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IMPACT OF HOMEOPATHIC MEDICINE ON THE DEVELOPMENT AND SILK PRODUCTION OF MULBERRY SILKWORM *Bombyx mori* L.

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Abstract

Enhancement of mulberry leaf quality through dietary supplementation plays a vital role in improving silkworm growth, cocoon productivity, and silk quality in sericulture. The present investigation was undertaken to evaluate the influenced of selected homeopathic formulations on the larval development, cocoon characteristics and silk filament parameters of *Bombyx mori*. The experiment was conducted during December 2025-January2026 at Nashik under, controlled conditions of 24-29°C temperature and 75-86 % relative humidity. Two homeopathic formulations were diluted at different concentrations according to larval instars and applied by spraying on mulberry leaves prior to feeding. The experiment was conducted in triplicate following a completely randomized design.
Larval growth increased progressively from the 1 st to the 5th instar, with significant improvement observed from the 2 nd instar onwards. The maximum 5th instar larval weight was recorded in T_2 (34.68 ± 1.54g), followed by T_1 (32.32±1.25g), compared with the control (28.48 ± 1.31 g; P = 0.006). Similarly, the 3rd instar larval weight was significantly higher in T_2 (6.083 ± 0.849 g) than in the control (3.983 ± 0.499 g; P = 0.013). Cocoon traits such as cocoon weight and shell weight were also enhanced under

treatment conditions, with T_2 recording the highest cocoon weight (19.13 ± 2.15 g) and shell weight (4.59 ± 0.57 g) compared with the control (15.45 ± 0.39 g and 3.45 ± 0.44 g, respectively). The effective rate of rearing (ERR) increased significantly from 90.00% in the control to 97.67% under T_2 (P=0.001).
Silk filament parameter showed marked improvement under homeopathic supplementation. T_2 recorded the highest number of revolutions (987.67 ± 55.71) and filament length (1111.13 ± 62.67 m). However, filament weight and denier did not differ significantly among treatments. The findings demonstrated that homeopathic enrichment of mulberry leaves positively influenced larval growth, cocoon productivity, and silk filament quality without adversely affecting rearing performance. Among the treatments evaluated, Iodium (T_2) proved to be the most effective. The study suggests that homeopathic supplementation may serve as a sustainable, eco-friendly, and economically viable approach for improving silk productivity and sericultural efficiency.

1. **Introduction:**

Sericulture constitutes an important component of the rural economy and textile industry, wherein silk production is primarily dependent on the healthy growth and development of the silkworm, *Bombyx mori* plays a decisive role in determining larval growth, cocoon development, and silk yield. In India, seasonal fluctuations, climatic variations, agricultural practices, pest infestation, and diseases frequently alter the nutritional composition of mulberry leaves, thereby adversely affecting silkworm performance and resulting in significant crop losses (Ito and Niminura, 1966). Consequently, the enhancement of the nutritive value of sericulture for improving cocoon productivity and silk quality (Masthan et al., 2011). Nutritional investigations in silkworms are therefore essential for the commercial advancement of sericulture, as nutrition is recognized as one of the major determinants influencing both the quantity and quality of silk production (Laskar and Datta, 2000).

Several studies have attempted to enrich mulberry leaves with proteins, carbohydrates, amino acids, vitamins, minerals, hormones, antibiotics, and plant extracts in order to improve the biological and economic traits of silkworms (Sannappa, 2002). Deficiencies of essential nutrients such as potassium, calcium, and phosphorus have been reported to negatively influence larval weight, cocoon weight, and other silk-related parameters (Patil, 2003). Earlier investigations demonstrated that supplementation of mulberry leaves with spirulina significantly enhanced larval growth and cocoon characteristics in *Bombyx mori* (Venkataramana, 2003). Similarly, aqueous extracts of plants such as zingiber officinale, Lantana camara, and mulberry leaves were found to improve silk quality and overall silkworm performance (Manjunatha et al., 2017). Supplementation with aqueous extracts of Vigna unguiculata (cowpea) at different concentrations also resulted in improvement in both the quantity

and quality of silk produced by silkworms (Sarvanan, 2011).

