

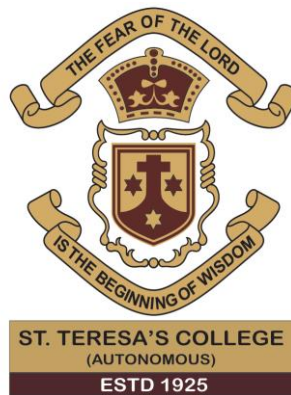
FORMULATION OF AN HERBAL TOOTHPASTE

Dissertation submitted in partial fulfillment of the requirements for the
award of degree of

BACHELOR OF SCIENCE IN BOTANY

by

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MAY 2023

CERTIFICATE

This is to certify that the investigatory project entitled “**Formulation of An Herbal Toothpaste**” submitted in partial fulfilment of the requirements for the degree of Bachelor of Science in botany is an authentic work carried out by **Ann Mariya Paul** (Reg. No. AB20BOT003) under the guidance and supervision of **Dr. Aghil Soorya A**, Assistant Professor, Department of Botany.

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DECLARATION

I, hereby declare that work which being presented in the dissertation, entitled **“Formulation of An Herbal Toothpaste”** in fulfillment of requirements for the award of the degree of Bachelor of Science in Botany and submitted to St. Teresa’s College (Autonomous), Ernakulam is an authentic record of my own work carried out during B.Sc. period under the supervision of Dr. Aghil Soorya A.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree of this or any other University/ Institute.

Place: Ernakulam

Date: / /2023

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CHAPTER 1
INTRODUCTION

1. INTRODUCTION

India is a one of the most noteworthy nations to be known for the ancient script the number system invention of zero and Vedas. In India, medicines are used about 70% World's population and are not used for only primary health care and in rural areas of developing countries, but also developed countries as well where modern medicines are predominantly used. While traditional medicines are obtained from medicinal plants, minerals, and so on, herbal medicines of organic matter are prepared medicinal plants only. Drugs have been used as the source of the plants and important component of the health care system in India. The Indian system of Medicine, most practitioners should make and share their own formulas, so it requires appropriate documentation and research. In the west, use of herbal medicines is increasing with the use of reporting about 40% of the population within the last one year of medical diseases to treat herbs. Due to the general public, education and government's interest in increasing are traditional medicines increasingly due to side effects of adverse drug reactions and cost factor modern medical systems. There are approximately 45,000 species of medicinal plants in India with locations centered in the eastern Himalayas, Western Ghats and the areas of Andaman and Nicobar Islands. Through the formally recognized, the medicinal capability of plants is 3000 then use traditional experts and more than 6000 (Urmila *et al.*, 2020).

India is the largest producer of medicinal herbs and it is called "Botanical-garden" of the world. There are presently around 2, 5,000 listed medicinal experts of the Ayurvedic system, as associated toward around 7, 00,000 of the new drug system. Depending on the 70% of population in rural India, there is a traditional medicine type Ayurveda. Ayurveda and Kiribati (herbal medicine) are two important forms that are alternative medicine Available widely in India since eras. It provides various techniques and things for employment to ill patients or patients for relief. One of the things that Ayurveda uses medicines of plant origin. In Traditional systems, different indigenous plants are being used physical, mental or social imbalance of diagnosis, prevention and eradication. The drugs are obtained with whole plant of different organs like leaves, stems, barks, root, flowers, seeds, etc. The source of medicinal plants are the active chemical components involved in medicinal plants because synthetic drugs and antibiotics associated with the health hazards and toxicity associated with the increase of human diseases in order to

eliminate important therapeutic help, the indiscriminate use of synthetic drugs and antibiotics (Urmila *et al.*, 2020).

Oral health refers to the health of the teeth, gums, and the entire oral-facial system that allows us to smile, speak, and chew. Some of the most common diseases that impact our oral health include cavities (tooth decay), gum (periodontal) disease, and oral cancer. The most prevalent oral diseases include dental caries (tooth decay), periodontal (gum) disease, tooth loss, and cancers of the lips and oral cavity. More than 3.5 billion people suffer from oral diseases, without any notable improvement of the situation between 1990 and 2017. Untreated dental caries in permanent teeth is the single most prevalent condition globally, affecting 2.3 billion people. Severe periodontal disease, a major cause of total tooth loss, is estimated to affect 267 million people, particularly older people (WHO, 2020). Oral health is essential to good health and well-being.

