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Formulation and Evaluation of Herbal Dentifrices



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ABSTRACT

Herbal preparations are gaining importance as they are safe, affordable, user-friendly and compatibility. The preparations which are used to endorse the appeal and to maintain the health of teeth are termed as dentifrices. The primary function of tooth powder is cleaning and secondarily for maintaining oral hygiene. They are used with toothbrushes or index finger. The tooth powders are intended to deliver prophylactic medicine and oral hygiene material. In addition to oral bracing, amputation of food elements, lessening of insincere plaque and tooth polishing. These tooth powders mainly contain abrasives, detergents, sweetener, preservatives, antioxidants, and organoleptic additives. Marketed tooth powders are available with synthetic material and used in tooth powders, which may injure gum and teeth.¹



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INTRODUCTION

Oral hygiene is a vital key to maintain good appearance, impression of an individual and gives self-confidence. The tooth consists mainly of two parts, crown and the root. The crown of the tooth is enveloped by outer surface called enamel and it is the toughest tissue in the tooth. The chief composition of enamel is hydroxylapatite other than that it consists of keratin and water². Dentine is the underneath part of the enamel, which is a composite of hydroxyl apatite. It also contains of 70% of the collagen water. Fluorine is the main component of dentine. Oral contain of not only tooth but also saliva for simple to swallow the food. Saliva is the main element which intended for lubricating the food and +752to maintain suitable environment in the mouth. Saliva is produced by various glands such as lingual, labial, buccal and palatal are the larger and smaller glands which produce saliva continuously to maintain the tooth environment in the dynamicstate³. Proteins, bacteria, enzymes and mucopolysaccharide are present in the saliva and the inorganic materials like calcium, chloride, sodium, phosphate, potassium ions etc. The calculus, plaque, periodontal diseases are the most important issues related to tooth. It is mostly caused by bacterial action and mineralized deposition leads to form calculus. These diseases are mostly due to the negligence in proper caring of tooth, so it can be controlled and prevented by proper brushing by using effective and efficient toothpastes and tooth powders⁴. Dentifrice can be used as prophylactic cosmetic for tooth to prevent and control bad breath and tooth decay. Dentifrice can be prepared by herbal and synthetic ingredients. Now a day's herbal formulation are high in demand and require due to its efficiency to avoid the side effects when compared with synthetic ingredient formulations. Tooth powders and tooth paste are based on its abrasive property, the powder and paste applied on the tooth to rub against the tooth which helps to eradicate the deposited food debris and minerals from tooth⁵. The herbal dentifrices are available in different formulations such as tooth powder, toothpaste, mouthwashes etc. Plaques can be removed by effective toothpowder and toothpaste due to the presences of ingredients which possess the antibacterial, antiseptic property and it also gives fresh and cool feeling⁶. The present study was to prepare and evaluate the herbal dentifrice of organoleptic properties, loss on drying, foaming character, swelling index, flow property, *In vitro* antibacterial activity.

MATERIALS AND METHODS

Materials

Ingredients of herbal dentifrice

Methods

Herbal tooth powder was prepared using *Ocimum tenuiflorum*, *Azadirachta indica*, *Syzygium aromaticum*, *Curcuma*, *Psidium guajava*, *Cinnamomum verum*, sodium chloride, *Stevia rebaudiana*, potassium aluminium sulfate. All the herbal ingredients were dried and grounded using domestic mixer. Then the tooth powder passed into sieve and made fine powder and mixed by mortar and pestle.

EVALUATION

Identification of Organoleptic properties^{7,8}

Colour

The prepared dentifrices powder was evaluated for its colour. The colour was checked visually.

Odour

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

Determination of foaming character⁹ 1gm of drug was taken in 500ml conical flask containing 100ml of boiling water. Moderate boiling temperature was maintained for 30minutes. Cooled and filtered in 100ml volumetric flask and volume was made up to 100ml with water. The decoction was poured into 10 test-tubes in successive portions of 1-10ml and the volume of each test-tube was made up to 10ml with water. Then test-tubes were shaken for 15 sec and allowed to stand for 15 min and the height of the foam was measured. The foaming index was calculated according to the height of foam observed in every test-tube.

