International Journal of Education and Science Research Review
IJESRR
E-ISSN 2348-6457
Jan-Feb- 2019, Volume-6, Issue-1
P-ISSN 2349-1817
www.ijesrr.org
Email- editor@ijesrr.org

BIOCHEMICAL ANALYSIS OF TASAR SILK HOST PLANT IN ACHANAKMAAR BIOSPHERE RESERVES

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Abstract

The Antheraea mylitta silkworm, which is responsible for the production of Tasar silk, is dependent on host plants for its food. This has a substantial impact on both the quality and output of the silk. This study focuses on the biochemical examination of major host plants that may be found in the Achanakmaar Biosphere Reserve, which is an important forest environment in India. For the purpose of this investigation, the principal host plants, Terminalia tomentosa (Asan) and Terminalia arjuna (Arjun), were chosen because of the significance they play in sustaining the lifecycle of the silkworm. The concentration of proteins, carbohydrates, amino acids, lipids, and other critical micronutrients that are found in the leaves of these plants are among the biochemical markers that are evaluated. The secondary metabolites, which include phenols, tannins, and flavonoids, are also evaluated in this study. These metabolites have an impact on the feeding behavior of the silkworms as well as their comprehensive health. In order to get a better understanding of the function that these plants play in the production of sericulture, the biochemical makeup of these plants at different times of the year and under varied environmental circumstances in the reserve was investigated. The nutritional profile of T. tomentosa and T. arjuna appears to have a considerable impact on the growth rate of the silkworms as well as the quality of the silk that they produce, according to the preliminary findings. It was discovered that the presence of secondary metabolites, in particular phenolic compounds, increased the silkworms' resilience to illnesses. As a result, these plants are essential for the production of tasar silk in a sustainable manner. In addition, the research highlights the significance of preserving the biological equilibrium of the biosphere reserve in order to protect the indigenous flora, which in turn helps to sustain the sericulture sector. The findings of this study add to a more comprehensive knowledge of the ways in which the biochemical characteristics of host plants impact the production of tasar silk. These findings also provide insights that may be used to improve sericulture techniques and preserve biodiversity in the Achanakmaar Biosphere Reserve.

