

Evaluation of *Ocimum Sanctum* Leaf Extract Performance On, Cocoon production and Silk Quality in *Bombyx Mori L*

Abstract:

The sericulture is an ancient traditional industry more Asia people is depended on it. The silkworm (*Bombyx mori*) is a well-known beneficial lepidopteran insect cultivated for the production of fine and lustrous silk fibre, often referred to as the "Queen of Textiles". Tulsi is an aromatic medicinal plant its contain diverse phytochemicals such as oleanolic acid, ursolic acid, etc., they exert significant biological effects on various animal systems. In this study, we investigated the effect of *o. sanctum* extract in variant type of concentration (1.0 % ,2.0%, 3.0%) on the growth 5th stage silkworm larvae on the biological and commercial traits of *Bombyx mori L*. the silkworm fed fresh mulberry leaves with sprayo. sanctum extract of coating leaves surface area and supplemented 4th and 5th instar silk worm. That study results fifth instar silkworm larva (Length and weight, Weight of cocoon and pupae) and silk parameters (shell ratio, Length of silk filament, denier) highly effect in larval. And thus, increase silk quality as compared to the control. the commercial parameters different concentration made different types of value get but economical parameters increase significantly. And some concentrations gave parameters result maximum value as compared to the control group. it is ratifyo. sanctum plant extract spray a coated mulberry leaf fed silk worm larval commercial traits positive effect *Bombyx mori L*.

Introduction:

Sericulture is 5000 year ancient of old cultivation agro - based global industry. Silk is the principal product obtained from silkworms. Silk is considered as one of the most beautiful and luxurious materials in the world because of its bright shine, natural beauty, ability to absorb vibrant dyes, light weight, softness, and long-lasting sturdiness. Because of silk has been called the "Queen of Textiles" (Anonymous, 2024). As a silkworm monophagous insect, the silkworm *Bombyx mori L*. only consumes mulberry leaves, (Triubhuvan and Mathur, 1989). The mulberry leaves main contributor of improved growth and insect body development physiology is rich in nutrients a diet (Murugan and George, 1992). The nutrient rich quality mulberry leaves in made up unattainable for reasons poor maintained, malignant fertilizer, and irrigation. so thus, as high effective fortification medicinal plant extract implemented silkworm. this strategy for in increasing economic worth and cocoon parameters.

the, synthetic pesticide chemicals and diseases harmful residues that can negatively impact larval health and silk production. In response, researchers are increasingly focusing on the use of **eco-friendly plant-based pest control methods** and **medicinal plant extracts** as sustainable alternatives, aiming to maintain silk quality and ensure optimal silk production without harming the environment or the silkworms. Silk production is largely influenced by larval nutrition, with the nutritive value of mulberry leaves playing a critical role in the development of healthy larvae and the production of high-quality cocoons. (Legay, 1958).

In 1977, artificial food were used for the first time in Japanese sericulture to raise immature silkworm larvae. (Bhattacharyya, et al., 2016).

The medicinal plant largest market producer in India so then called as Botanical Garden of the World". Some commercial selected herbal extract reflected into better response from the silk worm larval *bombyx mori L*. (Balamurugan R, Isaiarasu L 2007) Ancient literature describes tulsi, also referred

45 to as the "Queen of Herbs," as a holy and therapeutic plant. *Ocimum sanctum* (Linn) is the botanical
46 name for this plant, which is a species of the Labiatae family. The plant is cultivated all throughout
47 India.

48 Many insects' physiology, development, and behaviour have been shown to be influenced by plant
49 extracts. Still very little is known about how these extracts affect *Bombyx mori*, the silkworm. Thus,
50 the current research was conducted to assess the effect of leaf extracts from *Ocimum sanctum* (Tulsi)
51 on the silkworm *Bombyx mori* l cocoon characteristics.

52 **Key words :** *Ocimum sanctum* , silkworm larval(*Bombyx mori l*), economical parameters , medicinal
53 plants .

54 MATERIALS AND METHODS

55 Study area :

56 the present study, the second instar larvae of hybrid silkworm, *Bombyx mori* (L.) hybrid Race (*fc1 x*
57 *fc2*) was obtained from the, **srianjanisilk** worm rearing centre, kethanur in tiruppur, Tamil Nadu,
58 India.

