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Formulation and Evaluation of Dental Gel using the Guava Leaves with Clove Oil

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Abstract: ***The main purpose of this gel formulation of Guava leaves, Clove oil, and Honey flavor was to relieve pain and discomfort due to dental pain. As we know there are different types of teeth in the mouth that cause inflammation and pain. The most common dental pain are Local pain in the mount. Now many over-the-counter medications are essential to staying in primary health care because of the positive response and the most effective treatment with the least amount of side effects. Herbal medicines are still the backbone of almost 75-80% of the world's population, especially in developing countries, in primary health care due to better adherence to the human body, cultural acceptance and less side effects. They are found mainly in tropical and subtropical regions of India, the Americas and Africa, where they occur in various countries. The gel contains the main ingredients Guava Leaves Powder, Clove oil, Honey & Carbopol 934 as a gelling agent & and Propylene glycol as a co-solvent. Another ingredient Triethanolamine acts as neutralizer. The formulated gel was tested for different parameters such as physicochemical parameters (pH, viscosity, transparency, smoothness, clarity, grittiness, spreadability, and homogeneity etc.), inhibition area, etc. The gel is homogeneous mixture that shows the pH 6.8. This herbal gel was stable at room temperature protected from any germs and thus safe for use on dental pain. Formulation F2 was better than that of F1 and F3. From among all the developed formulation, F2 Shows better spreadability, Viscosity, physical appearance properties and excellent Extrudability. pH of the F2 Batch is Sufficient to treat the pain, also shows antibacterial activity i.e. zone of inhibition test. F2 Batch shows the good results than other Batches so F2 Batch is suitable for dental use.***

Keywords: Herbal Gel, Dental Gel, Guava Leaves, Honey Flavor

1. Introduction

1.1 Mucoadhesive Drug Delivery System

The buccal region of the oral cavity is an attractive target for administration of the drug of choice. Buccal delivery involves the administration of the desired drug through the buccal mucosa membrane lining of the oral cavity. Unlike oral drug delivery, which presents a hostile environment for drugs, especially proteins and polypeptides, due to acid hydrolysis and the hepatic first pass effect, the mucosa lining of buccal tissues provides a much milder environment of drug absorption. Other routes, such as nasal, ocular, pulmonary, rectal and vaginal drug administration have provided excellent opportunities for the delivery of a variety of compounds.

1.1.1 Mechanism of Buccal Absorption[2]

Buccal drug absorption occurs by passive diffusion of the non-ionized species, a process governed primarily by aconcentration gradient, through the intercellular spaces of the epithelium. The passive transport of non-ionic speciesacross the lipid membrane of the buccalcavity is the primary transport mechanism. The buccal mucosa has been said to be a lipoidal barrier to the passage of drugs, as is the case with many other mucosa membranes and the more lipophilic the drug molecule, the more readily it is absorbed. The dynamics of buccal absorption of drugs could be adequately described by first order rate process.

1.2 Anatomy And Physiology of Oral Mucosa[3]

The outermost part of buccal mucosa is composed of 40-50 layers of non-keratinized stratified squamous epithelialcells. With a surface area of 100 cm^2, it covers one-third of total surface.

1.2.1. Oral Mucosa Site

1) Sublingual Delivery
2) Buccal Delivery
3) Local Delivery

Structure

The oral mucosa is anatomically divided into three tissue layers.

These three layers are:

1) Epithelium
2) Basement membrane
3) Connective tissue

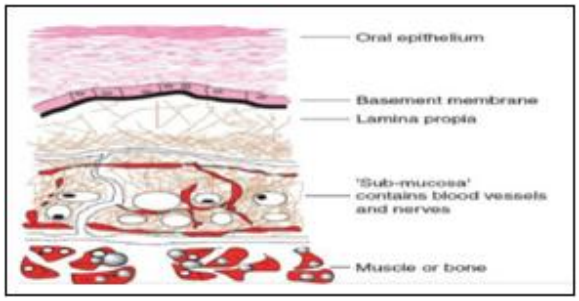


Figure 1: Schematic Diagram of Oral Mucosa

1.3 Gels[4, 5]

Gels are semisolid preparations that contain small inorganic particles or large organic molecules interpenetrated by a liquid. Gels made of inorganic materials are usually two - phase systems where small discrete particles are dispersed throughout the dispersion medium. Gels made of organic molecules are single phase systems, where no apparent physical boundary is seen between the dispersed phase and the dispersion medium. In most cases, the dispersion medium is aqueous. Hydroalcoholic or oleaginous

dispersion media are also used in some cases. Unlike dispersed systems like suspensions and emulsions, movement of the dispersed phase is restricted in gels because of the solvated organic macromolecules or interconnecting three dimensional networks of particles.

1.3.1 Gel forming compounds[6]

A number of polymers are used to provide the structural network that is the essence of a gel system. These include,

1) **Natural gums:** Alginates, carrageenan, tragacanth, pectin, xanthan, gum, etc.
2) **Carbomers:** Carbopol 934, Carbopol 940 and carbopol94 l.
3) **Cellulose derivatives:** Methyl cellulose, sodium carboxyl methyl cellulose, hydroxyl ethyl cellulose, hydroxy propyl cellulose and hydroxy propyl methylcellulose.
4) **Polyethylene:** PEG 200 to PEG8000.
5) **Colloidal dispersed solids:** Microcrystalline silica, montmorillonite clays, colloidal cellulose.
6) **Surfactants:** Non-ionic surfactants.
7) **Other gallants:** Bees wax, carnauba wax, cetyl esters wax, PEGs, etc.

