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Novel Witch Hazel Formulation for Enhanced Skin Barrier and Reduced Inflammation

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1. Introduction

Witch hazel (*Hamamelis virginiana*) has a long history of use in dermatology due to its anti-inflammatory and antimicrobial properties[1,2]. Despite its benefits, conventional extraction methods typically involve alcohol or heat, which can degrade active tannins and introduce irritants, limiting its application for individuals with sensitive skin. The demand for gentle, effective botanical formulations that preserve bioactive compounds and support skin barrier function is increasing. This study aims to develop and evaluate a novel witch hazel formulation using a cold maceration process that avoids alcohol and heat, thereby maintaining the integrity of active compounds. The formulation also includes aloe vera and glycerin to enhance hydration and skin barrier support[3,4]. We investigated the formulation's anti-inflammatory and antioxidant properties through both *in vitro* and *ex vivo* studies. Additionally, we assessed its effects on skin hydration, barrier function, and consumer perception in clinical trials. These trials included participants with a variety of skin types, including sensitive skin.

2. Materials and Methods

2.1 Formulation Development

The witch hazel formulation evaluated in this study was developed using a unique cold maceration process. Locally sourced *Hamamelis virginiana* (witch hazel) was combined with aloe vera and glycerin, and the entire process was conducted without the use of heat or alcohol. This gentle, alcohol-free method was specifically chosen to preserve the integrity of witch hazel's tannins, which are known for their anti-inflammatory and antimicrobial properties. The resulting formula is cruelty-free, non-drying, and designed to be suitable for all skin types, including sensitive skin.

2.2 *In Vitro* and *Ex Vivo* Studies

Published studies have investigated the mechanism of action of witch hazel using both *in vitro* and *ex vivo* models[5]. *In vitro*, the formulation reduced key pro-inflammatory cytokines such as IL-6 and IL-8 in stimulated keratinocyte cells. *Ex vivo*, it significantly lowered inflammatory markers and improved barrier function proteins like loricrin and transglutaminase-1. The formulation also demonstrated strong antioxidant activity by decreasing UV-induced reactive oxygen species in human skin explants.

2.3 Clinical Studies

Clinical Study 1: Six-Week Efficacy Trial

The first clinical study was a six-week, open-label trial that included seventy-five female participants aged 19 to 57 years, of whom thirty-nine self-identified as having sensitive skin. Participants were instructed to apply the witch hazel formulation twice daily to their face. The primary endpoints were improvements in skin texture (both visual smoothness and tactile softness), pore appearance, and overall skin quality. These parameters were evaluated by expert clinical graders and through participant self-assessment at baseline, two weeks, four weeks, and six weeks.

Clinical Study 2: Hydration and Barrier Function Assessment

The second clinical study focused on objective measurements of skin hydration and barrier function. Twenty-five female participants aged 19 to 65 years, representing a diverse range of ethnic backgrounds, participated in this study. Skin hydration was measured using corneometry at baseline, 15 minutes, 4 hours, and 8 hours after product application. Transepidermal water loss (TEWL), an indicator of skin barrier integrity, was measured at baseline and one hour post-application. These measurements were performed on the volar forearm under controlled environmental conditions.

2.4 Consumer Perception Study

A consumer perception study was conducted with 200 participants representing all Fitzpatrick skin types (I–VI) and a balance of ethnic backgrounds. Participants were asked to evaluate the product's tolerability, sensory attributes, and perceived efficacy immediately after use, after one day, and after one week. Responses were collected using a structured nine-point Likert scale, with higher scores indicating more favorable perceptions,

3. Results

3.1 *In Vitro* and *Ex Vivo* Findings

Published *in vitro* studies show that the witch hazel formulation significantly reduced inflammatory cytokine expression (IL-1α, IL-1β, IL-6, IL-8, and PGE-2) in TNF-α-stimulated keratinocytes, with the greatest effects observed at 2% and 8% concentrations[5]. *Ex vivo*, the formulation prevented the development of an inflammatory phenotype in human skin explants, preserved normal tissue morphology, and restored barrier proteins such as loricrin and transglutaminase-1. The formulation also exhibited strong antioxidant activity by reducing UVA-induced ROS and lipid peroxidation. Collectively, these findings demonstrate the formulation's published anti-inflammatory, antioxidant, and barrier-supporting effects at both cellular and tissue levels.

