International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

RESEARCH ON EVALUATION AND FORMULATION OF HERBAL PAIN RELIEF BALM

[1]Vaishnavi Lokhande, [2]Ravindra M. Hanwate, [3]Rajendra Kawade, [4]Sushmita Chavan, [5]Shital N. Murumkar

[12345]Valmik Naik College of Pharmacy Telwadi, India.

ABSTRACT:-

This study focuses on the preparation and evaluation of an herbal pain relief balm utilizing natural ingredients like Indian borage, peppermint, tulsi, camphor, beeswax, castor oil, eucalyptus oil, and others. The balm is designed to relieve body pain, headaches, and inflammation through topical application. Evaluation parameters such as spreadability, pH, non-irritancy, solubility, and appearance confirmed the balm‘s suitability for external use.

KEYWORDS:- Indian borage leaves balm, herbal analgesic, Arthritis, organic pain relief, eucalyptus oil balm.

INTRODUCTION:-

Balm is a semi-solid, anhydrous topical treatment that is traditional or Ayurvedic and frequently used to relieve body aches and pains. For best results, balm has to be applied with friction and rubbed or massaged into the skin. Generally speaking, they have a thicker consistency than ointments. Balms are better for topical application because they are occlusive, water-impermeable, moisture-protective, chemically and physically stable even without preservatives and have a slower rate of absorption.[1] The pain balm operates on the counter irritancy principle, which suppresses pain perception by increasing irritation to the point where the formulation is applied, rather than reducing pain. In common parlance, a balm is a semi-solid substance typically containing medication that is administered topically. This type of composition, known as pain balm, is designed to relieve mild to moderate pain.[2]

As many as 78% of people suffer from tension headaches. Unfortunately, it's also one of the most ignored and challenging headache kinds to manage.[3] Camphor is a natural substance that has long been used as an antibacterial, analgesic, antipurutic, counterirritant, and rubefacient. It is made from the wood of the cinnamonomum camphor tree.[4] These days, it is more crucial than ever to administer medications via the skin for therapeutic benefits.[5]

Bowel preparation is necessary prior to performing diagnostic tests like colonoscopies. Castor oil is useful for bowel evaluation, thus it may be utilized in these kinds of treatments.

However, with alternative laxatives like Sennosides, patients usually have better outcomes and are more satisfied after these treatments.[6]

ADVANTAGES AND DISADVANTAGES OF HERBAL PAIN RELIEF BALM:[7]

*ADVANTAGES**:-***

1. First pass metabolism should be avoided.
2. Convenient and simple to use.
3. The capacity to provide medication to a certain location more precisely.
4. Enhancing the pharmacological and physiological reaction.
5. Increasing adherence from patients.
6. Enabling the use of medications with brief biological half-lives.
7. Make self-medication appropriate.
8. The ease with which the medicine can be stopped when necessary.

DISADVANTAGES:-

1. Skin irritation of contact dermatitis may occure due to the drug and / or excipients.
2. Poor permeability of some drug through the skin.
3. Possibility of allergic reaction.

4. Can be used only for drugs which require very small plasma concentration for action.
5. Drugs of larger particle size not easy to absorb through the skin.[

MEDICINAL USES OF HERBAL PAIN RELIEF BALM:-

- Arthritis and Joint Pain
- Muscle Strains
- Sports Injuries
- Headaches
- Fever and cold
- Swelling

AIM:FORMULATION AND EVALUATION OF HERBAL PAIN RELIEF BALM OBJECTIVES OF HERBAL PAIN RELIEF BALM:-

- Natural ingredients.
- Effective pain relief.
- Improved blood circulation.
- Counter irritation mechanism.
- Anti-inflammatory properties.
- Suitable for chronic pain.
- Easy to use.

LITERATURE REVIEW:-

1] "Formulation and Evaluation of Herbal Pain Relief Balm" – *Poonam P. Papule & Prajwal Papule* EPRA International Journal of Research & Development (IJRD)
Main Focus: Development of a topical herbal balm for analgesic and anti-inflammatory activity, using ingredients like Dashamoola oil, Shallaki oil, camphor, and rosemary oil. The study highlights the mechanism of pain relief through prostaglandin inhibition and joint tissue rejuvenation2.

