



## Silk: The queen of fibres

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Silk is a natural protein fibre. The actual fibre protein, called *fibroin* is composed of fifteen amino acids hooked together in long molecular chain. *Sericin*, the gum that holds the filaments together, is also a protein substance. Silk is often called '*queen of fibres*'. Silk is produced by the larvae of several moths. These larvae live on mulberry leaves and each tiny larva consumes an extremely large number of leaves. Raising of these insects is a laborious job. The larva attaches itself to a specially constructed straw frames, rears its head, and begins to spew the silk liquid, which hardens on contact with air. The larva spins by moving its head in a figure-eight motion and contrasts the cocoon from the outside in. As it spins, the larva decreases in size, and upon completion of cocoon it changes into dormant chrysalis. Except for those to be used for breeding, the cocoons are subjected to heat; which kills chrysalis. These cocoons can be stored until unreeling in preparation for yarn manufacturing.

The silk worm extrudes the liquid fibre from two tiny orifices or spinnerettes in the air, it solidifies into silk filaments. The fibres have a coating of gummy substance called *serium*. The best-known type of silk is obtained from cocoons made by the larvae of the silkworm '*Bombyx mori*' (reared in captivity). Rearing of silkworms is called '*Sericulture*'. The length of the silk fibre depends on how it has been prepared. Since the cocoon is made of one strand, if the cocoon is unwound carefully the fibres can be very long. Degummed fibres from *B. mori* are 5-10µm in diameter. In woven silk, the natural shimmering appearance for which silk cloth is highly prized comes from the fibre's triangular prism-like cross-sectional structure acts as a prism and allows silk cloth to refract incoming light at different angles. *Spider silk* is known as the strongest natural fibre. The strongest *dragline silk* is five times stronger than steel and three times tougher than *Kevlar*. It is also highly elastic; the silk of the *ogre-faced spider* can be stretched six times than its original

length without any damage. As of 2005, there is no synthetic material in production that can match spider silk, but it is actively being sought by the U.S. military for such applications as body armour, parachutes and rope. Genetically engineered goats have been raised to produce spider silk in their milk at a cost of around \$1,500 per gram.

**History:** The possibility of making cloth from the filament that the silkworm spins into a cocoon was first discovered in china about 2600 B.C. Legends tell us that a cocoon accidentally dropped into a cup of tea that a Chinese princess was having in her garden. It began to unravel giving her the idea to use it as a yarn. For this, she had been prepared a hot liquid to soften it and loosened the fibre. Then the princess pulled and drew away it from the cocoon as a continuous strand. Another story cites Empress Si-ling-chi as the first producer of silk fibre, from which she made a silk robe for her husband. From antiquity until the more recent establishment of the Chinese Republic, she was venerated as the Goddess of the Silk worm. The Chinese who first cultivated the silk worm and developed a silk industry endeavoured to keep the source of the raw material secret. Their silk fabrics were highly priced Caravans carried silk into the Near East where they were traded for hundreds of years. It is believed that silk was introduced into Europe by Alexander the Great in the fourth century B.C.

As the desire for the silk fabrics expanded, the interest in its production also increased. About three thousand years after its original discovery the secret was stolen out of China.

The earliest mention of silk fabrics is attributed to ancient India and is thought to have been brought to other parts of the world by the Aryans, along with the horse. The symbol for silk was already part of the written language in China around 2600 BC and fragments of ancient silk fabrics have been found and dated back to around 1500 BC. Aristotle first mentions silk in Western culture around



300 BC but it was not until the “Silk Road” trading routes were established around 100 AD did silk become abundant in the West. Silk influenced the fortunes of many countries since and is said to be one of the financial bases of the Renaissance. Sericulture, as it is called, or silk production has been established in many countries since but China is still one of the most dominant suppliers of silk to the world. A large silk industry eventually developed in South Eastern Europe. Spain began to produce silk in eighth century. Italy began silk production in the 12<sup>th</sup> century and was leader for 500 yrs.

Silk continued to be prized by the consumer even though some man-made fibres now have some qualities that were formerly possessed by silk. Here, a list of some more common forms of silk is given:

**Raw silk:** Silk in its natural form is covered with a gum called sericin. Raw silk still has all the gum which is dull and stiff and can be in many

colours. Various processes can be used to remove the sericin to reveal the lustrous fibre beneath.

**Wild silk (Tussah silk):** This is usually not white and is from the tannins from eating plants other than the mulberry tree. It can be coarser than cultivated silk, making it better for high wear items. It is cheaper. Wild silk cocoons are usually gathered after the moth has emerged, therefore the staples or fibres will have been cut, making it only suitable for spinning. It usually has small black flecks throughout and more robust.

The silkworms that hatch from a wild species of moth, the *Antheraea mylitta* live on oak leaves instead of mulberry leaves that form the food of the cultivated

species. This coarser food produces an irregular and coarse filament that is hard to bleach and dye. The tannin in the oak leaves gives wild silk its tan colour and the silk is commonly woven with the naturally coloured thread. It is rarely dyed except in solid shades. It is less lustrous than cultivated silk as only a low percent of sericin is removed in the degumming process. Wild silk fabrics are durable and have a coarse, irregular surface. They are washable and generally less expensive than pure-dye silk.

