# "FORMULATION & EVALUATION OF POLYHERBAL EMULGEL FOR THE TREATMENT OF RHEUMATOID ARTHRITIS".

***A Project Work report submitted to***

***DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE***

***IN PARTIAL FULFILLMENT***

***OF THE REQUIREMENT FOR THE DEGREE OF***

***BACHELOR OF PHARMACY***

UNDER THE FACULTY OF

**SCIENCE AND TECHNOLOGY**

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**(Final Year B. Pharm.)**

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**2023 – 2024**

# Certificate

This is to certify that, the project work report entitled "**FORMULATION & EVALUATION OF POLYHERBAL EMULGEL FOR THE TREATMENT OF RHEUMATOID ARTHRITIS"** is compiled by **Ms. Sawant Dikshita Ganesh, Mr. Poyekar Sarvesh Arvind, Ms. Nikalje Amisha Sanjay, Mr. Thakur Balaji Gokulsing and Mr. Parab Niraj Vijay** under the guidance of **Ms. SHWETA V. Shirodkar** in partial fulfilment of the requirement for the award of the Degree of Bachelor of Pharmacy under the faculty of Science and Technology of Dr. Babasaheb Ambedkar Technological University, Lonere. The work has been carried out at Vijayrao Naik College of Pharmacy, Shirval has been examined by us during the academic year 2023-24.

***Place: Shirval***

***Date: -  / 07 / 2024***

***Internal Examiner***

(Name & Sign of Examiner)

***External Examiner***

(Name & Sign of Examiner)

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***Place: Shirval***

***Date: - / 07 / 2024***

*Principal*
***Mr. Chandrashekhar V. Babar.***
*Vijayrao Naik College of Pharmacy, Shirval.*

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This work presented in this project was carried out under my / our supervision and guidance.

***Place: Shirval***

***Date: - / 07 /2024***

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# Declaration

We undersigned hereby declare that, the project work report entitled **"FORMULATION & EVALUATION OF POLYHERBAL EMULGEL FOR THE TREATMENT OF RHEUMATOID ARTHRITIS"** completed and written by us and it is based on our own work carried out during the course of study under the guidance of **Ms. Shweta V. Shirodkar**, we further declare that to the best of our knowledge the report does not contain any work or part of work which has been submitted for award any degree or diploma in this University or any other University of India or abroad.

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# ABBREVIATIONS

| Abbreviation | Meanings |
|---|---|
| API | Active Pharmaceutical Ingredient |
| RA | Rheumatoid Arthritis |
| OA | Osteoarthritis |
| mm | Micrometer |
| IV | Intravenous |
| CMC | Carboxy methyl cellulose |
| HPMC | Hydroxypropyl Methyl cellulose |

# ABSTRACT

The present study was conducted to develop an emulgel formulation containing potential herbal anti-inflammatory agents, viz., ginger extract and eucalyptus oil. Emulgel is a topical preparation prepared by the combination of emulsion and gel. Polyherbal Emulgels are generally free from serious side effects. The primary intention of this new topical drug delivery system is to deliver hydrophobic drugs into systemic circulation through the skin. Inflammation and rheumatism remain serious problems in the present era. Although there are many allopathic formulations available on the market for the treatment of rheumatoid arthritis, allopathic medicine suffers from side effects like heartburn, stomach pain, nausea, vomiting, diarrhoea, constipation, liver damage, fluid retention, etc. Whereas Emulgel formulation avoids first pass metabolism and is more selective to a specific site, also this formulation improves patient compliance and is suitable for self-medication. It is considered that herbal medication is safer as compared to allopathic medicine. The herbal components ginger extract and eucalyptus oil have been selected for the development of an anti-inflammatory Emulgel formulation, as a literature review revealed that these are effective in the treatment of rheumatoid arthritis. Carbapol 934 and liquid paraffin were used as gelling agents, along with herbal extracts.

**KEYWORDS:** Emulgel, Polyherbal, Anti-Inflammatory, Ginger extract, Eucalyptus oil, Rheumatoid arthritis.

# CHAPTER 1: INTRODUCTION

## 1.1 Rheumatoid Arthritis:

Rheumatoid Arthritis (RA) is a chronic autoimmune disease characterized by joint synovial inflammation and progressive cartilage and bone destruction resulting in gradual immobility.

Rheumatoid arthritis RA is an autoimmune disease that can cause joint pain and damage

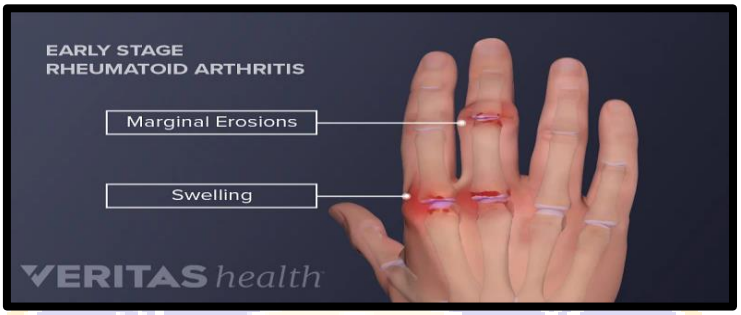



**Fig. No 1.1: Rheumatoid Arthritis**

throughout your body. The joint damage that RA causes usually happens on both sides of your body. So if a joint is affected in one of your arms or legs, the same joint in the other arm or leg will probably be affected. This is one way that doctors distinguish RA from other forms of arthritis, such as osteoarthritis (OA).

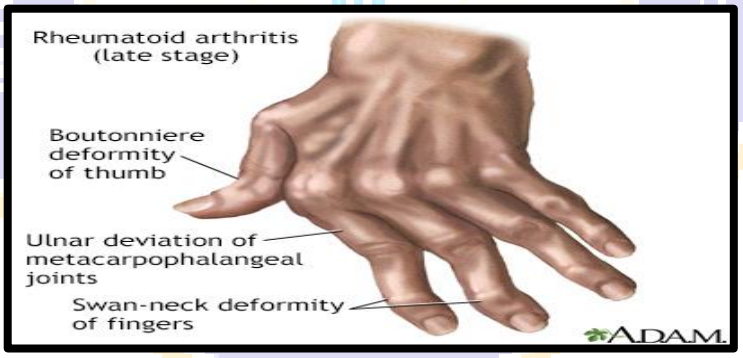



**Fig. No 1.2: Rheumatoid Arthritis**

RA is a long-term or chronic disease marked by symptoms of inflammation and pain in the joints. [1]

Inflammation is a complex process, which is frequently associated with pain and involves occurrences, such as increasing vascular permeability, protein denaturation, and membrane denaturation. Inflammation is a defensive response to stress characterized by redness, pain, swelling, and heat in the injured area.

The goal of treatment for RA is to reduce joint inflammation and pain, maximize joint function, and prevent joint destruction and deformity. Treatment regimens consist of combinations of pharmaceuticals, weight-bearing exercise, educating patients about the disease, and rest.

