

# PREPARATION AND EVALUATION OF VERSATILE HERBAL DENTIFRICES

Rimi Mondal\*, Dr. Suman Pattanayak, Dr. Lakshmi Kanta Kanthal

Department of Pharmacy, Haldia Institute of Pharmacy, Purba Medinipur, West Bengal-721631

## ABSTRACT

The conventional development of the child depends greatly on oral health, which is a component of overall health. Spit functions as a preventative measure against cavity development by supplying the host with the strongest defence system. Cavity is the most recent oral health trend in humankind. Proteins and amino acids found in large quantities in saliva contribute to the mouth cavity's equilibrium. Given the perception that natural substances are safer than synthetic ones, formulations including them are more acceptable. Dentifrices are products that are used to maintain oral hygiene, including breath freshness and tooth decay prevention. Throughout the day, oral hygiene can be maintained by using a variety of dentifrices made from natural and artificial substances. This research was done to create a tooth paste that may be used to maintain good oral hygiene and to combat the negative effects of traditional toothpaste made with synthetic chemicals. Several botanical components with antibacterial, antiseptic, and cooling characteristics were used to make the toothpaste. The herbal ingredients Neem, Guava, Babool, Spilanthes, Mango, Cinnamon, Clove, Mint, Eucalyptus, Arjuna, Tulsi, Camphor, Honey, and Gum Acacia were used to create the perfect toothpaste, which can satisfy all the necessary properties to keep the mouth fresh and to prevent tooth decay brought on by bacteria. To make sure the manufactured toothpaste has all the necessary qualities to be used against dental problems, it was assessed for its organoleptic and physical characteristics, including colour, odour, taste, stability, foamability, and abrasiveness. The outcome was determined to be within the legal bounds. However, there is a way to offer the recipe for an herbal dental product that is produced commercially and has eco-friendly qualities.

From this investigation we concluded that the formulated tooth pastes by herbal extract, Formulation 2 have all good characters of an ideal tooth paste when compared with all evaluation parameters for all formulations like F1, & F2 herbal tooth pastes from herbal extract.

## KEYWORDS

Herbal toothpaste, mango leaf extract, dentifrices, oral hygiene, anti-microbial

## INTRODUCTION

Oral hygiene is a very important key to maintaining beauty, personal impression and self-confidence. A tooth consists of her two parts: the crown and therefore the root. The crown is roofed by the outer surface called enamel, which is that the hardest tissue within the tooth. the most component of enamel is hydroxyapatite, which consists of water and keratin. Dentin is that the lower layer of enamel and is formed from hydroxyapatite. It also consists of 70% collagen water. Fluoride is that the main component of dentin. <sup>6</sup>Oral consists of not only tooth but also saliva for simple to swallow the food. Saliva is that the major element which intended for lubricating the food and to keep up proper environment within the mouth. Saliva is produced by various glands like Labial, lingual, buccal and palatal are the larger and smaller glands which produce saliva continuously to stay the tooth environment within the dynamic state. Proteins, enzymes, bacteria and mucopolysaccharide are present within the saliva and the inorganic materials like calcium, sodium, potassium, chloride, phosphate ions etc.<sup>4</sup>