2] "Formulation and Evaluation of Herbal Pain Relieving Balm" – *Telange-Patil P.V., Bendgude P.D., Chavan M.R., Jadhav S.T.*RJPN
Main Focus: Focuses on menthol and camphor-based herbal balm for muscle pain relief, emphasizing antioxidant properties and counter-irritancy principles. The study discusses menthol‘s interaction with TRPM8 receptors, which produce a cooling sensation and pain relief

3] Telange-Patil P.V., Bendgude P.D., Chavan M.R., Jadhav S.T.International Journal of Current Science and Research
Main Focus: This study highlights the use of menthol and camphor in herbal balms, focusing on their cooling and analgesic effects. It also explores the counter-irritancy principle, where irritation at the application site suppresses pain.

4] Poonam P. Papule and Prajwal Papule EPRA International Journal of Research & Development
Main Focus: This research delves into the formulation of herbal balms using Dashamoola oil and Shallaki oil, emphasizing their anti-inflammatory and analgesic properties.

5] Various contributors Research Journal of Pharmacy and Technology

Main Focus: This paper discusses the role of natural ingredients like rosemary oil and eucalyptus oil in enhancing the efficacy of herbal balms for muscle pain and arthritis.

HERBS USED IN HERBAL PAIN RELIEF BALM:-

1] INDIAN BORAGE:

BIOLOGICAL SOURCE:
Scientific Classification

- **Binomial Name**: Plectranthus amboinicus (Lour.) Spreng.
- **Family**: Lamiaceae (Mint family)
- **Common Names:** Indian borage, Country borage, Cuban oregano, French thyme, Mexican mint and Spanich thyme.

Indian borage is one of the most widely used herbs with a number of health advantages. Plectranthus amboinicus (Lour.) Spreng, Coleus aromaticus

Benth, and Coleus amboinicus Lour are some of its other names. Different vernacular names, such as "Pathachur" in Bengali and Hindi, have been used to refer to rural borage in various sections of India.[8]The Lamiaceae family, which includes 200 genera and 3200 species, is branching with shrubs, trees, and herbs. The main benefit of these plants is that they may be used for food and medicine.[9] Numerous illnesses, including malaria, inflammation, coughing, bronchitis, chronic asthma, liver problems, kidney stones, and gallstones, can be cured by the plant.[10]

The botanical classification of Indian borage:-[11]

Domain: Eukaryota
Kingdom: Plantea
Phylum: Spermatophyta
Subphylum: Angiospermia
Class: Dicotyledons
Family: Lamiaceae

Health Benefits of Indian Borage:-

Plant-based medicines are now commonly employed in many public health procedures worldwide due to their cost-effectiveness and safety, as well as the fact that they successfully treat a number of harmful illnesses and promote overall health.

In many ancient medicinal systems, including Sidda, Ayurveda, Unani, and folk medicine, herbal medicines have been used extensively.[12] Indian Borage contains carvacrol, which is used in mouthwash to stop germs from growing in the oral cavity.[13]

INDIAN BORAGE LEAVES

2] PEPPER MINT LEAVES:

SCIENTIFIC CLASSIFICATION:

- **BINOMIAL SOURCE: Mentha Pepperita**
- **FAMILY: Lamiaceae**
- **Common Name: Pudina**

Mentha piperita, also referred to as Mentha balsamea, is a perennial herbal remedy that is a member of the Lamiaceae family of mints. It is essential for boosting hunger and strengthening the immune system because of its potent anti-oxidant and anti-microbial qualities as well as the presence of active ingredients.[14,15]

Mint plants may grow across an undefined area and range in height from 10 to 120 cm.

Certain mints are classified as invasive due to their tendency to spread widely.[16]

Peppermint has blunt rectangular clusters of pink lavender flowers and smooth, dark green leaves with square stems. Similar to how peppermint plants may be generated extensively across a huge region with the use of stolons, or subterranean stems.

Numerous mint varieties are produced when peppermint naturally hybridizes with other wild plants. Black and white peppermint are the two most common types, which are well-liked by growers. Also referred to as English peppermint or mitchammint, black peppermint is mostly grown in the United States and has purple stems. On the other hand, because of its attractive odour, white peppermint has the highest commercial value and the lowest output. Peppermint leaves have a peppery flavour and a persistent sweetish smell that is refreshed after chewing. According to Padmini et al. (2010), peppermint is a vibrant and excellent source of several minerals, including Na, Mg, K, Ca, Cr, Fe, Co, Cu, Zn, and Se [17].

