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Increasing skin oxygenation using a cosmetic energy drink

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1. Introduction

The concept of "skin energy" is pivotal in dermatology and cosmetic science, denoting the skin's vitality, radiance, and overall health. Low energy levels are indicative of fatigue, dullness, and aging, whereas high skin energy correlates with a luminous, youthful complexion. Oxygenation, closely linked to skin microcirculation, is a critical factor influencing skin energy. Skin oxygenation involves the delivery of oxygen to skin cells, essential for maintaining cellular metabolism and energy production. Oxygen is primarily supplied to the skin via capillaries, delivering oxygen-rich blood to the dermal layers, with a minor amount absorbed directly from the air through the epidermis [1] (Figure 1). This dual mechanism ensures skin cells can perform essential functions such as repair, regeneration, and protection against environmental stressors. Microcirculation plays a crucial role in this process, facilitating the delivery of oxygen and nutrients while removing waste products and carbon dioxide. Adequate microcirculation prevents hypoxia and maintains skin functionality.

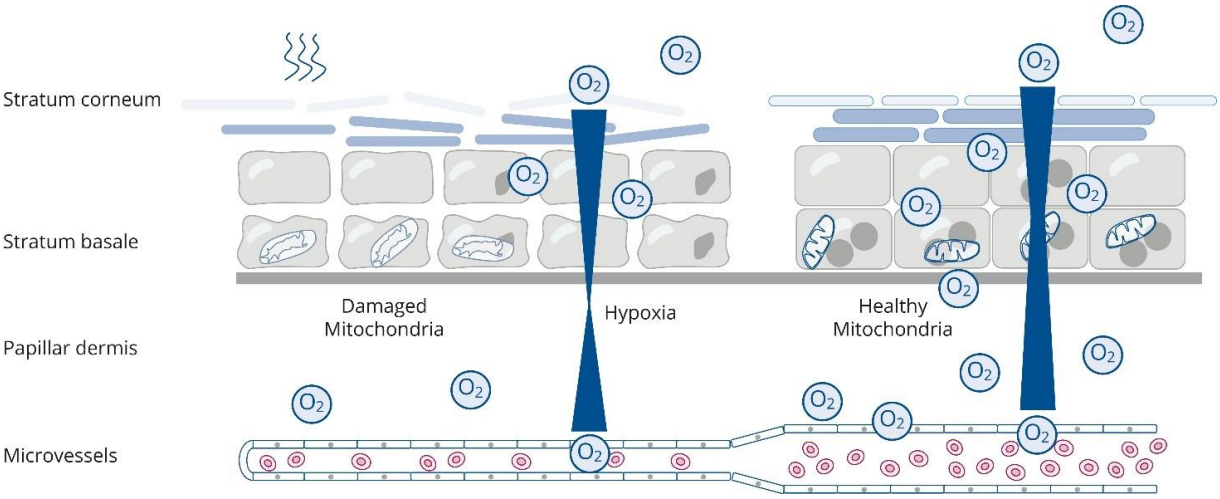

Figure 1: Cutaneous oxygenation is derived from atmospheric oxygen and capillary oxygenation. These sources establish an oxygen gradient, with the lowest concentration observed in the region encompassing the stratum basale of the epidermis and the stratum papillare of the dermis. Insufficient microcirculation may result in hypoxia, characterized by reduced oxygen partial pressure. Enhancing microcirculation can augment the endogenous oxygen supply, thereby ameliorating oxygenation levels within the skin.

Ilex Extract, derived from the yerba mate plant *Ilex paraguariensis*, offers a unique solution to enhance skin energy by improving microcirculation and tissue oxygenation. Yerba mate is rich in caffeine, polyphenols, and rutin [2], compounds known for their vasodilatory and antioxidant properties. These components synergistically increase blood flow, enhance oxygen delivery, and protect the skin from oxidative stress, while avoiding skin redness.

This article explores the scientific basis of Ilex Extract, examining its sourcing, environmental impact, and mechanisms through which it enhances skin vitality with immediate effect. Understanding the relationship between skin oxygenation and microcirculation allows appreciation of Ilex Extract's potential as a transformative skincare ingredient.

