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Preparation and Efficacy Evaluation of a Tibetan Gentiana Face Mask Suitable for Sensitive Skin

Luo Dan*

Tibet Autumn Girl Cosmetics Co., Ltd., Lasa, Xizang, 850000, China

Corresponding author: Luo Dan, luodanxizang123456@163.com

Abstract: This study aims to investigate the antioxidant activity of Tibetan gentian (Gentiana spp.) extract and its essence when compounded with a facial mask matrix. It also evaluates the efficacy of facial masks containing gentian extract on sensitive facial skin and analyzes the comprehensive performance of the mask. A total of 90 patients with facial sensitive skin, enrolled between October 2022 and December 2024, were randomly assigned to either a control group or an observation group, with 45 patients in each. The control group used standard facial masks, while the observation group used masks containing gentian extract. Both groups underwent a 4-week intervention. The efficacy, lactic acid stinging test indicators, and skin physiological function parameters were compared between the two groups. Results showed that the overall effectiveness rate in the observation group reached 93.26%, significantly higher than 71.20% in the control group ($P < 0.05$). After the intervention, both groups showed notable improvements compared to baseline in lactic acid stinging test scores and physiological skin indicators. Specifically, the observation group had significantly lower stinging scores and a longer latency before the onset of stinging compared to the control group. Moreover, the skin pH values were lower, while sebum levels and stratum corneum hydration were higher than those in the control group ($P < 0.05$). No serious adverse events occurred in either group. These findings suggest that facial masks containing gentian extract effectively alleviate symptoms of sensitive facial skin, enhance skin barrier function and tolerance, and are safe for use.

Keywords: Tibetan Gentian; Traditional Chinese Medicine Extract; Facial Mask Matrix Compounding; Antioxidant Activity; Sensitive Facial Skin

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Introduction

In recent years, plant-derived bioactive substances have been widely applied in the fields of food, medicine, and personal care due to their remarkable biological activities. Skincare products based on traditional herbal medicine are gaining significant traction in the global market owing to their natural properties and efficacy advantages [1]. China, with its abundant plant resources and well-established extraction technologies, has developed cosmetic ingredients that combine high efficiency and safety, forming a unique competitive edge in localized R&D. For example, Gentiana species, a distinctive medicinal plant from the Tibetan region belonging to the Gentianaceae family, is mainly distributed along the eastern edge of the Qinghai-Tibet Plateau and in the high-altitude areas of Gansu. It is a key component in many traditional Tibetan medicine formulations [2]. Despite its long history of traditional use, systematic research on this plant remains limited, with existing studies primarily focusing on the isolation and identification of its active constituents. Sensitive skin is characterized by a heightened reactive state, manifesting as burning, stinging, and often accompanied by objective symptoms such as erythema and desquamation. The core pathological mechanism is closely linked to impaired skin barrier function [3].

This study centers on the extract of Tibetan Gentiana as a core ingredient, combined with moisturizing and reparative excipients to develop a facial mask product. It systematically evaluates its antioxidant activity and clinical efficacy. By conducting comparative trials, this research aims to explore the mask's role in improving skin barrier function and to provide scientific support for the development of herbal cosmetics with both anti-sensitivity and reparative functions.

1.Materials and Reagents

1.1 Instruments and Equipment

Full-wavelength microplate reader (Boteng Instruments), Amenny skin tester (Shenzhen Fuheng).

1.2 Facial Mask Preparation

Tibetan Gentiana was sourced from a Chinese herbal medicine trading company, with in-lab extraction of the herbal components. The extract was prepared with a material-to-liquid ratio of 1:1. Moisturizing agents included sodium hyaluronate, 1,3-butylene glycol, glycerin, betaine, panthenol, 1,2-hexanediol, dipotassium glycyrrhizinate, and purified water, as well as EDTA-2Na, herbal extracts, xanthan gum, and p-hydroxyacetophenone.

The formulation ratios are detailed in Table 1. First, xanthan gum was swollen in an appropriate amount of purified water for 1 hour. Then, 40% of the total water volume was heated to 40°C in a beaker, followed by the sequential addition of sodium hyaluronate, the polyol mixture, chelating agents, and moisturizing actives. The mixture was stirred until completely dissolved. Xanthan gum was gradually incorporated while stirring continuously to form a gel matrix. After cooling, a phenylethanol-based preservative, hexanediol stabilizer, and the herbal active ingredient were added. The final product was obtained through homogenization and thorough mixing[4].

