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A COMPARATIVE STUDY OF DIFFERENT TYPES OF SILK FIBER AND ITS MULTIDIRECTIONAL APPLICATIONS

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Abstract

The fiber that was first discovered thousands of years ago called 'queen of fibers. Another name by which it is known all over the world is called silk. Silk was first introduced from China, which is believed to be in the 27th century BC. The method of making silk did not come out of China until the trade route was created. Between 4000 to 3000 to BCF, many evidences of silk have been found. (I) For many years, Chine did not allow the silk industry to come out of Chine. In Chine, silk material was reserved only for emperor. Even after hiding silk production from the world, silk gradually came out of chine and spread all over the world via Korea, Thailand, India and Europe. (II) Indian silk industry is the most important and very old industries which produces 18 percent of the world's silk in the production of silk. Among all fabrics, available silk is the most expensive and rich. It is still and has been in the latest fashion trend ever. Silk is known and used in all countries irrespective of the culture and dressing sense. (III)Ever since the discovery of silk, silk has been a fiber of lofty position associated with. Luster and smoothness are the main qualities of the silk, these qualities made from cultivated and degummed smooth filament of silk fiber. These qualities are associated with the concept of "silky". In this paper, the structure, composition, general properties, and applications are described. In addition, its application used for the fabrication and modification of various materials are briefly addressed.

Keywords: Silk, Trade, Expensive, Trend, Lofty, Cultivate, Degummed, Fabrication, Modification

Introduction

Silk is a fiber in which scientists have been interested since ancient times. The search for silk polymers is going on continuously, which is being done by many analytical methods, the results of which are also coming out continuously. Silk in India, industry is very earliest and its mainly cottage-based industry until today, from cocoon (raw material) making to fabric production. However, efforts are being made to modernize the industry very carefully in certain sectors like silk reeling, spun silk industry, silk weaving and wet processing. India is the only country producing commercially available four varieties of silk i.e., Mulberry, Tussar, Eri and Munga. This fiber is very, smooth, soft, lustrous, and durable than any or artificial fiber. The industrial and commercial uses of silk contributed to the silkworm promotion all over the world especially in developing nation. Fibroin and sericin are two types of proteins, which found in silk fiber. Quality of cocoons (raw material), yarn and fabrics in India is not up to the international levels because of many inter linked problems on account of cottage-based industry. Hence research is to be carried out to inject very simple devices to improve the quality and quantity of yarn and fabrics. The forgoing pages review the present position and research work done in various stages of natural silk industry in India from cocoon stage up to fabric stage for last three decades. The silk fiber is continuous protein filament produced by the silk worm. Fibroin and sericin, both these protein substances are found in silk fiber and this silk is called Bombyx Mori. There are some other substances like fatty, waxy, color and minerals which are found in small amounts in it. Fibroin founds 70 - 80 % of its weight; the fibroin is surrounded by sericin in a continuous covering, accounting for 20 - 30%. Fibroin sericin of silk has an almost equal percentage of elements. (IV)

Types of Silk	Species of Silkworm	Food Plant
Tussar	*Antheraea mylitte Drury*	Terminalia sps,Palm tree[V]
Mulberry	*Bombyx mori* L	Mora elba
Eri	*Philosamia ricini*	Ricinius communis(castor)
Munga	*Antheraea assamensis*	Tetraanthera monopetala
Oak Tasar	*Antheraea proyeli J*	Quercus Spp. & PhilosamiaSpp

Methodology

Structural aspects of silk

Silk fiber contains two families of proteins, called sericin and fibroin. Fibroin fiber is a glycoprotein secreted into the lumen of the posterior glands as a molecular complex comprising. In a silk filament, fibroin is arranged as micro fibrils in bundles of fibers. When cocooning has been done, two such filaments made a thread of silk, each filament from them is surrounded by sericin and this sericin emerges from the gland of silk. 25% to 30% of the cocoon's total weight is sericin, it is a family of glycoprotein and this glycoprotein is generated by alternative splicing of the sericin genes. [VI] The cocoon cell consists of a cell called a "bave" which is made up of a continuous protein filament. The length of this "bave" is 300 - 1600 meters, depending on the variation of race. This "bave" is divided into two parts, the core part is called fibroin and the outer cover is called sericin which is sticky. This bave is divided in to two parts, the core parts are called fibroin and the outer cover is called sericin which is sticky. This fibroin is divided in to two parts, both of which are called "brin". Silkworm's secrets a larva like substance from the mouth that is covered with a sticky sericin. There is fibroin inside this sticky sericin; sericin and fibroin formed a "bave".