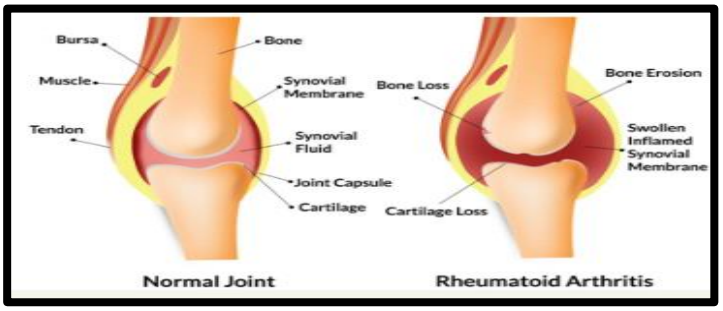



**Fig. No 1.3: Rheumatoid Arthritis**

Treatments are generally customized to a patient's needs and depend on their overall health. This includes factors such as disease progression, the joints involved, age, overall health, occupation, compliance, and education about the disease. [3]

- **RA symptoms, which can occur throughout the body, it includes:**

1) Joint pain
2) Joint swelling
3) Joint stiffness
4) Loss of joint function

**1.2 Skin:**

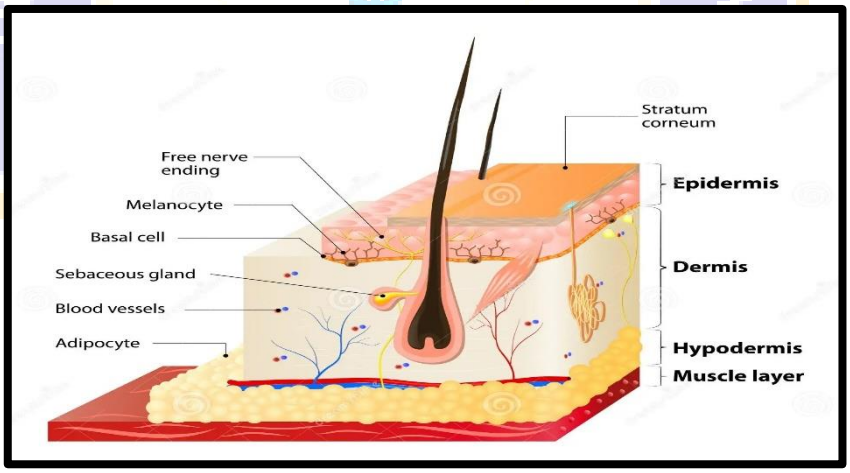



**Fig. No. 1.4: Skin Structure**

The skin is the largest organ of the body, accounting for more than 10% of body mass, and the one that enables the body to interact most intimately with its environment. Figure 1 shows a diagrammatic illustration of the skin.

In essence, the skin consists of four layers: the stratum corneum (nonviable epidermis), the remaining layers of the epidermis (viable epidermis), dermis, and subcutaneous tissues. There are also several associated appendages hair follicles, sweat ducts, apocrine glands, and nails. Many of the functions of the skin can be classified as essential to survival of the body bulk o

mammals and humans in a relatively hostile environment.

They are classified as protective, maintaining homeostasis, or sensing. The importance of the protective and homeostatic role of the skin is illustrated in one context by its barrier property. This allows the survival of humans in an environment of variable temperature; water content (humidity and bathing) and the presence of environmental dangers such as chemicals, bacteria, allergens, fungi, and radiation. In a second context, the skin is a major organ for maintaining the homeostasis of the body, especially in terms of its composition, heat regulation, blood pressure control and excretory roles. It has been argued that the basal metabolic rate of animals differing in size should be scaled to the surface area of the body to maintain a constant temperature throughout the skin's thermoregulatory control. (31)

**1.3 Emulgel:**

Topical drug administration is a localized drug delivery system anywhere in the body through ophthalmic, rectal, vaginal and skin as topical routes. Skin is one of the most readily accessible organs in the human body for topical administration, and it is the main route of the topical drug delivery system. Topical preparations are applied on the skin surface for local or systemic effects. Skin is the largest organ of the body. It is not uniformly thick. At some places, it is thick and in some places, it is thin. The average thickness of the skin is about 1 to 2mm. [1]

**Fig. No. 1.5: Emulgel**

The topical drug delivery system is the dosage form that is administered to the skin and other routes of drug delivery fail or cause skin disorders. The topical drug delivery system has the advantage of negotiating the first pass metabolism. It also helps to avoid the risk and inconvenience of IV route therapy. Topical formulations are prepared in different consistency such as solid, semisolid, and liquid. The topical delivery system is failed in the administration of hydrophobic drug. In each formulation with the active ingredients many excipients are used.

Sometimes more than one formulation can be combined to enhance the drug delivery. Emulgel is such a combination. It is a combination of emulsion and gel. [4] Emulgel is prepared both in oil in- water and water- in oil type emulsion mixed with gel. Oil- in- water type is used for lipophilic drugs and water- in- oil type is used for hydrophobic drugs delivery. [5] The emulgel has many advantages like thixotropic, greaseless, easily spreadable, easily removable, emollient, non-staining, bio-friendly, pleasing appearance, transparent and cosmetically acceptable, which also have a good skin penetration and long shelf- life. [6]

**Table No.1: Advantage and Disadvantages**

| Advantages | Disadvantages |
|---|---|
| 1. Avoidance of first pass metabolism. | 1. The possibility of allergenic reactions. |
| 2. Avoidance of gastrointestinal incompatibility. | 2. The poor permeability of some drug through the skin. |
| 3. More selective to a specific site. | 3. Skin irritation on contact dermatitis. |
| 4. Improve patient compliance. | 4. Drugs of large particle size are not easy to absorb through the skin. |
| 5. Suitability for self-medication. | 5. The occurrence of the bubble during the formulation of emulgel. [7] |

# CHAPTER 2: LITERATURE SURVEY

1) **Dr. Jasmine & Avari, Dr. Nilesh Mahakar, Shri Sai College of pharmacy Nagpur. university department of pharmaceutical science.**

The present study was conducted develop an emulgel from containing potential herbal anti-inflammatory agent ginger, black paper, inflammation and rheumatism remain serious problem in the present work from literature review it revealed that these are effective the treatment of an inflammation.

**2) DR. Sapna Desai, Ankita Desai and Divynag Patel pioneer pharmacy degree college vadora Gujarat**.

The polyherbal emulgel formulation were formulated to treat arthritis hydroalcholic extract of ginger. The herbs have been reported to have excellent, antioxidant, anti -inflammatory, anti -arthritic properties.

