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Extraction of Ocimum Basilicum and Its Application in Synthesis of Transdermal Patches for Medical Applications

[*]Ms. Akshaya A, [1]Sivapriya S, [2]Praneesh S
Assistant Professor, Sri Shakthi Institute of Engineering and Technology,Coimbatore-62, akshayabt@siet.ac.in
Sri Shakthi Institute of Engineering and Technology, Coimbatore.
Corresponding Author: Ms. Akshaya A

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ABSTRACT
This invention relates to the extraction of bioactive compounds from Ocimum basilicum for transdermal patch development in medical applications. The method utilizes efficient techniques for isolating therapeutic constituents, including essential oils and flavonoids. These compounds are formulated into a patch matrix that ensures controlled transdermal release. The patches present a non-invasive alternative to traditional drug delivery, enhancing patient compliance while reducing gastrointestinal side effects. They are engineered to maintain the stability and efficacy of active ingredients, facilitating effective therapeutic delivery. This invention encompasses the techniques for extraction, formulation processes, and evaluation methods for these patches. The primary objectives include enhancing the therapeutic potential of Ocimum basilicum, ensuring formulation safety, and providing effective treatments for conditions like pain and inflammation. The significance of this invention lies in its ability to integrate natural extracts into modern medicine, offering a sustainable and patient-centric drug delivery method. By utilizing the medicinal attributes of Ocimum basilicum, this invention aims to develop a versatile and effective transdermal delivery system for diverse therapeutic purposes.

KEYWORD: Ocimum basilicum, Bioactive compounds, Drug delivery, Transdermal patches, flavonoids, phytochemical, therapeutic properties, non- invasive.

I. INTRODUCTION

Ocimum basilicum commonly known as basil, is a plant with a rich history of use in both culinary and medicinal contexts. Its essential oils have garnered significant attention due to their diverse range of therapeutic properties, including antibacterial, antifungal, antioxidant, and anti-inflammatory activities. The primary bioactive constituents of basil, such as linalool, eugenol, and methyl chavicol, have been extensively studied and shown to possess numerous health benefits. This has led to an increasing interest in utilizing these natural compounds in advanced medical applications, particularly in the field of transdermal drug delivery systems.

Transdermal patches provide a non-invasive and effective method for administering drugs through the skin. This delivery route offers several advantages over traditional oral and injectable methods, including sustained and controlled release of medication, improved patient compliance, and a reduction in systemic side effects. By incorporating Ocimum basilicum essential oils into transdermal patches, it is possible to enhance their therapeutic efficacy through the inclusion of natural bioactive compounds.

The process of extracting essential oils from Ocimum basilicum can be carried out using a variety of methods, each with distinct benefits and limitations. The Soxhlet extraction method is a technique used to extract bioactive compounds from plant materials. It involves repeatedly washing the solid material with a solvent in a specialized apparatus, allowing for efficient extraction of the desired components. This method is widely used due to its ability to maximize yield and purity of the extracted compounds, making it ideal for isolating essential oils and other valuable substances from plants. Steam distillation is the most commonly used technique, wherein steam is passed through the plant material to vaporize the volatile compounds, which are then condensed back into liquid form and collected. This method is effective in producing high-quality essential oils but requires careful control of temperature and pressure to prevent degradation of the bioactive compounds. Solvent extraction involves using solvents like petroleum ether to dissolve the essential oils from the plant material, followed by evaporation of the solvent to leave behind the concentrated oil. This method can yield a higher quantity of oil compared to steam distillation, but there is a risk of residual solvents in the final product. A solvent to extract the essential oils, resulting in pure, high-quality oils without solvent residues. However, this method requires specialized equipment and is more expensive than other extraction techniques.

The formulation of transdermal patches incorporating Ocimum basilicum essential oils involves several critical steps to ensure their stability, efficacy, and controlled release of active ingredients. The selection of polymers is a fundamental aspect, as the polymer matrix forms the backbone of the transdermal patch and must be biocompatible, flexible, and capable of controlling the release rate of the essential oils. The extracted essential oils are then incorporated into the polymer matrix by dissolving them in a suitable solvent along with the polymer solution and casting the mixture onto a substrate to form a thin film.

The integration of Ocimum basilicum essential oils into transdermal patches presents a promising approach in the development of innovative therapeutic options. By harnessing the natural therapeutic properties of basil, these patches can provide effective treatment for a range of medical conditions while minimizing systemic side effects.