Longitudinal section of silk filament

Figure-1 show un-degummed and Figure-2 shows longitudinal view of Degummed silk fiber by scanning electron micrographs. The non-mulberry silks such as Tasar, Muga and Eri all have striations on their surfaces Mulberry silk expressions a more or less even surface whereas.

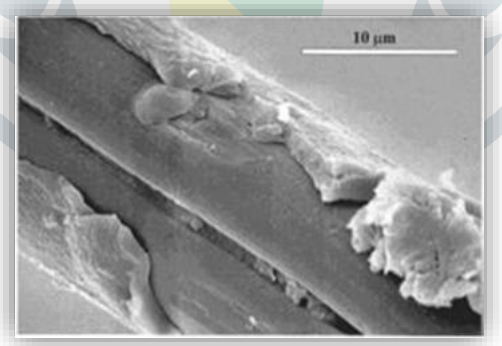
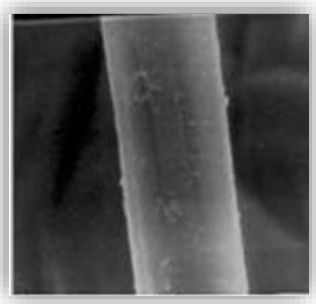
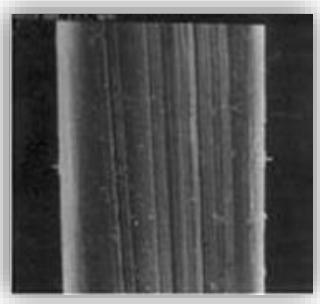


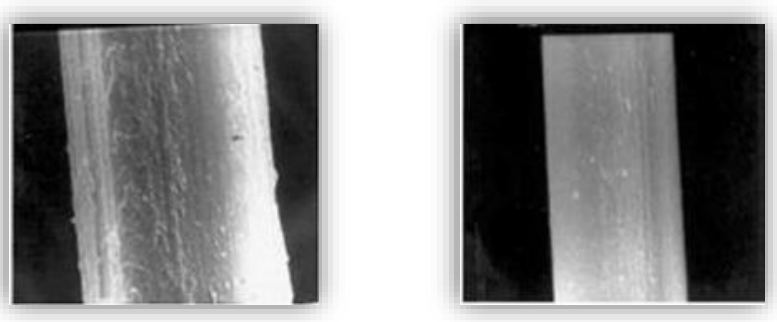
Fig.1- longitudinal view of un-degummed silk fibers [VII]



