

Aloe barbadensis: A Plant of Nutricosmetic Interest

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Abstract

Aloe barbadensis Miller (Aloe Vera Linne) products have long been employed in health foods and for medical purposes. It has anti-inflammatory, antifungal, antioxidant properties, which indicates excellent potential in antiaging cosmetic and skin protection products. The objective of this study is to evaluate the antiaging efficacy of dermocosmetic formulations containing *A. barbadensis* extract on young and mature skin using biophysical and skin imaging techniques. Twenty healthy adult volunteers participated in the study, aged between 20 and 65. The cream formulation, with 10% (w/w) of *A. barbadensis* extract, and placebo, were applied to the face of the volunteers. The effects were evaluated in terms of skin hydration and barrier effect by the measurement of transepidermal water loss (TEWL), derma firmness, and elasticity. The formulation containing *A. barbadensis* extract significantly improves water contained in the stratum corneum, firmness, elasticity of the skin, and decreased TEWL.

Keywords

Aloe barbadensis, TEWL, corneometry, cutometer, nutricosmetic, skin hydration

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The demand to prevent skin changes due to the aging process has led to developing innovative cosmetic products. The scaly and flaky appearance or the xerosis of the skin, occur in the absence or deficiency of water. Moisturization is a crucial point to maintain the skin soft, flexible, smooth, wrinkle-free, and therefore preserve a youthful and beautiful appearance. Hydration is critical for the typical operation of the skin and its cells. Water levels mainly depend on the nature of the stratum corneum (SC), the outermost epidermal layer of the skin, the aging, and the destructive agents like the heat and the wind. The demand of consumers in new natural ingredients and scientific evidence for their efficacy has grown in the last years. *Aloe barbadensis* contains carbohydrate polymers (glucomanans), mucilage, fructose, acids (uronic acid, tannic acid), vitamins (A, C, E, D, B₁, B₂, B₃), amino acids, and triterpenoids (lupeol, campesterol, cholesterol, β -sitosterol) that exert protective or disease-preventing effects.¹ Traditionally *Aloe* was used to treating skin injuries due to burning and swellings.¹ Although many studies have been carried out, clinical evidence remains unclear. Therefore, further research needs to be done to verify the effectiveness of *A. barbadensis* in cosmetic and pharmaceutical preparations. The objective of this work is to study, under real conditions of use, the efficacy of a cream containing 10% *A. barbadensis* leaf extract as antiaging using advanced biophysical techniques to determine hydration of the epidermis and skin elasticity (Figure 1).

The epidermis has 2 different levels of water, separated by the interface between the stratum granulosum (SG) and the stratum corneum (SC). Water present in the deeper epidermal layers goes upward to hydrate cells in the SC, and in part, it is lost by evaporation. Hydration of the upper skin layers decreases when the SC water is lost less quickly than that arrived from the lower layers of the skin.² Therefore, to evaluate, it is necessary to check the transepidermal water loss (TEWL) and the water content in the SC. The Tewameter can measure the TEWL, and the Corneometer can evaluate the water content in the SC. Since water and lipid contents determine the viscous resistance against deformation, the viscoelastic properties of the skin were verified with a Cutometer.³ This work is part of a project whose goals are the research of natural products both of animal⁴ and vegetable origin that can be used both topically and orally to inspire the formulation of innovative products for beauty care with proven effectiveness. The combination of topical agents and dietary supplements results in a superior cosmetic benefit, as the problem is attacked from opposing sides. The nutricosmetics “beauty from within” market has expanded in recent years and will continue to grow in

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Figure 1. *Aloe barbadensis*.

the coming years. It is considered the next frontier for improving skin health and beauty. According to a report published by Global Industry Analysts (2017), the nutricosmetics market size will reach US\$7.9 billion in 2025.⁵ Plant-based beauty is getting a significant investment in the marketplace. *Aloe barbadensis* was used in dermocosmetic cream considering its use in traditional medicine (emollient and anti-inflammatory)^{6,7}, in food preparation (beverages, yogurts, desserts), functional food with antioxidant and immune-modulatory preventive effects,⁸ and cosmetic products (suntan lotions, soaps, hand creams, cleansers, shampoos, and hair tonics, shaving preparations, makeup, and baby lotion).⁹ Future studies should investigate treatment with *A. barbadensis* supplement to verify the possible synergic effect of supplement and cream to prevent skin aging.