Toothpaste is a paste or gel to be used with a toothbrush to maintain and improve oral health and aesthetics. Since their introduction several thousand years ago, toothpaste formulations have evolved considerably - from suspensions of crushed egg shells or ashes to complex formulations with often more than 20 ingredients. It is believed to be the ancient Egyptians where the first who developed a dental cream around 3,000 - 5,000 BC, which contained powdered ashes from oxen hooves, myrrh, egg shells and pumice, primarily with the aim to remove debris from teeth (Van, 2013).

In India ayurvedic medicine was developed in ancient times that is still widely practiced in modern times. The usage of various ayurvedic formulation for various disease and for maintaining oral hygiene and health is prominent from ancient time and it's still continuing in a modern way. The constituents of various plants are highly helpful for the dental maintenance. This is widely utilized in herbal toothpastes.

Herbal extracts are effective because they interact with specific chemical receptors within the body and are in a pharmacodynamics sense, drugs themselves. By using herbal medicines, patients have averted the many side effects that generally come with traditional medicines, but this does not mean that side effects do not occur. Plants like Neem, turmeric, mint, Amla, ginger, cardamom, etc. have different properties which will help in oral maintenance.

By combining the previous knowledge about various ayurvedic plants and their actions in oral maintenance, a list of plants are selected for the production of a new ayurvedic toothpaste. By using fewer chemical products and more herbal ingredients a toothpaste was developed as a new innovation. This toothpaste will help to keep teeth strong and shine and helps to remove plaque. The antimicrobial activity of the toothpaste helps to maintain oral hygiene and health.

The current project aims to make Herbal toothpaste with herbal formulations by using various plant parts.

CHAPTER-2

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Dental caries is the microbial infectious diseases. In recent years, it is the most common health problem in the world (White, 1997; Stamm, 2007). It is a chronic disease which destroys the tooth tissue and affects chewing and aesthetic appearance and results in plaque. Fermentable carbohydrates are the sources of development of plaque forms and are carried continuously on the tooth surface (Collins, 2016). In all age groups, it can be avoided by brushing with a tooth brush with toothpaste. Brushing with toothpaste is important for several reasons. First and foremost, a toothpaste and a correct brushing action work for the removal of plaque, sticky harmful films of bacteria that grow on the teeth that cause cavities, gum diseases and eventual tooth loss if not controlled. Second, toothpaste contains fluoride which makes the entire tooth structure more resistant to decay and promotes remineralization, aids in repairing early decay before the damage can even be seen. Third, special ingredients in the toothpaste help to remove stains over time. Fourth, toothpaste helps freshen breath and leaves the mouth with a clear feeling (Wade and Addy, 1992).

Toothpaste has various uses, such as freshening the breath, helping to prevent oral problems including halitosis, whitening the teeth, and helping with overall teeth cleanliness. Moreover, it can be easily made at home using basic ingredients and a simple procedure. Currently, toothpaste serves two basic functions – therapeutic and preventive. In general, American Dental Association-approved toothpaste contains fluoride and other active ingredients which serve specific functions such as tooth whitening, minimizing gingivitis, and preventing halitosis (bad breath) and tooth erosion.

The effective removal of dental plaque is important for maintaining periodontal and oral health (Niklaus *et al.*, 1998). Although mechanical control of microbial plaque by self-care efforts is important to prevent plaque accumulation, this alone will not suffice. Chemical control of dental plaque is an adjunct therapy which may facilitate the removal and prevent the accumulation of microbial plaque, potentially reducing the dependence on mechanical oral care behaviors (Van and Hioe, 2005). Consequently, the use of both chemical and mechanical plaque control is recommended for optimal oral hygiene (Barnett, 2006; Serrano *et al.*, 2015). Various chemical agents have been used in toothpastes and mouth rinses and a few have been shown to reduce dental plaque

