American Journal of Biochemistry and Biotechnology

Review

Preparation and Functional Evaluation of Compound *Bletilla striata* Essence

[1]Mengnan Zhu, [1]Jiameng Shen, [2]Hongju Zhang, [1]Hongli Zhou and [3]Yang Liu

[1]*School of Chemistry and Pharmaceutical Engineering, Jilin Institute of Chemical Technology, Jilin 132022, China*
[2]*Faculty of Science, China Pharmaceutical University, Nanjing, Jiangsu 211169, China*
[3]*School of Biology and Food Engineering, Changshu Institute of Technology, Changshu, Jiangsu 215500, China*

Article history
Received: 02-07-2022
Revised: 12-11-2022
Accepted: 21-12-2022

Corresponding Author:
Hongli Zhou
School of Chemistry and Pharmaceutical Engineering, Jilin Institute of Chemical Technology, Jilin 132022, China
Email: zhouhongli@jlict.edu.cn

And

Yang Liu
School of Biology and Food Engineering, Changshu Institute of Technology, Changshu, Jiangsu 215500, China
Email: liuyang84@126.com

Abstract: The purpose of this study was to prepare a multi-functional skin care product and apply more plant resources to the skin care industry. The crude polysaccharides from *Bletilla striata*, *Panax ginseng*, and *Tremella fuciformis* were extracted under different conditions based on the characteristics of the plants. The formula ratio of the compound *Bletilla striata* essence was optimized through an orthogonal experiment. The moisturizing, whitening, and antioxidant properties of the compound essence were evaluated by the weighing method, tyrosinase activity test, and DPPH free radical scavenging test, respectively. Finally, the improvement degree of skin condition was detected using a skin water and oil test instrument. The results showed that the polysaccharide contents of *Bletilla striata*, *Panax ginseng*, and *Tremella fuciformis* were 18.00±0.5, 41.70±0.7, and 20.25±0.6%, respectively. The optimal formula for the essence was: *Bletilla striata* extract 12 mg, *Panax ginseng* extract 8 mg, *Tremella fuciformis* extract 8 g, sodium hyaluronate 20 mg, and ultra-pure water 50 mL. The moisture retention rate of the essence was 80.00±3.0%, the tyrosinase inhibition rate was 69.04±2.2%, and the DPPH radical scavenging rate was 71.03±2.5%. The skin water and oil test results showed that the compound essence can increase skin moisture and reduce skin oil. The product can reduce the content of pores, stains, wrinkles, roughness, acne and pigmentation, and has the potential to become a functional, natural and safe skin care product.

Keywords: *Bletilla striata*, *Panax ginseng*, *Tremella fuciformis*, Compound essence, Functional Evaluation

Introduction

At present, many skin care products have water and chemical material majority and spices, preservatives, pigments, heavy metals, and other allergenic ingredients, but the effect is relatively single and the chemical components may more or less cause skin sensitivity or even allergy (González-Minero *et al*., 2018). Plant skin care products attract many beauty lovers with their mild and no irritation. Although plant skin care products can better penetrate the skin, the functional effect is slow. Among them, plant polysaccharides are always a research hotspot of cosmetic ingredients. Most plant polysaccharides have the characteristics of moisture absorption and moisture retention. In recent years, many natural plant whitening agents have been found, whose effects are equivalent to those of synthetic whitening agents, but they are safer, less toxic, even non-toxic, and have good biocompatibility. Plant polysaccharides can inhibit tyrosinase activity, reduce melanin content and have antioxidant activity *in vitro* (Chien *et al*., 2008). However, there are not many multifunctional plant products on the market.

Bletilla striata is a perennial herb with high ornamental and medicinal value, belonging to the *Bletilla* H. G. reichenbach genus of *Orchidaceae*. (Zhang *et al*., 2015). As a natural polymer film-forming material, *Bletilla striata* polysaccharide can be added to skin care products to play a moisturizing role and are capable of scavenging free radicals, whitening, lightening speckles, nourishing skin and delaying skin senescence are nontoxic and not irritative to skins (Xu *et al*., 2021). *Bletilla striata* polysaccharide can improve the activity of superoxide dismutase, which can neutralize the free radicals in the body, and maintain the oxidation balance which is a natural antioxidant (Ismy *et al*., 2022). Ginseng can improve skin antioxidant enzyme activity, increase collagen content and water content and reduce wrinkles (Meng *et al*., 2022). The main active ingredient in *Panax ginseng* is polysaccharides which have antioxidant activity, anti-inflammation, anti-allergy, and other activities (Zhang *et al*., 2021). Polysaccharides of *Tremella fuciformis* are rich in the hydroxyl group, carboxyl group, and other polar groups that can form hydrogen bonds with water molecules. The abundant bonded water forms a layer of protective films on the skin's surface. Hence, *Tremella fuciformis* has a moisturizing ability and is widely used in skin care products (Yang *et al*., 2021).

A compound essence will be prepared to enrich the moisturizing, whitening and antioxidant properties of the above three plants. To some extent, this product can make up for some product defects in the current market. The plant extract rich in polysaccharides was extracted by hot water extraction as the raw material of the essence. The formula was selected through single factor and orthogonal tests, and the functional evaluation such as moisturizing, whitening, antioxidant and human efficacy evaluation was conducted (Fig. 1). This study will provide new ideas for more plant resources to prepare skin care products.

Materials and Methods

Materials

Bletilla striata (Thunb. ex A. Murray) Rchb. and *Panax ginseng* C. A. Meyer was bought from Jilin City Longtan Pharmacy of Jilin Province. *Tremella fuciformis Berk* was purchased from Tomato Supermarket in the Longtan District of Jilin City. Sodium hyaluronate (cosmetic grade) was produced by Tianjin Damao Chemical reagent factory (Tianjin, China). Phenol (analytical grade) was bought from Tianjin Rgent Chemical Reagent Co., Ltd. Tyrosinase, L-tyrosine, and 1,1-Dipheny l-2-Picryl Hydrazinyl radical (DPPH) were all analytically pure (Aladdin, Holy City, Shanghai, China). Ultrapure water was used throughout. A certain type of commercial essence was used as the control, which was added with glycerol, sodium hyaluronate, and lotus leaf extracts.