Keywords: *Tasar Silk , Host Plant, Achanakmaar*

Introduction

Tasar silk is a wild form of silk that is largely generated by the Antheraea mylitta silkworm. This particular silkworm feeds on certain forest-based host plants. There is a significant relationship between the nutritional makeup of the leaves that these silkworms ingest and the quality and production of the silk that they produce. Terminalia tomentosa (Asan) and Terminalia arjuna (Arjun) are two of the most important host plants because they supply the silkworms with the critical nutrients that are necessary for their growth and development. The native habitat of tasar silk host plants may be found within the Achanakmaar Biosphere Reserve, which is situated in the central region of India. This sanctuary is home to a diverse array of plant life. Because of its varied climatic conditions, extensive forest cover, and protected setting, the reserve is an ideal location for gaining an understanding of the biological interactions that exist between silkworms and the plants that they feed on. In light of the fact that tasar silk is becoming increasingly significant in both conventional textile businesses and rural economies, it is necessary to investigate the biochemical makeup of the plants that are responsible for the maintenance of this type of sericulture. Previous research has shed light on the significance of basic metabolites, which include proteins, carbohydrates, and lipids, as well as secondary metabolites, which include phenols and flavonoids, in the development of silkworms and their resistance to illness. The peculiar biochemical characteristics of T. tomentosa and T. arjuna inside the one-of-a-kind habitat of the Achanakmaar Biosphere Reserve have, however, been the subject of a limited amount of research. In order to address this deficiency, the purpose of this work is to carry out a comprehensive biochemical examination of the leaves of these important host plants. We are attempting to get an understanding of the ways in which the nutritional quality of these plants influences the lifespan of the silkworms and, as a result, the quality of the tasar silk by conducting an analysis of a number of different biochemical characteristics. These factors include the quantities of proteins, carbohydrates, amino acids, and secondary metabolites. Furthermore, this research will assist in understanding the seasonal fluctuations in the nutritional content of the host plants, which is essential for improving sericulture methods. This research will be of great assistance in this endeavor. Not only is it essential to have a better understanding of the relationship between host plants and the production of tasar silk in order to improve the quantity and quality of silk, but it is also essential for assuring the preservation of ecological variety inside the biosphere reserve. As a result, this study highlights the necessity of environmentally responsible methods in the sericulture industry that are in line with the efforts being made to preserve the ecosystem in the Achanakmaar Biosphere Reserve. The production of tasar silk is supported by the mutually beneficial interaction that exists between Antheraea mylitta and the plants that serve as its hosts. There are several elements of silkworm physiology that are influenced by the nutritional value that is received from the host plants. These characteristics include the growth rate, the development of the larvae, the quality of the cocoon, and the tensile strength of the silk thread. Because of this, gaining a knowledge of the biochemistry of host plants is not only of ecological interest but also of economic significance, particularly for rural populations who are engaged in the practice of sericulture. The Achanakmaar Biosphere Reserve provides a one-of-a-kind chance to investigate these processes in an ecosystem that is generally untouched by human activity. The reserve, with its abundant biodiversity and good climatic circumstances, serves as an excellent ecosystem for the purpose of investigating the ways in which local elements such as soil fertility, rainfall, temperature, and seasonal fluctuations impact the biochemical characteristics of the plants that serve as hosts. The purpose of this study is to give useful insights for enhancing sericulture results, not only in Achanakmaar but also in other places that produce tasar silk. This will be accomplished by determining how these variables impact the nutritional profile of T. tomentosa and T. arjuna. One of the most important factors that determines the health and production of silkworms is the biochemical content of the plants that they feed on. Primary metabolites, which include proteins and carbohydrates, supply the essential nutrients that are required for growth and the production of silk. Secondary metabolites, which include phenols, tannins, and flavonoids, play important roles in the mechanisms that plants use to defend themselves against disease and provide silkworms with enhanced disease resistance and survival mechanisms. Due to the fact that these secondary metabolites can also have an effect on eating behavior and digestion, it is vital to find the optimal balance between the availability of nutrients and the metabolic defense molecules that are present in the leaves. The purpose of this research is to analyze both primary and secondary metabolites of T. tomentosa and T. arjuna, with the objective of determining the function that these metabolites have in enhancing the production of tasar silk. In addition, the research will investigate the seasonal fluctuations in the biochemical characteristics of these plants. This will provide a full understanding of how environmental conditions influence the quality of the host plants and how well they are suited to the maintenance of silkworm populations. Through the process of correlating these biochemical characteristics with the performance of silkworms in terms of growth, survival, and silk yield, our objective is to make suggestions that are driven by data in order to significantly improve silk production. Furthermore, the findings of this study will assist in the identification of optimal practices for the sustainable management of the populations of host plants, which are essential for the continued viability of the tasar silk business over the long term. In conclusion, the findings of this study emphasize the need of combining ecological preservation with economic growth. This would ensure that the sustainable utilization of forest resources would be beneficial to both the preservation of biodiversity and the survival of local communities.

Figure 1: a) Tasar silkworms on the Arjuna tree, b) Tasar Cocoons, c) Tasar RawSilk.