**3) Dr. Pratiksha V.Shrikhande, IBBS College of pharmacy Malakpur Department of pharmaceutics.**

The present study was conducted to develop an emulgel formulation containing potential herbal anti- inflammatory agent ginger & eucalyptus oil. Inflammation and rheumatism remain serious problem in the present area although there are the number of allopathic formulation available in the market for the treatment of inflammation, but these suffer from side effects like heartburn, stomach pain, nausea, vomiting, diarrhea etc. It is considered that herbal medication as safer as compared to that allopathic medicine in the market

**4) Mrs. Rajashri R.Dhonnar, Mrs. Mona Y.Agarwal, Dr. Yogesh Agarwal, Government College of pharmacy kathora, Amravati, Department of pharmaceuticas.**

In Ayurveda, it is mentioned that multiple Herbs are used in defined proportion to treat illness. A polyherbal formulation is a formulation that contain two or more herbal drugs which act as active constituent and can show beneficial effects. The polyherbal formulation contains numerous phytoconstituents which give improve effect with pharmacological efficiency and minimum toxic effect.

**5) Brijesh Mahesh Patel, Ashwin Bhanudas Kuchekar and Saish Rajendra Pawar.**

Topical drug delivery encompasses delivering medications through various routes like the skin, vagina, eyes, and rectum, for both localized and systemic effects. These formulations can be solid, semi-solid, or liquid, tailored to the drug's properties. Emulgel, a stable formulation created by combining a surfactant and co-surfactant, enhances drug permeability and stability. It offers dual control and sustained release, improving bioavailability and patient compliance.

**6) SK Hettihewa (2021).**

Developed and evaluation of a novel herbal emulgel for potential anti-inflammatory and antioxidant In-vitro. Emulgel is a novel topical drug delivery system which can overcome the major limitation of gel, limited delivery of hydrophobic drug.

**7) Heba S. Elsewedy (2021).**

Developed Niosomal Colchicine Loaded into Jojoba Oil-Based Emulgel Using Response Surface Methodology of enhancement of Anti-Inflammatory Activity of Optimized. Recent progression in investigational studies aiming to integrate natural products and plant oils in developing new dosage forms that would provide optimal therapeutic effect.

**8) Vijay R. Mahajan (2022).**

Studied formulation & evaluation of herbal anti- inflammatory emulgel prepared form Ginger extract topical drug delivery system is dosage form which are apply directly to the skin to cure various diseases. The objective of the study was to prepared from the Ginger extract use in Carbopol 940 as gelling agent and it will be useful as anti-inflammatory gel.

# CHAPTER 3: NEED AND OBJECTIVES

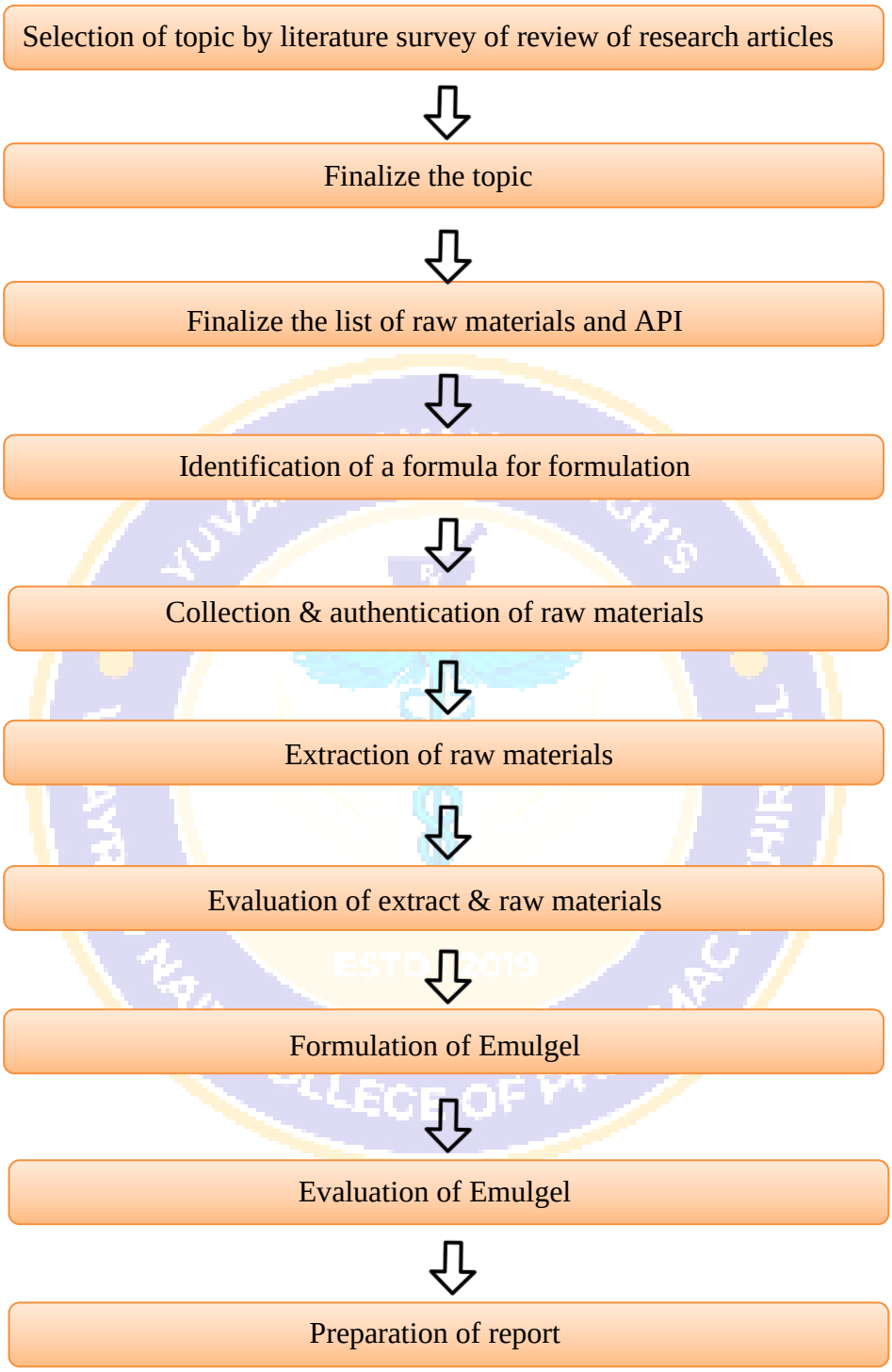
**Needs of Emulgel:**

- **Stability:**
  Emulgels are more stable than creams and ointments.
- **Consistency:**
  Emulgels have a gel-like consistency that allows them to adhere to the skin for longer periods of time, which improves skin penetration and the sustained release of active ingredients.
- **Delivery:**
  Emulgels can deliver both hydrophilic and hydrophobic drugs to the skin through a dual release mechanism.
- **Other Properties:**
  Emulgels are also greaseless, easily spreadable, easily removable, emollient, transparent, and have a longer shelf life.