Anti-headache properties of peppermint:-

The herbal plant has been used historically to treat headache-related conditions. Consuming peppermint oil and its byproducts helps to relieve headaches. According to a study, using eucalyptus and peppermint oil together effectively helped people with headache discomfort relax.[18,19]

PEPPERMINT LEAVES

3] HOLY BASIL(TULSI):-

- **BINOMIAL SOURCE**: Ocimum sanctum or Ocimum tenuiflorum
- **FAMILY:** Lamiaceae
- **Common Name**: Holy Basil, Tulsi

The "Queen of plants" and "the mother medicine of nature" are two names for tulsi.

Ocimum sanctum, also known as tulsi, is a herb with remarkable medicinal and prophylactic qualities. It has dark-coloured leaves and is used for the same purposes. Tulsi is frequently used as a home medicine to treat injuries, hepatic and respiratory conditions, viral infections, earaches, spine discomfort, hiccups, and neonatal conjunctival irritation.[20,21]

Tulsi classified into two types-

i. forestland
ii. cultivated land

Stress relieving agents:-

Stress is a widespread occurrence that every person encounters. "Nonspecific result of any demand upon the body" is how stress is defined. Stress may be psychological or physical. Extreme stress is bad for the body and should be managed as such. Psychiatric conditions like anxiety and depression, immunosuppression, endocrine disorders like diabetes mellitus, male impotence, cognitive dysfunction, peptic ulcers, hypertension, and ulcerative colitis are among the many diseases whose pathophysiology is influenced by stress. Rejuvenating properties of tulsi include lowering stress, promoting mental relaxation, and helping the body's memory. Tulsi has an antihypoxic action and lengthens survival. when under anoxic stress[22] A study conducted with rabbits has suggested that Tulsi decreased oxidative stress.[23]

MEDICINAL PROPERTIES:

- Tulsi has antioxidant properties and reduces blood glucose levels, and blood pressure.[24]
- It increases endurance and is a necessary component of herbal tea.[24]
- The water that is removed is used as a mouthwash to lessen toothaches.[24]
- It has insect-repelling properties. Thus, it is frequently used for grain storage.[24]
- It lowers the amount of lipids. Thus, it is beneficial for cardiac conditions.[25].
- Additionally, it is used to treat headaches, common colds, malaria, coughs, and stomach issues.[25]
- Because of its antibacterial properties, it is utilized in the production of several skin ointments and cosmetics [25].
- Its oil exhibits gastric poisoning against "malarial larvae."
- It has the ability to modulate the immune system [26].
- Beta-Ursolic acid, a substance found in tulsi, may one day be employed as an anti-fertility medication [25].

Traditional uses:-[27]

- Tulsi is known as "the elixir of life" because it encourages lifespan.
- In Ayurvedic and Siddha medicine, different plant components are utilized to prevent and treat a wide range of illnesses.
- The purpose of the leaves is to improve memory.

- Leaf chewing aids in the treatment of oral infections and ulcers.

Health benefits of Tulsi in our daily life:

- **Fever and Cold:** The leaves are used to treat a variety of fevers and colds. During the rainy season, when dengue and malaria fever are rampant across the region, the leaves are cooked with tea and administered to patients as a common treatment.[28]
- **Coughs:** Because it aids in the discharge of mucus in respiratory illnesses, it is a key component of several Ayurvedic cough syrups and other dose forms.[28]
- **Sore Throat:** A patient suffering from sore throat disease is given the plant's leaves after they have been cooked in water. This extract can also be gargled.[29]

TULSI

4] BEESWAX:-

- **Scientific name**: Ceraalba.
- **Synonym:** Yellow wax.
- **Family:** Apidae
- **Chemical constituents:** Myricylpalmitate (80%), free cerotic acid (15%), melissic acid Cerolein.

Beeswax is one product created from beeswax and other bee honeycomb. When pollen oils are combined with honeycomb wax, the white wax becomes yellow or brown. Beeswax is used to treat inflammation, high cholesterol, skin conditions caused by fungi, and other conditions. However, there is no reliable scientific data to support these usage. Both white and absolute beeswax—yellow beeswax that has been treated with alcohol—are used as food and beverage additives. Both yellow and white beeswax are used as stiffening agents, emulsifiers, and thickeners in the cosmetics industry.