Table 1 Mask formula

Raw materials	Formula	Function
Xanthan gum	0.2	Thickener
Sodium hyaluronate	0.1	Moisturizer
1,3-butylene glycol	2.0	Moisturizer
Glycerin	2.0	Moisturizer
Sodium EDTA	0.1	Skin conditioner
Betaine	0.9	Moisturizer
Panthenol	1.0	Moisturizer
Parahydroxyacetophenone	0.8	Antioxidant
1,2-hexanediol	1.5	Moisturizer
Dipotassium glycyrrhizinate	0.1	Moisturizer
Traditional Chinese medicine extract	0.4	Skin conditioner
Purified water	Fill to 100.0	Moisturizer

A 10.00 mL sample of the Tibetan Gentiana facial essence was prepared, and a serial dilution method was used with deionized water to obtain solutions of 50%, 25%, 12.5%, 6.25%, and 3.125%. Superoxide anion scavenging activity was measured according to the standardized protocol of the assay kit. The absorbance of the original (100%) and diluted solutions (50%, 25%, 12.5%, 6.25%, and 3.125%) was recorded, with each concentration tested in triplicate to calculate the average values. The superoxide anion scavenging capacity and the half-maximal effective concentration (EC_{50}) were determined [5].

The moisturizing performance of the Tibetan Gentiana facial mask was evaluated under different humidity conditions. As shown in Figure 1, the hydration retention rate decreased over time at varying speeds depending on the ambient humidity. In an environment with 82% relative humidity, the mask exhibited excellent water-retention capacity. Over a 24-hour monitoring period, its moisture retention rate consistently remained above the 90% baseline, with the lowest observed value still reaching 95.38%. When the relative humidity was reduced to 42%, the mask maintained a stable retention rate above 80% for 24 hours, with a temporary dip to 86.72%. Overall, its moisture-retaining performance remained at an industry-leading level. Under constant temperature conditions, higher humidity slowed the decline in moisture retention, resulting in improved moisturizing efficacy [6].