Instruments and Equipment

A FA1004N electronic balance (Shanghai Jinghai Instrument Co., Ltd.), an HH-6 digital display therrmostat water bath (Guohua Electric Appliance Co., Ltd., China), and a 300 mm glass drier (Nanjing Kangluoda Science Co., Ltd.) were used. Other instruments included a 752N ultraviolet-visible spectrophotometer (Shanghai Jinghua Technology Instrument Co., Ltd. China), a DZF-6020 skin water oil detector (Shanghai Yiheng Technical Co., Ltd., China), and a LD6021A magic mirror system (Guangzhou Renren Beauty Equipment Co., Ltd.).

Methods

Preparation and Content Determination of Extracts

Since plant active ingredients are hydrolyzed at high temperatures and after long-time storage (Németh and Jánosi, 2019). The plant polysaccharides are mainly extracted by water since hot water extraction can largely preserve their original structures at low temperatures (He *et al*., 2018).

Bletilla striata extracts: Hot water immersed extraction, liquid-to-solid ratio 30:1, temperature 60℃ and extraction time 5 h (Wang *et al*., 2020); *Panax ginseng* extracts: Microwave-assisted method, liquid-to-solid ratio 30:1, temperature 70℃, extraction time 6 min and power 550 W (Maria *et al*., 2018); *Tremella fuciformis* berk extracts: Hot water immersed extraction, liquid-to-solid ratio 30:1, temperature 90℃ and extraction time of 3 h (Yang *et al*., 2019). The *Bletilla striata* extracts and *Panax ginseng* extracts were freeze-dried. Because of high viscosity, *Tremella fuciformis* berk extracts can be used as natural thickeners and thus were freeze-stored as sticking semiliquids.

The content of polysaccharides from the extracts was detected using a phenol-sulfuric acid method (Xi *et al*., 2010).

Screening of Essence Composition

Preparation of Essence

The extracts of *Bletilla striata*, *Panax ginseng*, and *Tremella fuciformis* were sequentially added to 50 mL of deionized water. The mixture was put into a thermostat water bath at 60℃ and stirred until complete dissolution. Then sodium carboxymethyl cellulose and sodium hyaluronate were added slowly until dissolution. After that, glycerol and 1,2-propylene glycol was added. Finally, the mixture was adjusted to suitable pH by adding triethanolamine and was stirred evenly.

Single-Factor Test

The optimum conditions of single factors were determined using four-factor five-level tests, in which one factor was changed while the other three factors were fixed at constant levels.

The constant levels of *Bletilla striata* extract, *Panax ginseng* extract, *Tremella fuciformis* berk extract, and sodium hyaluronate were 12, 10, 10, and 20 mg respectively. The tested levels were: Dosage of *Bletilla striata* extract: 8, 10, 12, 14, 16 mg, the dosage of *Panax ginseng* extract: 4, 6, 8, 10, 12 mg, dosage of *Tremella fuciformis* berk extract: 4, 6, 8, 10, 12 g and dosage of sodium hyaluronate: 16, 18, 20, 22, 24 mg.

The essence solutions as prepared were put at 40±2-15±2℃, or natural illumination for 24 h. Then the changes in color, status, layering, and grains among different

DOI: 10.3844/ajbbsp.2023.1.11

temperatures were observed and comprehensively scored. The comprehensive score of physicochemical properties is 100, in which color, status, layering, and grains each account for 25. The concrete standards are listed in Table 1. Each experiment was repeated three times.

Orthogonal Test

On basis of the single-factor tests, four-factor three-level orthogonal tests (Table 2) were conducted to further screen the doses of *Bletilla striata* extract (A), *Panax ginseng* extract (B), *Tremella fuciformis* berk extract (C) and sodium hyaluronate (D). The optimal composition was determined.

Function Evaluation

Detection of Moisture Absorption Rate and Moisture Retention Rate of Essence with the Weighing Method

To investigate the moisturizing effect of the essence, the moisture absorption rate and moisture retention rate were measured by weighing method (Li *et al*., 2017).

Detection of moisture absorption rate: A control sample and the essence (each 10 g) were weighed and put into the drier at 20±2°C and 81% humidity (Saturated solution of ammonium sulfate). After 2, 4, 8, 12, 24, 36, 48, or 72 h, weigh and determine the moisture absorption rate. The moisture absorption formula is:

$$\frac{W_1 - W_2}{W_2} \times 100\% \tag{1}$$

In the type:

W_1: Weight of essence after a certain time

W_2: Original weight of essence

Detection of moisture retention rate: At room temperature, a control sample and the essence (each 10 g) were weighed and put inside the dryer with silica gel. After the same periods stated above, the samples were weighed to determine the moisture retention rate. The moisture retention formula is:

$$\frac{W_2}{W_1} \times 100\% \tag{2}$$

Tyrosinase Activity Suppression in Vitro

To investigate the whitening effect of the essence, four solutions of tyrosinase solution, l-tyrosinase solution, sample solution, and PBS solution were used according to Table 3 to determine the tyrosinase inhibition rate.

The compound essence was diluted into five concentrations: 0.2, 0.4, 0.6, 0.8, and 1.0 mg/mL. The L-tyrosine solution, sample solution, and PBS solution solutions were added into the test tube in order as shown in Table 3. Then, tyrosinase solution was added and mixed well. The obtained solution was centrifuged at 4500 r/min for 10 min at 37℃ for 20 min. 200 μL of the supernatant was added to the 96 well plates and the absorbance was measured at 475 nm with the microplate reader. The positive control group was the arbutin solution and the determination method was the same as that of the essence sample (Jiménez-Pérez *et al*., 2018). The tyrosinase inhibition rate is calculated by the following formula:

$$1 - \frac{A_3 - A_4}{A_1 - A_2} \times 100\% \tag{3}$$

In the type:

A_1: Absorbance value of the system containing only substrate and tyrosinase

A_2: Absorbance value containing only substrate

A_3: Absorbance value of the system containing only substrate, tyrosinase, and inhibitor

A_4: Absorbance value of the system containing only substrate and inhibitor

Determination of DPPH Radical Scavenging Rate

To determine the antioxidant activity of the essence, DPPH free radical scavenging method was used.

