

Formulation and Evaluation of Herbal Pain-killer Balm from *Bacopa Monniera*. Pre-formulation studies

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ABSTRACT

The present study focuses on the Formulation and Evaluation of an Herbal Pain-Killer Balm Using *Bacopa monnieri* (Brahmi), a medicinal plant traditionally recognized for its anti-inflammatory and analgesic properties. The work begins with comprehensive data collection on the phytochemical profile, therapeutic uses, and safety aspects of *Bacopa monnieri*. Fresh leaves of the plant are collected and authenticated to ensure botanical accuracy and quality. The authenticated samples are then shade-dried and processed into fine powder suitable for extraction. Herbal extract is obtained using the infusion extraction method, which preserves heat-sensitive phytoconstituents and ensures effective transfer of active compounds into the solvent system. The resulting extract is intended for incorporation into a topical balm formulation designed to relieve mild to moderate pain. This study aims to explore the feasibility of using *Bacopa monnieri* as a natural alternative to synthetic analgesics and to evaluate the formulated balm based on its physicochemical properties, stability, and potential therapeutic efficacy. The findings are expected to contribute to the development of safe, economical, and herbal-based pain-relief formulations.

Keywords: *Bacopa monnieri* (Brahmi), Plant collection, Herbal raw material processing, Powder preparation, Herbal drug powder, Infusion extraction, Herbal extract preparation, Phytochemical extraction

INTRODUCTION

Topical drug delivery systems are pharmaceutical formulations designed to deliver therapeutic agents directly to the skin for localized or systemic effects. They offer several advantages, including ease of application, avoidance of first-pass metabolism, improved patient compliance, and reduced systemic side effects. Among the various topical formulations—such as creams, gels, lotions, and ointments—balms represent semi-solid preparations widely used for delivering analgesic, anti-inflammatory, and soothing agents to the affected site. A balm is typically composed of a lipophilic base, such as beeswax, oils, or herbal extracts, which provides a protective barrier on the skin and facilitates the sustained release of active compounds. Due to their occlusive nature, balms enhance skin penetration and improve the therapeutic efficacy of herbal or synthetic ingredients. The growing preference for natural and herbal medicines has further increased interest in herbal balms, particularly those formulated

with plant-based bioactive compounds known for their analgesic and anti-inflammatory properties. In this context, *Bacopa monnieri* (Brahmi), a well-known medicinal herb with antioxidant, anti-inflammatory, and neuroprotective activities, offers potential as a natural analgesic agent in topical applications. Incorporating its extract into a balm formulation may provide an effective and safe alternative to conventional pain-relief products. Understanding the principles of topical drug delivery is essential for developing a stable, efficacious herbal balm and evaluating its physical and therapeutic performance.

Topical balms are particularly beneficial for localized treatment of conditions such as muscular pain, joint stiffness, headaches, and inflammatory disorders. They offer targeted action at the site of application with minimal systemic side effects. Incorporating herbal ingredients like *Bacopa Monniera* (Brahmi), known for its analgesic and anti-inflammatory properties, enhances the therapeutic value of balms

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while minimizing synthetic drug-related toxicity. The effectiveness of a balm depends on various factors such as skin permeability, drug solubility, formulation stability, and release kinetics. The formulation must ensure adequate skin penetration while maintaining physical and chemical stability during storage and application.

Topical drug delivery systems are pharmaceutical formulations designed to deliver active substances directly to the skin or mucosal surfaces, where they exert localized or sometimes systemic therapeutic effects. Among these, balms represent a semi-solid dosage form that is commonly applied to the skin to relieve pain, inflammation, or irritation.

History of Balm:

The use of balms dates back thousands of years and has been an integral part of traditional medicinal systems across various cultures. Historically, balms were semi-solid preparations made from natural waxes, oils, and plant extracts, applied externally for healing wounds, relieving pain, or protecting the skin. Ancient civilizations—including the Egyptians, Greeks, Chinese, and Indians—used herbal balms extensively for therapeutic and cosmetic purposes. In ancient Egypt, balms were prepared using beeswax, fats, and aromatic plant resins such as myrrh and frankincense. These balms were not only used for healing but also played an important role in preservation and embalming practices. Greek physicians later documented the medicinal properties of balms made from olive oil and herbal extracts, emphasizing their role in reducing inflammation, soothing muscle pain, and treating skin disorders.

