



Effect Of *Ocimum Sanctum* (Tulsi) Extract On The Growth And Economic Parameters Of The Silkworm *Bombyx Mori L*

M. Joseph lal *, S. Sumathi,

Research scholar Department of Zoology, Chikkanna Government Arts and Science College, Tirupur,
Tamil Nadu - 641 603

Associate professor, Department of Zoology, Chikkanna Government Arts and Science College,
Tirupur, Tamil Nadu - 641 603

Corresponding Author: M. Joseph lal

ABSTRACT:

Tulsi (*Ocimum sanctum*), often referred to as the "Queen of Herbs," is renowned in ancient texts as a spiritual and healing plant. Widely utilized in Ayurveda, Siddha, Unani, Greek, and Roman medicine, Tulsi is revered for its medicinal properties and is a significant part of Hindu spiritual practices. In sericulture, enhancing the quality of silk Fiber is of paramount importance, as silk is a luxury material with high demand. This study investigates the effect of supplementing mulberry leaves with ethanolic extracts of *O. sanctum* on the growth and economic parameters of silkworms (*Bombyx mori L.*), particularly during the fifth instar. The supplementation significantly improved larval growth, cocoon weight, shell weight, and silk quality compared to the control group. Among the tested concentrations, 5% ethanolic extract demonstrated the most pronounced effects. Feeding silkworms with fortified mulberry leaves resulted in superior commercial traits, indicating that *O. sanctum* extract can serve as a natural growth enhancer in sericulture. This research highlights the potential of *O. sanctum* supplementation as an eco-friendly, cost-effective strategy to improve silkworm productivity and silk quality, benefiting the sericulture industry.

Key words: *Ocimum sanctum* plant extract, silk parameters, cocoon parameters, silk worm (*Bombyx Mori L*), larval developments

INTRODUCTION:

The mulberry silkworm, *Bombyx mori* L., is a domesticated species of economic importance, forming the backbone of the sericulture industry. Enhancing the growth and productivity of silkworms is vital for improving silk yield and profitability. Various approaches, including nutritional supplements and bioactive compounds, have been explored to enhance the biological and economic traits of silkworms (Krishnaswami, 1986). The primary producer of silk is the silkworm (*Bombyx mori* L), a highly domesticated and economically significant insect. Global silk production in 2022 was 56,000 tonnes, with China and India being the largest producers. (Khaliknazarov.,et al,(2020).China is the unrivalled global silk industry leader, producing over 50,000 metric tons in 2023, accounting for roughly 70% of the world's silk supply. (Chand, (2023)) India is the world's second largest silk producer, behind China, where sericulture is both a tradition and a living culture. China, India, and Uzbekistan produce the most natural silk, accounting for around 98% of global production. (Czaplicki, 2021). India accounts for approximately 11% of global output and supplies approximately 38,913 metric tons of silk annually. Silkworm larvae feed solely on mulberry leaves, which contain vital nutrients such as carbohydrates, proteins, lipids, vitamins, and minerals. These nutrients are vital to silkworm growth, development, and reproduction. Man has greatly profited from the silk made by silkworms, so researchers have always been working to find the elements that might be controlled to help the rearers of silkworms. (Nair JS et al.. 2004). (Mahmoud SM 2016) Silkworms of the mulberry, the production of silk by *bombyx Mori L.* is affected by numerous pathogens, such as bacteria, viruses, fungi, and protozoa, which can harm up to 75% of cocoons. (Das 1950) Some plant extracts enhance nutrient intake, growth, and disease resistance. (Nikolova, 2020) *Ocimum sanctum* extract promotes silkworm growth and can be used in sericulture to increase silk yield and improve the commercial qualities of silk. (Prasad., et al. (2012). One natural supplement is *Ocimum sanctum* (commonly known as Tulsi), a medicinal plant renowned for its diverse pharmacological properties, such as antioxidant, antimicrobial, and growth-promoting effects (Prakash & Gupta, 2005). Its bioactive constituents, including eugenol, flavonoids, and phenolic compounds, have been documented to support growth and immunity in various organisms (Singh et al., 2010). In the context of sericulture, incorporating plant-based bioenhancers like Tulsi extract into silkworm diets could positively influence their growth, survivability, and silk productivity. Studies have demonstrated that natural additives improve the larval health and cocoon yield of silkworms, suggesting a promising role for *Ocimum sanctum* in boosting sericulture productivity (Ramesh et al., 2013). This study investigates the effect of *Ocimum sanctum* extract on the growth, developmental parameters, and economic traits of *Bombyx mori* L., aiming to establish its potential as a natural growth promoter in sericulture. The study investigated how feeding fifth-instar larvae mulberry leaves treated with a 5% ethanolic extract of *Ocimum sanctum* leaves impact several metrics such as cocoon weight, pupal weight, shell weight, shell ratio, and silk quality.