Preparation of 0.04 mg/mL DPPH solution: 2 mg of DPPH powder was added to the scale of 50 mL volumetric flask with absolute ethanol. 2 mL of DPPH solution was mixed with 2 mL of the essence of different concentrations (0.2, 0.4, 0.6, 0.8, 1.0 mg/mL). The mixed solution was kept at room temperature for 30 min and was centrifuged at 4500 r/min for 10 min. The supernatant measured the absorbance at 517 nm (Zhao *et al*., 2023). The DPPH radical scavenging rate is calculated by the following formula:

$$1 - \left(A_1 - A_2\right) / A_0 \times 100\% \tag{4}$$

In the type:

A_0: Absorbance value of 2 mL absolute ethanol +2 mL DPPH solution

A_1: Absorbance value of 2 mL sample solution +2 mL DPPH solution

A_2: Absorbance value of 2 mL sample solution +2 mL absolute ethanol

Human Efficacy Test

Sixty subjects were chosen and divided into 6 groups. Each subject used 5 mg of the essence at the same skin position for all subjects. After 5, 10, 15, 30, 60, and 90 min, the water and oil concentrations on the skin were measured using the water and oil analyzer. The subjects smeared the essence (5 mg each time) after washing both in the morning and at night. Before starting to use the essence, the subjects were tested with the instrument system in terms of splash, pigment, and moisture on the face. After 30 days of use, they were tested again. Then the data before and after the use were compared.

Table 1: Evaluation criteria for physical and chemical properties

		Score		
Number	Property	Good (18-25)	Modest (9-17)	Bad (0-8)
1	Color	Uniform color, transparent luster	Uniform color, transparent luster	Nonuniform color, non-transparent luster
2	Status	Smooth and even surface, good luster	A few agglomerates, slightly bad luster	Many infusible agglomerates, bad luster
3	Layering	No evident layering, uniform distribution	Partial layering, uniform distribution	Evident layering, nonuniform distribution
4	Grains	No evident grains, clear veins	A few grains, clear veins	Evident grains, unclear veins

Table 2: Level table of orthogonal factors

Factor/level	*Bletilla striata* extract /mg (A)	*Panax ginseng* extract /mg (B)	*Tremella fuciformis* Berk extract /g (C)	Sodium hyaluronate /mg (D)
1	15	5	4	16
2	20	10	6	18
3	25	15	8	20

Table 3: Reaction solution preparation scheme

	The volume of reaction liquid/mL			
Test solution	1	2	3	4
Tyrosinase solution	0.1	0.1	0.1	0.1
L-tyrosine solution	0.1	0.1	0.1	0.1
Sample solution	-	-	0.1	0.1
PBS solution	0.4	0.5	0.3	0.4
Total	0.6	0.6	0.6	0.6

Statistical Analysis

The results were represented as mean ± standard deviation of three separate experiments. Statistical analyses were carried out by SPSS 17.0 (SPSS Inc, Chicago, USA). One-way Analysis of Variance (ANOVA) was used by GraphPad Prism. Significant differences were set at *P*<0.05.

Results and Discussion

Detection of Plant Polysaccharides

To prevent the *Bletilla striata* polysaccharides from being destroyed, a low-temperature extraction method was chosen. A low liquid-to-solid ratio was selected to shorten the drying time and the extraction time was prolonged to improve the extraction rate. All these measures will maximally reserve the concentrations and diversity of crude polysaccharides in the plants. Results showed the extracted polysaccharide content from *Bletilla striata, Panax ginseng,* and *Tremella fuciformis* were 18.00±0.5, 41.70±0.7 and 20.25±0.6% respectively; *Tremella fuciformis* extract was not dried into powder for its high viscosity and was concentrated into semi-viscous liquid, to decrease the destruction of active ingredients.

Single-Factor Tests

The effects of a dose of *Bletilla striata* extract, *Panax ginseng* extract, or *Tremella fuciformis* extract on the physicochemical property scores were illustrated in Fig. 2 and 3.

The physicochemical property score is optimized when the doses of *Bletilla striata* extract, *Panax ginseng* extract, *Tremella fuciformis* extract, and sodium hyaluronate were 12, 8, 8, and 20 mg respectively (Fig. 2 and 3), which were adopted in the subsequent orthogonal tests.

Orthogonal Test

According to Table 2, the extract and supplementary material were proportionally added to 50 mL of ultrapure water and prepared the essence. Table 4 shows the results of the orthogonal experiment.

Based on visual analysis, range analysis shows the effects of different factors on the comprehensive sensory score rank as B>D>A>C. The optimal composition of the essence is determined to be: 12 mg of *Bletilla striata* extract, 8 mg of *Panax ginseng* extract, 8 g of *Tremella fuciformis* berk extract, and 20 mg of sodium hyaluronate, which are consistent with the results of single-factor tests. It is proved that the selection of polysaccharide types and the optimal composition are attributed to the film-forming ability of *Bletilla striata* polysaccharides, the moisture absorption of *Panax ginseng* polysaccharides, the viscosity of *Tremella fuciformis* berk polysaccharides and the lubricating and thickening abilities of sodium hyaluronate. All these abilities maximize the physicochemical property comprehensive score of the final essence in terms of color, status, layering, and grains.

Function Evaluation

Measurement of Moisture Effect

The moisture retention rates of the essence and the control group are 80±3.0, and 75.32±2.5% respectively (Fig. 4 and 5), which is because the synergistic effect of

DOI: 10.3844/ajbbsp.2023.1.11

Bletilla striata extract, *Panax ginseng* extract, and *Tremella fuciformis* extract makes the essence more capable of absorption and retain moisture.

Moisturizing is generally considered the first step to combat skin aging and other problems. The outermost stratum corneum of the skin is a barrier between the external environment and the internal environment, which can prevent water loss and foreign body invasion. Plant polysaccharides can form a film on the skin surface by absorbing moisture in the air and playing a moisturizing role (Li *et al*., 2022). Both *Bletilla striata* polysaccharides and *Panax ginseng* polysaccharides have excellent moisture-reserving abilities (Thacker *et al*., 2020) and *Tremella fuciformis* polysaccharides can bind with the hydrogen in water molecules and are highly capable of locking and reserving water. Moreover, sodium hyaluronate with high water solubility (Ma *et al*., 2021) can prevent moisture loss and moisturize skin. Hence, the formulation of *Bletilla striata*, *Panax ginseng*, *Tremella fuciformis*, and sodium hyaluronate can promote nutrient absorption and well protect moisture. The cosmetic moisturizing rate of ginseng-mediated nanoparticles was 75.6% (Jiménez-Pérez *et al*., 2018). It shows that this essence has a better moisturizing effect.

