IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ESSENTIAL OILS: A COMPREHENSIVE REVIEW ON CHEMICAL COMPLEXITY, THERAPEUTIC POTENTIAL, AND SAFETY CONSIDERATION IN MEDICINE, COSMETICS, AND PHARMACEUTICALS

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Abstract:

Plant-derived essential oils find widespread applications in the realm of medicine, cosmetics, and pharmaceuticals. Essential oils, which have a liquid extracts obtained from fragrant plants are extensively utilized across various industries due to their versatile applications. Different techniques are employed to extract essential oils, each of which has its own benefits and yields information about the chemical and biological characteristics of the oils that are extracted. Due to their ability to lower stress, increase relaxation, elevate mood, and treat a variety of medical issues, essential oils are frequently used in aromatherapy. It delves deeply into the chemical complexity of essential oils, which are made up of a wide range of constituents like phenols, aldehydes, ketones, and terpenes. The review highlights the role of these compounds in not only imparting unique aromas but also in conferring These extracts possess therapeutic attributes like antibacterial, anti-swelling, pain killer effects. Moreover, safety considerations surrounding the utilization of essential oils are addressed, emphasizing the importance of proper dilution, adherence to recommended guidelines, and awareness of potential adverse reactions. Understanding these safety measures ensures their responsible and effective utilization.

Keywords: Essential oil, aromatherapy, quality aspect, formulation.

Introduction:

Nyctanthes arbor-tristis Linn (Oleaceae), "Parijat," a frequently found wild shrub, thrives across the sub-Himalayan territories in Assam, Bengal, Madhya Pradesh, extending down to Godavari in the south[1]. Its leaf juice serves multiple purposes, functioning as a laxative, inducing perspiration (diaphoretic), aiding urine production (diuretic), and is employed in managing conditions like rheumatism, chronic fever, and bilious fever. There have been reports of the plant's effectiveness against amoebic, viral, and leishmanial illnesses. (Source:) It has traditionally been used in the Ayurvedic medical system to treat menorrhagia, cancer, wounds, ulcers, snake bites, and bites from wild animals[2,3]. The aim of this study was to isolate and partially identify the active compound present in the flowers of this medicinal plant due to its purported anti-cancer properties.

Lavender-(Lavandula angustifolia Mill.) is a everlasting and aromatic plant that is commonly grown in China, particularly in Yili, Xinjiang[4]. In excellent biological properties of lavender include antibacterial, anti-inflammatory, anticancer, and antioxidant actions [5,6,7], all of which are good for human health. Natural plant extracts are often made using edible ethanol or purified water used to extraction solvents, which allows for improve solubility, therapeutic activity and safety. These extracts are mostly used for creating food flavouring and beverages[8]. Preliminary research suggests that you don't need to keep a high amount of essential oil vapor around for a long time. Instead, it seems that the effectiveness of the oils is mostly influenced by reaching a high vapour concentration early on rather than keeping it high for a long period. In simpler terms, it's not about how long you expose something to the vapor, but rather how strong the vapor is at the beginning[9]. Lavender oil has long been considered "safe." Even though a new study found that lavender oil and its main component, linalyl acetate, can harm human skin cells in lab tests, it's quite rare for people to get skin irritation or contact dermatitis from using this oil[10,11].

Rosemary oil is aromatic oil and it is extracted from the plant's fresh leaves and flowering tips using steam distillation. This is why rosemary plants are grown. It is a light yellow liquid with the odour is different[12]. The bioactive components of rosemary, including polyphenols, diterpenes, and monoterpenes, are derived from plant materials by methods such as steam distillation. The most popular traditional techniques for obtaining essential oils include solvent extraction, decoction, hydro distillation, and maceration. Other techniques associated with "green chemistry" include the application of microwave and ultrasonic techniques as well as supercritical fluid extraction (SCF)[13, 14]. Rosemary contains many different types of chemicals that are produced in addition to the plant's main nutrients. Scientists use powerful methods like HPLC along with GC to find and identify these chemicals. They've discovered that rosemary has large quantities of volatile compounds and phenolic compounds like diterpenoids and flavonoids. Research investigating the effects of the additional chemicals in R. officinalis (rosemary) and its extracts has shown impacts on various parts of the body, such as the brain and hormonal systems. These studies have found effects on conditions like heart changes after a heart attack, changes in body weight, unhealthy lipid levels, reduced blood flow to the brain, potential harm to the liver and kidneys, stress, and feelings of worry. Additionally, these chemicals seem to have properties that fight against tumours, prevent damage caused by oxygen, fight infections, reduce inflammation, and relieve pain[15].

Peppermint is commonly used in traditional medicine; it is found in tea and essential oils. Grown naturally in many regions of the world, it is a cross between Mentha aquatic L., or Mentha spicata L., or spear mint. Steam distillation is used to extract it, and it demonstrates potential Mint possesses unique abilities to alleviate pain by acting as an analgesic. Additionally, it has been noted to exhibit various properties such as fighting cancer, allergies, microbes, viruses, fungi, parasites, inflammation, and oxidation. Furthermore, it also demonstrates effectiveness as an antiseptic and insect repellent. Its many uses in the pharmaceutical, food, and agricultural industries are a result of these qualities. It also has a positive effect on the respiratory, central, and peripheral neurological systems, as well as the gastrointestinal tract. The modern developments and uses of mint oil are the main topics of this study.

Essential Oils:

- **Nyctanthes Arbor-tristis Linn (Parijat):**

- **Plant Description:**

The Parijat is an evergreen, woody, glabrous, widespread small tree that typically reaches a height of 2-4 mr. Gardens, pathsides, clearings within forests, and landslide-affected areas.It thrives in moist or wet forests, including areas near rivers, younger forests, dense lowland forests, shrubby areas, and open spaces, whether they're natural or have been changed by human activity. Additionally, it has spread to shrublands, stream banks, open woods, and forest edges. The plant thrives in sandy soil that drains well, ideally in an area with plenty of room for the roots to spread out. Young branches have very small, thin hairs. Branches are lenticellate, glabrescent, olive or bluish-green, angular, and upright or drooping[16].

