



FORMULATION AND EVALUATION OF HERBAL DENTAL GEL BY USING MORINGA LEAVES

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Abstract:

This study aimed to formulate and Evaluate a dental gel utilizing the anti- Inflammatory properties of Moringa Oleifera leaves extract. The gel was Prepared using a simple method, incorporating various concentrations of Moringa extract to determine the Optimal formulation. Evaluation Parameters included pH, viscosity, Spreadability, and in-vitro release Kinetics. Additionally, the anti- Inflammatory activity of the formulated gel was assessed using an in-vitro model. Results demonstrated that the formulated dental gel exhibited desirable physical properties, with optimal anti-inflammatory activity observed at specific concentrations of Moringa extract. This study highlights the potential of Moringa oleifera as a natural source for developing effective dental care products with anti-inflammatory properties.

Phytomedicine refers to the use of naturally Derived products to cure and mitigate human conditions. Natural products have the advantages of causing minimum side effects, being biocompatible, available, and economical, with a wide array of biological activities. Reports have described the use of natural products with antimicrobial and anti-inflammatory properties to treat oral conditions and promote wound healing. Moringa oleifera, known as the “drumstick” or “horseradish”. Tree, is believed to have medicinal properties regarding a range of medical conditions. Focuses on the use of Moringa extracts in the management of oral conditions including oral infections, inflammatory conditions , the remineraliz action of hard tissues, oral wound healing, and tissue regeneration, drawing from both in-vitro and in-vivo studies. Which indicate that the potential of Moringa extracts in supporting Denting pulp regeneration after caries or Trauma is worthy of more careful consideration.

Keywords: Dental Gel, Moringa Oleifera, Drumstick, Horseradish , Anti- Inflammatory.

Introduction :

Moringa oleifera L. comes from the Moringaceae family and is commonly known as Kelor in Indonesia, Sahajan in India, and Horseradish tree or Drumstick tree in English. It is also described as a miracle tree due to its nutritional value, diverse functions, and medicinal properties. M. oleifera can grow up to 12 m in tropical and subtropical environments. Although it is native to South Asia, the cultivation itself has already spread to the Middle East, Africa, Asia, and other areas. Traditionally, M. oleifera has been used in medicine, skincare, breastmilk production, and even food. Almost all parts of M. oleifera can be useful. In recent years, natural remedies have gained considerable attention for their potential therapeutic benefits, particularly in the realm of oral healthcare. Moringa oleifera, commonly known as the moringa tree, has emerged as a promising source of bioactive compounds with diverse Pharmacological properties. Among its numerous health benefits, moringa leaves have been recognized for their anti-inflammatory potential, making them an attractive candidate for oral health formulations. Dental inflammation whether resulting from periodontal disease, gingivitis, or Other oral conditions, presents a significant health concern globally. Conventional treatments often involve the use of synthetic drugs with potential side effects, driving the search for safer and more effective alternatives. Moringa leaves, rich in bioactive compounds such as flavonoids, polyphenols, and vitamins, exhibit antiinflammatory properties that make them a compelling candidate for oral healthcare formulations. However, despite the growing interest in moringa as ar ‘oral remedy, research



focusing on its application in dental Moringa oleifera is a plant commonly termed as horseradish tree, the ben oil tree, or the drumstick tree. This plant of Indian origin with several medicinal properties has been used for several hundred years by various countries. The leaves of this wonder tree are rich in phytochemicals and nutrients such as



beta carotene, essential minerals, and proteins, and hence the tree is often known as a “miracle tree” and “mother’s best friend”. The leaves of this miracle tree can be consumed in several methods that will aid in the long-term maintenance and enhancement of nutritional status. Some countries of the African subcontinent have emphasized the development of these leaves as therapeutic nutritional supplements. In traditional medicine, these leaves have been explored for their use in the management of obesity, some cancers, hysteria, diabetes mellitus, and vitamin C deficiency.

The vital phytochemical content of this plant includes alkaloids, saccharides, tannins, saponins, glucosinolates, nitrile glycosides,” along with the well-known polyphenols and flavonoids, which are responsible for the medicinal property of the tree. Evidence has shown that the leaves of this plant exhibit antioxidant, anticancer, antidiabetic, antimicrobial, anti-inflammatory, anti-hypertensive, and hepatoprotective properties. Interestingly, the seeds and roots of this plant also have several medicinal properties like antioxidant (AO), anti-inflammatory, antitumor, and hypoglycemic activities. Thus, recently *M. oleifera* has gained importance in the field of pharmacognosy, and several research studies are being conducted to assess its use for the management of chronic illness.

