VIth sem-Paper-M-603 Economic Zoology

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SERICULTURE

INTRODUCTION-

Commercial rearing of silk producing silkworms is called sericulture. It is an agro-based industry comprising three main components- a)cultivation of food plants of the worms. b)rearing of silkworms. c) reeling and spinning of silk.

Taxonomy

Phylum- Arthropoda

Class- Insecta

Order- Lepidoptera

Family- Bombycidae /Saturniidae

Silk producing insects are commonly referred to as serigenous insects. Silkworm is a common name for the silk producing caterpillar Larva of silk moths.Silk moths produces natural silk. There are several species of silk worm that are used in commercial Silk production.

1. Mulberry silk:

***Bombyx Mori* - family -Bombycidae**

2.Non Mulberry silk-family - Saturniidae

Tasar silk- *Antheraea mylitta , A. pernia, A. yamamai, A. paphia ,A.royali*

Muga Silk-*Antheraea assama*

Eri silk- *Philosamia ricini*

Nature of Silk

The term silk refers to a wide range of filaments produced by several sp. Of order Lepidoptera under the phylum “Arthropoda”.

Composition, structure and material properties of silk produced by various arthropods namely silkworm,spiders,scorpions,mite,flies etc differs widely depending on the source and reeling conditions such as cotton and wool.The silk thread is extremely made up of long fibres. Silk is a natural protein fibre secreted by silkworm during the tenure of its life cycle.Silk is one of the oldest known natural protein fibres that can be woven into textile.The silk thread is made up of long fibre, which is very strong and lightweight. The sparkling appearance of silk comes from its structure.

Silk fibroin contains semi-crystalline, crystalline and amorphous regions. Tensile properties depend mainly on its crystalline structure, whereas the amorphous region

plays a key role in determining its physical properties.The silk fibroin is made up of various amino acids. Silk is highly prized for its exclusive textile properties. Although silk is exclusively used as a textile material. It also has a history of Bio-medical application.

Chemical Nature of Silk.

Silk principally consists of two proteins, Fibroin and Sericin, in a ratio of 80:20 in case of mulberry silk or pure silk. Fibroin ($C_{30}H_{46}N_{10}O_{12}$) is a yellow coloured fibrous protein, forming the core filament of silk thread. In the silk gland it is present as a helical, soluble protein. When this liquid is pressed or extruded, its helical structure is transformed into straight, crystalline chain structure. During this transformation various amino acids are also reoriented, imparting stability to the fibre.

Fibroin is composed of 2 polypeptide chains, the heavy or H-chain (Mol. wt. 350 kD) and the light or L-chain (Mol. wt. 25 kD) which are connected with each other by disulfide bonds. Sericin, ($C_{30}H_{40}N_{10}D_{16}$), on the other hand, is a gelatinous protein that remains as a covering around the fibroin fibre.Being water soluble, it gets dissolved to some extent while boiling the cocoons for silk extraction. Four types of sericins are generally present in silk like Sericin-I, Sericin-II, Sericin—III and Sericin-IV.Besides fibroin and sericin, silk also contains waxy matter, carbohydrates, minerals and some colouring substances.

Physical Properties.

(i) Length: Being the longest natural fibre, the length of an unbroken filament may be up to 1000 metres. The diameter is around 0.013 mm to 0.08 mm.

(ii) Density: Raw silk has a density of 1.33 gm / cc and that of boiled off silk is around 1.25 gm / cc. It is lighter than cotton.

(iii) Tensile strength: Silk is one of the strongest natural textile fibers. The tenacity of raw silk is 4.5 – 4.8 gm / denier and that of degummed silk drops to 3.3 gm/ denier. Silk can be stretched from 15 to 20% before it breaks.

(iv) Elasticity: Silk elasticity is measured as the tension required stretching it to a definite length. It requires as high as 0.90 gm tension / denier to stretch 1%, in comparison to only 0.32 gm tension / denier required for wool.

(v) Moisture take-up: The moisture regain is 11% in case of raw silk and only 9% following degumming. Its hygroscopic capacity is about midway between cotton and wool.

(vi) Electric properties: Silk is a poor conductor of electricity, though can accumulate static charge by friction. The charge can be dissipated by high humidity.

(vii) Scroop: Scroop is the cracking sound emitted when silk is squeezed and pressed. It is not an inherent property but can be imposed by dipping it in dilute acetic or tartaric acid followed by drying without rinsing.

(B) Chemical Properties:

(i) Heating: Silk can be heated to 140°C without any decomposition. It disintegrated at 170°C.

(ii) Action with sunlight: The strength of silk is reduced if exposed to UV rays of sunlight.

(iii) Action with water: Silk can readily be wetted by water; due to swelling in water it results in an increase in weight by 30-55% and diameter by 16- 18%. Boiling in water hydrolyses the fibroin more rapidly in alkaline pH.

(iv) Action with acids: The lustre of silk increases if treated with milk acid solution. Dilute nitric acid imparts a yellow colour which cannot be washed out easily. Strong acids, on the other hand, denature its protein structure.

(v) Action with alkali: Strong alkali dissolves the silk fibre, while mild alkaline solution may diminish its lustre.

(vi) Action with metallic salts: During mordanting, silk can absorb some salts like stannic chloride, resulting in weight increase. But salts like zinc chloride will dissolve silk. Sodium salt has no such effect but may cause tendering, if stored for a long time.

Among various natural silk, only 4 varieties are commercially valuable. The commercially exploited silk moths belong to either the family bombycidae a saturniidae under the order lepidoptera.These silk are commercially known as mulberry silk,Tasar silk, Muga silk and Eri silk. Due to their very beautiful appearance silk is highly valuable as textile materials. The simmering look of silk comes from the fibres triangular prism like structure due to which Silk cloth can refract incoming light at different angles.