IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 7, June 2025
Impact Factor: 7.67

A Research on Development of Herbal Topical gel Formulation for Enhanced Skin Permeation of Antifungal Agents

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Abstract: *Most of the time, the humans live in peaceful coexistence with the microorganisms that Surround them. An infection may emerge only when the defence system is damaged or the Concentration of pathogens reach an exceptionally high density. Most infections remain Unrecognized but sometimes the infecting agents do elicit a response of the body, which leads To clinical signs and symptoms, a condition known as infectious disease. As strategies to control bacterial infections in patients improved, fungi became the most hazardous Pathogens.[1].*

Keywords: *defence system*

I. INTRODUCTION

Most of the time, the humans live in peaceful coexistence with the microorganisms that Surround them. An infection may emerge only when the defence system is damaged or the Concentration of pathogens reach an exceptionally high density. Most infections remain Unrecognized but sometimes the infecting agents do elicit a response of the body, which leads To clinical signs and symptoms, a condition known as infectious disease. As strategies to control bacterial infections in patients improved, fungi became the most hazardous Pathogens.[1]

Fungal species are widely distributed in soil, plant debris and organic substrates, and make up Approximately 7 percent (6,11,000 species) of all eukaryotic species on earth, although only About 600 species are human pathogens.[2]

Fungal infection of skin is one of the most common dermatological problems throughout the World. Fungal infections occur in human, when an invading fungus occupies an area of the Body and is too much for the immune system to handle. The dermatophytic infections, Superficial candidiasis of the mouth, skin, or genital tract are the main afflicting conditions of Fungal diseases.[3]

For many decades treatment of such acute disease or a chronic illness has been mostly Accomplished by delivery of drugs to patients through various pharmaceutical dosage forms Including tablets, capsules, pills, suppositories, cream, gel, ointments, liquids, aerosols and Many other formulations as drug carriers. Delivery of drugs through skin is an effective and Targeted therapy for local dermatological disorders. Topical drug delivery has gained Popularity because it avoids first-pass effects, gastrointestinal irritations and metabolic Degradation associated with oral administration.[4]

Topical drug delivery system is the dosage form which is applied on the skin or mucous Membranes. Topical drug delivery systems are formulated in different consistency such as Solid, semisolid, and liquid. Topical drug delivery offers various advantages like patient Compliance, ease of administration, improved drug bioavailability, better physiological and Pharmacological response, reduced systemic toxicity and least exposure of drugs to non-

Infectious tissue/sites, easy termination of the treatment, avoid gastric incompatibilities, Minimum fluctuation in plasma levels and suitable for the drug with narrow therapeutic Window.[5].

Many widely used topical formulations like ointments, creams, lotions, gel are associated With disadvantages like stability problems, stickiness and lesser spreading abilities, irritation, Allergic reactions, poor permeability and poor absorption. Most of the topical delivery Systems have been failed in the administration of hydrophobic drug. To overcome this limit, Approach of emulgel has been designed.[6].

The word ‘’gel’’ as a categorization developed in the late 1800s, when scientists sought to describe Semisolid substances based on their phenomenological features rather than their chemical makeup. At The time, analytical tools

DOI: 10.48175/IJARSCT-28029

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for determining chemical structures were insufficient.Compared to other drug Administration techniques, the topical/transdermal (TT) route has various benefits, including increased Patient compliance, consistent drug delivery, fewer side effects, and avoidance of the hepatic first pass Effect Drugs for topical application are intended to be applied outside. Sunscreen, keratolytic agents, Local anaesthetics, antiseptics, and anti-inflammatory drugs are examples of products with a localized Action on one or more layers of the skin. Although some of the medicine in these topical formulations may reach the circulation unintentionally, it is often at subtherapeutic dosages and has no notable Negative effects, with the possible exception of pregnant or nursing patients (7).

First transdermal patches were authorized by the FDA in 1981. This approach is becoming more Common and convenient for administering drugs to patients, as well as increasing therapeutic advantages To patients. External application of gel at skin gives some evident advantages such as fast release of Medicine straight to the site of action, irrespective of the drug's water solubility, as opposed to lotions And ointment.(8).

Gels, also known as jellies, are semisolid substances that comprise either big organic Molecules interpenetrated by a liquid or suspensions made of minute inorganic particles, according to USP. There is reversibility between the gel and sol states in many polymer gels.

On the other hand, Because certain polymer gels' chains are covalently connected, their production cannot be reversed.[9]

The kingdoms of fungi, plants, animals, protests, and bacteria are distinct from one another. The primary Distinction that sets fungi apart from other kingdoms is the presence of chitin in their cell walls, which is Absent from those of other species. In the environment, fungi are present everywhere. Some of them are Helpful; for instance, they are found in foods like baker's yeast and mushrooms, and they play significant Roles in medicine. Most occurrences of localized fungal infections end with the issue going away once The bacteria start multiplying again(10).