In its natural state, the tropical tasar silkworm is a polyphagous insect. It has 51 host plants and based on the feeding preferences or rearing performance (Jolly et al., 1974), these are broadly divided into primary (Terminalia arjuna, Terminalia tomentosa, & Shorea robusta), secondary (Anogeissus latifolia, Hardwickia binata, Lagerstroemia parviflora, Ziziphus jujuba, & Ziziphus mauritiana), and tertiary food plants (Artocarpus lacucha, Bauhinia variegata, Bombax ceiba, Buchanania latifolia, Canthium didymium, Careya arborea, Carissa carandas, Celastrus paniculatus, The swietenia of chloroxylon, The species Cipadessa fruticosa, Dalbergia sissoo, Diospyros melanoxylon, and Dodonaea viscosa are commonly used. There is Emblica officinalis. The species of ficus benghalensis, ficus benjamina, ficus hispida, ficus religiosa, ficus retusa, ficus tsjahela, and ficus tsiela are all included in this group. Lucida Gardenia, plant Garuga pinnata, often known as Lagerstroemia indica, Lagerstroemia speciosa, Madhuca indica, Melastoma malabathricum, Mesua ferrea, Mimusops elengi, Prunus domestica, Pterocarpus marsupium, Rhizophora caseolaris, Semecarpus anacardium, Shorea talura, Syzygium cumini, Syzygium jambos, Tectona grandis, Terminalia bellirica, Terminalia catappa, Terminalia chebula, Terminalia paniculata, Ziziphus rugosa, and Ziziphus xylopyrus are some of the species that have been identified. On the other hand, cocoon crop performance was investigated by means of several rearings of A. mylitta D. larvae on primary and secondary food plants. The findings of this research led to the conclusion that the number and quality of cocoons produced by secondary food plants were much lower than those produced by primary food plants (Dash et al., 1992). Therefore, T. arjuna and T. tomentosa are the principal host trees for the propagation of tropical tasars in India for commercial purposes. Between T. arjuna and T. tomentosa, it is estimated that around 11.6 million hectares of forest area in India are inhabited by these two species. According to Suryanarayana et al. (2005), both species are able to tolerate a broad range of environmental conditions, including drought, alkalinity, and salt, and they are able to grow well even on marginal terrain. In addition, sal woods serve as a foundation for the gathering of a substantial number of naturally developed cocoons. These cocoons are routinely gathered from the sal forests of central India by tribal populations that are located in close proximity to the forests (Roychoudhury et al., 2011). On the other hand, the rearing performance of silkworms on Lagerstroemia speciosa was shown to be equivalent with that of T. tomentosa and T. arjuna, which are species of food plants. This was measured in terms of the number of cocoons produced per disease-free laying (DFL) and the silk ratio. The physiological and biochemical properties of these three plant species were superior to those of Terminalia bellirica, Terminalia chebula, and Lagerstroemia parviflora when it came to supporting the raising of silkworms. Lagerstroemia speciosa is being considered for use as an alternative food plant for tasar silkworm raising, according to the findings of a correlation research that was conducted between the performance of silkworm rearing and the contents of the food plant (Deka et al., 2015). In addition, Lagerstroemia speciosa is effortlessly propagated through the use of cuttings and coppices without any restrictions. Because the top of the tree is bushy and wide, it is considered to be more ideal for the breeding of silkworms. Furthermore, T. arjuna and T. tomentosa are slow-growing plants, and it takes a minimum of four or five years after plantation to begin silkworm rearing on these plants. This makes it difficult to cultivate silkworms on these plants. On the other hand, it has been discovered that silkworm raising may begin on the leaves of L. speciosa after two to three years of plantation, and that L. speciosa plants can successfully support two consecutive rearings. On the other hand, T. arjuna and T. tomentosa are only capable of supporting one rearing each year (Gargi et al., 2015).

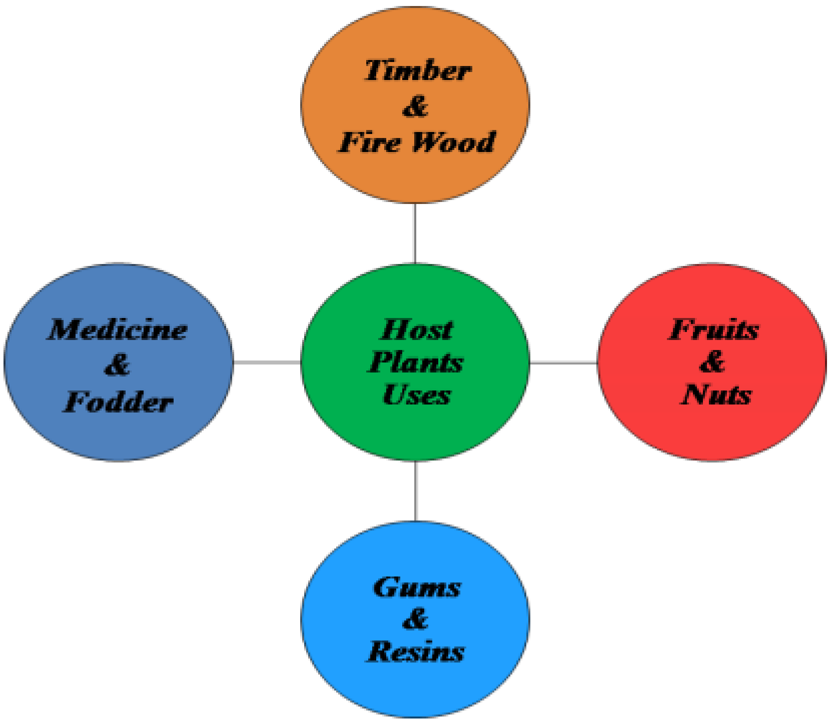

Figure 2: Tasar host plants have a variety of applications.