Plants are recognized as rich reservoirs of organic compounds, and phytochemicals are known to influence the growth, development, and behavioral responses of insects (Gouda et al., 1997). Several medicinal plant extracts supplemented with mulberry leaves have demonstrated beneficial effects on body weight, silk gland weight, and silk filament length in silkworms (Murugan et al., 1998). Dietary supplementation with extracts obtained from the leaves, flowers, and pods of Moringa oleifera enhanced the performance of final instar larvae of *Bombyx mori* (Rajeswari and Isaiarasu, 2004). Likewise, supplementation with chitosan solution elicited positive responses in larval growth and cocoon characteristics (Bin Li et al., 2010). A commercial herbal tonic, "logen", containing extracts of selected medicinal plants, also exhibited favorable effects on silkworm larvae (Balmurugan and Isaiarasu, 2007).

Furthermore, supplementation of mulberry leaves with amway protein (Rani et al., 2011). Royal jelly, Pollen grains, and bee honey (Kamel et al., 2016), as well as amino acids such as lysine, alanine, cysteine, and glycine (Meeramaideen et al.,2017), significantly improved larval growth, cocoon yield, and silk productivity. These findings collectively suggest that nutritional and botanical supplements can effectively enhance the biological efficiency and commercial value of sericulture.

Despite substantial progress in the field of nutritional and botanical supplementation, the application of homeopathic medicines in sericulture has received comparatively limited attention. Homeopathic formulations are considered eco-friendly, non-toxic, biodegradable, and economically viable. They are believed to stimulate physiological processes, improve metabolic activities, enhance immunity, and increase stress tolerance without producing adverse side effects. In silkworm rearing, supplementation with homeopathic medicines

may promote nutrient assimilation, Owing to these potential advantages, homeopathic formulations may serves as a novel and safe alternative for improving silkworm productivity.

Therefore, the present investigation was undertaken to evaluate the effects of fortifying mulberry leaves with selected homeopathic medicines on the growth, development, and cocoon production of *Bombyx mori*. This approach may provide a sustainable and environmentally safe strategy for enhancing silk yield and improving modern Sericultural practices.

2. MATERIALS AND METHODS:

2.1 Silkworm rearing:

The mulberry silkworm, *Bombyx mori* L. (Bivoltine hybrids), was used. Disease-free laying (DFLs) were procured from the Jilha reshim karyalay, Dwarka, Nashik, Maharashtra. Eggs hatched within eight days under standard conditions. Rearing was conducted during December 2025- January 2026 at 24-29°C and 75-86% relative humidity. The rearing room and equipment were disinfected with 2% formalin. Larvae were reared in sterilized trays and fed fresh mulberry leaves twice daily during the 1st - 3rd instars and three times daily during later stages.

2.2 Preparation of treatments:

Two homeopathic medicines with potency 30 CH, Calcarea carbonica (T_1) and Iodium (T_2), were used (Boerick, 2004; John clercke, 2020 VOLIII). The drugs were diluted with distilled water to prepare concentrations for larval stages: 1:8 for first and second instars (10 ml drug + 80 ml distilled water), 1:6 for third instar (10 ml drug + 60 ml distilled water), and 1:4(10 ml drug+40 ml distilled water). For fourth and fifth instars (Hiware, 2006; Avhad, 2015). Mulberry leaves were sprayed with 2 ml of the respective solutions during the first feeding. Control larvae were fed with leaves treated with distilled water. The treatments continued up to the spinning stage.

2.3 Experimental design:

A total of 300 larvae were divided into four groups (100 larvae in each group). One group served as control, while the remaining groups received treatments (T_1 and T_2). The experiment was conducted in triplicate. Standard rearing practices were followed (Krishnaswami, *et al*, 1973), and mature larvae were transferred to mountages for cocoon spinning

2.4 Estimation of biological and economic traits:

i) Larval weight (g): Ten larvae were randomly picked from each group (Control, T_1, T_2) and their weight was recorded using an electronic balance for each instar.

ii) Cocoon, Pupal, Shell weight (g): Ten cocoons were randomly selected and weighed on an electronic balance from each group to obtain Cocoon, Pupal, Shell weight.

iii) Cocoon shell ratio CSR (%): (Shell weight / Cocoon weight) × 100

vi) Effective rate of rearing (ERR) (%): Number of cocoons harvested / Number of larvae brushed × 100

vii) Number of revolutions of the manual reeling machine.