2. Materials and Methods

Ilex Paraguariensis Leaf Extract was manufactured using a water based extraction of mate leaf dust, which is a by-product in the mate tea leaf production (Further referred to Ilex Extract; INCI: Water, Pentylene Glycol, Ilex Paraguariensis Leaf Extract, Citric Acid). The efficacy of Ilex Extract was evaluated through *in-vivo* and *in-vitro* studies assessing its impact on various skin parameters. The *in-vivo* studies employed a double-blind, placebo-controlled design involving Caucasian and Chinese study panels, conducted in accordance with GLP, GCP, and ethical principles defined in the Declaration of Helsinki. Participants provided written informed

consent and applied emulsions containing different concentrations of Ilex Extract over a specified period. The Caucasian panel used an emulsion containing 0.5% Ilex Extract once daily for 28 days, with measurements after 14 and 28 days, and some parameters 30 minutes post-application. The Chinese panel used an emulsion containing 1% Ilex Extract in a single application, with measurements after 30 minutes and 1 day.

Laser Doppler Flowmetry (Periflux LDPM PF5000) assessed changes in skin microcirculation and tissue partial oxygen pressure, while VISIA-CR analysis provided insights into skin redness and gloss. Skin hydration was measured by corneometry.

Statistics: Comparative analysis was performed using Wilcoxon signed rank test or Student's t-test

3. Results

Yerba mate, indigenous to South America, is customarily consumed in Brazil, Argentina, Uruguay, and Paraguay as a natural energy drink. It is acclaimed for its stimulating effects on the central nervous system due to a caffein content similar to coffee or green tea. It contains about 55 mg/100 ml caffeine [2,3]. The aqueous extract utilized in this study is manufactured by using mate leaf dust, a side stream of mate tea leaf production. This dust, generated by rapid drying of the leaves is usually discarded but used as an upcycling ingredient for the development of this cosmetic active ingredient. It contains approximately 13-fold the polyphenols, double the caffeine, and 8-fold the rutin compared to conventional mate tea preparations [2] (Table 1). Notably, anthraquinone contamination, present in some mate tea preparations [4], was absent.

	Brasilian mate tea	Ilex Extract
Compounds	Amount (mg / 100 ml)	Amount (mg/100 ml)
Total polyphenols	101	1350
Caffeine	55	135
Rutin	8	67

Table 1: Comparative analysis of compounds in yerba mate tea versus Ilex Extract.

Long-term studies of Ilex Extract revealed a significant enhancement in skin health and vitality. In the *in-vivo* study involving the Caucasian cohort, a substantial increase in skin microcirculation was observed, with a 59.1% improvement post 28 days of application (Figure

2). The active ingredient facilitated a 30% increase in microcirculation within 30 minutes, attributed to the vasodilatory effects of caffeine and polyphenols, potentially enhancing oxygen and nutrient delivery to the skin. Indeed, skin oxygenation exhibited marked improvement within 30 minutes, achieving a 40.5% increase after 28 days of daily application. Enhanced oxygen delivery supports cellular metabolism and energy production, vital for maintaining healthy skin function. In this study, skin firmness and elasticity as well as skin hydration were improved as well [5]. Here, we focus on new data raised from the Chinese study cohort tested for immediate effects.

