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Processing, properties and applications

K. Murugesh Babu



The Textile Institute

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Introduction to silk and sericulture

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Abstract: This chapter reviews the different types of mulberry and non-mulberry species of silk moth. It discusses the cultivation of different varieties of mulberry (moriculture), the life cycle and rearing of silkworms as well as the harvesting of cocoons (sericulture). It also covers diseases of silkworms and physical characteristics of cocoons.

Key words: silkworm, mulberry and non-mulberry species, moriculture, sericulture.

1.1 Introduction

Silk is one of the oldest fibres known to man. It is an animal fibre produced by certain insects to build their cocoons and webs. Although many insects produce silk, only the filament produced by the mulberry silk moth *Bombyx mori* and a few others in the same genus is used by the commercial silk industry (Jolly *et al.*, 1979). The silk produced by other insects, mainly spiders, is used in a small number of other commercial applications, for example weapon and telescope cross-hairs and other optical instruments (Spring and Hudson, 2002).

Over the centuries, silk has been regarded as a highly valued textile fibre. Its qualities of strength, elasticity, softness, absorbency, affinity for dyes and adaptability to various forms of twisting continue to meet various applications. Because of its high (tensile) strength, lustre, durability and ability to bind chemical dyes, silk is still considered a leading textile material (Zarkoob *et al.*, 2000). Despite facing keen competition from man-made fibres, silk has maintained its supremacy in the production of luxury apparel and other high-quality goods (Robson, 1998). Silk fibres display unusual mechanical properties: they are strong, extensible and mechanically compressible (Matsumoto *et al.*, 2006). Silk is rightly called the 'queen of textiles' for its lustre and feel (Manohar Reddy, 2009). Silk's natural beauty and properties of comfort in warm weather and warmth during colder months have also made it ideal for high-fashion clothing. As a result there is significant research into the artificial production of silk fibres (Chen *et al.*, 2003).

Sericulture is an art of rearing silkworm for the production of cocoons which are the raw material for the production of silk. The major activities of sericulture comprises food-plant cultivation to feed the silkworms which spin silk cocoons and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving (Kumar *et al.*, 2001). Sericulture is ideally suited for improving the rural economy as it is practised as a subsidiary industry to agriculture. Recent research has also shown that sericulture can be developed as a highly rewarding agro-industry. Sericulture involves the cultivation of mulberry and production of cocoons to produce silk filaments. The best raw silk is obtained from the species of moth *B. mori*. Breeding of silkworm normally occurs once in a year but, under industrial conditions, eggs may be hatched three times a year. The female moth lays around 350–400 eggs, after which the moths die. As they are subject to hereditary infection, any eggs from infected moths are destroyed. Larvae of about 3 mm are hatched from the eggs. For about 20–30 days, they are carefully nurtured and are fed five times a day on chopped mulberry leaves. In the meantime, the larvae change their skin four times and are formed into caterpillars about 9 cm long. At this point they are ready to spin a cocoon, for which racks, clusters of twigs or straw are provided.

The caterpillars have small openings under their jaws called spinnerets, through which they secrete a protein-like substance. This substance solidifies when it comes in contact with air and the resulting filament is spun around the silkworm in a shape resembling the digit 8. The cocoon, which is about the size of a peanut shell, is completed. The filament is held together by sericin or silk gum. The life of the worm is ended by the process of ‘stoving’ or ‘stifling’ in which the cocoons are heated. Some of the cocoons are preserved so that the pupae or chrysalises inside them develops into moths for further breeding.

There are five major types of silk of commercial importance, obtained from different species of silkworms which in turn feed on a number of food plants. The main type is mulberry. Other varieties of silks are generally termed non-mulberry silks. India has the unique distinction of producing all these commercial varieties of silk.

1.2 Mulberry silk species

The bulk of the commercial silk produced in the world comes from this variety. Mulberry silk (Fig. 1.1) comes from the silkworm *B. mori* L., which feeds solely on the leaves of the mulberry plant. These silkworms are completely domesticated and reared indoors. In India, the major mulberry-silk-producing states are Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu and Jammu and Kashmir, which together account for 92% of country's total mulberry raw silk production.