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"Histological Changes of Skin Induced with Psoriasis and Treated with Aloe Vera Gel in Rats"

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Abstract

Psoriasis is a common chronic immune-mediated inflammatory skin disease with features of epidermal hyperproliferation and infiltration of leukocytes. The current work was performed to assess the histopathological changes of imiquimod (IMQ) induced psoriatic skin lesions and investigate the beneficial therapeutic targets after topical application of Aloe vera (AV) gel in experimental rats. A total of 24 male Wistar albino rats were divided into four groups: G1 (healthy control), G2 (psoriasis-induced control), G3 (psoriasis + AV gel treatment), and G4 (psoriasis + Tazarotene treatment). Histological analysis revealed that AV gel significantly reduced keratosis, acanthosis, and perivascular inflammation, comparable to the standard Tazarotene treatment. The stratum corneum thickness was significantly decreased in treated groups. These findings suggest that AV gel holds promise as a natural therapeutic option for psoriasis management.

Keywords: Psoriasis, Aloe vera, Imiquimod, Tazarotene, Keratinocyte Histopathology

1. Introduction

Psoriasis is a frequent, chronic immune-mediated skin disease that affects approximately 2–3% of the world population and is more frequent in Northern Europe [1,2]. Keratinocyte hyperproliferation and abnormal keratinocyte differentiation, immune cell infiltration, and the release of proinflammatory

cytokines result in the development of erythematous scaly plaques mainly on elbows, knees, scalp, or lower back [3,4]. This papulosquamous disorder may be responsible for substantial illness, psychological burden and comorbities such as metabolic syndrome, cardiovascular disease and psoriatic arthritis [5, 6]. The etiology of psoriasis is a multifactorial interaction between genetic predisposition, environmental factors and the dysregulation of both innate and adaptive immune system [7,8].Psoriasis is characterized histological by acanthosis (epidermal hyperproliferation) elongation of bemata/laminae with reduced or absent stratum granulosum and by parakeratosis.

Inflammatory cell infiltration and especially of T-helper 17 (Th17) cells, and dendritic cells were most relevant to pathophysiology of the chronicity and severity in disease [9, 10]. Retinoids, vitamin D derivatives, corticosteroids (e.g., Topically applied retinoid medication is commonly prescribed and includes For this reason these agents are frequently used in combination with other ototoxic drugs such as There are also some prescription medications that have been shown to be ototoxic These can damage the ear either temporarily or permanently depending on whether they are short-acting or long acting. They are utilized topically are first-line agents for mild-to-moderate psoriasis. But, adverse effects, tachyphylaxis, and patient-non-compliance usually restrict the prolonged use of these compounds [11]. Natural products or complementary herbal medicine are increasingly attracting attention as complementary or alternative strategies of treatment.

Phytopharmaceuticals Aloe vera (AV) is one of the most studied herbal drugs and has shown a diverse range of bioactivities. Aloe barbadensis Miller, the most widespread species of AV, contains numerous beneficial bioactive products such as polysaccharides (acemannan), anthraquinones (aloin), vitamins, minerals, and enzymes, which are responsible for its anti-inflammatory, antioxidant, antimicrobial, wound-healing, and immunomodulatory effect [12–14]. AV has been confirmed to be effective in treating inflammatory skin diseases including eczema, burns, and psoriasis in several studies [15,16]. It is reported to reduce pro-inflammatory cytokines like TNF-α and IL-6, increase collagen production and improve tissue healing [17,18]

The therapeutic effect of AV in psoriasis is related to its anti-proliferation activity of keratinocytes, restoration of skin barrier function, and immunomodulation [19,12]. Recent innovations in AV-based formulations such as hydrogels, creams, nanoemulsions are used to improve AV bioavailibility and efficacy in the treatment of dermatological disorders [20,21].With the limitations of current pharmacologic treatments and the ever-growing burden of chronic skin diseases, this study intended to investigate the histopathological effect of avanine-gV—AVgel (AV gel) cream on Imiquimod-induced psoriasis in rats in comparision with Tazarotene (standard topical retinoid therapy).

