



FORMULATION OF INSECT REPELLENT GEL BY USING ESSENTIAL OIL: CITRONELLA OIL AND TEA TREE OIL

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ABSTRACT

Regeneration and tissue repair processes consist of a sequence of molecular and cellular events which occur after the onset of a tissue lesion to restore the damaged tissue. In this research work, we have to formulate an essential oil-containing gel. Essential oils have been used for centuries to treat various skin conditions due to their natural healing properties and they may offer natural remedies that can be used as an alternative to synthetic treatments. here, we are using citronella oil and tea tree oil for the preparation of the gel. Both oils have properties such as anti-inflammatory, antimicrobial, moisturizing, skin rejuvenation, pain relief, acne treatment, and antioxidant. The purpose of this work is to formulate and evaluate essential oils base gel which has to ability to heal the skin.

KEYWORDS: antimicrobial, moisturizing, skin rejuvenation, pain relief, acne treatment, and antioxidant.

1. INTRODUCTION

Essential oils (EOs) have been used for centuries to treat various skin conditions due to their natural healing properties.^[1] EOs have been used in the skin (cosmetics and skin care products) and have percutaneous absorption until the bloodstream. Numerous essential oils have anti-inflammatory properties that can help to reduce redness, itching, and inflammation associated with skin conditions such as eczema, psoriasis, and rosacea.^[2] Additionally, some essential oils may possess antimicrobial properties that aid in the battle against bacteria, viruses, and fungi that can cause skin infections. Some essential oils contain natural emollients that can help to moisturize the skin, which is essential for people with dry skin or conditions like dermatitis.^[3] Many oils are rich in antioxidants, which can help to protect the skin from environmental damage, and promote skin cell regeneration and repair. As an alternative to synthetic treatments, essential oils provide natural remedies.^[4] Because essential oils have no adverse side effects, many people prefer them to other medications. In this study, we prepare an essential oil-based gel using tea tree and citronella oil. Citronella oil is derived from the leaves and stems of a type of grass called *Cymbopogon nardus* or *Cymbopogon winterianus*. It is commonly known for its insect-repellent properties^[5], but it can also have natural antimicrobial properties that can help to fight off bacteria and fungi that can cause skin infections. It can

be effective against *Staphylococcus aureus*, a bacterium that is often responsible for causing skin infections.^[6] *Cymbopogon* essential oils and constituents present therein e.g. citral, geraniol, citronellol, citronellal, and piperitone, have been known to possess impressive antibacterial, antifungal, anti-yeast, insecticidal, and insect repellent activities for a long time.^[7] However, the biological and pharmacological significance of these essential oils has been rapidly expanded in the past ten years; anti-inflammatory, anticancer, allelopathic, free radical scavenging, and other useful biological activities have now been demonstrated. The outstanding biological activities of *Cymbopogon* essential oils and constituents allow for the treatment of a variety of illnesses, including cancer, as well as important industrial uses, such as food packaging.^[8] Additionally, citronella oil can aid in the pain relief of skin conditions like burns, cuts, and insect bites.^[9-11] Additionally, citronella oil has anti-inflammatory properties that can help to lessen the swelling and redness brought on by skin conditions like rosacea, eczema, and psoriasis.^[12-15] Citronella oil contains antioxidants that can help to protect the skin from environmental damage and promote skin cell regeneration and repair.^[16] Another essential oil such as tea tree oil (TTO) is a natural essential oil derived from the leaves of the tea tree plant, also known as *Melaleuca alternifolia*. The major constituents of commercial TTO are terpinen-4-ol, γ -terpinene, 1,8-cineole, α -terpinene,

α -terpineol, p-cymene, and α -pinene. Fresh TTO is weak to the moderate sensitizer, but oxidation increases its allergenic potency. The major sensitizers appear to be ascaridole, terpinolene, α -terpinene, 1,2,4-trihydroxymethane, α -phellandrene, and limonene. The clinical picture of allergic contact dermatitis caused by TTO depends on the products used.^[17] It has been used for centuries as a traditional medicine to treat various skin conditions due to its natural healing properties.^{[18][19]} Tea tree oil has strong antimicrobial properties that can help to fight off bacteria, viruses, and fungi that can cause skin infections, such as acne, ringworm, athlete's foot, and nail fungus.^[20] Tea tree oil has anti-inflammatory properties that can help to reduce redness, swelling, and inflammation associated with skin conditions like eczema and psoriasis.^[21] This oil may also be helpful to protect the skin from environmental damage and promote skin cell regeneration and repair.^[22] Tea tree oil is an effective treatment for acne due to its antimicrobial and anti-inflammatory properties.^[23] It can help to reduce the severity and frequency of acne breakouts. These two most applicable oils contain gel that can be used to soothe and heal the skin without any negative side effects.