In traditional Chinese medicine and Ayurveda, herbal balms have been widely applied for centuries. Ayurvedic texts describe the use of medicinal plants such as *Bacopa monnieri*, *Curcuma longa*, *Mentha arvensis*, and *Camphora officinarum* for preparing topical formulations aimed at relieving pain, improving circulation, and promoting wound healing. These early formulations were often prepared using simple infusion or decoction techniques, followed by incorporation into ghee, oils, or waxes. With the evolution of pharmacy and industrialization, balms became more standardized, and their preparation

shifted from household remedies to commercially available products.

The introduction of petroleum jelly in the 19th century provided a stable semisolid base, allowing balms to be manufactured on a larger scale. Contemporary balms combine traditional herbal knowledge with modern pharmaceutical techniques to improve stability, spreadability, and patient acceptability. Today, herbal balms remain popular due to their natural origin, minimal side effects, and effectiveness in managing pain, inflammation, and skin conditions. The historical progression from ancient herbal mixtures to scientifically formulated balms highlights the enduring importance of topical therapies in healthcare.

Herbal balms have a long history, evolving from ancient remedies to modern formulations. Early balms, used for various ailments, often involved simple mixtures of herbs and natural oils. Innovation came with advancements in extraction techniques like distillation and supercritical fluid extraction, which allowed for more potent and targeted formulations. Modern herbal balms, like those used for pain relief or skincare, incorporate a wider range of ingredients and employ scientific methods for evaluation and quality control.

Early History and Traditional Uses:

1. Ancient Civilizations: Essential oils and balms were used in ancient India, Persia, and Egypt for medicinal and cosmetic purposes. These early preparations often involved infusing herbs and flowers into fatty oils.
2. Greek and Roman Trade: Greece and Rome traded extensively with the Orient for odoriferous oils and ointments.
3. Arab Innovations: The Arabs developed distillation techniques for extracting essential oils, a significant advancement over the previous methods of using fatty oils.
4. Middle Ages and Beyond: Distillation spread to Europe, and essential oils became a staple in medieval pharmacies.



A balm is a semi-solid topical formulation designed for external application to the skin to provide therapeutic effects such as pain relief, anti-inflammatory action, soothing, or protection. Typically composed of a waxy base—often beeswax, petroleum jelly, herbal oils, or butter—balms create an occlusive layer on the skin that enhances the penetration and sustained release of active ingredients.

Balms are distinguished by their thick consistency, stability, and ability to retain moisture while delivering medicinal compounds. They often contain natural or synthetic analgesic, aromatic, or anti-inflammatory substances, making them suitable for managing conditions like muscle pain, headaches, joint stiffness, insect bites, and minor skin irritations.

Unlike creams and gels, balms have minimal water content, giving them longer shelf life and improved protection of active plant constituents. Herbal balms, in particular, utilize plant extracts—such as *Bacopa monnieri*, eucalyptus, menthol, or camphor—to provide natural therapeutic effects without relying heavily on synthetic chemicals. Overall, balms serve as effective topical delivery systems widely used in traditional and modern medicine for their ease of application, localized action, and patient-friendly nature.

Treatment for pain:-

Analgesic herbal balm is something that is comforting and soothing. It is one which leads to the pain. Balms are widely used as topical therapeutic agents for the management of various types of pain, including muscular pain, joint pain, headaches, sprains, and minor inflammatory conditions. When applied to the affected area, balms provide localized relief through a combination of physical and pharmacological actions. Balms typically contain active ingredients such as herbal extracts, essential oils, or analgesic compounds that penetrate the skin and act on underlying tissues. These ingredients may exhibit anti-inflammatory, analgesic, counter-irritant, or soothing properties. By stimulating sensory receptors on the skin, balms can reduce the perception of pain and promote relaxation of muscles.