Ocimum basilicum plant:

Ocimum basilicum, commonly known as basil, is a highly aromatic herb belonging to the Lamiaceae family. Basil is an annual or sometimes perennial herb, depending on the climate. Originating from tropical regions in central Africa and Southeast Asia, basil has spread globally and is now a staple in culinary, medicinal, and ornamental applications. It is particularly well-known for its essential oils, which are rich in bioactive compounds. The plant produces small white to purplish flowers arranged in terminal spikes. Basil thrives in warm, sunny environments and well-drained soil, making it a common herb in home gardens and commercial farms. Basil is relatively easy to grow, making it a popular choice for home gardeners. It prefers warm climates with plenty of sunlight and well-drained soil. Basil can be propagated from seeds or cuttings. Regular pruning encourages bushier growth and prolongs the life of the plant. Harvesting should be done before the plant flowers to ensure the best flavor and highest concentration of essential oils.

Pimple:

Acne, a common dermatological issue, is characterized by inflamed or infected sebaceous glands, often resulting in pimples. Traditional treatments, while effective, can have adverse side effects and may lead to antibiotic resistance. This necessitates the exploration of alternative therapies. Transdermal patches have emerged as a promising delivery system for skin treatments. These patches offer controlled and sustained release of active ingredients directly to the affected area, improving efficacy and minimizing systemic side effects.

Wound healing property:

Wound healing is a complex process involving various stages: haemostasis, inflammation, proliferation, and remodelling. Effective wound care is crucial for preventing infections, reducing inflammation, and promoting tissue regeneration. Traditional wound treatments often involve topical antibiotics and antiseptics, which can have side effects and contribute to antibiotic resistance. This has led to the exploration of alternative therapies, including the use of natural products.

Transdermal patches have emerged as an innovative and effective method for delivering therapeutic agents directly to the wound site. These patches offer controlled and sustained release of active ingredients, improving the healing process and minimizing systemic side effects. Incorporating Ocimum basilicum essential oils into transdermal patches can enhance wound healing due to the natural antimicrobial and anti-inflammatory properties of basil.

Transdermal patches:

Transdermal patches are a sophisticated method of drug delivery designed to administer medication through the skin directly into the bloodstream. This non-invasive approach provides several advantages over traditional oral or injectable routes, including controlled and sustained release of drugs, improved patient compliance, and reduced systemic side effects.

Transdermal patches work by adhering to the skin and gradually releasing the active pharmaceutical ingredient (API) over time. The drug diffuses through the skin's outer layer, the stratum corneum, and enters the dermis, from where it is absorbed into the bloodstream. This controlled release mechanism ensures a steady plasma concentration of the medication, enhancing therapeutic efficacy and minimizing peak-trough fluctuations. The component present in transdermal patches is backing Layer which Protects the patch from the external environment and prevents drug loss. Drug Reservoir contains the API, which can be dispersed in a matrix or held in a separate compartment. Release Liner a peel-off layer that protects the drug during storage and is removed before application. Adhesive Layer ensures the patch adheres to the skin and can also contain the drug in some designs. Rate-Control membrane regulates the release rate of the drug into the skin.

II. MATERIALS AND METHODOLOGY

Materials and Methodology for Ocimum bacilicum plant extract:

Materials:

The fresh Ocimum Basilicum leaves were collected in the district of Tiruvarur, Tamil Nadu.
The selection of the organic solvent is critical and may include petroleum ether. The choice often depends on the specific nature of the extract desired for subsequent analysis

Procedure:

Ocimum basilicum leaves:

The basil leaves have not been previously dried, it is essential to undertake the drying process to remove moisture, which could adversely affect the extraction yield. Subsequently, the dried leaves must be ground into a fine powder, thus markedly increasing the surface area which is available for interaction with the solvent during the extraction phase. (Camlica, et al.,(2019))

Fig 1 Dryed ocimum Basilicum Levaes

Loading the Soxhlet Apparatus:

The finely powdered basil leaves are to be carefully placed into a thimble that is fabricated from filter paper, designed specifically for optimal fluid flow. This thimble is then inserted into the chamber of the Soxhlet extractor, ensuring that it is securely positioned for theextraction process.