1.3.1.1 Uses of Gels[7]

In the pharmaceutical and cosmetic industry, gel may be enumerated to have the following uses

1) As delivery systems for orally administered drugs.
2) To deliver topical drug applied directly to the skin, mucus membrane or the Eye.
3) As long acting forms of drug injected intramuscularly.
4) As binders in tablet granulation, protective colloids in suspensions, thickeners in oral liquid, and suppository bases.

1.4 Teeth[8]

The human teeth function to mechanically break down items of food by cutting and crushing them in preparation for swallowing and

1.5 Causes[9, 10]

Four things are required for caries to form a tooth surface (enamel or dentin), caries causing bacteria, fermentable carbohydrates (such as sucrose), and time. This involves adherence of food to the teeth and acid creation by the bacteria that makes upthe dental plaque.

1.6 Dental Pain[11]

Pain defines, it is an "unpleasant sensory and emotional experience associated with actual or potential tissue damage". Dentalpain is a common symptom associated with a variety of dental problems such as dental caries which significantly impacts the oral health-related quality of life Patient with dental pain. Often have a sense of anxietywith the use of pharmacological agents and tend to prefer the use of natural remedies due to its trusted efficacy and safety for all age groups.

1.7 Role of herbal medications in dentalpain management[12,13]

The major drawback of conventional drug therapies is the associated side effects. This has led to renewed interest in the use of complimentary herbal medicines such as clove oil, neem leaves, and turmeric, which have been popular household remedies for centuries.

1.8 Rationale for selecting herbal over synthetic medicine[14]

Patient with dental pain often have a sense of anxiety with the use of pharmacological agents and tend to prefer the use of natural remedies due to its trusted efficacy and safety for all age groups.

2. Review of Literature

2.1 Drug Profile

Plant description:

2.1.1. Guava

Figure 2: Guava Leaves

Taxonomical Classification[14, 15]

- Kingdom: - Plantae.
- Division:-Magnoliophyta.
- Class: - Magnoliopsida.
- Sub-class:- Rosidae.
- Order: - Myrtales.
- Family: - Myrtaceae.
- Sub-family:- Myrtoideae.
- Genus: - Psidium.
- Species: - Guvajava.

Vernacular names

- English name: Guava
- Botanical name: Psidium guvajava L.
- Hindi name: Amrud
- Marathi name: Peru
- Telugu name: Goya –pandu, jam pandu, jama.
- Sanskrit name: Amaratafalam, perala.

Parts used: Leaves

Uses[16]

1) It is widely used for treatment of various human ailments such as wound, ulcers, bowels, cholera.

2) The leaves possess analgesic and anti-inflammatory properties.
3) Prevents tooth decay and gum diseases.
4) The anti-inflammation properties of guava leaves can address the toothache pain, and aid in bringing swelling down
5) Guava leaves provide quick, short-term relief for toothaches.
6) They inhibit the growth of microorganisms.

2.1.2 Syzygium aromaticum L (Clove)[17] Taxonomical classification

- Domain : Eukaryote
- Phylum : Tracheophyta
- Class : Magnoliopsida
- Order : Myrtales
- Family : Myrtaceae
- Genus : Syzgium
- Species : *aromaticum*

Parts used: Bud and Stalk Uses:
1) As an Antimicrobial, to help kill bacteria
2) As a pain reliever for conditions such as tooth ache and muscle pain
3) For digestive upset
4) To relieve respiratory conditions like cough and asthma.

2.1.3 Carbapol[18]

IUPAC name: poly (acrylic acid)

Chemical formula: (C3H402)

Uses: Polyacrylic acid and its derivatives are used in disposal disperse ion exchange resins and adhesives .They are also popular as thickening suspending agent and emulsifying agent in pharmaceuticals.

2.1.4 Propylene glycol[18]

IUPAC Name: 1, 2 Propanediol, 2-Hydroxypropanaol, 1, 2-dihydroxypropane.

Chemical formula: CH3CH (OH) CH20H.

Uses: As a solvent for many substances, both natural and synthetic and as a humectant.

2.1.5 Methyl Paraben[18]

IUPAC Name: Methyl 4hydroxybenzoate

Chemical formula: C8H803

Uses: It is used as preservative.

2.1.6 Triethanolamine[18]

IUPAC Name: 2, 2', 2.-Nitrilotriethano

Chemical formula: C6H1sN03

Uses: Triethanolamine is widely used in topical pharmaceutical formulations primarily in the formation of emulsions.

3. Materials and Methods

3.1 Materials

The drug, chemicals and equipment used in the present research work are given in **Table 1** and **Table 2**. All the materials used were of analyticalgrade and procured either as gift samples or purchased.