MATERIALS AND METHODS :

Study Organism:

The study was conducted on the mulberry silkworm (*Bombyx mori* L.), a (**FC1 X FC2**) Foundation crosses are (CSR2 X CSR26) x CSR4XCSR27) bivoltine double hybrid. The silkworms were reared on mulberry leaves (*Morus alba*) under controlled environmental conditions following standard sericulture practices. (Krishnaswami, 1986).

Ocimum sanctum (Tulsi) plant:

Ocimum sanctum (Tulsi) (**Fig 1**) Extract is known for its adaptogenic and antioxidant properties. Tulsi extract enhances stress tolerance in silkworms, particularly under harsh conditions. This leads to constant silk production and increased cocoon yields. (Vidya Devi and Bai (2015). The Rishis have recognized these fragrant and medicinal herbs as vital to Ayurvedic medicine for thousands of years. The plant produces valuable essential oils and aroma compounds, including citral, geranial, eugenol, and thymol, which can be used in industry. (Jayaprakash rao, 1999)

Plant extraction method:

The herbal plant (*Ocimum sanctum*) (**Fig 2**) collected from my college near the nursery shops. The plant leaves were cleaned with tap water and then rinsed with distilled water. The extracts were prepared by crushing them in an electrical mixer and adding distilled water at a weight-by-volume ratio (1:10). After 50 -60°C heat hot plates in 5-10 minutes, and 24-42 hours kept in dark place. The crushed material solution was filtered through double-layered muslin fabric, and the filtrate was used as the stock solution. To achieve a 5% concentration, 0.5 mL of the stock solution was pipetted and diluted with 5 mL of distilled water. The stock solution was stored in a refrigerator, and a new dilution was prepared for application on the mulberry leaves and for silkworm consumption. (Gobena et al., 2015)

Two-group experiment :

- 1) Control group: Silkworms fed on plant V1 mulberry leaves
- 2) treatment group: Silkworms fed on mulberry leaves sprayed with *Ocimum sanctum* extract at concentrations of 5%

Each group consisted of 100 silkworms, with three replicates for each treatment.

Silk worm rearing:

The study employed third-instar larvae of (*Bombyx mori* L.) Race (CSR2 X CSR26) x (CSR4XCSR27) from a bivoltine double hybrid silkworm rearing station in Kethanur, Udumal Pet, Tiruppur, Tamil Nadu, India. The acquired larvae were raised in the Department of Zoology at Chikkanna Government Arts College, Tirupur, Tamil Nadu, India. The current study used fresh, healthy mulberry leaves (V1 variety). During the experiment,

the ideal temperature and relative humidity were kept at 25 ± 10 C and $70 \pm 5\%$ respectively. The bed cleaning, spacing, and feeding times were strictly adhered to (Krishnaswami's 1978) regulations.

Mode of application :

Plant extracts were mandated and implemented exclusively from the third instar onwards. The application schedule is as follows:

III instar (first day first feed),

IV instar (first and third day first feed) and

V instar (every day first feed).



