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RESEARCH ARTICLE

EVALUATION OF OCIMUM SANCTUM LEAF EXTRACT PERFORMANCE ON COCOON PRODUCTION AND SILK QUALITY IN BOMBYX MORI L

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Abstract

The sericulture is an ancient traditional industry more Asia people is depended on it.The silkworm *(Bombyx mori L*) 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 spray*Ocimum 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 cocoonand pupae) and silk parameters(shell ratio, Length of silk filament,denier)hi ghly effect in larval. And thus, increase silk qualityas 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 maximu m valueas compared to the control group.it is ratify *Ocimum sanctum* plant extract spray a coated mulberry leaf fed silk worm larval commercial traits positive effect *Bombyx moriL*.

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

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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, syntheticpesticide chemicalsand diseases harmfulresidues 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 theWorld". Some commercialselected herbalextract reflected into better response from the silk worm larval *Bombyx Mori L.*(Balamurugan R, Isaiarasu L 2007)Ancient literature describes tulsi, also referred to as the "Queen of Herbs," as a holy and therapeutic plant. *Ocimum sanctum* (Linn) is the botanical name for this plant, which is a species of the Labiatae family. The plant is cultivated all throughout India. Many insects' physiology, development, and behaviour have been shown to be influenced by plant extracts. Still very little is known about how these extracts affect *Bombyx mori,* the silkworm. Thus, the current research was conducted to assess the effect of leaf extracts from *Ocimum sanctum* (Tulsi) on the silkworm bombyx mori l cocoon characteristics.

Materials and Methods:-

Study area :

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

Silkworm rearing:-

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

Mulberry varity:-

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

Plant material collection:

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

Preparation of Extract and Treatment:

The plant material was thoroughly washed with tap water to remove surface contaminants and shade-dried for 30–45 days. A total of 25 grams of the dried plant powder was soaked in 150 mL of distilled water overnight. The mixture was then filtered through muslin cloth, and the filtrate was centrifuged at 3000 rpm for 15 minutes. The resulting supernatant was collected and considered as the stock solution (100%). From this stock, three different concentrations were prepared using distilled water. Mulberry leaves were treated with plant extracts at three different concentrations—T1 (1%), T2 (2%), and T3 (3%)—and subsequently fed to the silkworm larvae for fortification. Fresh extracts were prepared every third day to ensure consistency and potency.(Sujatha, Kuntamalla et al,. 2018).

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

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

Analysis of economic traits:-
The experiment was laid out in a Completely Randomized Design (CRD) with three treatments and one control, each replicated three times, comprising 200 larvae per replication. A silk worm of 25 larval and after spinning 25 cocoons from each experimental groups was collected for the analysis of economic parameters.

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

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

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

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

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

$$\textbf{cocoon shell ratio (\%)} = \frac{\textbf{cocoonshellweight}}{\textbf{cocoonweight}} \textbf{ x 100}$$

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

Silk filament length (m)= Revolutions of epprouvette X Wheel circumference (m)
7) Denier:
Denier is an important parameter that indicates the thickness or fineness of silk filament, expressed as the weight in grams of 9,000 meters of the filament. It reflects the size of the yarn and directly influences the quality of the raw silk produced. In this study, the denier value was calculated according to the method described by Sonwalkar (1993) using the following formula:

$$\textbf{Denier (D)} = \frac{\textbf{Weight of filament (g)}}{\textbf{Length of filament (m)}} \textbf{x9000}$$

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

Statistical analysis :
Results were presented as means ± SD in Microsoft excel 2019 model.

Results:-

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

content of mulberry leaves.Table 1 presents the effect of Ocimum sanctum plant extract supplementation at different concentrations (1%, 2%, and 3%) on the economic parameters of the silkworm, Bombyx mori. The aqueous mulberry leaves served as the control diet. The control group recorded a larval length of 5.95 ± 0.23 cm and a larval weight of 2.40 ± 0.15 g. The corresponding cocoon weight, pupal weight, and shell weight were 0.80 ± 0.12 g, 0.74 ± 0.09 g, and 0.19 ± 0.02 g, respectively. The shell ratio was 20.5 ± 5.73%, while the filament length, filament weight, and denier were 629.2 ± 35.4 m, 0.17 ± 0.02 g, and 2.00 ± 0.36, respectively.In the 3% treatment group, a marked elevation was observed in all economic parameters of Bombyx mori when compared to the control. The larvae recorded a length of 6.39 ± 0.39 and a weight of 2.76 ± 0.12 g. The cocoon weight, pupal weight, and shell weight were 1.10 ± 0.13 g, 0.89 ± 0.08 g, and 0.23 ± 0.03 g, respectively. The shell ratio increased to 23.5 ± 4.10%. Furthermore, the filament length, filament weight, and denier reached 948.5 ± 54.3 m, 0.25 ± 0.04 g, and 2.47 ± 0.40, respectively, indicating a significant improvement in the economic traits at the 3% concentration of O. sanctum extract.