In-vitro Tyrosinase Activity Test

Age spots, pigmentation, and regional skin darkening are caused by excessive melanin secretion, which is inhibited by tyrosinase and is the most commonly used whitening pathway (Burger *et al*., 2016). The tyrosinase inhibition rates of *Bletilla striata* extract, *Panax ginseng* extract, and *Tremella fuciformis* extract were 48.70±1.5, 52.02±2.0, and 11.85±0.3%, respectively. The tyrosinase inhibition rates of the essence and the control group are 69.04±2.2 and 31.72±2.0% respectively. In the study of the preparation and evaluation of the atractylodes peeling powder mask by (Zou *et al*., 2020), the tyrosinase inhibition rate was 49.09%. Skin color is mainly determined by melanin content. Controlling the production of melanin is very important for skin color. However, *Bletilla striata* extracts can inhibit melanin formation (Luo *et al*., 2022) and *Panax ginseng* prevents the transcription factors or signaling pathways involved in melanin formation (Kim *et al*., 2022), inhibiting melanin formation and achieving the whitening effect. Moreover, *Tremella fuciformis* polysaccharides bind with the residues outside the active center of tyrosinase and thus weaken tyrosinase activity, decreasing melanin formation and achieving the whitening effect (Park *et al*., 2015). The essence can better inhibit the synthesis of tyrosinase and has a whitening effect.

Antioxidant Activity

The mechanism of antioxidant activity measured by the DPPH method is that it acts directly on free radicals to prevent further reactions.

When the essence concentration was 1.0 mg/mL, the DPPH• clearance rate was 71.03±2.5%, which was higher than that of the control group (30.14±2.0%). Polysaccharides of *Bletilla striata*, *Panax ginseng*, and *Tremella fuciformis* all can clear away DPPH•. Moreover, polysaccharide concentration is positively correlated with the free radical clearance rate (Wang *et al*., 2020b; Li *et al*., 2021; Wen *et al*., 2016). *Bletilla striata* polysaccharide can protect damaged tissues from oxidative damage (Gou *et al*., 2022). *Panax ginseng* polysaccharide can enhance the antioxidation ability of the body, remove excessive free radicals in the body, reduce the degree of peroxidation of tissue cells, protect the skin from oxidative damage and play an anti-aging role. In the evaluation of the atractylodes peering powder mask by Zou *et al*. (2020) DPPH, the radical scavenging rate was 59.41%. The results show that this compound essence can better remove DPPH free radicals and can be used for aging.

Table 4: Results of the orthogonal experiment

	Influence factor				
No.	A	B	C	D	One-hour moisturizing rate %
1	1.0	1.0	1.0	1.0	14
2	1.0	2.0	2.0	2.0	32
3	1.0	3.0	3.0	3.0	28
4	2.0	1.0	2.0	3.0	26
5	2.0	2.0	3.0	1.0	19
6	2.0	3.0	1.0	2.0	20
7	3.0	1.0	3.0	2.0	22
8	3.0	2.0	1.0	3.0	25
9	3.0	3.0	2.0	1.0	17
k1	20.7	16.7	24.7	19.6	
k2	25.3	24.7	21.7	25.0	
k3	21.7	26.3	21.3	23.0	
Range R	4.6	9.6	3.4	5.4	
Ranking	B>D>A>C				

Table 5: Skin water and oil test table

Time/(min)	Water/oil contents in group 1 (%)	Water/oil contents in group 2 (%)	Water/oil contents in group 3 (%)	Water/oil contents in group 4 (%)	Water/oil contents in group 5 (%)	Water/oil contents in group 6 (%)
0	31.2/26.4	29.8/16.5	31.5/16.2	26.1/37.9	12.6/16.3	14.2/26.1
5	37.6/20.8	32.8/15.7	34.4/14.5	30.4/22.5	13.1/13.6	20.5/25.3
10	39.9/17.7	33.9/14.1	36.1/12.0	33.7/21.2	15.2/12.4	29.8/23.5
15	37.5/15.2	32.7/13.6	35.5/11.5	32.9/20.3	15.1/12.0	28.6/20.2
30	36.3/14.4	31.7/13.6	34.6/10.8	30.5/18.5	14.6/11.5	25.3/19.5
60	33.5/13.5	31.0/14.9	34.2/11.6	29.5/16.4	13.5/11.5	20.3/18.6
90	32.2/13.1	30.9/16.2	33.5/12.4	28.7/15.7	13.2/10.1	18.7/17.6