The warming or cooling effect produced by certain ingredients (e.g., menthol, camphor, eucalyptus oil, or herbal extracts like *Bacopa monnieri*) increases blood circulation, reduces stiffness, and enhances the healing process. Additionally, the semi-solid waxy base of the balm creates an occlusive layer that protects the skin, prolongs the contact time of the active agents, and facilitates their sustained release. This localized delivery avoids systemic side effects commonly associated with oral pain medications while ensuring fast and targeted relief.

Thus, balms provide a safe, convenient, and non-invasive method for managing mild to moderate pain, making them a popular choice in both traditional and modern therapeutic practices.



Fig.No.1:HerbalBalm IDEAL

PROPERTIES OF TRANSDERMAL BALM:

- Preventing first-pass metabolism.
- Good skin permeability.
- Convenient and simple to use
- Control drug release.
- Improve patient compliance.
- Easy to apply.
- It should not cause any damage to tissue.
- Nonallergic and non-irritant.

ADVANTAGES:

- Ability to deliver drug more selectively to specific site.



- ☐ Improving physiological and pharmacological response.
- ☐ Improving patient compliance.
- ☐ Providing utilization of drug with short biological half-life.
- ☐ Provide suitability for self-medication.
- ☐ Ability to easily terminate the medication when needed.

TYPES OF HERBAL BALM:

Herbal balm can be classified based on several factors.

A. Based on Therapeutic use

1. Analgesic balm-Relieves pain (E.g., containing menthol, camphor, winter green).
2. Anti-inflammatory balm-Reduces inflammation and swelling (E.g., containing eucalyptus, camphor, clove).
3. Relaxation balm-Relieving stressor sleep (E.g., lavender, sandal wood).
4. Cold & cough balm-For respiratory relief (E.g., containing Peppermint, clove, eucalyptus).
5. Skin healing balm-For burns, wound sores (E.g., calendula, aloe vera, tea tree).

B. Based on base Ingredients

1. Oil-based balm-Use carrier oils such as olive, coconut.
2. Bees wax-based balm-Uses bees wax for solidifies oil and makes a barrier.
3. Petroleum-based balm-Uses petroleum jelly for primary base.
4. Butter-Based balm-Uses cocoa butter or Shea butter for intense nourishment.

C. Based on Consistency

1. Soft balm-Contain higher amount of petroleum jelly or oil, easily spreads.
2. Gel balm-Alcohol-based or water-based, easily absorbs.
3. Hard-balm-Made up with bees wax for Flexibility and specific use.

Herbal Components of Analgesic Herbal Pain Balm:

1. Brahmi (*Bacopa monniera*): Known for its analgesic and anti-inflammatory effects due to active compounds like bacosides and flavonoids, providing topical relief from pain and muscle soreness.
2. Coconut Oil: Edible oil extracted from mature coconuts, resistant to rancidity, acts as a carrier oil and provides nourishment and stability to the balm.
3. Eucalyptus Oil: Essential oil from *Eucalyptus globulus*, known for its aromatic and anti-inflammatory properties.
4. Menthol: A monoterpenoid compound from mint oils, offering a cooling and pain-relieving effect.
5. Camphor: A white crystalline substance obtained from camphor laurel wood, acting as a counter-irritant and analgesic agent.
6. Beeswax: A natural wax from honeycombs, used to solidify the balm and provide a protective barrier.
7. Peppermint Oil: Essential oil from peppermint leaves, providing a refreshing, cooling, and soothing effect.

Brief Review of Skin Structure

Skin is the most accessible and largest organ of the body with a surface area of 1.7 m², comprising 16% of the total body mass of an average person. The main function of the skin is to provide a protective barrier between the body and the external environment against microorganisms, the permeation of ultraviolet (UV) radiation, chemicals, allergens and



the loss of water. Skin can be divided into three main regions.

