

AREVIEW

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# Importance of silkworm and its wastes to enhance socio-economic status in India

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## ABSTRACT

Mulberry sericulture always been recognized only for commercial production of silk from silkworm. Its quiet true also that at present this sericulture industry is looked as an important source by countries such as China and India to generate global currencies. But several resources regarding mulberry sericulture are still utilized properly. The sericulture waste can be emanated into three kinds *i.e.*, first is beds refuse after silkworm rearing, second mulberry twigs, surplus leaves along with fruits, third waste from cocoon reeling such as pupae. Also silkworm excreta and different by products can offer diverse utility either by direct or indirect way in agriculture and rural cottage industries. Hence helping to generate note worthy economic for the sericulture farmers.

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## INTRODUCTION

Sericulture or silk farming is an art of raising silkworm to produce a natural fibre in the form of cocoons known as silk which at present is an notable source for sericulture farmers. There are more than 58 countries practicing sericulture in the world. India is the second largest producer of raw silk after china with biggest consumer of raw silk and silk fabrics. Maharashtra is a non-traditional mulberry silk producing state in country occupying first position among non-traditional states (Jalba, 2016).

Seeing towards life cycle of mulberry silkworm *i.e.*, *Bombyx mori* a fascinating monophagous insect. It is basically a nocturnal moth native to China but has long

been domesticated throughout the world mostly in temperate and sub-tropical regions. It derives required nutrients from mulberry leaves for its fine cocoon filaments made up of sericin and fibroin valued in global market as silk which at present is generating huge global revenue for sericulture industry.

Sericulture recently has been an important mean for rural sector due to its high labour intensivity, profit orientation, low input and most of the indoor activities etc. Hence playing an important role in upgrading socio-economic condition of the rural folk. It is second largest employer of country next to handloom industry especially rural women's play an special role starting from farm activities to fabric production, marketing and consumption. A fact evident that 18 per cent of global

raw silk is produced in India from silk farming. Due to increased demand of silk and silk produce from developed countries which are leading to earn maximum foreign exchange within shortest possible time.

Looking to all the above major resources in mulberry sericulture been a person working under this field for last 10 years found an hidden angle on whom if been worked can substantially increase extra economic for sericulture growers. Hence from last few months 3 students of mulberry sericulture module of Ratnai College of Agriculture under my guidance have extensively researched upon different allied aspects related to mulberry sericulture. If been adopted by sericulture farmers will not only create employment but also help to generate economy without disturbing ecology and environment from our precise studies we have tried to elaborate and highlight certain unknown or neglected resources such as:

#### **Importance of various silkworm stages:**

The silkworm *i.e.*, *Bombyx mori* stages as eggs, larvae, pupae, moth and its products, by-products along with waste products are used as a potential medicinal source which has been reported by Singh and Jayasomu in 2002. Also their uses in pharmaceuticals, cosmetics, paper and leather industry has been studied by Anonymous (1996).

#### **Silkworm eggs:**

Silkworm egg contains 56 per cent albumin, 19.2 per cent fat and 7.7 per cent sugar. It is used in diet and also serves as male sexual stimulator, as its extract is rich in protein, embryo inductors, glycoproteins, vitamins B<sub>1</sub> and B<sub>2</sub> with energizing and hepatic protector action, hypolipidemic and hypoglycemic effect. Hence used in the pharmaceutical industry as well as in the food industry (Bhuroo *et al.*, 2018). Xia *et al.* (1989) reported that it contain chorionins, cysteine, proteinase etc. The silkworm eggs are also used extensively in transgenic studies as per the work conducted by Bharathi in 2018.

#### **Silkworm larvae:**

The silkworm being a phytophagous insect feeds exclusively on mulberry leaf during its larvae stages (Wani *et al.*, 2017). The silkworm larval life has five instars with four moults having distinct development stages to complete one generation.

A processed silkworm larva's are used as special diets for cardiac and diabetic patients because of their low cholesterol content and in powder form it is used as a common source of animal protein in soups and sauce preparations (Ramakanth and Raman, 1997).

Several chemical constituents such as Insulin like growth factor-II (IGF-II), adipokinetic hormone (AKH), chymotrypsin inhibitors, B-N-acetylglucosaminidase, quinone amine conversion factor and sex pheromone bombykol have been reported from the silkworm larvae by Matsumoto *et al.* (1996). Silkworm larvae from evolution stages are used as total proteic extract in pharmaceutical industry (Anti-diabetic action) or in the food industry as supplementary nutraceuticals (Bhuroo *et al.*, 2018).