- **Taxonomy:**

Taxonomical Classification Kingdom:

Plantae Division: Magnoliophyta
Class: Magnoliopsida
Order: Lamiales
Family: Oleaceae
Genus: Nyctanthes
Species: Arbor-tristis
Name: Nyctanthes arbor-tristis

- **Phyto-constituents:**

a)Leaves: Among the substances found in leaves are Nyctanthic acid, Tannic acid, Ascorbic acid, Methyl salicylate, resinous substances, Amorphous glycoside, Amorphous resin, Flavanol glycosides, Astragaline, Nicotiflorin, Oleanolic acid, a trace amount of volatile oil and Benzoic acid. Ayurvedic medicine makes use of all the significant phytoconstituents, which have been reported to help with laxatives, fevers, sciatica, arthritis, and other unpleasant disorders.
b)Flowers: Parijat flowers blossom at the ends of branches**,**where they emerge as compact clusters of blooms on short stalks from the points where the twigs and leaves meet. A tightly packed terminal cluster including both flowers and leaves is the end outcome. The flowers are tubular, greenish white to cream in colour (although there is a documented yellow variant), and the apex of the tube divides into five triangular lobes or petals that are sharply pointed. The length of the flower's tubular part is 2-2.5 cm, while the diameter of the opened bloom at night is roughly 1-1.3 cm. Within the floral tube are the stamens and anthers. The blossoms don't have much visual appeal, but their delicious aroma can be overwhelming. The perfume has a strong nighttime aroma, which has influenced the common name across all languages. The Manipuri name means moon flower, but the Hindi term means queen of the night. This nighttime beauty is essential to any fragrant garden. Even though night blooming jasmine is a stunning plant with endearing blossoms, some people are severely averse to the aroma[17].

***(a-Nyctanthes arbor-tristis* plant, b- Leaves, C-Stem and Bark, d- Flowers, e- seeds)**

Fig. 1 different parts of nyctanthes arbor-tristis linn (parijat)

- **Extraction:**

a) Extraction type – Cold Maceration-

Procedure: - In this procedure, a stoppered container containing the entire solvent is filled with coarsely powdered medicine. The container is then let to stand for a minimum of three to seven days, stirring often, until the soluble substance dissolves. Subsequently, the process involves passing the mixture through filter paper to separate it. The solid residue (marc) is pressed to extract any remaining liquid, and the collected liquids are either poured off gently or purified by filtration after allowing them to settle.

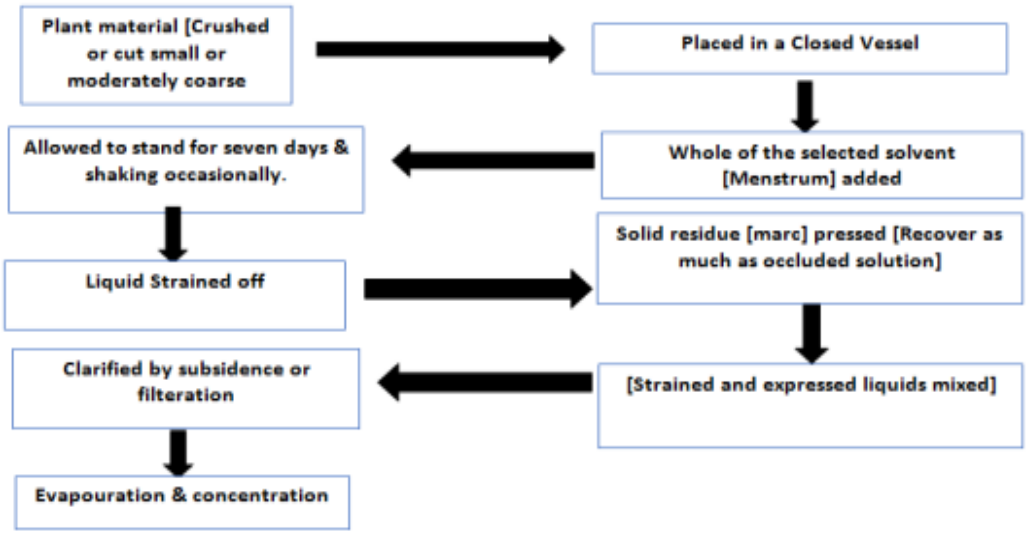

Fig. 2 extraction of nyctanthes arbor-tristis linn (parijat)

b) Soxhlet Extraction: The leaf material was mechanically pulverized after being shade dried. It took around two days (48 hours) to fully extract 250 grams of powdered material using solvents such as chloroform, petroleum ether and ethanol with the Soxhlet extraction method. The extracts were filtered and concentrated using a rotary flash evaporator under low pressure. Afterward, they were dried in a desiccator[18].

c) Maceration: Take Out The flower powder was extracted using a traditional approach. Twenty grammes of flower powder were macerated in 200 millilitres of ethanol, and ten grammes of powder were macerated in 130 millilitres of water. For 48 hours, the mixes were stored in a magnetic shaker. After filtering, it was placed in a rotating evaporator (Heidolph Model-G3, Germany) to evaporate. After that, the crude extracts were weighed and kept for later examination[19].

- **Formulation:**

1.Parijat leaves Powder: Consume 1-3 grammes of powdered Parijat leaves, or as prescribed by a doctor. Once or twice a day, after meals, mix it with honey.

2.Parijat leaves Capsules: Take one or two Parijat capsules, or as prescribed by a doctor. Once or twice a day, sip it with water.

3.Parijat Ark: It is a natural mixture made from the Parijat leaves and fruits and this traditional Ayurvedic remedy has been valued for centuries because it offers many health benefits.

- **Evaluation Test:**

1.Loss on drying at 105^0C/Moisture content:

After precisely weighing each herbal extract, 10 g was added to an evaporating dish that had been covered with tar to measure the weight loss during the drying process. After five hours of drying at 105^0C, the extract was weighed. The tarred evaporating plate was dried, then allowed to cool in desiccators for 30 minutes before being weighed.

- % of Loss on drying at 105^0 C= The difference in weight after heating/Weight of the sample taken x 100

  The powdered extract are 2 gm was burnt in a silica dish at a temperature below 450 degrees Celsius until only carbon-free residue remained. After cooling, the final weight was measured. The percentage of ash was determined based on the weight of the initial sample.

- % of Total Ash = Weight of ash obtained/Weight of sample taken x 100 [20].