1. The outer most layer, the epidermis, which contains the stratum corneum;
2. The middle layer, the dermis.
3. The inner most layer, the hypodermis.

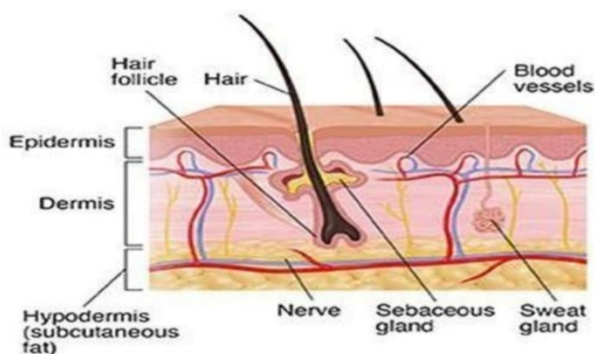


Fig.No.2:ANATOMY OF SKIN

The skin is a continuously self-renewing organ that covers the surface of the body and separates it from the outside world with which it connects in a dynamic way. It provides protection against external agents such as mechanical and chemical insults, heat, infections, water, and electromagnetic radiation. The skin is divided into two main structural compartments: the epidermis or epithelial component coating on the surface, and the in-depth dermis or connective component of nutrition.

Both skin compartments cooperate in the formation of a highly specialized matrix structure, the basement membrane, which physically separates the two compartments, providing a stabilizing as well as dynamic interface. Although the whole skin structure actively participates in the host defense, epidermis is important in preventing loss of water and other components of the body to the environment (inside–outside barrier) and in protecting the body from a variety of environmental insults (outside–inside barrier).

Epidermis: The *epidermis* is the thin, outermost layer of the skin. It acts as the body's first line of defense against the environment.

Key points:

- **Protective barrier** against pathogens, chemicals, and physical damage
- **Prevents water loss** through waterproofing (thanks to keratin)
- **Continuously renews** itself by producing new cells at the base
- **Contains melanin**, the pigment that gives skin its color and protects against UV radiation

Main layers (from deep to superficial):

1. **Stratum basale** – produces new skin cells
2. **Stratum spinosum** – strengthens the skin
3. **Stratum granulosum** – forms waterproof barrier
4. **Stratum lucidum** – present only in thick skin (palms, soles)
5. **Stratum corneum** – outer layer of dead, keratinized cells

Stratum corneum:

The *stratum corneum* is the **outermost layer of the epidermis**, made of flat, dead, fully keratinized cells. It serves as the skin's primary **protective barrier**.

Stratum lucidum

Stratum lucidum is a thin, clear layer of dead skin cells found **only in thick skin**, such as the **palms of the hands and soles of the feet**.

- ☐ Located **between the stratum granulosum and stratum corneum** in the epidermis
- ☐ Composed of **flattened, dead keratinocytes** filled with **eleidin**, a translucent protein
- ☐ Provides **extra protection** and helps the skin **withstand friction**
- ☐ Not present in **thin skin** (most of the body)

Stratum granulosum



Stratum granulosum is the epidermal layer where keratinocytes begin to die and become heavily keratinized, marking the transition between living and dead layers of the skin.

□ Located **above the stratum spinosum** and **below the stratum lucidum/corneum**

□ Cells contain **keratohyalin granules** and **lamellar granules**

- **Keratohyalin granules** → help form **keratin**
- **Lamellar granules** → release **lipids** that create a **water-resistant barrier**

□ **Functions:**

- **Prevents water loss**
- **Strengthens the skin**
- Marks the **beginning of programmed cell death (apoptosis)** in keratinocytes

Stratum spinosum:

Stratum spinosum (the “spiny layer”) is a thick layer of the epidermis where keratinocytes are actively growing and providing strength to the skin.

□ Located **above the stratum basale** and **below the stratum granulosum**

□ Composed of **several layers** of keratinocytes

□ Cells appear **“spiny”** under a microscope due to **desmosomes** (strong cell-to-cell junctions) pulling on the cell membranes when the tissue is prepared

□ Contains **Langerhans cells**, which are immune cells that detect pathogens.