2. Therapeutic Activity

2.1 Citronella Oil

Narayan et al., studied that citronella essential oil (CEO) has been reported as an excellent mosquito repellent; however, mild irritancy and rapid volatility limit its topical application. It was aimed to develop a nonirritant, stable, and consistent cream of CEO with improved residence time on the skin using an industrial approach. Phase inversion temperature technique was employed to prepare the cream. It was optimized and characterized based on sensorial evaluation, emulsification, and consistency in terms of softness, greasiness, stickiness, and pH.^[24]

Wathoni, et al., finding the combination of ylang and citronella oils on corn starch-based thixogel (F3) significantly improved repellent activity against *Aedes aegypti* compared to its single essential oils on corn starch-based thixogel (F1 and F2). These results suggest that cornstarch-based thixogel is a promising technology for the topical administration of essential oils as repellent agents, which are safe for humans, and domestic animals and environmentally friendly. synergistic repellent activity of the *Curcuma longa*, *Pogostemon heyneanus* and *Zanthoxylum limonella* essential oils might be useful for developing safer alternatives to synthetic repellents for personal protection against mosquitoes.^[25]

Willey et al., examine the active component of *Cymbopogon winterianus* (Java citronella) oil, as a green mosquito repellent, obtained through a steam distillation method. Java citronella oil, which contains citronellol, citronellal, and geraniol, was isolated by batch vacuum fractional distillation, and their effect was tested against the dengue fever (DF) vector, known as *Aedes aegypti*.

Furthermore, air freshener gels were formulated with Java citronella oil, carrageenan, gum, sodium benzoate, ethylene glycol, polysorbate 20, sodium chloride, and distilled water, at varying concentrations. The repellent activity of each active component was measured based on the period of protection conferred against the bites of *Aedes aegypti* within one hour, and the results showed geraniol and citronellol, with the respective activity of $78.00\% \pm 4.83$ and $77.34\% \pm 3.57$, as the most effective.^[26]

Santos et al., show essential oil of citronella (*C. nardus*) has efficient biofumigant activity against *C. maculatus* in stored cowpea grains. *C. nardus* shows repellent action to *C. maculatus* in stored cowpea grains. citronella oil at doses of 1.5×10^{-5} and 2.0×10^{-5} L resulted in higher insect mortality. France et al. (2012) found the insecticidal action of *C. nardus* oil on *Zabrotes subfascial* when using a dose of 0.5ml/kg in *Phaseolus vulgares* L. concluded that the essential oil of *C. citratus* showed a 90.6% reduction in oviposition, while, *C. nardus*, the reduction was 93.3%. The essential oil of citronella (*C. nardus*) exerts efficient biofumigant activity on *C. maculatus* in stored cowpea grains, as well as all concentrations evaluated in the free-choice test have repellent action on *C. maculatus*.^[27]

2.2 Tea Tree Oil

Arcella et al., Tea Tree oil (TTO), the essential oil from the Australian native *Melaleuca alternifolia* has demonstrated a variety of beneficial efficacies including antimicrobial, antifungal, antiviral, and anti-inflammatory. A growing body of scientific reports has recently focused on the potential of essential oils as an anticancer treatment in the attempt to overcome the development of multidrug resistance and important side effects associated with the antitumor drugs currently used.^[28]

Puvaca et al., Review the information on the antimicrobial, antioxidant, and acaricidal properties of tea tree (*Melaleuca alternifolia*) in poultry production. With minimal inhibitory concentrations ranging between 0.12 and 4 mg/ml, tea tree exhibits a broad spectrum of antimicrobial activities. Because of its constituents, including terpinen-4-ol, -terpineol, linalool, -pinene, -myrcene, and 1,8-cineole, tea tree has high antifungal, bacteriostatic, and germicidal activity (e.g., a decrease of 73.8 % in *Candida* sp.). When applied in concentrations of 100 and 200 l/ml, its bioactive compounds, such as terpinene, terpinolene, and terpinene, exhibit high antioxidant activity, while its essential oils exhibit a free radical scavenging activity of 60 to 80 %.^[29]

Malathi et al., find an antiprotozoal activity, as demonstrated by two distributions. The protozoa *Leishmania major* and *Trypanosoma brucei* each experienced a 50% reduction in development (compared to controls) when TTO has applied at convergences of 403 mg/ml and 0.5 mg/ml, respectively. Further

investigation revealed that terpinen-4-ol was primarily responsible for this movement. In a different experiment, TTO at 300 mg/ml destroyed *Trichomonas vaginalis* cells. Additionally, there is compelling *in vivo* evidence that TTO may be effective in treating *Trichomonas vaginalis* diseases.^[30]

Yasin et al., review that Australia has traditionally used TTO essential oil for its antimicrobial, anti-inflammatory, and anti-candidal properties. Terpinen-4-ol and 1,8-cineole are the two main antimicrobial agents found in tea tree oil, which is primarily derived from the *Melaleuca alternifolia* plant. The strong antifungal and antimicrobial properties of this oil have been used in toothpaste, creams, soaps, and other products. Its effects on several superficial infections, including tinea, acne, oral candidiasis, and cold sores, have also been studied. Additionally, *M. bracteates* oil exhibited antimicrobial properties. Using the Rideal Walker (RW) test, the first antimicrobial trial of tea tree oil was conducted on *Salmonella typhi* (previously known as *Bacillus typhous*).^[31]