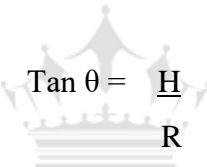
Determination of swelling index⁹ 1gm powder was accurately weighed and carefully introduced in 100ml glass –stopper measuring cylinder and 25ml of distilled water was added (measure the volume as form of initial volume) and mixture was shaken thoroughly in every 10 min for 1 hour and then, allowed to stand for 3 hours at room temperature. Volume was

measured in ml occupied by the drug. All marketed herbal tooth powders were taken separately into experiment. The mean value of the individual determinations was calculated, related to 1g of drug.

$$\text{S.I.} = \text{Final vol} - \text{Initial vol}$$

$$\text{S.F.} = \frac{\text{Swelling index} \times 100}{\text{Initial vol.}}$$

Determination of flow property¹⁰ A funnel was taken and was fixed with clamp to the stand. A graph paper was kept below the funnel and the height between graph paper and bottom of the funnel stem was measured. Then, 50gm of powder was weighed and poured into funnel by blocking the orifice of the funnel by thumb, the thumb was removed. The powder started flowing down onto the graph paper and formed a cone shaped pile until the peak of pile become touched to the bottom of the funnel stem. All marketed herbal tooth powders were taken separately into experiment. Then, the angle of repose was calculated by following formula.


$$\text{Tan } \theta = \frac{H}{R}$$

The flow property was observed as – (Powder flow property when $\theta < 25$ Excellent 25-30 good, 30-40 Passable, $\theta > 40$ very poor).

Determination of Bulk density¹¹ 50gm of powder was accurately weighed and carefully introduced into a 100ml graduated (1ml) measuring cylinder. The cylinder was dropped at 2-seconds interval onto a hard surface three times from a height of a 1 inch to equalize upper surface of powder. All marketed herbal tooth powder was taken separately into experiment. Then, the volume of powder was noted and the bulk density in gm/ml was calculated as

$$\text{Bulk density} = \frac{\text{Wt. of drug}}{\text{Bulk volume}}$$

Determination of Tapped density¹¹ 50gm of powder was accurately weighed and carefully introduced into a 100ml graduated (1ml) measuring cylinder. Measuring cylinder was fitted on the tapped density apparatus. The instrument was switched on. It raised the cylinder on the base from a height of about 4 inches. Number of strokes given until further bulk volume was

changed. Then, volume of powder was noted and the tapped density in gm/ml was calculated as.

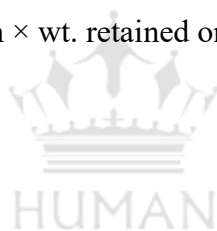
$$\text{Tapped density} = \frac{\text{Wt. of drug}}{\text{Tapped vol.}}$$

Determination of Particles size by mechanical sieve shaker¹¹ Select standard sieve set (IP or USP). Arranged them in such a manner that the coarsest at the top and finest at the bottom. 50gm powder was weighed and placed on the coarsest sieve set. Above sieve set fixed on a mechanical shaker and clamp it tightly. Switch on the mechanical shaker and timer was set for 15min. When the shaker automatically stops, sample was collected which retained on each sieve into a paper and weighed. All marketed herbal tooth powders were taken separately into experiment. Average particle size was calculated as

$$\text{Avg. particle size} = \frac{\sum nd}{\sum d}$$

Where, $\sum nd$ = Sum of arithmetic mean \times wt. retained on a sieve

$\sum d$ = Sum of wt. retained on a sieve.



% Loss on drying¹²

2 gm of sample was taken in the oven at a temperature 105° C, then cooled. The loss of weight is recorded as percentage loss on drying and calculated by the given formula.

$$\% \text{ Loss of drying} = \frac{\text{wt. after drying} \times 100}{\text{Sample wt}}$$

Spread ability

Spread ability was evaluated by spreading the powder manually.

