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# Biotechnological Advances in Tasar Silkworm Breeding

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**Abstract**

Tasar silk, primarily produced by the non-mulberry silkworm species *Antheraea mylitta*, is known for its coarse texture, strength, and natural golden-brown hue. Unlike mulberry silkworms, Tasar silkworms are semi-domesticated and require specific forest-based ecological conditions, making their breeding more challenging. Recent advances in biotechnology are addressing issues related to genetic improvement, disease resistance, and increased productivity in Tasar silk production. This article explores these advances and highlights the role of molecular biology, genomics, and tissue culture techniques in enhancing Tasar silkworm breeding practices.

**Introduction**

Tasar silk is a wild variety of silk that originates from the non-mulberry silkworm *Antheraea mylitta*, which thrives in forested areas, feeding primarily on host plants like *Terminalia arjuna*, *Terminalia tomentosa* and *Shorea robusta*. Tasar silk is largely produced in India, which holds approximately 80% of the global Tasar silk production (Sarkar et al., 2017). Unlike mulberry silk, Tasar silk cultivation poses unique challenges due to the limited control over environmental factors affecting the silkworm. Biotechnology presents opportunities to improve productivity, disease resistance, and overall quality of Tasar silk through genetic intervention, breeding programs, and pest management strategies.

**Biotechnological Approaches in Tasar Silkworm Breeding:**

1. **Genomics and Genetic Mapping:** Genomics has provided new insights into the Tasar silkworm's genetic makeup, allowing scientists to identify genes associated with

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desirable traits such as enhanced silk production and disease resistance. Advances in sequencing technology have enabled the development of the *Antheraea mylitta* genome map, facilitating molecular breeding efforts (Deepika et al., 2024). Using single nucleotide polymorphisms (SNPs), researchers can now select and breed silkworm strains with optimal traits, which aids in producing stronger and more resilient silkworm populations (Renuka et al., 2018).

2. **Genetic Modification and CRISPR Technology:** The CRISPR-Cas9 system, a revolutionary gene-editing tool, has been employed in silkworms to modify specific genes for increased silk production. While CRISPR applications in mulberry silkworms (Bombyx mori) are well-documented, researchers are now exploring its potential for Tasar silkworms (Omollo et al., 2021). By selectively targeting genes that control cocoon size and silk fibroin production, CRISPR technology can enhance silk yield, quality, and uniformity in Tasar silkworms.
3. **Marker-Assisted Selection (MAS):** Marker-assisted selection (MAS) is a valuable method for accelerating breeding programs in Tasar silkworms. MAS utilizes molecular markers to track beneficial traits at the genetic level. The process involves the identification of DNA markers linked to traits like heat tolerance, pest resistance, and increased silk productivity (Maheswari et al., 2023). According to Esfandiari et al. (2011), MAS has enabled scientists to develop hardier Tasar silkworm strains that can withstand environmental stress, resulting in higher silk yields and more resilient silkworm populations.
4. **Tissue Culture and Cellular Biotechnology:** Recent studies have shown the feasibility of using tissue culture in sericulture for the propagation of healthy silkworm tissue, which aids in the rapid multiplication of Tasar silkworms. Tissue culture techniques, specifically in vitro culturing, allow for the study of silkworm cell response to pathogens, leading to the development of disease-resistant strains. Experiments by Neshagaran et al. (2014) reveal that tissue-cultured Tasar silkworm larvae exhibit enhanced immunity against Nosema infections, a common pest in sericulture.
5. **Pathogen Detection and Disease Management;** Biotechnology plays a crucial role in monitoring and managing Tasar silkworm diseases, such as flacherie, pebrine, and grasserie. Advances in molecular diagnostics, including PCR and ELISA tests, enable

early detection of pathogens in Tasar silkworm populations (Mundkur & Muniraju, 2018; Buhroo et al., 2019). The development of diagnostic kits to detect pathogens at an early stage has significantly reduced the mortality rate in Tasar silkworm colonies and helped maintain high silk yields. Furthermore, RNA interference (RNAi) has shown promise as a potential strategy for controlling silkworm-specific viral infections by targeting viral mRNA sequences (Kumar et al., 2023).

**Applications and Future Perspectives**

The integration of biotechnological tools in Tasar sericulture offers promising applications for future production and quality control. However, due to the semi-domesticated nature of Tasar silkworms and their dependence on specific forest ecosystems, conservation-based breeding practices should be emphasized. Future research should focus on improving genetic resources, developing hybrid strains with enhanced characteristics, and ensuring sustainable rearing practices.

Additionally, public-private partnerships and government support for biotechnological research in Tasar sericulture could foster innovation and increase the adoption of these advances among rural farmers. Collaboration among research institutions, industry stakeholders, and sericulture farmers is essential to enhance the global competitiveness of Tasar silk while preserving ecological balance.

**Conclusion**

Biotechnological advances offer significant potential for transforming Tasar silkworm breeding by addressing the challenges of disease, productivity, and environmental dependency. Genomic research, genetic modification, and diagnostic innovations have paved the way for more efficient and sustainable Tasar sericulture practices. As research progresses, biotechnology will continue to play a critical role in preserving the cultural heritage of Tasar silk production while advancing it into modern textile markets.

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