

# Research on the Application of Silk Protein Masks in the Sensitive Skin Market

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**Abstract:** Silk fibroin is the main component of silkworm silk. A single silk filament is formed by bonding two parallel silk fibroin monofilament fibers, and the substance in the middle and outer periphery of the fibers that plays a role in bonding and wrapping is sericin. The content of silk fibroin protein accounts for 70–80% of silk, while sericin protein accounts for 20–30%. The silk fibroin obtained by removing sericin from silk contains 18 types of amino acids, including 8 essentials for the human body. Among them, amino acids such as glycine, alanine, serine, tyrosine, which have moisturizing and radiation protection functions, account for more than 80% of the total 18 types of amino acids. This high content of amino acids endows silk fibroin with excellent biological properties and diverse application potential.

**Keywords:** Market application; Sensitive muscles; Silk fibroin facial mask

**Online publication:** December 15, 2025

## 1. Introduction

Silk fibroin has various significant physical, chemical, and biological properties, including good biocompatibility and high transparency. These characteristics make silk fibroin used in the medical field to manufacture sutures, wound dressings, and tissue engineering scaffolds. In the field of beauty and skincare, it is widely used in various skincare products to improve skin condition and promote skin health<sup>[1]</sup>. Sensitive skin has more stringent requirements for skincare products, requiring products to have gentle, non-irritating, and effective characteristics. Silk fibroin is considered one of the ideal ingredients for sensitive skin care due to its excellent biocompatibility, moisturizing properties, and film-forming properties. Therefore, the demand and development potential of silk fibroin facial mask in the sensitive muscle market deserve further research and discussion.

### 1.1. Market background and competition analysis

Currently, the number of people with sensitive skin is constantly increasing, and the demand for skincare products is also showing a diversified trend. When choosing facial mask, consumers of sensitive muscles increasingly prefer

products with natural ingredients and repair functions. According to market research, about 70% of consumers of sensitive muscles would prefer to choose a facial mask with higher safety performance rather than a traditional facial mask, which reflects their recognition that this ingredient can bring greater effectiveness to consumers.

## 1.2. Definition and characteristics of sensitive skin

Sensitive skin is a common type of skin that is prone to discomfort when exposed to changes in the external environment or certain skincare products. These reactions include but are not limited to redness, tingling, itching, and tightness. The epidermal barrier function of sensitive skin is usually weak, and the skin's defense against external stimuli is low. At the same time, the water lipid membrane of sensitive skin is often unbalanced, leading to rapid dehydration and easy dryness. When the skin lacks water, the stratum corneum cannot function properly, further weakening the skin's barrier function. Therefore, sensitive skin is susceptible to external stimuli and may experience various discomfort symptoms.

Common factors that can cause sensitive skin include:

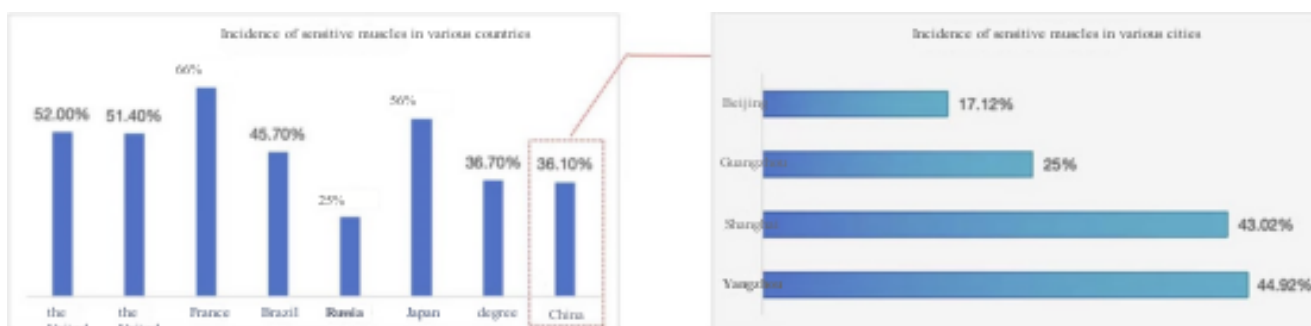
- (1) Genetic factors: People with a history of sensitive skin in their family have a higher probability of developing sensitive skin;
- (2) Environmental factors such as air pollution, climate change, and ultraviolet radiation can all cause stress on the skin;
- (3) Lifestyle: Irregular daily routines, excessive mental stress, and poor dietary habits can all affect the health of the skin;
- (4) Skincare habits: Frequent use of skincare products containing irritating chemicals, excessive cleansing, and unreasonable skincare routines can also damage the skin barrier.