Setting Up the Apparatus:

An appropriate volume of organic solvent, typically ranging from two to three times the volume of the plant material, should be introduced into the round-bottom flask to facilitate adequate extraction.
The Soxhlet extractor chamber must be meticulously connected to the round-bottom flask, followed by the attachment of the condenser atop the Soxhlet chamber to complete the apparatus setup. The entire apparatus is then positioned on a heating mantle or within a controlled water bath to maintain the necessary temperature throughout the extraction process.

Extraction Process:

The solvent within the round-bottom flask is heated to its boiling point, leading to vaporization the resultant vapor ascends into the condenser, where it is cooled and subsequently condenses back into a liquid state. (Dasgupta, T et al., (2015)).

This condensed liquid solvent then drips into the Soxhlet chamber, which contains the powdered basil, allowing for the extraction of bioactive compounds.

The liquid solvent accumulates in the Soxhlet chamber until it reaches the siphon arm, at which juncture it siphons back into the round-bottom flask, effectively carrying with it the extracted compounds from the basil leaves.

This cyclical extraction process continues over several hours, typically lasting between six to eight hours, or until the solvent in the siphon appears clear, signifying that the extraction of active compounds has ceased.

Fig 2 Soxhlet process for plant extraction

Recovery of the Extract:

Upon the completion of the extraction process, it is essential to allow the apparatus to cool to prevent any thermal damage or loss of extracted compounds. The round-bottom flask is then removed from the apparatus, and the solvent is subsequently evaporated using a rotary evaporator or through simple distillation techniques, thereby concentrating the extract.

The residue that remains in the flask after solvent removal constitutes the concentrated extract of Ocimum basilicum, rich in essential oils and other bioactive components. The resultant extract may undergo additional purification, thorough analysis, appropriate storage measures to preserve its integrity.

Materials and Methodology for chitosan:
Materials:

Chitosan powder: Commercially available. Acetic acid: Typically, 1-2% acetic acid solution.

Procedure:
Dissolving Chitosan:

Begin by accurately weighing a predetermined quantity of chitosan powder, which is typically within the range of 1-3% (w/v), with the exact concentration being contingent upon the specific viscosity characteristics desired for the final solution. Gradually incorporate the chitosan powder into a 1-2% acetic acid solution, all the while ensuring that continuous stirring is maintained to effectively avert any potential clumping or aggregation of the powder particles. Employ a magnetic stirrer or a mechanical stirrer to agitate the mixture for an extended duration, which usually spans several hours typically between 4 to 6 hours until such a time that the chitosan is fully dissolved and a clear, homogeneous solution is achieved, thereby ensuring the absence of any undissolved particles.

Fig 3 Chitosan Powder Fig 4 Magnetic Stirrer

Casting the Chitosan Solution:

Proceed to pour the meticulously prepared chitosan solution into appropriately designed molds or trays, thereby creating the specific shape and thickness that are intended for the final product. It is imperative to ensure that the chitosan solution is evenly distributed throughout the molds to facilitate uniform drying and solidification in subsequent steps.

Pre-freezing:

Carefully position the molds that contain the chitosan solution into a freezer set at a low temperature, typically at or below -20°C, and maintain this condition until the solution reaches a fully frozen state. This particular step is of paramount importance as it guarantees that the solution solidifies uniformly prior to the freeze-drying process. The duration of the freezing process generally spans several hours or may extend overnight, contingent upon the dimensions and thickness of the molds utilized in the process.

Freeze-Drying (Lyophilization):

Once the chitosan molds have been adequately frozen, transfer them to the freeze dryer, which is a specialized apparatus designed for this purpose. Adjust the freeze dryer settings to align with the appropriate operational parameters, which typically include a condenser temperature ranging from -50°C to -80°C and maintaining a vacuum pressure that is less than
0.1 mbar.

Primary Drying (Sublimation):

During this critical phase of the freeze-drying process, the freeze dryer will initiate the removal of the frozen solvent, specifically the water, by employing sublimation, a process that allows the solid ice to transition directly into vapor without undergoing a liquid phase. This primary drying phase can take several hours to a full day, depending on the size and thickness of the chitosan samples.

Secondary Drying (Desorption):

Following the completion of the sublimation phase, it is essential to gradually increase the temperature within the freeze dryer in order to effectively eliminate any residual water molecules that may be bound to the chitosan matrix, thus contributing to the overall stability of the final product.