There are a number of factors that determine the economic viability of A. mylitta D., including the leaf quality, production rate, and gestation duration of various forest host plants. According to Singhvi (2014), the nutritional content of the plants that tasar silkworms consume determines both the quality and amount of the silk that they produce. The weight gain of larvae, the proportion of larvae that survive, the growth index, the weight of pupae, the emergence of adults, and fertility are all influenced by the host plants, according to the findings of a number of studies (Sinha and Chaudhury, 1992). According to Sinha et al. (2000), the nutritional content of leaves has a direct correlation with the growth and development of tasar silkworm larvae as well as the economic aspects of cocoons. The presence of high-quality leaves is indicative of a higher likelihood of obtaining high-quality cocoon harvests. Among the significant aspects that contribute to the success of tasar crops, Sahay et al. (2001) found that leaf quality is one of the most important influences. As a result, the primary goals of tasar host plant breeding are to achieve increases in nutritional content, a decrease in the gestation period, and the creation of dwarf plants in host trees. The improvement of host plants via the collection, characterisation, and assessment of novel germplasm accessions, as well as the exploitation of these accessions in breeding programs, will assist in the improvement of the genetic basis of the host plants that are now accessible (Tikader et al., 2013). There are a total of 341 accessions that are being maintained by the Central Tasar Research and Training Institute (CTRTI), which is located in Ranchi. Out of these, 190, 94, 22, 17, 04, 03, 04, 06, and 01 are in the species of T. arjuna, T. tomentosa, T. belerica, T. chebula, T. myriocapra, L. indica, L. parviflora, L. speciosa, and Anogeissus latifolia, respectively. Characterization and assessment of a systematic nature are now being carried out at CTRTI, Ranchi. A Terminalia (section: Pentaptera) has been developed for the purpose of descriptor recording. This was done on the basis of observations that were made on 130 accessions that were collected from Central India (Srivastav et al., 1997). For the purposes of characterisation and assessment, a minimum descriptor is provided to capture the data in relation to physical characteristics (five descriptors), reproductive characteristics (seven descriptors), growth characteristics (seven descriptors), biochemical characteristics (five descriptors), biotic stress (one descriptor), and miscellaneous characteristics (two descriptors) (Kumar et al., 2002). The fundamental strategy for forest tree enhancement involves selecting superior parent trees and assembling them as clones in seed orchards in particular designs. This is done in order to maximize the amount of cross-pollination that occurs between the various clones and to minimize the amount of inbreeding that occurs. Inter-provenance hybrids and inter-specific hybrids are also utilized in exceptional circumstances, as stated by Kedharnath (44) in his work.

GENETIC RESOURCES, GENETICS AND BREEDING IN THE PRIMARY HOST TREES OF TASAR SILKWORM (ANTHERAEA MYLITTA D.).

Arjuna (Terminalia arjuna (Roxb) Wight & Arn)

Arjuna tree is Terminalia arjuna (Combretaceae). According to Orwa et al. (2009), this fast-growing deciduous tree species has great economic potential in wood, pharmaceutical, paper, tannin, soap, dye, match, food, fodder, and fuel sectors. T. arjuna is found in woodland streams, ravines, and river banks from Oudh to the peninsula and Sri Lanka, through Bihar, Orissa, Madhya Pradesh, and Karnataka. Champion and Seth (1968) describe it as a tree of dry tropical riverain forests and riparian fringe woods. It is a major species in Saurashtra's Gir forests (Luna, 1996). T. arjuna is 20-25 meters tall, has a buttressed trunk, and has thick, smooth, grey or pinkish-green bark that exfoliates in thin irregular flakes. Its large crown canopy has downward-sloping branches (Biswas et al., 2011). Leaves are simple, alternating, or first pair subopposite, exstipulate. Flattened, pubescent, 0.2-0.3 inch petiole with 2 (or 1) conspicuous glands.at petiole apex. Lamina 2.4-4.0 inches long, elliptical lanceolate, sharp apex and base, broadly serrulate, sparsely pubescent or glabrous on top, sub-arcuate venation, 8-12 pairs of lateral veins. It grows from seed or cuttings. T. arjun is propagated by seeds, cuttings, or air layering. The size of T. arjuna seeds affects germination. Large seeds germinate somewhat better than little ones (Kumar et al., 2017a). Terminalia arjuna has 2n=24 chromosomes and 7.13 pg 2C nuclear DNA (Ohri and Kumar, 1996). Wild and farmed trees have 12 bivalents and normal meiosis.