Uses:

1] Used as antibacterial, antifungal, anti-inflammatory and anti-allergic properties.
2] Used as antibacterial, antifungal.
3] It has anti-inflammatory and anti-allergic properties.
4] It mainly use as an emulsifying agents, stiffener and gentle skin adhesive.
5] Relieves stress and promote relaxation.
6] Reduce pain.

BEESWAX

5] CAMPHOR:-

- **Scientific Name:** Cinnamomum camphora
- **Synonym:** Alcanfor, Gum Camphor, Japan Camphor.
- **Family:** Lauraceae
- **Biological Source:** Camphor is a solid ketone, obtained from the volatile oil of Cinnamomum camphora (L.) Nees et Eber, belonging to family Lauraceae. Synthetic camphor, which is optically inactive, is prepared From turpentine and would probably have completely replaced the natural product.
- **Chemical constituent:** Camphor (40.54%), linalool (22.92%), cineole (11.26%), and 3,7,11-trimethyl-3-hydroxy-6,10dodecadine-1 ylacetate (4.50%).The wood of camphor laurel and other closely related laurel plants is the source of camphor. Camphor is a bicyclic monoterpene. It's a white, crystalline material that smells strongly and tests unpleasant. This combustible, waxy material is produced by steam distillation, purification, and sublimation of the tree's wood, twings, and bark. Due to its decongestant qualities, camphor is a useful component for relieving congestion in the chest.

Uses:

1] Provide relief from cold cough, chest congestion, bronchitis and asthma.
2] Improves blood circulation and help to curb muscular and joint aches.
3] Powerful analgesic oil that produces a cooling sensation to numb pain and a warming sensation to increase circulation.
4] Promote better sleep.

CAMPHOR

6] CASTOR OIL:-

- **Synonyms:** Castor bean oil, castor oil seed, oleum ricini, ricinus oil, oil of palma christi, cold-drawn castor Oil.
- **Scientific name:** Ricinuscommunis
- **Synonym:** Ricinus oil.
- **Family:** Euphorbiaceous
- **Biological Source:** Castor oil is the fixed oil obtained by cold expression of the seeds of Ricinus communis Linn.
- **Family:** Euphorbiaceous.
- **Chemical Constituents:** Castor oil consists of glyceride of ricinoleic acid, isoricinoleic, stearic, and dihydroxy stearic Acids. Ricinoleic acid is responsible for laxative property. Castor oil also contains vitamin F. 90% Of the fatty acid content is ricinoleic acid. The ricinoleic acid is an 18-carbon acid having a double Bond in the 9–10 position and a hydroxyl group on the 12th carbon. This combination of hydroxyl Group and unsaturation occurs only in castor oil.

CASTOR OIL

USES:-

1] Castor oil is used as a lubricant, plasticizer, wetting agent, ointment basis, and mild purgative and fungistatic.

2] In addition to being an emollient in lipstick formulation, dental formulation, and hair oil, ricinoleic acid is utilized in contraceptive creams and jellies.

3] They utilize the dehydrated oil to make alkyl resin and linoleum. 4] Castor oil is mostly used in the industrial fabrication of coatings, but it is also used in the leather and textile sectors to create polymers and fibers, as well as to make medications and cosmetics.

7] EUCALYPTUS OIL:-

- **Scientific name:** Eucalyptus globules labill
- **Synonym:** Eucalyptus
- **Family:** Myrtaceae.
- **Chemical constituents:** The essential oil was extracted by steam distillation and was analyzed for various chemical compositions using GC–MS. The major identified compounds in the leaf essential oil of E. maculata were Eucalyptol (54.29%), p-cymene (10.10%), α-pinene (7.78%), β-myrcene (7.78%), γterpinene (1.73%) and citronellal (1.62%); while Eucalyptol (51.62%), α-pinene (23.62%), p-cymene (10%), β-myrcene (8.74%), Terpinen-4-ol (2.74%) and γ-terpinene (2.59%) were the major compounds for E. globulus.The most common musculoskeletal condition in the world, osteoarthritis is a chronic illness that impairs quality of life, limits activities, and causes pain. Although osteoarthritis can affect any joint, it most commonly affects the knee. Osteoarthritis is most commonly characterized by pain, stiffness, edema, and inflammation. Patients who do not see symptom improvements with nonsurgical therapy may be candidates for surgery, particularly if their severe pain interferes with their day-to-day activities.