3.1.1 Chemicals

List of Chemicals

Table 1: List of Chemicals

Sr. No	Chemical Name
1	Carbopol 934
2	Honey
3	Triethanolamine
4	Propylene glycol
5	Methyl Paraben
7	Clove oil

3.1.2 List of Equipment's

Table 2: List of Equipment's

Sr. No	Name of Equipment
1	Electronic balance
2	Digital pH meter
3	Electron Microscope
4	Brookfield viscometer
5	FTIR

3.2 Methodology[19]

1) Preparation of Guava leaf powder:-
a) Fresh Guava use were collected and air dried for 10 days.
b) The dried leaves where then crushed and to make course powder the Powder was collected in air tight container and stored in cool dry place away from sunlight.

2) Preparation of methanol extract of guava leaf powder:
The methanol extract was prepared by mixing 20 gram of guava powder with 100 ml of methanol which was kept for 7 days in a cool dark place along with occasional stirring after 7days the extract was filtered

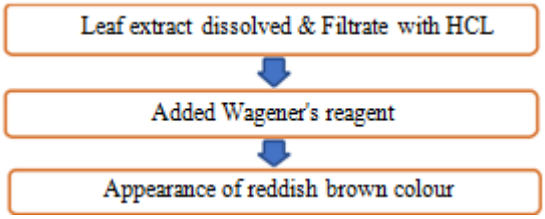
3.2.1 Preformulation Study:[20]
Preformulation testing is the first step in the rational development of dosage forms of drug substance. It can be defined as an investigation of physical and chemical prope1ties of a drug substance alone and when combined with excipients. The goal of Preformulation testing is to generate information useful to the formulator in developing stable and bioavailable dosage forms that can be man produced.

A) Phytochemical screening of guava leaves [19, 21]

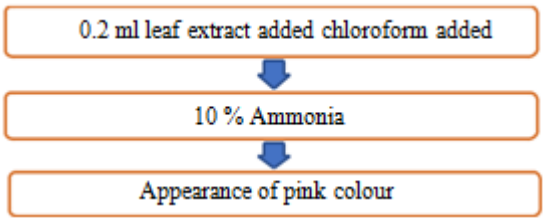
The methanolic extract of guava leaves was subjected to the following preliminary phytochemical analysis.

Test for investigation of phytochemicals:

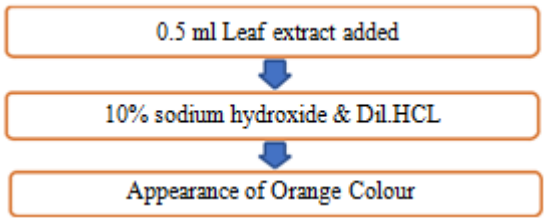
1) Test for Alkaloid



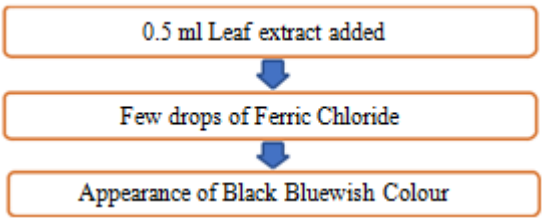
2) Test for Anthraquinones



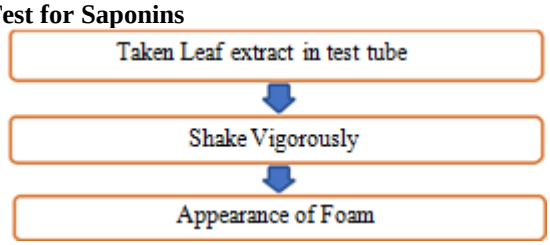
3) Test for Flavonoids



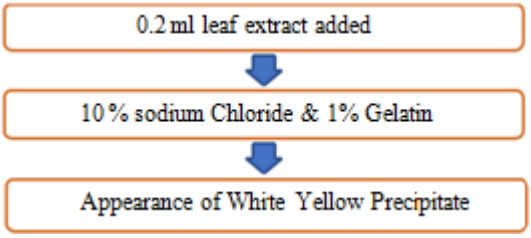
4) Test for Phenols



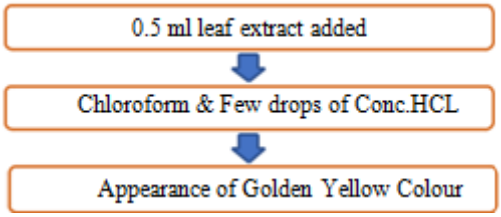
5) Test for Saponins



6) Test for Tannins



7) Test for Triterpence



B) Identification of Physiochemical Characteristics of Clove Oil:- [22, 23]

1) Acid Value:-

Chemicals: clove oil, phenolphthalein indicator, ethanol, sodium hydroxide.

Apparatus: burrate, burrate stand, volumetric flask, distilled water.

Process

- Prepare 0.1 N NaOH solution (0.4gm NaOH+100ml distilled water)
- Add 15 ml ethanol in volumetric flask add few drops of phenolphthalein indicator and titrate with 0.1 N NaOH.
- Initial value is obtained this will be taken for 3 times.
- Add 10 ml clove oil in another conical flask and heat on water bath for 10 min.
- After cooling add phenolphthalein indicator.
- Titrate with O.1 N NaOH and note down reading.
- Final acid value is obtained using the formula Acid value = Molecular weight × N × V ÷ weight of sample.