DRUG PROFILE:



Fig.No.3.1: Bacopa Monniera (Brahmi)

Biological Source:

Bacopa Monniera is a small, creeping herb. The whole plant is used for medicinal purposes.

Taxonomical Classification

Category	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta (Vascular plants)
Division	Magnoliophyta (Angiosperms)
Class	Magnoliopsida (Dicotyledons)
Order	Lamiales
Family	Plantaginaceae
Genus	Bacopa
Species	Bacopa Monniera (L.) Wettst.

Morphological Features.

- Type: Creeping succulent herb
- Leaves: Opposite, oblong, thick and fleshy
- Stem: Slender rooting at nodes
- Flowers: Small, pale blue or purple with 5 petals
- Roots: Fibrous
- Taste: Bitter
- Part used: leaves

EXCIPIENT:





Fig.No.3.2: BESSWAX

Table No.1: Properties of Bees Wax

IUPAC Name	Hexadecenoic acid triacontylester
Molecular Weight	600–1000 g/mol
Appearance	Yellow to brown solid (refined is white)
Odour	Mild honeylike
Melting Point	62–64°C
Density	0.95–0.98 g/cm ³
Acid Value	17–24
Solubility	Insoluble in water, soluble in oils, ether

USES:

1. Cosmetics: Emulsifier, emollient, and fragrance in soaps and perfumes.
2. Pharmaceuticals: Tablet coating, and ingredient in ointments.
3. Food Industry: Food additive (E901) to provide shine, film for wrapping cheese, stiffening agent.

MENTHOL-CRYSTAL

Fig.No.3.3: MENTHOL-CRYSTAL

Table No.2: Properties of Menthol Crystal

IUPAC name	1R,2S,5R-2-isopropyl-5-methylcyclohexanol
Boiling point	Approximately 212°C.
Appearance	Colorless or white crystalline solid.
Odour	Strong minty aroma.
melting point	41–44°C.
density	0.890 g/cm ³ .
Optical isomerism	Exhibits optical isomerism.
solubility	Soluble in ethanol and ether and water.

USES:

1. Pharmaceuticals: Used in cough syrups lozenges balms, and topical pain relief formulations for its cooling, analgesic, and soothing effects.

MATERIALS AND METHODOLOGY:

TABLE NO.8: INSTRUMENT/EQUIPMENT

SR.NO	EQUIPMENT	MODELS/COMPANY
1.	Hot Plate with Magnetic Stirrer	REMI 2MLHREMI Electrotechnics Ltd.
2.	Water Bath	Labline 12LL Labline Instruments
3.	Analytical Balance	Shimadzu AUW220D Shimadzu Corporation
4.	Beaker/Borosilicate Glassware 250 ml / 500 ml	Glass Beakers Borosil/DURA
5.	Spatula/Glass Rod	Standard Local Laboratory Suppliers
6.	Melting Water Bath (Double Boiler)	DB-4 Mediatech India Pvt Ltd
7.	Thermometer	HTC Instrument HTC DT302
8.	pH Meter	Labtronics LT-111 Labtronics Pvt Ltd

Table No.9: List of Drug and Materials:-

SR.NO	MATERIALS	MANUFACTURER
1.	Brahmi Infused Oil	DKCAGROTECH PVT. LTD
2.	Bees Wax	MWIT, TURKEWADI
3.	Menthol Crystals	MWIT, TURKEWADI
4.	Camphor	MWIT, TURKEWADI
5.	Eucalyptus Oil	MWIT, TURKEWADI
6.	Vitamin-E	MWIT, TURKEWADI
7.	Peppermint Oil	MWIT, TURKEWADI
8.	Hard Paraffin	MWIT, TURKEWADI

COLLECTION OF BACOPA MONNIERA:

The Bacopa Monniera plant powder was collected from local field of Belgaum Karnataka, India.

