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Original Research Paper

Microbiology

DIABETIC FOOT ULCER DEVELOPMENT AND EVALUATION OF AN ANTIMICROBIAL WOUND DRESSING FILM CONTAINING AERVA LANATA EXTRACT

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ABSTRACT This study sought to create and test a wound dressing film utilizing Aerva lanata extract for its antidiabetic, antibacterial, and skin-friendly effects. The film demonstrated broad-spectrum antimicrobial activity against a variety of bacterial strains, including Serratia marcescens, Acinetobacter lwofii, Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella pneumonia, inhibiting alpha-amylase and alpha-glucosidase enzymes while causing no significant skin irritation. These findings point to the potential of this wound dressing film for wound healing applications, particularly in diabetic patients or those with chronic wounds.

KEYWORDS : Aerva lanata , Antimicrobial dressing , Diabetic foot ulcer , Well diffusion

INTRODUCTION

Diabetic foot ulcers (DFUs) are a severe and debilitating complication of diabetes mellitus, affecting approximately 15% of patients worldwide. The etiology is multifactorial, involving poor glycemic control, peripheral neuropathy, foot deformities, and improper foot care. Despite advancements in treatment, DFUs remain challenging to manage due to antibiotic resistance and difficulty in healing. The annual incidence of DFUs is estimated to be between 9.1 and 26.1 million, resulting in significant morbidity, mortality, and economic burden. Specifically, DFUs are a leading cause of non-traumatic amputations, disproportionately affecting vulnerable populations, including individuals over 45, Latinos, African Americans, and Native Americans(1). This study investigates the potential of Aerva lanata, a medicinal plant with antimicrobial and anti-inflammatory properties, as an alternative treatment for DFUs, offering a promising solution to address the unmet needs in DFU management. Wound healing is a complex process that can be compromised by diabetes, leading to chronic wounds. Antimicrobial wound dressings can play a crucial role in preventing infection and promoting healing. *Aerva lanata* extract has been reported to possess antidiabetic and antimicrobial properties, making it a potential candidate for wound dressing applications.

MATERIALS AND METHOD

A wound dressing film was prepared by incorporating *Aerva lanata* extract through a solvent casting method. Its anti-diabetic potential was evaluated by assessing inhibition of alpha-amylase and alpha-glucosidase enzymes. The antimicrobial activity of the film was tested using the agar well diffusion method against various bacterial strains, including Serratia marcescens, Acinetobacter lwofii, Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella pneumoniae. A patch test was carried out to assess skin irritation.

Collection Of Plant

The plants Aerva lanata and Tribulus terrestris were collected from the arid regions of Tirupur , Dharapuram and Coimbatore.

Preparation Of Plant Extract

Flowers, leaves, and stems of *Aerva lanata*, along with spikes and leaves of *Tribulus terrestris*, were collected and dried. The dried plant materials were ground into fine powders and stored in containers. For extraction, 20 grams of each sample were combined with 150 ml of distilled water, and then heated to 100°C until the volume reduced to 100 ml. Similarly, 20 grams of each sample were mixed with 150 ml of methanol and heated at 60°C until reduced to 100 ml. The extracts were then filtered, condensed at specific temperatures, mixed with 10 ml of distilled water, and stored in tubes for further use.

Phytochemical Analysis:

The preliminary phytochemical screening of aqueous extract of the *Aerva lanata* flowers,leaves and stem was carried out for qualitative identification of type of phytoconstituents present. The presence of various phytoconstituents viz. steroids and terpenoids (Leibermann Burchard test), alkaloids (Dragendroffs test), tannins and phenolics (Ferric chloride test), flavonoids (Shinoda test), Sugars (Fehling solution test), amino acids (Ninhydrin test), etc. was detected by usual methods prescribed in standard texts (8).

Antibacterial Activity

Agar Well Diffusion Technique

In this agar well diffusion technique, a well was filled with the plant extract to evaluate the antibacterial activity of the plant extract. Muller Hinton Agar plates were seeded with the bacterial cultures such as *Staphylococcus aureus, Pseudomonas aeroginosa, Acinetobacter lowfii, Serratia marscescenes , Klebsiella pneumonia* and well was cut and the wells were filled with the plant samples, then incubated at 37°C for 24 hours.