It is noteworthy that periodontal disease is an oral inflammatory condition of polymicrobial etiology, where inflammation, microbial infection, and a jeopardized antioxidant response play a major role in mediating tissue destruction. Several surgical and nonsurgical therapy strategies are being developed as therapeutic measures to manage oral periodontal disease. In this connection, several herbs and their active phytoconstituents have been tried for periodontal disease management in various forms. So far very few studies have assessed the role of *M. oleifera* Lam. (MOL) as a host modulatory agent in periodontal therapy, and its properties in different extraction methods have not been fully exploited, which in turn forms the basis of the present study. Although there are several publications related to the anti-inflammatory and antioxidant activities of this plant, very little research has been done to compare the therapeutic properties of these leaves obtained as soluble extracts using distilled water (aqueous) and ethanol (ethanolic) extracts of leaves of this plant from Tamil Nadu, India as there are several genetic variations within the same species based on the place of cultivation and hybridization techniques for crop improvement. Moreover, crop improvement methods have been developed in Tamil Nadu and the commonly available subtypes in Tamil Nadu include Jaffna type, Moolanur moringa, Chavakacheri moringa, Valayapatti moringa, Kattumurungai, Palamedu moringa, Chemmurungai, Palmurungai, Kodikkalmurungai, and Punamurungai. The current research was performed to assess the AO and anti-inflammatory outcomes of aqueous and ethanolic extracts of MOL to check which extract is more superior to make a periodontal application with the extract for future use.

These reports demonstrated in vitro antibacterial activity of *M. oleifera* against caries-related bacteria and inhibition of artificially grown cariogenic biofilms. It is important to note that some of these studies had no conventional controls for comparison and that the methods of evaluation may not ideally represent in vivo conditions. Further work is clearly required to optimize the extraction of active ingredients, identify and purify potentially useful compounds, and conduct more rigorous evaluation using test models that reflect in vivo conditions. This should be combined with careful investigation of the safety and toxicity of these agents prior to their application.

Effects of Moringa in Oral Inflammatory Conditions:

Dos Santos et al. [40] studied natural isothiocyanate from *M. oleifera* and its seven analogue molecules (semisynthetic derivatives MC-D1, MC-D6, MC-D7, MC-D8, and MC-D9) in a TMJ inflammatory hypernociception model in rats. They found that MC-D7 and MC-D9 were effective in reducing nociception and formalin-induced inflammation, while MC-H was more effective against serotonin-induced hypernociception in comparison to indomethacin as a positive control. In another in vivo study of temporomandibular joint pain using male Wistar rats, the semisynthetic derivative MC-H exhibited antinociceptive and anti-inflammatory effects when administered orally. This potential analgesic effect could be peripherally mediated by the inhibition of the heme oxygenase-1 (HO-1) pathway, as well as through inhibition of intercellular adhesion molecule levels while centrally by the activation of opioid receptors (μ and δ) [41].

In a study employing network pharmacology and molecular docking, phenolic compounds derived from *M. oleifera* leaf were investigated for antiperiodontitis effects both in an in vitro RAW 264.7 macrophage cell culture and in an in vivo ligature-induced periodontitis rat model. Moringa leaf extract achieved antiperiodontitis activity by



regulating the p38a/MAPK14-OPG/RANKL pathway. The extract also decreased serum proinflammatory cytokines and increased anti-inflammatory cytokines and reduced alveolar bone resorption within the in vivo model . Herbal lozenges composed of *M. oleifera* leaf and *Cyanthillium cinereum* (Less.) H. Rob extracts showed an antioxidant activity with powerful effects in reducing gingivitis and oral inflammation in a double-blinded, randomized, controlled clinical trial of smoker volunteers . Mouthwashes containing ethanolic leaf extracts of *Citrus hystrix*, *M. oleifera*, and *Azadirachta indica* have been shown to decrease the gingival index and plaque index with a reduction in both *Staphylococcus* and *Candida* species in gingivitis subjects after 14 days in comparison with chlorhexidine gluconate . Thus, these new mouthwashes could reduce gingival inflammation and be a complementary treatment in microbial-induced gingivitis. A randomized clinical crossover study by Duarte et al. found that commercially available Moringa-based dentifrice was associated with a significant reduction in the gingivitis and plaque index compared with miswak dentifrice in subjects with mild-to-moderate gingivitis. However, this study has several limitations, such as short experimental duration, small sample size (only 20 subjects), and absence of a control group. It can be concluded that different parts of *M. oleifera* demonstrate anti-inflammatory properties with the potential to reduce proinflammatory mediators and control gingivitis. These studies were again limited by the absence of conventional controls. However, derivatives of medicinal plants such as *M. oleifera* are worthy of further exploration as alternative anti-inflammatory agents in the management of a range of mucosal, periodontal, and possibly pulpal inflammatory conditions.