2.Powder microscopy: To distinguish between the supply of undamaged or substituted powdered leaves and adulterated leaf material, a microscopic analysis of powdered leaf material was conducted in order to identify and quantify a number of unusual microscopic characteristics. Formalin, glycerine, and water (8:1:1 v/v/v) were used to make slides containing powdered leaf material. These slides were then embedded and observed using a B1 series motic microscope at various magnifications and following staining with Hydrochloric acid and phloroglucinol [21].

3.Determination of pH: pH 1% solution: Dissolve 1.0 g of precisely weighed powdered medication into the 100 ml of distilled water was used. After filtering, a standardized glass electrode was used to record the pH of the filtrate[22].

4.Phytochemical screening: The medication's phytochemical analysis was performed using the accepted methodology. A Soxhlet device was used to extract 5.0 g of previously dried powdered material using a series of organic solvents and water. Under vacuum, the extracts were evaporated until they were dry. The many phytoconstituents found in it, such as alkaloids, carbohydrates, carbonates, flavonoid, amino acids, saponins, mucilage, and resin, were all analyzed using these extracts[23].

- **Lavender:**

➢ **Plant Description:**

Lavender, scientifically known as Lavandula and the Lamiaceae family, it is widely studied medicinal herb[24]. The purple-blue flower of this shrub has long been used to treat a variety of illnesses. Lavender species that are most frequently utilized are Lavender angustifolia, Lavender latifolia, Lavender stoechas, and Lavender intermedia[25]. It is grown for commercial purposes all over the world. It is grown in the Indian states of Kashmir valley, Himachal Pradesh and UP. Anxiolytic, anti-inflammatory, antinociceptive, antioxidant, and antibacterial properties have all been documented for it.2-4 Herbal solutions such as essential oils containing lavender have the potential to address issues related to drug addiction, invasive treatments, side effects, and antibiotic resistance. Because of these qualities, lavender is a highly valuable therapeutic herb in the current era of drug resistance[26].

➢ **Taxonomy:**

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Lamiales
Family: Lamiaceae
Genus: Lavandula L.
Species: Species-Lavandula abrotanoides, Lavandula angustifolia, Lavandula canariensis.

➢ **Phyto-constituents:**

Flowers:
The therapeutic raw material is lavender flowers (Lavandulae flos), which picked prior to the flowering time. Triterpenes, phenolic compounds, essential oil components, and sterols are the primary physiologically active ingredients in lavender[27]. Lavender is primarily known for its essential oil, found in quantities between 2% to 3% in the plant. Steam distillation or hydrodistillation are the methods used to extract it from the blooms. There are over a hundred constituents in the essential oil, with linalool (ranging from 9.3% to 68.8%) and linalyl acetate (from 1.2% to 59.4%) being the principal ones. The large quantity of linalyl acetate, linalool as

well as their relative proportions, determine the quality of lavender essential oil [28, 29].borneol, limonene, camphene,eucalyptol, β-ocimene, 1,8-cineol, camphor, fenchone, lavandulol acetate, lavandulol, α-terpineol, β-caryophyllene, geraniol this are involve in terpine.α-pinen; octanon, octenol, octenylacetate, and octanol are involve in non-terpenoid aliphatic components among the main constituents [27, 29].

Fig. 3 flower of lavender

- **Extraction:**

a) Hydro-distillation (HD): Three liters of water were combined with 250 grammes of lavender. Using a Clevenger-style apparatus in accordance with the European Pharmacopoeia, the combination was subjected to hydro-distillation for two hours until essential oil was recovered). Before examination, the essential oil was collected, weighed, dried using anhy.NaSo4, and stored at 4°C. They conducted a minimum of three extraction processes for each examination[30].

b) Enzyme-assisted extraction: A solution was prepared by mixing three liters of distilled water with 12 grams of cellulase from Aspergillus (Sigma–Aldrich). This solution was then combined with 250 grams of lavender and stirred for 60 minutes at 40°C. Subsequently, the essential oils were extracted via hydro-distillation. Throughout the process, the same glassware and operational conditions were maintained for a thorough and direct comparison. Before being used, the extracted oils were weighed, recovered, and dried over anhydrous sodium sulphate (Na2SO4) in amber vials at 4 °C. At least three extractions were carried out for each[31].

c) Microwave steam distillation (MSD): The same tools and settings—power and time—were utilized to enable a thorough comparison. The procedure is based on the traditional steam distillation method, with the extraction reactor being the only area that receives microwave radiation. In order to use the water steam produced inside the vessel, a grid must hold 125 gm of the lavender above some boiling water. After heating the water, steam was released into the sample, where it carried the essential oil and evaporated, before being directed onto a Florentine flask and the condenser. Before being used, the essential oil was recovered, weighed, become dry it with anhy.NaSo4, and kept at 4 °C. At least three extractions were carried out for each.

- **Formulation:**

1.Emulsion Preparation:

An amount of essential oil, either two percent or five percent based on the total weight, was mixed with a five percent emulsifying blend (composed of Tween® 80 and Span® 80) tailored to match the essential oil's critical HLB value. Additionally, a polymer solution in the aqueous phase was incorporated into the essential oil emulsions to reach a final weight of 200 grams. Maltodextrin and Arabic gum were the materials used for encapsulation. To reach a solid content of 10% (by weight) and 20% (by weight) in the final product, polymer solutions were prepared by adding a specific quantity of polymer to filtered water. To allow the molecules to fully hydrate, the solutions were agitated at 500 rpm throughout the entire night. The inversion approach was used to achieve emulsification while continuous stirring was performed for 20 minutes at 600 rpm using an ES mechanical stirrer from Velp Scientifica in Usmate, Italy. It was decided to create eight different emulsions with different ratios of encapsulating polymer to oil[32].

2.Preparation of SLN based gel:

Solid Lipid Nanoparticles (SLN) containing around 1% lavender oil were made. To prevent lumps from forming, about 0.2% of Carbopol was dissolved in water for a full day. Mix in a 1% SLN dispersion and use a mechanical stirrer to stir after 24 hours. Pour in enough glycerol and propylene glycol to make it work. Add two to three triethanolamine drops. The solution becomes thick and gels as soon as the triethanolamine is introduced[33].