Uses:

1) Relieves stuff nose.

2) Eases sore muscle and joint pain.

3] Clears respiratory complaints.

4] Reduce stress.

5] Disinfects wounds and cuts.

EUCALYPTUS OIL

8] OIL OF WINTERGREEN(METHYL SALICYLATE):-

To treat musculoskeletal aches and pains, methyl salicylate, also known as oil of wintergreen, is frequently found in over-the-counter liniments, ointments, lotions, and medicinal oils. It's possible that many doctors are unaware of all the risks associated with these preparations. For instance, because of its liquid, concentrated form, methyl salicylate can induce severe, quickly developing salicylate poisoning if consumed accidentally or on purpose.[30]

USES:-

• **muscular Pain:** When administered directly to the afflicted area, oil of wintergreen provides specific relief for muscular sprains and strains.

• **Joint Pain:** It is commonly used in formulations to provide regional relief and lessen discomfort from joint pain associated with diseases like arthritis and other rheumatic aches.

• **Contusions and Bruises:** Topical treatment can help reduce discomfort from soft tissue injuries and bruises**.**

OIL OF WINTERGREEN

9] COCONUT OIL:-

Coconut oil is made from the dried flesh or kernel of the coconut, also referred to as copra.[31,32]

USES :-

1] Headache Relief: By increasing blood flow and lowering inflammation in the region, applying coconut oil to the temples can help relieve headaches**.**

2] Massage: Lightly cover the sore spot with coconut oil, then give it a mild massage. In addition to delivering the anti-inflammatory ingredients, this also facilitates pain alleviation and relaxation.

3] Infusions: To improve its efficacy for focused pain management, coconut oil can be infused with other pain-relieving substances, such as essential oils or even cannabis**.**

4] Relaxation Bath: You may relieve stress in your muscles and your entire body by adding coconut oil to a warm bath.

5] Compress: For long-lasting comfort, soak a towel in warm coconut oil and use it as a compress to sore spots.

COCONUT OIL

10] CLOVE OIL:-

- **Scientific name:** Syzygium aromaticum
- **Synonym:** Laung, Clavo.
- **Family:** Myrtaceae.
- **Chemical constituents:** Eugenol being most abundant constituent, often accounting for 85-92 percent of the oil. Other key component include eugenol acetate, beta-caryophyllen and trace amount of other compounds like caryophyllene oxide.

USES:

1] **Pain Relief for Muscles and Joints**: To alleviate pain from ailments including arthritis, sprains, and general aches, clove oil can be combined with carrier oils (such as coconut or almond oil) and applied to aching muscles or joints.

2] **Dental Pain Relief:** Clove oil has long been utilized in dental care products because of its numbing and antibacterial qualities. It can be used into dental pain balms to help with toothaches and post-procedure discomfort.

3] **Headache Relief:** Tension headaches can be relieved by applying clove oil balm to the forehead and temples. Clove oil is a natural cure for

headaches because of its cooling properties, which assist to relieve tension.

4] **Topical Applications:** Because of its relaxing and analgesic qualities, clove oil is frequently used in formulations for the treatment of small wounds, scrapes, and skin irritations.

CLOVE OIL

11] LEMON ESSENTIAL OIL:-

- **Scientific name:** Citrus limon.
- **Synonym:** Citrus Limon Peel Oil, Citrus Limonum.
- **Family:** Rutaceae.
- **Chemical constituents:** Terpenes, specially monoterpenes like d-limonene.

Lemon essential oil is commonly used in herbal hand sanitizers for its antimicrobial, antifungal, and antiviral properties. It enhances the effectiveness of the sanitizer while adding a fresh, citrusy fragrance.[33]

USES:

1] Compounds like citral and limonene, which are found in lemon oil, aid in the removal of dangerous bacteria, viruses, and fungus.
2] It gives out a cool citrus aroma that covers up the overpowering alcohol odour and makes the sanitizer more palatable to the senses.
3] Lemon oil, which is high in vitamin C and antioxidants, hydrates skin and keeps it from getting dry from alcohol-based sanitizers.
4] It functions as a natural cleaner, clearing hands of debris and pollutants while leaving them feeling clean and fresh.