Usually affecting the skin, nails, vagina, mouth, or sinuses, Localized fungal infections A significant intestinal urgery, the use of catheters, neonatal intensive care, or Liver transplantation are among the risk factors for the fourth most frequent inpatient acquired Bloodstream infection, which is candidiasis infection. Although more than a dozen species of Candida Can cause illness, Candida albicans is the most common in practically all patient populations and disease Presentations. This study will concentrate on Candida albicans, which initially develops as a benign Organism but has the potential to turn pathogenic, penetrating the mucosa and causing serious injury.[11).

A fungal infection of the nails known as onychomycosis affects millions of people worldwide and poses a persistent and difficult Clinical condition. Traditional therapies, like oral drugs and topical antifungal creams, frequently have poor effectiveness and carry The risk of side effects or drug interactions. A growing number of people are interested in investigating complementary and alternative therapies, especially those that come From natural sources, in light of these difficulties. Traditional medical systems have traditionally employed herbal treatments due to Their perceived safety and effectiveness. Because of their strong anti-fungal and anti-microbial qualities, clove oil, turmeric, and pure peppermint have become highly Promising options for the treatment of onychomycosis.

The component recognized for its broad-spectrum antibacterial activity, eugenol, is abundant in clove oil, which is extracted from The buds of Syzygium aromaticum.

One of the ginger family's rhizomatous herbaceous perennials, turmeric includes curcumin, a polyphenolic chemical that has been Shown to have anti-inflammatory and anti-fungal effects. Mentha piperita is the source of pure peppermint, which is extracted and Contains menthol and other bioactive ingredients with calming and antifungal properties. By going over possible mechanisms of action, this research aims to further our knowledge of natural methods of treating Onychomycosis. By investigating the potential of herbal remedies as a therapeutic tool and encouraging more research into their application to the Treatment of onychomycosis, our goal is to provide patients suffering from this common fungal infection with safe, efficient, and Easily accessible treatment options. (12).

Different Herbal gel formulation:

These are the types of formulations That are prepared by using herbal ingredients As an active pharmaceutical ingredient it is a Natural type of formulation with no adverse Drug reactions. These formulations include Herbal ingredients (Main ingredient), base, And preservatives.4 (Table 1).

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S. No.	Gel Name	Herbal Extract	Base	Preservative	Benefits
1	Aloe vera gel	Aloe vera	Carbapol 934	Phenoxyethanol	Soothes skin irritation and hydrates the skin Psoriasis
2	Turmeric gel	Turmeric	Hydroxyethyl cellulose	Potassium sorbate	Anti-inflammatory Antimicrobial Psoriasis
3	Neem gel	Neem	Sodium Alginate	Sodium benzoate	Antimicrobial Antifungal Psoriasis
4	Tea tree gel	Tea tree	Polyvinyl alcohol	Ethylhexylglycerin	Antimicrobial Antifungal Psoriasis
5	Avocado gel	Avocado	Carbapol 934	Methylparaben	Antifungal Antimicrobial Psoriasis
6	Ginger gel	Ginger	Carrageenan	Phenoxyethanol	Antimicrobial Antioxidant Psoriasis
7	Basil gel	Basil	Polyvinyl alcohol	Ethylhexylglycerin	Antimicrobial Antifungal Psoriasis
8	Cucumber gel	Cucumber	Hydroxyethyl cellulose	Potassium sorbate	Soothes and cools the skin and reduces inflammation Psoriasis

Fig Different Herbal gel formulation

The Material used for Herbal Antifungal gel:

1. Aloe vera

The Aloe Vera look like a cactus but it isn‘t.The botanical name of Aloe vera is Aloe Barbadensis Miller. It belongs to Ashodelaceae (Liliaceae) family, and is a shrubby or arborescent, perennial, Xerophytic, succulent, and pea- green colour plant. Inside the leaf is a jelly like substance. The Properties of Aloe vera were well accepted from China to India. Today, Aloe vera is cultivated Throughout the world. Terms including, the potted physician and nature‘s medicine chest, Attempted to describe the significant historical uses of Aloe vera. There are over 250 species of Aloe grown around the world. However, only two species are grown today commercially, with Aloe Barbadensis Miller and Aloe aborescens being the most popular. The Aloe plant is grown in Warm tropical areas and cannot survive freezing temperatures. The Aloe vera plant has been Known and used for centauries for its health, beauty, medicinal and skin care properties(13).

The Name Aloe vera derives from the Arabic word ―Alloeh‖ meaning ―shining bitter substance‖ ,while ―Vera‖ in Latin means ―true‖ 2000 year Ago, the Greek scientists regarded Aloe vera as the universal panacea. The Egyptians called Aloe ―the plant of immortality.‖ Today, the Aloe vera plant has been used for various Purposes in dermatology. Aloe vera has long been used as a remedy in many cultures. Aloe Preparation, including Products based on both the gel and leaf is used, among other reasons, as Laxative, in creams for skin in functional foods, and treatment for a wide range of diseases.