formation (Moran, 2008; Teles and Teles, 2009). Due to an increased awareness of indigenous medical practices in various parts of the world, the use of “herbal” medicine has engendered interest and facilitated the growth of complementary and alternative therapies in health care promotion. Herbal ingredients have been present in oral care products, more commonly in South Asian countries, for some time (Al-Kholani, 2011; Hosamane *et al.*, 2014; Abhishek *et al.*, 2015). The most common herbal ingredients to be incorporated into oral care products (e.g., toothpaste and mouth rinse) are sanguinarine, propolis, *Azadirachta indica* (Neem), charcoal, clove, and miswak (Kumar and Navaratnam, 2013). In the rural regions of South Asian countries, use of natural products like Neem twigs, charcoal powder, and others have been an important part of regular oral hygiene practice for centuries. Many of the herbal or plant extracts have been promoted as possessing anti-inflammatory, antipyretic, analgesic, antibacterial, antiviral, anticarcinogenic and antioxidant activities by means of *in vitro*, *in vivo*, and animal studies (Kumar and Navaratnam, 2013; Mohammad, 2016). Based on these observations, several oral care product manufacturers and multinational companies have incorporated herbal ingredients into their products. Manufacturers of these products use a wide range of herbal ingredients which they claim mimic the benefits of traditional toothpastes - the ability to fight plaque, freshen breath and prevent gum disease. The tendency to “go natural” has fueled an increase in demand for such products by consumers with many apparently opting for them because they are not tested on animals, carry no side effects, use no animal products, are vegan friendly, contains no added artificial colors or flavors, and for cultural reasons. In some regions, sale of herbal products outnumbers fluoride-based toothpastes (Herbal Toothpaste Market 2017).

The difference kinds of toothpaste may have all these properties but they focus on one type of things, which makes them different from others. For example: Colgate mainly focus on teeth whitening, close up focus on removing bad breath. Every toothpaste has its own way of cleaning the teeth. Other than using only chemical we have need to induce some of our traditional cleansing agents to the toothpaste. This new idea was formed ‘preparation of the toothpaste using Ayurvedic products. (Peter and Clair, 2020)

Different types of ayurvedic toothpaste and ayurvedic tooth powder are examined and the main ingredients are noted down. The composition and ratios of specific ingredients are evaluated. The idea of developing new ayurvedic toothpaste was formed. Every

toothpaste consists of two types of ingredients that is basic ingredients and special ingredients. Every toothpaste needs a basic set of ingredients, that is basic ingredients that is needed in order to make the toothpaste. Which includes chemicals like baking soda, glycerin, salt, essential oil and filtered water. There are the ingredients that is used in all kinds of toothpaste.

Though conventional toothpaste is usually safe for use, an overdose of some of these ingredients could be fatal. An overdose may result in stomach pain or an intestinal blockage. Hence there arise the significance of the formulation of the herbal toothpaste.

CHAPTER 3
MATERIALS AND METHODS

3. MATERIALS AND METHODS

3.1. Selection of materials

Ayurvedic plants and chemicals are selected based on their properties which will help in dental maintenance. The details of basic ingredients and herbal ingredients are shown in table 1 and 2 respectively.

Table 1. Base ingredients for the herbal toothpaste

SL.No.	Name of the ingredients
1.	Baking soda
2.	Diatomaceous earth
3.	Glycerin
4.	Charcoal (Paddy)
5.	Salt

Table 2. Herbal ingredients for the herbal toothpaste

SL.No.	Common name	Binomial name	Part used
1.	Mint	<i>Mentha spicata</i>	Leaves, bark and Peppermint oil
2.	Jeera	<i>Cuminum cyminum</i>	Seeds
3.	Clove	<i>Syzygium aromaticum</i>	Dried flower buds
4.	Star anise	<i>Illicium verum</i>	Seed pod
5.	Cinnamon	<i>Cinnamomum verum</i>	Inner bark
6.	Black pepper	<i>Piper nigrum</i>	Peppercorn
7.	Babool bark powder	<i>Valchellia nilotica</i>	Bark
8.	Bibhitaki	<i>Terminalia bellrica</i>	Fruit of the tree
9.	Neem	<i>Azadirachta indica</i>	Leaf, Bark
10.	Papaya	<i>Carica papaya</i>	Seed
11.	Ginger	<i>Zingiber officinale</i>	Rhizome
12.	Nutmeg	<i>Myristica fragrans</i>	Seed

13.	Mango	<i>Magifera indica</i>	Leaves
14.	Fennel	<i>Foeniculum vulgare</i>	Seed
15.	Cardamom	<i>Elettaria cardamomum</i>	Seed
16.	Gooseberry	<i>Phyllanthus emblica</i>	Fruit Powder
17.	Haritaki	<i>Terminalia chebula</i>	Roots
18.	Black cumin	<i>Nigella sativa</i>	Seed
19.	Turmeric	<i>Curcuma longa</i>	Rhizome
20.	Horse chestnut	<i>Aesculus indica</i>	Seed

3.2. Collection of materials

The plants are directly collected from the field. Mint, papaya seeds, Neem leaves, gooseberry and mango leaves are collected from Ernakulam district, Kerala. Horse chestnut was collected from Dindugal, Tamilnadu. Cardamom, black pepper, cinnamon, nutmeg, clove, star anise, Jeera, black cumin, fennel, turmeric, bibhitaki, haritaki and ginger were collected from Wayanad district, Kerala.