Mulberry



Tasar

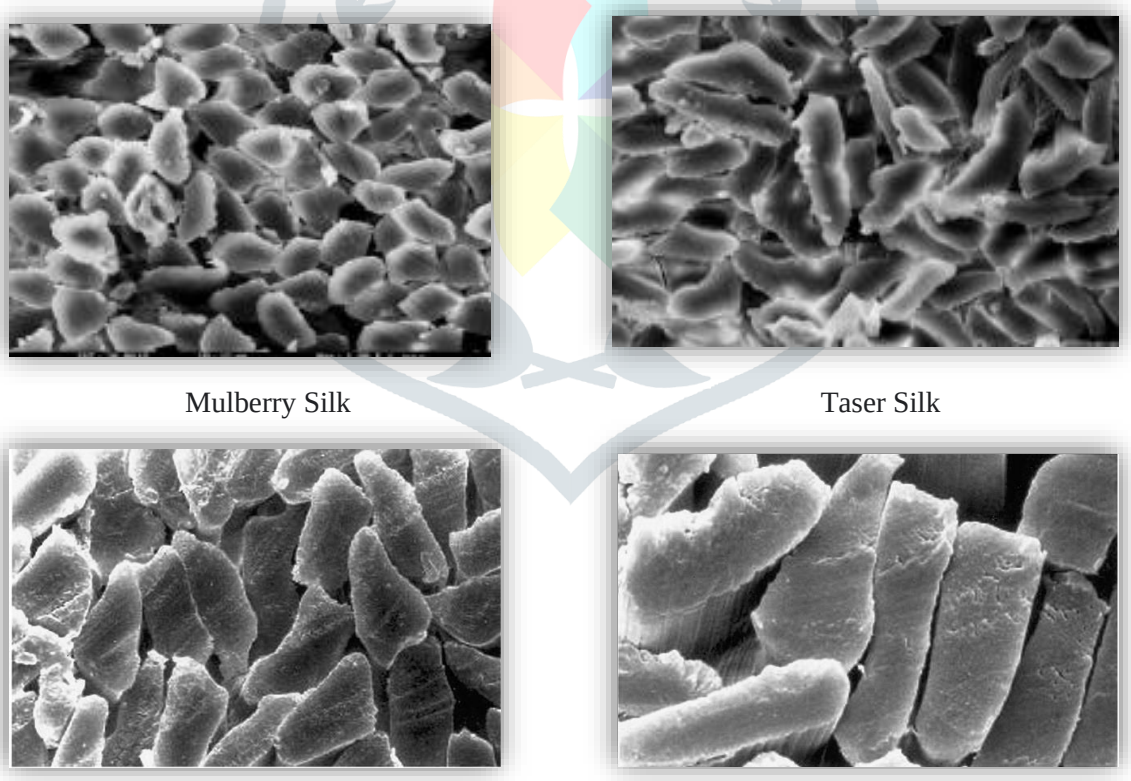


Muga Eri

Fig.2- longitudinal view of degummed silk fibers [VII]

Cross sectional shape and fiber surface

Cross sectional shape of different varieties of silk fibers, as viewed by a scanning electron microscope, are shown in Fig. 1. The cross sections of all non-mulberry silk fiber are more or less rectangular whereas cross section of Mulberry silk is near triangular. Striations are observed on the surface of Muga and Tusser silk fibers (Fig.1) and the harsh feel of these two fibers may due to these striations. Both domestic silk fibers, viz Mulberry and Eri, on the other hand, have relatively smooth surfaces. [VI]



Mulberry Silk Taser Silk

Eri Silk Muga Silk

Fig.3- Structure of raw silk fiber [VII]

Chemical composition

A graphical view helps to understand each element % present in the silk. The below are the table (Table 1).

Components of silk fiber	% To total
Fibroin	75
Ash of silk fibroin	0.5
Sericin	22.5
Fats and wax	1.5
Mineral salt	0.5
Total	100

(VIII)

Chemical properties

	Mulberry	Tussar	Eri	Munga
Fiber fineness	2.1 dtex	8.9 dtex	3.09 dtex	4.2dtex
Acid resistance	excellent	Good	Good	Good
Weight of cocoons	1.55 g	16.39gm	3.23 g	4.5 to 8.55gm
Elongation	9.34–12.99%	21%	16.88–22.6%	8.91%
Bleach resistance	Destroy	Destroy	Destroy	Destroy
Alkali resistance	Dissolve	Dissolve	Dissolve	Dissolve
Cross-section	Triangular	Elongated Triangle or Needle Shaped	Elongated Triangle or Needle Shaped	Elongated Triangle or Needle Shaped

Physical properties

	Mulberry	Tussar	Eri	Munga
Filament Length	869.17–1424 m	750m	317.8–452.37 m	600-800m
Density	1.3525 g/cm3	1.3525 g/cm3	1.303g/cm3	1.307g/cm3
Tensile strength	7.17–12.85 cN	28.6 cN	3.27–5.16 cN	3.7cN
Fiber fineness	2.1 dtex	8.9 dtex	3.09 dtex	4.2dtex
Toughness	0.6gf/ den	0.9gf/ den	0.5gf/ den	1.1gf/ den
Moisture Absorption	9%	10.76%	10%	8%
Appearance	Smooth in surface & gray to yellow	Brown	Irregular & gray	Golden yellow
Surface	smooth in surface	Harsh feel	smooth in surface	Harsh feel