Some central Indian plants contain two Bchromosomes but seem the same. Trees with and without B-chromosomes have approximately 100% pollen fertility. The pollen size was 16-18 µm. Gill et al. (1982) discovered Bchromosomes in T. arjun's wild population. Terminalia arjuna blooms April–July. Each hermaphrodite, actinomorphic, epigynous flower contains one gamotepalous perianth whorl. Pendulous terminal and axillary spikes carry them. Flowers bloom daily from 05:00 to 06:30 hours and anthesis occurs throughout the day. Honeybees, butterflies, wasps, flies, ants, and sunbirds forage. Yellow, medium, spherical pollen grains have tri zonocolporate apertures and smooth exines. Pollen:ovule ratio is 15,400:1. The best germination is in BBM + 12.5% sucrose. After 16 hours of anthesis, pollen grains die and fruit set fails. Natural fruit set is 48%. Wind and birds spread winged, woody fruits (Chauhan et al., 2008). In the T. arjuna X T. tomentosa combination, fruit initiation took 10 (Acc.701 X Acc.501) to 14 (Acc.533 X Acc.531) days, and fruit set was 1.5 to 2.4 percent (Gargi et al., 2015). Floral biology helps explain T. arjuna pollen-pistil interactions, gene flow, and heterozygosity (David et al., 2012). Terminalia arjuna outcrosses owing to andromonoecy and its showy and big stamens, which attract pollinators (Singh and Wani, 2018). Therefore, accessions included most of the genetic variation. T. arjuna accessions have strong cross-pollination, allowing gene flow between nearby accessions without impacting the gene pool (Kumar et al., 2018). Fruiting behavior suggests facultative xenogamy, however this species generally removes self-pollinated flower fruits. The facultative breeding strategy helps T. arjuna colonize by self-pollinating fruit (Chauhan et al., 2008). Small T. arjuna populations with minimal genetic diversity may have genetic drift, severe inbreeding depression, and low evolutionary potential, resulting in lower fruit/seed set (Singh and Wani, 2018). T. arjuna's leaf morphology may be due to genetic differences produced by adaptation to varied environmental circumstances (Wani and Singh, 2016). More genetic diversity is inside T. arjuna than between populations. Understanding T. arjuna's population genetic structure can help enhance and conserve its genetics (Singh and Wani, 2018). T. arjuna has high heritability, genetic advance, and genetic coefficient of variation for seedling height, indicating additive gene action, but half-sib seedlings have low GCV, low genetic advance, and high heritability for remaining leaf characters, indicating intra and inter-allelic interaction. Candidate plus tree progenies vary in fresh and dried shoot/root weight, plant height, bark content, and total biomass (Kumar et al., 2017b). The highest genotypic coefficient of variation is for leaf yield followed by number of leaves per branch, and the highest phenotypic coefficient is for leaf yield followed by breadth. Plant height is more heritable, followed by branch leaves. In T. arjuna, leaf yield, branch number, and plant height are efficient selection factors (Siddiqui et al., 1993). T. arjuna and T. tomentosa can hybridize. Inter-specific hybridization creates higher-yielding hybrid cultivars (Gargi et al., 2015). The Central Tasar Research and Training Institute (CTRTI), Ranchi, developed and tested 62 T. arjuna-T. tomentosa hybrids. These hybrids were rich in protein, glucose, and chlorophyll. After calculating leaf quantitative and biochemical traits, the best five hybrids from each batch grown in various years are chosen for field traits. Besides leaf biochemistry, hybrids are analyzed with RAPD and ISSR primers. One of the UBC primers bands the hybrid and parent DNAs well. Chloroplast (cpDNA) and mitochondrial (mtDNA) gene-specific primers must validate this. Accessions No.523 and No.525 of T. arjuna had greater stress tolerant indexes and improved plant development, physiological, and biochemical features (CTRTI Annual Report, 2017 & 2018). Terminalia sp. hybrids with high leaf yield, moisture, chlorophyll, protein, carbs, and phenol are best for tasar silkworm feeding (Manjappa et al., 2018). The CTRTI, Ranchi developed a tetraploid T. arjuna genotype boasting thick lamina (442.75 µm) and better leaf quality (77.36% moisture, 20.68 mg/g leaf protein, 3.54 mg/g total chlorophyll) than the control (284.62 µm thickness, 74.32% moisture, 14.64 mg/g protein, and 2.05 mg/g total chlorophyll).