- **Evaluation:**

1.Evaluation of anti-microbial gel

Organoleptic Evaluation: The antimicrobial gel that was made was examined for colour, homogeneity, consistency, and tactile (feel when applied) aspects[34].

2.pH: pH was measured by the pH meter[35].

3.Viscosity: The Brookfield viscometer is used to determine the antimicrobial gel's viscosity[36].

4.Spreadability: The duration needed for two slides to detach or separate from the gel and be placed in between each other under a specific stress is known as spreadability; the shorter the time it takes, the better the spreadability. It is calculated by using the formula:

$S = M. L / T$ ……Eq.1

Where, M = weight tied to upper slide

L = length of glass slides

T = time taken to separate the slide[37].

5.Cleansing Action: Grease was used to evaluate the cleaning impact on wool yarn. Even though the main purpose of shampoos is to remove solids or sebum for creating a standardized method to assess their experimental cleaning effectiveness has been difficult due to the absence of agreement on a uniform soil type, a consistent procedure to soil the surfaces, or the correct amount of soil removed by the shampoo. The amount of sebum eliminated by the various shampoos varies significantly, as can be observed from the results. When compared to the commercial formulation, the detergency ability result ranged from 18 to 33%. The result is presented in table. Cleansing Action of Herbal Shampoo is:

$DP = (1-T/C)$ ……Eq.2

Where,

DP = percentage of detergency power

C = weight of sebum in the control sample (Meera herbal shampoo)

T = weight of sebum in the test sample [38].

- **Rosemary:**

- **Plant Description:**

The plant that is commonly referred to as rosemary, R. officinalis L., it belongs to the Lamiaceae family and originates from the Mediterranean region. However, it has spread worldwide. This plant is a fragrant perennial shrub that can reach heights of up to two meters, characterized by green leaves emitting a unique scent. R. officinalis has leafy branches and is a versatile plant utilized as a spice in cooking, a decorative and medicinal herb, and also serves as a natural preservative in food production. From R. officinalis L. essential oils and extracts, a number of phytocompounds with pharmacological activity can be extracted, with the levels of these molecules vary in each plant sample[39]. Due to compounds such as rosmarinic acid, rosemary, or Rosmarinus officinalis L. (Lamiaceae), exhibits of inhibit bacteria and viruses, anti-inflammatory, and antioxidant characteristics. Compounds in the herb increase local blood flow, which heals the wound. One of the issues with recurring herpes labialis that people frequently report is local pain; rosemary can be used to treat this. Because of its strong scent, rosemary lends the product a refined flavour and aroma[40]. The phytocompounds include caffeic acid, carnosic acid, chlorogenic acid, monomeric acid, oleanolic acid, rosmarinic acid, ursolic

acid, alpha-pinene, camphor, carnosol, eucalyptol, rosmadial, rosmanol, rosmaquinones A and B, secohinokio, as well as luteolin and eugenol derivative have been documented the most[41].

- **Taxonomy:**

Kingdom: Plantae
Clade: Angiosperms
Division: Magnolyophyta
Class: Magnoliopsida
Order: Lamiales
Family: Lamiaceae or Labiatae
Genus: Rosmarinus
Species: Rosmarinus officinalis L. (Salvia rosmarinus Scheid.)

- **Phyto-constituents:**

a) Leaves: For many years, the family Lamiaceae has been using Melissa officinalis L. to treat recurrent herpes labialis. The active components of this herb consist of flavonoids (luteolin glycoside, quercetin, apigenin, and kaempferol), polyphenols derived from rosmarinic acid, protocatechuic acid, caffeic acid, chlorogenic acid, and hydroxycinnamic acid, as well as essential oils (0.1–0.2%) containing aldehyde monoterpenes (30%–40% citronellal), citral (20%–30%), and sesquiterpenes[42].
b) Flowers: Rosmarinic acid, carnosol, ursolic acid, betulinic acid, carnosic acid, camphor and caffeic acid are the primary phytochemicals found in R. officinalis. As a result, the primary constituents of R. officinalis include essential oils, di- and triterpenes, and phenolic compounds[43].

Fig. 4 flowers of rosemary

- **Extraction:**

1.Drying techniques include:
a. Air-drying: a process of drying is long-lasting several days, weeks, or even months. In order to expose the plant to ambient air, the process is carried out at room temperature. This prevents the heat from harming those unstable chemical components.
b. Microwave-drying: Because of the electromagnetic radiation, the drying process takes less time than air drying. This mechanism encourages the plant's molecules to collide, which heats the plant and causes the water to evaporate. As a result, a lot of phytocompounds have the potential to become modified and loss of their medicinal potency.
c. Oven-drying: By applying heat to cause evaporation of water into pant, the drying process is likewise accelerated. In contrast to microwave-drying, this method preserves the phytochemicals more effectively.
d. Freeze-drying: a drying process carried out using vapourization. After being frozen at -80°C for 12 hours, the sample is lyophilized right away. Compared to other drying techniques, this process yields larger amounts of phytocompounds while preserving their viability[44].
2.Volatile oil Distillation and Distillation Times (DT): Using biomass from three replicates of a well-established, five-year-old rosemary plantation, the distillation study trials were carried out in the fall of 2010

with either raw rosemary plant material. The sample duplicates match the duplicates in the field trial and consisted of rosemary aboveground plant components, such as stems, leaves, and flowers. In order to prevent oil losses from direct sun exposure and high temperatures, the study used air-dried biomass for the dried material, The study involving fresh rosemary biomass utilized recently harvested plant material that was promptly distilled within one hour. The biomass, either fresh or dried, was air-dried in a well-ventilated barn until it reached a consistent weight while being protected from direct sunlight. Then 400 g of fresh sample or 250 g of dried subsample is heating the mixture and using steam in a 2-liter equipment to separate the different components. The following eight distillation times (DT) were used: 1.25, 2.5, 5, 10, 20, 40, 80, and 160 minutes. There were three replications of the randomized content and DT combinations, for a total of 48 runs. Every DT time was started at the same instant the separator received the extract of essential oil. The power was cut off at the conclusion of each particular DT, and the bio flask was taken out of the separator and steam generator. After transferring the eluted oil into a glass vial, the mixture was carefully placed in a freezer. The following day, the oil was separated from the water and accurately measured using a precise analytical scale. Finally, the oil was safely stored in a dark freezer to maintain its quality and potency. For every replication, the amount of essential oil extracted from rosemary was measured in grammes per 100 grammes of raw rosemary plant material [45].