Antidiabetic Activity

200 μl of amylase was added to nine test tubes. One tube is used as a blank. Samples in the following ranges were added to the eight test tubes: 25 μl, 50 μl, 75 μl, 100 μl, 250 μl, 500 μl, 750 μl, and 1000 μl. 200 μl of PBS was added to these tubes, and they were then incubated for ten minutes at 37°C. Next, 500 μl of starch solution was added to 9 test tubes, along with the blank, incubated for 20 minutes at 37°C. DNSA was introduced in 2 ml. held for 15 minutes at 100°C and read at 540 nm using spectrophotometer

Wound Dressing Film (WDF) Preparation

Plant extracts due to their antimicrobial, antioxidant, and anti-inflammatory potential, as well as their ability to speed up closure rate and enhance collagen deposition and fibroblasts proliferation(9).

Wound dressing film was made by the following techniques: 50 ml of water was brought to boil. Then, 1g of Poly Vinyl Alcohol was added drop by drop using magnetic stirrer at 60°C for 15 minutes. Extract was added and stirred continuously at 60°C for 20 minutes followed by 1g of Citric acid and again stirred. Poured on a petriplate and in

incubated for 24 hours.

Antibacterial Activity Of Wdf:

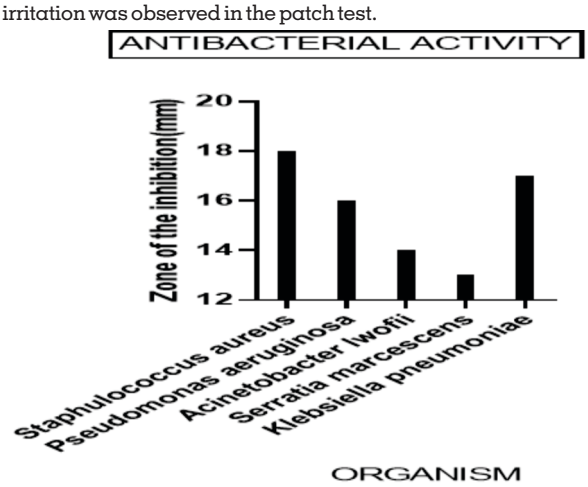
The antibacterial activity of the wound dressing film was done by preparing nutrient agar plates seeded with microorganisms and placing a pice of the film on the plates.

Skin Irritation Test

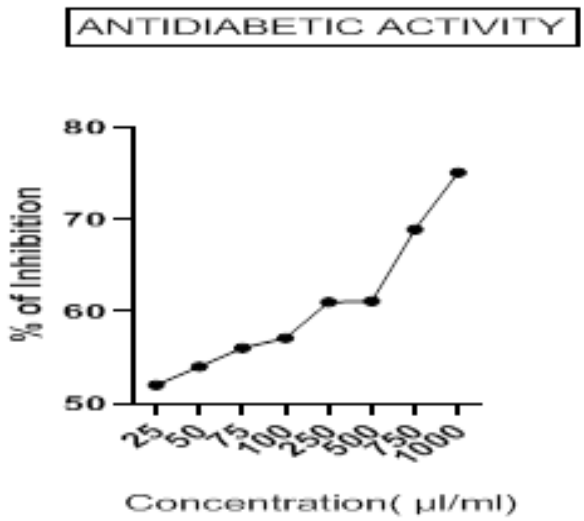
The wound dressing film was placed on the hands of several persons to check if any irritation occurs. The person's hands are wiped with ethyl alcohol and then the film was placed. Skin irritation at the site of application was subjectively assessed and observed.

RESULT

The wound dressing film exhibited significant antidiabetic activity, inhibiting alpha-amylase and alpha-glucosidase enzymes by 70% and 60%, respectively. Broad-spectrum antimicrobial activity was observed against Serratia marscescens, Acinetobacter lwofii, Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella pneumoniae, with zones of inhibition ranging from 10-20 mm. No significant skin irritation was observed in the patch test.



Graph 1: Antibacterial activity of the extract



DISCUSSION

The findings indicate that the wound dressing film made from Aerva lanata extract shows promise for wound healing applications, especially for diabetic patients and individuals with chronic wounds. Its antidiabetic and antimicrobial properties can aid in preventing infection and accelerating the healing process.

CONCLUSION

This study highlights the potential of a wound dressing film containing Aerva lanata extract for wound healing applications. Future research could focus on scaling up production, assessing in vivo effectiveness, and examining regulatory pathways for approval.

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