59 Silkworm rearing

60 Fresh and healthy leaves of mulberry leaves were used in the present study. An optimum temperature
61 of 25 ± 10 C and $70\pm 5\%$ relative humidity was maintained throughout the experimental period. The
62 bottoms of the rearing trays, Bed cleaning, spacing, and feeding time were adopted carefully
63 following the methods of Krishnaswami (1978).

64 Mulberry variety

65 Fresh v1 mulberry leaves (*Morus alba*) were collected daily from the mulberry farm during the early
66 hours of the day and stored in cool conditions to maintain their freshness using a wet gunny cloth.

67 Plant material collection:

68 The tulsi plant collected Mangalam surrounding region nurseries in Tamil Nadu. Tulsi (*Ocimum*
69 *sanctum*) is an aromatic and stimulant plant known for its potent antimicrobial properties . It belongs
70 to a significant group of medicinal and aromatic plants revered by ancient sages for thousands of
71 years in Ayurvedic medicine.

72 Preparation of Extract and Treatment:

73 The plant material was thoroughly washed with tap water to remove surface contaminants and shade-
74 dried for 30–45 days. A total of 25 grams of the dried plant powder was soaked in 150 mL of distilled
75 water overnight. The mixture was then filtered through muslin cloth, and the filtrate was centrifuged
76 at 300 rpm for 15 minutes. The resulting supernatant was collected and considered as the stock
77 solution (100%). From this stock, three different concentrations were prepared using distilled water.
78 Mulberry leaves were treated with plant extracts at three different concentrations—T1 (1%), T2 (2%),
79 and T3 (3%)—and subsequently fed to the silkworm larvae for fortification. Fresh extracts were
80 prepared every third day to ensure consistency and potency. (Sujatha, Kuntamalla et al., 2018).

81 Supplementation period:

Rearing Stage	Day of Application	Time of Application	Method
4 instar	Day 1–4 first feed	Morning	Leaf spray
5 instar	Day 1–6 first feed	Morning	Leaf spray

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Fig 1: cocoon weight measuring electrical balance



Fig 2: o. sanctum plant extract fed 5th instar silkworm



Fig 3: silk worm larval length measuring in scale



Fig 4: mulberry foam

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87 **Analysis of economic traits**

88 50 larval each groups rearing. A silk worm of 25 larval and after spinning 25 cocoons from each
89 experimental groups was collected for the analysis of economic parameters.

90 **1)Length and weight of silkworm:**

91 On the sixth day of the fifth instar, larvae were randomly selected from each group. The larval weight
92 was measured using an electronic balance and expressed in grams (g). The body length of the larvae
93 was measured using a ruler and expressed in centimeters (cm)

94 **2)Weight of cocoon:**

95 Cocoons were collected the completion of spinning and their weights were recorded using a electronic
96 balance. The cocoon weight was expressed in grams (g) for each experimental group.

97 **3)Shell weight:**

98 The same cocoons used for cocoon weight measurement were carefully cut open, and the cocoon
99 shells were separated. The shell weight of each cocoon was then measured using a digital balance to
100 determine the single shell weight, expressed in grams (g)."

101 **4)Weight of pupae:**

102 After recording the cocoon weight, the cocoons were carefully dissected to extract the pupae. The
103 pupal weight was then measured using a precision electronic balance and expressed in grams (g)

104 **5)Cocoon shell ratio:**

105 Shell ratio represents the proportion of the cocoon shell weight to the total cocoon weight and is
106 expressed as a percentage. It was calculated using the following formula, as described by Rajitha and
107 Savithri (2015)

$$108 \quad \text{cocoon shell ratio (\%)} = \frac{\text{cocoon shell weight}}{\text{cocoon weight}} \times 100$$