The plaque, calculus, periodontal diseases are the most important issues associated with tooth. it's mainly caused by bacterial action and mineralized deposition ends up in calculus. These diseases are mainly thanks to the negligence in proper caring of tooth, so it is often prevented and controlled by proper brushing by using effective toothpastes and tooth powders.<sup>2</sup> Dentifrice is used as prophylactic cosmetic for tooth to stop decay and bad breath. Dentifrice is prepared by synthetic and herbal ingredients now a days herbal formulation is high in demand because of its efficiency to avoid the side effects in comparison with synthetic formulations. Tooth paste and tooth powders are supported its abrasive property, the paste and powder applied on the tooth to rub against the tooth which helps to get rid of the deposited food debris and minerals from tooth.<sup>5</sup>The herbal dentifrices are available in several formulations like toothpaste, tooth powder, mouthwashes etc. Plaques are often removed by effective toothpaste and toothpowder because of the presences of ingredients which possess the antibacterial, antiseptic property and it also gives fresh and funky feeling. The toothpaste is principally composite of abrasive agents (e.g.: calcium phosphates, carbonate etc); detergents (e.g.: sodium lauryl sulphate, sodium ricinoleole, sodium sulphoricinoleole); humectants (e.g.: propylene glycol); gelling agents (eg:gum tragacanth, carrageenan) which is employed to take care of the soundness, dispersibility, foam properties. Other ingredients like sweetening agents, preservatives, colours also employed in the formulation, water is employed as vehicle.<sup>1</sup>The agent that might supplant patient dependent mechanical plaque control and it reduce and forestall oral disease. Self-performed mechanical plaque removal is one amongst most accepted method of controlling plaque and gingivitis. The mechanical plaque control is time consuming and a few are may lack motivation for these procedures. The therapeutic effect showing plants has been beneficial to the oral health from the thousands of years throughout the globe. the normal medicine has advantage quite the side effect like allergies. Neem is one amongst the foremost widely researched tropical trees for the event therapeutic action. 20 years ago the component of neem extract was analysed.<sup>16</sup>

The chewing sticks are widely employed in the Indian subcontinent, the centre East and Africa since ancient period. tooth decay is steadily increasing within the underdeveloped and developing country. Hence, there is an urgent must promote traditional preventive measured that are acceptable, easily available and price effective.<sup>2</sup>Food debris are white small particles on teeth, may be easily rinsed off. The bacterial plaque is thin film of bacteria that sticks to teeth and yellow colour cannot be rinsed off. There has been closer relationship between tartar, calculus, and periodontitis. The extract is use in various category like Neem-Antibacterial, Guava-Anti-inflammatory, Babool-Astringent, Spilanthes- anti-inflammatory, mango : antibacterial ,cinnamon: analgesic, Clove-analgesic, mint: Flavouring agent, eucalyptus: analgesic & favouring, Arjuna: antimicrobial and other ingredient are Camphor-Antiseptic, Honey-Sweetening agent, Glycerine-Humectant, Calcium Carbonate-Abrasive, gum acacia, SLS-Detergent and also use the common salt and water. This led to paying increased attention on using natural ingredients in herbal dentifrices.<sup>20</sup>

### Ideal properties

- Good abrasive effect
- Non-irritant and non-toxic
- Impart no stain in tooth
- Keep the mouth fresh and clean
- Prolonged effect
- Cheap and easily available
- Reduce incidence of tooth decay
- Good stability

The aim of study was to formulate herbal base product & evaluate the various parameter like colour, spread ability, foamability, extrudability and anti-bacterial activity etc. However, there is approach to provide the formulation for commercial production of herbal dental product with environment friendly attributes.

**Table 1: Chemical Composition of Formulation<sup>16</sup>.**

S.No.	Common Name	Scientific Name	Parts used	Chemical constituents	Category	Quantity(gm)	
						F1	F2
1.	 Neem	<i>Azadirachta indica</i>	Leaf, stem & bark	nimbolinin, nimbin, nimbidin	Antibacterial	2	3
2.	 Guava	<i>Psidium guajava</i>	Leaf	Guaijavarin, lyxopyranoside	Prevents bad breath	2	1
3.	 Babool	<i>Acacia arabica</i>	leaf	Di catechin, leucocyanidin gallate	Astringent	3	2
4.	 Spilanthes	<i>Spilanthes acmella</i>	Leaf	Spilanthol, acmellonate	Gum bleeding	2	3
5.	 Mango	<i>Mangifera indica</i>	Leaf	Humulene, Aromadendrene	Anti-inflammatory	1	2
6.	 Cinnamon	<i>Cinnamomum verum</i>	Bark	Cinnamic acid Cinnamic aldehyde	Flavouring agent & analgesic	2	1
7.	 Clove	<i>Syzygium aromaticum</i>	Flower bud	Eugenol, Gallotannic, Eugenitin	Anti-inflammatory	1	2
8.	 Mint	<i>Mentha piperita</i>	Leaf	Menthone, menthol, menthofuran	Flavouring agent	1	1