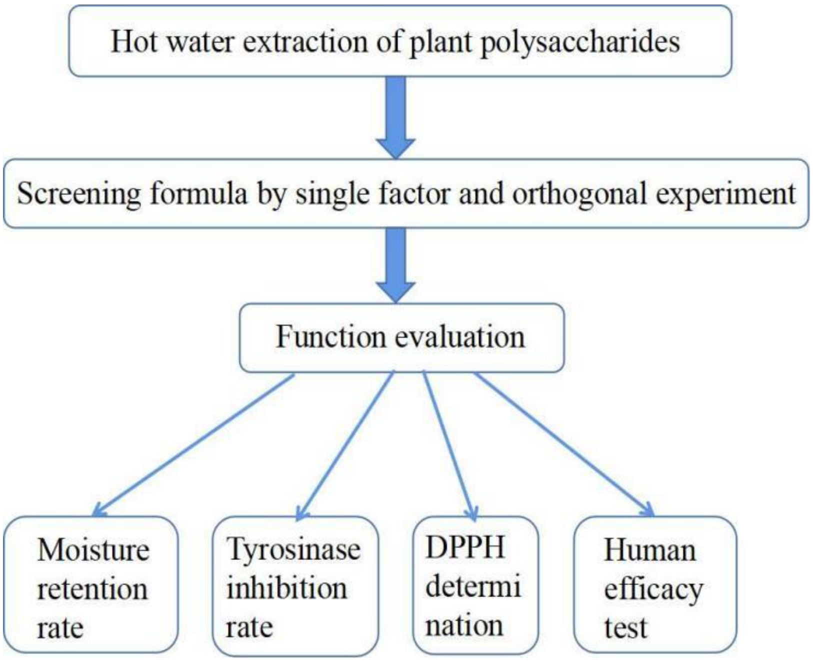

Fig. 1: The flow chart of the experiment methods

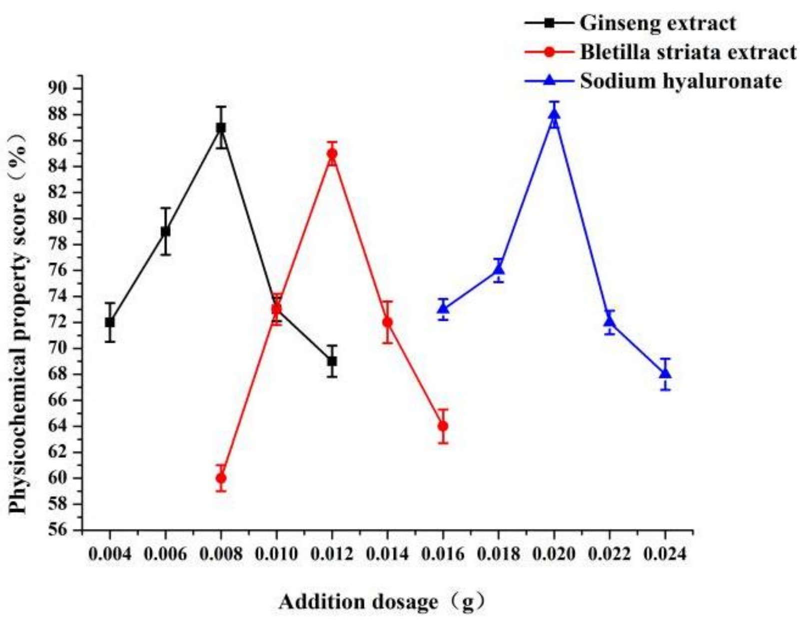

Fig. 2: Effect of dosage of *Bletilla striata, Panax ginseng* extract, and sodium hyaluronate on physicochemical properties score

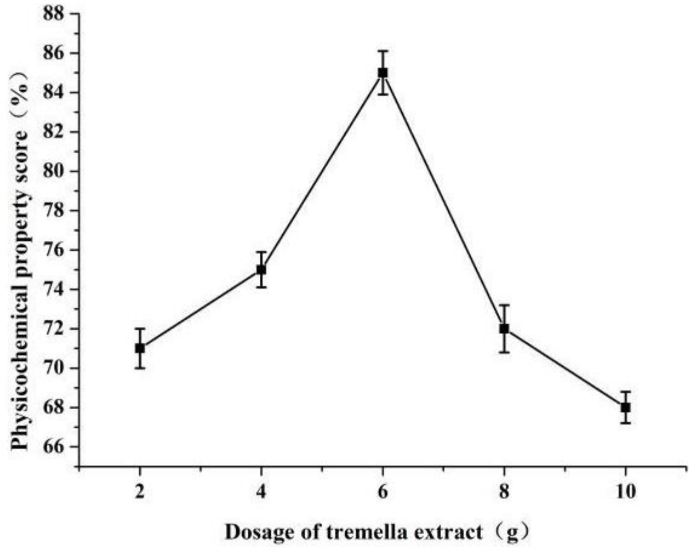

Fig. 3: Effect of dosage of *Tremella fuciformis* extract on physicochemical properties score