3.3. Formulation of toothpaste

The formulation ingredients are depicted in table 3.

Table 3. Formulation of herbal toothpaste

Name of the Ingredient	Quantity (grams)
Base Ingredients	
Baking soda	53
Diatomaceous earth	5.2
Glycerin	63.6
Charcoal (Paddy)	5
Salt	13
Special Herbal Ingredients	
Mint	0.3
Jeera	0.6
Clove	0.8
Star anise	0.4
Cinnamon	1.7

Black pepper	0.3
Babool bark powder	0.10
Bibhitaki	2
Neem twig powder	0.11
Papaya seed powder	0.6
Ginger	0.7
Nutmeg	0.1
Mango leaf powder	0.10
Fennel	0.7
Cardamom	0.10
Gooseberry	2
Haritaki	2
Black cumin	0.5
Turmeric	0.6

3.4. Preparation of toothpaste

All the herbal ingredients were cleaned, chopped into small pieces, shade dried and powdered into fine powder. The fine talc was obtained by filtering it using muslin clothe. The powders were stored in air-tight containers and refrigerated for further use.

To the three-fourth of the baking soda, one-fourth salt was added and then one-fourth of the glycerin was added. Glycerin was added again as the herbal ingredients were too dry. To the mixture, few drops of essential oil and few drops of filtered water was added and mixed well. Then other base ingredients followed by special herbal ingredients were added and mixed well. The obtained fine paste is filled into a tube and stored in refrigerator.

3.5. Evaluation of the toothpaste

3.5.1. Physical Examination:

Colour- Formulated toothpaste was evaluated for its brownish visually.

Odour- minty, clove and cinnamon smell was found by smelling the product.

Taste- Taste was checked manually by tasting the formulation which had a pungent taste.

3.5.2. Foaming

The formability of formulated toothpaste evaluated by taking small amount of formulation with water in a test tube and then shaken for multiple times. The foaming obtained was observed and noted.

3.5.3. Shape retention

Tooth paste was squeezed out from the tube and put entirely of a tooth brush and the state of the toothpaste after it was allowed to stand for 10 seconds was evaluated.

3.5.4. Storage stability

The toothpaste was filled in a toothpaste tube for storage and stored for 45 days at each of 5⁰C, room temperature and 40⁰C. The tube was then cut through and whether the liquid component was separated from the toothpaste or not was evaluated.

CHAPTER 4
RESULT

4. RESULT

Many toothpastes of different brands and articles based on the production of the toothpaste was reviewed. Proper analysis based on the ingredients was done. This led to the preparation of the toothpaste using Herbal products. This product provides the benefits of both the toothpaste and medicinal ingredients keeping the mouth healthy and fresh. The best set of basic ingredients were selected for the toothpaste making. Special ingredients were added to it in accurate proportion and definite quantities (Plate I, II).

Herbal toothpaste using medicinal and herbal ingredients was prepared. A tube of herbal paste of 165g was obtained after the process (Plate III). On physical examination, the Colour of the toothpaste was examined. It displayed a brownish red Colour which was due to the dried herbal ingredients. The Odour of the toothpaste was analyzed through the sense of smell and exhibited a pleasant minty mix which was due to the presence of mint, peppermint oil, and other ingredients. The taste was also analyzed through the sense of taste where pungent spicy taste was noted. Flavoring agents may be added to make it better in accordance with the age and interest of the consumers. The foaming test exhibited an average foaming capability required for a toothpaste. Addition of foaming agent or foaming herbal ingredient increases the foaming rate of the toothpaste. In case of shape retention test, the shape just after the toothpaste was squeezed out on the toothbrush was maintained. The prepared herbal toothpaste gave a positive result to the storage stability test where, even after 45 days of storage, separation of a liquid component is not observed at all (Plate III).