**Objective of Emulgel:**

- To develop an emulgel that can provide effective pain relief to individuals suffering from rheumatoid arthritis.
- To incorporate herbal ingredients with anti-inflammatory properties to reduce the inflammation and swelling in the affected joints.
- To enhance the delivery of active ingredients through the skin to reach the affected joints.
- Ensure that the emulgel formulation is safe for use with minimal side effects.
- To develop a formulation that remains stable over time, maintaining its effectiveness and consistency.
- To improve the bioavailability of herbal components, ensuring that they are absorbed and reach the target areas within the body.

# CHAPTER 4: PLAN OF WORK



# CHAPTER 5: MATERIALS AND EQUIMENTS

## 5.1 List of Materials:

**Table No.2: List of Ingredients**

| Sr. No. | Materials |
|---|---|
| 1 | Ginger |
| 2 | Eucalyptus oil |
| 3 | Span 60 |
| 4 | Tween 20 |
| 5 | Carbapol 934 |
| 6 | Methyl paraben |
| 7 | Propyl paraben |
| 8 | Liquid paraffin |
| 9 | Propylene glycol |
| 10 | Triethanolamine |
| 11 | Rose water |
| 12 | Menthol |
| 13 | Sodium CMC |
| 14 | HPMC 15 |

## 5.2 List of Equipment's:

**Table No.3: List of Equipment**

| Sr. No. | Name Of Equipment's |
|---|---|
| 1 | Condenser |
| 2 | Thermometer |
| 3 | Conical flask |
| 4 | Mortar & Pestle |
| 5 | Extraction chamber |
| 6 | Reflux condenser |
| 7 | Soxhlet extractor |

# CHAPTER 6: MATERIALS / EXCIPIENTS PROFILE

## 6.1 Eucalyptus Oil:

**Fig. No. 6.1 Eucalyptus oil**

- **Synonym:** Blue gum, lemon-scented gum.
- **Biological Source:** Made from the fresh leaves and branch tops of the eucalyptus plant.
- **Family:** Myrtaceae.
- **Chemical Constituents:** Essential oils like 1,8-cineol (49.07 to 83.59%) and α-pinene (1.27 to 26.35%), limonene (6.9%).
- **Therapeutic Role:** Works as disinfectant and wound healing & treatment of cuts, in Rheumatoid arthritis it helps to reduce pain & inflammation.
- **Storage Condition:** Store in a cool dry and well-ventilated place.[8]

## 6.2 Ginger:

**Fig. No. 6.2 Ginger**

- **Synonym:** Adrak, jengiber.
- **Biological Source:** Consists of the dried rhizomes of the Zingiber officinale Roscoe.
- **Family:** Zingiberaceae.
- **Chemical Constituents:** The major constituents in ginger rhizomes are carbohydrates

- (50–70%), lipids (3–8%), terpenes and phenolic compounds
- **Therapeutic Role:** Used in the treatment of rheumatoid arthritis it is used as anti-inflammatory & Prostaglandin and leukotriene inhibitor resulting in pain reduction.
- **Storage Condition:** Between 13-15°C and in desired humidity.[9]

**6.3 Span 60:**


**Fig. No. 6.3 Span 60**

- **Common Name:** Sorbitan Monostearate.
- **Synonym:** Sorbitan stearate, Arlacel 60, Qpan 60, FEMA 3028.
- **CAS Number:** 1338-41-6.
- **Category:** Emulsifier, detergent, spreading agent, or dispersing agent.
- **IUPAC Number:** 2-[(2R,3S,4R)-3,4-dihydroxyoxolan-2-yl]-2-hydroxyethyl octadecanoate.
- **Formula:** C24H46O6.
- **Molar Mass:** 430.63 g/mol.
- **Appearance:** Pale-yellow to yellow granular solid at room temperature. It can also appear as a brownish-yellow wax.
- **Description:** A biodegradable surfactant based on a natural fatty acid (stearic acid) and sugar alcohol sorbitol. This sorbitan ester is highly effective at forming oil in water emulsions.
- **Application:** Anti-static agent, emulsifier and stabilizer in medicine, cosmetics, food, pesticide, coatings, plastic and textiles industries.
- **Stability:** Span 60 is a stable, combustible substance that is incompatible with strong oxidizing agents.
- **Storage Condition:** Span 60 is stable and should be stored below 30°C.

**6.4 Tween 20:**

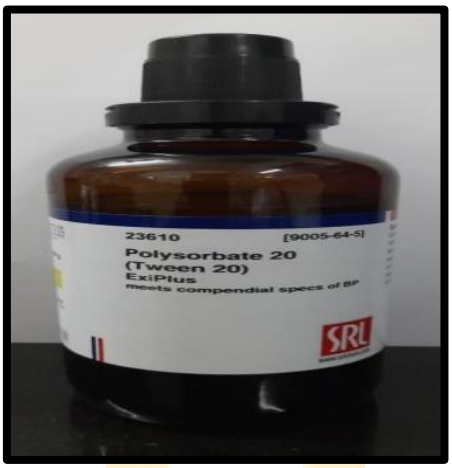



**Fig. No. 6.4 Tween 20**

- **Common Name:** Polysorbate 20.
- **Synonym:** Polysorbate 20, PEG (20) sorbitan monolaurate, polyoxyethylenesorbitan monolaurate.
- **CAS Number:** 9005-64-5.
- **Category:** Detergent and emulsifier.
- **IUPAC Name:** Polyoxyethylene (20) sorbitan monolaurate.
- **Formula:** C58H114O26.
- **Molar Mass:** 1228 g/mol.
- **Appearance:** Clear, yellow to yellow-green viscous liquid.
- **Description:** Used as emulsifying agents for the preparation of stable oil in water emulsions.
- **Application:** Serves as an emulsifier for the preparation of stable oil-in-water emulsions.
- **Stability:** Viscous liquid that is heat sensitive and will darken when exposed to high temperatures. It should be stored in a cool, dry, and draughty place, and has a shelf life of two years.
- **Storage Condition:** Stored at 4-8°C, and freezing is not recommended. [11]

**6.5 Triethanolamine:**


**Fig. No. 6.5 Triethanolamine**

- **Common Name:** Trolamine.
- **Synonym:** Daltogen, Sterolamide, Sting-Kill, Thiofaco T-35**.**
- **CAS Number:** 102-71-6.
- **Category:** Buffer, surfactant.
- **IUPAC Name:** 2, 2’, 2"-Nitrilotriethanol.
- **Formula:** C6H15NO3.
- **Molar Mass:** 149.188g/mol.
- **Appearance:** Colorless, viscous liquid that can appear pale yellow.
- **Description:** Colorless, viscous, oily liquid organic chemical compound.
- **Application:** It is used to maintain the pH of formulation & stabilize them.
- **Stability:** Stable under normal storage and handling conditions. It's stable for about a year at room temperature.
- **Storage Condition:** Storage temperature is 15–25°C. [12]

**6.6 Sodium CMC:**


**Fig. No. 6.6 Sodium CMC**

- **Common Name:** Cellulose gum.
- **Synonyms:** Carboxymethylcellulose sodium, Carmel lose sodium.
- **CAS Number:** 9004-32-4.