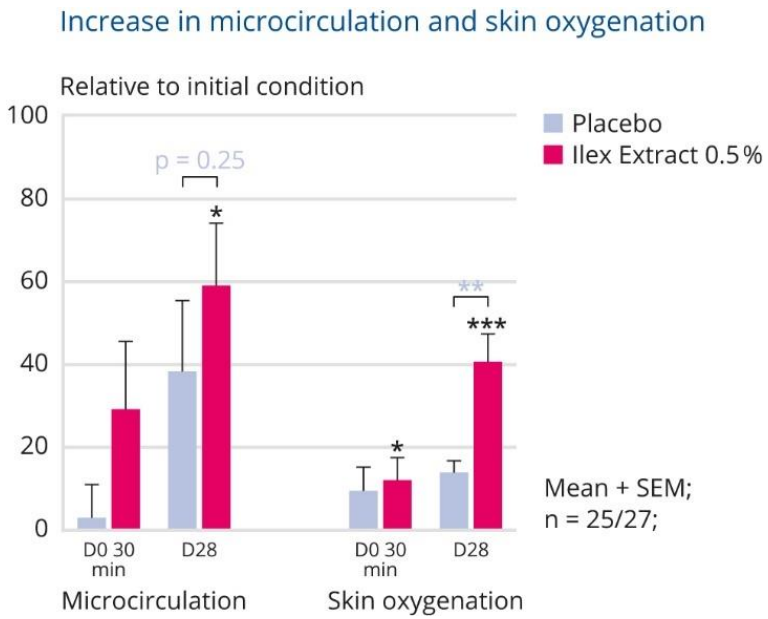

Figure 2: Laser Doppler analysis of microcirculation and transcutaneous partial oxygen pressure demonstrated significant increases following Ilex Extract application.

The Chinese cohort was tested with an emulsion containing 1 % Ilex Extract or not (placebo). Measurements were taken 30 minutes and 24 hours after a single application. VISIA-CR analysis of the red channel indicated a visible reduction in skin redness 30 minutes after application (Figure 3).

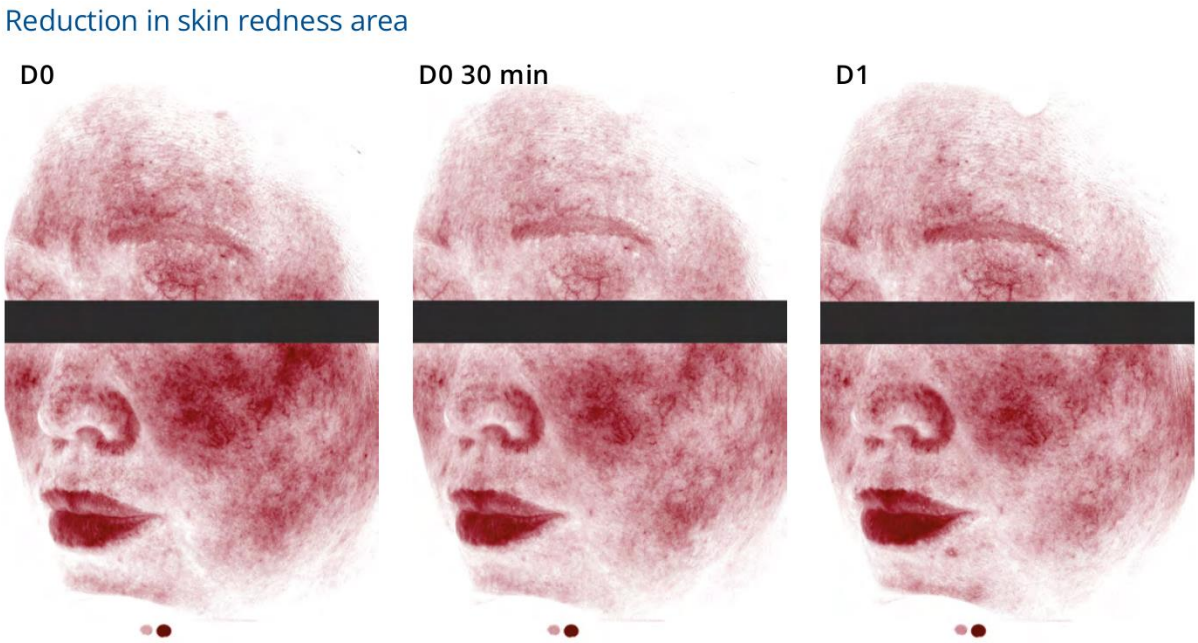

Figure 3: Ilex Extract reduces skin redness. Subject #24A, female, age 59 years, Ilex Extract 0.5%.

This outcome is unexpected, given that Ilex Extract enhances microcirculation, typically associated with increased skin redness. The effect lasted for more than 24 hours and was significant (Figure 4). It is in agreement of skin redness measured in the long-term study, though. Quantification revealed a 10 % reduction 30 minutes after application and a 7.8 % reduction 1 day after application.