Results and Discussion

The skin protects the body against water loss and stops microorganisms and viruses. Lipids and corneocytes of the SC make

a physical barrier; instead, lipids and sweat from the sebaceous gland form a biochemical barrier. The maintenance of skin barrier functionality depends on the SC hydration, the TEWL, and the sebum level.¹⁰ If chemical or physical agents damage the skin, the barrier function is compromised and an increase of TEWL is detected. In this work, the Tewameter was used to measure the water vapor that was released from the skin. It is a non-invasive method for determining the efficiency of the barrier function of the skin. The time course of TEWL following application of the *A. barbadensis* cream and placebo were shown in Figure 2.

The topical application of the *A. barbadensis* cream decreases the TEWL progressively from -22% after 1 hour to -28.0% after 15 days from the use of testing cream, showing a positive effect of the *A. barbadensis* cream on the functionality of the skin barrier. Measurement of the moisturizer efficacy was evaluated with a Corneometer. The latter evaluates the barrier capacity of SC, and its results are indicative of the normal desquamation and maturation of the SC. It is a non-invasive method based on the

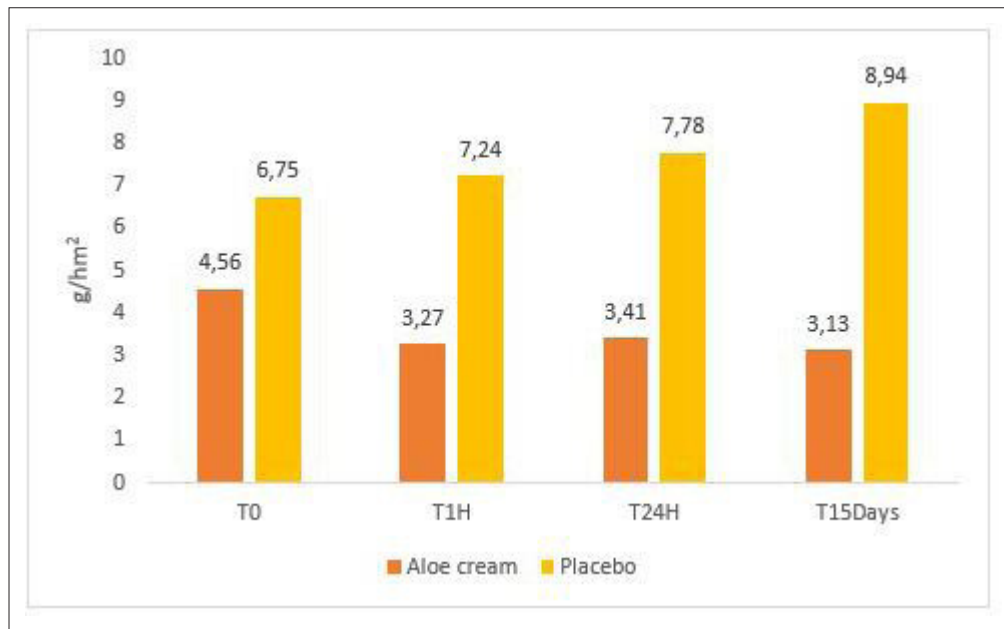


Figure 2. Transepidermal water loss measurements. T0: before treatment; T1H: 1 hour after treatment; T24H: 24 hours after treatment; T15 Days: 15 days after treatment. All the measures are statistically significant ($P < 0.05$).

measurement of the capacitance of the skin, which varies with the water content. The capacitance measurements of the skin surface are transformed into arbitrary hydration units.¹¹ Corneometry time course results were illustrated in Figure 3.

The topical application of *A. barbadensis* enhanced hydration units from 28% after 1 hour to 31% after 15 days from the use of the tested cream, showing the ameliorative effect of the *A. barbadensis* cream on the hydration of the skin barrier. Aloe extract contains glucomannan, acemannan, and amino acids that justify the moisturizing effect.¹² The firmness of the

skin was calculated by measuring total skin displacement R0 in mm. Cutometer R0 time course results were illustrated in Figure 4.