Abrasiveness

It was evaluated manually.

Foamability

The foamability of the product was evaluated by taking small amount of preparation with water in a measuring cylinder initial volume was noted and then shaken for 10 times. Final volume of foam was noted.

Stability The product was maintained in different temperature conditions to check its stability.

***In-vitro* Antibacterial activity¹³**

In-vitro antibacterial activity of all the four extracts was evaluated by using agar well diffusion method.

Agar well diffusion method

Preparation of Agar media

Suspended 9.5gm Mueller Hinton Agar media (MHA) in a 500ml conical flask and 250ml distilled water was added. Then, it was heat on hot plate with frequent agitation until it completely dissolved. Then, media was sterilized in autoclave at 121°C for 1 hour.

Procedure

Approximately 25ml of Mueller-Hinton Agar (MHA) was poured into sterile petridish and allowed to solidify. 50µl of bacterial inoculums was spread on the solidify MHA media by using sterile spreader. In each of these plates two wells (5mm diameter) was punched into the agar by using sterile cork borer. Then, working concentration of 100mg, 150mg, 200mg and 250mg dilution were prepared from 500mg/ml of stock solution of each extracts and 150µl of each extract was separately added into wells and allowed to diffuse at room temperature. Equal volume of alcohol was used as negative control and standard antibiotic (Azithromycin) was used as positive control. The plates were incubated for 24hours at 37°C and the diameter (in mm) of clear zone of growth inhibition was recorded and measured with the help of radius scale.

RESULTS AND DISCUSSION

Organoleptic characteristics of herbal tooth powder were showed in the Table No.1. The prepared herbal tooth powder showed characteristic odour, sweet and sour taste. Foaming

index in powder form when compared alcoholic extracts, herbal tooth powder showed in Table No.3, less than 1cm. % loss on drying was found to be 90%.Swelling index and swelling factor were found 2ml and 7.14% respectively Flow property of herbal tooth powders was calculated by angle of repose method. $\Theta^\circ = 29.68$, which signifies good flow property. Both of tapped density = 0.59gm/ml and Bulk density = 0.52gm/ml were found for herbal tooth powder. Carr's index 7 % and Hausner's ratio 1.13 were also shown good flow property. *In-vitro* antibacterial activity on prepared herbal tooth powder was performed against *Staphylococcus aureus* (gram positive) and *E.coli* (gram positive) by agar well diffusion method using different doses results were shown in Table No.7. Antibacterial activity against *Staphylococcus aureus* (gram positive) more than *E.coli* (gram negative).

Table No.1: Evaluation of Herbal Dentifrice

Sr. No	Parameters	Observations
1	Colour	Brown
2	Odour	Characteristic
3	Taste	Sour
4	Stability	Stable
5	Spread ability	Good
6	Abrasiveness	Excellent
7	Formability	Good

Table No.2: Ingredients of herbal dentifrice

Sr.No	Name of Drug	Biological Source	Family	Chemical constituent	Medicinal uses
1	Tulsi	<i>Tribe ocimeae</i>	Lamiaceae.	Eugenol, Rosmarinic acid, Estragole	Antimicrobial, anti-oxidant
2	Neem	<i>Azadirachta indica</i>	Meliaceae	Nimbin, Azadirachtin, Phytol	immunomodulatory, anti-inflammatory
3	Clove	<i>Myrtaceae</i>	Myrtaceae	Eugenol, Caryophyllene, Acetyeugenol	antioxidants
4	Turmeric	<i>Curcuma longa</i>	Zingiberaceae	Curcumin	Improves heart health
5	Guava	<i>Psidium guajava</i>	Myrtaceae	quercetin, avicularin, apigenin,	antimicrobial activity, anti-cough activity
6	Cinnamon	<i>Cinnamomum zeylanicum</i>	Lauraceae	Cinnamaldehyde, Eugenol, Caryophyllene	antioxidant, anti-inflammatory, antidiabetic
7	Salt	----	----	Sodium chloride	----
8	Stevia	<i>Stevia rebaudiana</i>	Asteraceae	Stevioside, Steviol glycoside, Rebaudioside A	hypoglycemic and hypolipidemic activities.
9	Alum	----	Amaryllidaceae	----	Wound Healing activity

