International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

# Review of Strategies for Economic and Quality Advancements in Silk Production using Botanical Extracts

**Miss R. D. Naik[1], Dr. R. D. Gawali[2]**

[1]Research Scholar, Department of Zoology, K. J. Somaiya College of Arts, Commerce and Science, Kopargaon, District: Ahmednagar, Maharashtra, India.
[2]Head of Department of Zoology, K. J. Somaiya College of Arts, Commerce and Science, Kopargaon, District: Ahmednagar, Maharashtra, India.

**Abstract**
The Indian sericulture industry focuses on enhancing cocoon production through improved mulberry leaf nutrition. Botanical extracts show promise in boosting silkworm (Bombyx mori L.) economic traits. They stimulate feeding, enhancing food consumption and digestion, crucial for larval growth and cocoon quality. Extracts like Coffee Arabica, Eclipta prostrata, and Centella improve food absorption and larval development. Citrus limon enhances cocoon and silk weights. Botanicals from families like Lamiaceae (e.g., Ocimum species) not only promote growth but also offer antimicrobial protection, vital for disease-free rearing. Additionally, botanicals induce synchronized spinning behavior and improve silk gland activity, enhancing silk production efficiency. Disease management benefits include reduced mortality from diseases like grasserie, supported by botanical antimicrobial properties. Overall, fortifying mulberry leaves with botanicals represents a sustainable strategy to enhance silk production economically and qualitatively. These approaches align with the industry's goal of achieving higher yields and superior silk quality in a cost-effective and environment friendly manner.

**Keywords:** Bombyx mori L., Botanical, eco-friendly, economic traits, fortification.

## 1. Introduction

The silkworm, Bombyx mori, is a classic example of a monophagous insect, feeding exclusively on one type of food—mulberry leaves. The quality and nutritional status of these leaves are crucial for the healthy development of silkworms and their significant economic traits [1]. The amount of food consumed and the digested by the silkworms have a direct effect on its physiological performance and silk production [2]. Recent studies state that mulberry leaves when treated with medicinal botanical plant extracts, hormones, vitamins have significant influence on the quality and quantity of the silk production. It has also shown influence on the life, development and reproduction of the silkworm [3,4]. Plants are great resource of medicine, phytochemical intermediate. Various extracts of medicinal plants have been tested to influence the body weight, silk gland weight and the silk thread length in Bombyx mori [5].The nutritional quality of mulberry leaves can be enhanced using readily available plant extract improving the rearing performance of silkworms. The plant extracts also provide uniform spinning in larvae and

protection from disease causing pathogens. This review paper focuses on the influence of botanical extracts on the growth, development and economic traits of silkworm.

**Impact of Botanical extracts on economic traits of Bombyx mori**

**1.1 Impact on feeding competence**

Research by several scientists has shown that botanicals possess feeding stimulating factors and supplementing mulberry leaves with certain botanicals can stimulate feeding in silkworms. Studies reveal that most of the botanicals belonging to family Solanacea possess a good phagostimulant property. However, few members like Capsicum anum L. and Nicotiana tobaccum L. show an inimical effect on feeding of larva of Bombyx mori [6]. Enhanced food absorption rates were noted with the addition of Coffee Arabica (member of family Rubiaceae) leaf, fruits and seed extracts to mulberry leaves, leading to increased food consumption and digestibility [7]. Utilization of leaf extracts of Eclipta prostrata extract and Centella of family Asteraceae and Apiaceae respectively have shown improvement in food consumption and digestion which had a direct effect on larval instars and their conversion[8]. The study by Padmalatha et.al. [9]. have proved improvement in food consumption value when the Bombyx mori was fed with mulberry leaves fortified with aqueous extracts of fern .Citrus limon of family Rutaceae is noted to be a profitable supplementary diet. It has shown improvement in cocoon weight, shell weight, raw silk weight [10].

**1.2 Impact on disease free larval and cocoon development**

The leaf extracts of Leucas aspera, Ocimum basilicum and Ocimum sanctum members of family Lamiaceae have great impact on feeding of silkworm and directly exhibit improvement in profitable characters of Bombyx mori [11]. Ocimum sanctum, medicinal botanical also has growth promoting influence on larval development and cocoon parameters [12]. The antimicrobial property of Ocimum also contributes to protection of larva from disease causing pathogens [13]. The growth promoting factors in Ocimum sanctum enhances the commercial qualities of silk produced by healthy larva which develops in cocoon. It helps to enhance the commercial qualities of silk and can be used in sericulture for yield improvement. Botanicals possess properties influencing the silk gland protein; DNA and RNA profile in silkworms. A protein rich soyabean meal is known to increase the weight of silkworm larvae and fresh silk glands [14].

The synchronized spinning behavior in silkworms is induced due to induction of ethanolic leaf extract of Ocimun sanctum [15].The application of the extracts of P. hysterophorus. T. procumbens resulted in higher cocoon and pupal weights and better survival [11]. The leaf and seed extract from Ipomea hederacea influenced the development of B. mori, uniformity and effective spinning [16]. Extracts from Cassia tora accelerated spinning of larvae within 24 h from the onset of larval maturation [17]. The studies using phytoecdysteroids resulted in inducing uniform spinning activity by the silkworms without affecting the cocoon quality [18]. Spraying of aqueous leaf extract of Tribulus terrestris on silkworm during third, fourth and fifth instars resulted in higher cocoon and shell weights, silk productivity and shell ratio[19]. Gupta et al. [20].observed an increase in larval weight and all economic traits following the application of a 2% ethanolic extract of Ocimum sanctum, Azadirachta indica, and Vitex negundo in conjunction with mulberry leaves. Sridevi et al. [21] investigated the effects of extracts (0.1% and 0.5%) from medicinal plants Tagetes erecta, Tinospora cordifolia, and Adhatoda vasica on cocoon and reeling parameters of Bombyx mori fed with extract-treated mulberry leaves, resulting in improved cocoon and reeling parameters.