2) Saponification value

Chemicals: clove oil, Potassium Hydroxide, Hydrochloric acid, Phenolphthalein

Apparatus: - Burrate, Burrate stand, volumetric flask, distilled water etc.

Process:-

- 2 gm. of clove oil taken in a conical flask.
- Dissolved in 25 ml of 0.5 N KOH(2.8 gm. KOH in 100 ml distilled water)
- Reaction mixture is reflexed using a water bath for half an hour. Then this solution is cooled and adding 1 ml phenolphthalein.
- Then titrate with 0.5 N HCl(4.15 HCl ml in 100ml distilled water)
- Titrate until pink colour changes into colorless.
- As same titrate done for Blank sample.
- Saponification value is obtained using the following formula
- **Saponification value** = Volume of acid required to neutralize remaining KOH × 0.02805 (e. f) × 1000 ÷ weight of sample

3) Ester value

Identification of ester value this is done using the acid value.

Ester value = Saponification value – Acid value.

4) Density of Clove Oil

Process:

- First take the empty density bottle weight

- Then take the weight of density bottle filled with clove oil
- Using formula, obtain the density of clove oil.

Determination of density oil: Mass of oil ÷ volume of oil.

B) Drug - Excipient compatibility studies by FTIR analysis[24]

Infrared spectrum of any compound or extract gives information about the groups present in that particular compound. The IR absorption spectra of the pure drug and physical admixtures of active constituents with various excipients in the ratio of 1:1 was taken in the range of 4000-400cm- l using Shimadzu and observed for characteristic peaks of drug.

Active constituents-excipient compatibility was carried out by FTIR analysis.

3.3 Formulation and Development

3.3.1 Formulation of dental gel

Table 3: Formulation of Dental Gel

S. NO	Ingredients	F1	F2	F3
L	Guava leaves powder	2.5g	2 g	1.5g
2	Clove oil	1ml	1ml	1ml
3	Carbopol 934	0.4g	0.4g	0.4g
4	Honey	1 ml	1 ml	1 ml
5	Propylene glycol	3ml	3ml	*3* ml
6	Methyl Paraben	0.18g	0.18g	0.18g
7	Triethanolamine	Ad to pH 6.8	Ad to pH 6.8	Ad to pH 6.8
8	Distilled water	q. s	q. s	q. s

3.3.2 Procedure [25, 26]

Formulation of gel

1) Dispersed carbapol 934 in distilled water.
2) 5 ml water + methyl paraben
3) Heated on water bath
4) After cooling add propylene glycol.
5) Guava leaves powder extract mix in above mixture.
6) Add clove oil and honey Volume made up to 20 ml With Distilled water.
7) Add carbapol 934 properly
8) Adjust pH 6.8 - 7 Triethanolamine added dropwise.

3.4 Evaluation Parameters

3.4.1 Physicochemical evaluation of dental gel

Gels were evaluated for their pH, homogeneity, Spreadability, viscosity, drug content, extrudabi1ity, Transparency, Smoothness, Relative density, Microbial growth by using standard procedure. All studies were carried out in triplicate and average values were reported.

The physical appearance of the formulation was checked visually

1) Colour[27]

The colour of the formulations was checked out visually.

2) Odour

The odour of the gel was checked by mixing the gel in water taking the smell.

3) Transparency[28]

Formulated gel was taken in the 10 ml test tube and its transparency was checked visual.

4) Smoothness

The smoothness of the formulation was tested by rubbing the gel formulation between the fingers and it was observed that whether the gel is smooth, clumped, homogenous or rough.

5) Clarity of gel[29]

The clarity of gel was determined by visual inspection.

6) Stability study

Stability studies were done with open and close container. Here, by subjecting the product to room temperature for 1 month.

7) Grittiness[33]

All the formulations were evaluated Viscosity microscopically for the presence of particles if any no appreciable particulate matter was seen under light microscope. Hence obviously the gel preparation fulfils the requirement of freedom from particular matter and from grittiness as desired for any topical preparation.

8) Spreadability[31]

Spreadability is expressed in terms of time taken by two slides to slip of from gel that is placed in between the slides under the direction of certain load. Lesser the time taken to separate the slide better is the spreadability. Spreadability is calculated by using the formula,

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

Where,
M= weight tied to a upper slide, L =length of glass slides,
T= time take to separate the slides.

9) Measurement of PH [30]

The pH of herbal gel formulation where determined by using digital pH meter one gram of gel was taken and disperse in 10 ml of distilled water and keep a side for 2 hours the measurement of pH of formulation was carried out in three times and the average values are reported.

10) Homogeneity

All developed gel formulations where tested for homogeneity by visual inspection after the gels have been set into the container homogeneity of gel formulation was reported in result table.

11) Viscosity[34]

Viscosity is determined by using Brookfield viscometer. With spindle No.L1, L2 and L3 at 30 rpm

12) Extrudability [32]

To determine Extrudability a closed tube containing formulation was pressed firmly at the crimped end. When

the cap was removed, formulation extruded until the pressure dissipated .Weight in grams required to extrude 0.5 cm ribbon of the formulation in 10 sec was determined. The average extrusion pressure in grams was reported.