## 1.3. Sensitive muscle consumer groups and consumption habits

The consumer group for sensitive skin is large and constantly growing. According to market research data, more than half of women worldwide consider themselves to have sensitive skin, and in China, this proportion is as high as 36%. Sensitive skin is usually characterized by redness, stinging, itching, burning, and tightness, which can occur in people of different ages and genders, but are more common in certain specific populations. According to multiple market surveys, sensitive muscle problems have significant regional differences globally, and the incidence varies greatly between different countries and cities. France has the highest sensitive muscle incidence rate, reaching 66%; Russia has the lowest incidence of sensitive muscle, only 25% (**Table 1**).

**Table 1.** Demographic and behavioral characteristics of consumers with sensitive skin

Characteristics	Description
Age distribution	Mainly concentrated among young women aged between 18–45, especially those aged 25–35
Gender ratio	Women make up the majority, accounting for approximately 70–80% of people with sensitive skin
Geographical distribution	There are more urban residents, especially in metropolitan areas with severe environmental pollution
Consumption habits	Tend to choose skincare products that are gentle, non-irritating, and labeled as suitable for sensitive skin
Question type	Skin is prone to redness, stinging, itching, burning, and tightness

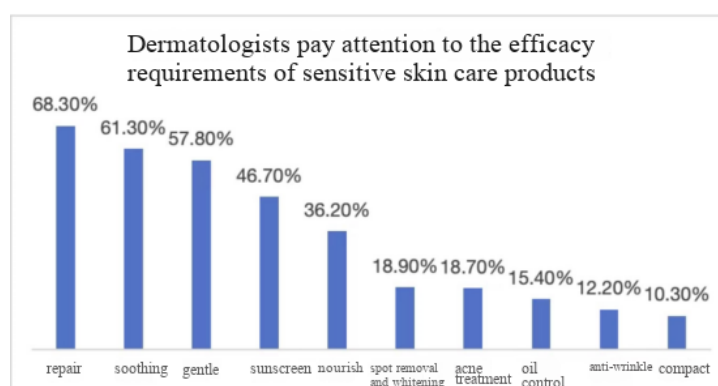


**Figure 1.** Incidence of sensitive skin in different countries and major Chinese cities [Adapted from Clinical Diagnosis and Treatment Guidelines for Sensitive Skin in China (2024 Edition)].

There are also significant differences in the incidence of sensitive skin among cities in China, with a higher incidence in the East China region. The incidence of sensitive skin in Yangzhou and Shanghai is 44.92% and 43.02% respectively. Beijing has the lowest incidence of sensitive skin, at only 17.12% (**Figure 2**). Consumers with sensitive skin seek high-performance skincare products that can alleviate skin discomfort without causing irritation. When selecting products, they typically consider the following key factors:

- (1) Ingredient safety: People tend to choose products with natural, mild ingredients that do not contain potential irritants such as fragrances, alcohol, and preservatives;
- (2) Clear efficacy: A functional product for skin barrier repair, inflammatory skin relief, and calming and soothing effects <sup>[2]</sup>;
- (3) Brand reputation: People tend to trust brands with professional medical backgrounds or good reputations more, and they are more likely to trust product lines specifically designed for sensitive skin;
- (4) User experience: Emphasis is placed on the sensory experience of the product, such as its refreshing texture, easy absorption, and non-greasy feel;
- (5) Price premium: Due to the special needs of sensitive skin, these consumers are more willing to pay a premium for products with high quality and high safety.