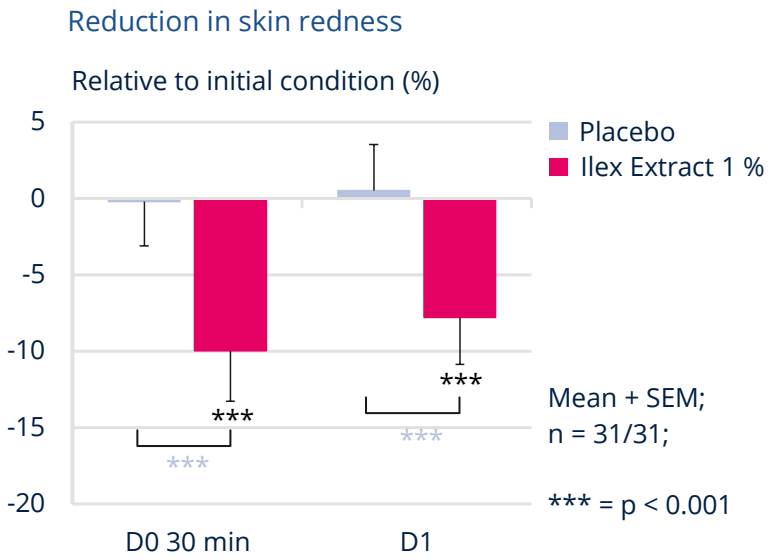

Figure 4: Ilex Extract instantly and significantly reduces skin redness.

Regarding skin hydration, Ilex Extract resulted in a 66.8 % increase after 30 minutes which was still increased by 40 % after 24 hours. Expectedly, placebo also had a significant effect but was clearly outperformed by verum (Figure 5).

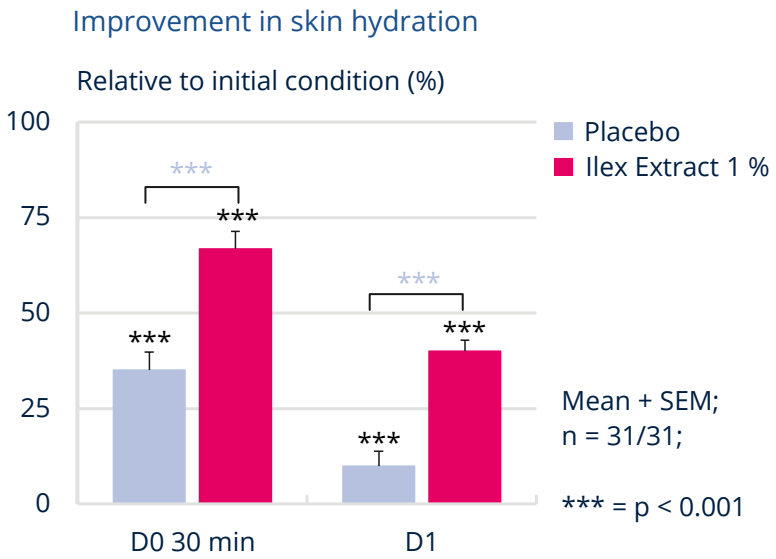

Figure 5: Ilex Extract instantly and significantly increases skin hydration for more than 24 hours.

Additionally, Ilex Extract improved skin gloss instantly as measured with a glossymeter. 30 minutes after application, skin gloss was increased by 18 %, lasting for at least 24 hours (Figure 6).