3.2 Clinical Study 1: Six-Week Efficacy Trial

In the six-week clinical trial, the witch hazel formulation delivered statistically and clinically significant improvements in multiple aspects of skin quality(Table1). As early as week two, participants demonstrated significant improvements in skin texture, both in terms of visual smoothness and tactile softness, compared to baseline. These benefits continued to increase through weeks four and six. By week six, the formulation also produced significant improvements in the appearance of pores and overall skin quality, as assessed by expert graders. Importantly, among participants with sensitive skin, the product was well tolerated, with no reports of irritation or adverse effects. The reduction in visible erythema and the enhancement of overall skin appearance suggest that the formulation effectively soothes sensitive skin while improving its visual and tactile properties. These benefits align with consumer expectations for products that provide gentle yet noticeable improvements in skin health and appearance.

3.3 Clinical Study 2: Hydration and Barrier Function Assessment

The hydration and barrier function study confirmed the formulation's ability to deliver rapid and sustained improvements in skin moisture and barrier integrity. Corneometry measurements revealed a significant increase in skin hydration as early as 15 minutes post-application, with continued improvements observed at 4 and 8 hours. At the 8-hour mark, skin hydration was 32% higher than baseline, indicating long-lasting moisturization. In addition, TEWL measurements showed a significant reduction one hour after application, demonstrating enhanced barrier function. These results are particularly relevant for individuals with dry or compromised skin, as improved hydration and reduced TEWL are directly linked to a healthier, more resilient skin barrier.

Table 1. Clinical grading of efficacy parameters. Red/ Bold indicate statistical significance p≤0.05. Blue indicates statistically significant improvements.Negative mean percent change values indicate an improvement for all attributes.

Assessment	Time Point	n	Mean ± SD			Mean Change from Baseline (±SD)			Mean % Change from Baseline	% Subjects Showing Improvement	p-value
Skin texture smoothness	Baseline	75	3.52	±	0.68						
	Immediate	75	3.38	±	0.73	-0.14	±	0.24	-4.0%	27%	**<0.001**
	Week 2	75	3.16	±	0.73	-0.36	±	0.35	-10.2%	57%	**<0.001**
	Week 4	75	3.13	±	0.71	-0.39	±	0.38	-11.2%	65%	**<0.001**
	Week 6	75	3.05	±	0.71	-0.47	±	0.38	-13.4%	77%	**<0.001**
Skin texture softness	Baseline	75	3.47	±	0.68						
	Immediate	75	3.35	±	0.71	-0.11	±	0.23	-3.3%	21%	**<0.001**
	Week 2	75	3.03	±	0.76	-0.44	±	0.38	-12.7%	65%	**<0.001**
	Week 4	75	2.81	±	0.83	-0.65	±	0.46	-18.8%	80%	**<0.001**
	Week 6	75	2.70	±	0.80	-0.77	±	0.42	-22.1%	89%	**<0.001**
Appearance of pores	Baseline	75	4.22	±	0.89						
	Immediate	75	4.22	±	0.89	0.00	±	0.00	0.0%	0%	1.000
	Week 2	75	4.17	±	0.89	-0.05	±	0.16	-1.3%	11%	**0.008**
	Week 4	75	4.03	±	0.88	-0.19	±	0.26	-4.6%	37%	**<0.001**
	Week 6	75	3.91	±	0.91	-0.31	±	0.35	-7.3%	49%	**<0.001**
Overall skin quality / healthy appearance	Baseline	75	4.21	±	0.77						
	Immediate	75	4.20	±	0.78	-0.01	±	0.06	-0.2%	1%	1.000
	Week 2	75	4.01	±	0.81	-0.20	±	0.25	-4.8%	40%	**<0.001**
	Week 4	75	3.85	±	0.80	-0.35	±	0.29	-8.4%	64%	**<0.001**
	Week 6	75	3.74	±	0.79	-0.47	±	0.32	-11.1%	76%	**<0.001**