2. Phytochemical Constituent:

The pharmacological effects of *M. oleifera* are influenced by its phytochemical components. Previous studies have reported that there are several groups of compounds that are unique to each part of *M. oleifera*. The flowers are known to contain flavonoids, alkaloids, sucrose, and amino acids such as kaempferitrin, isoquercitrin, and rhamnetin. Furthermore, the stem contains alkaloid compounds such as moringinine and moringin, octacosanoic acid, B-sitosterol, and 4-hydroxymellein.

The compounds are thought to exert their anti-inflammatory effects due to:

- (1) inhibition of proinflammatory enzymes: quercetin and kaempferol inhibit the pro-inflammatory enzymes (cyclooxygenase and Lipoxigenase).
- (2) regulation of cytokine production.



Fig. Dental diseases



Advantages Of Moringa :

1. Rich in Nutrients: Moringa leaves are packed with essential vitamins (A, C, B) and minerals like calcium, iron, and potassium, making them a nutrient-dense food.
2. Antioxidant Powerhouse: Moringa contains various antioxidants, like quercetin, which help protect cells from damage and reduce oxidative stress.
3. Anti-inflammatory Properties: Compounds in moringa leaves can help reduce inflammation, potentially alleviating pain and managing conditions like arthritis.
4. Blood Sugar Management: Research suggests that moringa may help stabilize blood sugar levels and improve insulin sensitivity.
5. Cholesterol Lowering: Moringa can contribute to lower cholesterol levels, potentially reducing the risk of heart disease.
6. Liver Support: Preliminary studies indicate that moringa may help protect the liver from damage.
7. Skin and Hair Health: Moringa can nourish skin and hair, potentially improving elasticity and reducing wrinkles.
8. Immune System Support: The high nutrient content in moringa leaves can boost the immune system, helping the body fight off infections.
9. Cognitive Function: Antioxidants and neuro-enhancers in moringa may support brain health and cognitive function.
10. Other Potential Benefits: Moringa may also help with digestion, promote eye health, and support maternal health during pregnancy and lactation.

Disadvantages Of Moringa :

1. Digestive Issues: Moringa's laxative properties can lead to diarrhea, bloating, gas, and stomach cramps if consumed in large amounts.
2. Interactions with Medications: Moringa can interact with medications, particularly those for diabetes (lowering blood sugar) and blood thinners.
3. Pregnancy Concerns: Moringa, especially the bark and root extracts, can trigger uterine contractions, potentially increasing the risk of miscarriage or preterm labor.
4. Potential for Liver and Kidney Strain: Overconsumption may put strain on the liver and kidneys, especially in individuals with pre-existing conditions.
5. Allergic Reactions: Some individuals may be allergic to moringa, leading to skin rashes, irritation, and breathing difficulties.
6. Kidney Stones: In rare cases, heavy doses of moringa may contribute to kidney stone formation, though more research is needed.
7. Hormonal Effects: Moringa may interfere with hormone levels, potentially affecting fertility or causing uterine contractions.

PLANT PROFILE;

Common names:

Moringa, drumstick tree, ben oil tree, benzolive tree, benzoil tree, horse-radish tree, horseradish tree, West Indian ben [English]; ben oléifère, ben ailée, moringa ailée, pois quénique [French]

Moringa (*Moringa oleifera* Lam.) is a multipurpose tropical tree. It is mainly used for food and has numerous industrial, medicinal and agricultural uses, including animal feeding. Nutritious, fast-growing and drought-tolerant, this traditional plant was rediscovered in the 1990s and its cultivation has since become increasingly popular in Asia and Africa, where it is among the most economically valuable crops.

It has been dubbed the “miracle tree”.



Fig.No 02

Morphology Taxonomic Classification:

- **Kingdom:** Plantae
- **Subkingdom:** Tracheobionta
- **Synonyms:** Drumsticks tree, Horseradish tree
- **Family:** Moringaceae
- **Genus:** Moringa

MATERIALS AND METHOD:

Plant Materials:

Leaves of Moringa Olifera were collected from the residential areas of DR KOLPE INSTITUTE OF PHARMACY, KOLPEWADI, KOPERGAON, AHILYANAGAR.

