

Research on the Characteristics and Development of Liaoning Tussah Silk

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Abstract: Based on research conducted from multiple perspectives, including the earliest origin and development of tussah, natural ecological and climatic resources in the tussah region, tussah cocoons and professional techniques for processing and weaving tussah silk, as well as the characteristics, classification, and use of tussah silk fabrics, it is summarized that tussah, tussah silk, and their production and production processes have been inherited and spread through the wisdom and wisdom of generations of the people for thousands of years, and have produced a systematic system of tussah, cocoons, silk principles and practical experience in silk production. Liaoning tussah silk fabric has a unique style, unique craftsmanship, wide range of uses, and profound significance. It is an irreplaceable textile and holds an important position in the country and even the world.

Keywords: tussah silk, process technology, cultural development

1. Introduction

China is the earliest country in the world to raise silkworms and weave silk. The production areas of tussah silk are mainly concentrated in Liaoning, Jilin, Shandong, Hebei, and other places. Liaoning oak silk accounts for about 80% of the production. Liaoning tussah silk is not only sold domestically, but also exported to more than 50 countries and regions such as Japan, India, France, Italy, and the United States. As early as the late Qing Dynasty, the production of tussah cocoons in Liaoning was almost the same as that of mulberry cocoons, and it was in an international leading position in sericulture, silk reeling, weaving, process technology, research and development of silk fabrics, and comprehensive applications around tussah[1].

At the end of the 20th century, the problems of outdated operation management and process equipment in Liaoning's tussah silk industry led to the lowest stage of the entire tussah silk industry since the reform and opening up. At the beginning of the 21st century, industry leaders, experts, scholars, and relevant personnel conducted long-term research and argumentation, calling for the protection of excellent tussah silk products, promoting the spirit of inheritance and innovation, and promoting the development of Liaoning's tussah silk industry towards a new pattern direction [2].

2. The origin and development of Liaoning tussah silk

Silk culture has a long history in China, and tussah silk has a history of over 3000 years. According to literature records, the "Jin case" of Wozhou Zhimian "in the" Biography of Dongyi in the Later Han Dynasty "states: "I know how to raise silkworms to make cotton clothes "; The Book of Wei in the Records of the Three Kingdoms states: "There are silkworms raised for cotton, which is also known as the Ailanthus silkworm." Tussah and tussah silk are unique natural and precious resources in China, with great development and research value. The tussah silk industry has always been a dominant industry in Liaoning.

During the Kangxi period of the Qing Dynasty (1662-1722), refugees from Shandong and Hebei flooded into Liaoning and brought tussah silkworm seeds to the areas of Andong and Lingyuan for grazing. In the 15th year of Kangxi's reign in the Qing Dynasty (1676), under the advocacy of the Supervisor of the County County of Haicheng, farmers began to raise silkworms and filature, and then tussah sericulture developed rapidly. During the Qianlong period of the Qing Dynasty (1736-1796), it was the beginning of the silk industry, during which the technology and businesses of using silk spools

to draw silk emerged. During the Tongzhi period of the Qing Dynasty (1862-1875), the influx of more refugees brought increasingly mature techniques for stocking tussah silkworms. At the same time, foot operated silk reeling machines were introduced from Shandong, and silk reeling businesses and small workshops began to emerge [3].

In the 34th year of the Guangxu reign of the Qing Dynasty (1908), more than a thousand immigrants from Changyi, Shandong Province migrated to the Kuandian area, brought cocoon silk technology, and founded a silk weaving workshop with an annual output of about 16000 pieces. The silk reeling industry had a preliminary development, and the silk industry in Andong began to take shape. With the outbreak of World War I and the economic recovery after the war, tussah silk clothing materials were prevalent in Europe and America, and the demand for goods in the international market increased sharply. Equipment, processes, and products were rapidly updated and expanded in scale, and the influence of silk products in the international market gradually increased. In the fifth year of the Republic of China (1916), Anton (renamed Dandong in 1965) produced tussah cocoon medicinal silk, which has the characteristics of good color, high strength, and good luster. It is popular in the international market and has played an important role in promoting the development of the silk industry. In the 18th year of the Republic of China (1929), the Yitaixiang Silk Factory opened and introduced Jintian and Fukui looms for weaving, including 64 looms and an annual production of 15000 pieces of silk. It gradually developed into the largest silk factory in Andong[4].

After the victory of the Anti Japanese War in 1945, Xiuyan Silk Reeling Factory (renamed by Xiuyan Chuzhang of Manchuria Tussah Association), Zhonghua Cotton Mill (renamed by Andong Factory of Manchuria Corporation), and Andong Silk Reeling Factory 1, 2, 3, and 4 in the silk industry resumed production one after another. In July 1949, Liaodong Province Yingtussah Silk Weaving Company was established, with Manager Sun Zhenfang, Deputy Manager Luo Jianhua, and Chief Engineer Zhong Qiyu as the core. It unified the management of the entire region's tussah and silk industries, providing organizational support for the development of the silk industry, and causing a historic change in Liaoning's tussah silk industry. After the 1960s, the introduction of jacquard shedding machines improved weaving techniques, allowing Liaoning tussah silk not only to have a variety of plain fabrics, but also to develop large patterned jacquard fabrics with unique tussah silk characteristics.