Fig 1: *Ocimum sanctum L.*



Fig 2: *Ocimum sanctum extract*

Silkworms were reared in environment:

- Temperature: $25 \pm 2^\circ\text{C}$
- Relative Humidity: 70–80%
- Photoperiod: 12-hour light and dark cycles

Feeding time:

Mulberry leaves were washed, air-dried, and sprayed with the appropriate concentration of *Ocimum sanctum* extract. The treated leaves were provided to the silkworms four times daily (8:00 AM, 5:00 PM,). Control group silkworms received untreated mulberry leaves. The feeding protocol was continued throughout the larval period.

Data collection:

The larval, cocoon, and post-coon traits were recorded as follows:

(R. N. Bhaskar. 2015)

Larval weight (g):

At the end of the v instar, 25 larvae were randomly selected from each treatment replication and measured using a digital balance.

Cocoon weight, pupal weight, and shell weight (g):

To determine cocoon, pupal, and shell weights, 25 randomly selected cocoons from each replication were weighed using a digital balance.

Cocoon shell ratio (%):

The cocoon shell ratio is the proportion of shell weight to cocoon weight expressed in percentage and is calculated as follows:

$$CSR (\%) = \frac{SW (g)}{CW (g)} \times 100$$

where CSR is the cocoon shell ratio, SW is the shell weight in grams, and CW is the cocoon weight in grams.

Silk filament weight (g):

20 cocoons of reeled silk were oven-dried at 85°C to determine the average weight.

Denier:

Denier was computed using the following formula:

$$\text{Denier} = \frac{SWF}{SFL} \times 9000$$

where SFW is the silk filament weight (g), SFS is the silk filament length (m), and 9000 is a constant value.

Average filament length (m):

20 cocoons from each replication were collected and reeled on a single reeler (eprouvette). The number of revolutions was recorded and converted to meters using the following formula:

$$L = R \times 1.125$$

where L is the filament length (in meters) per cocoon and R is the number of revolutions recorded by the eprouvette. The circumference of Epprouvette was 1.125 The average filament lengths of the three cocoons from each replication were determined.

Statistical analysis: The data were analysed using statistical and provided as means $\pm$ SD values by using Microsoft excel 2021.

Results:

The economic parameters of the silkworm were influenced by the Ethanol extracts of *Ocimum santum* and mulberry leaves, as demonstrated in Table 1 Figs Fig. 1, 2, 3, 4, and 5. The over changes analysed with reference the economici traits of sericulture, viz, Larval linear, Larval weight, Cocoon weight, Shell weight, Pupal weight, Shell ratio, Filament length, Filament weight, and Denier.

Ocimum sanctum and mulberry leaves:

The effect of *Ocimum sanctum* extract on silk worm larval and cocoon characters showed **table 1** The result of larval weight and length (Fig 5) increased significantly in the control group (3.37g) (6.1M), with a greater increase noted in the 5% *Ocimum.santum* extract (4.67g) (7.0 m). The study found that using *Ocimum santum* plant extracts increased the mean (Fig 3) cocoon weight (2.28g) and pupal weight (1.75g) of final instar larvae compared to the control group (1.53g) and (1.15g). The fact that this is the case suggests that the extract *Ocimum sanctum* is capable of changing the, a soon as well larval parameters larva.

(Table 1) lists the silk characteristics. Larvae treated with *Ocimum sanctum* plant extract exhibited significant increases in silk characteristics, including **(Fig 4)** filament weight (0.55g), **(Fig 7)** denier (4.2 %), **(Fig 2)** shell weight (0.46g), and **(Fig 7)** shall ratio (25%). The control values were (0.25g, 4.1%, 0.37g, and 23%). The silkworm breed is classified based on their average filament length. Silk fibre length varies depending on breed and raising conditions. In the current investigation, supplementation with plant extracts significantly increased filament length compared to controls. During the maximum average filament length The *O. sanctum* treatment produce a much longer mean (Fig 6) filament length (1100 m) compared to the control groups (532 m)

TABLE: 1

Effect Of Supplementary *Ocimum sanctum* (Ethanolic) Extract on Economic Parameters of Silkworm *Bombyx Mor L*.