Preparation of Plant extract:

Shade drying was done for almost a month as to avoid chemical degradation due to sunlight. Grinding of the dried material was done, with the aid of a grinder and converted into coarse powder. The powder was sieved. 50 gm defatted powdered; material was extracted in methanol 100 ml by maceration process

Chemicals:

Moringa Carbapol, Polyethylene glycol, Glycerine, Methyl Paraben, Propyl Paraben, Honey, Distilled Water.

Apparatus: Apparatus such as beaker, glass slide, measuring cylinder, test tube, volumetric flask Instruments: pH meter, Mechanical stirrer, Viscometer.

Methodology Formulation of Moringa oleifera leaves powder Drying of leaves:

- ❖ **Collection:** The leaves were collected from the university campus.
- ❖ **Sorting:** Fresh, green undamaged leaves were collected to produce the best quality powder.
- ❖ **Cleaning and washing:** The stalk of the leaves was cut from the main branches and were washed 3-4 times with plenty of water to remove all the adhering dust, and dirt particles.



- ❖ **Blanching and Drying:** Moringa oleifera leaves were immersed in boiling water at 100° C for 5 minutes and then it was immersed in cold water for 2 minutes. Blanched leaves were dried in neat and clean dust free dark shadow place at temperature ranged from 25-30° C. The leaves were completely dried in 24-38 hours. Dried them till leaves became brittle and crushed easily.
- ❖ **Grinding of leaves:** Dried leaves were ground into fine powder
- ❖ **Storage:** Moringa oleifera leaves powder were stored in airtight containers protected from humidity, heat, and light to avoid the growth of molds at room temperature.



Fig. Extration sample of Moringa olifera

Phytochemical Screening Alkaloids:

1) Dragendroffs test:

few drops of dragendroff reagent (a mixture of potassium bismuth iodide & tartaric acid) + Sample → **Reddish Brown PPT**





Fig No 5

2) Mayers test:

Potassium mercuric iodide + sample → **Creamy PPT**



Fig No 6

3) Wagners test:

Wagners reagent (a solutions of iodine in potassium iodide) + sample → **Reddish Brown PPT**

4) Hagers test:

Hagers reagent (solutions of picric acid + Hcl → **Yellow PPT**



Fig. Hagers test

Flavanoid:

1) Shinoda test :

few drop of conc. HCl + sample piece of magnesium ribbon → Pink, Red Or **Voilet** Colour

2) Alkaline reagent test :

few drop of dilute alkaline solutions (Sodium Hydroxide / potassium hydroxide) + Sample → Yellow colour → turn colour less upon add dilute acid.

3) Lead acetate test:

Lead acetate soln + sample followed by dilute HCl → yellow ppt or colour change

4) Ferric chloride test :

ferric Chloride soln + sample → green / **blue** / purple.



Fig. Ferric chloride test



Fig. Sample Test

Table 6.1: List of materials:

Sr no	Materials	Quantity F1	Quantity F2	Quantity F3
1.	Moringa extract Pharmaceutical (Active components)	1 ml	2 ml	3 ml
2	Carbapol 940 (Gelling agent)	0.3gm	0.4 gm	0.5gm
3	Methyl paraben (Preservative)	0.18gm	0.20 gm	0.21 gm
4	Propyl paraben (Preservative)	0.02gm	0.04 gm	0.05 gm
5	Propylene glycol (Cosolvents)	5 gm	6 gm	7 gm
6	Glycerine (Drug solubilizer)	5 gm	6 gm	7 gm
7	Triethanolamine (Neutralizer)	0.5 gm	0.6 gm	0.7 gm
8	Honey (Sweetner)	1 gm	2 gm	3 gm
9	Distilled water (Vehicle)	q.s	q.s	q.s

Table 6.2: List of Equipments:

Sr. No.	Equipment Name
1.	Measuring Cylinder
2.	Beaker
3.	Glass slide
4.	Conical flask
5.	Funnel
6.	Water bath
7.	Tripod stand
8.	Test tube

BENEFITS:



1. **Antimicrobial properties:** Many dental gels contain ingredients that help reduce plaque, gingivitis, and bad breath.
2. **Desensitizing:** Some dental gels can help alleviate tooth sensitivity by blocking dentinal tubules.
3. **Whitening:** Certain dental gels may contain mild abrasives or whitening agents to help remove surface stains and brighten teeth.
4. **Fresh breath:** Dental gels can leave your mouth feeling clean and fresh.
5. **Easy to use:** Dental gels are often applied directly to the teeth and gums, making them a convenient addition to your oral care routine.

