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Altitude specific leaf quality of the host plants of tasar silkworm *Antheraea mylitta* Drury (Lepidoptera, Saturniidae) in Similipal Biosphere Reserve, Odisha, India

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ABSTRACT: Altitudinal variation and role of leaf nutrients in the host plants of tasar silkworm *Antheraea mylitta* Drury (Lepidoptera, Saturniidae) influences, the rearing, grainage and quantitative traits of tasar and in the quality of cocoon formed. The present works analysed the nutritional status of the tasar host plant leaves of asan (*Terminalia tomentosa*) and arjun (*T. arjuna*) collected from Kendujuani (508 m ASL), Mudrajodi (223 m ASL) and Kuliana (64 m ASL) in the district of Mayurbhanj, in Similipal Biosphere Reserve, Odisha. The study revealed that, nutritional value of asan leaves is better at a higher altitude (Kendujuani). The concentration of ascorbic acid in the leaves of asan and arjun was found higher in the leaves from Kendujuani. © 2022 Association for Advancement of Entomology

KEYWORDS: *Terminalia tomentosa*, *T. arjuna*, ascorbic acid, chlorophyll, phenolics, protein

Tropical tasar silkworm a wild type *Antheraea mylitta* Drury (Lepidoptera, Saturniidae) is polyphagous in nature and reared outdoor on arjun (*Terminalia arjuna*) and asan (*T. tomentosa*). Similipal Biosphere Reserve (SBR) is situated in Mayurbhanj district of Odisha in India between $21^{0}28'$-$22^{0}8'$ north latitude and $86^{0}4'$-$86^{0}37'$ east longitude. Mayurbhanj is the largest tasar producing district in Odisha. The wild ecoraces are mainly distributed in high altitude of SBR and all are mostly univoltine in nature (Singh and Srivastava,1997; Dey *et al*., 2010). The thickness of leaf increases with enhancing altitude (Körner, 2003; Zhang *et al.,* 2014). Although there are reports on rearing behaviour on different food plants, there is scanty information on the basis of altitudinal variation and role of leaf nutrients in controlling the rearing, grainage and quantitative traits of tasar silkworm *A. mylitta* along with effect on the nutritional status of some biomolecules of the arjun and asan. The study was conducted in three sericulture farms, viz., Kendujuani (508 m ASL), Mudrajodi (223 m ASL) and Kuliana (64 m ASL) in the district of Mayurbhanj, Odisha, India during the rearing period of tasar silkworm on primary host plant leaves. In the present study various biochemical constituents of host leaves like protein, ascorbic acid, total carbohydrate, total phenolic and total chlorophyll content of the host leaves of different eco-pockets of SBR on the basis of altitude analysed.

Collection of leaf samples: In all the experiments freshly green leaves of asan and arjun plant were collected from the above-mentioned farms. Samples

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were placed in clean polyethylene bags, sealed and transported under refrigerated condition to the laboratory. For further analyses samples were washed under running tap water to remove the adhering dirt and stored at -20°C. Analysis was completed within 24 hours of sample collection.

Biochemical Analysis: Five grams of each leaf samples were homogenized in ice-cold extraction buffer. The homogenates were centrifuged for 20 min at 10,000 rpm. The supernatants were collected for further biochemical analyses. Protein concentrations of various samples were estimated by the method of Lowry *et al*. (1951). Ascorbic acid concentration was measured according to the method of Jagota and Dani (1982).Carbohydrate concentration was measured according to the method of Yemm and Willis (1954). Total phenolic content was measured according to the method of Slinkard and Singleton (1977). Total chlorophyll content was measured according to the method of Anderson and Boardman (1964).

Statistical analysis was performed for mean values and standard deviation, besides analysis of variance. Differences were considered statistically significant when $p < 0.05$. Tukey's post-hoc test was done to establish the honest significant difference (HSD) or Critical Difference (CD) among the mean values (Tukey, 1977). All the analyses were carried out by using MS-Excel software package and Statistics.

Leaf biochemical contents of asan: Total protein content of leaf tissues of asan at Kendujuani showed the higher value than that at the Mudrajodi and Kuliana. Ascorbic acid concentration of leaf tissues from Mudrajodi and Kuliana was lower than that of Kendujuani. In the case of total carbohydrate concentration both at Kendujuani and Mudrajodi were at par with each other and higher values over Kuliana. The level of total leaf phenol content at Kuliana and Mudrajodi was higher than that found at the Kendujuani. Total chlorophyll concentration at all three places were at par with each other (Table 1).