2. Materials and Methods

2.1. Experimental Animals and Grouping

A total of 24 adult male Wistar albino rats (aged 13 months; 350–400 g) were used in this study. Animals were randomly assigned to four groups (n = 6 per group:(

Group 1 (G1): Healthy control group (no psoriasis(

Group 2 (G2): Psoriasis-induced group (IMQ only(

Group 3 (G3): Psoriasis + Aloe vera gel treatment

Group 4 (G4): Psoriasis + Tazarotene cream treatment

Each group was subjected to treatment for 3, 7, or 17 days, and animals were sacrificed accordingly for histological assessment.

2.2. Induction of Psoriasis

Psoriasiform skin inflammation was induced by the application of a 5% w/w Imiquimod (IMQ) cream. The dorsal region of the rats was shaved and depilated with the aid of Veet® cream. Eighty to one hundred-twenty milligrams of IMQ were applied topically on the lower back, 10 mg on the right ear for a period of 6 days in rats from Group 2, 3 and 4, once a day [24]. Group 2 was treated with Vaseline alone as placebo, signs of psoriasis induction on the skin of mice, such as redness, skin thickening, and scaling, appeared on imiquimod-treated skin and remained severe until the last day of induction. The efficacy of this model was assessed utilizing the Psoriasis Area Severity Index (PASI) score [31] in mice. Throughout the induction phase, the following modifications were noted in the animals: skin erythema, increased skin thickness, and scaling. These manifestations were specifically noted in animals that had topical cream in for psoriasis135progressed past day 6 of induction. This is regarded as an effective induction model [32].

2.3. Psoriasis Area Severity Index (PASI) Score

The assessment of treatment efficacy and the success of the induction models in this investigation incorporated the utilization of the PASI clinical scoring system to determine the severity of inflammation on the dorsal skin of the rats. Three specific traits were visually assessed on the dorsal surface (scale

[desquamation], redness [erythema], and thickness [induration]) of each mouse. Each attribute was assigned a numeric value from zero to four: zero was the absence of an attribute, one indicated mild presence of an attribute, two indicated moderate presence, three indicated strong presence, and four indicated very strong presence. This would result in a cumulative score, which could range from 0 to 12 [31]. This study was an evaluation randomly conducted by a single researcher.

2.4 Aloe Vera Preparation

Four-point six KG of the fresh Aloe vera leaves were sourced locally from Iraq. The leaves were washed thoroughly and incised to collect the n_2o. This sap was then dehydrated by air under controlled conditions and has been subsequently pulverised into powder, with 500 g of concentrate residue available for formulation purposes.

2.5 Aloin Content Analysis

TLC, ethyl acetate:methanol:water (5:0·0.85:0.65) Aloin was observed by TLC with a solvent system of ethyl acetate:methanol:water (5:0·0.85: 0) and viewed in UV light. The plates were post-sprayed with 10% methanolic potassium hydroxide and visualised under UV (365 nm). The aloin was quantified through spectrophotometer by comparing with absorbance at 365 nm to standard calibration curve of aloin in 80% methanol, if any.

2.6 Ointment Formulation

Fusion method was used for the fabrication of Aloe Vera (AV) gel ointments. The appropriate base of ointment was heated and melted, then the prepared Aloe extract was added with constant agitation in small quantities to obtain a good dispersion. 3, at which the cooling mixture may be a homogeneous and stable topical preparation.

2.7. Histological Assessment

Immediately after excision, skin tissue specimens were collected in 10% neutral-buffered formalin for initial histopathologic examination and maintenance of cellular structures against autolysis. Following fixation, samples were subjected to standard processing and paraffin embedding for sectioning on a microtome. 25,26) The sections were subsequently stained with Hematoxylin and Eosin (H&E), using conventional histopathological techniques [22]

2.8. Statistical analysis

The skin specimens were directly fixed in 10% neutral-buffered formalin in order to obtain initial histopathology evaluation and preserve cellular morphology against autolysis. After fixation, samples were processed in routine manner, embedded in paraffin blocks and sectioned on a microtome. The sections were then subjected to H & E staining in accordance with common histopathological protocols.

2.9 Ethical Considerations

Experimental procedures using animals were approved by the Institutional Animal Ethics Committee (approval no. 1742; November 24, 2024). All applicable international, national, and institutional guidelines for the care and use of animals were followed, and the study was conducted according to the applicable regulations of the study country, with the aim of ensuring animal welfare and scientific integrity.