LEMON ESSENTISL OIL

FORMULA:

1] PREPARATION OF HERBAL INFUSED OIL:-

INGREDIENTS	**AMOUNT(gm/ml)**
Indian borage (karpooravalli)	**5gm**
Peppermint Leaves	**5gm**

Tulsi Powder	**2gm**
Coconut oil	**15ml**
Castor Oil	**3ml**

Table No.1

2] PREPARATION OF HERBAL PAIN RELIEF BALM FOR 35gm:-

INGREDIENTS	**AMOUNT(gm/ml)**
Herbal infused oil	**15ml**
Beeswax	**10gm**
Camphor	**2gm**
Eucalyptus oil	**3ml**
Oil of Wintergreen(Methyl Salicylate)	**2ml**
Clove Oil	**1.5ml**
Lemon Essential Oil	**1.5ml**

Table No.2

PROCEDURE:

1] Make Herbal Infusion:

- Heat coconut oil(15ml) and castor oil(5ml).
- Add crushed Indian borage leaves, Peppermint leaves and Tulsi powder.
- Let it simmer on low for 15-20 minutes. Do not boil.
- Filter the oil by using filter paper. Now this if herb infused oil.

2] Melt the Base:

- Melt beeswax over low flame .
- Add herb infused oil to the melted beeswax. Stir well.

3] Add Camphor and Essential Oil:

- While still warm, stir in camphor until fully dissolved.

- Let the mixture cool slightly (not solidifying),
- Then add,
  - Eucalyptus oil
  - Clove oil
  - Lemon essential oil
  - Oil of wintergreen(Methyl salicylate)

4] Final mix and Pour:

- Stir thoroughly to combine.
- Pour into sterilized balm tins and jars.
- Let cool and solidify at room temperature

5] Direction for use:

- To be rubbed externally.
- Rub gently on the skin with the help of finger.
- Do not apply on skin an cuts.
- The first stage involves using a pain reliever as needed
- Second step involves applying it gently to the afflicted region. It aids in easing headaches, aches, and Sprains.

6] Formulation of herbal pain relief balm:-

Fig.1

Fig.2

Fig.3

EVALUTION TESTS:-[34,35]

Following evaluation parameters were preferred to ensure superiority of prepared pain relieving balm.

1. **Organoleptic Evaluation:**
   Organoleptic Evaluation such as colour and clarity were done by sensory and visual inspection.
   - **Colour :**Light Green
   - **Odour:** characteristic
   - **Appearance:** pain relief balm
   - **Texture:** smooth

2. **Consistency:** Smooth and no greeting is observed.
3. **Spreadability:**
   The spreadability was determined by placing sample between two glass slides which was compressed to uniform thickness by applying definite time period.

SPREADABILITY

The time required to separate the two slides was measured as spreadability less time taken for separation of two slides shown better spreadability calculated by formula,

$$S = M * L / T$$

S = Spreadability.
M = Weight applied to slides.
T = Time taken to separate the slides.

4. **Solubility:**
   Soluble in boiling water, miscible with alcohol and ether.

SOLUBILITY

5. Washability:

Ointment was applied to the skin then washability with water was checked.

WASHABILITY

Non-irritancy:

Prepared formulations was applied to the skin of human being and observed the effects.

NON-IRRITANCY

6. pH:

The PH of the prepared formulation was determined by using pH paper. The pH about 6 to 7.

pH

7. Phase Separation:

The prepared balm was transferred in a suitable wide mouth container. Set aside for storage, the oil phase and aqueous phase separation were visualizing after 24h.

RESULT:

PARAMETER	RESULT
Colour	**Light Green**
Odour	**characteristics**
Appearance	**Pain balm**
Texture	**Smooth**
Consistency	**Smooth**
Spreadability	**4.33**
Solubility	**Soluble in boiling water**
Washability	**Easily washable**
Non-irritancy	**No irritation**
pH	**6**
Phase Separation	**No phase separation**

REFERENCE:-

1] Pandey, S. (2017) '"preparation and characterization of herbal solid dosage form for anti-diabetic activity"', *World Journal of Pharmaceutical Research*, pp. 869–890. doi:10.20959/wjpr20175-8357.