Also the silkworm larvae can serve as bioreactor for the production of low cost vaccines against various infectious diseases as studied by Datta, 1994. Silkworm larvae have been also used as infection model to screen and to discover novel therapeutic antimicrobial agents (Panthee *et al.*, 2017).

#### **Silkworm pupae:**

After reeling silk from cocoons the fresh silkworm pupae are normally thrown as they are highly degradable product which causes environmental pollution and off smell in the near vicinity area. Therefore proper utilization of valuable resources is necessary (Sheikh *et al.*, 2018). Pupae contain 50-60% protein, 25-30% fat, 8-10% sugar, vitamins B<sub>1</sub>, B<sub>2</sub>, E, Nicotinic acid, Pantothenic acid, calcium, copper, phosphorus, iron, selenium, chitin and tricanthol (Majumder, 1997). In pupa a complete protein and amino acids compositions are with appropriate proportion in line with FAO/WHO standards (Xia and Zhao, 2003). Pupal oil is used to treat liver and blood diseases (Koul *et al.*, 1994).

#### **Pupae as food:**

The human being also eat silkworm pupae since long before and are considered as a delicacy in regions of India and other countries (Longvah *et al.*, 2011). It can be used as astronaut food to complete nutritional requirements of astronaut (Velayudhan *et al.*, 2008). Due to its high protein content it have been used to fed livestock, notably for poultry, pigs, fish and also for ruminants as per studies of Trivedy *et al.* (2008).

Narang and Lal (1985) reported that silkworm meal

could safely replace 33 per cent of groundnut cake (GNC) in fattening diets of jersey calves without affecting performance which results in cheaper diet. De oiled pupae fed to hens improves their egg laying capacity with impact on colour of egg yolk (Bhuroo *et al.*, 2018). The protein rich oil free pupal powder is also utilized in preparing dog biscuits (Majhi *et al.*, 1991). The silkworm pupal fat and oil is useful in soap or cosmetology industries and found working in anti-aging, darkening grey hair and body weight reduction (Velayudhan *et al.*, 2008).

#### **Silkworm cocoons:**

Cocoon is a stage between larvae and adult moth. The silkworm larvae spin a cocoon for protection and to permit the development of the pupa. The major product of sericulture *i.e.*, silk is obtained from cocoons through reeling process. Silkworm cocoons contain two major protein component *i.e.*, fibroin and sericin.

#### **Fibroin and sericin:**

Silk fibroin can be used as the substratum for the culture of animal cells in place of collagen (Inouye *et al.*, 1998).

The silk proteins *i.e.*, fibroin and sericin are potentially used as bandages to promote wound healing, potential material to fight diabetes, sinusitis, arthritis, edema, cystitis, epididymitis, tissue regeneration, cancer, post surgical trauma and used as antioxidative, bio-adhesive ultraviolet screens and moisturizing, anti-wrinkle, anti-aging and bio active textiles.

Pelade obtained from reeled cocoons is readily digestible and forms an valuable ingredient of food and reduces cholesterol and blood sugar as per studies conducted by Singh and Jayasomu (2002). Also the silkworm cocoon wastes are used to prepare different art crafts like garlands, flower vase, wreath, penstand, dolls, jewellery, wall hanging, wall plates, clocks, bouquets, greeting card etc. (Vathsala, 1997).

#### **Silk moth:**

Moth is the adult stage of silkworm which emerges from the cocoons having a short life span of 5-10 days during which both individuals mates and females lays 350-450 eggs. Leaving this an silkworm adults can also be used as an important resources through which we can obtain; A unique lipophilic peptide (VAP peptide) has been isolated from the heads of male moths. It acts as a

bioactive material for inducing egg diapause (Imai *et al.*, 1996). Silkworm moth oil can be used to obtain textile dyes and superior soaps (Gui and Zhuang, 2000). Adult moth are used in making wine and medicine. In china male moths are used to treat sterility as studied by Raju (1996).

Silkworm moth are also used to prepare pharmaceutical product for curing trauma and to strengthen masculine function. The liquid extract from the moth can be used to treat impotence, abnormal mensuration, menopausal symptoms as been shown by Bharathi (2018).

#### **Silkworm haemolymph:**

*Bombyx mori* haemolymph is an insect serum that has been widely used as a medium supplement in insect or animal cell cultures (Kim and Park, 1999). Singhal *et al.* (2001) studies showed that the haemolymph of silkworm is rich in glutamine, histadine, lysine, serine, glycine. Antibacterial peptides were isolated from silkworm haemolymph such as moricin and lebocin which were first proline rich anti-bacterial peptide found in lepidopteran insect as per the work of Hara *et al.* (1995).