3. Results

3.1. Induction of Psoriasis in Rats

Histological section of normal skin tissue of a control group (G1) of male Wistar albino rats (Figs. Pathological section (H–E, 10×), showing normal skin architecture. The epidermal layer (EP), dermal layer, and dermal papillae are marked similarly and shows clearly and indicate normal skin morphology. The most superficial layer, the stratum corneum (SC) looks homogeneous and preserved. The topical treatment group with distilled water showed no signs of psoriasis-like alterations.

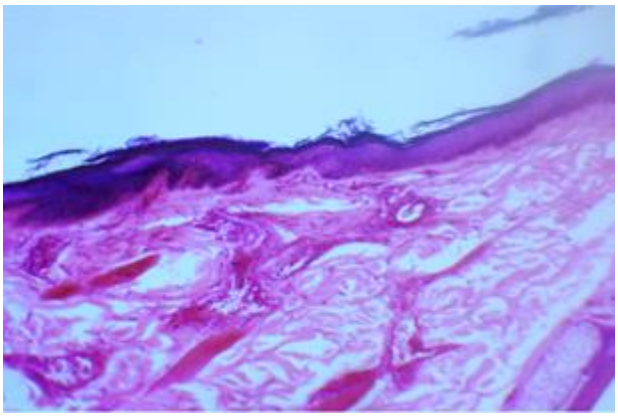


Figure 1: Histological cross-section in normal skin of the control group (G1) stained with H&E (10×) Figure2: Skin Tissue A shows intact skin layers (SC – stratum corneum; EP – epidermis). No histopathological abnormalities are present.

Histological sections are as shown in figure 2 above of dorsal skin on G2 rats after applying imiquimod (IMQ) cream topically. These sections demonstrate the histopathologic features of psoriasis, which includes keratosis, acanthosis, and perivascular inflammatory cell infiltrate. Taken together, these pathological characteristics represent successful psoriasis induction.

During the six days of topical application of 37.5 mg/cm² IMQ daily, the psoriatic features became progressively more pronounced. Erythematous and scaly lesions were observed from days 4 to 6. Conducting behavioral analysis on day 6 revealed that the pruritus (scratching episodes) were obviously increased, further confirming that inflammation and hyperproliferation was established. Interestingly, the rise in scratching behavior was associated with PASI (Psoriasis Area and Severity Index) progression (threefold increase in optic-microscopic grading) in IMQ-treated rats vs. controls.

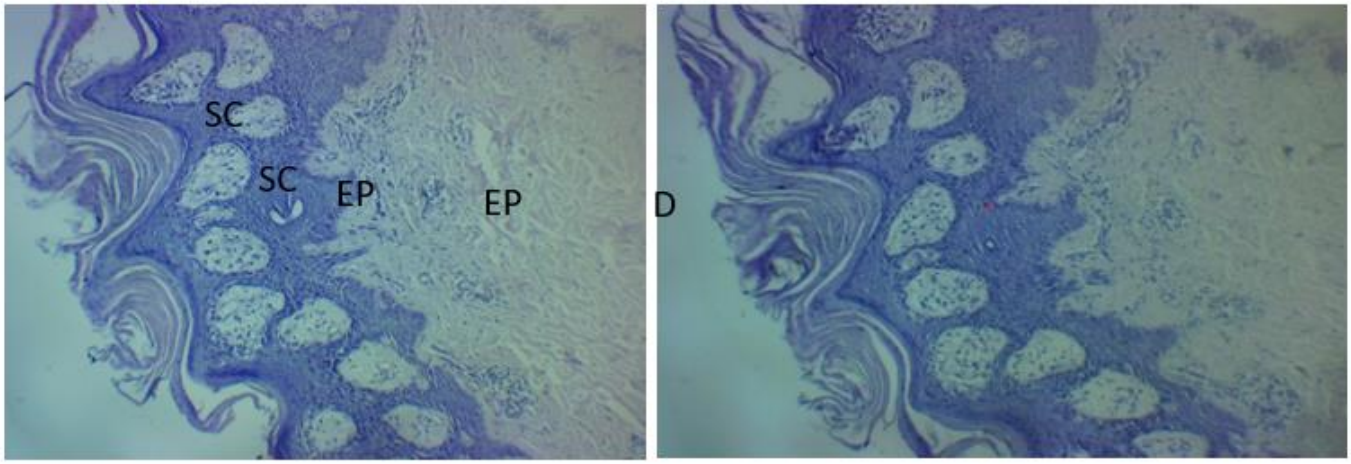


Figure 2: Histological sections of the skin of Psoriasis-induced group (G2) stained with H&E (10×), indicating the signature histopathological alterations of psoriatic lesions among which are epidermal hyperplasia (acanthosis), hyperkeratosis and dermal inflammatory infiltration.