3.Gas Chromatography (GC): To analyze the rose essential oil, we used a gas chromatography Hewlett Packard 6890 GC. The oil profiles of 48 samples were examined using helium as the carrier gas, flowing at a constant rate of 2.5 ml/min. The injection was split 60:1 at 0.5 µL, and the injector temperature was maintained at 220°C. The oven temperature was programmed to start at 60°C for one minute and then increase by 10°C per minute until reaching 250°C. We used a flame ionization detector (FID) in the gas chromatography analysis of the rosemary essential oil. The FID temperature was set at 275°C. Additionally, we utilized an HP-IN-NOWAX column, which was a cross-linked PEG measuring 30 meters in length, with a diameter of 0.32 millimeters and a film thickness of 0.5 micrometers. Through this method, we were able to identify the various constituents of the rosemary oil by analyzing their retention time, mass spectroscopy, and individual peaks [46].

- **Formulation:**

a) Evaluation and foemulation of 1% herbal hair lotion: Tween 60, propylparaben, and ethyl paraben were taken in concentrations of 3.5%, 2%, 0.126%, and 0.126%, respectively, to create the oil phase stearic acid. Water, triethanolamine, and plant extract were present in the aqueous phase in the following concentrations: 8%, 1%, and 1%, respectively. To create the desired product, we began by separately heating the necessary components for the aqueous and oil phases to a temperature of 50°C. Next, we added the required amount of plant extract to the aqueous phase and thoroughly mixed it at the same temperature. Finally, we combined the aqueous and oil phases, ensuring to agitate them well until we achieved the desired consistency. The mixture was then sealed tightly and kept in an airtight container[47].

b) Rosemary Cream: Emulsification was used to create an aqueous cream (O/W) base. First, using a calibrated analytical balance, all A.P.I. and excipients were precisely weighed. In order to prepare the oil phase, 9 g of nonionic emulsifying wax were heated in a water bath until molten, and then 15 g of white soft paraffin were added and cooked to the same temperature. They were then stirred with 6 g of almond oil until an oily foundation formed. After that, the beaker containing the oily phase was heated to between 60 and 70 ^{o}C. To create the aqueous phase, we dissolved the preservatives (0.18g of methyl paraben sodium and 0.02g of propyl paraben sodium) and rosemary extract (0.5g in F1, 1g in F2, and 2g in F3) in 60ml of distilled water. After that, we added 10 ml of glycerin and 0.5 ml of Tween 80 to the aqueous phase. Once the oily and aqueous phases were both heated to a temperature of 60-70 ^{o}C, we added the aqueous phase slowly into the oily phase while ensuring constant stirring. The mixture was stirred continuously until it thickened and solidified[48].

c) Rosemary Gel: A.P.I. and the excipients were precisely weighed using a calibrated analytical balance. After that, the necessary amount of gelling agent (2.5g of xanthan gum in F5 and carbomere 974 in F4) was mixed in water until it was evenly distributed. This stirring process was repeated for a further 20 mins. After the gel base had solidified, we proceeded to incorporate preservatives to ensure its stability. We dissolved 0.002g of propyl paraben sodium and 0.18g of methyl paraben sodium in water and added them to the gel. To neutralize the gel, we introduced a buffer solution consisting of 0.1g of citric acid monohydrate and 3.5g of trisodium citrate dihydrate in water. Lastly, 0.5 grammes of rosemary extract were distributed[49].

- **Evaluation:**

1.Centrifuge test: Using a centrifugal device, the stability of formulations was examined against gravity (centrifuge 5430). For 5, 15, 30, and 60 minutes at 2000 rpm, to separate the different components within each formulation, we placed them in separate tubes that were 10 cm long and 1 cm in diameter. These tubes were then spun rapidly in a centrifuge. Lastly, the sedimentation of each formulation was examined[50].
2.Heating and cooling test: Tubes containing each formulation are prepared and tested for six consecutive periods, including 48 hours at 25°C and 48 hours at 4°C. Products were assessed for apparent quality at the[51].
3.Globule size determination: Using a compound microscope, the formulation's globule size was measured, and the average diameter of 20 particles was found.
4.Thermal stress test: As a primary stability study, the test was conducted. Products in packages were subjected to heat stress within tubes covered in aluminium. For six months, the samples were kept in an oven set relative humidity at 30°C ± 2°C and 60% ± 5%. The gel formulations were assessed after a day, a week, a month, three months, and six months[52].
5.pH determination test: First, standard buffers (pH 4 and 7) were used to calibrate the pH meter. After preparation, the pH of the goods was determined 48 hours, 1 week, 2 weeks, 1 month, 3 months, and 6 months later. There were three attempts at the test[53].

- **Peppermint:**

- **Plant description**:

Plants in the Lamiaceae family, including peppermint (Mentha piperita L.), are grown all over the world. The essential oil (EO) and leaves of peppermint have been used for therapeutic purposes as a carminative and stomach stimulant. Peppermint oil is one of the highly valued and widely used essential oils (EOs) for flavouring dental care products, chewing gum, refreshments, candies and cough syrups. It has been discovered that peppermint essential oil possesses antiviral, antimicrobial, antifungal, and to treat paracite like properties. It has a distinct flavour and aroma and is freely soluble in 70% ethanol. It also has a feeling of coldness. Opalescence could be visible in the solution.1The oil is located on the undersides of the leaves, is extracted by steam distillation, and is usually fractionated and rectified prior to use[54].

- **Taxonomy:**

Kingdom: Plantae
Clade: Angiosperms
Division: Magnolyophyta
Class: Eudicots
Order: Lamiales
Family: Lamiaceae
Genus: Mentha
Species: Mentha piperita

- **Phyto-constituents:**

a) Leaves: The essential chemical constituents of fresh peppermint herb oil are limonene, menthone, menthofuron, and various flavonoid glycosides. The oil content ranges from 0.4-0.6% and is made up of secondary metabolites. It facilitates faster breathing and lessens sunburn discomfort.