2] Alloui, A. *et al.* (2002b) 'Paracetamol exerts a spinal, tropisetron-reversible, antinociceptive effect in an inflammatory pain model in rats', *European Journal of Pharmacology*, 443(1–3), pp. 71–77. doi:10.1016/s0014-2999(02)01578-9.

3] Ahmadi, A., Schwebel, D.C. and Rezaei, M. (2008) 'The efficacy of wet-cupping in the treatment of tension and migraine headache', *The American Journal of Chinese Medicine*, 36(01), pp. 37–44. doi:10.1142/s0192415x08005564

4] Strickley, R.G. (2004) 'Solubilizing excipients in oral and injectable formulations', *Pharmaceutical Research*, 21(2), pp. 201–230. doi:10.1023/b:pham.0000016235.32639.23.

5] Klein, R.R. *et al.* (2010) 'Development of an in vitro release test (IVRT) for a vaginal microbicide gel', *Dissolution Technologies*, 17(4), pp. 6–10. doi:10.14227/dt170410p6.

6] Mohammed Alatawi, A. *et al.* (2022) 'Therapeutic and adverse effects of metformin in diabetes :doi:10. 22376/ijlpr.2023 .13.1.l261-272.

7] Khare, C.P. (2007) 'Clerodendrum serratum (Linn.) moon.', *Indian Medicinal Plants*, pp. 1–1. doi:10.1007/978-0-387-70638-2_374.

8] '*glossary of Indian medicinal plants*.R. N. Chopra, S. L. Nayar, I. C. Chopra' (1958) *The Quarterly Review of Biology*, 33(2), pp. 156–156. doi:10.1086/402350.

9] Datiles, M.J. (2014) 'Plectranthus amboinicus (Indian borage)', *CABI Compendium* [Preprint]. doi:10.1079/cabicompendium.119834.

10] Kaliappan, N. and Viswanathan, P. (2008) 'Pharmacognostical studies on the leaves of *plectranthus amboinicus (lour) spreng*', *International Journal of Green Pharmacy*, 2(3), p. 182. doi:10.4103/0973-8258.42740.

11] KUMAR, P., SINGH, S. and KUMAR, N. (2020) 'Plectranthus amboinicus: A review on its pharmacological and, pharmacognostical studies.', *American Journal of Physiology, Biochemistry and Pharmacology*, 10(2), p. 55. doi:10.5455/ajpbp.20190928091007.

12] Manjamalai, A. and Grace, V.M. (2012) 'The chemotherapeutic effect of essential oil of *plectranthus amboinicus*(lour) on lung metastasis developed by B16F-10 cell line in C57BL/6 mice', *Cancer Investigation*, 31(1), pp. 74–82. doi:10.3109/07357907.2012.749268.

13] Santos, F.A.V. *et al.* (2016) 'Antibacterial activity of plectranthus amboinicus lour (Lamiaceae) essential oil against streptococcus mutans', *European Journal of Integrative Medicine*, 8(3), pp. 293–297. doi:10.1016/j.eujim.2015.11.021

14] Dorman, H.J. *et al.* (2003) 'Antioxidant properties and composition of aqueous extracts from *mentha* species, hybrids, varieties, and cultivars', *Journal of Agricultural and Food Chemistry*, 51(16), pp. 4563–4569. doi:10.1021/jf034108k.

15] Austin, D.F. (1996) 'CRC Handbook of Alternative Cash Crops', *Economic Botany*, 50(1), pp. 25–25. doi:10.1007/bf02862109.

16] Jin Park, K., Vohnikova, Z. and Pedro Reis Brod, F. (2002) 'Evaluation of drying parameters and desorption isotherms of Garden Mint leaves (Mentha crispa L.)', *Journal of Food Engineering*, 51(3), pp. 193–199. doi:10.1016/s0260-8774(01)00055-3.

17] Argyropoulos D, Muller J. Changes of essential oil content and composition during convective drying of lemon balm (Melissa officinalis L.). Industrial Crops and Products. 2014; 52:11-124.

18] Levin, M. (2012) 'Herbal treatment of headache', *Headache: The Journal of Head and Face Pain*, 52(s2), pp. 76–80. doi:10.1111/j.1526-4610.2012.02234.x.