109 **6)Length of silk filament:**

110 Approximately some cocoons from each group were selected and immersed in hot water maintained
111 at 65–75 °C for 10 minutes to soften the sericin and loosen the tightly spun filament. The silk filament
112 was then carefully reeled using a manual reeling apparatus (Epprouvette). The total filament length
113 per cocoon was measured and expressed in meters (m), and the filament weight was also recorded.
114 The silk filament parameters were estimated using the following formula, as described by Rajitha and
115 Savithri (2015):"

$$116 \quad \text{Silk filament length (m)} = \text{Revolutions of epprouvette} \times \text{Wheel circumference (m)}$$

117 **7) Denier:**

118 Denier is an important parameter that indicates the thickness or fineness of silk filament, expressed as
119 the weight in grams of 9,000 meters of the filament. It reflects the size of the yarn and directly
120 influences the quality of the raw silk produced. In this study, the denier value was calculated
121 according to the method described by **Sonwalkar (1993)** using the following formula:

122 **Denier (D) = $\frac{\text{Weight of filament (g)}}{\text{Length of filament (m)}} \times 9000$**

123 Variations in the denier of cocoon silk filament affect the Uniformity, texture, and mechanical
124 properties of reeled silk yarn. A stable and uniform denier is essential for producing high-quality silk
125 suitable for commercial use.

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127 **Statistical analysis :**

128 Results were presented as means \pm SD in Microsoft excel 2019 model.

129 **RESULTS :**

130 Mulberry leaves are the exclusive food source for the silkworm *Bombyx mori* L. The freshness and
131 nutritional quality of the leaves play a crucial role in larval growth, cocoon formation, and overall silk
132 productivity. To enhance both the quality of silk and the quantity of cocoons produced, it is essential
133 to improve and enrich the nutrient content of mulberry leaves.

134 Table 1 presents the effect of *Ocimum sanctum* plant extract supplementation at different
135 concentrations (1%, 2%, and 3%) on the economic parameters of the silkworm, *Bombyx mori*. The
136 aqueous mulberry leaves served as the control diet. The control group recorded a larval length of 5.95
137 ± 0.23 cm and a larval weight of 2.40 ± 0.15 g. The corresponding cocoon weight, pupal weight, and
138 shell weight were 0.80 ± 0.12 g, 0.74 ± 0.09 g, and 0.19 ± 0.02 g, respectively. The shell ratio was
139 $20.5 \pm 5.73\%$, while the filament length, filament weight, and denier were 629.2 ± 35.4 m, 0.17 ± 0.02
140 g, and 2.00 ± 0.36 , respectively.

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142 In the 3% treatment group, a marked elevation was observed in all economic parameters of *Bombyx*
143 *mori* when compared to the control. The larvae recorded a length of 6.39 ± 0.39 and a weight of 2.76
144 ± 0.12 g. The cocoon weight, pupal weight, and shell weight were 1.10 ± 0.13 g, 0.89 ± 0.08 g, and
145 0.23 ± 0.03 g, respectively. The shell ratio increased to $23.5 \pm 4.10\%$. Furthermore, the filament
146 length, filament weight, and denier reached 948.5 ± 54.3 m, 0.25 ± 0.04 g, and 2.47 ± 0.40 ,
147 respectively, indicating a significant improvement in the economic traits at the 3% concentration of *O.*
148 *sanctum* extract.

149 At the 2% concentration, the *O. sanctum* aqueous extract also demonstrated notable fortification of
150 the economic parameters of *B. mori*, although the improvements were moderate compared to the 3%
151 group. The mean larval length and larval weight were 6.33 ± 0.34 cm and 2.59 ± 0.24 g, respectively.
152 The cocoon weight, pupal weight, and shell weight recorded were 0.92 ± 0.12 g, 0.86 ± 0.08 g, and
153 0.21 ± 0.01 g. The shell ratio reached $21.6 \pm 3.82\%$, while the filament length, filament weight, and
154 denier were 937.0 ± 88.7 m, 0.21 ± 0.02 g, and 2.45 ± 0.32 , respectively, showing a moderate
155 enhancement over the control.

