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Scope of Utilizing Tropical Tasar (*Antheria mylitta* Drury) Pupal Waste for the Mass Production of Microbial biopesticides

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Introduction

Silk production, one of the oldest agro-based industries, produces valuable silk fibers alongside large quantities of biomass waste. Tropical Tasar silk, in particular, is a non-mulberry silk variety primarily produced in India. The main by-product of this industry is tasar pupal waste, consisting of the pupae left behind after silk extraction in the reeling industry. With increasing focus on sustainable agricultural practices and waste reduction, there is an opportunity to explore innovative uses of tasar pupal waste, particularly in the mass multiplication of biopesticides.

Microbial biopesticides are natural biopesticides, derived from microorganisms such as bacteria, fungi, viruses or algae that are used to control pest populations in agriculture, horticulture and forestry. These biopesticides are an important component of Integrated Pest Management (IPM), and are considered an environmentally friendly alternative to chemical pesticides because they target only specific pests and leaving beneficial organisms, such as pollinators or other non-target species unaffected, and do not leave harmful residues. However, the large-scale production of biopesticides faces challenges related to substrate availability and cost. Utilizing tasar pupal waste as a substrate for microbial growth provides a sustainable, cost-effective alternative, creating an additional economy within the silk industry.

Tasar pupal waste and its nutritional potential

India is the largest producer of tropical tasar silk in the world earning about 15 – 40 crore rupees of foreign exchange. In India, tasar culture is practiced by nearly 3 lakh tribal

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families in the states of Jharkhand, Chattisgarh, Odisha, Andhra Pradesh, Telangana, Uttar Pradesh, Maharashtra, Madhya Pradesh, bihar and West Bengal producing around 2000-2300 million cocoons annually. So, the annual pupal waste generation by the reeling industry would be around 16000-18000 metric tons, considering the average pupal weight of 8 gms. Considering the current annual consumption of 8000 metric tons of biopesticides in India and its expanding trend in market size, there is a huge scope to divert and utilize the tasar pupal waste for the mass production of microbial biopesticides.

Tropical Tasar pupae are a rich source of proteins, fats, minerals, and both water- and fat-soluble components all of which can support microbial growth and metabolism. The proximate biochemical composition of 100 gm of tasar pupal waste powder is as follows.

Biochemical Component	**Quantity**
Moisture	11.23 %
Crude Protein	60.67 %
Fat	23.83 %
Carbohydrate	3.29 %
Ash	5.1 %
Chitin	3.87 %
Magnesium	208 mg
Calcium	48 mg
Iron	38 mg
Tocopherol	13 µg
Ferulic Acid	1317 µg
p-coumaric acid	730 µg
Flavonoids catechin	41 µg
Myricetin	12.5 µg
Palmitic Acid	6.6 mg

This nutrient rich profile of Tasar pupal waste makes it ideal candidate for use as a substrate in biopesticide production with proper modifications and standardization according to the different biopesticidal agent.

Targeted microbial biopesticides for mass production using tasar pupal waste.

There are several species of viruses, bacteria, fungi that can serve as potential biopesticides. However, the mass production of viruses are carried our using specific living hosts. Hence, the tasar pupal waste could be targeted to produce bacterial and fungal

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biopesticides considering their growth requirements. Some of the well known bacterial and fungal biopesticides are listed below in the table.

Microbial biopesticides	Target pest
Bacterial	
Bacillus thuringiensis subsp. *aizawai*	Lepidoptera
B. thuringiensis subsp.*israelensis*	Diptera
B. thuringiensis subsp. *kurstaki*	Lepidoptera
B. thuringiensis subsp. *tenebrionis*	Coleoptera
Paeniacillus popillae	Japanese beetle
Fungal	
Beauvaria bassiana	Coleopterea
Metarhizium anisopliae	Coleoptera, Diptera, Hemiptera, Isoptera
Hirsutella thompsonii	Acarida
Paecilomyces lilacinus	Plant parasitic nematodes
Nomureya rileyi	Lepidoptera

Challenges in the Use of Tasar Pupal Waste for Biopesticide Production

Despite its potential, several challenges must be addressed to effectively utilize tasar pupal waste in biopesticide production:

- **Standardization of Substrate Processing**: Pupal waste needs to be processed to ensure it is free of chitin and other contaminants and is consistent in composition. Processes such as sterilization and homogenization are required, which may add to production costs.
- **Quality Control and Product Stability**: Consistent quality is crucial for biopesticide effectiveness. The degradation of organic matter in pupal waste over time may affect microbial growth, necessitating research into preservation techniques for prolonged storage.
- **Regulatory Compliance**: The use of organic waste in biopesticide production must comply with regulatory standards to ensure safety for agricultural application. This includes stringent testing for any residual pathogens or harmful contaminants.

Scaling up the utilization of tasar pupal waste

Scaling up the utilization of Tasar pupal waste is necessary to overcome the challenges. This includes optimization the composition of tasar pupal waste for each microbial species to enable their optimum growth. This may involve adjusting nitrogen, carbon, or mineral contents to enhance microbial growth. Additionally Standard protocols for processing tasar pupal waste and cultivating microbial biopesticides can aid in commercial scalability. Protocols should focus on sterilization methods, nutrient supplementation, and growth conditions specific to each biopesticidal organism. Finally, the Pilot-scale production can help assess the economic feasibility and logistical requirements of using tasar pupal waste on a commercial scale. This phase will also help determine optimal storage conditions and identify potential challenges in biopesticide formulation.

Conclusion

The utilization of tropical tasar pupal waste for the mass production of microbial biopesticides presents a promising, sustainable solution to both by-product utilization in the silk industry and the growing demand for eco-friendly pest control. With its rich nutritional profile, including high levels of protein, fats, and essential minerals, tasar pupal waste can serve as an excellent substrate for the growth of bacterial and fungal biopesticides. The integration of this waste into biopesticide production offers a dual benefit i.e. generating circular income from the silk industry while supporting the growing market for biological pest management in agriculture. However, challenges such as substrate standardization, quality control, and regulatory compliance must be addressed through further research and process optimization. By overcoming these hurdles and scaling up production, tasar pupal waste can become a valuable resource in the biopesticide industry, contributing to sustainable agricultural practices and adding economic value to the silk sector.

References:

Ananta, S., Jena, K., Das, S., Singh, J., Sinha, A., & Sathyanarayana, K. (2023). Evaluation of proximate compositions and profiling of nutritional aspects in pupae of tasar silkworm *Antheraea mylitta* (Drury) as potential for food and feed resources. *Journal of Environmental Biology*, *44*, 485-490.

Arjjumend, H., & Koutouki, K. (2018). Science of biopesticides and critical analysis of Indian legal frameworks regulating biocontrol agents. *International Journal of Agriculture, Environment and Biotechnology*, *11*(3), 579-587.

Chakraborty, N., Mitra, R., Pal, S., Ganguly, R., Acharya, K., Minkina, T., Sarkar, A. & Keswani, C. (2023). Biopesticide consumption in India: insights into the current trends. *Agriculture*, *13*(3), 557.

Rai, S. (2022). Trend of tasar silk industry in India - A statistical approach. *Plant Archives, 22,* 265-273.