Irritation and Redness in Sensitive Skin and Enhancing Skin Barrier Function"

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1. Introduction

Sensitive skin refers to a hyperreactive state that occurs under physiological or pathological conditions, where the skin is prone to symptoms such as burning, stinging, itching, and tightness when exposed to external stimuli. The causes of sensitive skin are complex[1], with psychological stress potentially triggering neurotensin release through reflex mechanisms, thereby inducing skin sensitivity. Edelweiss, a unique organic species selected from the high-altitude Alps, is extracted through advanced manufacturing processes using mountain spring water and fully recycled organic ethanol[2]. Our objective is to combine edelweiss with other natural organic ingredients to create a solution that effectively alleviates skin irritation and redness in sensitive skin while strengthening the skin barrier function.

2. Materials and Methods

In our current studies, we evaluated the soothing and reparative efficacy of three ingredients—edelweiss extract, oat beta-glucan, and olive leaf extract—through in vitro hyaluronidase inhibition assays and fibroblast scratch wound healing rate experiments, respectively.

2.1 Hyaluronidase Inhibition Assay

Materials:Hyaluronidase (BR)、Sodium hyaluronate (BR)、Dipotassium glycyrrhizinate
Methods:
2.1.1 Preparation of Controls and Test Samples
①Sample Group: Dilute the test sample with purified water to a final concentration of 0.05%.
②Positive Control (Dipotassium glycyrrhizinate): Dilute with purified water to a concentration of 3%.
③Negative Control: Purified water.
2.1.2 Experimental Procedure
Establish four groups: Sample Group, Sample Background Group, Solvent Group, and Solvent Background Group, each with three replicates. Add respective reagent solutions to each group, vortex thoroughly, and incubate at room temperature for 30 minutes for color development. Measure the absorbance at 528 nm using a UV spectrophotometer.
2.1.3 Result Calculation
Calculate the hyaluronidase inhibition rate of the samples based on the absorbance values using the designated formula, followed by statistical analysis.

2.2 Fibroblast Scratch Wound Healing Assay

Materials: MF52-N inverted fluorescence microscope、Mouse fibroblasts (3T3 cells)
Methods:
2.2.1 Preparation of Test Samples
①Sample Group: Dilute the test sample with purified water to a 5% solution, filter through a 0.22 μm filter, and collect the filtrate as the stock solution.
②Negative Controls: Basal culture medium（For cell viability assay）；Incomplete culture medium（For scratch assay）
③Positive Control: Basal culture medium.
2.2.2 Experimental Procedure
2.2.2.1 Cell Viability Assay: Seed 3T3 cells in a 96-well plate. After 24 h, remove the medium and replace with basal medium containing different concentrations of the test sample. Incubate for 24 h, then measure OD490 nm using the MTT assay. Analyze the impact of samples on cell viability via t-test.
2.2.2.2 Fibroblast Scratch Assay: Seed fibroblasts in a 6-well plate and culture for 24 h. Create a scratch in the cell monolayer using a sterile pipette tip. Replace the medium with: Basal culture medium（Positive control）、Incomplete culture medium（Negative control）、Medium containing the test sample（Sample group）. Observe and photograph cell migration at 0 h and 24 h post-scratch.
2.2.3 Result Calculation
Calculate the scratch wound healing rate using the designated formula and perform statistical analysis.

