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UNIVERSITI
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MARA



PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIIICaS 2024)



*"Flourish and Nurturing Sustainable
Innovation for a Prosperous Nation"*

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector



Assalamualaikum warahmatullahi Wabarakatuh,
Salam Sejahtera, Salam Malaysia MADANI and
Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most
Merciful.

It is a great honor to welcome you to the Johor
International Innovation, Invention, Competition, and
Symposium 2024 (JIIICaS 2024). This event

connects various disciplines, focusing on education and engaging educators,
students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and
determination to turn those ideas into reality. The remarkable projects
showcased today highlight the dedication and spirit of all participants.
Initiatives like this not only explore new technologies but also cultivate skills
and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor
Branch, we are fully committed to fostering a dynamic culture of innovation,
promoting the commercialization of new products, and encouraging
meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all
sponsors, judges, the College of Computing, Informatics and Mathematics,
UiTM Pasir Gudang Campus as the event organizer, as well as to the
researchers and participants for their hard work in making this event a
success. Let us continue striving for innovation and excellence. May the
ideas presented today inspire us and lay the groundwork for future
achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-PP015) ELECTROSPUN ANTI-INFLAMMATORY PATCH LOADED WITH CITRUS LIMON (L.) EXTRACTS INCORPORATED WITH DIMETHYL SULFOXIDE (DMSO) FOR ACCELERATING WOUND HEALING

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ABSTRACT

The four consecutive phases of haemostasis, inflammation, proliferation, and remodelling comprise the normal natural wound healing process. The proper sequence and duration of these phases are essential for effective healing. On the contrary, endotoxins and bacterial infections can prolong the inflammatory phase by elevating pro-inflammatory cytokines, including TNF- α and interleukin-1 (IL-1). Should this extension continue, there is a chance the wound will become chronic and never heal. Numerous studies are being carried out to expedite the wound healing process for endotoxins and bacterial infections. However, factors like bacterial resistance to antibiotics and their narrow spectrum have made it more difficult to treat patients accurately. Therefore, it is advised to choose an approach that combines antibacterial and anti-inflammatory qualities for wound healing. This study aims to provide susceptibility to the bacteria and broaden the spectrum of antibiotics for various bacteria to address these issues. To address these challenges, this study proposes an electrospun anti-inflammatory patch loaded with Citrus limon (L.) extract incorporated with Dimethyl Sulfoxide (DMSO) for accelerating the wound healing process. Two different solvents (i.e., 70% ethanol and 10% DMSO) will be loaded onto the extracted citrus limon to generate the electrospun anti-inflammatory patch. DMSO is added as a carrier when ethanol is used as the solvent to improve Citrus limon's ability to permeate into the bacterial cell membrane. This patch has strong anti-inflammatory qualities and shows promise as a successful way to treat bacterial infections. This patch also has antioxidants, which can help shield body cells from harm. The effective development of the patch on eliminating germs and speed up wound healing, it will solve many chronic diseases linked to bacterial infections and improve wound healing, enabling us to treat wounds as soon as possible at our convenience.

Keywords: Wound Healing, Bacterial infection, Citrus limon, Electrospun anti-inflammatory patch, DMSO.

1.0 INTRODUCTION

The 20th century shows significant medical discoveries, including antibiotics, which reduced morbidity and death in bacteria-related infections. The "Golden Era of Antibiotics" occurred in the mid-19th century, with the emergence of antibiotic-resistant strains. However, antibiotic resistance has spread uncontrollably due to excessive use and improper utilization, exacerbated by clinicians prescribing antibiotics excessively and the industry's widespread use, including livestock breeding and cultivation industries (Baran et al., 2023). Dr Tedros Adhanom Ghebreyesus warns of the global rise of antibiotic-resistant bacteria, posing a threat to healthcare advancements and equitable development (Sarkar et al., 2021). Projections suggest most bacteria will become resistant within 25 years, with antimicrobial resistance-related mortality potentially causing a million annual fatalities (Kaur Sodhi and Singh, 2022; Murray et al., 2022; Halawa et al., 2023).

It is believed that in heavily colonised and infected wounds, bacterial toxins contribute to the delayed healing process. Endotoxins, which are discharged from Gram-negative bacteria either through the lysis of the bacteria by human phagocytes during a defence response or by antimicrobial drugs, can impact every facet of the wound's recovery, resulting in postponed healing and exacerbating the chronicity of the wound (Rippon et al., 2022). Clinical investigation has revealed that endotoxins in the wound area can trigger the synthesis of inflammatory agents including TNF-alpha and interleukins, which in turn can trigger the synthesis of endogenous matrix metalloproteases (MMPs). Many forms of nonhealing wounds are known to have elevated MMP levels, which are thought to play a role in the local degradation of growth factors, receptors, and tissue constituents (Landén et al., 2016).