13) Antibacterial Test [35, 36, 37]

Procedure: Antibacterial activity against

S. Aureus bacteria by well diffusion method

The inoculums of the microorganism were prepared from the bacterial cultures. 15 ml of nutrient agar (Hi media) medium was poured in clean sterilized petri plates and allowed to cool and solidify. 100µl of broth of bacterial strain was pipette out and spread over the medium evenly with a spreading rod till it dried properly. Once the agar was hardened, then Sample Slides was placed on the plate in the manner and the plates were incubated at 37 ^{O}C for 24 h. Antibacterial activity was evaluated by measuring the diameters of the zone of inhibitions (ZI).

4. Results and Discussion

4.1 Formulation of Gel:

The gel was formulated using the ingredients as specified in table 4.1. The plant material used in the formulation is rich in various phytochemicals. These phytochemicals consist of pentacyclic, triterpenoid, guajanoic acid, olenolic acid, unsolic acid, along with antioxidants which helps to give us therapeutic activity, decrease the pain and demonstrated antibacterial activity.

A good Gel must have ideal viscosity to facilitate the flow of formulation from the bottle. Carbapol was added as gelling agent. Clove oil is added to enhance the therapeutic activity of gel, Methyl paraben is added as preservative, trietaloamine added to the formulation for adjust PH and honey is added as sweetening agent.

4.2 Evaluation tests for the Gel

Evaluation of the dental gel is done using various physiological and chemical tests. These tests provide with information regarding various parameters of the formulation. The results of the tests recorded in table 10.

4.3 Phytochemical screening

Table 4: Phytochemical investigation of Guava leaves

S. No.	Bioactive Compound	Results
1	Alkaloid	+
2	Anthraquinones	–
3	Flavonoid	+
4	Phenols	+
5	Sponins	+
6	Tannins	+
7	Triterpens	+

(+) indicates presence whereas (–) indicates absence of the phytochemical

Figure 3: Phytochemical investigation of Guava leaves

In plants, the naturally occurring chemical compounds are phytochemicals. They give organoleptic properties and colour to the plant. Some phytochemicals are known to reveal medicinal and physiological activities which are phenols, tannins, flavonoids, saponins, carbohydrates, alkaloids, and triterpence etc. Tests were carried out to detect the presence of secondary metabolites such as alkaloids, Phenols, flavonoids, Triterpens, Sponins, Tannins and compounds. The results of the same are mentioned in table 4.

4.4 Physiochemical Characteristic of Clove

Oil:-

1) **Colour** - yellowish
2) **Odour** – Aromatic
3) **Acid value**

Acid value = molecular wt. × N × v ÷Wt. of sample
= 40 × o.1 × 9.34 ÷ 10
= 3.736

4.5 Saponification value

Sample wt.:- 2 gm.
Final burrate reading I.e. for excess KoH remaining =29.7
Initial or blank reading =32.66
Sv = volume × equivalent factor × 1000 ÷ Weight of Sample
= b – a × 0.02805 × 1000 ÷ 2
= 32.66 - 29.7 × 28.5 ÷ 2
= 42.18. 5.

4.6 Ester value = Saponification value - Acid value
= 42.18 - 3.76
= 38.42

4.7 Density

Weight of empty density bottle (a) = 20.57. Weight of density bottle filled with oil (b) = 47.49.
Volume of oil = 25 Determination of density of clove oil = b - a ÷ volume
= 47.49 – 20.57 ÷ 25
= 1.08

Physiochemical Characteristic of Clove Oil:

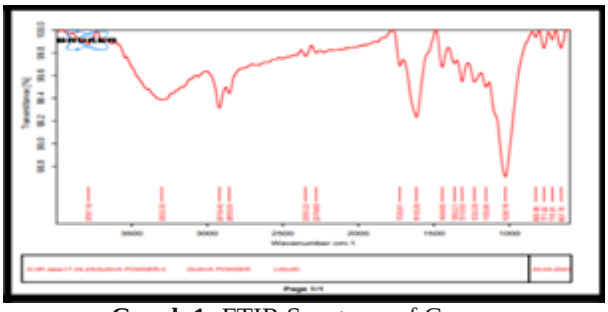
Table 5: Physiochemical Characteristic of Clove Oil

SR. NO.	TESTS	RESULTS
1	Colour	yellowish
2	Odour	Aromatic
3	Acid value	3.736
4	Saponification value	42.18
5	Ester value	38.42
6	Density	1.08

Acid value of clove oil indicates that the oil is free from rancidity, according to the ester value of clove oil indicates that it contains the low fats, and with measures the density of clove oil indicates that they do not float on other substances they will sink when placed in a liquid.

4.8 Drug – Excipient Compatibility Studies by FTIR Analysis.

1) Guava leaves powder FTIR Analysis



Graph 1: FTIR Spectrum of Guava

Leaves Powder

Table 6: FTIR Spectral assignments of Guava Leaves Powder

Sr. No	Wavenumber (cm·1)	Functional Group
1	2919.4	C-H Stretching
2	3302.35	0-H Stretching
3	1616.26	C=C Stretching
4	28.55	0-H Stretching
5	1725.91	C=O Stretching
6	1444.6	CH3 Stretching
7	1026.76	C-O Bending

2) Guava leaves powder with carbapol 934 FTIR Analysis.