S.N 0	EXPERI MENTA L GROUP	Larva l weight (g)	Larva l length (g)	Pupal Weight (g)	Cocoon Weight (g)	Shell Weight (g)	Shell Rati o (%)	Filamen t length (g)	Filamen t weight (g)	Denier
1	CONTRO L (mulberry)	2.97± 0.2701	5.842± 0.282	1.0171± 0.1070	1.235± 0.1231	0.337± 0.0325	20.7 28±3 .466 3	467.285 ±31.494 5	0.22±0.0 216	3.514± 0.6542
2	<i>o. sanctum</i>	3.858± 0.4239	6.485± 0.3313	1.442±0 .2489	1.951± 0.2319	0.422± 0.0281	22.8 28±3 .498 0	968.85± 92.4560	0.426±0. 0539	3.785± 0.3398

Fig. 3: Effects of ethanolic plant extract on pupal weight and cocoon weight

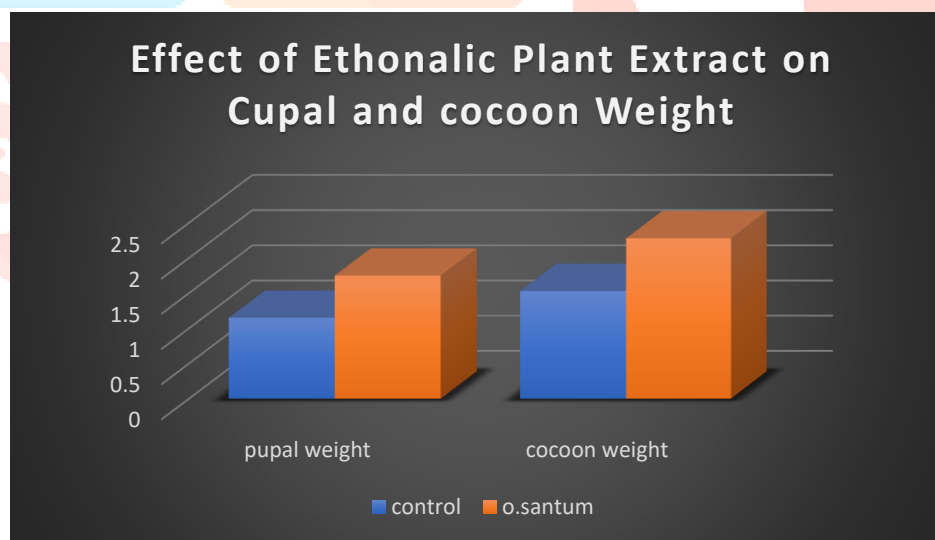


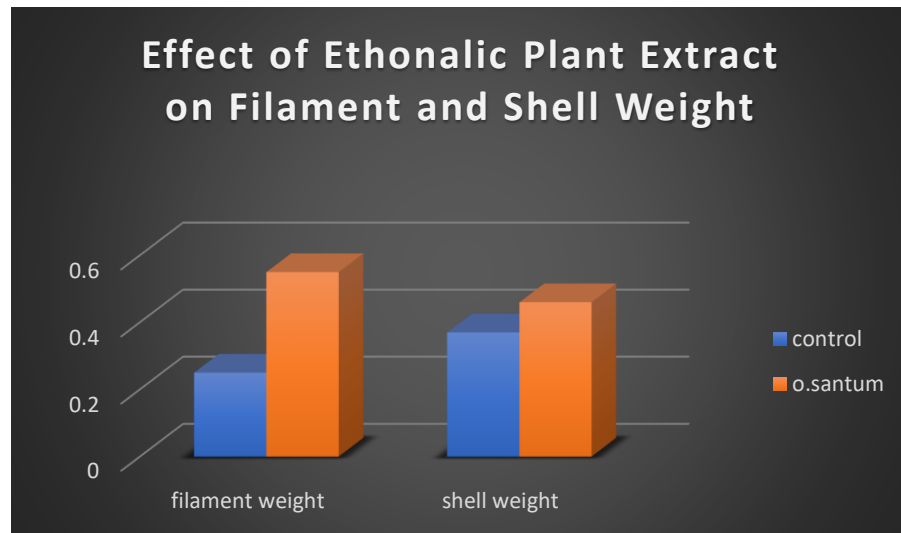
Fig. 4: Effects of ethanolic plant extract on Filament and Shell weight