viii) Silk filament length (m): Three cocoons from each replication were taken and reeled individually on the manual reeling machine. The total number of revolutions was recorded.

$$L = R \times 1.125$$

Where L total length of the filament in meters per cocoon, and R is the number of revolutions.

ix) Denier = (SFW / SFL) × 9000

Where SFW is Silk Filament Weight (g), and SFL is Silk Filament Length (m)

Larvae and cocoon were randomly selected to measure the weight of larvae, Cocoon weight, pupal weight, shell weight, and silk filament length

2.5 Statistical Analysis:

Data were analyzed by using analysis of variance (ANOVA), and mean comparisons were performed

using Duncan's Multiple Range Test (DMRT) with IBM SPSS.

3. Results and Discussion:

The present study evaluated the effect of different treatments on larval growth, cocoon traits, and silk filament parameters of *Bombyx mori*. Results indicated that treatment responses varied with developmental stage and trait, with more pronounced effects observed during later larval instars and in silk filament characteristics.

Table 1. Effect of homeopathic treatments on the larval weight (g) of *Bombyx mori L* (mean ± SE)

Treatments	Weight of 1st instar(g)	Weight of 2nd instar (g)	Weight of 3rd instar(g)	Weight of 4th instar(g)	Weight of the 5th instar(g)
Control	0.060^{a}± 0.010	0.300^{b} ± 0.017	3.983^{b} ± 0.499	19.69^{c} ± 0.64	28.48^{b} ± 1.31
T_1 -Calcarea carbonica	0.090^{a}± 0.036	0.353^{a} ± 0.032	5.047^{ab} ± 0.419	$22.53a^{b}$ ± 1.24	32.32^{ab} ± 1.25
T_2-Iodium	0.093^{a} ±0.032	0.367^{a} ± 0.015	6.083^{a} ± 0.849	24.45^{a} ± 0.58	34.68^{a} ± 1.54
P value	0.256	0.026	0.013	0.001	0.006
F value	1.73	7.11	9.84	24.67	13.92

*Values followed by different letters within a column differ significantly at $P \leq 0.05$ (DMRT).

Table 2. Effect of homeopathic treatments on the cocoon parameters of *Bombyx mori L.* (mean ± SE)

Treatments	Cocoon weight(g)	Pupal weight(g)	Shell weight(g)	Cocoon shell ratio (%)	Number of cocoon harvested	Number of larvae brushed	Effective rate of rearing
Control	15.45^{b} ± 0.39	12.91^{a} ± 0.62	3.45^{b} ± 0.44	22.36^{a} ± 3.35	90	100	90.00^{c} ± 1.00
Calcarea carbonica	17.51^{ab} ± 1.18	13.85^{a} ± 0.71	4.07^{ab} ± 0.25	23.27^{a} ± 1.32	93.33	100	93.33^{b} ±1.53
Iodium	19.13^{a} ± 2.15	14.64^{a} ± 1.78	4.59^{a} ± 0.57	24.08^{a} ± 2.53	97.67	100	97.67^{a} ± 0.58
P value	0.021	0.127	0.044	0.694	-	-	0.001
F value	7.84	2.96	5.61	0.39	-	-	36.40

***** Values followed by different letters within a column differ significantly at P ≤ 0.05 (DMRT).

Table3.Effect of homeopathic treatments on the silk filament parameters of *Bombyx mori* L.(mean ± SE)

Treatments	Number of Revolution (R)	Silk filament length(m)	Silk filament weight (mg)	Denier
Control	819.33^{b} ± 48.11	921.75^{b} ± 54.12	0.397^{a} ± 0.065	3.87^{a} ± 0.55
Calcarea carbonica	938.67^{a} ± 13.43	1056.00^{a} ± 15.11	0.393^{a} ± 0.025	3.35^{a} ± 0.17
Iodium	987.67^{a} ± 55.71	1111.13^{a} ± 62.67	0.440^{a} ± 0.089	3.55^{a} ± 0.59
P value	0.006	0.006	0.693	0.448

F value	13.24	13.24	0.39	0.92

3.1 Larval growth:

In Table no 1. Larval weight increased progressively from the 1st to the 5 th instar in all treatments, with T_2 consistently recording the highest values. During the 1 st instar, No significant difference was observed among treatments (F=1.73, P=0.256), indicating that treatment effects were not evident during the early larval stage. However, from the 2nd instar onward, significant differences emerged. In the 2nd instar, T_2 (0.367± 0.015) and T_1 (0.353 ± 0.032) were significantly superior to control (0.300 ± 0.017) (F=7.11, P=0.026). A similar trend was observed in the 3rd instar, where T_2 recorded the highest larval weight (6.083 ± 0.849), followed by T_1 (5.047± 0.419) and control (3.983 ± 0.499) (F=9.84, P=0.013).