Aloe vera Latex commonly known as aloin having a bitter taste and purgative quality.

Because of Its bitter taste, it is also known as bitter aloes. Aloin is destructive to healthy tissue and cells. It is obtained from specialized cells known as pericyclictubules that occur just beneath the Epidermis or rind of the same leaves from which the juice is derived. Aloe can be used in raw Form or in processed forms; it can be used both externally and internally. Dried Juice is commercially known as aloe or musavvar. This is the solidified juice coming spontaneously when the leaf is cut out of the cells in pericycle And adjacent leaf parenchyma. This juice is then dried with or without heat to give a strongly bitter Substance having a characteristic disagreeable odor. This is known as aloe in the market. (14).

Three types of aloe are available in market depending upon the source plant viz.

i. Curacao aloe: a dark brown colored substance sourced from Aloe vera

ii. Cape aloe: greenish brown colored aloe sourced from Aloe ferox and

iii. Socotrine aloe: reddish black colored aloe sourced from Aloe peyrii baker.

iv. The original commercial use of the Aloe plant was in the production of a latex Substance called Aloin, a yellow sap used for many years as a laxative ingredient.[7]

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Fig . Aloe Vera

1. Botanical names: Aloe barbadensis miller
2. Family: Liliaceae
3. Synonym: Aloe barbadensis, Aloeindica, Aloe arborescens, Aloe ferox

4. Common names :

Languages Names

Languages	Names
Nepali	Gwarpatha
Sanskrit	Ghritkumari
Hindi	Musabar
Marathi	Korphad
kannada	kathaligida

Active Constitutes of Aloe Vera:

The Aloe vera leaf gel contains about 98% water 6. The total solid content of Aloe vera gel is 0.66% and soluble solids are 0.56% with some seasonal fluctuation. On dry matter basis aloe gel Consists of polysaccharides (53%), sugars (17%), minerals (16%), proteins (7%), lipids (5%) and Phenolic compounds (2%) Aloe vera contains 200 potentially active constituents: vitamins, Enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids, which are Responsible for the multifunctional activity of Aloe vera.

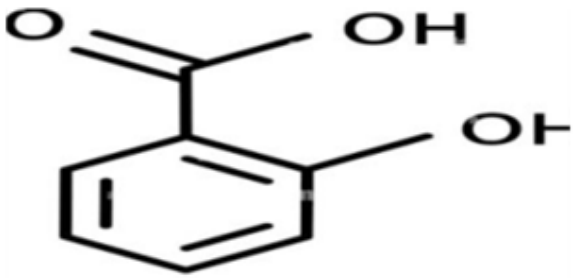

Fig. Salicylic acid

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Vitamins:

It contains Vitamins A (beta-carotene), C and E, which are antioxidants. It also contains Vitamin B12, folic acid, and choline. Antioxidant neutralizes free radicals.

Enzymes:

It contains 8 enzymes: aliiase, alkaline phosphatase, amylase, brady kinase, carboxy- peptidase, Catalase, cellulase, lipase, and peroxidase. Brady kinase helps to reduce excessive inflammation When applied to the skin topically, while others help in the breakdown of sugars and fats.

Minerals:

It provides calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium And zinc. They are essential for the proper functioning of various enzyme systems in different Metabolic pathways and few are antioxidants.

Sugars:

It provides monosaccharides (glucose and fructose) and polysaccharides: (glucomannans/Polymannose). These are derived from the mucilage layer of the plant and are known as Mucopolysaccharides. Recently, a glycoprotein with anti-allergic properties, called alprogen and Novel anti-inflammatory compound, C-glucosyl chromone, has been isolated from Aloe vera.

Anthraquinones:

It provides 12 anthraquinones, which are phenolic compounds traditionally known as laxatives. Aloin and emodin act as analgesics, anti-bacterial and anti-viral.

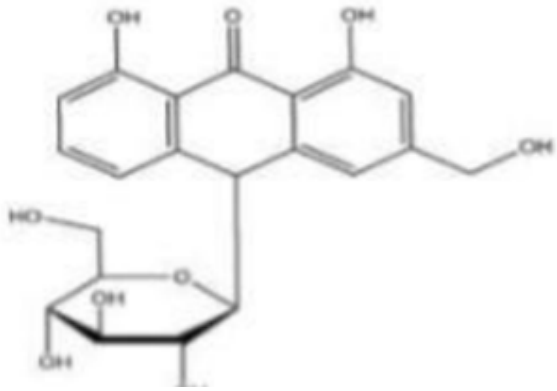

Fig. Aloin

Fatty acids:

It provides 4 plant steroids; cholesterol, campesterol, β -sisosterol and lupeol. All these have Anti-inflammatory action and lupeol also possesses antiseptic and analgesic properties.

