Sericin, a protein secreted by silkworms that has proven benefits in skincare, is typically removed when silk filaments are harvested and refined. In Gunma, however, a range of attractive products, such as these silk-mesh washcloths, are made with the sericin left on the threads. Effective in promoting skin elasticity and hydration, sericin has many cosmetic and medical applications and is hailed for its anti-wrinkle and antiaging properties. In Japan, products made with it are popular among people with sensitive skin. Throughout the process, from raising silkworms to silk reeling and manufacture, Gunma silk products are gentle on the environment.

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# Gunma Silk

#### **Brand Highlights**

- Washcloths and soaps made with sericin, highly effective in skincare
- Environmental commitment: no formalin used in silk reeling
- Support of local sericulture farms through original product development



Cocoons flow over a light table in the inspection area at Usui Raw Silk Company in Annaka, Gunma. Each one is visually inspected. The quality of the cocoon is affected by the health of the silkworm, which in turn is influenced by the climate. The hotter the summer, for example, the smaller the cocoons. Those whose pupae have expired, or cocoons that may cause problems in reeling, such as double ones formed by two or more silkworms, are removed by hand.

Japan's top silk producer, Gunma is home to the "Tomioka Silk Mill and Related Sites" recognized by UNESCO on its World Heritage list. Despite these achievements, sericulture farms and silk mills in the prefecture have declined drastically in number, pressured by the lower prices of synthetic fibers and raw silk threads made abroad. Yet when it comes to quality, Gunma silk has clear advantages over such competition.

Sericin, a natural protein secreted by the *Bombyx mori* silkworm larva to coat the outer layer of the silk filament, is not removed in the production of Gunma silk. This valuable polymer is rich in serine, an amino acid with a similar composition to human skin. Its biocompatibility makes serine well suited for cosmetic and medicinal applications. An effective antioxidant, it has excellent moisture release, water absorption, anti-wrinkling, and antibacterial properties, and can be used for UV protection as well as wound healing. Silk products made in Gunma are especially popular among people with allergic or sensitive skin.

All steps in production, from growing the mulberries on which the *Bombyx mori* larvae feed to raising them, breeding new varieties, and harvesting and reeling their silk, are performed entirely in Gunma. The small carbon footprint and sustainability of Gunma silk are additional competitive advantages.

In Japan alone more than one million tons of clothing are disposed of each year. As worldwide concern about oceanic microfiber pollution grows, fashion brands must engage in responsible procurement at all stages of production. Gunma silk is gentle not only on the skin, but on the environment as well. It is just the kind of industry we need to preserve and pass on to future generations. Moisturizing bath infusions by Shimoyama Housei Co., Ltd. make clever use of the *kibiso* layer of filaments produced by the larvae to form the outer surface of the cocoon. Because these are thicker and stiffer than the inner layers of the cocoon, they are not suitable for silk textile production and are typically discarded—a shame as they are especially rich in sericin. Shimoyama Housei retrieves the filaments and dyes them with turmeric, a proven antibacterial and anti-inflammatory agent that helps improve circulation. The bright yellow all-natural strands are then packaged in sachets that can be used in the bath for up to one month.



Handmade plant-derived soap bars by Kiryu Silk Soap Factory contain natural olive oil, palm oil, coconut oil, and sericin and absolutely no petroleum-based or synthetic surfactants. They are cold-process cured over time without added water or heat to preserve the full cosmetic efficacy of their active ingredients. They are gentle on the skin and leave it feeling moisturized.

# Gentle skincare items made with sericin, a silk by-product

The filament of a silkworm's cocoon is made of two types of protein: fibroin, the structural center accounting for 70 to 80 percent, and sericin, the adhesive binder that coats the latter with sticky layers to aid in the cocoon's formation. In the textile industry sericin is typically removed during raw-silk production and discharged into the water system as waste. In Gunma, however, methods have been devised to retrieve this valuable all-natural polymer for optimal use of its many properties listed below.