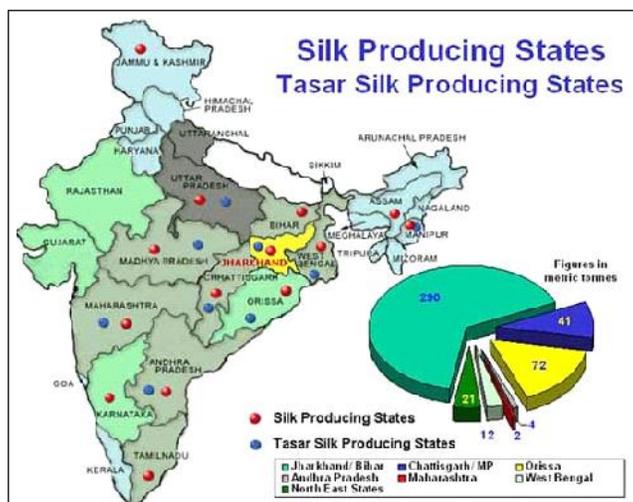
Typical fabrics are rajah, shantung, tussah and pongee.

**Cultivated silk:** This has become a highly technical and controlled industry where silkworms are raised and fed mainly on mulberry leaves to produce a near white coloured silk. Often the chrysalis or grub is destroyed before it has a chance to eat its way out of the cocoon, so that the fibre can be reeled off in one long fibre.

**Thrown silk:** Made from the long filaments of silk upto 1500 m. long. It is nearly always made from cultivated silk. It is more expensive due to the extra work required in reeling off the single filaments. It requires very little twist so retains more lustrousness, and can be woven into fabrics that are almost transparent, also called Reeled Silk. Some types of thrown silk fabrics include: voile, georgette, organza and crepe.

**Noil silk:** It is made from very short staple and contains little tangle balls of fibre. To make fabric from it, the shorter waste fibres in the form of comber noils from spun silk processing are spun into coarser, irregular, neppy yarns using the woollen spinning system.

**Dupion silk:** This is silk which retains the lumps where



two threads join. It is a characteristic which is admired and should not be considered a flaw.

**Spun silk:** Short length of inferior silk filaments obtained from waste material is not used in producing reeled silk. After the short lengths have been carded and combed, they are spun together much as cotton, linen or wool yarns are spun. Spun silk yarns are soft but they are less lustrous than reeled silk and are not as strong or elastic. Spun silk fabrics tends to become fuzzy after weaving because the yarn is made up of short staple. It includes varieties such as Shantung, Mutka and Noil.

There are several sources of staple silk:

- **Pierced cocoons**, the result of breeding moths that have emerged from their cocoons.
- **Double cocoons**, the result of two cocoons having been spun by two silkworms too close together called ‘Doppioni Silk’.
- **Floss**, brushed from cocoons before reeling.
- **Frison**, the coarse and uneven silk fibre at the beginning and end of each cocoon.
- **Scrap**, the machine waste left from reeling, throwing and the like.

Spun silk is less expensive than reeled silk. Although spun silk has less strength and elasticity because of the shorter staple used, it possesses all the general characteristics of reeled silk.

**Qualities of silk :** Silk has many qualities which sets it apart from other fibres.

- Silk is a lustrous fibre.
- The filament of silk is a continuous thread of great tensile strength measuring from 500 to 1500 metres in length, with a diameter of 10-13 microns.
- It has good absorbency, low conductivity and dyes easily. The colours take on a bright sparkle. Silk can absorb an amazing 30% of its dry weight in moisture, giving it similar properties to wool. This makes it a comfortable year-round fibre to wear.
- Silk is highly resistant to mould and mildew. It is also resistant to moths and dust mite. It thrives in water, although detergents and perspiration can break down the fibre.
- Silk is warm to touch but without weight and also warm to wear. It breathes so can be used as a summer fibre, but makes for light weight insulation in the cold. It has been used for glove liners and sleeping bag inners for extra warmth. For e.g., a silk shirt is warm without having any bulk.
- Silk is strong. It is finer than human hair yet is as strong as an iron wire of the same diameter.

– Silk is a fine fibre so when silk is subject to abrasion making it unsuitable for high rub areas like carpets or regularly used furniture.

– Silk is very elastic fibre. It can stretch 10% to 20% without breaking.

– It resists creasing and can be combined with other fibres like wool to help knits return to their original shape.

– It is a very good fibre to use as a warp. If nothing else, it is the soft, warm handle which sets it apart.

**Care of silk :** Care of silk is similar to caring for wool. So, wash gently in luke warm water.

– Pure silk and water are quite compatible. It does not go mouldy even after long periods of being damp. If there is a large amount of gum left, this can begin to ferment and give off an odour, but the smell should wash away.

– Never use bleach on silk fabrics.

– Always handle with care.

– Squeeze or allow to drip dry.

– Never wring or rub them.

– Do not expose silk for large lengths of time to sunlight. It will break down the fibres over time. Preferably dry flat away from direct sunlight.

– During washing, shrinkage may occur due to the fibre absorbing moisture. Preferably, the fabric should have been pre-shrunk but pressing on a silk heat setting should return it to close its original size.

– It has a natural elasticity which does not hold creases well. So, start with a dry iron on the silk setting, preferably while the garment is still a little damp. Steam can be used on heavier silks, but could cause puckering and shrinkage on finer fabrics. Make sure it does not leave a shiny finish. It is safer to iron with a cloth or on the wrong side. But do not iron silk velvets.

– Silk can be dry cleaned. But any silk with an embossing or moiré finish, if the dirt is oily or greasy, go and visit a professional dry cleaner.

**Application of silk in daily life:**

**Apparel fabrics:** Dresses, blouses, sophisticated lingerie, ski underwear and formal dress.

**Accessories:** Scarves, squares, gloves, ties, hats, artificial flowers, ribbons, handbags and umbrellas.

**Household textiles:** Drapes, wall coverings, carpets, lampshades and bed clothes.

**Industrial textiles:** Sewing threads, embroidery threads, typewriter ribbons, racing bicycle tyres.