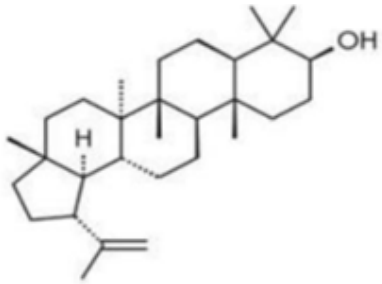

Fig. Lupeol

Hormones:

Auxins and gibberellins that help in wound healing and have anti-inflammatory Action.

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Others:

It provides 20 of the 22-human required amino acids and 7 of the 8 essential amino acids. It also contains salicylic acid that possesses anti-inflammatory and antibacterial properties.

Lignin, an inert substance, when included in topical preparations, enhances penetrative effect of The other ingredients into the skin. Saponins that are the soapy substances form about 3% of the Gel and have cleansing and antiseptic properties.

Uses

The plant Aloe vera is used in Ayurvedic, Homoeopathic and Allopathic streams of medicine, and Not only tribal community but also most of the people for food and medicine.

The plant leaves Contain numerous vitamins, minerals, enzymes, amino acids, natural sugars and other bioactive compounds with emollient, purgative, antimicrobial, anti-inflammatory, anti- oxidant,

Aphrodisiac, anti-helminthic, antifungal, antiseptic and cosmetic values for health care. This plant

Has potential to cure sunburns, burns and minor cuts, and even skin cancer. The external use in Cosmetic primarily acts as skin healer and prevents injury of epithelial tissues, cures acne and Gives a youthful glow to skin, also acts as extremely powerful laxative.[15]

2. Coconut oil:

Coconut oil has been used in herbal antifungal treatments due to its natural antimicrobial properties, which are largely attributed to its high content of lauric acid and caprylic acid.

These compounds have demonstrated antifungal, antibacterial, and antiviral activity. Several studies have explored its efficacy in treating fungal infections, particularly for skin conditions like ringworm, athlete's foot, yeast infections, and candida.Lauric acid, the primary medium-chain fatty acid in coconut oil, has been shown to possess antifungal properties, particularly against Candida albicans, a common yeast that can cause infections in humans.(16).

Caprylic acid is another medium-chain fatty acid found in coconut oil. It has been shown to disrupt the cell membrane of fungi, especially in Candida infections.

Coconut oil is frequently used topically as an antifungal agent for conditions like ringworm, athlete's foot, and other dermatophyte infections. Its effectiveness is believed to be due to the combination of lauric acid and caprylic acid, which penetrate fungal cells and disrupt their structure.

Coconut oil is sometimes used in combination with other herbal antifungal agents, such as tea tree oil or oregano oil, to enhance its efficacy. The combined antifungal activity of these oils can be used to treat more stubborn fungal infections.(17).

Fig . Coconut oil

The botanical name : Cocos nucifera.

The family : Arecaceae

Synonyms: Copra oil

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Active Constituents of coconut oil:

Coconut oil is composed mainly of saturated fatty acids, with a significant presence of medium-chain triglycerides (MCTs). Below is a breakdown of the chemical constituents of coconut oil, accompanied by a general diagram of the triglyceride structure.

1.Major Fatty Acids in Coconut Oil:

Coconut oil primarily consists of the following fatty acids: Lauric Acid ($C_{12}H_{24}O_2$): 47-50%

Myristic Acid ($C_{14}H_{28}O_2$): 18-19%

Palmitic Acid ($C_{16}H_{32}O_2$): 8-10%

Caprylic Acid ($C_8H_{16}O_2$): 5-9%

Capric Acid ($C_{10}H_{20}O_2$): 5-6%

Oleic Acid ($C_{18}H_{34}O_2$): 5-8%

Linoleic Acid ($C_{18}H_{32}O_2$): 1-2%

These fatty acids are mainly saturated, which contributes to coconut oil's solid form at room temperature and its stability against oxidation.

2.Triglyceride Structure:

Coconut oil is primarily composed of triglycerides, which are molecules consisting of a glycerol molecule ($C_3H_8O_3$) bonded to three fatty acids.

Here's a diagram illustrating the general structure of a triglyceride molecule, which is common in coconut oil:

```
CH2-O-C(R1)-COOH
                |
CH2-O-C(R2)-COOH
                |
                CH2-O-C(R3)-COOH
```

3.Minor Constituents:

Coconut oil also contains:

Polyphenols: Antioxidants that help prevent oxidation.

Tocopherols and Tocotrienols (Vitamin E): These antioxidants contribute to the oil's stability and skin-health benefits.

Uses:

1.Skin Care:

Moisturizer: Coconut oil is an effective moisturizer for dry skin. Its high-fat content helps to retain moisture and improve skin elasticity. It is also used in homemade lotions and body butters.