Most dermatologists hope that skincare products can repair skin problems. Data shows that 68.3% of dermatologists believe that repair is the most important efficacy requirement for sensitive skin skincare products. At the same time, soothing and mildness are also efficacy concerns for people with sensitive skin, with 61.3% of respondents choosing soothing and 57.8% choosing mildness.



**Figure 2.** Efficacy attributes of sensitive skin care products valued by dermatologists [Adapted from Scientific Skin Care Innovation Alliance (SIA Alliance), Insights from the report on the development of Chinese dermatologists and functional skincare products industry].

People's emphasis on skin care knowledge and skin health is continuously increasing, and the demand for specialized skin care products among sensitive skin consumer groups will further increase. This provides a huge market opportunity for products designed for sensitive skin, such as silk fibroin facial masks.

## **2. Advantages of silk fibroin facial mask for sensitive skin**

Silk fibroin, as a natural high-molecular protein extracted from silk, possesses excellent biocompatibility, moisturizing properties, and certain repairing effects. For individuals with sensitive skin, using silk fibroin facial masks can reduce the risk of skin allergies while meeting moisturizing and repairing needs, thereby achieving higher efficacy. The structure of silk fibroin is similar to the stratum corneum of human skin, making it easily accepted and absorbed by the skin, without easily causing immune rejection or allergies.

### **2.1. Biocompatibility of silk fibroin**

Silk fibroin is a natural degradable polymer, characterized by its stability, non-toxicity, low cost, and accessibility, as well as its absence of inflammatory response. It exhibits excellent degradability and biocompatibility.

### **2.2. Hydrophilicity and lipophilicity**

Silk fibroin can maintain a hydrophilic-lipophilic balance, which has special effects on protecting the skin and preventing skin dryness. Regular use of cosmetics containing silk fibroin can keep human skin moist, fair, and elastic. The amino acids and trace elements contained in silk fibroin have good affinity with human skin and are easily absorbed by it. In addition, silk fibroin can be used as a "green" emulsifier in skin care product formulas.

### **2.3. Anti-inflammatory properties**

Silk fibroin inhibits lipopolysaccharide (LPS)-induced inflammatory responses by regulating the signaling pathway of TOLL-like receptor 4 (TLR4), which recognizes pathogenic microorganisms and viruses inside and outside cells. It can reduce the expression of proteins in signaling pathways such as tumor necrosis factor receptor-associated factor 6 (TRAF6), interleukin-1 receptor-associated kinase-4 (IRAK4), and transforming growth factor  $\beta$ -activated kinase 1 (TAK1), significantly decreasing the expression of pro-inflammatory mediators such as interleukin 18 (IL-18), IL-1 $\beta$ , inducible nitric oxide synthase (iNOS), and cyclooxygenase-2 (COX-2) genes, thereby inhibiting inflammatory responses. Simultaneously, silk fibroin can reduce oxidative stress by upregulating the expression of genes encoding superoxide dismutase 1 (SOD1), and glutathione peroxidase 1 (GPx1). Furthermore, as the concentration of silk fibroin increases, the inhibitory effect on inflammatory factors intensifies. Compared to commercial gelatin and collagen, silk fibroin uniquely stimulates the production of anti-inflammatory factors (IL-10) and possesses anti-inflammatory and scar-preventing properties.

### **2.4. Antioxidant property**

Silk fibroin and its enzymatic hydrolysis products exhibit antioxidant properties, which is attributed to the abundant hydroxy amino acids present in silk fibroin, such as serine and threonine. Some researchers have found that silk fibroin polypeptides obtained through pancreatic enzyme hydrolysis have a molecular weight below 10,000, making the antioxidant residues of small molecular peptides more easily exposed and more likely to enter cells and exert their function. Subsequent in vitro cell experiments have also confirmed their significant repair effect on cell damage caused by hyperoxia, making them excellent antioxidants.