The 60 Co source induces mutation in T. arjuna seeds with gamma radiation from 0 to 200 Gy. Comparison of gamma radiation's effects on growth and biochemical components with control plants. At 25 Gy, germination speed is 0.65, twice that of unirradiated seeds. Lower radiation doses promote germination, vigour index, and dry weight growth. Proline levels rose with dosage. At 100 Gy, chlorophyll concentration rose to 12.2 mg/g FW from 8.44 mg/g FW. Phenolic content and radical scavenging ability increase at 25 and 150 Gy. Lower doses of radiation can boost T. arjuna germination, development, and vigor and elevate plant metabolites including proline and phenolics (Akshatha et al., 2013).

Due to the rising demand for drugs, overexploitation by leather and timber industries, indiscriminate tree felling, conversion of forest land into agricultural land, low seed germination, and poor breeding system knowledge, T. arjuna's natural population is declining rapidly (Pandey et al., 2006). The identification of candidate pulse trees (CPT) with higher nutritional and medicinal value and the development of highly efficient methods for micropropagation and conservation of this medicinally valuable plant species are urgently needed. Recent reports describe a T. arjuna seedling and mature tree explant regeneration methodology. T. arjuna micropropagated shoots were initially tested for genetic integrity, synthetic seed generation, and ex vitro rooting. Choudhary et al. (2018) examined how genotypes affect T. arjuna tissue culture.

Asan (Terminalia tomentosa (Roxb) Wight & Arn)

A huge deciduous tree, Terminalia tomentosa (Combretaceae), thrives in damp, thick clayey soil. Its distinctive bark makes it known as 'Asan' and 'Crocodile Bark Tree'. It is a heavily exploited plant in the medicinal, tanning, and lumber sectors. One of the main species in tropical forests from India's southern Western Ghats to northern Himalayas. This huge tree species stores more carbon than others in the nation due to its greater wood density (0.73-0.77 g/cm3) and basal area (Mohanta et al., 2018). Though widespread and dense at adulthood, the plant seldom regenerates in most Indian woods. Therefore, climate change biodiversity protection must include T. tomentosa (Sharma et al., 2018). Terminalia tomentosa has 2n=2x=24 chromosomes, according to Mehara (1976), Gill et al. (1982), and Ohri (1996). It may grow to 30 m tall; its bark is 15-20 mm thick, grey-black, rough, profoundly vertically fissured, horizontally broken, generating tessellated, thick flakes; and its blaze is red. Leaves simple, opposite to subopposite, exstipulate; petiole 10-20 mm long, stout, grooved above, glabrous; lamina 13-20 x 5-13 cm, oblong, oblong-ovate, elliptic-oblong, or elliptic-ovate; base oblique; apex acute, round, or obtuse, margin entire or crenulate, glabrous, coriaceous, midrib with 2 stalked glands near base beneath; lateral nerves 10-20 pairs, parallel, T. tomentosa blooms and fruits in April–May. The inflorescence is axillary spike or terminal panicle. Anthesis and anther dehiscence of greenish-white bisexual flowers are lengthy. The stigma is most responsive on the third day of flowering. The first day of flower opening presents pollen, whereas the next four days leak nectar. Pollen, measuring 12-14 µm, has a prolate spheroidal form, three zonocolporate apertures, and a thin psilate exine (Gill et al., 1982). Hand pollination showed no autogamy or geitonogamy. Xenogamy produced 80% fruit set on day 3 of anthesis. T. tomentosa accessions display early and late flowering genotypes based on reproductive behavior. This species complex produces more blooms than seeds because to genotypic variations.