### 1.3 Botanicals and disease management

Sericulture, an agro based cottage industry contributes to a small, marginal, regular income to the farmers. The continuous rearing has also made it susceptible to various disease. The botanicals possess antimicrobial and antiviral properties which contribute in silkworm rearing and disease management. Spraying of mulberry leaves with Parthenium extract at 30 per cent recorded minimum grasserie (6.00%), flacherie (4.33%) and muscardine (1.00%) [22]. The aqueous extract of Psoralea corylfolia, Tribulus terrestris at concentration of 800 ppm once reduced grasserie by 80% [23]. Antiviral property of Bougainvillea was found to reduce the mortality due to grasserie in silkworms[24].Seed extract of P. corylifolia and leaf extract of Plectranthes ambonicus to third instar silkworms resulted in reduction of mortality due to grasserie [25,26]. Feeding silkworms with Psoralea corylifolia at a concentration of 800 ppm during the third instar reduced grasserie disease by 80%. Thuja orientalis L. demonstrated effectiveness under in vitro conditions by inhibiting the growth of B. thuringiensis at a dose of 100 ppm, providing 50% protection against muscardine infection [27].

Research indicates that the alcoholic extract of neem (Azadirachta indica) flowers and leaf powders of Ocimum sanctum, Azadirachta indica, and Vitex negundo, when combined with mulberry leaves and fed to diseased larvae, effectively controlled flacherie caused by NPV infection [28]. According to Shubha and Bhaskar [29], leaf extracts of Adhatoda vasica, Phyllanthus niruri, Psoralea corylifolia, Tribulus terrestris, and Withania somnifera, when supplemented with mulberry leaves to BmNPV-infected larvae, inhibited the multiplication of BmNPV.

Botanical-based bed disinfectants are preferred for field use in disease management. Sharma et al. [30] conducted a study to develop aneffective eco-friendly bed disinfectant for managing silkworm diseases. Aqueous extracts from Tribulus terrestris, Tribulus procumbens, and Withania somnifera were screened in vitro and found effective against NPV, Beauveria bassiana, and other pathogens.Supplementation of mulberry leaves with extracts of Allium sativum and Eucalyptus sp. significantly reduced incidences of muscardine, flacherie, and grasserie in silkworms. Patil et al. , Rani et al. [31,32] discovered that aqueous extracts of Acalypha indica and Cinnamomum zeylanicum exhibited effective antibacterial properties, while Eclipta prostrata and Phyllanthus niruri showed potent antifungal activity against flacherie and muscardine diseases in silkworms. Divya and Patil[33] reported that oral supplementation of 1.5% amla juice and 3% lime juice to fifth instar Bombyx mori L. silkworms positively impacted cocoon shell ratio (21.61% and 20.86%, respectively).

This study thus reports significant role of botanical extracts in improvement of feeding competence, healthy larval and cocoon development and disease management.

## 2. Discussion

Botanical extracts such as Coffee Arabica, Eclipta prostrata, and Centella have been shown to stimulate feeding and improve food consumption and digestion in silkworms[7,8,9].These enhancements are crucial for larval growth and silk production efficiency, contributing to improved economic traits of Bombyx mori [7,8,10].Botanical extracts from plants like Ocimum species (Lamiaceae) exhibit antimicrobial properties that reduce mortality rates from diseases such as grasserie and flacherie [11,13,22].Ocimum sanctum not only promotes growth but also protects against pathogens, enhancing cocoon quality and silk production[12], [13].Extracts of various botanicals improve silk gland activity and induce synchronized spinning behavior, leading to increased cocoon and silk weights [12,15,16].Citrus limon, for instance, has been noted for its positive effects on cocoon weight and silk quality, demonstrating botanicals' potential

in enhancing economic traits of silk production [10].Using botanicals extracts to fortify mulberry leaves offers a sustainable method to boost silk production both economically and quantitatively. This strategy aligns with the sericulture industry's goals of achieving higher yields and superior silk quality in a cost-effective and eco -friendly manner. Future research could focus on optimizing botanical formulations and their application methods to further improve silk production outcomes.

Continued exploration of botanicals' potential in disease management and their long-term impact on sericulture sustainability remains a key area for future investigation.

## 3. Conclusion

Improving the nutritional requirements of the silkworm, B. mori, is crucial for enhancing the quality of silk production. In tropical regions, issues such as lower cocoon yield and inferior yarn quality have been persistent barriers to the growth of the silk industry. Recent advances in fortifying mulberry leaves with botanical additives have led to innovative strategies aimed at overcoming these challenges. This approach not only enhances nutritional efficiency but also maximizes cocoon productivity. Botanical supplements are cost-effective and have shown promise in elevating both the yield and quality of cocoon crops. Various studies highlight the effectiveness of fortifying mulberry leaves with botanical extracts, demonstrating their ability to improve economic outcomes and manage pests and diseases. Reports indicate significant increases in crop yield through the use of plant-derived products. Therefore, these environment friendly methods to enhance crop yield and silk quality are increasingly recognized as essential in the pursuit of sustainable silk production.

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