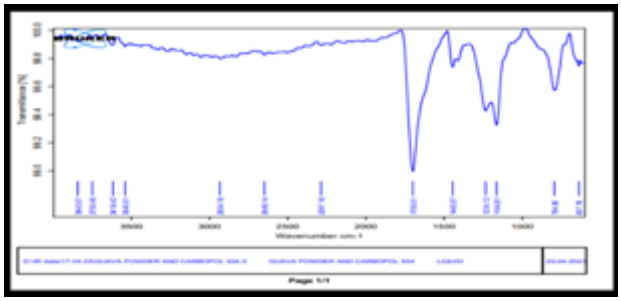
Table 7: FTIR Spectral assignments of Guava Leaves Powder with Carbopol 934

Sr. No	Wavenumber (cm·1)	Functional Group
1	794.6	C-H Stretching
2	3618.42	0-H Stretching
3	1445.57	C=C Bending
4	2649.14	0-H Bending
5	1700.01	C=O Stretching
6	1445.57	CH3 Stretching
7	1234.12,1164.81	C-O Stretching
8	637.76	C-Cl Stretching

4.8.1 Physical appearance

1) Colour and odour

The prepared formulation is examined visually. The formulation must be visually appealing for greater customer satisfaction. The prepared formulation must be free from any agglomerates and must be uniform in nature.



Graph 2: FTIR Spectrum of Guava

Leaves Powder with Carbopol 934

F1F2F3

Figure 4: Appearance of the dental gel

2) Transparency

The formulation must be visually appealing for greater customer satisfaction. The formulated dental gel was translucent and appearance was homogenous.

Figure 9: Transparency of the dental gel

3) Spreadability

Good spreadability can be guarantee the distribution of gel when apply to the skin; good spreadability ranges from 17.21-25.48 gm.cm/sec. The spread test result of the dental gel preparations reveal a value between 22.5-25.2 gm.cm/sec. which indicates that gel as a good spreadability.

Figure 5: Spreadability of the dental gel

4) pH

The topical skin is extremely sensitive to the pH variation of the products applied in its surface. The pH of formulated dental gels was determined using pH meter. The results of all the formulation from F1 to F3 were within the standard limit range that is pH 6.8 - 7 as shown in table No: **10.**

5) Grittiness

Multiparticulate formulations are composed of multiple solid dosage units which can be administered orally. According to the result obtained from light microscope, there is no any aggregate form.

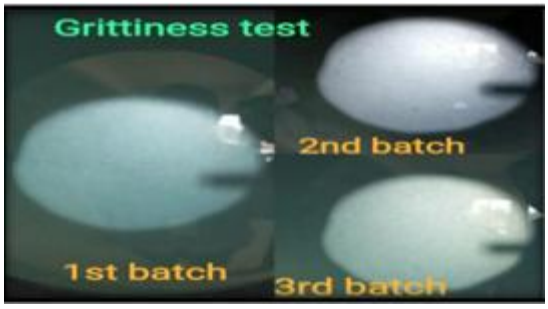


Figure 6: Determination of Grittiness

4.8.2 Physiochemical analysis

1) Determination of viscosity

Measuring the viscosity of the formulation is an essential part of quality control of the product. Product viscosity plays an important role in defining and controlling many attributes such as shelf life, stability and product aesthetics such as clarity, ease of flow on removal from packing and spreading on application to dental gel and product consistency in the package.

Table 8: Viscosity by Brookfield viscometer

Batch No.	Spindle Number		
	L1	L2	L3
F1	21.56	41.52	18.21
F2	21.56	48.64	59.19
F3	21.57	43.66	48.98

2) Stability testing:

Stability testing was carried out to check the quality of the product at room temperature which was kept for the period of one month. Formulated gel containing open container when expose to ambient room temp then syneresis was observed it means concentration of gel by separating out of liquid syneresis it means form of instability in aqueous gels.

Table No. 9: Stability Testing

Open container	Closed container
Not stable	stable

3) Antibacterial Testing:

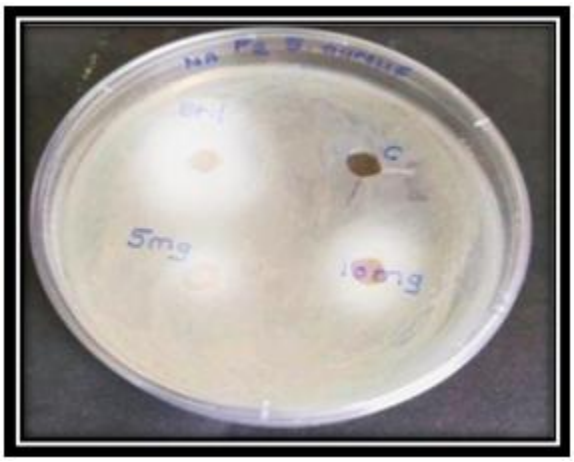


Figure 7: Antibacterial Activity of samples against Stap. Aureus

The given sample F2 used for the antibacterial activity by using bacterial strain Stap. Aureus, which at the concentration 10 mg showed activity as compared to standard.