Figure 1 Moisture Retention Variation

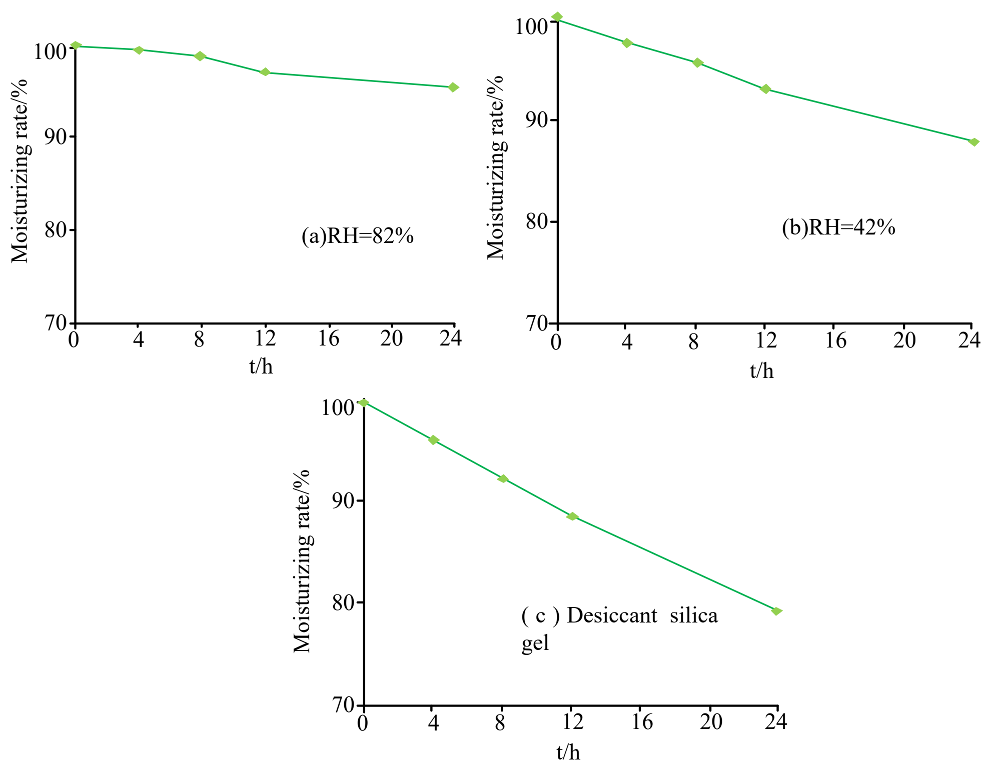

Figure 2. Free Radical Scavenging Activity of Tibetan Gentiana Facial Essence

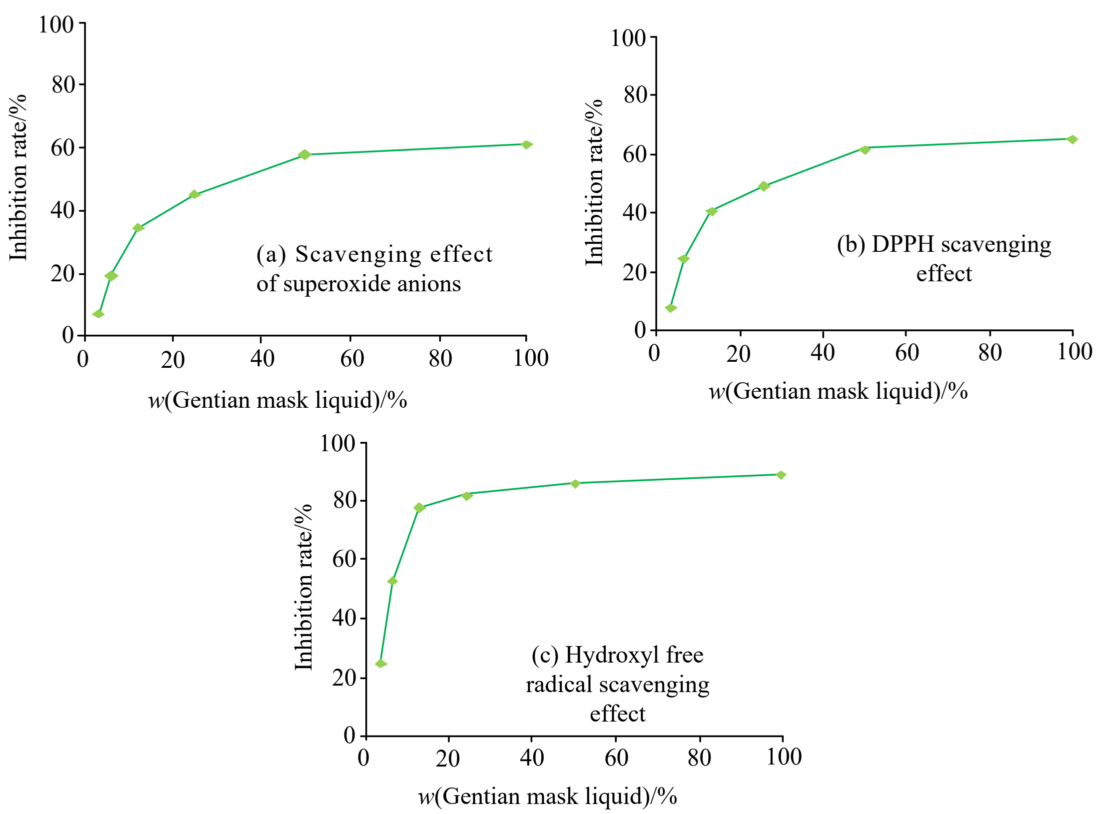

Figure 2 illustrates the free radical scavenging activity of the Tibetan Gentiana facial essence. The antioxidant efficacy of the Gentiana extract showed a significant dose-dependent relationship. At a concentration of 25%, the increase in hydroxyl radical scavenging rate began to plateau, with an incremental gain of less than 5%. When the concentration reached 50%, the scavenging curves for superoxide anion and DPPH radicals entered a plateau phase, with the slope decreasing to below 0.15. According to the in vitro antioxidant evaluation system, the half-maximal inhibitory concentrations (IC_{50}) of the facial essence for the three types of free radicals were determined to be 9.81% for superoxide anions, 3.42% for DPPH radicals, and 5.60% for hydroxyl radicals. These results suggest that the formulation possesses excellent free radical scavenging properties and demonstrates strong in vitro antioxidant activity [7].