The treatment effect became more pronounced during the later instars. In the 4th instar, T_2 produced significantly higher larval weight (24.45 ± 0.58) compared with T_1 (22.53 ± 1.24) and control (19.69 ± 0.64), with highly significant variation among treatments (F=24.67, P=0.001). Similarly, during the 5th instar, T_2 recorded the maximum larval weight (34.68 ± 1.54), followed by T_1 (32.32 ± 1.25) and control (28.48 ± 1.31) (F= 13.92, P= 0.006). The consistent superiority of T_2 across advanced instars indicates enhanced nutrient utilization, improved larval growth, and better physiological performance under treatment conditions.

3.2Cocoon parameters and rearing performance:

Cocoon characteristics were markedly influenced by the treatments, with T_2 showing superior performance for most economic traits. In Table no. 2 Cocoon weight increased significantly from (15.45^b ± 0.39) in Control to (17.51 ± 1.18) in T_1 and (19.13 ± 2.15) in T_2 (F=7.84, P=0.044). The increase in shell weight

suggests greater silk deposition and improved silk gland activity in treated larvae.

In contrast, pupal weight and cocoon shell ratio did not differ significantly among treatments. Pupal weight ranged from (12.91 ± 0.62) in control, (13.85 ± 0.71) in T_1 and (14.64 ± 1.78) in T_2 (F= 2.96, P=0.127), While cocoon shell ratio varied from 22.36 ± 3.35 in Control to 24.08^a± 2.53 in T_2 (F= 0.39, P=0.694). The effective rate of rearing showed highly significant improvement, increasing from 90% in Control, 93.33% in T_1 and 97.67 % in T_2 (F=36.40, P=0.001).The exceptionally high ERR in T_2 reflects improved larval survival, better cocoon recovery , and enhanced rearing efficiency. Overall, T_2 proved most effective in improving cocoon productivity and economically important silkworm traits.

3.3Silk filament parameters:

The silk parameters Table no.3 demonstrated substantial improvement under treatment conditions, particularly in T_2. The number of revolutions increased significantly from 819.33 in control to 938.67 in T_1 and 987.67 in T_2 (F= 13.24,P= 0.006), indicating improved reelability and cocoon quality. A similar trend was observed for silk filament length, which increased significantly from 921.75 m in Control to 1056.00 m in T_1 and 1111.13 m in T_2 (F= 13.24, P =0.006). The enhanced filament length under T_2 indicates greater silk productivity and improved commercial value of cocoons as shown in table no 3.

However, silk filament weight and denier did not show significant variation among treatments. Filament weight ranged from 0.393 mg to 0.440 mg (F=0.39, P= 0.693), while denier values varied from 3.35 to 3.87(F=0.92, P=0.448). The non-significant differences suggest that treatments primarily improved filament length and reelability without affecting filament thickness or fineness. Overall, T_2 exhibited superior performance in enhancing silk yield and quality- related traits, confirming its positive impact on silkworm productivity.

Discussion:

The present study demonstrated that homeopathic enrichment of mulberry leaves significantly influenced larval growth, cocoon traits, and silk filament characteristics of *Bombyx mori*. Since silkworm larvae depend exclusively on mulberry leaves for nutrition, the quality and nutrient composition of the feed directly affect larval growth, cocoon production, and silk quality. Similar observations were reported by Das et al. (2001) and kumar and vadamalai (2010), who emphasized that nutritional quality of mulberry leaves determines the conversions efficiency of food into insect biomass and ultimately influences cocoon economic traits. In the present investigation, larval weight increased progressively from the 1st to the 5th instar, with T_2 consistently recording higher values that T_1 and Control. Significant differences were observed from the 2nd instar onwards ($P < 0.05$), while the 4th and 5th instars showed highly significant improvement in larval weight under T_2 treatment ($P < 0.01$). These findings are in agreement with murugappan et al. (1996), who reported that nutritional supplementation of mulberry leaves improved cocoon weight and shell weight considerably. Similarly, Shoukry et al. (1998) observed increased cocoon production and shell ratio following supplementation with volatile oils, while Prasad et al. (2001) reported enhanced cocoon weight and shell weight in silkworms fed on enriched mulberry leaves. In contrast, pupal weight and cocoon shell ratio in the present study did not differ significantly among treatments ($P > 0.05$), indicating that these traits are comparatively stable and may be governed by genetic and environmental factors rather than dietary supplementation alone. Similar observations were reported by Sannappa et al. (2002), who stated that cocoon characteristics often remain relatively unaffected despite improvements in silk quality traits.