The R0 value for Aloe cream, decreasing by 18.4%, demonstrated the cream's ability to restore skin firmness. The standard parameter of elasticity (R2) was also determined. This parameter represents the ability to return to the original position after a mechanical pressure. The skin elasticity increased when the R2 value is closer to 1 (100 %). Cutometer R2 time course results were illustrated in Figure 5.

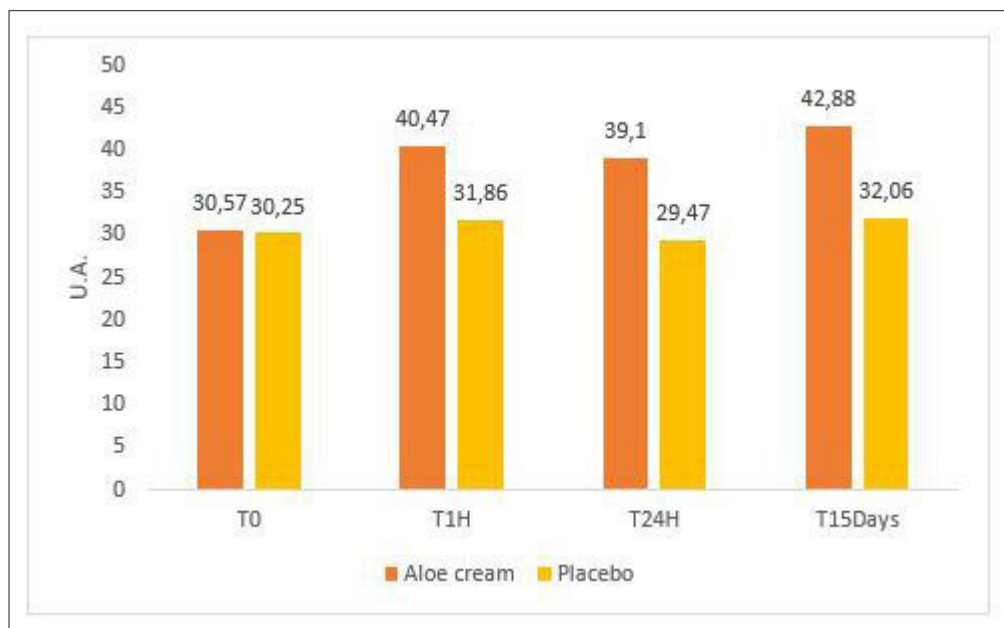


Figure 3. Hydration index. T0: before treatment; T1H: 1 hour after treatment; T24H: 24 hours after treatment; T15 Days: 15 days after treatment. All the measures are statistically significant ($P < 0.05$).

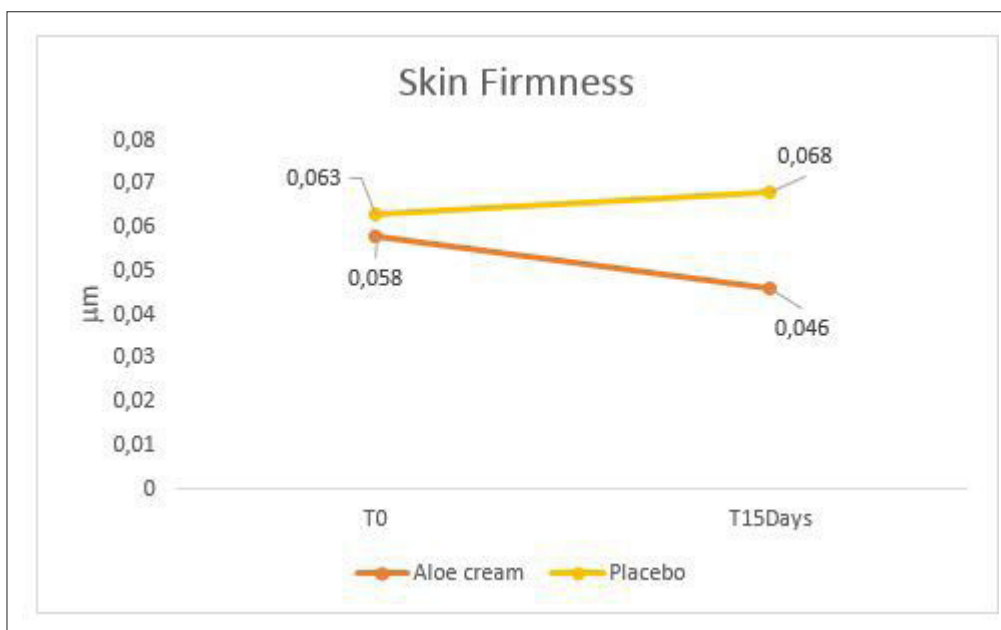


Figure 4. Skin firmness. T0: before treatment; T15 Days: 15 days after treatment. All the measures are statistically significant ($P < 0.05$).

