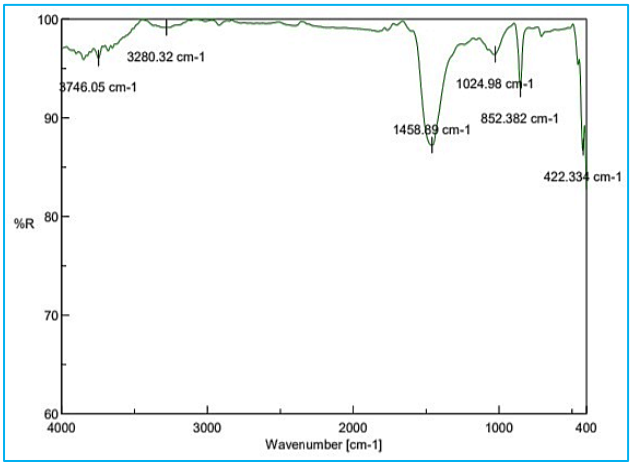

Fig 3 FTIR analysis

FTIR spectrum

Data depicted in (Fig 3) shows the spectrum of herbal toothpowder. The FTIR is a powerful technique for the interpretation of structural changes in samples. The absorption peak at 3746.05 cm represents the O-H stretch of alcohol, 3280.32 cm represents the N-H stretch of secondary amides, 1458.89 cm represents the C-H bend of an alkane, 1024.98 cm represents the C-O stretch of alcohol, carboxylic acid, and ester, and 852.382 cm represents the C-H stretch of an aromatic, respectively [20-22].

CONCLUSION

In view of the numerous factors that might damage our teeth, maintaining good dental hygiene is crucial. Our teeth will decay and cause a lot of issues if we don't stop these hazardous chemicals. The ingredients used in this study were screened and chosen to have an antibacterial effect and to maintain oral hygiene, as evidenced by their effectiveness as toothpowder. Oral hygiene can be maintained in a reliable, safe, and inexpensive way by using herbal tooth powder. The preparation and quantitative analysis of synthetic and natural toothpowder were studied, and results were obtained. Herbal tooth powder contains calcium and phosphorous, which are highly present in natural tooth powder when compared to synthetic tooth powder. As a result, in order to avoid tooth decay and cavities, people should use natural toothpowder rather than synthetic toothpowder [1], [3].

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