The silk filament parameters exhibited remarkable improvement under treatment conditions. The number of revolutions and silk filament length increased significantly in T_2 ($P < 0.01$), indicating enhanced reelability and silk

yield. The maximum filament length recorded under T_2 treatment confirms improved silk productivity and commercial value. These findings supports the reports of zannon (1994), who observed longer and heavier silk filaments following nutritional supplementation. Kuntamalla and Rao (2004) similarly reported increased filament length and silk ratio in larva fed with enriched mulberry leaves, while Khalil et al. (2009) also observed a significant increase in silk filament length following dietary supplementation with spirulina. The present results therefore support earlier reports that nutritional enrichment during larval stages positively influences silk filament production.

Although silk filament weight and denier showed numerical variation, the differences were statistically non-significant ($P > 0.05$). However, the slight reduction in denier observed under treatment conditions suggests the production of finer silk filament, which is commercially desirable. Similar findings were reported by Zannoon (1994), who observed improvement in filament length and weight without major changes in filament size. The enhancement in filament parameters may be associated with increased haemolymph protein content and improved silk gland activity due to better nutrient availability, as suggested by Mbaebie et al. (2010) and Crews et al. (2006). The nutritional and antioxidant properties of enriched feed materials likely improved metabolic conversion efficiency, thereby enhancing silk synthesis.

Overall, the present study clearly demonstrates that homeopathic enrichment of mulberry leaves positively influenced larval growth, cocoon productivity, and silk filament characteristics of silkworms. The significant enhancement

observed, particularly in later instars, cocoon weight, shell weight, ERR, Filament length, and number of revolutions, suggests improved nutrient assimilation and metabolic efficiency under treatment conditions. The findings are consistent with earlier reports indicating that nutritional supplementation enhances silk productivity without adversely affecting silkworm survival or rearing performance. Among the treatments tested, T_2 proved to be the most effective in improving economically important traits of silkworm rearing and silk production.

Conclusion:

The present investigation demonstrated that homeopathic enrichment of mulberry leaves had a positive influence on the growth, cocoon characteristics, and silk filament parameters of *Bombyx mori*. Among the treatments evaluated, T_2 (Iodium) consistently produced superior results compared with T_1 (Calcarea carbonica) and the control. Significant improvements were observed in larval weight from the 2nd instar onwards, with the highest values recorded during the 4th and 5 th instars under T_2 treatment. These findings indicate enhanced nutrient utilization and improved physiological performance of silkworm larvae under enriched feeding conditions.

Cocoon productivity was also positively affected by the treatments. T_2 recorded the highest cocoon weight, shell weight, and effective rate of rearing, suggesting improved silk gland activity, better larval survival, and enhanced cocoon recovery. Although pupal weight and cocoon shell ratio did not differ significantly among treatments, the numerical improvement observed under T_2 indicates a favorable trend towards better cocoon quality.

Similarly, silk filament characteristics showed marked enhancement under treatment conditions. The significant increase in the number of revolutions and filament length in T_2 indicates improved reelability, higher silk productivity, and greater commercial value of the cocoons. While filament weight and denier did not vary

significantly, the treatments improved silk yield without adversely affecting filament fitness.

Overall, the study confirms that homeopathic enrichment of mulberry leaves can effectively enhance economically important traits in silkworm rearing. Among the tested treatments,

Iodium (T_2) proved to be the most effective in improving larval growth, cocoon traits, rearing efficiency, and silk filament quality. Therefore, the application of suitable homeopathic supplements may serve as a promising and eco-friendly strategy for improving sericultural productivity and silk quality in commercial silkworm rearing.

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