

### 7.3.3.2. Silk

Silk is a natural protein fibre which can be woven into textiles. The protein present in silk is fibroin and is produced by certain insect larvae to form cocoons

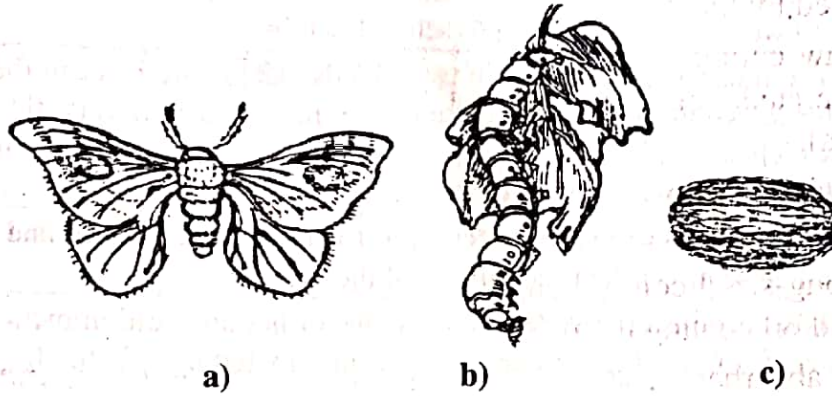


Figure 7.14: Silk Worm Moth *Bombyx mori* Linn.  
a) Moth, b) Cocoon, and c) Larva

#### Synonyms

Mantua, Pongee, Samite, and Sendal.

#### Source

Silk is the fibre obtained from the cocoons of *Bombyx mori* (Mulberry silkworm) and other species of *Bombyx* and also from *Antheraea* species.

#### Family

Bombycidae

#### Occurrence and Distribution

Fine quality of silk is manufactured in Japan, Italy, China, and France. In India also large quantity of silk is being produced.

#### Preparation

Figure 7.15 indicates the steps involved in production of silk. The above mentioned steps are described in detail in the table 7.4:

Cultivation of Silkworms



Hatching



Moulting



Spinning the Cocoon



Sorting Cocoons



Softening the Sericin



Reeling the Filament

Figure 7.15: Flowchart of Silk Production

**Table 7.4: Steps Involved in Preparation of Silk**

Steps	Description
<b>Cultivation of Silkworms</b>	Silkworm ( <b>figure 7.14</b> ) is the caterpillar of small half moths belonging to "bombyx" which lives only on leaves of mulberry tree. The silkworm spent their entire life in eating these leaves.
<b>Hatching</b>	Eggs of silkworm are warmed up for hatching in winter by spreading them over the trays in the hatching shed and chopped leaves of mulberry trees are spread on the perforated paper. For eating the leaves, the worm climbs through the holes.
<b>Moulting</b>	After 35 days of hatching, worm is 10,000 times as heavy as it was born. Worm becomes greenish white caterpillar, and starts spinning; and the silkworm built its cocoon to settle down in it.
<b>Spinning the Cocoon</b>	The liquid silk comes from two glands called <b>spinneret</b> in the silkworm head. As the liquid comes out, it is hardened into very fine filaments which are coated by a gummy substance called <b>sericin</b> which comes from other two glands nearby.
<b>Sorting Cocoons</b>	The cocoons are sorted according to colour, size, shape, and texture, as all these affect the final quality of the silk.
<b>Softening the Sericin</b>	The cocoons are put through a series of hot and cold immersions, as the sericin must be softened to permit unwinding of the filament as a continuous filament.
<b>Reeling the Filament</b>	The process of unwinding of the filament from cocoon is called <b>reeling</b> .

### Organoleptic Evaluation

- 1) **Form:** Very fine, solid, and smooth.
- 2) **Colour:** Yellow.
- 3) **Length:** About 1200m long,
- 4) **Diameter:** 5-25 $\mu$  in diameter.
- 5) **Solubility:** Soluble in cuoxam solution, 66% sulphuric acid, and concentrated hydrochloric acid.

### Chemical Constituents

Natural silk consists of **fibroin** protein which hydrolyses into **glycine** (44%), **alanine** (27%), **serine** (11%), **tyrosine** (5%), and other amino acids. The molecule exhibits a chain-like structure having a 0.7nm long repeating unit which when analysed by radiography was found to be corresponding in length to that of two fully extended amino acid residues. It does not contain sulphur.