T. tomentosa regenerates and propagates mostly from seeds. Seed characteristics vary greatly among species from different locales (Kumar et al., 2006). A nursery study of seeds from 10 phenotypically superior T. tomentosa trees by Karoshi and Patil (2000) found variation in seed germination and seedling height development. The progenies of 24 T. tomentosa genotypes and their natural hybrids from Orissa, Madhya Pradesh, and Bihar (India) are evaluated for correlation, path coefficients, and coheritability of plant height, number of branches and leaves/plant, leaf length and width, and leaf yield/plant All six characteristics except plant height have stronger coheritability than heritability alone (Srivastav et al., 1999). 50 T. tomentosa accessions are categorized into 17 morphological traits. Most accessions (45) have upright plant character, whereas 5 have spreading nature. The accessions evaluated had ovate (27), elliptical (16), lanceolate (4), oblique (2), and obovate (1) leaves. Only 2 accessions had glabrous leaves, whereas others exhibited pubescence. All accessions have opposing phyllotaxy. The maximum lamina length is medium, except for 15 big accessions. Twenty-six accessions are medium and fourteen are short inter-nodal. In 42 accessions, leaf moisture is medium and in 3 high. This characterisation will assist identify commercially valuable T. tomentosa accessions for breeding (Kumar et al., 2009). Singh and Wani (2017) evaluated T. tomentosa's germination, growth, and vigor under different gamma irradiation dosages. Increases in germination and development characteristics under lower continuous and fractionated gamma irradiation suggest that lower doses may benefit T. tomentosa's early growth. In contrast, greater levels of gamma irradiation delay germination, development, and vigor, making the tree more sensitive to them.

Fractionated dosages limit germination and growth more than continuous doses. Growth and germination characteristics were most acceptable and enhanced at 10kR continuous dosage. The most sensitive growth characteristics were leaf development and radicle, with LD-50 values varying. The PCA reveals that continuous and fractionated gamma irradiation doses affect Terminalia tomentosa germination and early development (Singh and Wani, 2017).

Sal (Shorea robusta Gaertn. f.)

Shorea robusta (Dipterocarpaceae) is a vital multipurpose tree. It is one of India's primary commercial timbers, collected wild for local use and export. A resin is sold and anoil is used locally and exported in huge amounts. Tannins, edible seeds, and native remedies are also available. Commercial plates and containers are made from the leaves (Timilsina et al., 2007). Its enormous range in India and the sal woods' distinct facies are due to its dominance. In northern and central India, it grows in the Sub-Himalayan area (north of the Gangetic plain) along the Ganga. The SubHimalayan area spans east from 31°N latitude in Punjab to Assam, Uttar Pradesh, Bihar, West Bengal, Nepal, and Bangladesh. The Assam northeastern boundary is Darrang. Balaghat in Madhya Pradesh is its western boundary south of Ganga, expanding south to northern Andhra Pradesh and east via Orissa south of West Bengal and Bihar. It is typically found in Bhabar, Terai, and the foothills running west to east in Nepal (Krishna and Nora, 2006). As the Dipterocarps' northwestern boundary, this species' range is important. The IUCN Red List of Threatened Species (2010) classifies it as 'Least Concern' and propagates largely by cuttings (Kumar et al., 2016). Sal, a moderate to slow-growing deciduous tree, can grow to 30-35 m tall with a trunk diameter of 2-2.5 m. Its clean, straight, cylindrical bole often has epicormic branches, and its crown is spread and spherical. Dark brown, thick bark with longitudinal cracks deep in the poles and shallow in mature trees protects against fire. Simple, glossy, glabrous leaves are 10-25 cm long, 5-15 cm broad, roughly oval at the base, and tapering into a long tip. New leaves are scarlet, then delicate green. It is evergreen in wetter locations but dry-season deciduous in drier areas, losing most of its leaves in February to April and leafing out again in April and May (Orwa et al., 2009). S. robusta has yellow blooms in early summer. Axillary/terminal racemose panicle, 8-25 cm long; flower complete, hermaphrodite, pentamerous, actinomorphic, hypogynous, gamosepalous, polypetalous; stamens abundant, tricarpellary, syncarpous (Srivastav et al., 2005). Thysanoptera insects naturally spread pollen. Previous droughts frequently cause tropical wood genus Shorea to blossom heavily. Starting at age 15, S. robusta yields fruit every 2 years and has good seedbearing years every 3-5 years. Wind and water disperse seeds (Orwa et al., 2009). S. robusta seeds are ovoid (~8mm diameter), weighing up to 2g, with two shorter and three longer wings. The stubborn seeds lose viability within a week of dropping (Tewari, 1995). S. robusta shoots were propagated in vitro on MS medium with growth regulators by Jain and Chaturvedi (2002). In vitro shoot cut ends have produced rhizogenesis. Natural Shorea robusta is diploid (2n=2x=14). The chromosomal length is 1.4-2.8 µm (Roy and Jha, 1965) and the 2C nuclear DNA content is 1.15 pg (Ohri and Kumar, 1986). In 1999, Suoheimo et al. found isoenzyme-based genetic diversity in a wild S. robust population utilizing 12 loci from 8 isozyme systems. The average number of alleles per locus is 2.16, and 58.3% are polymorphic (95%). Pandey and Geburek (2011) examined the genetic diversity and structure at four microsatellites of 15 Nepalese S. robusta populations, including continuous-peripheral and disjunctperipheral populations. In another research, the same authors compared adult and juvenile genetic diversity in a semi-isolated Nepalese S. robusta population (Pandey et al., 2011). Due to significant genetic diversity, restricted gene flow, and genetic differentiation, S. robusta populations need in situ and ex situ conservation. ISSRs are an effective marker technique for measuring genetic diversity in S. robusta populations (Surabhi et al., 2017).