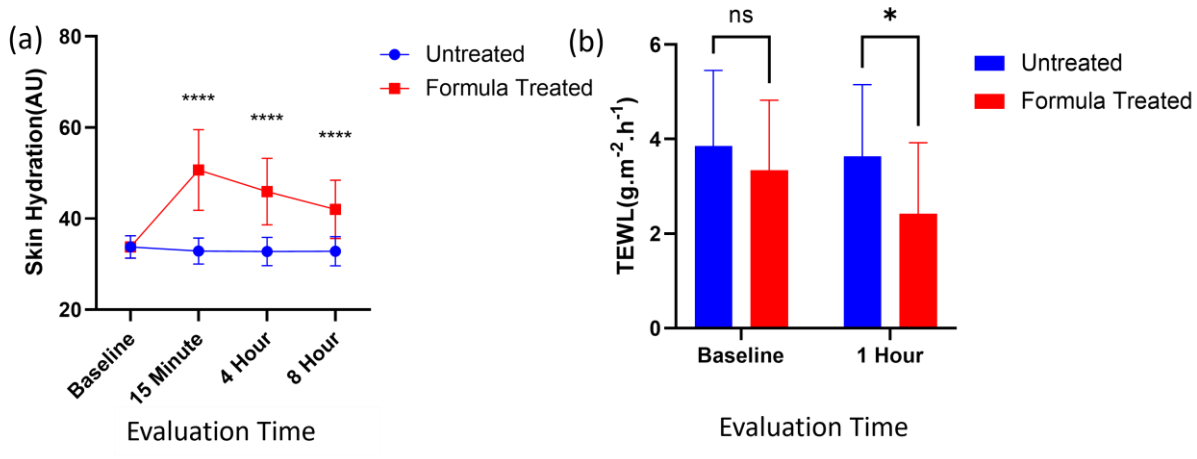
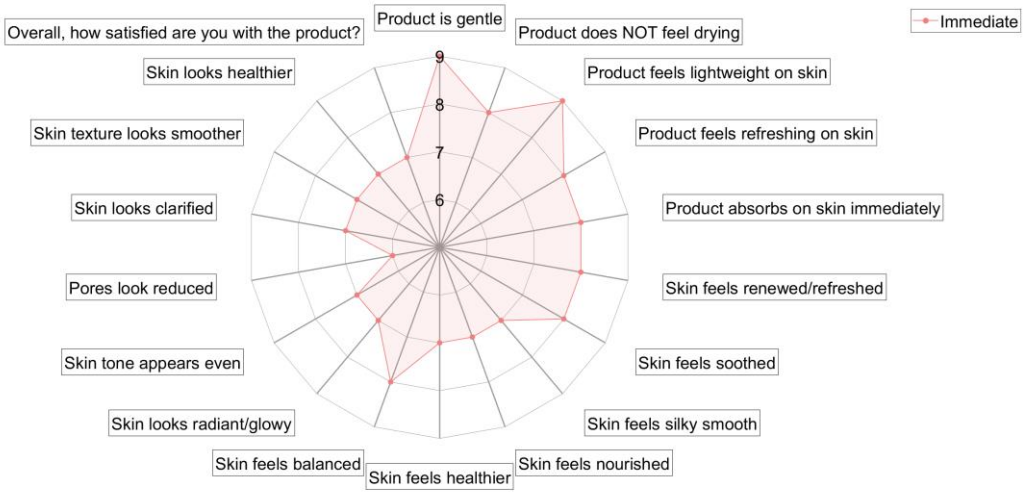


Figure 1. Significant improvement in skin hydration of the sites treated with witch hazel toner were found at 15 minutes, 4 hours, and 8 hours post application compared to baseline measurement and untreated site (a). Barrier function evaluation (TEWL) also confirmed that the application of witch hazel toner decreased TEWL level significantly compared to baseline and untreated site at 1 hour post application (b). 2way ANOVA, ns, $P > 0.05$, *, $P \leq 0.05$, **, $P \leq 0.01$, ***, $P \leq 0.001$, ****,$P \leq 0.0001$.

3.4 Consumer Perception Study

The consumer perception study provided further evidence of the formulation's broad appeal and efficacy. Participants across all skin types and ethnic backgrounds reported high levels of satisfaction with the product's texture, absorption, and sensory qualities. Immediately after use, most participants felt their skin was nourished, balanced, and soothed. After one week of use, a majority reported that their skin appeared healthier and more radiant. Notably, 94% of participants with sensitive skin reported no irritation, underscoring the formulation's suitability for this population. These positive perceptions reinforce the clinical findings, as well as the results from *in vitro* and *ex vivo* studies, and highlight the product's potential for widespread acceptance and use.