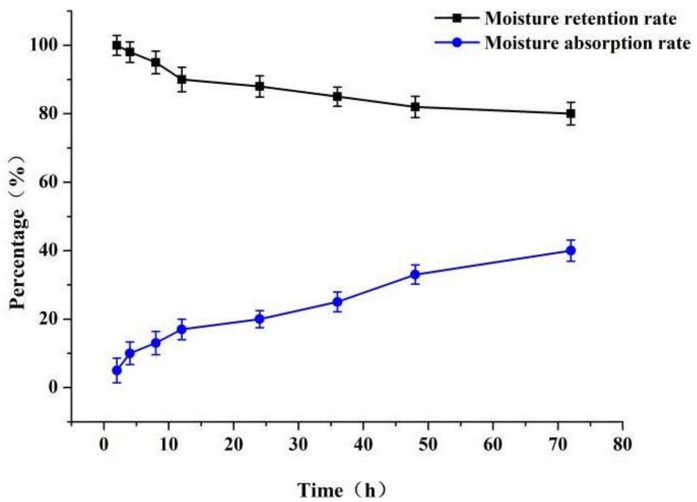

Fig. 4: Moisture retention and moisture absorption rate of the essence

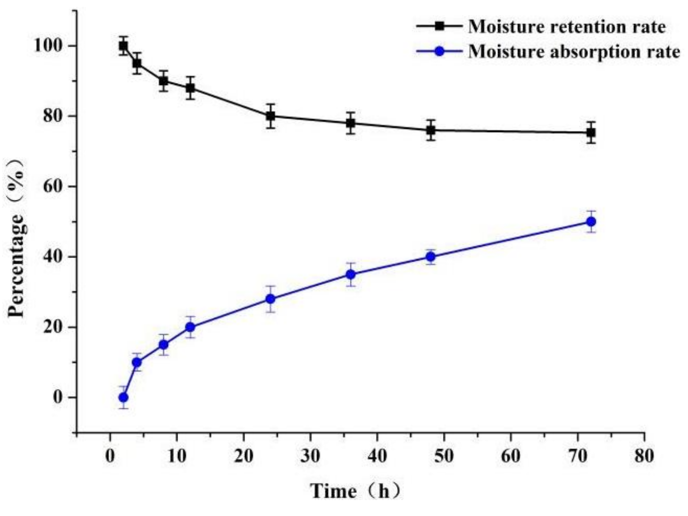

Fig. 5: Moisture retention and moisture absorption rate of the control group

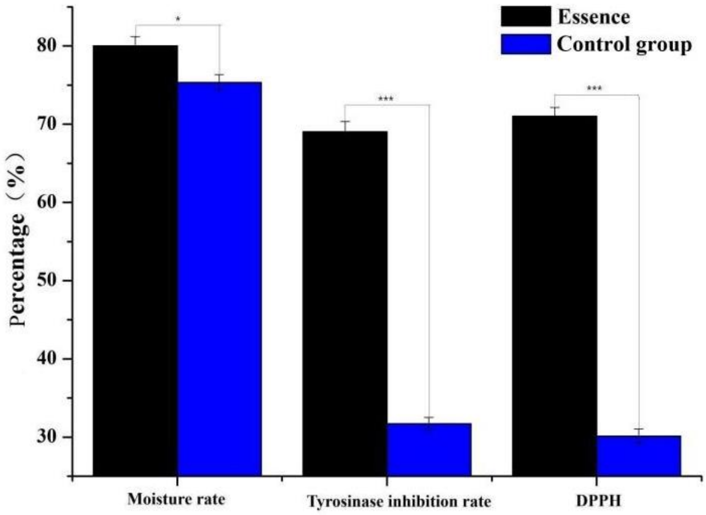

Fig. 6: Comparison of three effects of the compound essence

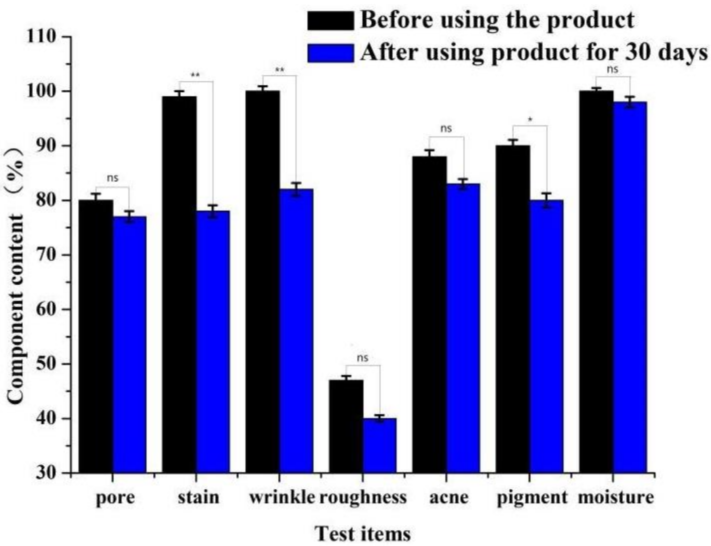

Fig. 7: Statistical difference before and after using this essence for 30 days

Statistical Difference

The statistical comparison between the essence and the control group in terms of moisture retention, whitening, and antioxidation is shown in Fig. 6. Compared with the control group, the moisture retention rates were significantly different between groups (0.01<*P*<0.05) and both tyrosinase inhibition ratios and DPPH• clearance rates were very significantly different between groups (*P*<0.01).

Skin Efficacy Evaluation

The skin oil levels in all 6 groups of subjects decreased after the use of the product (Table 5). The moisture levels gradually increased within 10 min, stabilized within 10-15 min, and slowly decreased after 15 min. The moisture levels after 90 min were still higher than that before the use of this product. The water-soluble moisturizing ingredients of plant extracts absorb and retain moisture mainly through hydrogen bonding with hydroxyl or phenolic hydroxyl group, providing skins with water. Because of their excellent film-forming ability, polysaccharides construct wet-protecting barriers on the skin, decreasing water evaporation, and achieving a moisturizing effect (Wang *et al*., 2020).

The human test results of this product are shown in Fig. 7. After one month of using the compound essence, the subject's wrinkle decreased by 15.3% and pore decreased by 3.8%, the subject's wrinkles in the literature using the facial mask 4 weeks were reduced by 4.8% and pore was reduced by 3.1% (Park *et al*., 2021). At the same time, the component contents of skin stain, roughness, acne, and moisture were decreased, but those of the pore, roughness, acne, and moisture level were not significantly different. The component contents of stain and wrinkle are very significantly different ($P<0.01$), and pigment levels are significantly different ($0.01<P<0.05$). This was because the moisture content detected here was the water under the surface layer and due to the short use time, the deeper layers of the skin are slightly less hydrated. Hence, this essence has a remarkable effect on improving skin. The main reason is that *Bletilla striata* can form flexible films on the skin surface, which prevent moisture loss from the skin (Chen *et al*., 2022). *Panax ginseng* extracts can increase the density of dermal cells, relieve epidermis proliferation, promote cell proliferation and decrease skin wrinkles (Park *et al*., 2016). *Panax ginseng* extract can regulate the level of matrix metalloproteinase in type I collagen of human fibroblasts and improve skin elasticity and moisture (Meng *et al*., 2022). *Tremella fuciformis* polysaccharides can increase water content in the skin epidermis, improve skin roughness and dispel facial freckles (Lourith *et al*., 2021). Sodium hyaluronate with high transdermal absorption ability is not irritative and makes skins feel flat and wet (Shin *et al*., 2016). Results show formulation of various extracts in rich polysaccharides at a certain ratio can well protect moisture and moisturize skin, regulate water-oil balance in skin and improve skin quality.

Conclusion

The purpose of this study is to prepare safe and effective skincare products that meet the expectations of the public and to develop a variety of plant resources for the preparation of skin care products. The extracted polysaccharide contents from *Bletilla striata*, *Panax ginseng*, and *Tremella fuciformis* by hot water under different conditions were 18.00±0.5, 41.70±0.7, and 20.25±0.6%, respectively. The moisture retention rate, tyrosinase inhibition ratio, and DPPH clearance rate of the essence prepared from the extracts were 80.00±3.0, 69.04±2.2, and 71.03±2.5%, respectively, which prove the essence has multifunctional effects of moisturizing, whitening and anti-oxidation and can improve water-oil balance in skins and surface pigments and wrinkles. The above results show that natural plants can exhibit a variety of biological activities. The synergistic use of plant polysaccharides not only ensures the safety of the product, but also improves the slow action characteristics of traditional skin care products. This essence meets the public pursuit for natural skin care products and can be referred to in selecting, extracting, and formulating plant polysaccharide types for skin care products in the future. Moreover, the natural plants selected for the products are widely planted and cheap, which makes the products have high promotion and application value.

