

Boosting Silkworm Health: Enhancing Mulberry Leaves with Plant Extracts for Superior Silk Production

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ABSTRACT

The benefits of adding medicinal plant extracts into the diet of silkworms (*Bombyx mori* L.) to improve their nutrition, enhance the quality and value of the silk they produce. Since silkworms play a crucial role in the sericulture industry, their diet directly influences their growth, health and silk quality. It has been found that adding plant extracts to mulberry leaf can lead to significant improvements, such as increased silkworm weight, better cocoon quality and higher resistance to diseases. Various studies have explored different plant extracts, demonstrating these additions not only promote health of silkworms but also result in superior silk production and hence offers a sustainable way to boost the profitability of sericulture.

INTRODUCTION

Silkworm (*Bombyx mori* L.) is the heart of the sericulture industry, converting mulberry leaves into the luxurious silk

fibers that have been prized for ages. The health and productivity of silkworm is directly linked to their diet making nutrition a critical

factor in silk production. Mulberry leaves are the only food source for silkworms throughout their larval stage providing essential nutrients such as proteins, carbohydrates, lipids, vitamins and minerals. These nutrients are vital for the silkworm's growth, development and silk production. The quality and composition of mulberry leaves can considerably influence the health of silkworms and the quality of the silk they produce. Factors such as soil quality, climate conditions and agricultural practices affect the nutrient content of mulberry leaves which in turn affects silkworm performance.

Despite the critical role of mulberry leaves, there are limitations to relying solely on them for silkworm nutrition. Variations in leaf quality due to environmental factors and the limited availability of certain nutrients in mulberry leaves can result in suboptimal growth and silk production. This has led researchers to explore alternative ways to enhance silkworm diet through dietary fortification. Recent research has highlighted the potential of fortifying mulberry leaves with various plant extracts to enhance silkworm diet leading to improved silk quality, increased cocoon yield and better overall silkworm health.

The Concept of Dietary Fortification in Sericulture

Dietary fortification involves supplementing the natural diet of an organism with additional nutrients or bioactive compounds to enhance health and productivity. In the context of sericulture, this means adding specific plant extracts to mulberry leaves to improve the nutritional profile of the silkworm diet. These plant extracts are selected based on their known benefits such as antioxidant properties, immune-boosting effects or their ability to enhance growth and silk production.

The concept of fortifying silkworm diets with plant extracts is rooted in the understanding that certain phytochemicals (plant-derived compounds) can have a positive impact on insect physiology. These compounds can enhance digestion, improve nutrient absorption and stimulate metabolic pathways that lead to better silk production. By incorporating these beneficial compounds into the silkworm diet researchers aim to overcome the limitations of traditional mulberry leaf feeding and optimize the conditions for silk production.

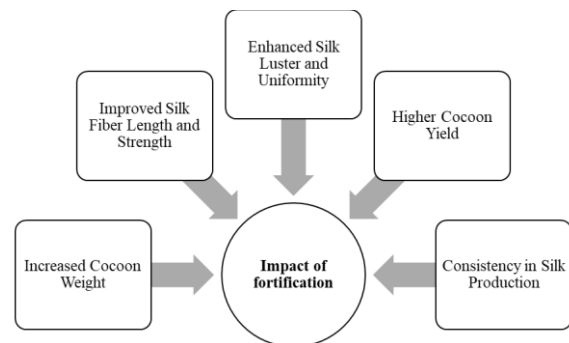


Fig 1: Impact of fortification on Silk Production

Types of Plant Extracts Used in Silkworm Diet Fortification

Several plant extracts have been identified as potential fortifiers for mulberry leaves, each offering unique benefits to silkworm health and silk production. Here are some of the most commonly used plant extracts in silkworm diet fortification:

1. *Ocimum sanctum* (Tulsi) Extract

Tulsi, or holy basil, is revered for its adaptogenic and antioxidant properties. Tulsi extract has been found to improve stress tolerance in silkworms, especially during adverse environmental conditions. This leads to more consistent silk production and higher cocoon yields Vidya Devi & Bai (2015).



2. *Moringa oleifera* Extract

Moringa is a nutrient-dense plant, rich in vitamins, minerals, and essential amino acids. Fortifying mulberry leaves with moringa extract provides a nutritional boost, enhancing silkworm growth rates and increasing silk fiber length and strength (Hassan *et al.*, 2018). Moringa's high antioxidant content also helps protect silkworms from oxidative stress.



3. *Curcuma longa* (Turmeric) Extract

Turmeric is widely known for its anti-inflammatory and antioxidant properties, primarily due to the presence of curcumin. Turmeric extract in silkworm diets can improve immunity and reduce inflammation, leading to healthier silkworms that are less prone to disease. This, in turn, results in better silk quality and higher yields (Garcia *et al.*, 2023).



4. *Trigonella foenum-graecum* (Fenugreek) Extract

Fenugreek is valued for its ability to improve digestion and metabolism. When incorporated into silkworm diets, fenugreek extract enhances the efficiency of nutrient absorption, leading to faster growth and improved silk production. Fenugreek's high protein content also



contributes to stronger and more durable silk fibers.

5. *Withania somnifera* (Ashwagandha) Extract

Ashwagandha is an adaptogen known for its stress-reducing and immune-boosting properties. Including ashwagandha extract in silkworm diets helps silkworms cope with environmental stressors, leading to more stable cocoon yields and improved silk quality (Hajam *et al.*, 2024).