Fig. 5 leaves of peppermint

b) Root: Hexane, petroleum ether, and chloroform are all present in mentha root. They are utilised for sauces and flavour syrups with a minty flavour, such as homemade mint or colonial shrubs.
c) Steam: The contents of mentha steam, which includes ethanol, methanol, ethyl acetate, chloroform, hexane, and petroleum ethane, can be used to treat septicemia, wound healing, and flour, sauces, soups, and stews[55].

- **Extraction:**

a) Solvent extraction: Using a shaker, 700 mL of ethyl alcohol and 60 g of fresh and dried peppermint were combined and left for 6 hours at 70°C. the liquid was taken out in a laboratory fume hood and allowed to evaporate for 30 minutes under a gentle stream of warm air at a temperature of 37°C. The resulting oil was collected by evaporating it off with the help of a rotary evaporator. The solvent was then stored in a refrigerator in a dark bottle.
b) Soxhlet extraction: 100g of dry and fresh peppermint were weighed and added to the Soxhlet device. The solvent hexane 300 mL was added. Once the solvent is heated to its boiling point, the resulting vapor travels up a distillation arm and enters the chamber where the solid thimble is located, filling it completely[56].
c) Microwave-Assisted Hydro-distillation: Using a modified glass apparatus and a microwave oven (MM817ASM, Bosch, Germany), microwave-assisted hydro-distillation (MWHD) was carried out in accordance with a method previously documented. In a manner similar to HD, plant material of 40.0g was deposited into a 1-liter glass balloon in the laboratory, 400 millilitres of distilled water poured into it, and then the MWHD was baked. For a total of 120 minutes, extractions were carried out at five different heater power levels (90, 180, 360, 600, and 800 W), and the EO yield was measured at the same intervals as the HD. After the water and EO mixture condensed, the liquid was transformed into vapor and guided through a glass pipe, where it was then carefully collected in a Unger apparatus. The EO's Y was displayed as % (v/w)[57].
d) Supercritical Fluid Extraction: Using a lab-scale extraction system (HPEP, NOVA-Swiss, Effretikon, Switzerland) with features fully detailed by Pekić et al., peppermint was extracted using supercritical CO2. An extractor was filled with 70.0 ± 0.01 g of plant material for every supercritical fluid extraction (SFE). Every experimental run had a constant temperature of 40 °C, a constant CO2 flow rate of 0.3 kg/h, and an extraction time of 180 minutes. The pressure was changed for every SFE to be between 100, 200, 300, and 400 bar. After supercritical fluid extraction, the solvent was removed from the peppermint extracts at a temperature of 25 °C and a pressure of 15 bar. The solvent-free extracts were then collected in glass vials and stored at a temperature of -18 °C before analysis[58].

- **Formulation:**

1.Peppermint oil: Take some fresh neem and mint leaves. Pack every leaf into a jar that is dry. Pour in 15 ml of vegetable oil of any sort. Thoroughly combine the leaves and oil. Store it under the sun for ten days. After ten days, thoroughly heat the mixture. To heat, choose a hob with a low flame. Once the contents have been extracted, thoroughly filter it. Now that peppermint oil is ready.

2. Peppermint Gel: Five distinct formulations (F1, F2, F3, F4, and F5) were produced by adjusting the amounts of the gelling agent, Carbopol 940, and the active components, peppermint oil and eucalyptus oil. The cold process approach was utilised in the preparation of each composition. After dispersing Carbopol 940 in filtered water and letting it hydrate for a full day, oils and other excipients might be added while stirring constantly to create a uniform mixture. All gels were kept in a cool, dry place until they were needed again, after adding methylparaben as a preservative and using triethanolamine to bring the pH down to 6.0[59].

Table 1 five distinct formulation

Formulation	Eucalyptus Oil (mg/g)	Peppermint Oil (mg/g)	Carbopol 940 (%)	Propylene Glycol (ml/g)	Methylparaben (mg/g)	Purified Water (ml/g)
F1	100	50	1	5	0.5	3.5
F2	150	75	1	5	0.5	3.25
F3	200	100	1	5	0.5	3
F4	250	125	1	5	0.5	2.75
F5	300	150	1	5	0.5	2.5

- **Evaluation:**

a) pH: pH is a crucial factor to consider when evaluating the safety and quality of gels. This crucial value was precisely measured using a digital pH metre since gel stability, effectiveness, and safety are all impacted by pH. Make sure the pH stays within the intended values to keep your gel safe and functional[60].

b) Essential Oil for the Anti-bacterial Activity: Using the paper-disc approach, microorganisms were examined for oil sensitivity levels. Three duplicate measurements of the inhibition zone (diameter in mm) were made, and the mean value (μ) was tabulated[61].

c) Homogeneity: Gel uniformity is measured using homogeneity. The homogeneity was evaluated using the glass slide method, which involves sandwiching the gel between two glass slides and looking for lumps or aggregates. For consistent efficacy and safety during product manufacture, a homogenous gel is required[62].

d) Spreadability: One important factor that affects how quickly gel spreads on skin is its spreadability. Two glass slides were sandwiched between the gels, and the distance spread over time was recorded to determine the spreadability of the gels. This parameter influences the gel's application and absorption rates[63].

References:

[1] Tandon J.S., Srivastava V. and Guru P.Y.,J. Nat. Prod., 1991;(4):1102-1104.

[2] Rathore A., Srivastava V., Srivastava K.C.and Tandon J.S. 1990. Phytochemistry, 29(6): 1917-1920.

[3] Chitravanshi V.C., Ghoshal S., Singh A.P.,Prasad B.N.K., Srivastava V. and TandonJ.S. 1992. Pharma. Biol, 30(1): 71-75.

[4] Dong, G.; Bai, X.; Aimila, A.; Aisa, H.A.; Maiwulanjiang, M. 2020. Study on lavender essential oil chemical compositions by GC-MS and improved pGC. Molecules, 25: 3166

[5] Carrasco, A.; Martinez-Gutierrez, R.; Tomas, V.; Tudela, J. 2016. Lavandula angustifolia and Lavandula latifolia essential oils from Spain: Aromatic profile and bioactivities. Planta Med, 82:163–170.

[6] Giovannini, D.; Gismondi, A.; Basso, A.; Canuti, L.; Braglia, R.; Canini, A.; Mariani, F.; Cappelli, G. 2016. Lavandula angustifolia Mill. essential oil exerts antibacterial and anti-inflammatory effect in macrophage mediated immune response to Staphylococcus aureus. Immunol. Investig, 45: 11–28.