**Preparation of plant extract of Bacopa Monniera (Brahmi):**

Take 10g of Brahmi herb (coarse powder / dried leaves). Tie in muslin cloth Place the Brahmi in a clean muslin cloth pouch and tie it securely (like a tea bag). Immerse in oil – Place the pouch in 100 ml base oil (coconut oil) contained in a glass jar. Infusion– Keep the jar in sunlight for 7–10 days, shaking it gently once daily. (Alternatively, keep in warm conditions around 40–50 °C for 5–6 hours/day for 3 days). Squeeze & filter – After infusion, squeeze the pouch to release absorbed oil and then filter again through fresh muslin cloth. Collection – Collect the clear in fused Brahmi oil and store it in an amber glass bottle to protect from light.

METHOD OF PREPARATION OF HERBAL ANALGESIC BALM:

For the preparation of the balm, the solid bases, namely beeswax (7 g) and hard paraffin (2 g), were weighed accurately and melted together in a clean beaker on a water bath at about 70 °C. To the molten base, Brahmi-infused oil (10g) and coconut oil were added with continuous stirring to obtain a uniform mixture. Subsequently, menthol crystals (3g) and camphor (2 g) were incorporated into the warm mixture (55–60 °C) until completely dissolved. After partial cooling to below 50 °C, the volatile constituents, eucalyptus oil (2 g), peppermint oil (1.5

g), and Vitamin E (1.5 g) were added to the preparation and mixed thoroughly to ensure uniform distribution.