#### 1. Moisturizing

Serine, which accounts for some 20 to 30 percent of the sericin protein, is the most abundant amino acid in the protective chemical coat produced by the outer layer of our skin. A natural humectant, it facilitates water absorption and enhances elasticity, making it effective in both hair conditioning and anti-wrinkle treatments.

#### 2. Protective Coating

Sericin creates a thin film on the surface of skin and hair, reducing moisture evaporation and preventing drying.

### Original silkworm varieties developed in Gunma



Gunma 200 The Bombyx mori variety that yields the most commonly produced silk thread in Gunma is easily cultivated. The thread is 3 denier and is used in both traditional Japanese and Western-style apparel.



Seiki Niichi This strong and hardy variety of silkworm produces fine fiber of 2.5 denier and up to 1,500 meters in length. It has excellent dyeability with a good texture and an elegant sheen.



Shinkoishimaru A triplecross hybrid of Koishimaru, grown at the Imperial Palace farm, and the Chinese varieties 1 and 2. It yields a fine silk of uniform consistency suitable for use in high-end kimono.



Shinseihaku This is a firstgeneration hybrid of the Chinese variety 200, raised at the Gunma Sericultural Technology Center, and the Japanese breed Seihaku. The raw silk is glossy with a distinctive light-green hue.



Gunma Gold Another Chinese-Japanese firstgeneration hybrid, Gunma Gold crosses the Si-125 and Gunma varieties. Its glossy raw-silk thread is approximately 2.5 denier, and true to its name in color.







Shinsuke Nagatake (right) of Miyama Zenshoku and Haruo Kubozuka of Kubozuka Textiles in Kiryu discuss an order of washcloths that Kubozuka will make. The city of Kiryu has a long tradition of textile production in Gunma.

0%						100	
Redness / inflammation (n=18)	39% (7) 61			61% (1	1% (11)		
Rash (n=20)	75% (15)				25% (5)		
Pimples (n=13)	69% (9)				31% (4)		
Evidence of scratching (n=11)	73% (8)				27% (3)		
Erosion (n=4)	50% (2)			50'	50% (2)		
Dampness (n=8)	50% (4)			50% (4)			
Dryness / scaling n=16	56% (9)			44% (7)			
Swelling (n=5)	20% (1) 80% (4)			% (4)			
Hardening (n=6)	33% (2)			67% (4)			
erall absolute evaluation (n=14)	71% (10)				29% (4)		
verall relative evaluation (n=11)	91% (10)					9% (1)	
	Improve	d	No Chang	e 👘	Worse	I	

This chart shows results by type of symptom for tests of 31 women with atopic and contact dermatitis who wore brassieres coated with sericin. The variable *n* indicates the number of subjects affected. Many subjects showed improvement, and there were no cases where symptoms worsened, indicating that undergarments containing sericin have beneficial effects.

Source: "Study of Patients with Atopic and/or Contact Dermatitis Wearing a Sericin-Coated Undergarment (Brassiere)," Osaka Dermatology Regional Association Journal *Skin Research* 41, no. 4 (August 1999).

#### 3. Antioxidant Qualities

The antioxidant power of sericin is equivalent to that of vitamin C, helping to prevent wrinkles and pigmentation.

#### 4. Brightening

Sericin inhibits tyrosinase, an enzyme that catalyzes the production of melanin and other darkening pigments in response to environmental factors.

#### 5. UV Defense

The silk amino acids tyrosine and tryptophan absorb harmful UV rays and protect the skin. The yellowing of silk over time is an indicator of this effect: the protein fibers turn yellowish-brown in response to light.

#### 6. Static Electricity Prevention

Sericin has excellent absorbency. Its ability to retain moisture effectively discharges static electricity.

It's no surprise that the silkworm's cocoon, built to shelter the pupa from natural elements as it develops, is equipped with natural defense capabilities—just like the skin of a fruit. Established in 1955, Miyama Zenshoku Ltd. of Midori, Gunma, is an avid developer of silk products that contain sericin. In addition to washcloths, the firm markets shawls, socks, and gloves.

For one of its lines, open-mesh cloths are knit at slow speed on Raschel machines developed in Germany for the production of fine lace and decorative trimmings. The thread used is raw silk with the sericin left intact. Compared to conventional refined silk, it has a crisp, slightly stiff texture that can be softened with processing as needed.