The 1980s was the heyday and prosperity stage of Liaoning's tussah silk industry, with complete mechanical and electronic production equipment, rich product types, and a total output value of over one billion yuan per year for the national tussah silk industry. 30% of the production of tussah silk is exported to Europe, America, Southeast Asia, and other regions, with 70% being used as raw materials in the domestic silk weaving industry, including bleached silk, yarn-dyed silk, jacquard silk, and cotton, linen, and chemical fiber blended fabrics. The tussah silk industry in Liaoning basically covers various fields such as tussah rearing, silk reeling, weaving, silk spinning, printing and dyeing, and has a comprehensive supporting production system, teaching system, and scientific research system. It has made important contributions to the development of China's economy and the cultivation of technical talents.

3. Characteristics and classification of Liaoning tussah silk

Tussah silk is a natural fiber material that belongs to protein fibers and conforms to modern environmental protection concepts. It also has characteristics and functionality such as moisture absorption, insulation, heat resistance, sound insulation, insulation, flame retardancy, anti-corrosion, and antibacterial. The differences in the production process and specifications of tussah silk can form different appearances and textures, such as the glossy, delicate, and elegant fabric composed of fine and uniform silk threads; the fabric composed of rough and irregular silk threads is thicker and has a relief texture. Tussah silk, with its tactile and visual advantages and functional characteristics, is often used in fields such as clothing fabric design, home textile design, decorative wallpaper design, carpet design, and packaging design [5].

The classification of tussah silk can be divided into water reeled silk and dry reeled silk according to different silk reeling processes. Water reeling silk is made by reeling it in warm water on a water reeling machine. The medicinal solution is a peroxide substance, so the bleached cocoon silk has a light yellow color, bright and smooth, and has great elasticity. It is a high-quality material for weaving tussah silk fabrics. Dry silk reeling is made by reeling on a wooden reeling machine table, and is often used as a flat or interwoven type of tussah silk fabric material. In addition, there are also tussah silk and

irregular silk. Tussah silk is the leftover material from tussah cocoons during the silk reeling process, which is processed by silk spinning technology and is often used as a fabric material for silk thread blending, interweaving, and twisting. From the perspective of appearance, irregular silk can be divided into two types: large strip silk and nodular silk. Its unique style and artistic beauty make it a highly distinctive raw material for oak silk thread in Liaoning. The yarn of the large silk is relatively coarse and loose, with a natural texture style such as hemp thread, which is yellow brown and can be used as a weaving material for high-end woolen fabrics or decorative wall coverings; the uneven thickness of the silk thread of Gedan Silk presents a randomly sized Gedan shape. Due to its strong artistic effect, Gedan Silk is often used as a common material for special clothing fabrics, wall coverings, and carpets, with an elegant and stylish style.

The differences in Liaoning tussah silk thread constitute various forms of tussah silk fabrics, which not only have a special aesthetic feeling, but also have functional properties due to the physical properties of the material itself. Combining with process technology not only enriches the variety and color of silk fabrics, but also enriches their application fields, which is also a major feature that distinguishes tussah silk from other fiber materials.

4. Liaoning tussah silk fabric and its production technology

4.1 Classification and characteristics of tussah silk fabrics

The typical styles of Liaoning tussah silk fabrics are diverse, with some being elegant, simple, and fresh and unique; some are grand and bold, elegant and bold. According to its shape and functional characteristics, tussah silk fabrics can be classified as follows:

4.1.1 Thin fabric

Thin fabrics within 100g/m², such as 5001 Liaoning tussah silk, also known as blue edged fifty yard tussah silk, are products created by the "Yitaixiang" silk factory and the first well-known product in the modern silk weaving industry of Dandong, Liaoning, selling well in countries such as France, Switzerland, and Japan. The so-called "fifty yards" refers to the name that reflects the style characteristics and specifications of this silk fabric, that is, the fabric is fifty yards long, and there are 40 edges arranged on the left and right sides of the fabric, with two white and two blue edges arranged alternately. With the continuous development of the production process of tussah silk fabrics, printing, bleaching, scouring and other technologies have begun to be applied, which has to some extent changed the appearance, length, amplitude and other parameter indicators of silk fabric production, gradually resulting in product numbers such as 5002, 5004, and 5023. The 5023 tussah silk of the "Red Rose" brand is a representative of this type of product. The fabric is lightly dyed, printed, and has a gorgeous appearance, making it an ideal material for high-end clothing.