Table 10: Results of Evaluation Tests

Evaluation Characteristics	Formulation		
	F1	F2	F3
Colour	Pale Yellow	Pale Yellow	Pale Yellow
Odour	Aromatic	Aromatic	Aromatic
Transparency	Translucent	Translucent	Translucent
Smoothness	Good	Good	Good
Clarity	clear	Very clear	Poor clear
Grittiness	No aggregate form	No aggregate form	No aggregate form
Spreadability	22.5	22.54	25.2
pH	6.85	6.87	7
Homogeneity	Good	Very Good	Good
Viscosity (cP)	21.56	21.56	21.57

5. Conclusion

It has been observed that the demand for plant based healthcare and cosmetic preparations has increased over the last few years due to increased adverse effects caused by the synthetic chemicals used in the developing products.

The main purpose of this study was to formulate a stable and functionally effective dental gel with addition herbs with synthetic chemicals. The research concluded that natural remedies are more acceptable and are safer with minimum side effects than synthetic preparation .the data presented in this study , it was demonstrated that the developed gel processes significant, therapeutically efficacious, suitable vehicle for drug delivery in low cost but definitely with high potential

The above formulated tooth gel totally capable to the tooth , maintain the oral hygiene and it and it and showed the action against pathogen i.e. antimicrobial activity ,therefore preventing approach to the growth of microorganism inside the oral cavity . The formulation tooth gel was show the good scope in future about dental research in natural remedies.

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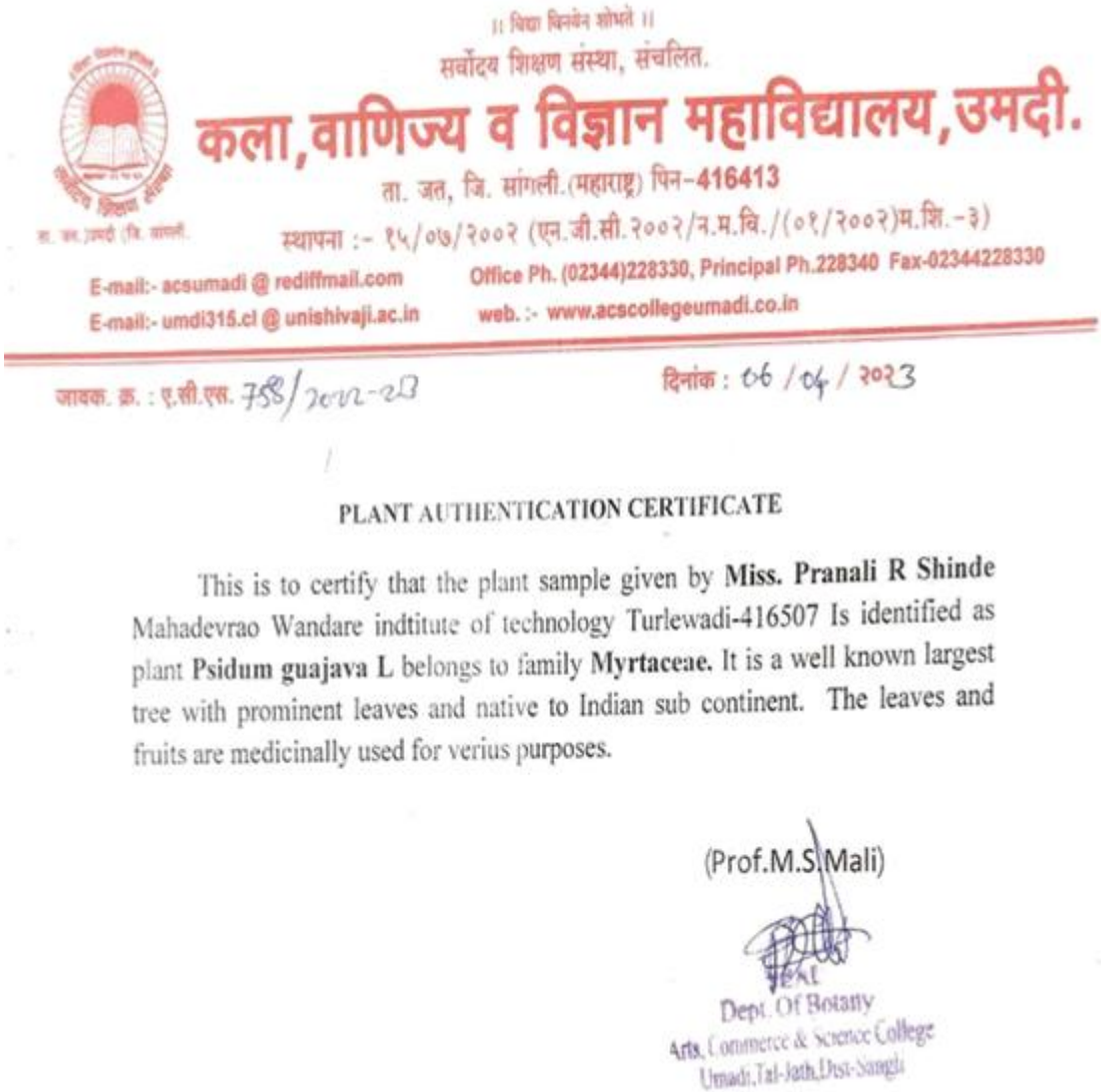
Annexure

1) Guava Authentication Latter:-



॥ विद्या विनयेन शोभते ॥

सर्वोदय शिक्षण संस्था, संचलित.