Anti-aging: Due to its antioxidant properties, coconut oil can help reduce wrinkles and fine lines by promoting skin hydration.

Wound Healing: It has antibacterial and anti-inflammatory properties that may help in the healing of minor cuts, scrapes, and burns.

Makeup Remover: Coconut oil can be used as a natural makeup remover, as it gently dissolves makeup without irritating the skin.

Lip Balm: It helps to soothe chapped lips due to its moisturizing properties.

3. Hair Care:

Hair Conditioner: Coconut oil works as a natural conditioner. When applied to the hair and scalp, it helps to lock in moisture and improve hair texture. It is especially helpful for dry and damaged hair.

Dandruff Treatment: Coconut oil's antimicrobial properties make it effective in reducing dandruff and soothing an irritated scalp.

Hair Growth: It may help with hair growth by nourishing the scalp and improving blood circulation.

Shine and Frizz Control: A small amount can be applied to the hair to add shine and reduce frizz.

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3.Anti-fungal and Antibacterial Uses:

Topical Fungicide: Coconut oil is effective in treating fungal infections like athlete's foot, ringworm, and candida. Its antifungal properties make it a natural remedy for skin infections.

Antibacterial: It can be applied to minor cuts, abrasions, and acne as it helps to fight bacteria and reduce inflammation.

4.Sun Protection and After-Sun Care:

Natural Sunscreen: While not as effective as commercial sunscreens, coconut oil offers a mild SPF of around 4-5, which can provide minimal protection. It is often used as an additional layer for sun protection.

After-Sun Lotion: Coconut oil can be applied after sun exposure to soothe and moisturize the skin.(18).

3.Neem oil:

Azadirachta indica (A. indica) belongs to the botanic family Meliaceae, commonly known as Neem. It is used in traditional medicine as a source of many therapeutic agents. A. indica (leaf, Bark and seeds) are known to contain antibacterial and antifungal activities against different Pathogenic microorganisms; in addition to antiviral activity against vaccinia, chikungunya, Measles, and Coxsackie B viruses Different parts of Neem (leaf, bark and seeds) have been shown to exhibit wide pharmacological Activities such as antioxidant, antimalarial, antimutagenic, anticarcinogenic, anti-inflammatory

Antihyperglycemic, antiulcer, and anti-diabetic properties. The biological activities are attributed To the presence of many bioactive compounds in its different parts. Aqueous extract of Neem leaf Extract has a good therapeutic potential as an antihyperglycemic agent in insulin dependent and Non-insulin-dependent diabetes mellitus. (19).

Fig Neem Oil

Botanical name: - Azadirachta Indica

Family: Mahogany

Synonyms: -margosa, arishth, , Melia Azadirachta, rosehip, witch-hazel melaleuca,

Common Name:

LANGUAGES	NAME
English	Paradise tree
Sanskrit	Aristha
Urdu	Neem
Hindi	Nim
Marathi	Kadu-limba

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Chemical Constituents: -

Constituents: Leaf extracts: Active constituents of neem leaf extract include isomeldenin, nimbin, Nimbinene, 6-desacetyllnimbinene, nimbandiol, immobile, nimocinol, quercetin, and beta-Sitosterol. Two additional tetracyclic triterpenoids zafaral [24,25,26,27- tetranorapotirucalla (apoeupha)-6alpha-methoxy-7alpha-acetoxy-1,14-dien-3,16-dione-21-al] and maleinanhydride [24,25,26,27-tetranorapotirucalla-(apoeupha)-6alpha- hydroxy,11alpha- methoxy-7alpha,12alpha-Diacetoxy,1,14,20(22)-trien-3-one] have been isolated from the methanolic extract of neem Leaves.

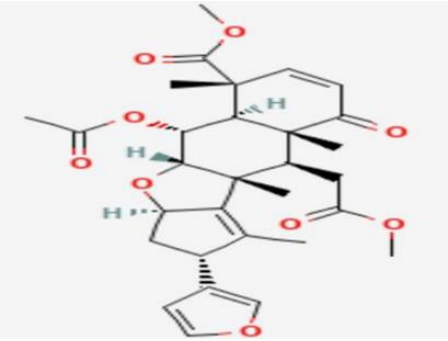

Fig . Nimbin

Uses:

Neem is considered a boon for mankind by nature. Use of Neem has been recommended by Ayurveda for a wide range of diseases. Such usage is attributed to its purification effect on blood. Scientific research on Neem demonstrates it to be a Panacea. It is suggested to be an antibacterial, Anthelmintic, antiviral, anticancer and more importantly immunomodulatory agent.[20]

4.Vitamin E oil:

Vitamin E oil is a potent antioxidant that is often used in skincare and haircare. It is derived from vitamin E, a fat-soluble vitamin known for its ability to protect cells from oxidative stress and support the body's immune function. In its oil form, it can be used topically for various purposes

Vitamin E oil is a fat-soluble nutrient that plays a key role in the body's antioxidant defense system. It is derived from a group of compounds known as tocopherols and tocotrienols, the most common form being alpha-tocopherol. The oil form of vitamin E is often used for its skincare and health benefits due to its potential to nourish the skin, protect against oxidative stress, and promote overall wellness.(21).