3.2. Psoriasis Induction and Behavioral Assessment in the IMQ-Treated Group (G2)

As presented in Figure 2, a classical model using daily topical applications of imiquimod (IMQ) for six days straight at different concentrations successfully induced psoriasis-like skin lesions in Westar albino rats. The PASI (Psoriasis Area and Severity Index) score logarithmically increased day by day during the treatment, whilst erythema, scaling and skin thickening became evident between days 4-6. Pruritic activity was statistically increased on day 6 based on the behavior response. The quantitative analysis demonstrated that the number of scratching bouts in IMQ-treated rats was thrice as high when compared to those in the normal control group, which represented an increasd psychological discomfort and inflammatory response. These results were also supported by the fact that the histological was observed in group 2, such as epidermal hyperplasia, keratosis and inflammatory infiltrate.

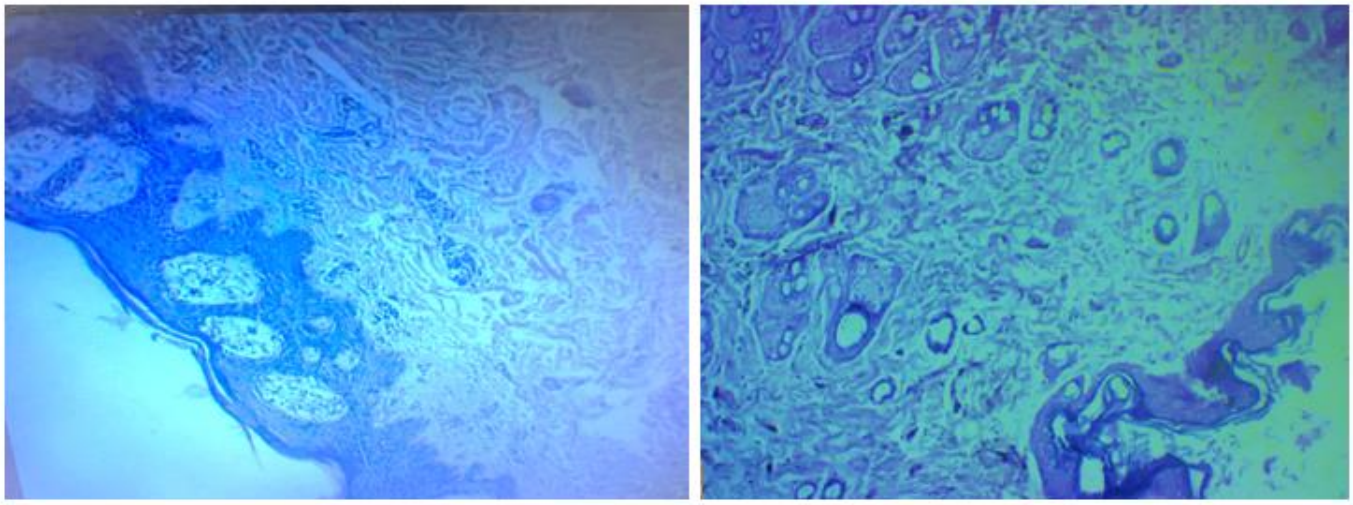
3.3. Treatment of Westar albino rats with Aloe Vera (AV) and Tazarotene cream3.4. Therapeutic Effect of Aloe Vera (AV) Gel on Psoriasis-Induced Rats (G3)

Histological sections of dorsal skin of G3 group rats topically treated with Aloe vera (AV) gel after the induction of psoriasis by IMQ are shown in Figures 3A and 3B. The tissues treated with AV presented partial recovery compared to the G2 (psoriasis untreated).

Histological examination demonstrated that epidermal thickening, acanthosis and inflammatory cell infiltration into the dermis were suppressed. The stratum corneum structure was observed to be improved, and the epidermal hyperplasia was reduced apparently. These changes indicate an anti-inflammatory and pro-regenerative role of Aloe vera, which may be a consequence of its bioactive.

polysaccharides and antioxidants which can modulate cytokine activity and enhance wound healing.