- **Category:** emulsifier, stabilizer, thickener, gelling agent and binder.
- **IUPAC Name:** Sodium 2,3,4,5,6-pentahydroxyhexanal acetate.
- **Molar Mass:** 108.97 g/mol.
- **Appearance:** White or yellowish powder.
- **Description:** White or slightly yellowish or greyish, odorless, and tasteless powder or fibrous granules.
- **Application:** Emulsifier, binder, stabilizer, gelling agent, it increases viscosity in topical formulation.

- **Stability:** Generally stable, with a shelf life of 24–36 months, stable in the range of pH 7-9.
- **Storage Condition:** Cool, dry, ventilated area with a maximum temperature of 40°C and relative humidity less than 80%.[13]

**6.7 HPMC 15 (Hydroxypropyl Methylcellulose):**


**Fig. No. 6.7 HPMC**

- **Common Name:** Hydroxypropyl methylcellulose.
- **Synonym:** Hydroxypropyl methylcellulose or hypromellose.
- **CAS Number:** 9004-65-3.
- **Category:** Thickener, emulsifier, and stabilizer.
- **IUPAC Name:** Propyl 2-hydroxyethyl cellulose.
- **Molar Mass:** 59.08g/mol.
- **Appearance:** White powder.
- **Description:** White, odorless, and tasteless powder or granules that can appear yellowish white or greyish-white. It is also Hygroscopic after drying.

- **Application:** Binder, polymer, thickening agent, it also used as a key excipient for controlled release.
- **Stability:** Stable at a pH of 4–8 in a 1% solution at 25°C. As the temperature increases, the viscosity of the solution decreases.
- **Storage Condition:** Keep away from hot water, direct sunlight, air radiators, and steam pipes, maintain a relative humidity of 40–65%, and maintain temperature of 20–35°C. [14]

**6.8 Liquid Paraffin:**


**Fig. No. 6.8 Liquid Paraffin**

- **Common Name:** Paraffin oil.
- **Synonym:** Paraffin liquidum, Russian mineral.
- **CAS Number:** 8012 -95-1.
- **Category:** Moisturizing agent.
- **Description:** Liquid paraffin is very highly refined distilled fraction of petroleum that contain a mixture of hydrocarbons.
- **Application:** Good dispersion property in gel formulation. Liquid paraffin is primarily used as a pediatric laxative in medicine and is a popular treatment for constipation and encopresis.
- **Stability:** Stable under room temperature.
- **Storage Conditions:** Store in cool place in an airtight container.
- **Incompability:** Liquid paraffin interferes with the absorption of fat-soluble vitamins.
- **Safety and Handing Precautions:** Avoid contact eyes and clothing.[15]

**6.9 Methyl Paraben:**

**Fig. No. 6.9 Methyl Paraben**

- **Common Name:** Methyl hydroxybenzoate.
- **Synonym: Methyl hydroxybenzoate.**
- **CAS Number:** 99-76-3.
- **Category:** Preservative, Antimicrobial.
- **IUPAC Name:** Methyl 4-hydroxybenzoate.
- **Formula:** C8H8O3.
- **Molar Mass:** 152.15 g/mol.
- **Appearance:** Colorless crystals or white crystalline powder.
- **Description:** Methyl Paraben is the 4-hydroxybenzoate ester resulting from the formal condensation of the carboxyl group of 4-hydroxybenzoic acid with methanol.
- **Application:** They prevent harmful mold, bacteria and fungi from infecting products.
- **Stability:** Chemically stable under normal storage conditions.
- **Storage Condition:** Store in dry, cool and well-ventilated place.
- **Incompability:** Strong oxidizing agents, strong base.[16]

**6.10 Propyl Paraben:**

**Fig. No. 6.10 Propyl Paraben**

- **Synonym:** Propyl Parahydroxybenzoate, Propyl 4-hydroxybenzoate).

- **CAS No:** 94 -13- 3.
- **Formula:** C10H1203.
- **Category:** Antimicrobial preservative.
- **Melting Point:** 96 -99°C.
- **Solubility:** Soluble in water, ethanol, and ethyl ether slightly soluble in chloroform.
- **Description:** Propyl paraben occur as a white, crystalline, odorless and tasteless Powder.
- **Uses:** Used as antimicrobial preservative in pharmaceutical foods, cosmetics and shampoos.[17]

**6.11 Carbapol 934:**

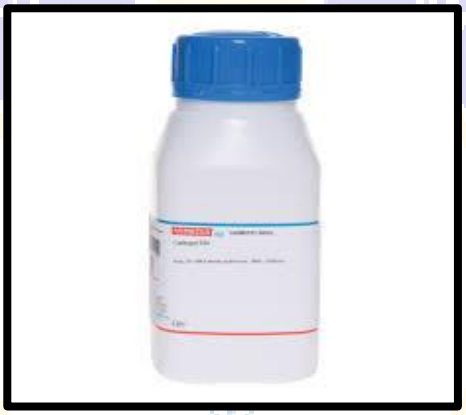


**Fig. No. 6.11 Carbapol 934**

- **Synonyms:** Steric acid, stereophonic acid.
- **CAS No:** 9003- 01-4.
- **Molecular Formula:** C18 H36 O2.
- **Molecular Weight:** 284.5g/mol.
- **Water Solubility:** 0.597mg /L (at 25°c).
- **Density:** 0.86 at 68°F.
- **Application:** Used as a gelling agent in gel preparations. Carbapol is used in manufacture of cosmetic, including gels, creams, and lotions, detergents, and air freshener. Increases the thickness and stability of the formulation.[18]

**6.12 Propylene Glycol:**


**Fig. No. 6.12 Propylene glycol**

- **Synonyms:** 1, 2-dihydroxypropane.
- **IUPAC Name:** propane-1, 2-diol.
- **CAS No:** 57-55-6.
- **Chemical Formula:** C3H8O2.
- **Molar Mass:** 76.095 g·mol−1**.**
- **Boiling Point:** 188.2 °C.
- **Storage Condition:** Store in a cool, dry, well-ventilated area away from incompatible substances. Store protected from moisture.
- **Application:** It is used to absorb extra water and maintain moisture in certain medicines, cosmetics, or food products. [20]