## 2.5. UV resistance

The glycine (36.8%) and valine (4.08%) in silk fibroin can resist radiation and prevent the decrease of white blood cells. The small molecular substances formed by the hydrolysis of silk fibroin are silk peptides, which can effectively inhibit the production of melanin, which is unmatched by other cosmetic additives. Some researchers have compared the UV protection and epidermal cell proliferation effects of silk fibroin with different molecular weights <sup>[3]</sup>.

The formation of sensitive skin is related to a weaker skin barrier, a rich variety of nerves within the stratum corneum, and frequent inflammatory reactions. Sensitive skin is prone to a series of inflammations caused by irritation or allergies. Inflammation can further damage the barrier structure and nerve endings, forming a vicious cycle. Therefore, an effective strategy for repairing sensitive skin is to enhance the skin's barrier function and maintain its anti-inflammatory effect. Silk fibroin can maintain the hydrophilic-lipophilic balance of the skin and has good film-forming properties. Based on these characteristics, nano-micron films with good skin affinity can be prepared and closely attached to the surface of the stratum corneum, resisting water washing and not easily peeling off, thus enhancing the stratum corneum and skin barrier. In marketing promotion, the main efficacy claims of silk fibroin facial masks include deep hydration, soothing sensitive skin, repairing skin barrier, reducing redness and inflammatory reactions, etc.

## 2.6. Unique selling points and competitive advantages of silk fibroin facial mask

The selling points and competitive advantages are as outlined:

- (1) Natural ingredients: Silk fibroin, a natural protein extracted from silk, is rich in amino acids and exhibits excellent biocompatibility, making it less likely to cause allergic reactions. This characteristic gives silk fibroin facial masks a significant advantage in the sensitive skin care market;
- (2) Versatility: Silk fibroin not only has a moisturizing effect, but also effectively soothes the skin, reduces inflammatory reactions and redness. At the same time, it can enhance the skin's self-protective function and promote the repair of the skin barrier;
- (3) Long-lasting effect: Silk fibroin has long-lasting moisturizing and repairing functions, which can significantly improve the skin's moisture content and health status after use. Clinical verification shows that after using silk fibroin facial mask, the skin's moisture content can increase by 20%, and sensitive symptoms such as erythema and itching can be reduced by more than 50%;
- (4) User experience: The silk fibroin facial mask has a soft texture and good conformability, providing a cool and comfortable feeling during use. Many users report that their skin feels very hydrated and soft after use, without any sticky or greasy sensation;
- (5) Eco-friendly: Silk fibroin is a biodegradable material, making it environmentally friendly. With the increasing awareness of environmental protection, this characteristic also adds a lot of value to the product.

## 3. Market trends and growth potential

The increasing attention to skin health and the higher expectations for the efficacy of skincare products have led to a significant growth trend in the sensitive skin care market (**Figure 3**).

### 3.1. Huge market potential

An increasing number of consumers are paying attention to the ingredients and efficacy of skincare products, and the group of people with sensitive skin is continuously expanding, driving the demand for mild and effective skincare products.



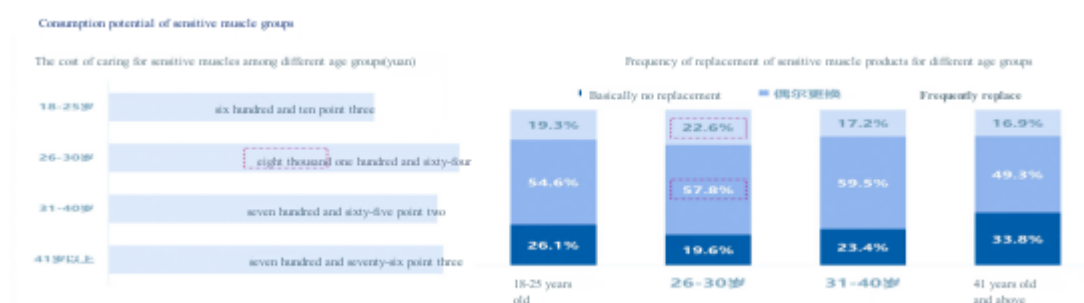
**Figure 3.** Market size forecast and growth rate of China's sensitive skin care industry (2019–2028) [Adapted from Gongyan Industry Consulting (Gongyan Network)-Market Size of Sensitive Skin Care Industry (in billion CNY)].