The histological alterations seen in this study are consistent with the possible therapeutic effect of Aloe vera against IMQ induced psoriatic lesion management.



Figures 3A and 3B: Skin sections from G3 rats treated with Aloe vera gel (H&E stain, 10× magnification) showing disappearance of hyperkeratosis as well as epidermis and dermis thinning; no thinning over the papilla with the absence of Monru's abscess; parakeratosis; and Rete's ridges with only a minimal inflammatory response moderate improvement in epidermal architecture and reduced dermal inflammation compared to the IMQ-only group

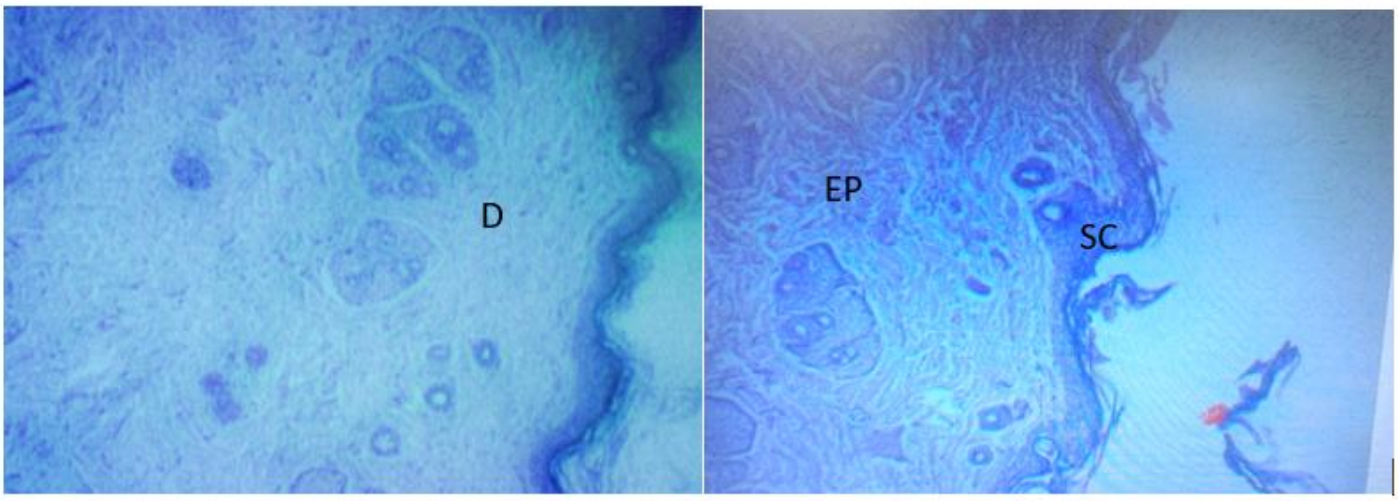


Figure (4) Tazarotene treated tissue section of Psoriatic skin Less keratosis no acanthosis- no perivascular inflammationno suprapapillary thinning in Tazarotene treated tissue. (H&E,10X).

3.4. Histological Evaluation of the Stratum Corneum Thickness

Dorsal skin sections (Figure 2) showed obvious structural differences among groups by histology. The control group (G1) showed a regular epidermis structure with a clear SC, EP and D. On the other hand, group G2 (psoriasis-induced) exhibited significant thickening of SC to give evidence for hyperkeratosis, which is among signs of psoriasis pathogenesis.

Notably, treatment with Aloe vera cream (G3) and Tazarotene (G4) markedly reduced the SC thickness compared to the psoriasis-induced group, suggesting a therapeutic effect (Table 1).

Statistical Analysis of Stratum Corneum Thickness

Group	Treatment	SC Thickness μm(M ± SE)
G1	Distilled Water (Control)	145 ± 14.4
G2	Psoriasis-Induced	263 ± 13.6 ***
G3	Aloe vera Cream	169 ± 12.1
G4	Tazarotene	134 ± 12.1
LSD	—	17.19

One-way ANOVA with LSD post hoc test indicated that the stratum corneum thickness for all sets of examined was significantly different (*$p < 0.001$). Of note were the differences between psoriasis and two treated groups (AV, TZ). These findings confirm that both AV and Tazarotene significantly attenuated the SC thickening associated with psoriasis.