Many studies show that sericin has numerous beneficial effects and applications. New branding initiatives are underway at Miyama Zenshoku for other products made with natural sericin recovered from the silk manufacturing process, such as bath infusions and gentle soaps. When mature silkworms are placed on latticed wooden frames, each moves in turn to the highest compartment available and begins to build its cocoon. The larva then spins a single continuous filament as it bends its body and flexes its neck in a figure-eight pattern. After one to two hours, an elliptical outline of that trajectory arises, as if by magic.



# Supporting Sericulture Farms in Decline

In Japan, sericulture farmers reverently call silkworms—*kaiko*— "Okaiko-san." In decades past, many rural households engaged in sericulture. The larvae, a valuable revenue source, shared the family's living space. The number of sericulture farms in Gunma prefecture peaked in 1970 at 66,200. As prices for cocoons plummeted, that number dropped to just 1,930 farms by 1999. As of 2017, a mere 121 farms remained. With only 336 farms left nationwide now, the fate of the silk industry in Japan rests largely on Gunma. To this end, the prefectural government offers support to new entrants. Four years ago Miyama Zenshoku financed operations at an abandoned sericulture farm. The first order of business was to secure the proper temperature, humidity, and ventilation of the rearing house. When we visited in September, preparations were underway for the mature silkworms' fifth and final molt, when they build cocoons. The larvae are placed in rotating wooden frames split into 12-centimeter square compartments. These are stacked in groups of ten and suspended from the ceiling. In due time each silkworm finds and occupies the highest spot available and begins to spin its nest.







In the last week before cocooning, the silkworms are fed mulberry leaves four times a day, from morning to night. They eat ravenously, increasing their weight 10,000-fold in just seven days. A small truckload of the leaves, which are grown without the use of pesticides, is brought in for each feeding.

Usui Raw Silk Company, Japan's largest silk mill, is nestled in the low foothills surrounding Annaka. The craggy peak in the background is Mount Myogi, renowned for its striking rock formations. The Usui River flows behind the mill. This abundant source of water allows the company to operate without burdening the environment.

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# Gunma Silk is Environmentally Friendly

Usui Raw Silk Company in Annaka, Gunma, is Japan's largest silk mill. In 1970 there were 106 silk mills operating in the prefecture. Now, Usui is the only one left. It is the last bastion of support for sericulture farms producing high-quality cocoons in Gunma.

Each cocoon is spun of a single strand of silk. The reeling, or extraction, process unravels those individual filaments and spins them together to make one much thicker thread. A huge reeling machine—like something you might imagine from the Machine Age of the early 20th century—is used for this. Nothing is computerized. With people operating the reeler and carefully tending the process, the silk rendered is of far higher quality. Silk making at Usui is environmentally conscious. Sustainability is emphasized; waste is minimized. The mill obtains cocoons only from sericulture farms that use no chemical pesticides in cultivating their mulberry trees. Once the silk filament has been harvested the expired pupae are used as food for monkeys at the Japan Monkey Centre, and for carp. Silkworm feces are collected and returned to the earth as fertilizer. No formalin or other disinfectants are used in the reeling process. Waste yarns are graded for quality and repurposed as spun silk. Such sustainable measures taken throughout the production process heighten the intrinsic quality and appeal of Gunma silk.

#### Silk Reeling 1

Cocoons, softened in hot water to make them easier to unravel, flow into a tank where rotating brushes tease out the end of each filament for automatic gathering.







#### Silk Reeling 2

The machine rolls the filaments of several cocons into a single thread. When it senses a knot in the line, it stops. A worker then quickly cuts out the knot and rejoins the thread by hand.



#### **Re-reeling**

To make skeins of standard size, the thread is re-reeled on larger reels of about 150 centimeters in circumference. This also ties up broken ends and makes the thread continuous.



**Finishing** With their sericin coating left intact, the newly minted threads are gathered into 250-gram skeins. These in turn are bundled into lots of 20 and shipped as raw silk.