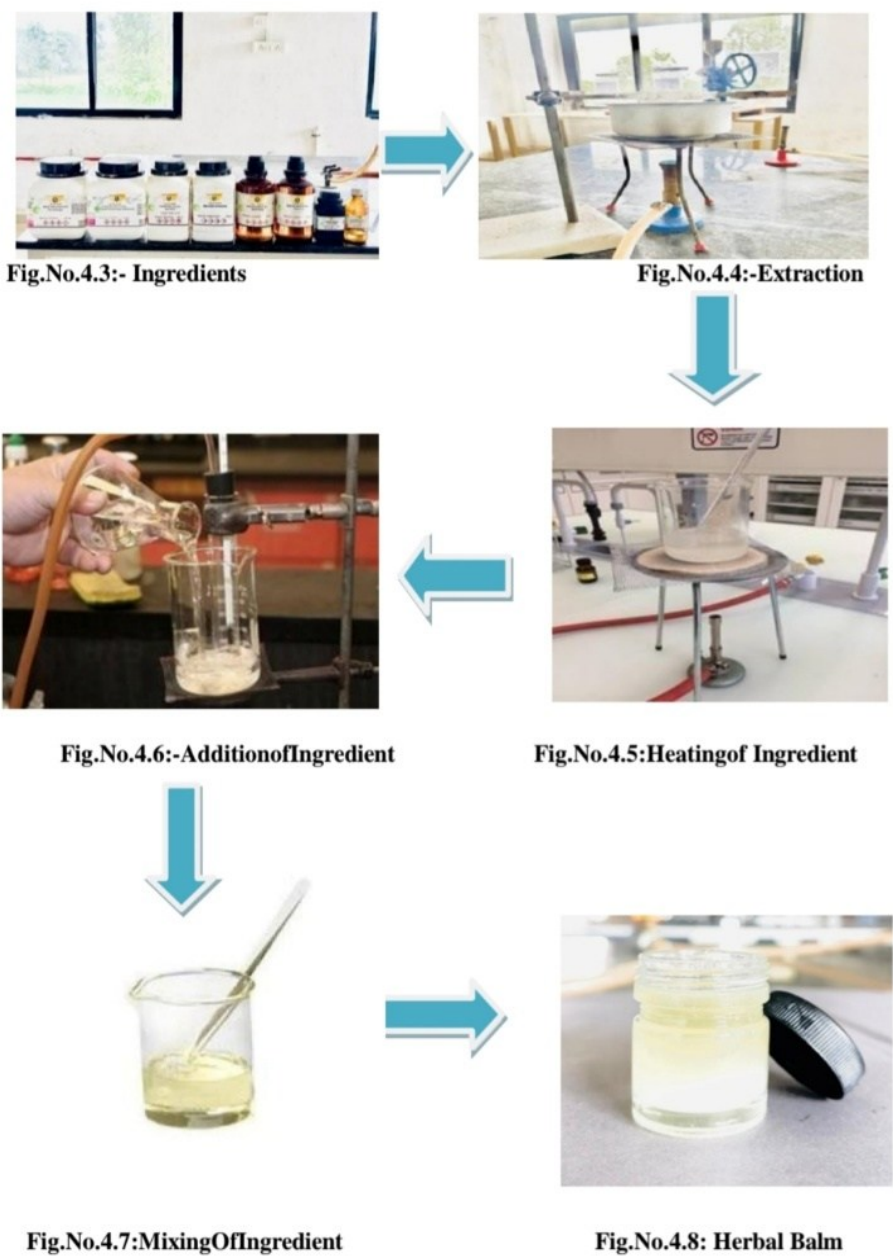
Fig.No.4.2:Infusion Oil

Table No.10:LIST OF INGREDIENTS AND ITS USES:

Sr.No	INGREDIENTS	USES
1.	Brahmi Infused Oil	Analgesic, anti-inflammatory, nerve relaxant.
2.	Bees Wax	Solidifying agent, gives hardness to balm
3.	Menthol Crystals	Cooling effect, counter-irritant, enhances pain relief
4.	Camphor	Rubefacient, relieves muscle stiffness & joint pain
5.	Eucalyptus Oil	Enhances penetration, anti-inflammatory, soothing effect
6.	Vitamin-E	Antioxidant, prevents rancidity of oils
7.	Peppermint Oil	Provides cooling, refreshing sensation; relieves headache & muscle pain
8.	Hard Paraffin	Solidifying agent and improves stability

Table No.11: Formulation Table for Analgesic Herbal Balm:

Sr.No	INGREDIENTS	F1
1.	Brahmi Infused Oil	10gm
2.	Bees Wax	7gm
3.	Menthol Crystals	3gm
4.	Camphor	3gm
5.	Eucalyptus Oil	2gm
6.	Vitamin-E	1.5gm
7.	Peppermint Oil	1.5gm
8.	Hard Paraffin	2gm
Total		30 gm



RESULTS AND DISCUSSION.

Qualitative Phytochemical Test: The phytochemical tests were performed on various extracts of Bacopa Monniera, and the results are shown in Table 2. The extracts tested positive for alkaloids, glycosides, tannins, phenolic compounds proteins carbohydrates, and flavonoids, whiles. These results indicate the presence of bioactive compounds responsible for the plant’s analgesic, anti-inflammatory, antioxidant, and neuroprotective properties, supporting its use in herbal analgesic balm formulations.

Table No.12:QualitativeChemicalExaminationofVariousExtractsofBacopaMonniera

Test	Extract
Alkaloid	+
Glycoside	+
Saponin	-
TanninandPhenolic Compounds	+
Protein	+
Carbohydrate	+
Phytosterols	-
Flavonoids	+

Organoleptic Evaluation:



Table No.13: Organoleptic Evaluation of Herbal Analgesic Balm

Sr.No	Organoleptic Character	Observation
1	Color	Uniform greenish-brown
2	Odor	Pleasant herbal smell
3	Appearance	Smooth, homogeneous, no grittiness

pH determination

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Table No.14: pH of Herbal Analgesic Balm

Sr.No	Parameter	Result
1	pH	5.91 ± 0.01 (n=3)

CONCLUSION

The present study focused on the formulation, evaluation, and stability assessment of a herbal analgesic balm containing Bacopa Monniera (Brahmi) oil along with supportive excipients such as beeswax, hard paraffin, menthol, camphor, eucalyptus oil, peppermint oil, and Vitamin E. The primary objective was to develop a safe, effective, and stable topical formulation with analgesic and anti-inflammatory properties suitable for human use.

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