The observed hyperkeratosis in the psoriatic model aligns with previous reports describing epidermal hyperplasia and SC thickening in response to psoriasis-like inflammation (Nestle et al., 2009; Griffiths et al., 2007). The reduction in SC thickness following Aloe vera application is consistent with its reported anti-inflammatory and skin-soothing effects (Surjushe et al., 2008), while Tazarotene's efficacy corresponds with its established role as a topical retinoid in modulating keratinocyte differentiation and proliferation (Lebwohl, 2004).

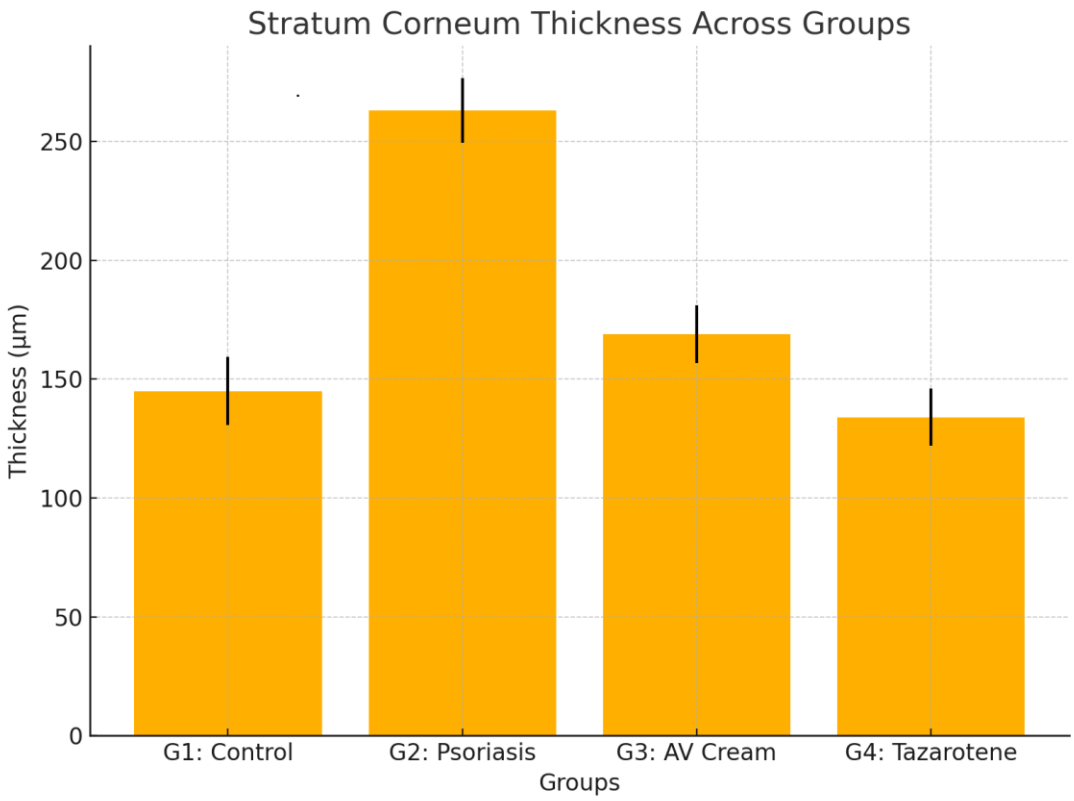


Figure 4. Comparison of Stratum Corneum Thickness Among Experimental Groups.

Bar chart illustrating the mean thickness (± SEM) of the stratum corneum in control, psoriasis-induced, Aloe vera-treated, and Tazarotene-treated rat skin. Significant thickening was observed in the psoriasis group compared to the treated groups.

4. Discussion

Despite many clinical and biochemical descriptions of psoriasis, the exact aetiology of the disease is not fully understood. Many in vitro and in vivo models of psoriatic state have been created, yet the models have not reproduced the intricate histo-pathological characteristics of the disease (Mills et al., 1994). Psoriasis is a disorder characterized by increased proliferation and abnormal differentiation in keratinocytes with inflammatory infiltrates. Keratinocytes constitute the majority of the epidermis, in which the other cell types, such as melanocytes, Langerhans cells, and Merkel cells, are also present and are indispensable for barrier defense. Disruption in the homeostasis of epidermal renewal can lead to a variety of chronic inflammatory disorders like psoriasis, which affects an estimated 2–3% of the population worldwide (Ortiz-López et al., 2022). However, new research indicates that redox imbalances in the skin and blood, as well as increased reactive oxygenspecies (ROS) generation, play an essential role in the pathogenesis of psoriasis (Barygina VV, Becatti et.al.,2013) .