# CHAPTER 7.1: MATERIALS AND METHODS

- **Polyherbal emulgel consist of following raw materials:**

**Table No.4: List of Materials**

| Sr.No. | Name of Material | Manufacturer/Supplier | Use in Formulation |
|---|---|---|---|
| 1 | Ginger | CAMY Lab Pune | API |
| 2 | Eucalyptus oil | CAMY Lab Pune | API |
| 3 | Jojoba Oil | CAMY Lab Pune | API |
| 4 | Neem Oil | CAMY Lab Pune | API |
| 5 | Span 60 | CAMY Lab Pune | Emulsifying agent |
| 6 | Tween 20 | CAMY Lab Pune | Emulsifying agent |
| 7 | Carbapol 934 | CAMY Lab Pune | Gelling agent |
| 8 | Methyl paraben | CAMY Lab Pune | Preservative |
| 9 | Propyl paraben | CAMY Lab Pune | Preservative |
| 10 | Liquid paraffin | CAMY Lab Pune | Oil - Vehicle |
| 11 | Propylene glycol | CAMY Lab Pune | Humectant / Solubilizer |
| 12 | Triethanolamine | CAMY Lab Pune | Buffer |
| 13 | Sodium CMC | CAMY Lab Pune | Gelling agent |
| 14 | Sodium HPMC | CAMY Lab Pune | Gelling agent |
| 15 | Ethyl Cellulose | CAMY Lab Pune | Thickening Agent |
| 16 | Menthol oil | CAMY Lab Pune | Penetration enhancer |
| 17 | Sandalwood | CAMY Lab Pune | Fragrance |
| 18 | Menthol | CAMY Lab Pune | Fragrance |
| 19 | Alcohol | CAMY Lab Pune | Vehicle |
| 20 | Water | - | Vehicle |

## 7.2 RAW MATERIALS USED FOR PREPERATION OF EMULGEL

For the preparation of emulgel some constituents are used including drug, which are:

- **Vehicle:**

Vehicle should follow the ideal characters given in the Pharmacopeias.

- **Aqueous material:**

The aqueous phases used are water, alcohol, etc.

- **Oil:**

Oils are used for preparation of emulsion. Mineral oils and paraffin are used either alone or in combination. [22]

- **Emulsifiers:**

Emulsifiers used for preparation of emulsion. Some examples are span 60, tween 20, stearic acid, sodium stearate.

- **Gelling agents:**

Gelling agents are used for prepare gels, which enhance consistency of preparation.

- **Penetration enhancers:**

Penetration enhancers help to absorb drug to the skin.[23]

- **pH adjusting agent:**

pH adjusting agent is used to maintained the pH of the emulgel which is suitable for skin.

**Ideal properties of additives:**

- ☐ They should be nontoxic.
- ☐ They should be easily available.
- ☐ They should be cheap.
- ☐ They do not be contraindicated.
- ☐ They should chemically and physically stable.

# CHAPTER 7.3: DEVELOPMENT OF FORMULATION

- **Formula:**

**Table No.5: List of Raw Materials**

| Ingredients | Role | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 |
|---|---|---|---|---|---|---|---|---|---|
| Ginger | API | 5% | 5% | 5% | 5% | 5% | 5% | 5% | 5% |
| Eucalyptus Oil | API | - | 5% | 5% | - | 5% | 5% | 5% | 3% |
| Neem Oil | API | 5% | - | - | - | - | - | - | - |
| Jojoba Oil | API | - | - | - | 5% | - | - | - | - |
| Span 60 | Emulsifying agent | 2.88 % | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% |
| Tween 20 | Emulsifying agent | 3.12 % | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 1.55% |
| Liq. Paraffin | Oil- Vehicle | 7.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 2.6% |
| Methyl Paraben | Preservatives | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01% |
| Propyl Paraben | Preservatives | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01 % | 0.01% |
| Propylene Glycol | Humectant/ Solublizer | 10% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% | 3.5% |
| Triethanolamine | Buffer | Q.S. | Q.S. | Q.S. | Q.S. | Q.S. | Q.S. | Q.S. | Q.S. |
| Menthol Oil | Penetration enhancer | Q.S. | Q.S. | Q.S. | Q.S. | Q.S. | Q.S. | Q.S. | - |
| Ethyl Cellulose | Thickening Agent | - | - | - | - | 0.3% | 1% | 1% | - |
| Carbapol 934 | Gelling Agent | 4% | 4% | - | - | - | 3.5% | 4% | 1% |
| Sodium CMC | Gelling Agent | - | - | 4.5% | - | 2% | - | - | - |
| HPMC 15 | Gelling Agent | - | - | - | 4.5% | 2% | - | - | - |
| Sandalwood | Fragrance | - | - | Q.S. | - | - | - | - | - |
| Water | Vehicle | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| Alcohol | Vehicle | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |

## 7.4: PROCEDURE FOR EXTRACTION OF GINGER

Zingiber officinale was collected from college laboratory.

**Apparatus**: Soxhlet apparatus.

**Extraction of zingiber officinale**:

From the dried samples of zingiber officinale was weighed into the thimble and solvent was added after fixing the thimble into the Soxhlet apparatus, and then the application of heating. After fixing the thimble into the Soxhlet apparatus the setup was heated for about six hour. During the boiling of the solvent, and the condensation of the gas, the gas at the reflux condenser dropped into the sample in the thimble, there by initiating the extraction of the oil in the sample. Then the color of the liquid from the thimble turned light yellow. The light yellow liquid became darker due to more extraction of oil through the capillary tube of the thimble into the round bottom flask. This reaction is observing until there is no more colored liquid coming from the thimble. [21]

**Fig. No. 7.1: Extraction**

## 7.5: EVALUATION OF EXTRACT

- **Carbohydrates:**

1) Molish Test: 2 ml Extract + 2ml Naphthol, shake & add 1 ml concerted sulphuric acid and cold in ice bath get Violet red color. = Present.

2) Fehling's-1ml ext. + Fehling A + B → Boil get Red PPT. = Present.

- **Phenolic & tannin:**

1) Ferric Chloride – Ext + Ferric Chloride = Present (Red).

2) Lead Acetate – 1ml Ext + D. Water + 3ml lead Acetate solution = White PPT = Present.

- **Alkaloids:**

1) Mayer reagent – 1 ml ext. + Mayer reagents =Present.

2) Hangers – 1ml ext. + Hanger Reagent = Yellow color = Present.

- **Saffonin:**

1) ext. + Water + Shake 15 min + Stand for 10 min = Present.

- **Phytosterols and Triterpenoids:**

1) Solkowaski = Conc. Sulphuric acid + extract + Shake & Stand = yellow colour = Present.

## 7.6: EVALUATION OF RAW MATERIALS

- **The different test were carried out for testing raw materials:**

**Table No. 6: Evaluation of Excipients**

| Ingredients | Colour | Odour | Solubility |
|---|---|---|---|
| Carbapol 934 | White | Pungent | Soluble in water |
| Methyl Paraben | White | Pungent | Soluble in water |
| Triethanolamine | White | Pungent | Soluble in water |
| Propyl Paraben | White | Pungent | Soluble in water |
| Span 60 | White Flake | Slight for smell | - |
| Propylene Glycol | White Flake | Slight for smell | - |
| Tween 20 | Pale Yellow | Faint | - |
| Liquid Paraffin | White | Pungent | - |

## 7.7: PROCEDURE FOR PREPERATION OF EMULGEL

1. Prepare gel base by addition of Carbapol 934 in distilled water
2. Aqueous phase preparation:
   I. Add tween 20 in distilled water.
   II. Dissolve methyl paraben and propyl paraben in propylene glycol.
   III. Mix extract in ethanol.
   IV. Mix all the above solutions and heat up to 70-80℃.
3. Oil phase preparation:
   Prepare the oil phase by mixing Eucalyptus oil, span 40 and liquid paraffin and heat up to 70-80℃.
4. Then transfer the oil phase dropwise into the aqueous phase with continuous stirring.
5. At the end add the gel base into the emulsion with continuous stirring, and maintain pH by adding triethanolamine.