2.Experimental Preparation

2.1 Study Subjects

This study enrolled 90 patients with clinically diagnosed facial sensitive skin who were admitted to the hospital between October 2022 and December 2024. Participants were randomly assigned into two groups using a random number table method.

In the control group (n = 45), the gender distribution was 1:2 (15 males, 30 females), with an age range of 18–50 years (mean age: 35.60 ± 4.76 years). The disease duration ranged from 6 to 30 months, with a median of 17.48 months. The observation group (n = 45) had comparable baseline characteristics: gender ratio of 2:3 (18 males, 27 females), mean age of 36.94 ± 4.52 years, and mean disease duration of 16.33 ± 4.18 months. Statistical analysis confirmed that the two groups were well balanced with respect to gender, age, and disease duration.

The study protocol was conducted in strict accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Review Committee, and all participants provided written informed consent and completed GCP-compliant training.

Inclusion criteria:

Clinically diagnosed with sensitive facial skin

Skin lesions confined to the facial area

Good treatment compliance and ability to follow the intervention protocol

Exclusion criteria:

Coexisting facial infectious dermatoses or other skin disorders

Serious cardiovascular, cerebrovascular, hepatic, renal, or coagulation disorders

Underwent aesthetic procedures or used hormone therapy, immunosuppressants, anti-infectives, or antihistamines within 30 days prior to enrollment

History of hypersensitivity to the study product

Presence of psychiatric disorders or cognitive impairment

Pregnant or breastfeeding women

The observation group received facial masks containing Tibetan Gentiana extract, while the control group used commercially available standard masks. Both groups applied the mask once nightly before bed for four consecutive weeks.

2.2 Observatory Parameters

This study established a therapeutic efficacy evaluation system based on relevant clinical standards, with efficacy categorized as follows:

Complete remission: efficacy index ≥90%

Marked improvement: efficacy index between 60% and 89%

Partial improvement: efficacy index between 30% and 59%

Ineffective: efficacy index <30%

The efficacy index was calculated using the formula:

Efficacy Index (%) = [(Pre-treatment subjective and objective score – Post-treatment score) / Pre-treatment score] × 100%

The total effective rate was defined as the percentage of patients achieving either complete remission or marked improvement.

Assessment Methods:

Lactic Acid Stimulation Test:

A 5% lactic acid solution (prepared at a 50% concentration) was evenly applied to the nasolabial folds and both cheeks before and after treatment. The onset time of stinging was recorded, and the degree of stinging was evaluated using the Visual Analog Scale (VAS). A score ≥3 was considered a positive reaction.

Skin Physiological Function Testing:

After facial cleansing and a 10-minute rest period, a non-invasive skin analysis device was used to simultaneously measure transepidermal water loss (TEWL), sebum secretion, stratum corneum hydration, and skin pH levels.

Safety Evaluation:

Throughout the study, all adverse events—including itching, erythema, dryness, and desquamation—were recorded to assess the safety profile of the intervention.

2.3 Data processing and statistics

SPSS 22.0 statistical analysis platform was used to complete data processing. The measurement indicators were described in the form of mean standard deviation $(x \pm s)$. The paired t test was used to analyze the data within the group, and the independent sample t test was used for inter-group comparison. The categorical variable data were presented as frequency (constituent ratio), and the x^2 test was used for inter-group comparison. All statistical inferences were based on (P<0.05) as the significance threshold.

3.Result analysis

3.1 Comparison of the effects of the mask after use

The efficacy of the observation group and the control group is shown in Table 2. The effective rate of the observation group is as high as 93.26%, and the total effective rate of the observation group is significantly higher than that of the control group (71.20%).

Table 2 Efficacy of observation group and control group [cases (%)]

Group	Completely improved	Significant improvement	Improve	Invalid	Total effective
Observation group (n=45)	24(53.14)%	18(40.02)%	3(5.76)%	0(0.00)%	41(93.26)%
Control group (n=45)	9(22.21)%	20(49.01)%	9(19.98)%	4(8.99)%	32(71.20)%
x^2 value	-	-	-		5.874
P value	-	-	-	-	<0.05

3.2 Lactic acid stimulation test

Table 3 compares the lactic acid stinging score and the onset time of lactic acid stinging. The research data show that there is no statistical difference between the two groups of subjects in the lactic acid stimulation score and the time of stimulation reaction (P<0.05). After intervention treatment, the pain assessment values of both groups of patients decreased significantly compared with the baseline level, and the latency of pain reaction showed a trend of extension. The lactic acid stinging score of the observation group was relatively lower than that of the control group (P<0.05), and the onset time of lactic acid stinging was longer than that of the control group (P<0.05).