Tazarotene, an acetylenic retinoid of the topical retinoid class, has shown substantial therapeutic benefit in the treatment of psoriasis. When applied to the skin, it is rapidly metabolized to its active form, Tazarotenic acid, that acts as a selective modulator of gene expression of keratinocytes and inflammation. In contrast to the first-generation retinoids, like etretinate, Tazarotene has low systemic availability, mainly as a result of its very fast break down and therefore low risk for long-term side effects (Gerald et al., 1997; Kang et al., 2005).

These findings are consistent with those reported that Tazarotene decreases stratum corneum thickness and improves psoriatic symptoms on a mild localized skin irritation basis, as is characteristic of topical retinoids (Gerald et al., 2003; Lebwohl et al., 2001). Being available in several formulations (cream or gel)

it has the advantage to be used as monotherapy or in association with corticosteroids (Guenther et al., 2002).

Concurrently, Aloe vera (Aloe barbadensis Miller) from the family Asphodelaceae has been extensively examined for dermatological purposes on account of its diverse phytochemical composition that includes its polysaccharides such as acemannan that exhibit anti-inflammatory, wound healing, immunostimulant and antimicrobial activities (Hamman, 2008; Ray and Aswatha, 2013). Aloe vera hydrogel has been proposed as an adjuvant therapy for psoriatic skin conditions, given its potential for improving skin hydration as well as barrier function.

In support of the previous study, a strong reduction of horny layer thickness was achieved in psoriatic lesions treated with Aloe vera cream, as found in overt keratolytic and anti-inflammatory activities. The histological data supports the ancient anecdotal claim of Aloe vera as a natural antidrug to epidermal hyper-proliferation and also makes evidence in wound repair by A. vera (Surjushe et al., 2008; Silvana et al.; 2022).

Nevertheless, although encouraging, further studies, especially RCTs are needed to elucidate the long-term efficacy, safety matters and way of action of treating psoriatic patients by Aloe vera-based hydrogels (Reynolds & Dweck, 1999; Vijayalakshmi et al., 2020).

5. Conclusion

The results of the present study corroborate accumulating evidence demonstrating the medical effectiveness of Aloe vera extract, especially in connection with dermatological use. The present experimental model of psoriasis revealed quite apparently that topical application of A. vera cream exerted a remarkable therapeutic effect on psoriatic skin lesions. Acanthosis was markedly diminished, keratosis had decreased and across all animals there was no evidence of perivascular inflammation – features consistent with the reversal or substantial attenuation of the markers of inflammation and hyperproliferation characteristic of psoriatic tissue. Moreover, skin tissue architecture recovery, observed by the decreased thickness and normalization of epidermal layers also reveals an anti-inflammatory and tissue-regenerating effect of Aloe vera. These effects are attributed at least in part to the connective composition of the A. vera hydrogel, which improve elasticity of the skin, possibly through modulation on fibroblast stimulation and increased repair of extracellular matrix component. This is important given that the dermis and epidermis are structurally altered through psoriatic mechanisms. In contrast to the Tazarotene-treated group with a pronounced improvement in skin structure as well, treatment with A. vera might provide an alternative that is even closer to nature and probably safer without notable side effects. The A. vera cream was equally, or even more effective in reducing the severity of psoriatic plaques. Furthermore, the thinner epidermis of A. vera treated group that could be seen histologically validates the possible contribution of the hydrogel in regulation of keratinocyte replication, which is remarkable for development of psoriasis. These results validate the potential of A. vera hydrogel in clinics for psoriasis treatment. Considering its natural profile, and anti-inflammatory, healing and skin-regenerating potential demonstrated activity, it may be worth pursuing further clinical studies to be incorporated in the integrative dermatological preventive/therapeutic arsenal. More studies, especially clinical trials in human are needed to confirm these findings and to establish the suitable dose of A. vera and its form and further characterize safety profile for chronic inflammatory skin disease such as psoriasis.

Declaration Statements

Ethical approval: This article was in accordance with the ethical approval and in compliance with how to review it, and the local ethics Committee, 24 for release of data on no, 1742.

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