In our study, the R2 value, enhanced after 15 days of treatment from 0.78 to 0.87 (+13,6%), confirmed the *A. barbadensis* cream ability to improve the skin elasticity. The acemannan and the aloeride in the *A. barbadensis* plant supported this evidence.¹³ The acemannan stimulates lymphocyte response to alloantigen, activates the interleukins-1 and 6, interferon, and tumor necrosis factor, enhances the phagocytosis, and improves the monocytes and the macrophages. The aloeride is a polysaccharide able to activate nuclear factor (NF- κ B).¹⁴⁻¹⁶ Defects,

inflammatory processes, and cancer occurred in the skin when NF- κ B activity decreased.

Materials and Methods

Treatment

The test was conducted according to the principles of the Helsinki Declaration (Ethical principles for medical research

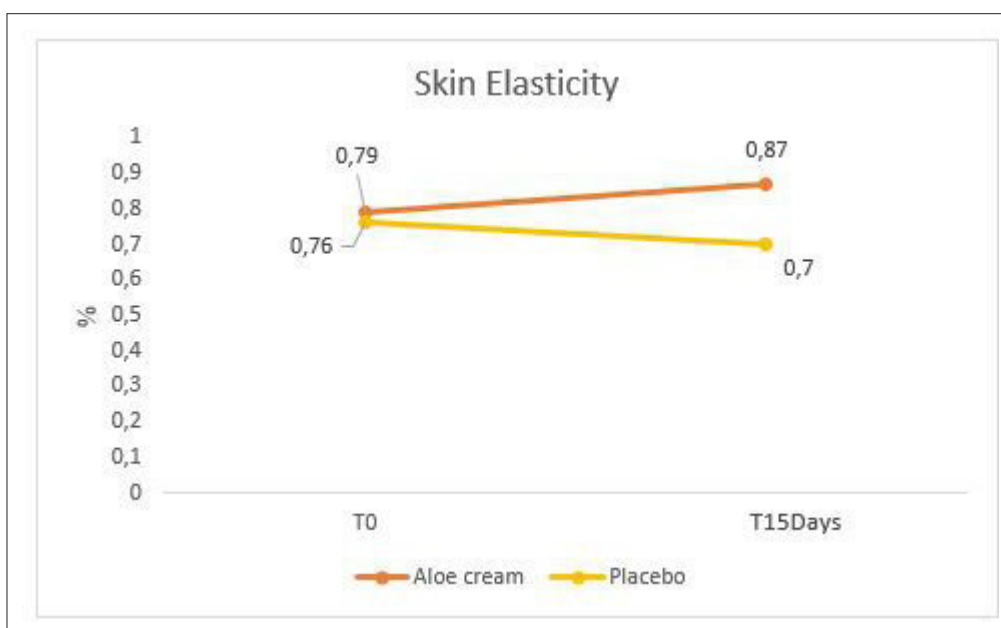


Figure 5. Skin elasticity. T0: Before treatment; T15 Days: 15 days after treatment. All the measures are statistically significant ($P < 0.05$).

that involves human subjects, Helsinki, Finland, June 1964) and subsequent revisions endorsed by the European Community (fourth revision, called Somerset West, South Africa, 1996; Saunders and Wainwright, 2003) and according to the Colipa Guidelines for the evaluation of the efficiency of cosmetic products (May 2008). The technical staff applies in single-blind, about 2 mg/cm² of *A. barbadensis* cream or placebo in the area of the face right and left of the volunteers, previously cleansed, avoiding direct contact with the eyes and gently massaging until completely absorbed. TEWL and corneometry measurements were read before putting the cream (T0), after 1 hour (T1), 24 hours (T2), and 15 days (T3) after the beginning of treatment. Cutometer measures were done before cream application (T0) and after 15 days (T1).