### 3.2. Product innovation

To meet the constantly evolving needs of consumers, skincare brands continuously innovate and launch new, gentle, and effective products. For example, silk fibroin facial mask is one of the new products that have garnered significant attention in recent years.

### 3.3. Brand competition

Emerging silk fibroin brands have entered the market through differentiated positioning and innovative formulas, facilitating consumers' choice of new product categories. In terms of brand loyalty, individuals aged 26–30 spend the most on products for sensitive skin care (CNY 816.4), and they tend to switch sensitive skin products relatively frequently. Specifically, 57.8% of this age group occasionally switch brands, while 22.6% frequently switch brands (Figure 4).



**Figure 4.** Consumption potential of sensitive skin care products of different age groups [Adapted from digital 100 research data].

### 3.4. Technological advancements

Advanced biotechnology and dermatological research have provided support for the development of more effective skin care ingredients.

### 3.5. Education and promotion

Through platforms such as social media, blogs, and professional skincare forums, people with sensitive skin have gained more channels for acquiring skincare knowledge and product information, which helps enhance their awareness and acceptance of high-quality products. Among those with sensitive skin, domestic brands are the preferred choice for most. Domestic brands usually have a better understanding of the skin characteristics and needs of Chinese consumers, and their marketing strategies are more aligned with the culture and habits of local consumers, enabling effective communication with consumers through channels such as social media and KOLs (Key Opinion Leaders). Combining consumption potential data from people aged 26–30, it can be found that this age group has a higher proportion of choosing European and American brands, followed by domestic brands (Figure 5).

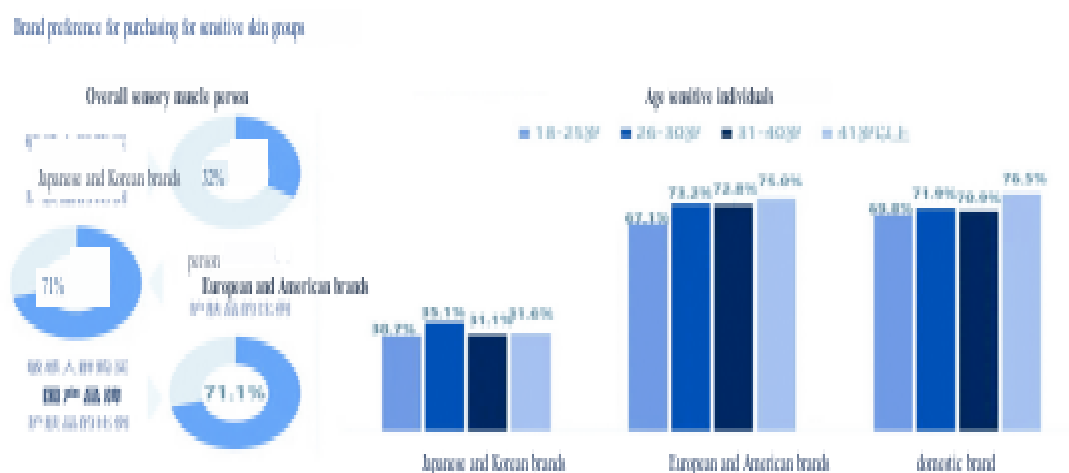


Figure 5. Brand preference for purchasing for sensitive skin groups [Adapted from digital 100 research data].