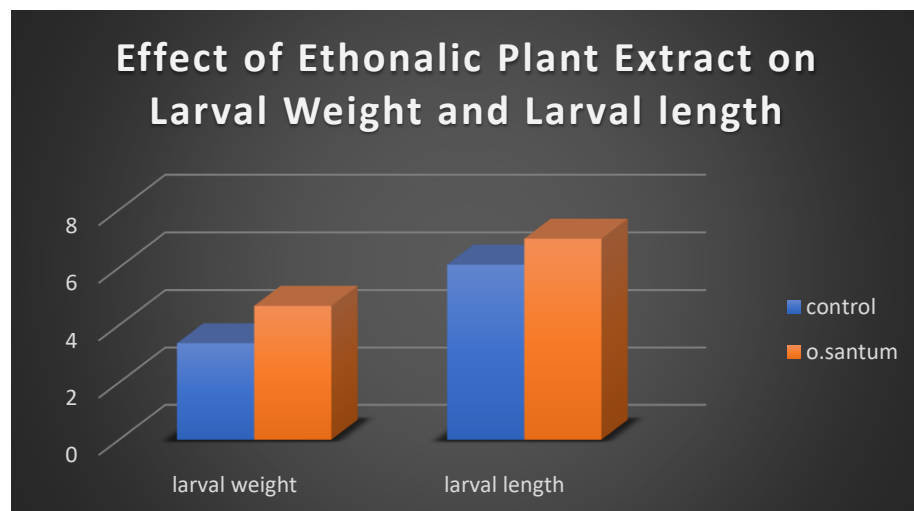
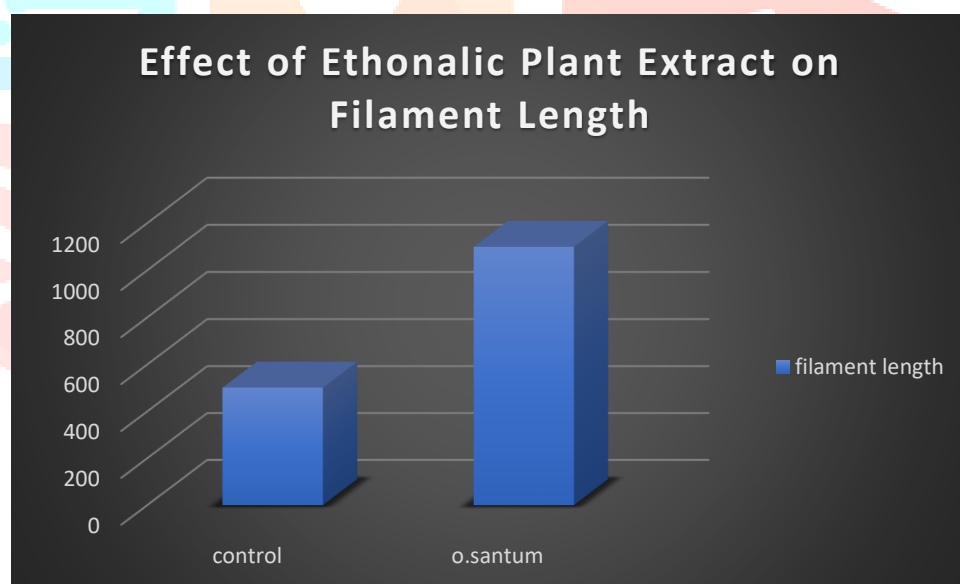
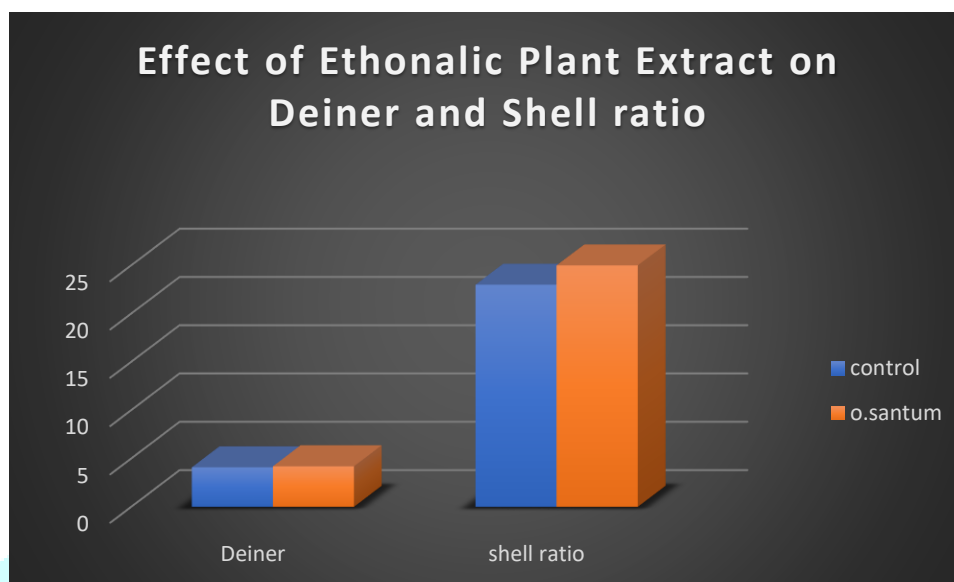
Fig. 5: Effects of ethanolic plant extract Larval Weight and Length**Fig. 6: Effect of ethanolic plant extract Filament length**