Table 1. Leaf yield of Host plants.

Plant name	Leaf yield/plant (kg)	Remarks	References
Terminalia arjuna	3.79 - 5.56 kg	Six years old	Chakraborty, 2018
Terminalia tomentosa	4.41 - 5.64 kg	Six years old	Singhvi, 2014
Lagerstroemia speciosa	1.50 kg	Two years old	Gargi et al., 2015

Table 2. Nutritive value of the leaves of primary food plants of Tasar silkworm.

Nutritional parameters	Arjuna (*Terminalia arjuna*)	Asan (*Terminalia tomentosa*)	Sal (*Shorearobusta*)	Queen's crepe myrtle (*Lagerstroemiaspeciosa*)
Moisture(%)	71.37	72.86	66.99	69.25
Crudeprotein(%)	11.28	12.17	10.80	11.24
Crudefiber(%)	12.82	16.09	18.50	13.76
Aminoacids(µg/g)	61975	61250	59625	-
Totalsugar(%)	5.70	7.90	5.30	6.80
Reducingsugar(%)	4.30	2.70	4.70	6.10
Totalminerals(%)	6.82	8.08	3.61	-
References	Sinha*et al.*,2005			Gargi*etal.*,2015

Conclusion

The importance of the tasar silk host plants, Terminalia tomentosa and Terminalia arjuna, in supporting the Antheraea mylitta silkworm populations in the Achanakmaar Biosphere Reserve is highlighted by this study, which offers important insights into their biochemical makeup. Biochemical studies have shown that these plants' main and secondary metabolites have a major impact on silkworm development, health, and growth, which in turn affects tasar silk quality and productivity. Based on the results, it appears that proteins, carbs, and amino acids are the main metabolites that silkworms need to thrive and produce silk. Secondary metabolites including flavonoids, tannins, and phenols also improve silkworm disease resistance, which in turn increases silkworm survival and quality. Having the right amount of each chemical is essential, though, because too many secondary metabolites might affect digestion and eating habits. Adaptive sericulture procedures that match with environmental changes are even more important when considering the seasonal fluctuations in the nutritional profile of these host plants. To maintain constant and high-quality silk production all year round, it is important to understand these seasonal fluctuations so that host plant resources may be effectively managed. The significance of combining sericulture with ecological protection is shown by this study. The future of the tasar silk business and the biosphere reserve's biodiversity depend on Achanakmaar's host plants being managed sustainably. We can help the environment and the people who live in rural areas that rely on tasar silk by advocating for sustainable methods that keep host plants healthy. Finally, this study emphasizes how the biochemistry of host plants is highly related to tasar silk synthesis. Improving the nutritional and biochemical characteristics of these plants can increase the yield of high-quality tasar silk while also helping to preserve biodiversity and promote sustainable development in rural areas. This study highlights the need of balanced and environmentally sensitive ways to promote silk production and ecosystem health. It also offers practical advice for sericulture practitioners and forest managers.

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