#### **Silkworm extracts:**

The extracts is a preparation containing the active ingredient of a substance in concentrated from which is obtained from the crushed silkworms.

Today silkworm extracts is found as an ingredient in various health supplements in dried form. It contain unsaturated fatty acids, vitamins, proteins, amino acids, cephalic and various other beneficial compound (Bhuroo *et al.*, 2018). It also works as an wonder in treating conditions like migraine, carpel tunnel syndrome, osteoarthritis, rheumatoid arthritis, fibromyalgia, prostate hyperplasia and even erectile dysfunction is said to be cured with this product as shown by Qian in 1997. Bhuroo *et al.* (2018) studies reveal that the enzyme found in silkworm intestine was "Serrapeptase" which is good for enhancing blood circulation and treating arterial plaque. Silkworm protein *i.e.*, serratiopeptidase is used in pharmaceuticals for anti-inflammatory, anti-tumefacient, action of acute sinusitis, tonsillectomy, oral surgery during filling, cleaning, and taking out teeth as per the findings of Reddy Manohar (2008).

### **Silkworm excreta/faeces:**

Silkworm excreta or faeces of silkworm (*Bombyx mori*) is considered to be a major waste product of sericulture which should be utilized properly as per different research workers findings the major components extracted from silkworm excreta or faeces having several economical importance which are;

- Solanesol - can be used as a highly valued precursor for many cardiac drug (Babu, 1994).
- Chlorophyll - extracted from the faeces of silkworm used as medicine for gastric disorders *i.e.*, ulcer and hepatitis, to treat liver and blood disease (Koul *et al.*, 1994).
- Pectin - mostly used to reduce blood cholesterol (Raju, 1996).
- Phytol - used for preparation of Vit. E, K and carotene which is source of Vit-A (Koul *et al.*, 1994).

Also most of the sericulture waste can be converted into valuable products by adopting suitable technology such as;

### **Preparation of compost:**

Silkworm litter, unfed leftover mulberry leaves, soft twigs, cocoons, pupae and excreta from which the plant nutrients such as N, P, K as well as essential micro-nutrient like Zn, Fe, Cu etc. can be generated when properly composted (Ghonmode, 2020). The silk wastes from the raw material of spun, silk yarns can easily be recycled into good organic manure through composting as per the findings of Singhal *et al.* (2001).

### **Preparation of vermicompost:**

Sericulture waste can be effectively used in the preparation of vermicompost as shown by Rathore and Srinivasula (2018).

### **Production of biogas:**

The silkworm waste can be utilized as a good source of biogas production (Rajasekaran, 1986).

### **Cultivation of button mushroom:**

Recently different silkworm residues are been used for cultivation of button mushroom (Reddy *et al.*, 2018).

### **Socio – economic status of silkworm:**

Silkworm (*Bombyx mori*) is an highly domesticated and economically important insect which is a primary

producer of silk. Apart from silk production *Bombyx mori* has a lot of application in biological and scientific research (Soumya *et al.*, 2017). Apart from being a great economic insect silkworm also proved its importance in biotechnology as a bioreactor for production of recombinant protein and silk based biomaterial (Kato *et al.*, 2010). Sericulture waste *i.e.*, silkworm excreta and mulberry waste can be helpful to improve soil health through nutrient recycling and can reduces the use of chemical fertilizers. Water saving measures proved to be effective in controlling soil degradation; Also helps to increase soil health level especially by phosphorus, potassium, and micro nutrient such as manganese, zinc, iron as per findings of Patil *et al.* (2009). According to his statement sericulture waste have great impact on environment and soil health which can be exploited.

Sericulture is an important means for the socio-economic development of rural sector (Vishakanta, 2018). Sericulture gives returns within 30 days and generate moderate flow of income and create employment opportunities for substantial section of low skilled marginal rural inhabitants in India several socio-economic studies have affirmed that the benefit-cost ratio in sericulture is more among comparable agriculture crops and ultimately it results in change of socio-economic status as per research carried by Deewangan (2017).

At present high demand of silk product in global level market is playing an important role in foreign exchange earning for most of the developing countries in the world (Siddappaji, 2014). Hence we can say that it is providing an opportunity to women to contribute in uplift socio-economic status of weaker section women by low gestation and higher returns.

### **Conclusion:**

We strongly believe that living the major source of silk production we can make mulberry sericulture more sustainable and economical. This can be achieved by rational utilization and disposal of all the organic wastes for compost, vermicompost, mushroom cultivation, biogas production, pharmaceutical and other allied industries to enhance their economic gains and create more employment in rural sector.

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