(a)



(b)

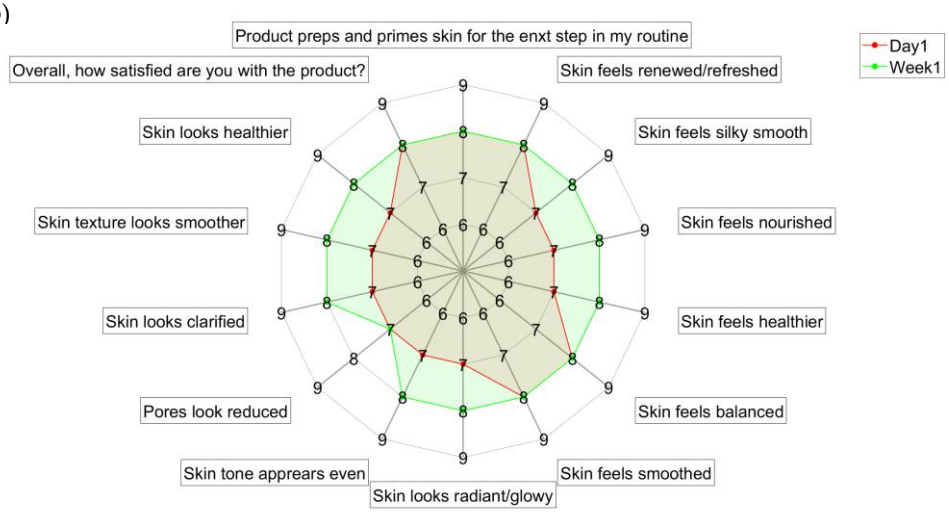


Figure 2. The novel witch hazel formula was well appreciated by consumers from a consumer study which included men and women from multiple ethnic backgrounds and all skin types (Fitzpatrick I-VI). Immediately after using the product (a), consumers felt that their skin feels nourished, balanced, and soothed and after 1 week of use consumers felt their skin looked healthier(b).

4. Discussion

The results of this comprehensive evaluation demonstrate that the novel witch hazel formulation provides significant skin benefits across multiple dimensions. The *in vitro* and *ex vivo* findings confirm that the formulation exerts potent anti-inflammatory and antioxidant effects, which are essential for maintaining skin health and preventing damage from environmental stressors. The restoration of barrier proteins and reduction of inflammatory cytokines at the tissue level translate directly to the clinical improvements observed in both studies.

The six-week efficacy trial showed that the formulation not only improves the visual and tactile qualities of the skin but also addresses common concerns such as pore appearance and overall skin health. These improvements are particularly meaningful for individuals with sensitive skin, who often struggle to find products that deliver results without causing irritation. The hydration and barrier function study further supports the formulation's ability to enhance skin moisture and reinforce the skin's natural protective barrier. These benefits are critical for preventing dryness, irritation, and the exacerbation of inflammatory skin conditions.

Consumer feedback aligns with the clinical and *in vitro* and *ex vivo* data, indicating that the product is well tolerated, pleasant to use, and effective in delivering the promised skin benefits. The high level of satisfaction reported by participants, especially those with sensitive skin, suggests that the formulation meets the needs of a diverse and demanding consumer base.

5. Conclusion

In conclusion, the integration of anti-inflammatory, antioxidant, and barrier-supporting properties in a gentle, alcohol-free witch hazel formulation represents a significant advancement in skincare. The demonstrated improvements in skin texture, hydration, and barrier function, coupled with excellent tolerability, position this product as a valuable option for individuals seeking effective and gentle solutions for healthy, resilient skin.

6. Reference

1. Thring, T. S., Hili, P. & Naughton, D. P. Antioxidant and potential anti-inflammatory activity of extracts and formulations of white tea, rose, and witch hazel on primary human dermal fibroblast cells. *J. Inflamm.* **8**, 27 (2011).
2. Trüeb, R. M. North American Virginian Witch Hazel (Hamamelis virginiana): Based Scalp Care and Protection for Sensitive Scalp, Red Scalp, and Scalp Burn-Out. *Int. J. Trichology* **6**, 100–103 (2014).
3. Fluhr, J. W., Darlenski, R. & Surber, C. Glycerol and the skin: holistic approach to its origin and functions. *Br. J. Dermatol.* **159**, 23–34 (2008).
4. Liu, X. & German, G. K. The effects of barrier disruption and moisturization on the dynamic drying mechanics of human stratum corneum. *J. Mech. Behav. Biomed. Mater.* **49**, 80–89 (2015).
5. Tamer-, X. L. & Li-, W. H. Revealing the Therapeutic Potential : Investigating the Impact of a Novel Witch Hazel Formula on Inflammation and Antioxidation. 1–9 (2025) doi:10.1111/jocd.16662.