Excipient Profile:

1. Moringa:

Moringa oleifera is a quickly growing, short-lived, drought-tolerant tree belonging to the Moringaceae family, originally from northern India and widely utilized in South and Southeast Asia. It is commonly referred to as moringa, drumstick tree, horseradish tree, or malunggay.

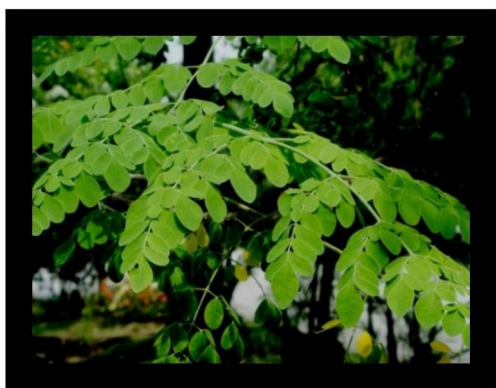


Fig. Moringa

2. Carbapol 940 :

High molecular weight, cross-linked, and based on acrylic acid are carbopol polymers. These are acrylic acid polymers that have been linked together with poly alkenyl ethers or divinyl glycol. They are created from parent polymer particles with an average diameter ranging from 0.2 to 6.0 microns. When created, the flocculated agglomerates are incapable of being broken down into the final particles. A system consisting of networks of polymer chains connected by cross-linking can be thought of as each particle. The pH will be lower because the concentration increases the carboxyl concentration

3. Methyl paraben :

Methylparaben is a commonly utilized preservative, recognized mainly for its ability to combat microbes in personal care products, medicines, and food items. It is the methyl ester of p-hydroxybenzoic acid and falls under the category of parabens. Although it is generally regarded as safe for application, a few individuals may suffer from allergic responses or skin irritation.

4. Propylene glycol (PG):

Propylene glycol (PG) is a colorless, odorless, slightly viscous liquid that's a synthetic cosolvent used in various industries. It's known for its water-absorbing properties and is used in food, pharmaceuticals, cosmetics, and other applications. PG is also used as a solvent, in antifreeze solutions, and to create artificial smoke or fog.

5. Propylparaben:



A chemical substance called propylparaben is employed as a preservative in food, medications, and cosmetics and other personal care items. It belongs to the class of parabens, which are p-hydroxybenzoic acid ester derivatives. Propylparaben prolongs the shelf life of items by halting the growth of microbes.

6. Triethanolamine (TEA):

Triethanolamine (TEA), sometimes referred to as trolamine, is a viscous liquid organic molecule with the chemical formula $(C_2H_4OH)_3N$ that is colourless or slightly yellow. It is frequently utilised as a pH adjuster, emulsifier, and surfactant in detergents, personal care products, and other industrial uses.

7. **Glycerine** :Glycerine, sometimes referred to as glycerol, is a sweet-tasting, colourless, odourless liquid. It is a naturally occurring substance present in plant and animal fats and oils. Glycerine is frequently used as a sweetener, emollient, solvent, and medication. Additionally, it is a humectant, which means it keeps the skin and hair hydrated.

8. Honey :

The most well-known bee species are honey bees, which produce the sweet, viscous liquid known as honey. The purpose of honey production and storage is to support bee colonies. Bees make honey by collecting and purifying the sugary plant secretions (mostly flower nectar) or insect secretions (such as aphid honeydew). This refinement occurs in the hive during storage, when water evaporation concentrates the honey's carbohydrates until they are thick and viscous, as well as within individual bees through regurgitation and enzymatic activity.

PROCEDURE :

Procedure for the preparation of dental gel:

- 1) Soaking: soaked carbapol 940 in water.
- 2) Neutralization: Neutralize with triethanolamine to pH 9.4.
- 3) Addition of preservative: Addition of propyl and methyl Paraben.
- 4) Addition of co-solvent and API: Addition of propylene glycol and MOE in another test tube.
- 5) Addition of sweetener: Finally, honey is added.
- 6) Stirring: Stirring is done until a homogeneous product is formed.