कला, वाणिज्य व विज्ञान महाविद्यालय, उमदी.

ता. जत, जि. सांगली.(महाराष्ट्र) पिन-416413

स्थापना :- १५/०७/२००२ (एन.जी.सी.२००२/न.म.वि./(०१/२००२)म.शि.-३)

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जावक. क्र. : ए.सी.एस. 758/2022-23 दिनांक : 06 / 04 / 2023

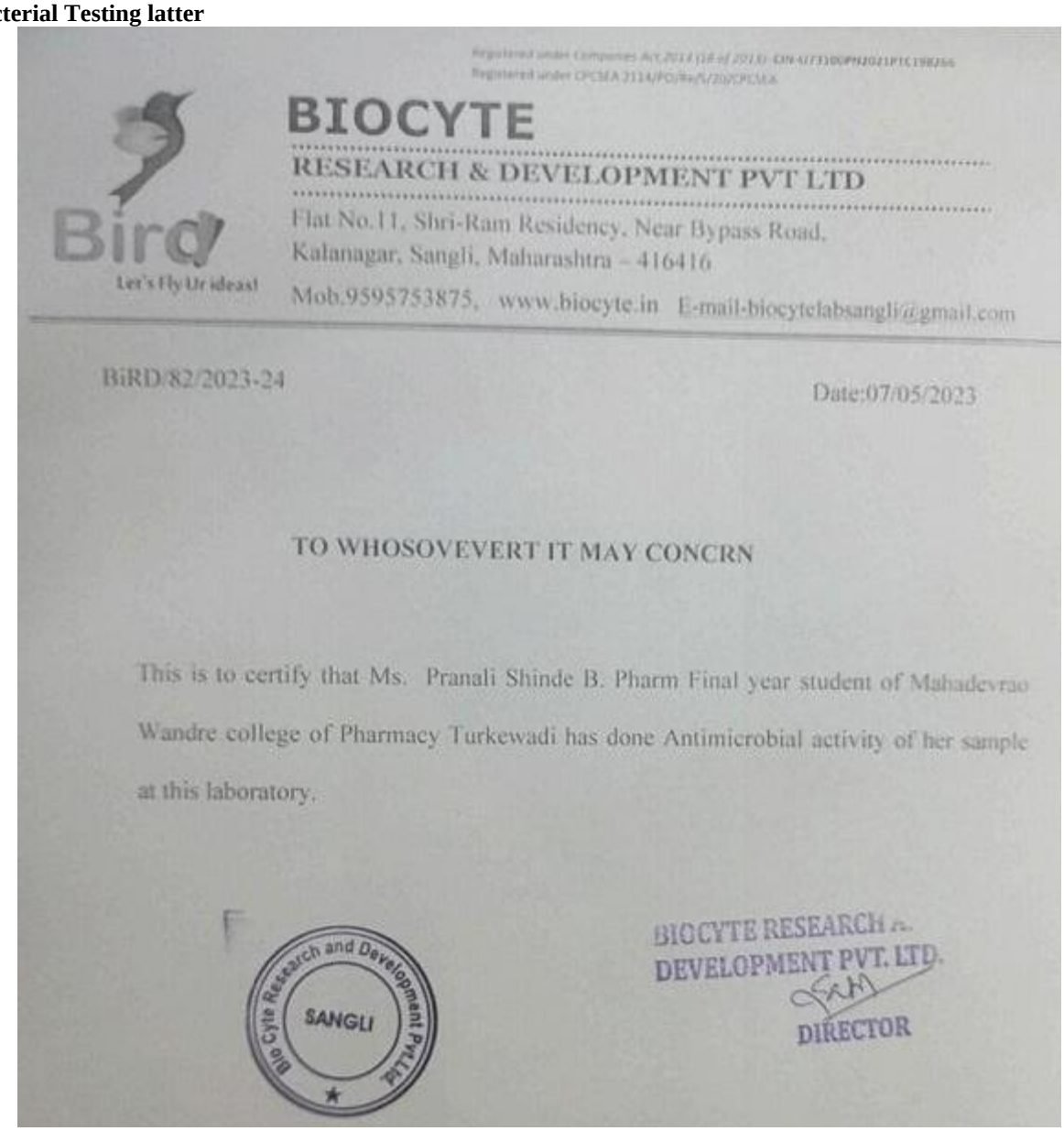
PLANT AUTHENTICATION CERTIFICATE

This is to certify that the plant sample given by **Miss. Pranali R Shinde** Mahadevrao Wandare indtitute of technology Turlewadi-416507 Is identified as plant **Psidum guajava L** belongs to family **Myrtaceae.** It is a well known largest tree with prominent leaves and native to Indian sub continent. The leaves and fruits are medicinally used for verius purposes.

(Prof.M.S.Mali)

Dept. Of Botany
Arts, Commerce & Science College
Umadi.Tal-Jath.Dist-Sangli

2) Antibacterial Testing latter



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This is to certify that Ms. Pranali Shinde B. Pharm Final year student of Mahadevrao Wandre college of Pharmacy Turkewadi has done Antimicrobial activity of her sample at this laboratory.

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SANGLI

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