156 The results shown by the 1% *O. sanctum* supplemented group correspond to the assessed
157 economic characteristics of *Bombyx mori*. The measurements of the larval weight and length
158 were 2.66 ± 0.12 g and 6.01 ± 0.28 m, respectively. The weights of the cocoon, pupal, and
159 shell were 1.03 ± 0.10 g, 0.76 ± 0.08 g, and 0.22 ± 0.02 g, respectively. The shell ratio was
160 $22.0 \pm 2.92\%$. The filament weight and denier measured 0.24 ± 0.03 g and 2.46 ± 0.28 ,
161 respectively, indicating a significant improvement in the filament properties. The 1%
162 treatment values were significantly higher than the control, although being lower than those

163 found in the 2% and 3% groups. This suggests a modest but significant improvement in the
 164 economic attributes.

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Concentration of <i>O. sanctum</i>	Average larval length (m)	Average Larval weight (g)	Average cocoon weight (g)	Average pupal weight (g)	Average shell Weight (g)	Average shell ratio (%)	Average filament length (m)	Average filament weight (g)	Denier (%)
control	5.95±0.23	2.40±0.15	0.80±0.12	0.74±0.09	0.19±0.02	20.5±5.73	629.2±35.4	0.17±0.02	2.00±0.36
1%	6.01±0.28	2.66±0.12	1.03±0.10	0.76±0.08	0.22±0.02	22.0±2.92	775±36.8	0.24±0.03	2.46±0.28
2%	6.33±0.34	2.59±0.24	0.92±0.12	0.86±0.08	0.21±0.01	21.6±3.82	937.0±88.7	0.21±0.02	2.45±0.32
3%	6.39±0.39	2.76±0.12	1.10±0.13	0.89±0.08	0.23±0.03	23.5±4.10	948.5±54.3	0.25±0.04	2.47±0.40

167 **Table1: Effect of different concentration in osmium sanctum plant extracts on Larval and silk**
 168 **parameters of silkworm bombyx mori**

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173 **DISCUSSION :**

174 Sericulture is a lucrative industry that offers substantial employment opportunities. The
 175 "sericulture" describes the large-scale raising of organisms that produce silk. *Bombyx mori*,
 176 the mulberry silkworm, is the only product used in India's sericulture sector. The mulberry
 177 leaves with extra supplement nutrients required. Supplementing mulberry leaves with additional
 178 nutrients significantly enhanced the cocoon's economic value. The medical plants more nutrients
 179 serve as best quality of cocoon and silk and improved of silk economy. (Sevarkodiyone, et al, 2003)

180 *Ocimum sanctum* (Tulsi) extract to the food of *Bombyx mori* has been proven to
 181 improve the development of larvae, the weight of cocoons, the ratio of shells, and the overall
 182 quality of silk. There are always internal and external elements that affect how silkworms
 183 grow and develop (Murugan et al., 1998). Plant extracts and other dietary supplements may
 184 help the body work better, which may trigger higher growth, greater feeding efficiency, and
 185 more silk production. This can make sericulture more productive and profitable (Nivetha et

186 al., 2021; Fouad et al., 2025). Alagumalai et al. (1991) found that adding black gramme and
187 red gramme flour to mulberry leaves promoted *B. mori* larvae development and made their
188 cocoons better. Likewise, extracts from many prevalent plant species—*Tribulus terrestris*,
189 *Phyllanthus niruri*, *Boerhaviadiffusa*, *Psoralea corylifolia*, *Caesalpinia coriaria*, and
190 *Parthenium hysterophorus*—have been shown to increase silk and egg production in
191 silkworms (Murugan et al., 1998). Kumar et al. (2009) showed that a 300-ppm *Spirulina*
192 treatment made the cocoon weight, shell weight, pupal weight, shell percentage, and silk
193 filament length much higher than the control. Jeyapaul et al. (2003) noted that silkworm
194 larvae fed mulberry leaves treated with *Coffea arabica* leaf extract had a significantly greater
195 shell weight (0.296 g) in comparison to the control group. In the spring, adding 3% *O.*
196 *sanctum* gave the maximum cocoon weight (2.40 g), shell weight (0.54 g), and shell ratio
197 (22.40%) (Hajam et al., 2024).