2.3 In Vivo Moisturizing, Soothing, and Reparative Efficacy Testing
Materials: 10% lactic acid、Courage+Khazaka skin hydration probe (Corneometer® CM825)、Khazaka transepidermal water loss (TEWL) probe (Tewameter™ TM300)、VISIA-CR imaging system with Image Pro Plus image analysis software
Methods:
2.3.1 Formulation Preparation: Combine the three active ingredients into a single skincare serum.
2.3.2 Sensitive Skin Screening via Lactic Acid Stinging Test: Apply 10% lactic acid to the nasolabial fold and one cheek under room temperature. Assess the stinging response at 0.5, 2.5, and 5 minutes using a 4-point scale (0 = no discomfort; 3 = severe stinging). Sum the scores from all three time points. Participants with higher total scores are classified as having sensitive skin.
2.3.3 28-Day Serum Application and Evaluation： Selected sensitive individuals apply the serum daily for 28 days. Perform regular follow-up assessments to measure: Stratum corneum hydration、Transepidermal water loss (TEWL) and Skin imaging (VISIA-CR) for visual analysis of redness and texture.
2.3.4 Result Calculation and Analysis：Evaluate the serum's efficacy based on Increased hydration levels (moisturizing effect)、Reduced TEWL values (barrier repair) and Image analysis (soothing effect via reduced redness/irritation). Perform statistical comparisons to validate significance.

3. Results

3.1 In vitro: The hyaluronidase inhibition rates and 24-hour fibroblast scratch wound healing rates of edelweiss extract, olive leaf extract, and oat beta-glucan are shown in the table and figure below. All three ingredients exhibited significant soothing and reparative effects.

Ingredient	Concentration	Hyaluronidase inhibition rate	Fibroblast scratch healing rate	P value

edelweiss extract	2%	40.517%	25.11%	0.05
olive leaf extract	0.01%	45.682%	10.52%	0.05
oat beta-glucan	0.05%	53.684%	30.53%	0.05

Table 1. The hyaluronidase inhibition rates and 24-hour fibroblast scratch wound healing rates of edelweiss extract, olive leaf extract, and oat beta-glucan

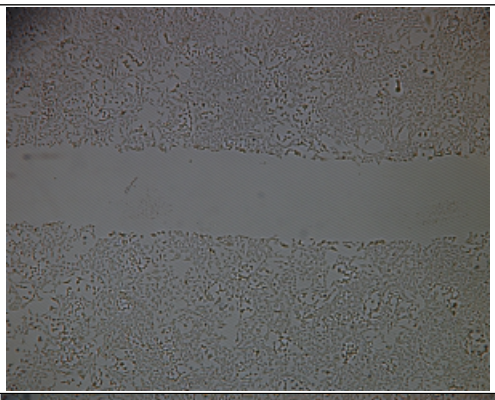
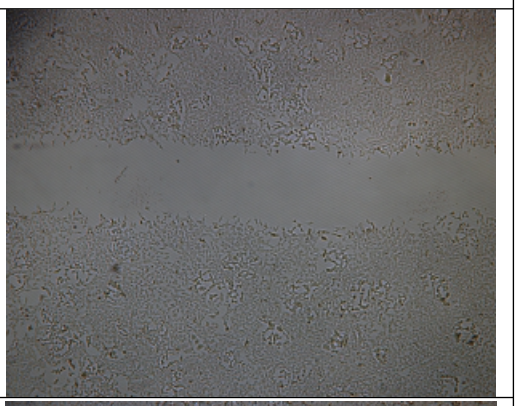
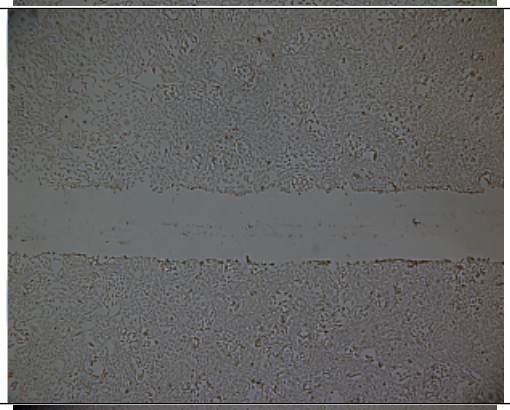
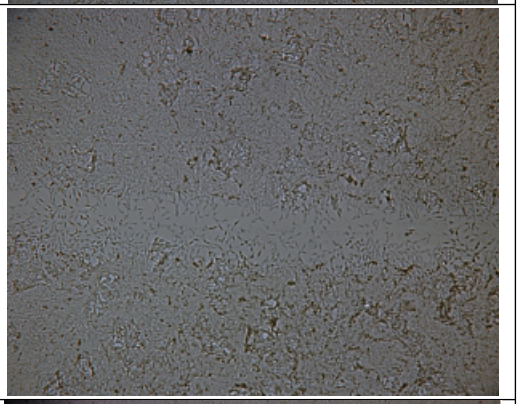
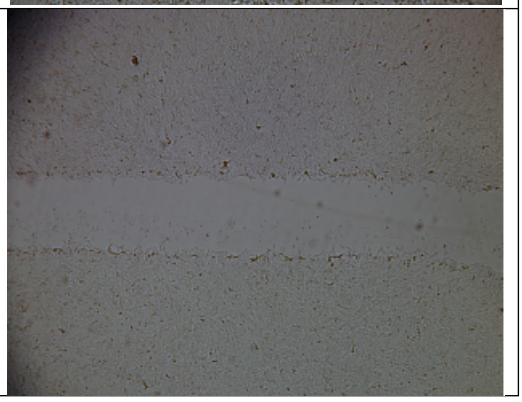
Group	Picture0h	Picture24h
Negative Controls		
Positive Control		
Sample Group		