## 4. Analysis of differentiated pricing strategy: Safe and effective value-oriented pricing

Considering the high demands and willingness to pay of sensitive skin individuals for skincare products, the silk fibroin facial mask can adopt a pricing strategy slightly higher than the market average. The unique selling points and advantages of the silk fibroin facial mask should be emphasized, such as natural ingredients, strong moisturizing effect, and repair function, to enhance the added value of the product and the brand image<sup>[4]</sup>.

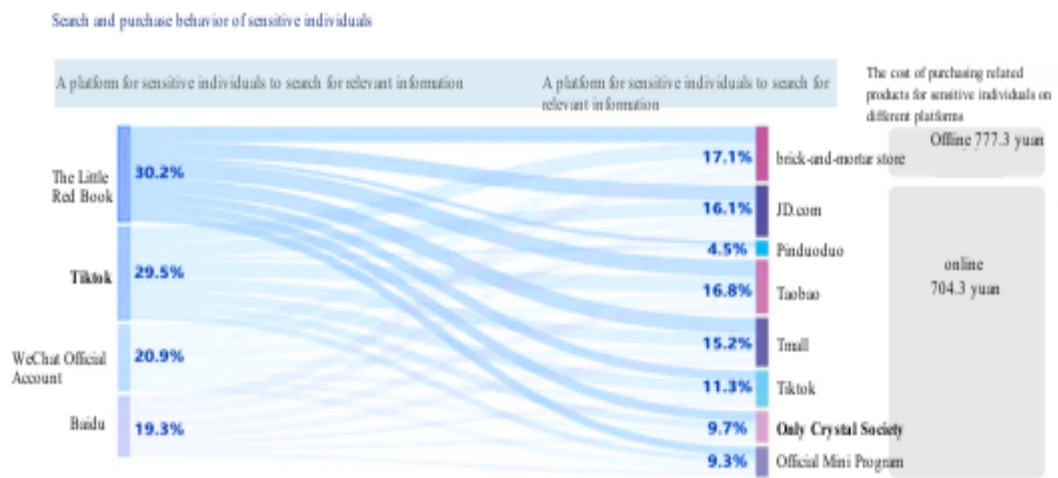
By providing high-quality products and services, we can earn the trust and loyalty of our consumers, ultimately achieving higher profit levels. For instance:

- (1) Strengthen brand building and promotional efforts to enhance the visibility and reputation of silk fibroin facial masks in the sensitive skin market;
- (2) Continuously monitor consumer demands and market changes, and flexibly adjust pricing and marketing strategies;

- (3) Strengthen product research and development and innovation investment, continuously improve the quality and effectiveness of silk fibroin facial masks to meet consumers' higher demands.

## 5. Purchase channels

From the perspective of purchasing channels, Xiaohongshu and Tiktok are the main platforms for sensitive skin individuals to obtain information. In addition, physical stores remain an important purchasing channel for sensitive skin individuals, albeit with higher expenses. Brands can provide product trials and professional consulting services through offline experience stores, counters, and other means to enhance consumer trust and satisfaction (Figure 6).



**Figure 6.** Search and purchase behavior of sensitive individuals [Adapted from digital 100 research data].

In terms of information acquisition, people with sensitive skin have diversified channels for obtaining information, leading to an increase in the frequency of product replacement. Data shows that when people with sensitive skin have one or two channels for obtaining information, the frequencies of them basically not changing products are 31% and 24% respectively. However, when the number of channels increases to four or more, the frequency of them basically not changing products has dropped to 15%. Diversified information channels may lead consumers to receive excessive information, increasing the complexity and uncertainty of their choices, thus prompting them to frequently try new products.

From the perspective of the purchasing path, the purchasing path of sensitive skin products has shifted from linear to multi-point triggered purchasing. In the linear purchasing path, the brand department launches relevant marketing content during user inquiries and efficacy investigations, which can stimulate users' interest in a certain sensitive skin product and thus facilitate purchasing decisions. In the multi-point purchase path, consumers may experience a purchasing impulse due to high-quality content that inspires them during the process of searching for knowledge about sensitive skin and researching product efficacy, ultimately leading to a purchase. Therefore, brands introduce endorsements from doctors and KOLs in their content introducing knowledge about sensitive skin, and on platforms like Xiaohongshu, they encourage users to share their real usage experiences, promoting a purchasing impulse among consumers during the product inquiry process.