Evaluation Parameters:

- 1) **Appearance:** All the formulation of lantana gel were pale yellow in colour.
- 2) **Consistency:** the consistency was checked by applying on teeth.
- 3) **Greasiness:** The Greasiness was assisted by the application on to the teeth.
- 4) **Determination of pH:** pH of gel determined is in digital pH meter by the dipping the glass electrode completely into the gel system.
- 5) **Determination of viscosity:** Viscosity of formulated gels was determining using Brook field viscometer, spindle no 7 and spindle speed 60 rpm at 25-C was used gels, the corresponding dial reading the viscometer was noted.
- 6) **Determination of spreadability:** Spreadability was measured by this method on the basis of the slip and the drug characteristics of the gel put on the ground slide and the excess gel (approximately 2 g) under analysis. The gel was then placed between the slides and 200 g weighted for 5 minutes was placed on the top of 2 slides to expel air to provide a uniform gel film between the slides where excess gel was scrapped off the edges. The time noted by the top slide (in seconds) to cover a distance of 7.5 cm must be noted. Spreadability was determined using following FORMULA

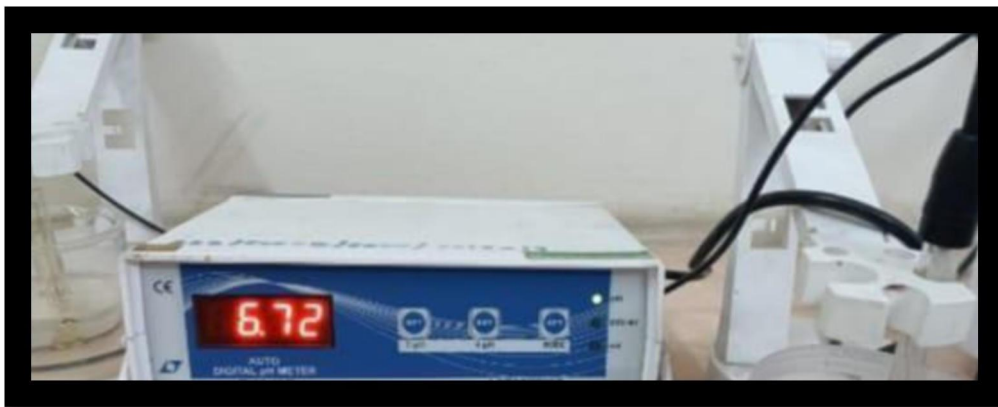


Fig. Determination of spreadability

RESULT AND DISCUSSION :

Herbal dental gel was evaluated for organoleptic parameter showed in the table. The colour of formulation was The odor of prepare formulation was

All results of different parameters of evaluation are recorded. The physical parameter such as color, appearance, feel on application are observed and shown in Table 4. The color of prepared herbal gels was yellowish. The color of extracts was greenish yellow. A ppearance of gel was translucent and it was smod on application. So it shows significant physical evaluation parameters. The subjective properties mentio Table 2 such as consistency was good and texture of prepared herbal gel was found to be smooth. All the prepared herbal gel formulations show desirable spreadability values.

Observation table of Evaluation Parameter:

A) The physical characteristics of Herbal dental gel:

SR. NO	EVALUTION PARAMETER	OBSEVATION
1.	Appearance	Pale yellow
2.	Odour	Characteristics
3.	Taste	Sweet
4.	PH	6.72
5.	Spreadability	17.30gm
6.	Extrudability	93.40%
7.	Homogeneity	Very good

**B) Stability study after one week:**

SR.NO	PARAMETER	OBSERVATION
1.	Appearance	Pale yellow
2.	Odour	Characteristics
3.	Taste	Sweet
4.	PH	6.72
5.	Spreadability	17.04gm
6.	Extrudability	93.58%
7.	Homogeneity	Very Good

Discussion:

Herbal dental gel is used for rinsing the mouth, alleviating inflammation and bleeding. The benefits of herbal dental cosmetics include their non-toxic characteristics, which help address dental issues like mouth ulcers and prevent bleeding between the teeth and gums. The formulation had a pale yellow and a semi-solid consistency.

Conclusion:

Herbal dental gels offer a promising alternative to traditional oral care products, leveraging natural ingredients to promote oral health. With their potential antimicrobial, anti-inflammatory, and soothing properties, these gels can be a valuable addition to one's oral care routine. However, it's essential to choose products with clinically tested ingredients and consult with a dentist to ensure they meet your specific oral health needs.

Future scope :

- Selection of drug having anti-inflammatory and analgesic activity.
- Extraction of phytochemical constituent.
- Phytochemical screening.
- Formation of convenient dosage form.
- Analysis of antiinflammatory activity.