							
9.	Eucalyptus 	<i>Eucalyptus globulus</i>	Leaf	$\alpha$ -pinene, 1,8-cineol, eucalyptol	Flavouring agent & analgesic	2	2
10.	Arjuna 	<i>Terminalia arjuna</i>	Bark	gallic acid, oligomeric proanthocyanidins	Anti-inflammatory	1	1
11.	Tulsi 	<i>Ocimum sanctum</i>	Leaf	Eugenol, Carvacrol, Linalool	Prevents bad breath	1	1
12.	Camphor 	<i>Cinnamomum camphora</i>	Bark	Cineole, $\alpha$ -terpineol, linalool	Antiseptic	0.5	0.5
13.	Honey 	<i>Apis mellifera</i>	Insect	<b>fructose , glucose</b>	Sweetening agent	1	1
14.	Gum acacia 	<i>Acacia senegal</i>	Gum exudates	Arabin, Arabinose	Gelling agent	0.5	0.5
15.	Glycerine	-	-		Humectant	5	5
16.	Calcium carbonate	-	-		Abrasives	15	15
17.	Calcium phosphate	-	-		Abrasives	10	10
17.	Sodium lauryl sulphate	-	-		Detergent	1.5	1.5
18.	Sodium benzoate	-	-		Preservative	1	1
19.	NaCl	-	-			0.5	0.5
20.	Chlorella pigment	<i>Chlorella vulgaris</i>	Algae		Colouring agent	1	1
21.	Distilled water	-	-		Vehicle	Q.S	Q.S

## MATERIALS & METHOD

Crushing of the leaves was done with the help of pestle and mortar at room temperature. The crushed sample was stored at room temp. Extraction is that the crucial start within the analysis of healthful plants, as a result of it is necessary to extract the required chemical elements from the plant materials for any separation and characterization. The fundamental operation enclosed steps, similar to pre-washing, drying of plant materials or freeze drying, grinding to get the same a sample and sometimes homogeneous extraction humanizing the dynamics of analytic abstraction and conjointly increasing the interaction of sample superficial with the solvent system. Proper actions ought to be taken to assure that potential active constituents don't appear to be lost, distorted or destroyed throughout the preparation of the extract from plant samples.

The required quantity of Ingredients was weighed and taken in mortar. Calcium carbonate, Sodium lauryl sulphate, calcium phosphate, honey and Glycerine were mixed in water. Acacia was added into the above mixture. This solution was added drop wise into mortar containing herbal ingredients and triturated well until a paste consistency is formed.

2gm of the Neem extract, 2gm of Guava leaf extract, 3gm of babool extract , 2gm of spilantes leaf extract, 1gm of mango leaf extract, 2gm of cinnamon extract, 1gm of tulsi extract , 1gm of arjuna bark extract, along with oils of 1gm clove oil, 1gm of mint oil, 2gm of eucalyptus oil, 0.5gm of camphor were triturated with 1gm of sodium benzoate (as a preservative) and 0.5 gm of sodium chloride in a Mortar-pestle. 1.5gm of the sodium lauryl sulphate are using as foaming agent and Honey are added as a sweetener agent. Further 5 ml of Glycerine was added as humectant and acacia gum are used as a binder, triturated well and to adding 80 ml of demineralized water was added to make up the to 100gm. pH is adjusted with a solution of sodium hydroxide.<sup>20</sup>

## EVALUATION

### 1. Physical Examination

- Colour- Formulated toothpaste was evaluated for its colour . The visually colour was checked.
- Odour- Odour was found by smelling the product.

- Taste- Taste was checked manually by tasting the Formulation

2. **Relative density-**

Relative density was determined by weight in gram taken in 10 ml formulation and 10 ml distilled water using RD bottle.