CHAPTER 5
DISCUSSION

5. DISCUSSION

Oral health problems constitute a significant health concern in India and are cause of considerable morbidity (Balaji, 2018). However, this increase has not seen the commensurate increase in the acceptance of professional dental services. Oral health problems, occupying the lowest position in the hierarchy of importance and treatment needs, do not provide a compelling cause for seeking professional advice and care (Singh *et al.*, 2013). Self-remedying of oral health problems is still a common phenomenon. It is because of oral health neglect and tendency to avoid professional care that over-the-counter products gain so much traction in the Indian psyche.

Recently repeated concerns have been raised about the harmful effects of nonherbal toothpaste's basic ingredients like sodium lauryl sulfate (Lipper, 2013) and fluorides (Orisakwe *et al.*, 2016). In a country like India, where "safe," "natural," and "effective" are usually taken as synonymous, any reasonably priced over-the-counter herbal product with a promise to alleviate the manifestations of dental and oral problems is expected to be readily accepted by masses. This was especially noticed after the introduction of "Dant Kanti" toothpaste by Patanjali when there was a wave of change of toothpaste from nonherbal to "Dant Kanti." (Yadav, 2017; Pandey and Paul, 2020) Herbal versions of many other toothpastes like "Colgate Vedshakti" by Colgate-Palmolive India Ltd. (Malviya and Tyagi, 2016) and "Lever Ayush" by Hindustan Unilever Ltd. were also launched subsequently (Sarkar, 2015).

In this backdrop, the reasons for high reliance upon herbal toothpastes in the era of evidence-based therapeutics are worth studying. Previous studies on preference of toothpaste in Indian population report media information, cavity prevention, brand, flavor, dentist advice, peers influence, tooth whitening, and cost as the main factors in selection of a toothpaste (Logaranjani *et al.*, 2015; Kote *et al.*, 2013). Studies from other parts of the world also mention taste, cost, presence of fluoride, dentifrice availability, dentist recommendation, texture, and previous experience as the factors which are usually taken into consideration while selecting toothpaste (Adegbulugbe and Adegbulugbe, 2007; Opeodu and Gbadebo, 2017). However, the specific factors which

led to wide acceptance of herbal toothpastes in recent years are not thoroughly studied yet.

The base ingredients, glycerine is a humectant (it holds onto water and prevents the toothpaste from drying out in the tube and also prevents dryness in the mouth during brushing. Baking soda is effective teeth whiten when used approximately to brush the tooth. Helps in removing stains on the teeth and whitening smile. Charcoal is used to lift stains from your teeth and to make your teeth look brighter and whiter. As salt is mildly abrasive, it can swiftly remove plaque and other remnants from the teeth of using as a cleaning powder. The anti-bacterial properties to salt make it a good additive in various toothpaste brands. Essential oil that we have used is peppermint oil that adds odour, freshness and flavor to the paste. Special ingredients are unique ingredients that makes each toothpaste different from others. That can be chemicals or herbal or ayurvedic products or extractions from the other plant. They are adding in unique proportions. Generally, surface active agents lower the surface tension, penetrate and loosen surface deposits and emulsify or suspend the debris which the dentifrice removes from the tooth. Diatomaceous earth help remove bacteria which can lead to plaque buildup and discoloration. (Dental Newsletter, 2022).

The herbal ingredients play specific role in making of a toothpaste. Mint is the main ingredient which is used in variety of toothpaste. In order to give the freshness and nice cool breath. It is used as a flavoring agent. (Methyl tricks the brain, sending that you have ice in your mouth). Jeera is one of the main ingredients which is a in variety of ayurvedic toothpaste, fight against bad smell. It helps in curing bleeding gums, prevent oral ulcers and halitosis. Clove is one of the main ingredients which is a in variety of ayurvedic toothpaste. It possesses anti-inflammatory, antibacterial properties, which can help fight tooth and gum infections. Star anise refreshes the teeth, disinfect, whiten the teeth, tone the throat and gums. Cinnamon bark powder exhibit antimicrobial activities against oral pathogens. Black pepper contains calcium which is good for bones and teeth. Babool bark powder is helpful in managing teeth disorders like plaque formation, gingivitis. Neem leaf and bark helps in curing gingival problems, reduce bad breath. Papaya seed powder served as teeth whitening agent. Ginger powder is used as a flavoring agent, prevents cavities and remove plaque, strengthen the gums tissue around the teeth, temporary relief for oral pain including toothaches. Nutmeg is effective in managing bad