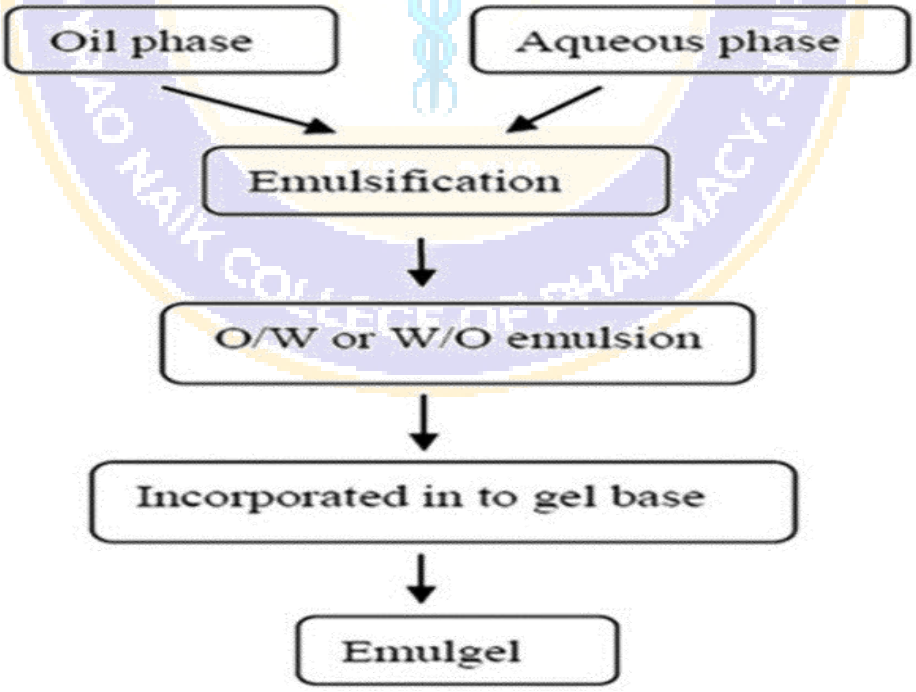



**Fig. No. 7.2: Flow chart of emulgel preparation [25].**

## 7.8: IDENTIFIED EVALUATION TESTS FOR EMULGEL

**7.8.1 Physical examination:** The Appearance of polyherbal emulgel Color, Odour, are studied here. [26]

**7.8.2 Spreadability:** The emulgel was sandwiched between 2 petri plates and the diameter of circle of spreaded emulgel was used to determine the spreadability. 1 gram of emulgel was weighed and placed on a petri plate. Other petri plate was placed on its top and weight of 50 grams was placed on the top of petri plate for about 60 seconds. After completion of 60 seconds the diameter of circles formed from the spreaded emulgel were measured in triplicate. The average of the reading was calculated. The reading was put into the following formula.

**Fig. No. 7.3: Spreadability**

**S = M x L / T**

S = Spreadabilit

M = Mass

L= Diameter

T = Time

**7.8.3 Determination of pH:** It is determined by using digital pH meter. The pH meter is dipped into the emulgel and the pH is checked; it is repeated for 3 times.

**Fig. No. 7.4: pH Meter**

**7.8.4 Rheological study:** In Rheological study the viscosity is determined at 25 ºC. The apparatus used is Brookfield viscometer [27]

**Fig.No.7.5: Brookfield Viscometer**

**7.8.5 Drug Content:** The drug content is determined by UV spectroscopic analysis.

The equation used is,

Drug content = (Concentration × Dilution factor × Volume taken) × Conversion factor.

**7.8.6 Swelling index:** 1 gram of emulgel is taken in a porous aluminum foil and placed separately in a 50 ml beaker containing 10 ml of 0.1 N NaOH. Then, the

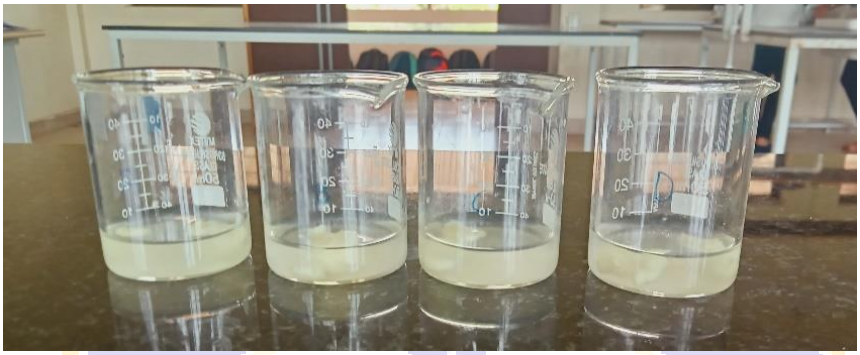


**Fig. No. 7.6: Swelling index**

determined by the equation:

Swelling index (SW) % = [(Wt-Wo)/Wo] × 100

Where,

Wt = Weight of swollen emulgel after time t,

Wo =Original weight of emulgel at zero time.

# CHAPTER 8: RESULT

The polyherbal emulgel containing active ingredient i.e. Ginger and eucalyptus oil, represents a noteworthy convergence of traditional herbal knowledge and modern pharmaceutical advancements. This emulgel, designed to be applied topically, boasts a combination of natural components that are renowned for their therapeutic properties. The gel component ensures a smooth, non-greasy application, while the emulsion provides stability and facilitates the dispersion of both water-soluble and oil-soluble components. This balanced formulation enhances the overall user experience and ensures that the active ingredients are effectively delivered to the target site.

- **Extraction of Ginger:**

The extraction of ginger using the Soxhlet apparatus is a meticulous process. Ethanol is chosen for the extraction of ginger, Ethanol is a versatile and polar solvent aimed at optimising the extraction of a broad spectrum of compounds from ginger. This solvent‘s unique properties include its moderate boiling point and ability to dissolve both polar and non-polar substances. Ethanol is a less polar solvent than other solvents, offered its advantages. Its lower boiling point expedited the extraction process, potentially reducing the risk of thermal degradation of sensitive compounds. However, the choice of ethanol also necessitated a careful consideration of its selectivity in extracting specific ginger constituents.

In conclusion, the extraction of ginger using the Soxhlet apparatus with ethanol solvent. This approach not only underscores the importance of solvent selection in optimizing extraction outcomes but also emphasizes the Soxhlet apparatus reliability in facilitating continuous and controlled extraction processes for botanical samples like ginger.