3. **Abrasiveness-**

A pea size amount of formulated toothpaste was placed on a clean plastic microscope slide and a drop of distilled water added. A clean cotton swab was rubbed on the toothpaste sample in a back and forth motion 30 times using short strokes. The slide was care-fully rinsed and dried with soft tissue. The slide was examined under a dissecting microscope illuminated from above. The number of scratches on the surface of the slide were determined and rated on a scale of 0 (no scratch) to 5 (high degree of scratches).<sup>16</sup>

4. **Determination of spread ability –**

In this method slip and drag characteristic of paste involve. Formulated paste (2g) placed on the ground slide under study. The formulated paste placed like sandwich between this slide and another glass slides for 5min to expel air and to provide a uniform film of the paste between slides. Excess of the paste was scrapped off from the edges. The top plate was then subjected to pull of 80g with the help of string attached to the hook and time (sec) required by the top slide to cover a distance of 7.5cm was noted. A short interval indicated better spread ability. Formula was used to calculate spread ability:

$S = M \times L / T$  Where,

S= Spread ability

M= Weight in the pan (tied to the upper slide)

L= Length moved by the glass slide

T=Time (sec) taken to separate the upper slide from the ground slide.<sup>19</sup>

5. **pH determination :**

pH of formulated herbal toothpaste was deter-mined by using pH meter. 10g of toothpaste placed in 150ml of beaker. Allow the 10ml of boiled and then cooled water. Stir vigorously to make a suspension.

6. **Homogeneity:**

The toothpaste shall extrude a homogenous mass from the collapsible tube or any suitable container by applying of normal force at  $27 \pm 20^\circ\text{C}$ . in addition bulk of contents shall extrude from the crimp of container and then rolled it gradually.

7. **Foaming character:**

About 10 g of the sample was accurately weighed and placed in a 100 ml glass beaker. 10 ml of water was added and the beaker and covered with a watch glass and allowed to stand for 30 min. This operation was carried out to disperse the toothpaste in water. The contents of the beaker were stirred with a glass rod and the slurry was transferred to a 250 ml graduated measuring cylinder, during this transfer ensured that no foam was produced, and no lump paste went into the measuring cylinder. The residue left in the beaker was transferred with a further portion of 56 ml of water to the cylinder. The content of cylinder was adjusted to 50 ml by adding sufficient water, and the content has to be maintained at  $30^\circ\text{C}$ . Stirred the contents of the cylinder with a glass rod to ensure a uniform suspension. As soon as the temperature of the content reached  $30^\circ\text{C}$ , the cylinder was stoppered, and 12 complete shakes were given to it. The cylinder was allowed to stand for 5 min and the volume of foam with water (V1) and water only (V2) was noted for all samples.<sup>17</sup>

Determination of froth power

Foaming power =  $V1 - V2$

V1- Volume in ml of foam with water.

V2- Volume in ml of water only.

8. **Stability:**

The stability study was performed as per ICH guideline. The formulated paste was filled in collapsible tube and stored at different temperature and humidity conditions,  $25^\circ\text{C} \pm 2^\circ\text{C} / 60\% \pm 5\% \text{RH}$ ,  $30^\circ\text{C} \pm 2^\circ\text{C} / 65\% \pm 5\% \text{RH}$ ,  $40^\circ\text{C} \pm 2^\circ\text{C} / 75\% \pm 5\% \text{RH}$  for the period of three months and studied for appearance, pH and spread ability.<sup>19</sup>

9. **Determination of moisture and volatile matter:**

5 g of formulation placed in a porcelain dish containing 6-8 cm in diameter and 2-4 cm depth in it. Dry the sample in an oven at  $105^\circ\text{C}$ .

Calculation

By mass =  $100MI/M$  MI-Loss of mass (g) on drying M- Mass (g) of the material taken for the test.<sup>16</sup>

10. **Extrudability :**

In this method, the formulated paste was filled in standard capped collapsible aluminium tube and sealed by crimping to the end. The weights of tubes were recorded. The tubes were placed between two glass slides and were clamped. 500g was placed over the slides and then cap was removed. The amount of the extruded paste was collected and weighed. The percent of the extruded paste was calculated.