Fig. 7: Effects of ethanolic plant extract Deiner and shell ratio**DISCUSSION :**

Alcoholic *Moringa* extract promotes development by increasing 5th instar larval and cocoon weight, pupal weight. Aqueous Rosemary extract enhances larval weight and cocoon shell weight, especially in imported hybrids, demonstrating its positive impact on silkworm growth and development. These results indicate that plant extracts are viable and environmentally acceptable alternative to synthetic additives alternative sing silkworm productivity. The good reactions seen in local hybrid positive reactions observed potential for optimising silkworm raising optimizing's in specific agricultural environments. (Rateb,...etl.2015)

The results of the present study are in similar sentence with the findings of (Hajam et al.,2024) where 3% *Ocimum sanctum* concentrations significantly enhanced the average filament length, measuring 1221 m compared to 1071 m in the control group. A One study found that supplementing with 20% Parthenium leaf extract resulted in the longest silk filament (873 m). this finding (Rudroju et al. 2017) indicated that *Trichosanthes cucumerina* seed extract yielded the greatest cocoon weight, shell weight, silk ratio, and filament length. (Saad et al. 2019) found that larvae fed on mulberry leaves with 3.2% basil leaf extracts had the highest cocoon weights, while 3.1% black cumin seed extracts resulted in significantly higher cocoon shell weights. Additionally, all tested quantities of black cumin seed extract resulted in higher silk ratios in the Cocoons. the shell ratio similar result where found in (Chavan, K. K., et al. 2023) (Vitamin C 0.25% + soya flour 0.25% + vitamin B-complex 0.5% + methionine 0.5%) T5 exhibited the highest mean cocoon shell ratio at 24.59 %.

(Sujatha et al. 2015) as the 3% (T3) *ocimum sanctum* improved, there was a significant rise in economic traits as compared to the control.

There was a strong link between silkworm growth and silk production after leaf treatment with *T. terrestris*, *B. diffusa*, and *P. niruri* extracts. The plant extracts helped the silkworms grow because they contained an active bio compound that make nutrients easier for the silkworms to digest (Murugan K., et al 1998) Supplementation with concentrations of *Sida acuta* plant extracts in methanol all over silk and larval characters impacted. Proper nutrition stimulates the growth and development of *B. mori*.

