

ABSTRACT

Diabetes mellitus is a chronic metabolic disorder affecting millions of people worldwide. One of the most serious complications associated with this disease is the development of diabetic wounds, particularly foot ulcers. These wounds pose a major challenge to healthcare providers due to their slow healing process, which is further exacerbated by the patient's compromised immune system and the increased risk of infection. In diabetic patients, high blood sugar levels cause a variety of physiological disruptions, including impaired blood circulation, reduced immune response, and delayed wound healing. Consequently, diabetic wounds can become chronic, leading to severe infections, gangrene, and even amputations if left untreated. The growing prevalence of diabetes and its associated complications calls for novel therapeutic interventions that can accelerate wound healing and reduce the risk of infections. In this context, traditional medicine systems, such as Ayurveda, offer a rich source of potential remedies for diabetic wounds. Ayurvedic medicine is based on the use of natural herbs and plant-based compounds, many of which have been used for centuries to treat wounds and skin infections. This research is centered on the development and evaluation of a polyherbal Ayurvedic formulation aimed at addressing the issue of diabetic wounds. The formulation utilizes sesame oil as a base and incorporates extracts from four key medicinal plants: *Securinega leucopyrus* (Katupila), *Azadirachta indica* (Neem or Limdo), *Acacia catechu* (Khadir), and *Vitex negundo* (Nirgundi). These plants have been selected based on their known therapeutic properties, which include anti-inflammatory, antimicrobial, and wound-healing activities. The primary objective of this research is to develop a **topical polyherbal formulation** using Ayurvedic principles to treat diabetic wounds. The formulation blends extracts from **Katupila, Neem, Khadir, and Nirgundi** in sesame oil. Sesame oil is traditionally used in Ayurveda due to its ability to penetrate deep into the skin and its own wound-healing properties. The research seeks to evaluate the formulation's phytochemical composition, its effects on wound healing *in vitro* (in a controlled laboratory environment) and in human trials, and its potential to address key challenges in diabetic wound care, such as infection control, oxidative stress reduction, and promotion of healthy tissue growth. The phytochemicals like phenolics (35.07 mg/mL), flavonoids (1.28 mg/mL), tannins (3.58 mg/mL), alkaloids (17.24 mg/mL), terpenoids (0.8 mg/mL), saponins, and glycosides, have been qualitatively and quantitatively reported while some of them were characterized by GCMS viz. 2, 4-decadienal, sesamin, and gamma sitosterol. To further

evaluate the efficacy of the polyherbal formulation, ***in-vitro* studies** were conducted using cell lines to simulate diabetic wound conditions. One of the major challenges in diabetic wound healing is impaired cell migration, which is necessary for wound closure. The *in-vitro* analysis demonstrated that the formulation significantly enhanced **cell migration** to the wound site, suggesting that it can help speed up the healing process by promoting the movement of fibroblasts and other cells involved in tissue repair. Moreover, the formulation was found to **reduce oxidative stress**, which is elevated in diabetic wounds and contributes to delayed healing. By lowering oxidative stress, the formulation creates a more favourable environment for wound healing. Additionally, the formulation enhanced **apoptosis** (programmed cell death) in damaged or dysfunctional cells, which helps clear out non-viable cells and make way for healthy new tissue. The promising results from *in-vitro* studies led to **human trials** to evaluate the real-world efficacy of the formulation in diabetic patients with chronic wounds. The formulation was applied topically, and the progress of wound healing was monitored through **photographic documentation** and opinions from medical officers and surgeons.

The results were highly encouraging, showing significant improvements in wound healing, including:

- **Healthy cellular growth:** The formulation promoted the growth of new, healthy tissue at the wound site, which is essential for wound closure.
- **Gap filling:** The formulation helped close the wound by promoting cell proliferation and tissue regeneration.

No adverse effects were reported during the trials, indicating that the formulation is safe for use as a topical treatment.