4.1.2 Medium thick fabric

Medium thick fabrics within 100-175g/m², such as 2001 dress silk, are typical representatives of this period. Made of 16 strands of 35D tussah silk twisted and woven together, it has high elasticity and a neat appearance. It is mainly used in the production of diplomats' gowns, military officers' gowns above the rank of general, and book covers made of silk. Compared to 5001 silk, the production process of 2001 silk is more complex, which has promoted the improvement of the production process level of Liaoning tussah silk fabric and laid the foundation for the subsequent rich production types of tussah silk fabric.

4.1.3 Thick and heavy fabric

The 175g/m² or above are thick and heavy fabrics, such as B2081 jacquard Yajiang silk, 2300 Yajiang silk, etc. The fabric yarn belongs to tussah shaped silk, also known as special craft silk. On the basis of traditional production techniques, thick and heavy fabrics are added with irregular tussah thread, combined with modern weaving techniques such as yarn-dyed weaving and jacquard weaving, to ultimately obtain the finished product. Tussah shaped silk fabric is the most representative product of Liaoning Tussah silk fabric, with a variety of different styles. In Liaoning Province in the 1980s, represented by B2081, the tussah silk jacquard Yajiang silk was developed by Dandong Silk Sample Factory. The pattern was designed by Mr. Song Dechang (As is shown in Figure 1), and the texture was designed by Mr. Cheng Zhongshu. The fabric was mainly hand-spun large strips of silk, combined with dry and water reeled tussah silk, cleverly using the alternating plain weave of the surface and inner layers, This special craftsmanship creates a three-dimensional layering on the surface of the fabric, with

patterns that combine geometric shapes, deformed flowers, and animal forms, creating a relief like three-dimensional effect.



Figure 1: The pattern designed by Mr. Song Dechang

4.1.4 Functional fabrics

Tussah silk not only has a luxurious and elegant appearance, but also has physical properties such as acid and alkali resistance, oil corrosion resistance, strong strength, and good elongation. Therefore, it has advanced into the field of industrial production protection in product development. Representative fabrics include live working silk, breathable acid resistant silk, anti oscillation silk, and anti-static work clothes. In 1982, a new type of conductive fiber K83 was developed by Dandong Fourth Factory, which was combined with the high-strength wear resistance of polyester fiber and the good moisture absorption of tussah silk. Through the study of reasonable fiber ratio and interweaving methods, the tussah polyester interwoven anti-static fabric - anti oscillation silk was produced, marking that Dandong Fourth Factory was one of the earliest manufacturers in China to develop anti-static fabrics and made important contributions to industrial production safety protection.

4.2 Production process of tussah silk fabric

The transformation of silk from raw materials to silk fabrics requires special production processes, which are complex and vary among different types of tussah silk fabrics.

Firstly, there are differences in the color and luster of tussah silk from different origins and production batches. In order to achieve unified fabric standards, strict screening of raw materials is necessary. Secondly, steaming and rewinding. The molecular structure of tussah silk is relatively loose, and deformation and elongation will occur due to tension during the reeling process. Therefore, the raw silk needs to be steamed, so that the deformed and elongated slivers due to reeling can be retracted, and problems such as greater elongation and unevenness can be avoided; Inverted yarn refers to winding the same type of bobbin yarn onto another type of bobbin yarn, thereby changing the packaging method and laying the foundation for subsequent production. The third is merging and twisting, where two or more single fibers are combined to form strands, and then twisted to change the physical and mechanical indicators of the strands to meet the subsequent production requirements of different silk fabrics. The fourth is shaping, warping, and sizing. Under certain temperature and time conditions, the twist of the twisted silk thread is fixed, and various rolled silk threads are wound into warp shafts through warping before sizing. The fifth is weaving and dyeing and finishing. There are many types of weaving processes for tussah silk fabrics, and the weaving processes are divided into: opening, picking, beating, let-off, coiling, etc; Dyeing and finishing are further processed according to the production requirements of tussah silk fabrics, such as bleaching and dyeing treatment. Finally, there is the inspection process. Before leaving the factory for sale, tussah silk fabrics need to undergo processing such as measuring, inspecting, printing, labeling, packaging, and packing.

5. Conclusion

The natural and ecological use of tussah resources, as well as the theoretical system and process technology of tussah silk production, have already entered a period of maturity, stability, and improvement. Contemporary digital communication technologies such as textile CAD, digital intelligent electronic spray printing, and nano technology have been widely promoted and utilized in the field of tussah silk processing. They have also developed tussah silk puffing technology, silk quality protection scientific innovation and development skills, effectively supplementing the blind spots and shortcomings in the production and production of tussah silk and silk fabrics.

With the arrival of the global economic wave and the changes in the development situation and production pattern of the international and domestic textile industry, the traditional textile industry has accelerated its transformation and upgrading, promoting the application of digital technology in industry design, production, and marketing. Nowadays, big data and the Internet of Things have given rise to new formats, while also providing a broad platform for innovation in the tussah silk industry. At present, studying and sorting out the characteristics, craftsmanship, and development space of tussah silk has profound historical significance for the new era of tussah silk industry.

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