Aloe barbadensis Cream and Placebo Compositions

Oil phase: cetyl alcohol (2.5%), *Helianthus annuus* seed oil (7.5%), polyglyceryl-3 methylglucose distearate (5.0%), ceteryl alcohol (2.5%), tocopheryl acetate (1.0%).

Water phase: water (q.b to 100), *A. barbadensis* leaf extract (10%), sodium benzoate, potassium sorbate, phenoxyethanol (0.5%), perfume (0.1%).

The placebo cream contains all the components without *Aloe* leaf extract. All cream's ingredients were purchased from ACEF (Fiorenzuola D'Arda, Italy) and Parfum by Farotti essence (Rimini, Italy). *Aloe* extract (active water extract *Aloe* leaf cosmos) was purchased from ACEF (Fiorenzuola D'Arda, Italy).

Formulation development. The formulations used are O/W emulsions containing ingredients listed before. The oil phase was prepared placed on a heating plate so that a liquid oily component was formed. At the same time, the water was heated up to the same temperature as the oil phase. Subsequently, the aqueous phase is poured flush into the oil phase, shaking vigorously by a Silverson L5M-A Laboratory Mixer; after the emulsion was cooling in an ice bath and, at room temperature, the remaining components were added. The pH of emulsions was calculated with a PHmeter Crison GPL20 (Hach Lange Spain, S.L.U.3, Barcelona, Spain), and its viscosity (28.640-30.314 mPa; L4, 20 rpm) was calculated with a rheometer Visco Basic Plus, Fungilab (Barcelona, Spain).

Instrumental Measurements

Instrumental measurements were made after a 30-minutes acclimatization period in a room maintained at 20-24°C and with relative humidity of 50% ± 5% as recommended by guidelines from the European Group for Efficacy Measurements on Cosmetics and Other Topical Products (EEMCO).¹⁷

Transepidermal water loss. TEWL was measured utilizing a Tewameter Probe Dual MPA 580 (Courage +Khazaka electronic GmbH, Köln, Germany).

Skin hydration. Skin hydration was measured using a Probe Corneometer DUAL MPA 580 (Courage +Khazaka electronic GmbH Mathias-Brüggen-Str.91 50829 Köln, Germany). Six successive measurements were taken at 5-second intervals, and the mean value was calculated for each skin site. Results were expressed in arbitrary units.

Skin firmness and elasticity. Skin firmness and elasticity were evaluated using a Cutometer dual MPA 580 (Courage +Khazaka Electronic, Köln, Germany). A constant pressure with a probe (2 mm diameter) of 350 mbar for 5 seconds, followed by a relaxation time of 1 second for 5 repetitions, was applied.¹⁸ The curves of skin deformation were analyzed using the Cutometer Dual Version 1.4.6.2 software. R0 (skin firmness) and R2 (skin elasticity) parameters were evaluated.¹⁹

Volunteer Selection

Twelve Caucasians volunteers (healthy adults), aged between 20 and 65 years, were enrolled in the study. According to the Helsinki declaration of ethical principles for medical research, all volunteers signed an informed consent page and are subject to a careful clinical examination and thorough case history.

Inclusion criteria. Participants were obligatory to renounce to the use of dietary supplements, exposure to artificial ultraviolet treatment, cosmetic products on the forearms. Also, only the subjects who are cooperative, able to follow the instructions, and comply with the study requirements were enrolled.

Exclusion criteria. People do not engage were women who are pregnant or nursing during 3 months or more from the study start; people with a history of intolerance reactions or skin hyper-reactivity to product constituents, skin diseases, suffering (eczema, psoriasis, lesions), receiving topical retinoids during the previous 12 months and systemic retinoids in the last 45 days before the start of the study.

Statistical Tests

The analysis of variance test was performed using IBM SPSS software (version 15; Milan, Italy). For all experiments, the differences were significant at a value of $P \leq 0.05$.

Conclusion

This study showed that the *A. barbadensis* cream improves skin barrier function, increases the skin's moisture content, and enhances skin firmness and elasticity more than a placebo cream. According to the in vivo results, the topical application of *A. barbadensis* cream promises results in preventing skin

aging. Future studies should investigate treatment with *A. barbadensis* supplement to verify the possible synergy effect of supplement and cream to prevent skin aging.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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