**11. Determination of sharp and edge abrasive particles :**

Extrude the content 15-20 cm long on the butter paper, repeat the same process for at least ten collapsible tubes. Press with the contents of the entire length with fingertip for the presence of sharp and hard edged abrasive particles. Toothpaste shall not contain such particles.

**12. Cleaning ability :**

Eggshells contain high amount of calcium and most approximate tooth enamel for testing cleaning ability of toothpastes. One egg-shell was used for each toothpaste tested. 200ml of water was heated to boiling in a beaker. 15ml and 20 drops of vinegar and red food colouring were added respectively. A hard-boiled egg was immersed in the food colouring solution for 5 minutes until it is stained with red colour. Using a permanent marker, a line was drawn along the length of the eggshell dividing it in half. A tooth-brush moistens with distilled water and the water shaken off was used to brush one side of the egg for 10 strokes (each stroke was a complete back and forth motion). The egg was inspected for any colour removal. The toothbrush was rinsed with water and the water shaken off, a pea-sized amount of formulated toothpaste was placed on the toothbrush and the brush was used to brush one side of the egg for 10 strokes. The egg was rinsed and inspected for colour removal. The procedure was repeated for each toothpaste that was tested.<sup>19</sup>

**13. Gritty matter :**

Small amount of the toothpaste was rubbed into a piece of butter paper. The number and intensity of scratches that appear on the butter paper was recorded as absent or present.

**14. Antimicrobial activity:**

The disc diffusion method was used to conduct an in- vitro anti-bacterial research of the prepared paste against a pathogenic bacterial strain E. coli utilizing Soybean casein digest medium. When Escherichia coli, Staphylococcus aureus, oral microflora cells were first grown, they tended to multiply in agar plates. Plates were streaked with inoculum first, then 5mm diameter bores were created into the medium with a sterile cork borer. The agar plate's surface was rotated to provide an even dispersion of inoculums throughout the hole. The prepared paste and amoxicillin were then inserted into the bores of the cultured plates. The plates were wrapped in paraffin, labelled, and incubated for 24 hours at 37 degrees Celsius. After a 24-hour incubation period, each plate was examined. The diameter of zone of inhibition (ZOI) was measured in millimetres (mm) with a ruler.<sup>17,11</sup>

**RESULT & DISCUSSION****Table No.2: Physical examination**

S.No.	Parameters	Observation
1.	Colour	Sea weed green
2.	Odour	Pleasant
3.	Taste	Slightly bitter
4.	Smoothness	Smooth
5.	Relative density	10.4

**Table No.3: Evaluation Result**

S.No.	Parameters	Observation
1.	pH determination	6.8
2.	Foaming ability	12ml (good)
3.	Moisture content	14.68%
4.	Spread ability	3.7cm/sec
5.	Homogeneity	Good
6.	Abrasiveness	No abrasives
7.	Stability	Stable
8.	Microbial growth	No microbial growth
9.	Cleaning ability	Good cleansing
10.	Gritty matter	No gritty matter present

**Stability****Table No.4: Stability result At 25°C ±2°C/ 60% ± RH (3rd month)**

Colour	Appearance	Spread ability	pH
Sea weed green	Homogenous	3.7	6.8

**Table No.5: Stability result At 35°C ±2°C/ 65% ± RH (3rd month)**

Colour	Appearance	Spread ability	pH
Sea weed green	Homogenous	3.67	6.7

**Table No.6: Stability result At 40°C ±2°C/ 75% ± RH (3rd month)**

Colour	Appearance	Spread ability	pH
Sea weed green	Homogenous	3.2	7

**Table No.7: Extrudability result**

Extrudability	Mean of three tubes
Net wt. of formulation in tube (g)	12.9
Wt. of toothpaste extruded (g)	12.1
Extrudability amount percentage	93.7