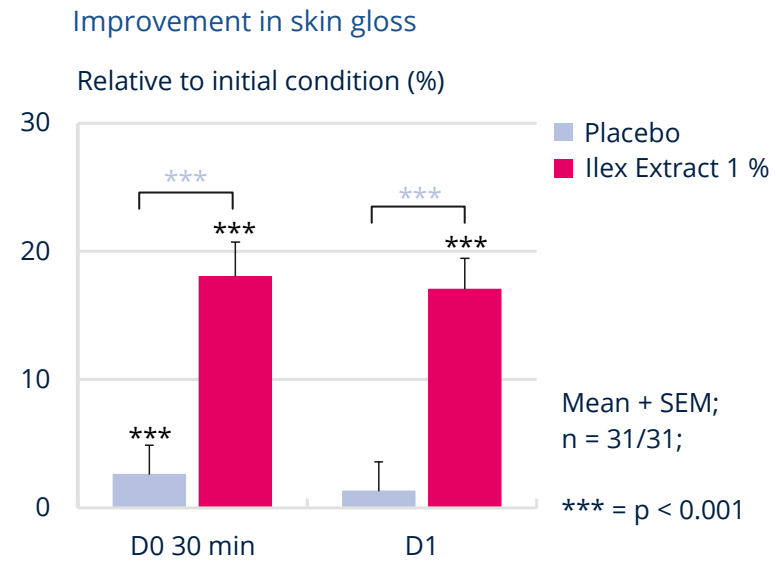

Figure 6: Ilex Extract instantly and significantly increases skin gloss for more than 24 hours.

4. Discussion

The results of the studies highlight the multiple benefits of Ilex Paraguariensis Leaf Extract in enhancing skin vitality and supporting healthy aging. The extract, derived from upcycled yerba mate residuals, offers a sustainable and potent solution for improving dermal and epidermal health through various mechanisms.

The enhancement of microcirculation and oxygenation observed in the *in-vivo* studies underscores the extract's ability to invigorate skin energy, crucial for maintaining cellular metabolism and overall skin health. The vasodilatory effects of caffeine and polyphenols facilitate increased blood flow and oxygen delivery, essential for cellular repair and regeneration. The unexpected reduction in skin redness, despite enhanced microcirculation, suggests a unique mechanism by which Ilex Extract modulates vascular responses, potentially through its antioxidant properties.

Improvements in skin barrier, skin hydration, firmness, and elasticity further highlight the extract's efficacy in fortifying the epidermis and enhancing dermal structural integrity. The increase in ceramide production observed in *in-vitro* studies supports these findings, indicating that Ilex Extract not only boosts moisture retention but also strengthens the skin's natural defence mechanisms. In line with these observations, an *in-vitro* study revealing mitochondrial protection strengthens the hypothesis of increased skin energy. The above mentioned results were published elsewhere [5].

The immediate effects observed in the Chinese cohort described here, including increased hydration demonstrate the extract's rapid action and lasting benefits for at least 24 hours. The enhancement of skin gloss further supports its role in improving skin appearance and vitality. While an increase in skin gloss over a longer period of time could be explained by a healthier epidermis, explanation for this quick result is more difficult for a plant based active ingredient. The analysed active compounds of Ilex Extract, caffeoylquinic acids, rutin and caffeine do not seem to be good candidates to immediately increase skin gloss. As the extract is quite concentrated in comparison with regular mate tea, some other ingredients may support skin appearance. However, the anti-oxidant properties of the polyphenols can be the reason for rapid reduction in skin redness. Immediate action on vasodilation and increase in skin oxygenation could be a result of caffeine penetration into skin. Caffeine, when applied to the

skin, penetrates relatively quickly, with studies indicating it can be detected in the blood within 5 minutes, especially when penetrating through hair follicles. The maximum absorption, however, appears to take about 100 minutes, based on research from human *in-vivo* studies [6], which would explain the higher effects after 28 days of use. While an increase in skin microcirculation is supposed to increase skin redness, we observed the opposite effect: reduction in skin redness. Studies on an active ingredient from *Helichrysum italicum* containing caffeoylquinic acids suggested a reduction in microcirculation [7]. As Ilex Extract contains both caffeine and caffeoylquinic acids, there might be a subtle balance of microcirculation increasing and reducing agents which are in favour of a slight increase in microcirculation without creating skin redness. In this way, the skin does not look irritated, although it gains more oxygen.

5. Conclusion

In conclusion, Ilex Paraguariensis Leaf Extract represents a valuable addition to skincare formulations aimed at enhancing dermal vitality and supporting healthy aging. Its sustainable production from upcycled materials aligns with eco-friendly practices, while its multifaceted benefits offer a comprehensive approach to improving skin health and appearance directly after application. Future research may further elucidate the molecular mechanisms underlying its effects and explore its potential applications in broader dermatological contexts.

6. References

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