## 6. Future prospects

### 6.1. Strong market demand

With the increasing number of people with sensitive skin and the growing demand for high-quality skincare products, silk fibroin facial masks have demonstrated strong potential in the market. Their natural ingredients and hypoallergenic properties cater to consumers' pursuit of safe and effective skincare products. The application of nanotechnology and other cutting-edge technologies will further enhance their market competitiveness.

### 6.2. Obvious technical advantages

Advanced extraction technology and production processes ensure the high quality of silk fibroin, which exerts excellent performance in skin care products and enhances the user experience for consumers.

### 6.3. Implement differentiated pricing strategy

Silk fibroin facial masks can still stand out in the market, especially under the trend of environmental protection and sustainable development, where their natural degradable properties are a significant advantage. Currently, the facial mask market is in a fully competitive state. Through differentiated positioning and technological innovation, the uniqueness of the product can be highlighted. Based on the inherent characteristics of silk fibroin materials, the pricing strategy is planned as follows:

- (1) Analyze competitors: Conduct an in-depth study of the pricing strategies, product features, and market shares of the competitors;
- (2) Highlight differentiated competition: We emphasize our value through product differentiation (such as unique formulas, better user experience, etc.), and implement differentiated pricing for different packaging specifications (such as single-piece, three-piece, ten-piece, etc.) or different product grades (such as regular, advanced, luxury, etc.), making consumers feel that they are getting value for money and quickly seizing market share. Based on the prices and sales in **Table 2**, we can adopt a pricing method of 50/35/25 Chinese Yuan per piece;
- (3) Customer segmentation and differential pricing: Implement differential pricing based on the consumption habits and price sensitivity of different customer groups, such as new customers, regular customers, and members. New customers can be attracted to try by offering a discount on their first order, regular customers can enjoy regular prices or slight discounts due to their loyalty, and members can enjoy higher-level price discounts and services (**Table 2**).

**Table 2.** Comparative analysis of medical skin repair dressings on major e-commerce platforms

Taobao			JD		
Monolithic (component)	Price (per box)	Sales volume (monthly/box)	Monolithic (component)	Price (per box)	Sales volume (monthly/box)
FORSMILE/Fen Sheng Yuan (Hainan Fensen Medical Equipment Co., Ltd)					
Skin repair dressing: Post-medical aesthetic repair, repair of dermatitis, eczema, and damaged skin barrier					
73.6	368	300000+	67.6	338	200000+
Chuangfukang (Guangzhou Chuang'er Biotechnology Co., Ltd)					
Collagen patch dressing: Mild to moderate inflammatory acne; skin allergies, scars after laser and photorejuvenation treatments					
31.6	158	100000+	39.6	198	200000+