Fig . Vitamin E Oil

Botanical name:triticum vulgara

Family: Vitamin E family

Synonyms: Tocopherol

Active Chemical constituents:

1.Tocopherols:

These are the most common and well-known forms of vitamin E. There are four types of tocopherols, each having a different structure, and all contribute to the antioxidant activity of vitamin E oil.

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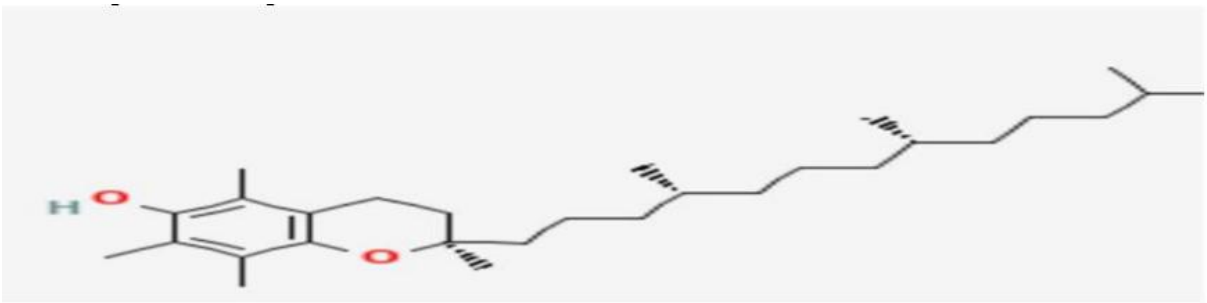
Alpha-tocopherol (α-tocopherol): The most abundant and biologically active form of vitamin E in the human body.
Beta-tocopherol (β-tocopherol): A less common form of vitamin E with antioxidant properties.
Gamma-tocopherol (γ-tocopherol): Found primarily in certain vegetable oils like soybean and corn oils. It is also a potent antioxidant.
Delta-tocopherol (δ-tocopherol): The least common form, but still an effective antioxidant.



2.Tocotrienols:
Tocotrienols are another class of vitamin E compounds, and they are structurally similar to tocopherols, but with an unsaturated side chain. They are thought to have stronger antioxidant and anti-inflammatory properties than tocopherols.
Alpha-tocotrienol (α-tocotrienol): The most active form among tocotrienols.
Beta-tocotrienol (β-tocotrienol): Less common but still has beneficial effects.
Gamma-tocotrienol (γ-tocotrienol): Known for its antioxidant and anti-inflammatory properties.
Delta-tocotrienol (δ-tocotrienol): Found in smaller quantities but has similar benefits.

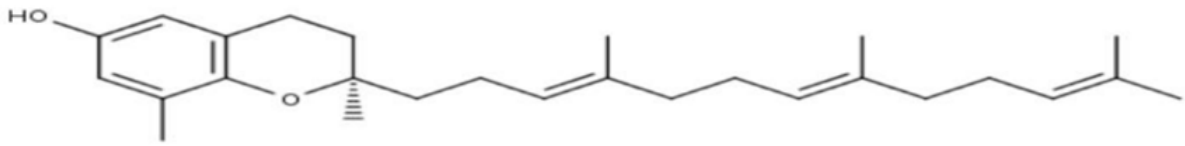


Fig. Tocotrinol

Uses.
Vitamin E oil is widely used for its various health and cosmetic benefits, primarily due to its potent antioxidant and moisturizing properties. Here are some of the common uses of vitamin E oil, along with references to scientific studies and resources:
1.Skin Care and Anti-Aging
Vitamin E oil is frequently used in skincare products for its antioxidant properties, which help protect the skin from oxidative damage caused by free radicals. This is believed to reduce the appearance of fine lines, wrinkles, and age spots.

2. Wound Healing and Scar Treatment
Vitamin E oil is often used to improve wound healing and reduce scarring. It is believed to promote cell regeneration and reduce the appearance of scars, though research results have been mixed.
3.Moisturizing and Hydrating Skin
Vitamin E oil is an excellent moisturizer due to its ability to lock in moisture and promote hydration in dry or flaky skin. It helps restore the skin's natural moisture barrier.
4. Sun Protection
Vitamin E oil is sometimes used in conjunction with sunscreen to offer additional protection from UV-induced damage. It is thought to reduce the harmful effects of UV rays, including sunburn and photoaging.(22).
5.Tea Tree oil:

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Tea tree oil is an essential oil derived from the leaves of the Melaleuca alternifolia, a plant native to Australia. It is known for its antibacterial, antifungal, anti-inflammatory, and antiviral properties, making it a popular ingredient in skincare and health products. Here is detailed information about tea tree oil along with references to scientific studies.
Tea tree oil is a versatile natural remedy, thanks to its broad-spectrum antimicrobial and anti-inflammatory properties. However, it is important to use it properly and consult with a healthcare professional if you are unsure about its application.(23).