At the 2% concentration, the O. sanctum aqueous extract also demonstrated notable fortification of the economic parameters of B. mori, although the improvements were moderate compared to the 3% group. The mean larval length and larval weight were 6.33 ± 0.34 cm and 2.59 ± 0.24 g, respectively. The cocoon weight, pupal weight, and shell weight recorded were 0.92 ± 0.12 g, 0.86 ± 0.08 g, and 0.21 ± 0.01 g. The shell ratio reached 21.6 ± 3.82%, while the filament length, filament weight, and denier were 937.0 ± 88.7 m, 0.21 ± 0.02 g, and 2.45 ± 0.32, respectively, showing a moderate enhancement over the control.The results shown by the 1% O. sanctum supplemented group correspond to the assessed economic characteristics of Bombyx mori. The measurements of the larval weight and length were 2.66 ± 0.12 g and 6.01 ± 0.28 m , respectively. The weights of the cocoon, pupal, and shell were 1.03 ± 0.10 g, 0.76 ± 0.08 g, and 0.22 ± 0.02 g, respectively. The shell ratio was 22.0 ± 2.92%. The filament weight and denier measured 0.24 ± 0.03 g and 2.46 ± 0.28, respectively, indicating a significant improvement in the filament properties. The 1% treatment values were significantly higher than the control, although being lower than those found in the 2% and 3% groups. This suggests a modest but significant improvement in the economic attributes.

Table1: Effect of different concentration in *ocmium sanctum* plant extracts on Larval and silk parameters of silkworm *bombyx mori l*

Concentration of O. sanctum	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

Discussion:-

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

Ocimum sanctum (Tulsi) extract to the food of *Bombyx mori l* has been proven to improve the development of larvae, the weight of cocoons, the ratio of shells, and the overall quality of silk. There are always internal and external elements that affect how silkworms grow and develop (Murugan et al., 1998). Plant extracts and other dietary supplements may help the body work better, which may trigger higher growth, greater feeding efficiency, and more silk production. This can make sericulture more productive and profitable (Nivetha et al., 2021; Fouad et al., 2025). Alagumalaiet al. (1991) found that adding black gramme and red gramme flour to mulberry leaves promoted *Bombyx mori l* larvae development and made their cocoons better. Likewise, extracts from many prevalent plant species—*Tribulus terrestris, Phyllanthus niruri, Boerhaviadiffusa, Psoralea corylifolia, Caesalpinia coriaria,* and *Parthenium hysterophorus*—have been shown to increase silk and egg production in silkworms (Murugan et al., 1998).Kumar et al. (2009) showed that a 300-ppm *Spirulina* treatment made the cocoon weight, shell weight, pupal weight, shell percentage, and silk filament length much higher than the control. Jeyapaul et al. (2003) noted that silkworm larvae fed mulberry leaves treated with *Coffea arabica* leaf extract had a significantly greater shell weight (0.296 g) in comparison to the control group. In the spring, adding 3% *O. sanctum* gave the maximum cocoon weight (2.40 g), shell weight (0.54 g), and shell ratio (22.40%) (Hajam et al., 2024).The larval weight of mulberry leaves treated with 20*% Azolla* was substantially greater than that of the control. The rich nutritional content of *Azolla*, which is a strong source of protein, vital amino acids, and minerals, may be contributing to this improvement (Simon, et, al.,2023)

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

The current study supports previous findings showing that plant extracts have a major impact on larval development and cocoon production. According to Swarnlata and Hassan (2023), feeding silkworm larvae mulberry leaves fortified with a 3% concentration of *giloy* plant extract boosted the larvae's growth, development, and economic characteristics.The other plant extracts also shown significant increases in cocoon characteristics, which might be explained by the silkworms' increased vigour and hunger as well as the presence of bioactive biochemical components in the plant extracts that raised the feed's nutritional effectiveness. These botanicals' stimulatory effects on protein synthesis in the silk gland during the larval stage were probably responsible for the increased nutritional availability and utilisation. According to Gayathri et al. (2006), mulberry leaves treated with several medicinal plant extracts were given to silkworms, resulting in increases in cocoon weight, pupal weight, shell weight, cocoon shell ratio, and cocoon yield.

Additionally, phytochemical investigations of *O. sanctum* have validated the presence of sterols, tannins, and aromatic compounds with significant antibacterial properties (UP Neumann et al.). These components help the silkworms stay healthy and make them more useful for the sericulture industry. Sterols, especially, may serve as both nutrition and feeding stimulants. Thus, the sterols found in *O. sanctum* leaves seem to play a substantial role in embryonic development, hatching, larval growth, and pupation (Gilbert & Chopra).The artificial extract enhanced Antioxidants and vitamins C and B, which are coenzymes in the metabolism of amino acids, may boost larval

growth by raising the concentrations of amino acids in larval tissues and increasing productivity (Bhattacharyyaetal., 2016).

Conclusion: -

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

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