2.3 Aloe Vera

Hagir et al., looked at the antimicrobial activity by using various extracts and minimum inhibitory concentration of aloe vera sap and leaves. Using the agar-well diffusion technique, the extracts of aloe vera sap and leaves were studied at various concentrations. Both varieties of the extract showed antimicrobial inhibitory effects that were strong, moderate, and weak. Against all test microorganisms, the sap extract was more effective than the leaves extract. The sap water extract (100 g/ml) demonstrated the highest mean diameter of the zone (MDIZ) against *Pseudomonas aeruginosa* and *Bacillus subtilis* (47 mm). Except for *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Staphylococcus aureus*, all test microorganisms (12–14 mm) were resistant to the lowest specimen's sap and leaf saponins (100 g/ml), which were present in the plant (0.0 mm). For nearly all the samples, the minimum inhibitory concentration (MIC) was 6.25 g/ml.^[32] *Maysaa et al.*, find a multi-drug resistant (MDR) *Staphylococcus aureus* specimen isolated from patients with skin infections in Baghdad that was examined for its antibacterial activity using an aloe vera essential oil

extract (0.8gm/100 ml). Due to the presence of anthraquinones, which aloe vera contains, aloe vera essential oil extract demonstrated pronounced antistaphylococcal activity (aloin 2.3%, iso barbaloin 36.1%, anthranol 42.6%, aloetic acid 16.8%, and aloemodin 2.1%). Aloe vera essential oil has an antibacterial effect against skin infections caused by *Staphylococcus aureus*, and it works better when combined with Clindamycin than it does when used separately.^[33]

Koratala et al., studied aloe gel acts like an antibiotic when compared to oral etiologic bacteria like gram-negative bacteria. Aloe vera has antimicrobial properties in addition to favorable interactions with dental cells, which make it a potential periodontal treatment. By inhibiting pancreatic alpha-amylase activity, aloe vera extracts controls the hyperglycemia state. Since ancient times, aloe vera extract has been used extensively due to its well-known anti-inflammatory, antiviral, and antimicrobial properties.^[34]

3. MATERIAL AND METHOD

3.1 Collection of essential oils

Citronella and tea tree oils are collected by a local market.

3.2 Preparation of essential oil-based gel

The following steps are followed for the preparation of gel.

- About 0.5 g of Carbopol was diluted in 30 ml of distilled water at 80°C.
- The mixture was stirred at 200 rpm for 5 minutes.
- The mixture of 2 drops of triethanolamine, 0.1 g Methylparaben, and 1 mL of glycerin diluted in 10 mL of Isopropyl alcohol 70% was prepared. The Carbopol and alcohol mixture was then homogenized.
- Add essential oils dropwise.
- Stirred at some 1 hour and get gel-based formulation.

The essential oil base gel was prepared by the formula given in table 1.

Table 1: Key Components and their activities.

Sr. No.	Active Ingredients	Activity	Quantity
1	Citronella oil (<i>Cymbopogon nardus</i>)	Insect repellent, Anti-fungal, Parasitic infection, wound healing, fight fatigue or lift mood (Aroma therapy).	1 ml
2	Tea tree oil (<i>Melaleuca alternifolia</i>)	Anti-bacterial, Anti-fungal, Anti-oxidant, Anti-inflammatory, Enhance healing.	1 ml
3	Aloe vera	Anti- Bacterial activity, Anti-Oxidant activity	0.5 gm
4	Carbopol	Act as a thickening agent.	0.5 gm
5	Triethanolamine	Act as an emulsifier agent and surfactant agent.	2 drops
6	Glycerin	Act as humectants.	1 ml
7	Methyl Paraben	Act as a preservative.	0.5 gm
8	IPA	Denaturation of proteins in the plasma membrane	20 ml
9	Water	As a Vehicle	Q.S.

4. RESULT AND DISCUSSION

3.1 Evaluation Parameter

To Check out the various parameters of essential oil base gel were evaluated by using Physicochemical appearance, pH, Stability study, and homogeneity. Table 2 Revealed the results of the evaluation parameters.

Table 2: Evaluation Parameters.

Sr. No.	In Vitro Parameters	Result
1.	Color	Colorless
2.	Order	Pleasant
3.	pH	5.1 to 6.5
4.	Stability Study	
	0° C	Viscous
	35° C	No Change
	45° C	Color Change
5.	Homogeneity	Uniform

5. CONCLUSION

Essential oils of *Cymbopogon* species that are diverse in chemical composition possess many important and potential bioactivities of great pharmaceutical and medicinal significance. Some of the novel bioactivities of *Cymbopogon* essential oils and constituents include anti-inflammatory, anti-cancer, anti-oxidant, and insect repellency. In addition, they have several other activities of ecological and industrial significance. The second most usable and biologically applicable oil is tea tree oil (TTO) is also known as a potent essential oil for its basketful application such as anti-microbial, anti-inflammatory, anti-acne, and many more. At present, the focus of recent research laboratories is to formulate essential oil-based gel which having multiple bioactivities in a single formulation. and it is evaluated by various parameters such as pH, stability, and physical appearance.

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