Fig . Tea Tree Oil

Botanical Name: Melaleuca alternifolia
Family: Myrtaceae family.
Synonyms: Tea tree essential oil
Active Chemical constituents:
The active chemical constituents of tea tree oil are primarily responsible for its
antimicrobial, anti-inflammatory, and therapeutic properties. These constituents slightly depending on the source and distillation process, but the most important compounds include:
1.Terpinen-4-ol:
Percentage: One of the most abundant compounds in tea tree oil, often constituting about 30-48% of the oil.
Properties: Terpinen-4-ol is primarily responsible for the antibacterial and antifungal activities of tea tree oil. It has been shown to combat a wide range of pathogens, including Staphylococcus aureus, Escherichia coli, and Candida albicans.

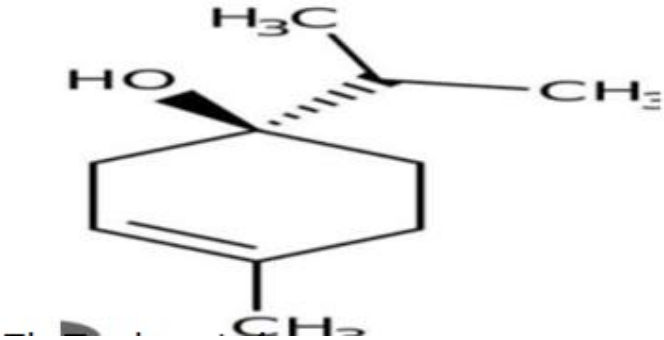

Fig Terpinen-4-ol

2.Alpha-terpineol:
Percentage: Typically 5-13% of the oil.
Properties: Alpha-terpineol is known for its antibacterial, anti-inflammatory, and
antioxidant properties. It is often cited for its role in promoting wound healing and reducing skin irritation.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 7, June 2025
Impact Factor: 7.67

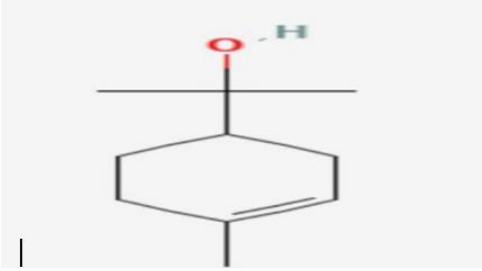

Fig Alpha- terpineol

Uses:

Tea tree oil is a versatile essential oil that has been used for centuries due to its antimicrobial, anti-inflammatory, and healing properties. It is commonly used for a variety of therapeutic and cosmetic applications.

Tea tree oil is a natural, versatile remedy for various skin, health, and household concerns, with substantial scientific backing supporting its efficacy.

Here are some common uses of tea tree oil,

1.Acne Treatment

Tea tree oil is widely used for treating acne due to its antibacterial and anti-inflammatory properties. It helps reduce acne lesions and inflammation by targeting the bacteria Propionibacterium acnes, which causes acne.

2. Treatment of Skin Infections

Due to its antimicrobial properties, tea tree oil is often used to treat minor skin infections such as cuts, abrasions, and fungal infections (like athlete's foot, ringworm, and thrush).

3.Dandruff and Scalp Health

Tea tree oil is commonly used to treat dandruff and other scalp conditions like seborrheic dermatitis. Its antifungal properties help combat the yeast-like fungus Malassezia, which is often implicated in dandruff.

4.Wound Healing

Tea tree oil has been shown to promote wound healing due to its antibacterial and anti-inflammatory properties. It prevents infection and accelerates the healing process of minor cuts and abrasions.

5.Treatment of Fungal Infections

Tea tree oil is widely used to treat fungal infections, such as athlete's foot, ringworm, and nail fungus. Its antifungal activity is particularly effective against fungi like Candida albicans.(24).

Mechanism of action of Herbal Antifungal agents:

Fig . Mechanism of action

Mechanism of action of Gels takes place in three steps. The first step Is absorption and retention, the next step is Network formation, and the last step is the Release mechanism.

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.Absorption and Retention:

Gels Absorb and hold liquids via hydrogen Bonding, electrostatic interactions, or Van der Waals forces between the Polymer chains or colloidal particles And the liquid.

• Network Formation:

The absorbed Liquid forms a network of polymer Chains or colloidal particles, trapping The liquid and giving the gel its semi-Solid qualities.

• Release Mechanism:

Gels can release Stored liquid using a variety of methods, Including diffusion, erosion, and Polymer network deterioration. (25).