Silk Applications

	Different Applications of Silk	
1.	**Textile Application**	The cultivation of silk is called sericulture. Silk is considered the most beautiful of all fibers due to its luster and shine quality, and that is why silk is called the queen of textile fibers. Due to the increase in the demand for natural products and the resultant, the importance of silk has increased in the textile sector. Silk is different from all the fibers and it remains in its own place even if it is always produced in the cottage industry and not on a large scale. This fiber is different from all the fibers due to its high quality and it is maintaining its own place even though its production is always done in the cottage industry, not on a large scale.
2.	**Cosmetic**	Silk fibroin, fibroin protein, bio polymer of silk is used in a verity of cosmetics. Peptides, a substance found in silk fibroin, are used in a variety of make-ups. Peptides are characterized by silky, elastic, elastic coating powder, easy dispersion and adhesion properties. Silk sericin has inundation, revitalizing and UV ray absorbing properties. Due to these properties, sericin is used as a skin moisturizer, anti-irritant, anti-wrinkle and sun protector. On the other hand, the bio-polymer found in silk has been used in wound healing, in the treatment of burn victims, and in tissue regeneration. Hydrolyzed silk, silk powder, raw silk and amino acids these are all the components of silk fiber, which are used in cosmetic products, soap making and personal care. There are 18 types of amino acids found in silk protein, including glycine, alanine, serine and tyrosine is important as skin nourishment.
3.	**Art And Craft**	The art of making craft from silk is very interesting, which along with additional income, also enhances the skills of the humans. Silk waste is used to make various types of crafts like pen stand, jewelry, flower vase, greeting cards, decorative items, dolls; boxes etc. there are many things that are made from silk best paper like greeting cards, decorations, decorative flowers. Products like carpet, furnishing and fancy jackets, these are high value products reformed by tow silk, hybrid silk, silk weave and net raw silk.
4	**Biomedical**	Silk is a fiber in which biopolymer protein is found and this fiber is renewable. Excellent mechanical properties are found in this fiber. It is used in textile industries as well as in medical applications. Silk fiber has been used in medical applications since ancient time due to the properties found in it such as good biocompatibility and bioresorbable capacity. Due to being rich in silk full of protein, it has high mechanical strength; this mechanical strength makes it suitable as a biological material. A silk fiber has many excellent characteristics such as absent or minimal immunogenicity, limited bacterial adhesion, biocompatibility, and controllable biodegradability, this normal biopolymer has been found to be proper for a variability of biomedical engineering applications. The evolution of silkworm silk started with its biomedical application as sutures for wound treatment.
5.	**Pharmaceutical**	Silk is also used to fight various diseases such as impotence, adenosine augmentation therapy, epididymitis, cancer, cystitis and edema. Derivatives of silk fibers are used to treat a verity of ailments. Sericin is also used in clinical diagnostic techniques production of medical importance in jeans and lowering blood glucose level.

6.	**Dietary**	Silk fiber is important as a dietary applicator in many ways like silk fiber is rich in amino acids and silk protein which are the best nutrition for human body. Also, silk powder, amino acids found in silk fiber and hydrolyzed silk protein is used in many food products. Apart from this, silk protein is specially used in the diet of heart and diabetic patients, which increases their digestive power and energy. Silk fiber will now also be used in astronaut food, which has been released by some aerospace agencies.
7.	**Antibacterial**	Sericin water obtained after the degummed process, which has a variety of properties such as antibacterial, UV resistant and easy moisture absorption. Concentrated solution of sericin is weak and layered on cotton fabric to increase its uncontaminated assets. Concentrated solution of sericin is diluted and coated on cotton fabric to enhance its antibacterial property. sericin extraction and then reusing of this waste water also decrease the pollution.
8.	**House Building**	Composites of silk fiber with polypropylene are known to be superior to plastics. Standard glass fiber is made from polypropylene and silk fiber. Due to good tensile and elastic properties of silk fiber, these properties can be increased or decreasing by increasing or decreasing the contents silk fiber. Being glossy and silky appearance in silk fiber, they are used in decorative laminates like plywood. Beautiful silk flowers are made using many colored silk papers of high embellishment value. During propitious, the fabric is made more beautiful by using silk leather paint in silk powder for interiors decoration.
9.	**Automobiles**	Silk fibroin has good tensile strength as well as many mechanical properties, due to these properties it is used in automobiles. Silk fiber can absorb equal to 30% of moisture by its own mass and feels dehydrated to the touch due to its hygroscopic properties. Silk fiber increases up to 35%. As soon as it reaches the breaking point, it increases in stiffness, strength and elongation, which makes it applicable in automobiles. If seen in terms of environmental improvement, then the use of natural fiber in automobiles also reduces pollution to a great extent.

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