**Table No. 7: Result of extraction**

| Ingredient | Solvent | Apparatus | Observation |
|---|---|---|---|
| Ginger | Ethanol | Soxhlet apparatus | **Colour:** Slightly brownish. **Odour:** Aromatic. |

**Evaluation of Emulgel:**

- **Physical examination:**

**Table No. 8: Result of Physical examination**

| Physical evaluation | Results |
|---|---|
| Appearance | Semi- solid |
| Color | Whitish color |
| Odour | Aromatic |

- **Spreadability:**

**Table No. 9: Result of Spreadability**

| Diameter (l) | Time(t) | Weight of petri dish(m) | Spreadability(S) | Average Spreadability |
|---|---|---|---|---|
| 5.6 | 30 sec | 50 gm | 9.33 | 7.41 |
| 6 | 45 sec | 50 gm | 6.66 | |
| 7.5 | 60 sec | 50 gm | 6.25 | |

- **Swelling Index:**

**Table No. 10: Result of Swelling Index**

| Time (t) | Initial weight of emulgel (gm) | Final weight of emulgel (gm) | Swelling index % |
|---|---|---|---|
| 15 min | 1 | 1.16 | 16% |
| 30 min | 1 | 1.70 | 40% |
| 45 min | 1 | 1.50 | 50% |
| 60 min | 1 | 1.60 | 60% |

- **Rheological study:** The rheological study was carried out by using Brookfield viscometer as an equipment and following result was observed:


**Fig. No. 8.1: Result by Brookfield viscometer**

**Table No. 11: Result of Viscosity**

| Sample Name | Name of Parameter | Method / Instrument used | Observed value | Torque value | Spindle | RPM |
|---|---|---|---|---|---|---|
| **Polyherbal Emulgel** | Viscosity | Brookfield viscometer | 5946 cp. | 99.1% | 64 | 100 |

- **Drug Content**: There are two API used in formulation and drug content of both API are as follows**:**

**Table No. 12: Result of Drug Content**

| API'S | Absorbance | Concentration | % Drug content |
|---|---|---|---|
| **Ginger** | 1.812 | 0.046 | 92.92 |
| **Eucalyptus** | 1.924 | 0.044 | 87.18 |

Date: 22/06/2024

## Analysis Report

**Name Of sample:** Polyherbal Emulgel

**Nature:** Semisolid

**Analyzed by:** Mr. Mote G.D

**Analyzed on:** 22/06/2024

**Data Report**

| Sample Name | Name of Parameter | Method/instrument used | Observed value | Torque value | Spindle | RPM |
|---|---|---|---|---|---|---|
| Polyherbal emulgel | Viscosity | Brookfield viscometer | 5946 cp | 99.1% | 64 | 100 |


**Fig. No. 8.2: Viscosity Report**

## Spectrum Point Pick Report

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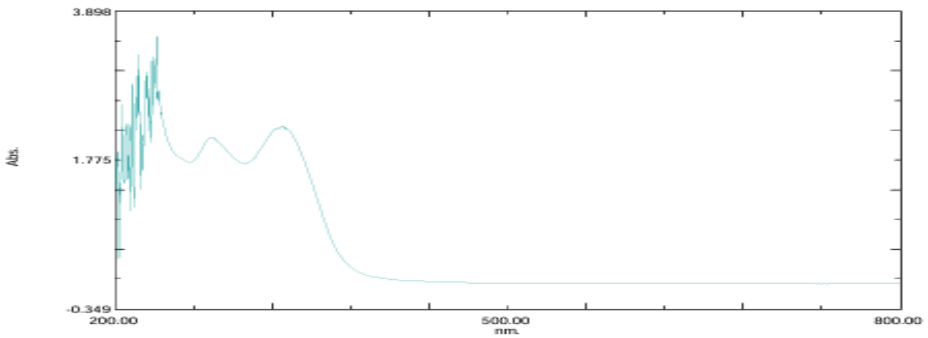
Data Set: - Polyherbal Emulgel




| No. | Wavelength | Absorbance | Description |
|---|---|---|---|
| 1 | 234.00 | 1.924 | |
| 2 | 220.00 | 1.812 | |

[Measurement Properties]
Wavelength Range (nm.): 200.00 to 800.00
Scan Speed: Medium
Sampling Interval: 0.5
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

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**Fig. No. 8.3: Spectrum Point Pick Report**

# CHAPTER 9: DISCUSSION

The total eight formulation were prepared for the emulgel. While doing so, the API and ingredient concentrations were changed in every formulation, and the formulation outcome was verified. Numerous challenges arose during the formulation and examination of every formulation. The best formulation that has been prepared is F8. Hence, we have chosen F8 formulation which is having acceptable consistency for further evaluation.

In the F1 to F7 formulation, there was phase separation, low spredability, grittiness formation, and bubbles that occurred during formulation.

The F8 has been selected because no phase separation occurred during preparation and good consistency, absence of gritty particles as well as acceptable results are shown as compared to other formulations.

# CHAPTER 10: FUTURE PROSPECTS

The future prospects of emulgel, a combination of emulsion and gel, look promising in various fields, including pharmaceuticals and cosmetics. Emulgels offer controlled drug release, enhanced stability, and improved skin penetration, making them valuable for topical drug delivery. Continued research and innovation in emulgel technology may lead to advancements in drug delivery systems and skincare formulations, expanding their applications in the cosmetic industry and medical industry.

**1) Skin irritation test:** Emulgel is applied to the animal skin, and then the animals are returned in to their cages. After 24 hr. the animals are tested. Then the emulgel are removed from the site and wiped with tap water.

**2) Stability studies:** The emulgel were packed in aluminum collapsible tubes, stored in extreme conditions, and the stability is checked. [29]

3) **Accelerated Stability Studies:** It is performed by ICH guidelines. The stability test is done in hot air oven at 37± $2^0$C, 45±$2^0$C, and 60± $2^0$C for 3 months. [28]

# CHAPTER 11: CONCLUSION

In the coming years topical drug delivery will be used extensively to import better patient compliance. Emulgel is a recent technique for topical drug delivery and it is suitable for hydrophilic drugs since it is also capable of enhancing spreadability, adhesion, viscosity and extrusion. Emulgel could become a medium for the use of Topical pharmaceutical preparation easily and effectively. Emulgel is being developed with modern techniques of preparation and innovations to provide analgesic, anti-inflammatory, antifungal and skin protective purposes.

Moreover, emulgel may offer relief from pain. Ginger has been traditionally used for pain management, Eucalyptus oil, with its cooling sensation, may further enhance the pain-relieving aspects of the formulation. This makes the emulgel a potential option for individuals seeking a topical solution for pain management. Using polyherbal formulation containing natural ingredients provides more efficacy, reduces toxicity, minimize side effects and drug interactions.

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