breath, contains antiseptic properties, treat gum problems and curing teeth pain. Mango leaf provide freshness and removes bad breath. Bibhitaki is one of the powders in *Triphala* and is good for teeth and it strengthens the gums. Fennel exhibits anti-inflammatory, anti-fungal and antibacterial properties and thus fight against infections. Cardamom helps eliminate bad odour and imparts fresh breath. It is also known to have antioxidant properties that help treat teeth and gum infections. Amla powder benefits to teeth and gums, anti-caries effect by increasing salivary pH and inhibiting the common bacteria responsible for caries. Haritaki is good for teeth, most efficacious for bleeding gums and gingival ulcers as well as carious teeth. Black cumin is effective in inhibiting the growth of plaque bacteria. Horse chestnut is used as a cleaning agent in toothpaste. Turmeric is a tooth whitening agent, used to give Colour to the toothpaste base. (Clove 2021)

Culture has a predominant effect on behavioural practices of an individual. The use of plant-based products like Neem twigs (*Azadirachta indica*), owing to its antimicrobial and astringent properties (Sharma *et al.*, 2014), is quite popular even today in rural India. Consequently, any new promising herbal oral hygiene product has a high probability of acceptance by the Indian populace.

Similar to the results by Kumar *et al.*, (2013) nearly 75% of participants of the present study responded in favour of herbal toothpastes when asked which toothpaste was better in their opinion among herbal and non-herbal ones. 44.8% of these respondents justified by saying that herbal toothpastes are safe as they are free from chemicals or side effects. Thus, concern of toxicity and side effects seems to be one of the major driving forces for the observed shift.

Though tooth sensitivity and yellow discoloration of teeth were cited as the main reasons for the shift to herbal toothpaste, no significant association was observed between type of shift and perceived improvement in symptoms, i.e., for any type of shift, approximately half of the respondents perceived an improvement in symptoms and the other half did not perceive any improvement. Previous studies have also reported equal potency of herbal and non-herbal toothpastes in reducing dental caries and gingivitis (Goldman *et al.*, 2008; Chen *et al.*, 2013; George *et al.*, 2009).

Another significant finding in this study was that the major reasons cited by the users either to shift from non-herbal to herbal toothpastes or from herbal to non-herbal toothpastes were the same: tooth sensitivity and yellow teeth. This suggests that these two symptoms are the most common problems for which patients tend to seek self-treatment by trying various types of oral healthcare products.

A vast majority of respondents, who preferred non-herbal toothpastes more, did so because of their taste. Taste was also reported to be a significant factor in toothpaste selection by Opeodu and Gbadebo (2017) and Kote *et al.* (2013). This suggests taste perception is an important consideration, and making a product pleasant to taste significantly increases its chances acceptance.

The current toothpaste preparation fulfils the basic needs of a toothpaste. For the next stage of improvement of the product, the taste of the toothpaste would be taken into consideration so that it different age groups of consumers may get benefitted with their preferences.

CHAPTER 6

SUMMARY AND CONCLUSION

6. SUMMARY AND CONCLUSION

As brushing is a very basic phenomenon of our life and atleast we should take care of such a small action. We can do it by using chemical toothpaste but to go for herbal toothpaste which are free from artificial dyes and chemicals provides a healthy lifestyle with minimal side effects. Hence herbal toothpaste is a wise and healthier choice. Herbal toothpaste contains natural antibacterial agents that eliminate bacterial and keep our mouth healthy. The current project has prepared one such herbal toothpaste with 20 herbal ingredients, each with its unique and significant role to safeguard maintain a healthy oral hygiene. The paste contains plants such as mint, papaya seeds, neem leaves, gooseberry, mango leaves, cardamom, black pepper, cinnamon, nutmeg, clove, star anise, Jeera, black cumin, fennel, turmeric, horse chestnut, bibhitaki, haritaki and ginger. These ingredients not only protect the mouth from germs and bacteria, but also serves as medicinal agents to cure certain diseases. The physical evaluation of the prepared herbal toothpaste satisfies the basic requirements for a standard herbal toothpaste. Hence the toothpaste can be taken up to its next level of improvement of flavour in accordance with different age group. Further specific experimental quantification and evaluations are to be carried out in future to develop this toothpaste as a product so that to be benefitted by the society.

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