Table 3 Comparison of lactic acid stinging scores and lactic acid stinging onset time $(x \pm s)$

Group	Lactic acid sting score/points		Lactic acid tingling sensation onset time/min	
	Before use	After use	Before use	After use
Observation group (n=45)	5.13 ± 0.82	1.05 ± 0.23*	3.45 ± 0.49	6.96 ± 0.83*
Control group (n=45)	5.11 ± 0.95	2.86 ± 0.39*	3.51 ± 0.54	5.1+ ± 0.62*
x^2 value	0.472	4.528	0.634	4.791
P value	0.518	<0.001	0.381	<0.001

Note: *Compared with the same group before use, P<0.05.

3.3 Comparison of skin function physiological parameters between groups

Before the intervention, there was no significant difference in the baseline data of core parameters such as transepidermal water loss (TEWL), sebum secretion, stratum corneum water holding capacity and skin surface pH value between the two groups of subjects (P>0.05). Compared with before use, the skin pH value and TEWL of the control group and the observation group were significantly reduced after use, and the sebum content and stratum corneum water content increased (P<0.05). The TEWL and skin pH value of the observation group were lower than those of the control group (P<0.05), and the sebum content and stratum corneum water content were significantly higher than those of the control group (P<0.05). Among them, * compared with the same group before use, P<0.05.

Table 4 Comparison of skin physiological function indicators between the two groups after use ($x \pm s$)

Group	TEWL/[g/(m²·h)]		Sebum content μg/ cm		Water content of stratum corneum %		Skin pH	
	Before use	After use	Before use	After use	Before use	After use	Before use	After use
Observation group (n=45)	24.36 ± 4.66	12.59 ± 1.32*	70.52 ± 3.25	78.05 ± 5.23*	52.17 ± 2.36	61.93 ± 4.35*	6.31 ± 0.35	5.16 ± 0.21*
Control group (n=45)	24.47 ± 4.79	17.52 ± 2.90*	70.48 ± 3.35	74.31 ± 3.59*	52.30 ± 2.81	58.90 ± 3.14*	6.27 ± 0.41	5.80 ± 0.30*
x^2 value	0.679	6.381	0.826	5.191	0.542	4.250	0.825	3.805
Group	0.375	<0.001	0.290	<0.001	0.482	<0.001	0.171	<0.001

4.Discussion

The facial mask containing Gentiana extract from the Tibetan region exerts significant therapeutic effects on sensitive skin through a multi-target synergistic mechanism. It effectively reduces facial inflammatory responses, alleviates discomfort symptoms such as capillary dilation, burning sensation, and stinging, and inhibits histamine release, thereby providing anti-allergic and anti-itch benefits[8]. Simultaneously, it stabilizes the skin tissue structure, enhances stratum corneum hydration, reduces transepidermal water loss (TEWL), stimulates collagen synthesis, and accelerates tissue repair—thus promoting the restoration of the skin barrier function[9]. Moreover, its antioxidant properties contribute to collagen regeneration, effective scavenging of free radicals, and the repair of damaged cells, leading to an overall improvement in skin physiological function[10].

The experimental findings indicate that the Gentiana-based mask significantly enhances the care efficacy for sensitive skin by improving physiological skin parameters and skin tolerance, all while maintaining a favorable safety profile. Future research should expand the clinical sample size to provide more robust evidence supporting its application in the scientific management of sensitive skin.

5.Conclusion

This study investigated the reparative effects of a topical preparation containing active compounds from high-altitude Gentiana on facial sensitive skin. Results demonstrated that the use of the Gentiana-infused mask significantly reduced skin irritation scores and delayed the onset of irritation responses. It also decreased TEWL and skin pH while increasing sebum secretion and stratum corneum hydration levels. These outcomes suggest a synergistic effect when combining routine skincare with a facial mask containing Gentiana extract, leading to improved efficacy and excellent skin tolerance. As a targeted anti-sensitivity agent, the active compound from Gentiana exhibits several advantageous properties, including high selectivity, rapid onset of action, sustained efficacy, and broad-spectrum anti-inflammatory activity. These characteristics underscore its potential value in the management of sensitive skin.

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no

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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