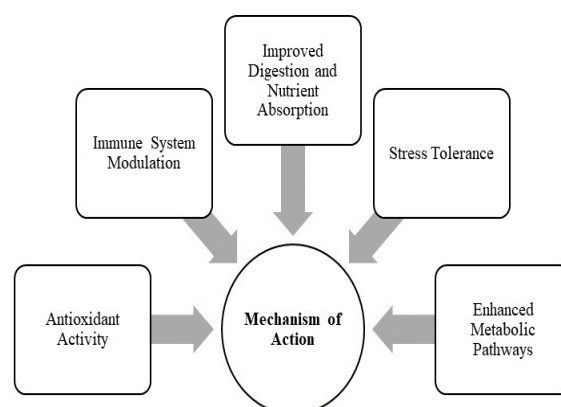


Fig 2: How Plant Extracts Enhance Silkworm Health

Practical Implications for Sericulture Farmers

- 1. Cost-Effectiveness:** While the initial cost of sourcing plant extracts may be a concern, the long-term benefits of improved silk yields and quality can offset these expenses. Farmers should assess the cost-effectiveness of dietary fortification by comparing the additional investment with the expected increase in income from higher silk production.
- 2. Availability of Plant Extracts:** The availability of plant extracts can vary depending on the region and season. Farmers may need to explore local sources

or collaborate with suppliers to ensure a consistent supply of high-quality extracts for fortification.

- 3. Dosage and Application Methods:** Determining the optimal dosage and application methods for plant extracts is crucial for achieving the desired results. Farmers may need to experiment with different concentrations and feeding schedules to find the most effective approach for their specific conditions.
- 4. Training and Extension Services:** To successfully implement dietary fortification, farmers may benefit from training programs and extension services that provide guidance on best practices. Agricultural extension agencies and research institutions can play a vital role in disseminating knowledge and supporting farmers in adopting these innovations.
- 5. Scaling Up and Commercialization:** For large-scale sericulture operations, the scalability of dietary fortification practices is an important consideration. Commercialization of fortified mulberry leaf products could provide a convenient option for farmers who prefer ready-to-use solutions.

Case Studies:

Several case studies have demonstrated the positive impact of dietary fortification on silkworm health and silk production. These studies demonstrate the importance of nutrition and fortification in sericulture:

- 1. Fortification with *Parthenium hysterophorus* L., *Phyllanthus niruri* Hook, and *Psoralea coryleifolia*:** In a study by (Gobena and. Bhaskar 2015), researchers investigated the impact of fortifying M5 mulberry leaves with botanical extracts on silkworm (*Bombyx mori* L.) growth and commercial traits. Three botanicals *Parthenium hysterophorus* L., *Phyllanthus niruri* Hook, and *Psoralea coryleifolia* were tested along with two controls. Feeding silkworms with fortified leaves led to better larval growth and development, resulting in significantly improved economic traits such as cocoon weight, filament length, and silk productivity.
- 2. *Aloe vera*, *Ocimum sanctum*, and *Withania somnifera* Extracts:** Another study by (Hajam et al., 2024) explored the effects of feeding silkworms fortified mulberry leaves with extracts from *Aloe vera*, *Ocimum sanctum* (holy basil), and *Withania somnifera* (ashwagandha). These plant extracts were added to the diet to enhance cocoon production. The results highlighted the positive influence of these extracts on silkworm biology and silk production.
- 3. Natural (Bee Honey) and Synthetic (Pharovit Iron) Fortification:** In a different investigation, (Khedr et al., 2013) fortified mulberry leaves with natural (bee honey) and synthetic (Pharovit iron) multivitamin sources. They examined the impact on larval, cocoon, shell, and pupal weight, filament length, and the number of breaks during reeling. This study sheds light on the potential benefits of fortification for silk production.

Challenges and Future Directions

- 1. Standardization and Quality Control:** Ensuring the consistency and quality of plant extracts used for fortification is critical. Variability in extract composition can lead to inconsistent results, making it important to establish standardized protocols for extraction and application.
- 2. Research and Development:** Continued research is needed to identify new plant

extracts with potential benefits for silkworms, as well as to refine existing practices. Collaboration between research institutions, government agencies, and the private sector can drive innovation and support the development of more effective fortification strategies.

- 3. Awareness and Education:** Raising awareness among sericulture farmers about the benefits of dietary fortification is essential for promoting adoption. Educational campaigns, workshops, and demonstration projects can help bridge the knowledge gap and encourage farmers to embrace this practice.
- 4. Environmental Sustainability:** As with any agricultural practice, the environmental impact of dietary fortification must be considered. Sourcing plant extracts in a sustainable manner and minimizing waste are important for ensuring that fortification practices support broader sustainability goals.

CONCLUSION

The fortification of mulberry leaves with plant extracts represents a promising approach to enhancing silkworm health, improving silk quality and increasing cocoon yields. This innovation has the potential to revitalize the sericulture industry offering farmers a practical and effective way to boost productivity and income. As the sericulture sector continues to explore and adopt these practices, the future of silk production in India and beyond looks brighter than ever. The key to success lies in continued research, collaboration, and a commitment to innovation. By harnessing the power of nature through plant extracts sericulture can evolve into a more sustainable and resilient industry capable of meeting the demands of a growing global market.

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