19] Göbel, H., Schmidt, G. and Soyka, D. (1994) 'Effect of peppermint and eucalyptus oil preparations on neurophysiological and experimental algesimetric headache parameters', *Cephalalgia*, 14(3), pp. 228–234. doi:10.1046/j.1468-2982.1994.014003228.x.

20]Vasudevan, M. (2003) 'Holy company helps greatly', *Emotional Stress*, pp. 279–279. doi:10.5005/jp/books/10257_40.

21] Prajapati, V. *et al*. (2003) 'Anti-insect screening of medicinal plants from Kukrail Forest, Lucknow, India', *Pharmaceutical Biology*, 41(3), pp. 166–170. doi:10.1076/phbi.41.3.166.15092.

22] Rai, V., Iyer, U. and Mani, U.V. (1997) 'Effect of tulsi (ocimum sanctum) leaf powder supplementation on blood sugar levels, serum lipids and tissues lipids in diabetic rats', *Plant Foods for Human Nutrition*, 50(1), pp. 9–16. doi:10.1007/bf02436038.

23] Rastogi, S. (2009) 'Ayurveda for comprehensive healthcare', *Indian Journal of Medical Ethics* [Preprint], (2). doi:10.20529/ijme.2009.031.

24]] Staples, G.W. and Kristiansen, M.S. (1999) *Ethnic culinary herbs* [Preprint]. doi:10.1515/9780824844622.

25] Vaideanu, M. *et al*. (2022) 'Wastewater treatment plant efficiency on antibioresistance profile of potentially pathogenic bacteria', *Book of Abstracts SIMI 2022*, pp. 52–53. doi:10.21698/simi.2022.ab18.

26] Warrier, R.R. (2022) 'Demand and sustainable use of medicinal trees', *Medicinal and Aromatic Plants of the World*, pp. 277–290. doi:10.1007/978-3-030-98701-5_9.

27] Prajapati, V. *et al.* (2003a) 'Anti-insect screening of medicinal plants from Kukrail Forest, Lucknow, India', *Pharmaceutical Biology*, 41(3), pp. 166–170. doi:10.1076/phbi.41.3.166.15092.

28] Nabati, F. *et al.* (2021) 'Evaluating the quality of commercial Iranian honeys', *Journal of Medicinal Plants*, 20(78), pp. 14–25. doi:10.52547/jmp.20.78.14.

29] Kumar, V. *et al*. (2018) 'Comparative study on antimicrobial activity of Tulsi (ocimum sanctum) and neem (azadirachta indica) methanol extract', *Asian Journal of Pharmaceutical and Clinical Research*, 11(12), p. 514. doi:10.22159/ajpcr.2018.v11i12.28756.

30] LIEBELT, E.L. and SHANNON, M.W. (1993) 'Small doses, big problems', *Pediatric Emergency Care*, 9(5), pp. 292–297. doi:10.1097/00006565-199310000-00008.

31] Nevin, K.G. and Rajamohan, T. (2004) 'Beneficial effects of virgin coconut oil on lipid parameters and in vitro LDL oxidation', *Clinical Biochemistry*, 37(9), pp. 830–835. doi:10.1016/j.clinbiochem.2004.04.010.

32] Creswell, D.C. and Brooks, C.C. (1971) 'Composition, apparent digestibility and Energy Evaluation of coconut oil and coconut meal', *Journal of Animal Science*, 33(2), pp. 366–369. doi:10.2527/jas1971.332366x.

33] Kurniawan, M.F. and Dwiaprinia, R. (2021) 'Formulation and antibacterial activity of citrus limon peel essential oil and eucalyptus globulus essential oil combination as gel hand sanitizer with the simplex lattice design method', *ad-Dawaa' Journal of Pharmaceutical Sciences*, 4(2). doi:10.24252/djps.v4i2.23539.

34] Nalla, A. (2017) 'Novel herbal drug delivery system - an overview', *World Journal of Pharmacy and Pharmaceutical Sciences*, pp. 369–395. doi:10.20959/wjpps20178-9712.

35] Sekar, M. and Abdul Jalil, N.S. (2017) 'Formulation and evaluation of novel antibacterial and anti-inflammatory cream containing Muntingia Calabura leaves extract', *Asian Journal of Pharmaceutical and Clinical Research*, 10(12), p. 376. doi:10.22159/ajpcr.2017.v10i12.21963.