Acknowledgment

The Ultraviolet spectrometry data were obtained using equipment maintained by Jilin Institute of Chemical Technology Center of Characterization and Analysis.

Funding Information

This research is supported by the science and technology planning project of 2021, Suzhou Science and Technology Bureau (Grant No. SNG2021017) and Scientific Research Foundation for Advanced Talents, Changshu Institute of Technology (Grant No. KYZ2020045Q).

Author’s Contributions

Mengnan Zhu: Responsible for experimental data analysis, chart processing, and manuscript writing.

Jiameng Shen: Collection and summary of experimental data.

Hongju Zhang: Responsible for experimental operation.

Hongli Zhou: Experimental designed and modification of manuscript.

Yang Liu: Revision of manuscript.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and that no ethical issues are involved.

References

Burger, P., Landreau, A., Azoulay, S., Michel, T., & Fernandez, X. (2016). Skin whitening cosmetics: Feedback and challenges in the development of natural skin lighteners. *Cosmetics*, *3*(4), 36. https://doi.org/10.3390/cosmetics3040036

Chien, C. C., Tsai, M. L., Chen, C. C., Chang, S. J., & Tseng, C. H. (2008). Effects on tyrosinase activity by the extracts of Ganoderma lucidum and related mushrooms. *Mycopathologia*, *166*(2), 117-120. https://doi.org/10.1007/s11046-008-9128-x

Chen,T. Y., Guo, X. Y., Huang, Y. P., Hao, W. T., Deng, S. Y., Xu, G. W., Bao, J. J., Xiong, Q. S., & Yang, W. (2022). *Bletilla striata* polysaccharide-Waterborne polyurethane hydrogel as a wound dressing. *Journal of biomaterials science. Polymer Edition*, 11-13. https://doi.org/10.1080/09205063.2022.2157673

González-Minero, F. J., & Bravo-Díaz, L. (2018). The use of plants in skin-care products, cosmetics and fragrances: Past and present. *Cosmetics*, *5*(3), 50. https://doi.org/10.3390/cosmetics5030050

Gou, K. J., Li Y., Qu Y., Li H., & Zeng R. (2022). Advances and prospects of *Bletilla striata* polysaccharide as promising multifunctional biomedical materials. *Materials & Design*, 223, 111198-111215. https://doi.org/10.1016/j.matdes.2022.111198

He, L., Yan, X., Liang, J., Li, S., He, H., Xiong, Q., ... & Huang, S. (2018). Comparison of different extraction methods for polysaccharides from Dendrobium officinale stem. *Carbohydrate Polymers*, *198*, 101-108. https://doi.org/10.1016/j.carbpol.2018.06.073

Ismy, J., Syukri, M., Emril, D. R., Sekarwana, N., & Ismy, J. (2022). Superoxide Dismutase Reduces Creatinine and NGAL by Restoring Oxidative Balance during Sepsis. *Emerging Science Journal*, *6*(2), 286-294. https://doi.org/10.28991/ESJ-2022-06-02-06

Jiménez-Pérez, Z. E., Singh, P., Kim, Y. J., Mathiyalagan, R., Kim, D. H., Lee, M. H., & Yang, D. C. (2018). Applications of *Panax ginseng* leaves-mediated gold nanoparticles in cosmetics relation to antioxidant, moisture retention and whitening effect on B16BL6 cells. *Journal of Ginseng Research*, *42*(3), 327-333. https://doi.org/10.1016/j.jgr.2017.04.003

Kim, J. H., Kim, T. I., & Ma, J. Y. (2022). Synergistic effects of novel herbal decoctions from *Panax ginseng* and Morus alba on tyrosinase activity and melanogenesis *in vitro*. *Heliyon*, *8*(2), e08866. https://doi.org/10.1016/j.heliyon.2022.e08866

Li, Y., Ma, Z., Yang, X., Gao, Y., Ren, Y., Li, Q., ... & Zeng, R. (2021). Investigation into the physical properties, antioxidant and antibacterial activity of *Bletilla striata* polysaccharide/chitosan membranes. *International Journal of Biological Macromolecules*, *182*, 311-320. https://doi.org/10.1016/j.ijbiomac.2021.04.037

Li, Y., Zhang, G., Du, C., Mou, H., Cui, J., Guan, H., ... & Wang, P. (2017). Characterization of high yield exopolysaccharide produced by Phyllobacterium sp. 921F exhibiting moisture preserving properties. *International Journal of Biological Macromolecules*, *101*, 562-568. https://doi.org/10.1016/j.ijbiomac.2017.03.089

Li, Z. W., Du, Z. M., Wang, Y. W., Feng, Y. X., Zhang, R., Yan, X. B. (2022). Chemical Modification, Characterization, and Activity Changes of Land Plant Polysaccharides: A Review. *Polymers*, *14*(19), 4161. https://doi.org/10.3390/polym14194161

Lourith, N., Pungprom, S., & Kanlayavattanakul, M. (2021). Formulation and efficacy evaluation of the safe and efficient moisturizing snow mushroom hand sanitizer. *Journal of Cosmetic Dermatology*, *20*(2), 554-560. https://doi.org/10.1111/jocd.13543

Luo, Y., Wang, J., Li, S., Wu, Y., Wang, Z., Chen, S., & Chen, H. (2022). Discovery and identification of potential anti-melanogenic active constituents of *Bletilla striata* by zebrafish model and molecular docking. *BMC Complementary Medicine and Therapies*, *22*(1), 1-14. https://doi.org/10.1186/s12906-021-03492-y

Ma, X., Yang, M., He, Y., Zhai, C., & Li, C. (2021). A review on the production, structure, bioactivities and applications of Tremella polysaccharides. *International Journal of Immunopathology and Pharmacology*, *35*, 20587384211000541. https://doi.org/10.1177/20587384211000541

Meng, H., Liu, X. K., Li, J. R., Bao, T. Y., & Yi, F. (2022). Bibliometric analysis of the effects of ginseng on skin. *Journal of Cosmetic Dermatology*, *21*(1), 99-107. https://onlinelibrary.wiley.com/doi/abs/10.1111/jocd.14450