**Table 2 (Continued)**

Taobao			JD		
Kefu Mei (Shaanxi Juzi Biotechnology Co., Ltd)					
Recombinant collagen dressing: This product is used to provide a healing environment for wounds after laser treatment, inhibiting and alleviating skin inflammatory reactions					
37.6	188	400000+	37.6	188	2000000+
Fu Qing (Hunan Yinhua Tang Pharmaceutical Technology Co., Ltd)					
Medical sodium hyaluronate care patch: Nursing of non-chronic wounds and surrounding skin					
33.6	168	70000+	35.6	178	100000+
Kefu Mei (Shaanxi Juzi Biotechnology Co., Ltd)					
Kiehl's Medical Hyaluronic Acid Repair Patch: Nursing of superficial wounds, non-chronic wounds after laser treatment, phototherapy, alpha hydroxy acid (AHA) peel, and micro-plastic surgery					
21.8	109	40000+	23.6	118	100000+
Eve Charm (Harbin Yunmeida Biotechnology Co., Ltd)					
Eve Spring Medical Sodium Hyaluronate Repair Patch: This product is suitable for mild to moderate acne, promoting wound healing and skin repair					
0	-	-	15.8	79	50000+
<a href="#">Fu Yi Qing</a> (Harbin Norwell Medical Technology Co., Ltd)					
Medical recombinant type III humanized collagen protein raw material repair dressing [Medical Green Collagen]: By forming a protective layer on the skin surface, it serves as a physical barrier, providing a healing microenvironment for wounds and promoting wound healing. It is suitable for the care of non-chronic wounds and surrounding skin on the human body.					
0	-	-	13.6	68	20000+
Kefu (Kefu Medical Technology Co., Ltd)					
Medical sodium hyaluronate repair patch (After medical cosmetic procedures, skin allergies, acne, dermatitis, and scars)					
19	95	100000+	13	65	100000+
Si'en Tengrui Bei'an (Hunan Xiangfei Medical Equipment Co., Ltd)					
Sodium hyaluronate patch: Moisturizing and hydrating, post-operative repair, removing redness for sensitive skin, alleviating dermatitis, and relieving tingling					
11.96	59.8	10000+	12.36	61.8	20000+
JUYOU/Zhanyan (Xi'an Deno-Hais Medical Technology Co., Ltd)					
Medical dressing (2-piece set): Dermatitis and eczema, acne, photorejuvenation, alpha hydroxy acid peel, facial laser surgery					
11.95	23.9	70000+	11.95	23.9	500000+
Hurmevkor/Huameike (Jilin Guoda Biological Engineering Co., Ltd)					
Medical sodium hyaluronate skin repair patch A: Non-chronic wound					
7.8	39	20000+	11.6	58	10000+
<a href="#">HURMEVKOR</a> (Jilin Guoda Biological Engineering Co., Ltd)					
Huamei Type A (ellipsoidal): By forming a protective film on the surface of the skin wound, it repairs the skin barrier and maintains the moist state of non-chronic wounds					
0	-	-	11.6	58	10000+



**Table 2 (Continued)**

Taobao			JD		
Fuerjia (Harbin Fuerjia Technology Co., Ltd)					
Medical sodium hyaluronate repair patch: It is suitable for mild to moderate acne, promoting wound healing and skin repair. It has adjuvant therapeutic effects on early pigmentation after acne healing, skin allergies, and laser phototherapy, as well as reducing scar formation					
10.8	54	500000+	9.98	49.9	500000+

The data is sourced from major online platforms

## 6.4. Strengthen brand building and marketing

Through multi-channel marketing and promotion, enhance brand exposure and user recognition. Leverage social media and KOL collaborations to expand influence, while paying attention to user feedback and reputation management to enhance brand loyalty.

## 6.5. Consumer awareness enhancement

Consumers' understanding of the ingredients and manufacturing processes of personal care products has deepened, leading to higher expectations for product quality. Therefore, strengthening science popularization and raising public awareness of silk fibroin can drive sales growth.

## 6.6. Favorable policy support

Silk fibroin materials have been listed in the 13<sup>th</sup> Five-Year Plan. The government encourages the adoption of new technologies and materials to develop new products, creating favorable conditions for domestic enterprises to increase R&D investment and accelerate industrial upgrading. This helps narrow the gap with international leading levels, allowing Chinese silk fibroin materials to showcase their charm on the world stage.

## 7. Conclusion

With its unique advantages, silk fibroin facial mask is expected to occupy an important position in the sensitive skin market. In 2023, the market size of China's sensitive skin care industry will reach 30 billion yuan, a year-on-year increase of 9%. It is expected that the market size of sensitive skin care in China will reach 40.39 billion Chinese Yuan by 2028, with a compound annual growth rate of 6% from 2023 to 2028. Through continuous innovation and precise market positioning, especially the differentiated marketing in terms of product efficacy, safety and user experience, silk fibroin facial mask is expected to continue to expand its market share in the future, driving the rapid growth of silk fibroin facial mask demand.

## Disclosure statement

The author declares no conflict of interest.

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