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In vitro wound healing and cytotoxic activity of the gel and whole-leaf materials from selected aloe species

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ABSTRACT

Ethnopharmacological relevance: *Aloe vera* is one of the most important medicinal plants in the world with applications in the cosmetic industry and also in the tonic or health drink product market. Different parts of *Aloe ferox* and *Aloe marlothii* are used as traditional medicines for different applications. Although wound healing has been shown for certain aloe gel materials (*e.g. A. vera*) previously, there are conflicting reports on this medicinal application of aloe leaf gel materials.

Aim of the study: The present study aimed at determining the wound healing properties of the gel and whole-leaf materials of *Aloe vera*, *Aloe ferox* and *Aloe marlothii*, as well as their cytotoxic effects on normal human keratinocyte cells (HaCaT).

Materials and methods: Nuclear magnetic resonance spectroscopy was used to chemically fingerprint the aloe gel and whole-leaf materials by identifying characteristic marker molecules of aloe gel and whole-leaf materials. An MTT assay was performed to determine the cytotoxicity of the various aloe whole-leaf and gel materials on HaCaT cells. Wound healing and *in vitro* cell migration were investigated with HaCaT cells by means of the CytoSelect™ assay kit.

Results: The *in vitro* wound healing assay suggested that all the aloe gel and whole-leaf materials examined, exhibited faster wound healing activity than the untreated control group. After 48 h, all the aloe gel and whole-leaf materials almost completely caused full wound closure, displaying 98.07% (*A. marlothii* whole-leaf), 98.00% (*A. vera* gel), 97.20% (*A. marlothii* gel), 96.00% (*A. vera* whole-leaf), 94.00% (*A. ferox* gel) and 81.30% (*A. ferox* whole-leaf) wound closure, respectively. It was noteworthy that the gel materials of all the three aloe species exhibited significantly faster ($p < 0.05$) wound healing actions when compared to their respective whole-leaf materials at 32 h.

Conclusion: The gel and whole-leaf materials of *A. vera*, *A. ferox* and *A. marlothii* have shown the ability to heal wounds at a faster rate and to a larger extent than untreated keratinocytes. The MTT assay results suggested that the gel and whole-leaf materials of all the selected Aloe species showed negligible toxicity towards the HaCaT cells.

1. Introduction

A wound can be described as a laceration or break of the skin surface caused by thermal or physical injury (Hashemi et al., 2015). Wound healing is a dynamic and multi-faceted process that can be divided into four phases, namely hemostasis, inflammation, proliferation (granulation and contraction) and re-modeling (maturation) (Ørsted et al., 2004). Each phase of the wound healing process is characterized by the migration of specific cell types into the wound to interact with the environment and other cells (Topman et al., 2013).

The use of medicinal plants for the treatment of various skin conditions has been popular for decades. Some of these natural medicines are believed to possess considerable therapeutic potential and should therefore be investigated for use in the advancement of products in the treatment of skin burns and wounds (Serafini et al., 2014).

The medicinal properties of aloe plants, especially *Aloe vera* (*Aloe barbadensis* Miller) are well-known worldwide. It has been reported that *A. vera* possesses various therapeutic properties, specifically in promoting wound, burn, and frost-bite healing. Additionally, this

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