Table no.3: Determination of foaming character

Foaming Character	Powder	Extract
	Less than 1cm	Less than 1cm

Table No.4: Determination of % loss on drying

Sr. No	Sample Amount	Sample weight		% loss on Drying
		Before Drying	After Drying	
1	3 gm	3 gm	2.7gm	90%

Table No.5: Determination of swelling index

Sr.No	Sample Amount (gm)	Volume		Swelling Index(ml)	Swelling Factor(%)
		Initial Vol(ml)	Final Vol(ml)		
1	1	28	30	2	7.14

Table No.6: Determination of flow property

Sr.No	Tapped density(gm/ml)	Bulk density(gm/ml)	Avg. particle size(μ m)	Carr's index (%)	Hausner's ratio
1	0.59	0.52	347	7	1.13

Powder flow property when $\theta < 25$ Excellent, 25-30 Good, 30-40 Passable, >40 very poor.

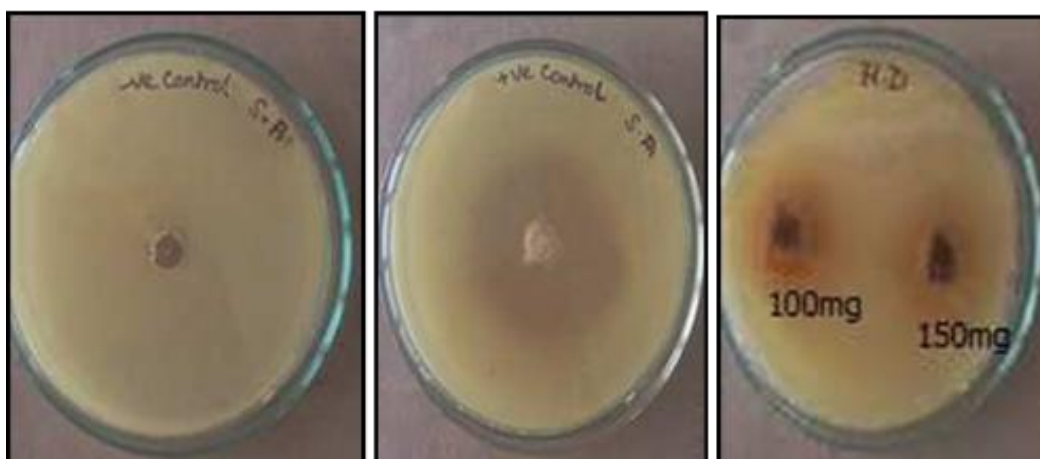
Carr's index $< 23\%$, Hausner's ratio < 1.25 to good in flo

Table No.7: *In-vitro* Antibacterial activity against *S.aureus* and *E.colion* herbal tooth powder by Agar well diffusion method

Sr.No	Concentration (mg)	Zone of inhibition	
		s.aureus	E.coli
1	100	10.7	9
2	150	12.3	11
3	Alcohol (negative control)	0	0
4	Chloramphenicol-100mg (positive control)	23	20



Figure No.1: Formulated Herbal Dentifrice



Negativecontrol

Positivecontrol

Samples

In-vitro Antibacterial activity against *S.aureus*



Negativecontrol

Positivecontrol

Samples

In-vitro Antibacterial activity against *E.coli*

CONCLUSION:

The ingredients used in the present work, was screened and selected to have antibacterial effect and to maintain oral hygiene as it can be claimed by its results as efficient and successful tooth powder. Any herbal tooth powder is considered safe to use twice a day and it does not cause any harmful effects, instead imparts good freshness and away from bad odour. Oral hygiene can be maintained in a reliable, safe and inexpensive way by using herbal tooth powder.

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CONFLICT OF INTEREST

Authors declare no conflict of interest.

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