### Identification

- 1) It is soluble in ammoniacal copper oxide solution. Thus, it can be separated from wool and cotton by using an alkaline solution of copper sulphate and glycerol of known strength.
- 2) When treated with alkali and lead acetate solution, silk does not form a black coloured precipitate as it has little or no sulphur content (distinction from wool).
- 3) It rapidly dissolves in concentrated hydrochloric acid (distinction from wool).

### Uses

Silk fibres are used for preparing special types of sutures, sieves, and ligatures.

### 7.3.3.3. Wool

Wool is a specific type of hairs of some mammals. It is mainly obtained from sheep and goats and sometimes also comes from other animals like qiviut from musk oxen, angora from rabbits and other types of wool from camelids.



**Synonym**

Sheep wool

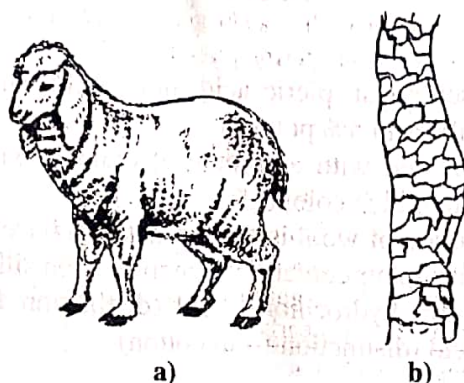
**Source**Wool is obtained from the fleece of sheep *Ovis aries* (figure 7.16).

Figure 7.16: a) Sheep, b) Wool Fibre

**Family**

Bovidae, (Order Ungulata)

**Occurrence and Distribution**

Wool is manufactured in Australia, U.S.A, Argentina, Russia, and many countries including India.

**Preparation**Wool hair originates in deep pits or hair follicles in the skin and **wool grease** is secreted by the nearby sebaceous glands. Its preparation takes place in the following steps:

- 1) Wool is removed from the body of sheep.
- 2) The wool sorter spreads the fleece on a frame covered with wire netting and separates it into wool of different qualities.
- 3) The dust and dirt is removed by beating the wool over the netting.
- 4) The dirt passes through netting and the burrs and pieces of straws, etc. are picked up.
- 5) The wool is washed in tanks with warm soapy water.
- 6) It is then squeezed between rollers.
- 7) After washing the wool is dried and the fibres are mechanically loosened.
- 8) These are then carded and spun into yarn.

**Organoleptic Evaluation**

- 1) **Appearance:** Wool hairs are smooth, elastic, lustrous, curly, hygroscopic, and slippery; they have the tendency to cling together.
- 2) **Solubility:** Insoluble in 66% sulphuric acid, concentrated hydrochloric acid, and cuoxam solution.
- 3) **Size:** Wool hairs are 2-50cm long, 5-100 $\mu$ m wide, and 13-40 $\mu$ m in diameter; fleeces are removed by shearing lack the bases of the hair and tapering ends, known as **lamb ends** found in wool after the first shearing.

**Chemical Constituents**Wool fibres are made up of **keratin** protein. They show elasticity, in contrast to the cellulose and silk fibres. On examining the stretched and unstretched fibres with X-rays, it was observed that the elasticity arises from a reversible intramolecular transformation of the fibre substance.

The radiography of stretched fibres is much similar to the results given by silk, with fully extended polypeptide chains. In this condition, each amino acid residue is 0.34nm long. This unstable form of keratin is the  $\beta$ -keratin. While the stable form,  $\alpha$ -keratin is contracted and the structural unit of 0.51nm long corresponds to three amino acid residues.

### Identification

- 1) Wool responds to molisch's test, picric acid, nitric acid, and millon's reagent just like silk. It readily solubilises in 5% potash.
- 2) When wool fibres are treated with ammoniacal copper oxide solution, the scales separate and the fibres attain blue colour.
- 3) When a caustic soda solution of wool is treated with lead acetate, a black precipitate is formed due to the high sulphur content (distinction from silk).
- 4) Wool is insoluble in warm hydrochloric acid (distinction from silk) and in cold concentrated sulphuric acid (distinction from cotton).

### Uses

- 1) It is used in manufacturing dressings like domette and crepe bandages and flannel.
- 2) It is used as a filtering and straining medium.