This secondary drying phase may last for several hours, with the final temperature potentially reaching room temperature or slightly elevated levels, generally between 20-30°C to ensure complete drying.

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Completion:

Upon the successful conclusion of the freeze-drying process, it is crucial to proceed with caution while removing the chitosan product from the freeze dryer to avoid any potential damage to the now dried sample.

Storage:

Finally, it is important to store the freeze-dried chitosan product in a dry and cool environment, ideally within sealed, sterile packaging, to effectively prevent moisture absorption and subsequent contamination, thereby ensuring the longevity and integrity of the product.

III. RESULT AND DISSUSSION

The process involving the extraction of the aromatic herb Ocimum basilicum, commonly known as basil, was meticulously carried out utilizing petroleum ether as the solvent through the application of the Soxhlet extraction method, which is a well-established laboratory technique designed to efficiently extract compounds from solid materials through the continuous cycling of the solvent, thereby ensuring that the maximum yield of phytochemicals is obtained from the plant's cellular structure.

Fig 5 Plant Extract

The transdermal patches were meticulously fabricated utilizing chitosan as the primary biopolymer, employing an innovative freeze-drying process that not only enhances the stability and efficacy of the patches but also ensures the uniform distribution of the active pharmaceutical ingredients within the polymeric matrix, thereby facilitating optimal drug delivery through the skin barrier.

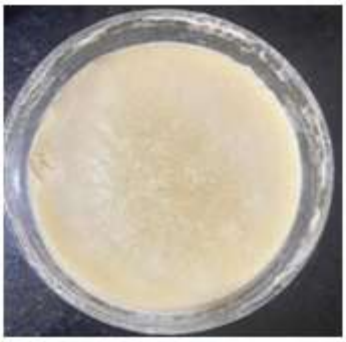

Fig 6 Chitosan Bandage

The extract was successfully incorporated into the chitosan matrix using a solvent casting method, which ensured uniform distribution of the extract throughout the bandage. The resulting in antimicrobial activity.This antimicrobial effect can be attributed to the phenolic compounds in the basil extract, which will to disrupt microbial cell membranes and inhibit bacterial growth.

The results suggest that the incorporation of Ocimum basilicum extract into chitosan bandages not only enhances their antimicrobial properties but also promotes faster wound healing, making them promising candidates for medical applications in wound care without any observed side effects or toxicity.

Phytochemical Analysis:

Phytochemical class	**Test Method**	**Result**	**Componds Present**	**Properties**
Carbohydrate	Molish's Test	Positive	Polysaccharide, Simple sugar	Energy source, Bioactivityenhancer
	Benedict's Test	Positive	Reducing sugar	Antioxidant,Cellular metabolism
Flavonoids	Alkaline Reagent Test	Positive	Flavonoids	Anti- inflammatory, Antioxidant
Glycosides	Keller-Killani	Positive	Cardiac	Cardiotonic,

	Test		Glycosides	Antimicrobial
Steroids	Salkowski'sTest	Positive	Sterols	Anti- inflammatory, Cell membrane stabilization
Terpenoids	Copper Acetate Test	Positive	Terpenoids	Antimicrobial, Antifungal

Table 1 Phytochemical Analysis

IV. DISSUSSION AND CONCLUSION

The extraction process utilized petroleum ether, which successfully isolated non-polar bioactive compounds, primarily essential oils, terpenoids, and sterols. Phytochemical analysis revealed the presence of key compounds such as linalool, methyl chavicol, and eugenol, known for their antimicrobial and anti-inflammatory properties. These compounds' identification was crucial as they align with the therapeutic goals of creating patches for wound care and inflammation management.

The implications of this project extend beyond immediate medical applications. It suggests a sustainable approach to utilizing natural products in drug delivery systems, promoting a shift toward herbal medicines in modern therapeutic practices. The growing interest in phytopharmaceuticals emphasizes the need for rigorous scientific validation of traditional remedies. This project successfully bridges the gap between traditional knowledge and modern science, highlighting Ocimum basilicum's role in developing effective transdermaldrug delivery systems.

Future directions for research could include optimizing the extraction process to enhance yield and bioactivity, conducting in vivo studies to confirm efficacy, and exploring the potential of other plant extracts in similar formulations. Investigating the interaction between different bioactive compounds within the patches may also provide insights into synergistic effects that enhance therapeutic outcomes.

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