The supplement of 5% Tulasi plant extract find the improve larval and silk yield. The ultimately increase in the silk length, larval weight and length of the experimental group on the silkworm. The *B. mori* the *Sida acuta* plant extract was investigated against Vth instar larvae of silkworms in order to enhance the performance of growth and cocoon traits of silkworms by (Barge and Pardeshi (2022).

Many studies have shown that varying concentrations of plant extract and their natural formulation, including Ascorbic acid, folic acid, thiamin, vitamins, hormones, Aloe tonic etc., improve the larval and cocoon features. (Manimuthu M , et al.,2010) (Etaberi K ,. 2004) Efforts have been made to improve the quantity and quality of silk production, such as nutrient-boosting leaves, spraying with antibiotics, vitamins, hormones, plant products, and extracts. Plants contain the most organic molecules on the plant, and phytochemicals can affect insect survival and functionality (Narzary et al., 2023)

Conclusion:

In the study, a 5% *Ocimum sanctum* (ethanolic) extract significantly improved all economic and charitable traits of silkworms. This plant extract favorably influenced cocoon and larval growth traits when used in a double hybrid, showing important beneficial effects on economic parameters. Supplementation of mulberry leaves with *Ocimum sanctum* extract positively impacted the growth and economic parameters of silkworms. The treatment group demonstrated significant improvements in larval weight, pupal weight, cocoon weight, shell ratio, filament length, and filament weight compared to the control group. These findings highlight the potential of *Ocimum sanctum* as a natural growth enhancer in sericulture.

REFERENCE:

1. Barge, S.B., and A.B. Pardeshi (2018). Influence of dietary supplementation with of *Sida acuta* plat extract on the mulberry silkworm, *B. mori* L. International Journal of Zoology Studies, Volume 3; Issue 2; Page No. 199-202.
2. Chand, Sujata, Sasmita Chand, and Bauri Raula. "Usage of silkworm materials in various ground of science and research." Journal of Natural Fibers 20.1 (2023): 2139328.
3. Chavan, K. K., et al. "Effect of leaves mulberry leaves enrichment with nutritional supplements on economic parameters of FC1 x FC2 Silkworm, *Bombyx mori* L." (2023).

4. Czaplicki, Zdzisław, Eulalia Gliścińska, and Waldemar Machnowski. "Natural Silk—an Unusual Fiber: Origin, Processing and World Production." *Fibers & Textiles in Eastern Europe* 29.5 (149) (2021).
5. Das GMR (1950) Diseases of silkworm monograph on cottage industries. No1, Govt. India Press, Calcutta, 25
6. Etaberi K, Kaliwal B, Matindoost L. Supplementation of mulberry leaves in sericulture, theoretical and applied aspects. *Int. J Indust Entomol.*2004; 9: 14-28
7. Gobena, W. Sori, and R. N. Bhaskar. "Fortification of mulberry leaves with medicinal botanical plant extracts effect on silkworm, *Bombyx mori* L.(PM× CSR2)(Lepidoptera: *Bombycidae*) larval growth and cocoon traits." (2015): 199-206.
8. Hajam, O. Ahmad, et al. "Influence of plant extract fortified mulberry leaf on some reeling parameters of silkworm, *Bombyx mori* L." (2024).
9. Jayaprakash rao "Effect of few Botanicals and iodine compounds on the economic traits of eri silk worm M. Sc (Sericulture) Thesis, University of Agriculture Science, Dharwada [1999]
10. Jiang, Li., Peng, L., Cao, Yu-Yao., Thakur, K., Hu, F., Tang, S., & Wei, Zhao-Jun. (2019). Effect of Dietary Selenium Supplementation on Growth and Reproduction of Silkworm *Bombyx mori* L.. *Biological Trace Element Research* , 193 , 271 - 281 .
11. Khaliknazarov, U., Akbarov, D., Tursunov, A., Gafforov, S., & Abdunabiev, D. (2021). Existing problems of drying cocoon and making chrysalis feeble, and their solutions. *IOP Conference Series: Earth and Environmental Science*, 939(1). <https://doi.org/10.1088/1755-1315/939/1/012020>
12. Krishnaswami, S. (1986). *Sericulture Manual II: Silkworm Rearing*. FAO Agricultural Services Bulletin.
13. Mahmoud SM (2016) *Silk agriculture and industry*. Noor publishing, GmbH, Nordersted /Germany, pp . 1–288
14. Manimuthu M, Isaiarasu L. Influence of herbal tonic Aloe on the overall performance of the mulberry silkworm *Bombyx mori* L. *Journal of Biopesticides*. 2010; 3(3):567-572
15. Murugan K, Jeyabalan D, Senthikumar N, Senthilnathan S, Sivaprakasam N. Growth Promoting effect of plant products on silkworm: A Biotechnological Approach. *J Sci Ind Res* 1998; 57:740-745
16. Murugan K, Jeyabalan D, Senthikumar N, Krishna SS, Sivaprakasam N. Growth-promoting effects of plant compounds on silkworm. *Proceedings of the National Seminar on Tropical Sericulture*; 1999 Dec 28-30; Bangalore, India; c1999. p. 107-108.
17. Nair JS and Kumar SN, Artificial diet for the silkworm, *Bombyx mori*, L., retrospection through the decades. *Indian Journal of sericulture*, 2004, 43(1):1-17.
18. Narzary, Prety & Dutta, P. Lushan, I. Nath, Inand A. Gadge. Gadge(2023). Role of Plant Extracts on Growth and Development of Mulberry and Non-Mulberry Silkworms. 494-501. 10.5281/zenodo.7827408.
19. Nikolova, Tsvetelina. "Growing mulberry silkworm with artificial diet with added extract *Tribulus terrestris* L." *Bulgarian Journal of Agricultural Science* 26.5 (2020): 1041-1046.