Maria, C. P., Alejandro R., Antonio M., & Dolores R. (2018). Effect of thermal treatment, microwave, and pulsed electric field processing on the antimicrobial potential of açaí (Euterpe oleracea), stevia (Stevia rebaudiana Bertoni), and ginseng (*Panax quinquefolius* L.) extracts. *Food Control*, *90*, 98-104. https://doi.org/10.1016/j.foodcont.2018.02.022

Németh, Á., & Jánosi, S. (2019). Extraction of steviol glycosides from dried Stevia rebaudiana by pressurized hot water extraction. *Acta Alimentaria*, *48*(2), 241-252. https://doi.org/10.1556/066.2019.48.2.12

Park, K. M., Kwon, K. M., & Lee, S. H. (2015). Evaluation of the antioxidant activities and tyrosinase inhibitory property from mycelium culture extracts. *Evidence-Based Complementary and Alternative Medicine*, *2015*. https://doi.org/10.1155/2015/616298

Park, M., Kim, H., Kim, S., Lee, J., Kim, S., Byun, J. W., ... & Park, K. H. (2021). Changes in skin wrinkles and pores due to long-term mask wear. *Skin Research and Technology*, *27*(5), 785-788. https://doi.org/10.1111/srt.13019

Park, S. Y., Shin, Y. K., Kim, H. T., Kim, Y. M., Lee, D. G., Hwang, E., ... & Yi, T. H. (2016). A single-center, randomized, double-blind, placebo-controlled study on the efficacy and safety of "enzyme-treated red ginseng powder complex (BG11001)" for antiwrinkle and proelasticity in individuals with healthy skin. *Journal of ginseng research*, *40*(3), 260-268. https://doi.org/10.1016/j.jgr.2015.08.006

Shin, E. J., Park, J. W., Choi, J. W., Seo, J. Y., & Park, Y. I. (2016). Effects of molecular weights of sodium hyaluronate on the collagen synthesis, anti-inflammation and transdermal absorption. *Journal of the Society of Cosmetic Scientists of Korea*, *42*(3), 235-245. https://doi.org/10.15230/SCSK.2016.42.3.235

Thacker, M., Tseng, C. L., Chang, C. Y., Jakfar, S., Chen, H. Y., & Lin, F. H. (2020). Mucoadhesive *Bletilla striata* polysaccharide-based artificial tears to relieve symptoms and inflammation in rabbit with dry eyes syndrome. *Polymers*, *12*(7), 1465. https://doi.org/10.3390/polym12071465

Wang, B., Xu, Y., Chen, L., Zhao, G., Mi, Z., Lv, D., & Niu, J. (2020). Optimizing the extraction of polysaccharides from *Bletilla* ochracea schltr. using response surface methodology (RSM) and evaluating their antioxidant activity. *Processes*, *8*(3), 341. https://doi.org/10.3390/pr8030341

Wang, S., Zhao, H., Qu, D., Yang, L., Zhu, L., Song, H., & Liu, H. (2022b). Destruction of hydrogen bonding and electrostatic interaction in soy hull polysaccharide: Effect on emulsion stability. *Food Hydrocolloids*, *124*, 107304. https://doi.org/10.1016/j.foodhyd.2021.107304

Wen, L., Gao, Q., Ma, C. W., Ge, Y., You, L., Liu, R. H., ... & Liu, D. (2016). Effect of polysaccharides from *Tremella fuciformis* on UV-induced photoaging. *Journal of Functional Foods*, *20*, 400-410. https://doi.org/10.1016/j.jff.2015.11.014

Xu, J., Chen, Z., Liu, P., Wei, Y., Zhang, M., Huang, X., ... & Wei, X. (2021). Structural characterization of a pure polysaccharide from *Bletilla striata* tubers and its protective effect against H2O2-induced injury fibroblast cells. *International Journal of Biological Macromolecules*, *193*, 2281-2289. https://doi.org/10.1016/j.ijbiomac.2021.11.060

Xi, X. G., Wei, X. L., Wang, Y. F., Chu, Q. J., & Xiao, J. B. (2010). Determination of tea polysaccharides in Camellia sinensis by a modified phenol-sulfuric acid method. *Archives of Biological Sciences*, *62*(3), 669-676. https://doi.org/10.2298/ABS1003669X

Yang, D., Lian, J., Wang, L., Liu, X., Wang, Y., Zhao, X., ... & Hu, W. (2019). The anti-fatigue and anti-anoxia effects of Tremella extract. *Saudi Journal of Biological Sciences*, *26*(8), 2052-2056. https://doi.org/org/10.1016/j.sjbs.2019.08.014

Yang, M., Zhang, Z., He, Y., Li, C., Wang, J., & Ma, X. (2021). Study on the structure characterization and moisturizing effect of Tremella polysaccharide fermented from GCMCC5. 39. *Food Science and Human Wellness*, *10*(4), 471-479. https://doi.org/10.1016/j.fshw.2021.04.009

Zhang, Y., Hou, B., Zhang, W., & Ding, X. (2015). Isolation and characterization of novel microsatellite markers for *Bletilla striata* and inter-specific amplification in 2 congeneric species. *Conservation Genetics Resources*, *7*(2), 483-485. https://doi.org/10.1007/s12686-014-0401-7

Zhang, X. Y., Liu, Z. J., Zhong, C., Pu, Y. W., Yang, Z. W., & Bao, Y. X. (2021). Structure characteristics and immunomodulatory activities of a polysaccharide RGRP-1b from radix ginseng Rubra. *International Journal of Biological Macromolecules*, *180*, 980-992. https://doi.org/10.1016/j.ijbiomac.2021.08.176

Zhao, Z., Wang, L., Ruan, Y., Wen, C., Ge, M., Qian, Y., & Ma, B. (2023). Physicochemical properties and biological activities of polysaccharides from the peel of Dioscorea opposita Thunb. extracted by four different methods. *Food Science and Human Wellness*, *12*(1), 130-139. https://doi.org/10.1016/j.fshw.2022.07.031

Zou, Y., Jing, P., & Dan, Y. (2020). Preparation and Evaluation of Atractylodes Peeling Powder Mask[J]. *Guangdong Chemical Industry*. 47(13), 58-60. https://doi.org/10.1016/j.powtec.2020.03.041