[7] Lee, K.-G.; Shibamoto, T.2002. Determination of antioxidant potential of volatile extracts_isolated from various herbs and spices. J. Agr. Food Chem, 50: 4947–4952.

[8] Mierin, a, I.; Jakaite, L.; Kristone, S.; Adere, L.; Jure, M. 2018. Extracts of peppermint, chamomile and lavender as antioxidants. Key Eng. Mater, 762: 31–35.

[9] Inouye S, Tsuruoka T, Uchida K & Yamaguchi H. 2001 Effect of sealing and Tween 80 on the antifungal susceptibility testing of essential oils. Microbiol Immunol, 45: 201-208.

[10] Prashar A, Locke IC & Evans CS. 2004. Cytotoxicity of lavender oil and its major components to human skin cells. Cell Prolif, 37221-229.

[11] Matthieu L, Meuleman L, Van Hecke E, Blondeel A, Dezfoulian 8, Constandt L & Goossens A. 200

4. Contact and photocontact allergy to ketoprofen: the Belgan experience. Contact Dermatitis, 50: 238- 241.

[12] Tyler V E, 1976. Brady L R & Robbers J E, Pharmacognosy (Lea and Febiger, Philadelphia), 171.

[13] Andrade, J.M.; Faustino, C.; García, C.; Ladeiras, D.; Reis, C.P.; Rijo, P. 2018. Rosmarinus officinalis L.: An update review of its phytochemistry and biological activity. Future Sci. OA, 4:283.

[14] Hernández, M.D.; Sotomayor, J.A.; Hernández, A.; Jordán, M.J. 2016. Rosemary (Rosmarinus officinalis L.) oils. In Esential Olis in Food Preservation, Flavor and Safety; Preedy, V., Ed.; Academic Press: London, UK, 677–688.

[15] De Oliveira, J.R.; Camargo, S.E.A.; de Oliveira, L.D. 2019. Rosmarinus officinalis L. (rosemary) as therapeutic and prophylactic agent. J. Biomed. Sci., 26:5.

[16] Hussain A and Ramteke A. 2012 Oct-Dec. Flower extract of Nyctanthes arbor-tristis modulates glutathione level in hydrogen peroxide treated lymphocytes. Pharmacognosy Res, 4(4): 230–233

[17] Agrawal J and Pal A. 2013 Apr 19. Nyctanthes arbor-tristis Linn--a critical ethnopharmacological review. J Ethnopharmacol, 146(3): 645-58.

[18] Manjunatha BK, Patil HSR, Vidya SM, Kekuda TRP, Mukunda S and Divakar R. 2006. Studies on the antibacterial activity of Mucuna monosperma DC. Indian Drugs, 43: 150-152.

[19] Sankavi Selvaraj Department of Floriculture and Landscape Architecture, & Haripriya Shanmugam. 2022. Department of Nanoscience and Technology, Tamilnadu Agricultural University, Coimbatore, Tamil Nadu, India published by The Pharma Innovation Journal, 11(8): 192-194.

[20] Rinki Kumari, G.P. Dubey. 2020. Standardization of Ayurvedic Drug- Nyctanthes arbor-tristis, Hippophae salicifolia, Ocimum tenuiflorum and Reinwardtiaindica and Combined Herb-Herb Biotechnol, 8(1): 36-53.

[21] Anonymous Quality control methods for medicinal plant material, WHO Geneva, (1998): 28-78.

[22] Gupta AK. 2003. Quality standards of Indian medicinal plants. Indian council of medicinal research, New Delhi, 1: 57-81.

[23] Chase CR Jr, Pratt. 1949. Fluorescence of powdered vegetable drugs with particular reference to development of a system of identification. J Am Pharm Assoc Am Pharm Assoc., 38: 324-331.

[24] Balchin L, Lavender MT. In: In: Book Series: 2002. Medicinal and Aromatic Plants-Industrial Profiles, Hardman, R, editor Taylor and Francis, New York The genus Lavandula, 2: 34–37.

[25] Cavanagh HM, Wilkinson JM. 2002. Biological activities of lavender essential oil. Phytother Res., 16(4): 301–308.

[26] Mahboubi M, Shah CF, Feyzabadi M. 2006. Bactericidal effects of essential oils from clove, lavender and geranium on multi-drug resistant isolates of Pseudomonas aeruginosa. Iran J Biotechnol, 4: 137–140.

[27] EMA . Mar 27, 2012. Assessment Report on Lavandula angustifolia Miller, Aetheroleum and Lavandula angustifolia Miller. Monograph European Medicines Agency; Amsterdam, The Netherlands.

[28] Danh L.T., Triet N.D.A., Han L.T.N., Zhao J., Mammucari R., Foster N. 2012. Antioxidant activity, yield and chemical composition of lavender essential oil extracted by supercritical CO2. J. Supercrit. Fluids, 70: 27–34.

[29] Prusinowska R., Śmigielski K.B. 2014. Composition, biological properties and therapeutic effects of Lavender L). A review. Herba Pol, 60: 56–66.

[30] J.F. Clevenger. 1928. Apparatus For Determination of Volatile Oil, J. Am. Pharm. Assoc., 17(4): 345.

[31] Andreas Klamt, Frank Eckert,COSMO-RS. 2000. a novel and efficient method for the a priori prediction of thermophysical data of liquids, 172(1): 43-72.

[32] Bissera Pilicheva, Yordanka Uzunoba and Plamen Katsarov. 2021. Comparative Study on Microencapsulation of Lavender (Lavandula angustifolia Mill.) and Peppermint (Mentha piperita L.) Essential Oils via Spray-Drying Techniue, 26(24): 7467.

[33] Aland R, Ganesan M, Rao R. 2019. In vivo evaluation of tazarotene solid lipid nanoparticles gel for topical delivery. Int J Pharm Sci Drug Res., 11: 45-50.

[34] K.Kumari et al. 2013. Formulation and evaluation of topical hydrogel of Mometasoncfuroate using different polymers. International Journal of Pharmaceutical and Chemical sciences, 2 (1): 89-100.