20. Prakash, P., & Gupta, N. (2005). Therapeutic uses of *Ocimum sanctum* (Tulsi) with a note on eugenol and its pharmacological actions: A review. *Indian Journal of Physiology and Pharmacology*, 49(2), 125-131
21. Prasad MP, Jayalakshmi K, Rindhe GG (2012) Antibacterial activity of *Ocimum* species and their phytochemical and antioxidant potential. *Int J Microbiol Res* 4(8):302–307
22. Rudroju, S. S.; Akula, S.; Janga, S. and Kuntamalla, S. (2017). Effect of leaf and seed extract of *Trichosanthes cucumerina* L on antibacterial activity and economic traits of mulberry silkworm, *Bombyx mori* L. *J. Entomo. and Zool. Studies*, 5(2): 889-894.
23. S. H., and Y. A. Abdel-Rahman. "Effects of some Extracts on Growth Characters of Mulberry Silkworm" *Bombyx mori* L." *Assiut J Agric Sci* 46 (2015): 58-71.
24. Saad, Mahmoud SI, Enas MY Elyamani, and Walaa MM Helaly. "Controlling of bacterial and fungal diseases that contaminating mulberry silkworm, *Bombyx mori* by using some plant extracts." *Bulletin of the National Research Center* 43 (2019): 1-9.
25. Singh, S., Malhotra, M., & Majumdar, D. K. (2010). Antioxidant and anti-inflammatory activities of *Ocimum sanctum* (Linn). *Journal of Ethnopharmacology*, 33(3), 235-243
26. Sujatha, Kuntamalla, Janga Sathish, and Jirra Anitha. "Effect of medicinal botanical (*Ocimum sanctum*), Family, Labiateae on commercial parameters of the silkworm, *Bombyx mori*, L." *International Journal of Multidisciplinary and Current Research* 3 (2015): 76-78.
27. Umadevi, M., Sampath Kumar, K. P., Debjit Bhowmik, & S. Duraivel, *Journal of Medicinal Plants Studies*, 2013.
28. Vidya Devi, P. S., and Bai, M. R. (2015). Effect of *Ocimum sanctum* L. plant extract on the economic parameters of silkworm, *Bombyx mori* L. *Journal of Entomology and Zoology Studies*, 3(2), 62–64