The idea in combining antimicrobials and anti-inflammatory medications has attracted a lot of attention lately as a way to accelerate wound healing (García-Salinas et al., 2020). Lemons (*Citrus limon*) are significant flavonoid and phenolic acid-rich plants that are also environmentally sustainable (Farhat et al., 2024). Because of its wide-spectrum antibiotic properties and multitarget bactericidal effects, limonene, another compound found in citrus limon, is a viable antimicrobial against multidrug-resistant pathogens (Chen et al., 2024). In a recent study, researchers discovered that limonene significantly improved pulmonary function and anti-inflammatory effects in mice with acute lung damage caused by lipopolysaccharide. This was due to its ability to inhibit signal pathways like ERK, MAK, NF- κ B, and C-Jun N-terminal kinase (Chen et al., 2024).

The solubility and pharmacological formulations of lemon's natural components have revealed several limitations, nevertheless (García-Salinas et al., 2020). Different delivery methods have been created to get over these obstacles and produce improved solubility and efficacy while keeping effective oversight and discharge (Justo et al., 2015). Therefore, in these studies, there has been investigation into the potential of electrospun patches containing antibacterial and anti-inflammatory medications as a means of creating medical dressings that improve wound healing. In order to lower inflammation during wound healing, a polycaprolactone (PCL) electrospun nanofibrous patch loaded with Citrus limon (L.) extract incorporated with Dimethyl Sulfoxide (DMSO) is proposed to overcome this situation. According to Lima de Souza et al. (2019), PCL is a nontoxic and bioresorbable polymer that has received FDA approval

for utilisation in several healthcare equipment and medication delivery devices. Hence, utilizing this patch associated with an antibacterial component is a significant approach to the medical field.

2.0 OBJECTIVE

In order to speed up the healing of wounds and any bacterial infections, primarily from *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, this study aims to develop a polycaprolactone (PCL) electrospun nanofibrous patch loaded with *Citrus limon* (L.) extract incorporated with Dimethyl Sulfoxide (DMSO). These pathogens are frequently the ones that colonise the surface of long-term wounds and slow down the healing process.

3.0 METHODOLOGY

3.1 Lemon Extract Preparation

Following the washing process, the lemon peels were separated and dried in an oven at 55°C. The lemon juice was then extracted using a lemon squeezer. With the aid of a blender, the lemon peel will be finely crushed into a coarse powder once it has fully dried. Juice and peel powder samples will be extracted using two distinct solvents. 70% ethanol and 10% DMSO are used as the solvents (50gm powder combined with 500ml ethanol/DMSO for peel extract and 50ml juice in 450ml ethanol/DMSO for juice extract, respectively). The mixture will be continuously stirred in the incubator for 72 hours at 30°C. followed by filtration with Whatman No. 1 filter sheets. After that, the filtrate was centrifuged for 15 minutes at 4000 rpm. After that, the mixture was evaporated at 50 degrees Celsius until a sticky mass was formed. This mass was weighed and then dissolved in an aliquot of 10.0 millilitres of 10% v/v dimethyl sulfoxide (DMSO). Before being used again, the substance will be kept at 4°C.

3.2 PCL Patch Preparation

A PCL solution will be prepared using a dichloromethane (DCM): dimethylformamide (DMF) mixture and lemon extracts. A Yflow 2.2 D500 electrospinner will be used to create patches with a single lemon extract. The process will be carried out at room temperature with a relative humidity of 30-50%, with a flow rate of 1.0 mL/h and a distance of 18 cm between needle tips. Figure 1 illustrate the experimental procedure in preparing the PCL Patch material.

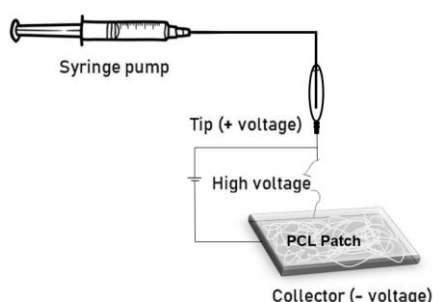


Figure 1 Preparation of the PCL Patch material

4.0 Expected Result

The patch will reduce inflammation, especially for wounds and inflammatory conditions. Its organic antibacterial component reduces bacterial infections and provide protection to the wound. This makes the patch adaptable, promotes faster healing, and minimizes pain or discomfort. Its antibacterial properties also improve cleanliness. Electrospinning polymer fibers allow for extended release of anti-inflammatory and antibacterial materials, providing long-lasting effects compared to single dosage treatments. These patches are biocompatible, making them suitable for direct contact with tissues. When used with therapeutic agents, they blend into the body, reducing side effects from oral or intramuscular administration.

5.0 CONCLUSION

Using an electrospun anti-inflammatory patch can help hasten the healing process of wounds and stop the spread of germs. Nonetheless, a PCL electrospun nanofibrous patch made of different materials may have distinct effects on gram positive and negative bacteria. Development of this patch is targeting to have a broad-spectrum protection against different types of bacteria.

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