Table 2. Fibroblast healing results of edelweiss extract

3.2 In vivo: The results of lactic acid stinging assessment scores, stratum corneum hydration levels, transepidermal water loss (TEWL) values, and facial image analysis for 36 Asian adult female subjects with sensitive skin, measured after single application and 28 days of continuous use of the product, are shown in the table below.

Evaluation parameters	Time points	Rate of change	P value
Skin stratum corneum moisture content	After 7 days of product application	15.73%	<0.001
	After 28 days of product application	35.20%	<0.001
Skin transepidermal water loss	After 7 days of product application	-14.35%	<0.001
	After 28 days of product application	-21.97%	<0.001
Skin color (red-green) values a* value	After 7 days of product application	-11.75%	<0.001
	After 28 days of product application	-15.14%	<0.001
Lactic Acid Tingling Assessment	After 15 minutes of product application	-29.79%	<0.001
	After 28 days of product application	-65.96%	<0.001

Table 3. The results of lactic acid stinging assessment scores, stratum corneum hydration levels, transepidermal water loss (TEWL) values, and facial image analysis

4. Discussion

As demonstrated by the in vitro results above, edelweiss extract, oat beta-glucan, and olive leaf extract each exhibited strong soothing and reparative effects. The skincare serum formulated with these three actives significantly reduced lactic acid stinging scores in individuals with sensitive skin. After sustained use, it also markedly increased skin hydration levels, decreased transepidermal water loss (TEWL) values, and lowered the a value (red-green axis)* in facial image analysis. These findings indicate that the combination of the three actives delivers exceptional moisturizing, soothing, and barrier-repairing efficacy, effectively enhancing the skin barrier function of sensitive skin and alleviating irritation-induced redness.

5. Conclusion

Edelweiss extract, oat beta-glucan, and olive leaf extract each demonstrate strong individual soothing and reparative properties. When combined synergistically, this trio exhibits enhanced efficacy in soothing and repairing sensitive skin, with long-term use significantly improving the tolerance and barrier function of sensitive skin. This study highlights that the edelweiss-based complex effectively alleviates irritation-induced redness in sensitive skin, offering an emerging natural organic solution that provides a novel direction for developing skincare formulations tailored to sensitive populations.

[1]Lulli.D, Potapovich A,Riccardo M, “Anti-Inflammatory Effects of Concentrated Ethanol Extracts of Edelweiss (Leontopodium alpinum Cass.) Callus Cultures towards
Human Keratinocytes and Endothelial Cells,” Mediators of Inflammation, Volume 2012, Article ID 498373
[2] Stefan. S, Rinaldo C, Christoph S ,et al., “Leontopodic acid—a novel highly substituted glucaric acid derivative from Edelweiss (Leontopodium alpinum Cass.) and its antioxidative and DNA protecting properties,” Tetrahedron 61 (2005) 4621–4630