**Table No.8: Antimicrobial activity**

Inhibition zone of Toothpaste Formulation			
Bacteria	Amoxicillin	F1	F2
Staphylococcus aureus	10	6	7
Escherichia coli	12	5	6
Oral micro flora	9	6	6

## CONCLUSION

Due to its bitterness, neem's findings are consumed in extremely little doses; nonetheless, this bleeding has an anti-inflammatory effect on the gums. Due to the scent of mint and camphor, it aids in eliminating foul breath. Arjuna, cinnamon, and clove are administered topically to the gums to treat soreness, control discomfort during dental procedures, and treat "dry socket," a problem associated with tooth extraction. Along with being administered topically to treat mouth and throat inflammation, it is also used as a pain reliever for neck pain. By reducing the risk of oral pathogens like pyorrhoea and cavities, it aids in the eradication of oral bacteria. Chlorohexidine, an anti-microbial and anti-septic agent used in oral hygiene, is replaced with eucalyptus and spilanthus. Leaves of Neem (*Azadirachta indica*), Mint (*Mentha piperita*), Guava (*Psidium guajava*), (Babool) *Acacia arabica*, (*Spilanthus*) *Spilanthus acmella*, Mango (*Mangifera indica*), Eucalyptus (*Eucalyptus globulus*), Tulsi (*Ocimum sanctum*), Camphor bark (*Cinnamomum camphora*), Cinnamon bark (*Cinnamomum verum*), Arjuna bark (*Terminalia arjuna*) and Clove bud (*Syzygium aromaticum*), were extracted by Hot percolation & steam distillation. The developed dentifrice was evaluated for chemistry parameters such as colour, odour and hydrogen ion concentration.

The development dentifrice was tested for antibacterial drug against *Staphylococcus aureus*, *Escherichia coli* and oral micro flora the efficiency was qualitatively and quantitatively assessed by the presence or absence of a zone of inhibition and zone diameter values. The developed dentifrice exhibited extremely vital result towards the entire tested microorganism, whereas the negative management doesn't turn out noticeable repressive result for any of the tested microorganism

Neem (*Azadirachta indica*), Guava (*Psidium guajava*), Clove (*Syzygium aromaticum*), Camphor bark (*Cinnamomum camphora*), Cinnamon bark (*Cinnamomum verum*) and Tulsi (*Ocimum sanctum*) were potential for inhibition bacteria. The antibacterial drug activity of the developed Polyherbal dentifrice conjointly showed vital antibacterial drug activity against all the tested microorganisms. This observation indicates that the activity to the presence of huge kinds of phytoconstituents within the extract.

The research concluded that Herbal toothpaste an emphasizing and more acceptable in dental research and they are safer with minimum side effect than synthetic preparation. The formulated toothpaste capable to the toothpaste and oral hygiene show the antimicrobial activity against pathogen.

The formulated herbal toothpaste has been good scope in future in nature remedies research and Dental health of public.

## ACKNOWLEDGEMENT

I'm thankful to our chairman & the Department of Pharmacy of Haldia Institute of Pharmacy, Purba Medinipur, West Bengal, India for providing laboratory facility to carry out the work.

## CONFLICT OF INTEREST

I declare no conflict of interest.

## REFERENCES

1. Kirtikar KR, Basu BD. Indian medicinal plants, 2 nd ed India, International book distribution, 1991.
2. Khandelwal KR, Kokate CK, Power AP, Ghosle SB, Practical Pharmacognosy. 1 st ed, Nirali prakshan, 1995.
3. Jensena J L, Barkvoll P. Clinical Implications of the Dry Mouth: Oral Mucosal Diseases, Annals of the New York Academy of Sciences, 842(1), 1998, 156-162.
4. Kirtikar KR, Basu BD. Indian medicinal plants, 2 nd ed, Vol, India, International book distribution, 1999, 2767.