198 The larval weight of mulberry leaves treated with 20% *Azolla* was substantially greater than
199 that of the control. The rich nutritional content of *Azolla*, which is a strong source of protein,
200 vital amino acids, and minerals, may be contributing to this improvement (Simon, et,
201 al., 2023)

202
203 In this investigation, supplementation with 1% *O. sanctum* extract resulted in the most
204 significant enhancements in the single cocoon weight, shell weight, and shell ratio compared
205 to the control groups. These improvements in cocoon characteristics may be due to the
206 bioactive substances in the plant extract, which probably affected the growth and activity of
207 the silk glands that make silk proteins and create the cocoon shell. This discovery
208 corroborates the recognised notion that diet significantly influences cocoon quality and
209 output. Consequently, combining mulberry leaves with plant extracts like *O. sanctum* may
210 constitute an efficacious approach to enhance both the quality and quantity of the cocoon
211 harvest (Manimuthu & Isaiarasu, 2010; Gobena & Bhaskar, 2015). According to Gupta et al.
212 (2022), *Bombyx mori* showed significant boosts in larval weight, cocoon weight, shell
213 weight, pupal weight, shell percentage, filament length, fibroin, sericin, and silk filament
214 denier when mulberry leaves were fortified with *Ocimum sanctum*, *Azadirachta indica*, and
215 *Vitex negundo*. Barge and Pardeshi (2024) showed that supplementing fourth-instar *Bombyx*
216 *mori* larvae with *Sida acuta* plant extract at dosages of 0.5, 1.0, 1.5, 2.0, and 2.5% greatly
217 improved cocoon properties. The research also showed that *S. acuta*'s phytoecdysteroids
218 stimulate silkworm development and boost cocoon production.

219 The current study supports previous findings showing that plant extracts have a major impact
220 on larval development and cocoon production. According to Swarnlata and Hassan (2023),
221 feeding silkworm larvae mulberry leaves fortified with a 3% concentration of giloy plant
222 extract boosted the larvae's growth, development, and economic characteristics.

223 The other plant extracts also shown significant increases in cocoon characteristics, which
224 might be explained by the silkworms' increased vigour and hunger as well as the presence of
225 bioactive biochemical components in the plant extracts that raised the feed's nutritional
226 effectiveness. These botanicals' stimulatory effects on protein synthesis in the silk gland
227 during the larval stage were probably responsible for the increased nutritional availability and
228 utilisation. According to Gayathri et al. (2006), mulberry leaves treated with several
229 medicinal plant extracts were given to silkworms, resulting in increases in cocoon weight,
230 pupal weight, shell weight, cocoon shell ratio, and cocoon yield.

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232 Additionally, phytochemical investigations of *O. sanctum* have validated the presence of
233 sterols, tannins, and aromatic compounds with significant antibacterial properties (UP
234 Neumann et al.). These components help the silkworms stay healthy and make them more

235 useful for the sericulture industry. Sterols, especially, may serve as both nutrition and feeding
236 stimulants. Thus, the sterols found in *O. sanctum* leaves seem to play a substantial role in
237 embryonic development, hatching, larval growth, and pupation (Gilbert & Chopra). The
238 artificial extract enhanced Antioxidants and vitamins C and B, which are coenzymes in the
239 metabolism of amino acids, may boost larval growth by raising the concentrations of amino
240 acids in larval tissues and increasing productivity (Bhattacharyya et al., 2016).

241 **Conclusion :**

242 The current research shows that the cocoon and silk characteristics of the silkworm,
243 *Bombyx mori* L., are greatly improved by fortifying mulberry leaves with medicinal plant
244 extract *Ocimum sanctum* compared to the control. Important economic characteristics, such
245 as cocoon weight, shell weight, and shell percentage, were enhanced by the enriched diet; the
246 best results were shown at 3% *Ocimum sanctum* concentrations. The bioactive chemicals in
247 the extracts, which improved larval growth, silk gland development, and total silk output, are
248 responsible for these benefits. The results demonstrate the possibility of using enriched
249 mulberry leaves as a calculated nutritional intervention to enhance the growing of silkworms,
250 eventually beneficial. This way provides a durable and economical solution for treating a lack
251 of nutrition in silkworm diets, enhancing commercial results.

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