Preparation method of gel:

1.The Fusion Method of Gel

A popular method of creating gels, Particularly for use in food, cosmetics, and

Pharmaceutical applications, is the fusion Process. To create the gel, the gelling agent And the other ingredients must be heated Until they dissolve or disperse evenly, and Then must be cooled.

Fusion Method Steps Use precise measurements for the gelling Agent (gelatin, agar), including solvents, oils, Etc.

• Blending: To guarantee that the gelling Agent and other components are evenly Dispersed throughout the liquid phase, Constant stirring is done.

• Cooling: The solution is well mixed and Then cooled gradually. Gelatin results From structural alterations in the gelling Agent, such as the creation of a polymer Network, that occurs during cooling.

Cooling Method Steps in the Gel Preparation :

Break down The Ingredients:

.To Guarantee full dissolving, combine the Gelling agent (such as agar, gelatin, or Carbomer) with the solvent (often water Or any other liquid) by heating it.

• Heat the Mixture: to activate the Gelling capabilities, heat the solution to A particular temperature that varies Based on the gelling ingredients.

• Cool the Solution: let the mixture cool To room temperature gradually. This Stage aids in the cell's structural .(26).

Sol-Gel Method :

To create the gel, the gelling agent And the other ingredients must be heated Until they dissolve or disperse evenly, and Then must be cooled.

Fusion Method Steps :

• Ingredient Mixing: To begin, we Dissolve these metal alkoxides in a

Liquid, typically alcohol or water. This Results in a solution known as a "sol." Imagine it as our cake's batter. 2

• Gel Formation: The molecules in the Sol begin to bind together through a Sequence of chemical events, creating a Network that holds the liquid in place. This process is known as "gelation," and The combination that is produced is Known as a "gel." Picture the batter Becoming a spongy mass.

• Drying and Shaping: After the gel has Been dried, the liquid is removed, Leaving a solid structure in its place. This solid can be formed into a variety Of shapes, including powders, fibers, And thin films. (27).

Evaluation of herbal gel:

Evaluation of the preparation of topical gels Is crucial to ensure their safety, efficacy, and Quality over time. Below is a structured Procedure for the evaluation of gel

Determination of PH:

The PH of the Formulation is measured by using a digital PH meter. The electrodes are completely Dipped into the gel. Each of the gel Formulations was tested.

Determination of Spreadability:

Two sets Of glass plates were taken which have aDimension of 20x20cm. Then 0.5gm of Avocado gel is placed. The gel was Sandwiched between the two slides after that Other slide was positioned on top of it. For Five to 5 minutes, a 125 g weight was Applied to the upper slides to evenly press The gel between the two slides into a thin Layer.

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Determination of Viscosity:

A Brookfield Viscometer DVII model was used to measure The gel's viscosity. The sample container was A 100ml beaker filled with 50g of gel. Making sure the T-bar spindle did not come Into contact with the beaker's bottom, it was Lowered perpendicular to the beaker's center. A few viscosity-affecting variables, such as Temperature, pressure, and sample size, were Kept constant throughout the procedure. A Speed of 200 rpm (rounds per minute) was Used to revolve the spindle.

Determination of Irritancy:

Apply a Certain quantity of the gel to a predetermined Spot on the skin to conduct an irritability Test. Observe any signs of irritation over a Period. It fails the test if irritation happens. If Not, the test is passed.

Determination of Sunscreen Activity:

A 20% w/v solution of the gels was prepared to Test the avocado gel's sunscreen properties, And a UV spectrophotometer was used to Quantify each gel formulation's absorbance. The absorbance was measured at different Wavelengths of 290nm, 330nm, 370nm, and 410nm.

Determination of Antibacterial Activity:

A Culture medium containing Staphylococcus Aureus bacteria and avocado oil extract was Used to test the antibacterial activity of Avocado oil. The prepared gel was examined For the desired effect by looking at the zone Of inhibition that formed around each Component following inoculation for 24 Hours at 37 degrees Celsius.

Determination of Clarity Test:

The Prepared formulations were evaluated by Visual inspection under a black background And graded as follows: +turbid, ++clear, +++very clear (glassy). The clarity of Prepared formulations was observed in the Results.

Extrudability Study of the Topical Gel:

The gel to be tested should be put into a collapsible tube made of plastic or metal. Collapsible tube made of plastic or metal. Make sure the tube is free of air bubbles.

Fill A collapsible tube with the gel to be tested. Check whether there are no air bubbles in The tube. To provide steady pressure, use a Plunger or set weights (such as 0.5 kg, 1 kg, Etc.) on top of the tube. If using a manual Approach, use your hands to evenly push the Tube. Measure the length of gel extruded in a Predetermined amount of time and weigh the Amount of gel that is removed from the tube In a predetermined amount of time (for Example, 30 seconds). To ensure Consistency, run the test three to five times, Then average the results. (28).

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