5. Vyas KY, Bhatnagar M, Kanika Sharma K. In vitro evaluation of antibacterial activity of an herbal dentifrice against *Streptococcus mutans* and *Lactobacillus acidophilus*. *Indian journal of dental research* 2008; 19(1):26-28
6. Lieberman HA, Rieger MM, Banker GS. *Pharmaceutical Dosage Forms: Disperse Systems*. Informa Healthcare. 2008;2:423-45.
7. Adejumo OE, et al., Assessment of in-vitro and in-vivo antimicrobial activities of selected Nigerian toothpastes and mouth washes on some oral pathogens. *Adv. in Med. Dent. Sci.* 2008; 2(3):61-5.
8. Golpar R, et al., study to assess the plaque inhibitory action of herbal-based toothpaste: A double blind controlled clinical trial. *J. of Medicinal Plants Research* Vol. 4(12), pp. 1182-1186, 18 June, 2010.
9. Davies R, Scully C, Preston AJ. Dentifrices- an update. *Medicina Oral Patologia Oral. Cirugia Bucal.* 2010;15(6):976-82. doi:10.4317/medoral.15.e976.
10. X. Fatima Grace, Darsika C, Sowmya K.V, Azra Afker, S. Shanmuganathan. Preparation and evaluation of herbal dentifrice. *Int. Res. J. Pharm.* 2015; 6(8):509-511 <http://dx.doi.org/10.7897/2230-8407.068102>
11. Mahendran Sekar, Muhammad Zulhilmi Abdullah. Formulation, evaluation, and antimicrobial properties of polyherbal toothpaste. *Int J Curr Pharm Res* 2016;8(3):105-107
12. Pavan Deshmukh, Roshan Telrandhe, Mahendra Gunde, Formulation and Evaluation of Herbal Toothpaste: Compared With Marketed Preparation *International Journal of Pharmaceutics & Drug Analysis* VOL.5 ISSUE 10, 2017; 406 – 410; <http://ijpda.com>; ISSN: 2348-8948
13. Mamatha D, Naveen Kumar G. Preparation, Evaluation And Comparison of Herbal Toothpaste With Markedly Available Tooth Pastes. *IOSR Journal of Pharmacy and Biological Sciences.* 2017;12(6):1-06. (IOSR-JPBS) e-ISSN:2278-3008, p-ISSN:2319-7676.
14. Joel Ogboji IY, Chindo I, Aliyu Jauro DEA, Boryo I, Lawal NM. Formulation, physicochemical evaluation and antimicrobial activity of green toothpaste on streptococcus mutans, *International Journal of Advanced Chemistry, International Journal of Advanced Chemistry.* 2018;6(1):108-11.
15. Kavita Varma Shukla, Deepika Kumari\* Formulation Development and Evaluation of Herbal Toothpaste for Treatment of Oral Disease *Journal of Drug Delivery & Therapeutics.* 2019; 9(4-s):98-104
16. Rajendran S et al. Preparation and evaluation of herbal dentifrice, *Asian Journal of Pharmaceutical Analysis and Medicinal Chemistry*, 8(1), 2020, 16-23.
17. Urmila Nishad et al Formulation and Evaluation of a Polyherbal Toothpaste using Medicinal Plants *J. Pharm. Sci. & Res.* Vol. 12(1), 2020, 105-111
18. Priyal G. 1, Maji Jose 2, Shruti Nayak 3, Vidya Pai 4, Sudeendra Prabhu, Evaluation of efficacy of different tooth paste formulations in reducing the oral microbial load - An in vivo study, *Biomedicine:* 2021; 41(2) Supplementary issues: 465-471
19. Revan Siddappa Malgi, Datta V Mane, Dr. D Nagendra Kumar, Vinayraj, Param Shetty and Shivanand Kobanna, Formulation and evaluation of herbal tooth paste by *Cajanus cajan* (L.) Leaf extract, *Journal of Pharmacognosy and Phytochemistry* 2022; 11(1): 175-178
20. Senthilkumar KL, Venkateswaran. S, Vasanthan A, Chiranjeevi P, Mohamed N, Dinesh S, Neshkumar. KLS. Formulation development and evaluation of novel herbal toothpaste from natural source. *Int J Pharm Chem Anal* 2022;9(1):17-21.



IJRTI