[35] Patel Japan, Patel B. 2011. Formulation and Evaluation of topical Aceclofenac gel using different gelling agent. International journal of drug development & research, 3(1): 156-164.

[36] Chandira R.M ,Design. 2010. Development and formulation of Antiacne Dermatological gel. Journal of Chemical and Pharmaceutical Research, 2(1): 401-404.

[37] Lognathan V, Manimaran S, Jaswanth A, Sulaiman A, Reddy MVS, Kumar BS, Rajaseskaran A. 2001. The effects of polymers and permeation enhancers on the releases of flurbiprofen from gel formulations. Indian J Pharm Sci., 63(3): 200-204

[38] Pushpangadan, P.; Tewari, S. 2006. Peppermint. In Handbook of Herbs and Spices; Elsevier: Amsterdam, The Netherlands, 460–481.

[39] Brewer MS. 2011. Natural antioxidants: sources, compounds, mechanisms of action, and potential applications. Compr Rev Food Sci Food Sa., 10: 221–47.

[40] Blumenthal M, Goldberg A, Brinckmann J. 2000. Expanded Commission E Monographs. New York: Integrative Medicine Communications. Herbal Medicine, 207–18.

[41] Martínez AL, González-Trujano ME, Pellicer F, López-Muñoz FJ, Navarrete A. 2009. Antinociceptive effect and GC/MS analysis of Rosmarinus officinalis L. essential oil from its aerial parts. Planta Med., 75: 508–11.

[42] Koch C, Reichling J, Schnitzler P, Watson RR, Preedy VR. 2008. Essential oils inhibit replication of herpes simplex virus type 1 and type 2. Bot Med Clin Pract., 192.

[43] Aumeeruddy-Elalfi Z, Gurib-Fakim A, Mahomoodally MF. 2016. Chemical composition, antimicrobial and antibiotic potentiating activity of essential oils from 10 tropical medicinal plants from Mauritius. J. Herb. Med., 6(2): 88–95.

[44] Azwanida NN. 2015. A review on the extraction methods use in medicinal plants,principle, strength and limitation. Med Aromat Plants, 4: 1–6.

[45] Gawde, A. J.; Cantrell, C. L.; Zheljazkov, V. D. 2009. Dual ex-traction of essential oil and podophyllotoxin from Ju-niperus virginiana. Ind., 30: 276-280

[46] Bharate, S. B.; Khan, S. I.; Yunus, N. A.; Chauthe, S. K.; Jacob, M. R.; Tekwani, B. L.; Khan, I. A.; Singh, I. P. 2007. Antiprotozoal and antimicrobial activities of O-alkylat-ed and formylated acylphloroglucinols. Bioorg. Med. Chem., 15: 87-96

[47] Lachman L, Lieberman HA, Kanig JL. 2009. Theory and Practice of Industrial Pharmacy. 3rd ed, New Delhi: CBS Publications.

[48] Lourdes Mayordomo. 2010. Raw Material Documentation, 4173000G – Rosemary- ECO, Version. 21.

[49] Varun Thakur. 2012. Formulation and In Vitro Evaluation of Gel for Topical Delivery of Antifungal Agents Fluconazole. Department of Pharmaceutics, Manay Bharti University, Solan HP., India. 173229.

[50] 18. Serkedjieva J, Ivancheva S. 1999. Antiherpes virus activity of extracts from the medicinal plant Geranium sanguineum L. J Ethnopharmacol, 64: 59–68.

[51] Aslani A, Ghannadi A, Najafi H. 2013. Design, formulation and evaluation of a mucoadhesive gel from Quercus brantii L. and Coriandrum sativum L. as periodontal drug delivery. Adv Biomed Res., 2: 21.

[52] Regupathi T, Chitra K, Ruckmani K, Lalitha KG, Kumar M. 2017. Formulation and evaluation of herbal hair gel for hair growth potential. J Pharmacol Clin Res., 2: 1–8.

[53] Saleem MA, Bala S, Liyakat, Aeajaz A. 2010. Effect of different carriers on in vitro permeation of meloxicam through rat skin. Indian J Pharm Sci., 72: 710–8.

[54] Pushpangadan, P.; Tewari, S. Peppermint. 2006. In Handbook of Herbs and Spices; Elsevier: Amsterdam, The Netherlands, 460–481.

[55] Mamata Sharma, Deepak Goutam. 2022. Phytoconstituent And Medicinal value of Mentha Piperita, 15: 156-160

[56] Azhari Siddeeg, Zakaria A. Salih, Rabab M. E. Mukhtar & Ali O. Ali. 2018. Extraction and Characterization of Peppermint Essential Oil and its Assessment as Antioxidant and Antibacterial, 13(1): 1-2

[57] Nagy, B.; Simándi, B. 2008. Effects of particle size distribution, moisture content, and initial oil content on the supercritical fluid extraction of paprika. J. Supercrit. Fluids, 46: 293–298.

[58] Pavlić, B.; Bera, O.; Vidović, S.; Ilić, L.; Zeković, Z. 2017. Extraction kinetics and ANN simulation of supercritical fluid extraction of sage herbal dust. J. Supercrit. Fluids, 130: 327–336.

[59] Dai, J., Ding, M., Chen, J., Qi, J., Zhu,Y., Li, Z., ... & Wang, G. (2020). 2020. Optimization of gel mixture formulation based on weighted value using response surface methodology. CyTA-Journal of Food, 18(1): 500-507.

[60] Bolla, P. K., Clark, B. A., Juluri, A., Cheruvu, H. S., & Renukuntla, J. 2020. Evaluation of formulation parameters on permeation of ibuprofen from topical formulations using Strat-M® membrane. Pharmaceutics, 12(2): 151.

[61] Pattnaik, S., Subramanyam, VR., Bapaji, M., Kole, CR. 1997. " Microbios", 89: 39-46.

[62] Duong, V. A., Nguyen, T. T. L., & Maeng, H. J. 2020. Preparation of solid lipid nanoparticles and nanostructured lipid carriers for drug delivery and the effects of preparation parameters of solvent injection method. Molecules, 25(20): 4781.

[63] Iriventi, P., & Gupta, N. V. 2020. Topical delivery of curcumin and caffeine mixture-loaded nanostructured lipid carriers for effective treatment of psoriasis. Pharmacognosy Magazine, 16(1): S206-S217.