Leaf biochemical contents of arjun: Highest level of total protein was found at Kendujuani. The ascorbic acid content in all three places was at par with each other. Total carbohydrate concentration both at Kendujuani and Mudrajodi were at par with each other and were higher values over Kuliana. Reverse pattern was found in the case of total phenol, i.e., Kuliana and Mudrajodi had almost similar values with lower value at Kendujuani. The concentration of total chlorophyll was highest at Kendujuani and slightly lower at Mudrajodi, while lowest at Kuliana (Table 2).

Deka and Kumari (2013) corroborates with the findings, that leaf proteins have an important role for production of silk. The leaves enhanced with protein showed significance on production of cocoon. Tasar silkworm, *A. mylitta* has tremendous ability to convert the leaf proteins into synthesis of silk with the silk gland. Kendujuani is placed at medium altitude suitable for Daba variety indicates a better source of protein for the larva of *A. mylitta*, as dietary proteins provided essential amino acids needed for building of new tissues. All type of proteins present in the host plant leaves are digested and assimilated in silkworm gut and converted into body matter and also silk filaments leading to formation of cocoon (Krishnaswami, 1978). Ascorbic acid acts as a catalyst in redox reactions which has the strong ability to reduce the reactive oxygen species (ROS) (Padayatty *et al*., 2003). In addition to its antioxidant potentials, ascorbate also acts as substrate for ascorbate peroxidase, the redox enzyme which has a strong role in stress resistance function of plants (Shigeoka *et al*., 2002). High ascorbic acid concentration in the Asan and Arjun leaves at Kendujuani (Table 1, 2) corroborates the findings of Shigeoka *et al*. (2002). It may be suggested that this host plant ascorbic acid content providing stress resistance and also fighting extremities of climatological factors, like temperature, relative humidity etc. Our results also demonstrate high carbohydrate concentration of food at Kendujuani while lowest at Kuliana, indicating high carbohydrate content of food found to be gaining in larval mass as reported earlier (Bernays and Chapman, 1994). Deka and Kumari (2013) ascribed higher carbohydrate content of asan leaf to the higher rate of photosynthesis. Carbohydrates are required for the energy metabolism too. In the plants phenols have the

Table 1. Tukey's post-hoc test on the quality of Asan and Arjun leaf tissue (n=10)

Ecopocket	Protein ($mg\ g^{-1}$)	Ascorbic acid ($\mu g\ g^{-1}$)	Carbohydrate ($mg\ g^{-1}$)	Phenolics ($mg\ g^{-1}$)	Chlorophyll ($mg\ g^{-1}$)
Asan leaf tissue					
Kendujuani	257.0^{a}	1.58^{a}	2.91^{a}	30.97^{b}	3.17^{a}
Mudrajodi	225.0^{b}	1.46^{b}	2.71^{a}	32.58^{a}	2.50^{b}
Kuliana	218.0^{b}	1.34^{b}	2.08^{b}	33.66^{a}	2.45^{b}
CD	12.7^{***}	0.12^{***}	0.39^{***}	1.52^{ns}	0.54^{**}
Arjun leaf tissue					
Kendujuani	219.29^{a}	1.51^{a}	4.45^{a}	31.68^{b}	3.09^{a}
Mudrajodi	209.26^{b}	1.27^{b}	3.71^{b}	32.08^{b}	2.81^{b}
Kuliana	206.51^{b}	1.23^{b}	1.96^{c}	34.42^{a}	2.60^{b}
CD	7.77^{*}	0.21^{*}	0.62^{***}	2.01^{ns}	0.22^{**}

Note: The superscripts a, b and c denote the grouping of parameter values based on Tukey's Post hoc test; $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$, ^{ns} – Not significant (ANOVA)

functions like defense against pests and diseases, herbivores, phytophagous insects and fungal, bacterial pathogens (Lappartient and Touraine, 1997; Strack, 1997; Jones and Hartley, 1999; Lappartient *et al*., 1999; Wuyts *et al*., 2006). In the present study, the level of total leaf phenol content in Kuliana and Mudrajodi was significantly higher than that of the Kendujuani (Table 1, 2), that supports the findings of Sawa *et al*. (1999) that phenols have the role of antioxidants with free radical scavenging capacity, where they break the free radical chain reaction by donating hydrogen atom. In many plants phenolic compounds found to be protect leaves from photo damage. In our present investigation total chlorophyll concentration in all three places were found to be identical, the variation indicates that the chlorophyll content of primary food plants plays a pivotal role for the successful larval rearing resulting to higher cocoons as well as better quality of silk for commercial purpose as reported by Baskey *et al*. (2019). According to Sujathamma and Dandin (2000) the higher chlorophyll content in mulberry leaves adjudicates the higher photosynthesis rate, thus it serves as one of the important criteria in evaluating leaf quality.

Considering overall performance of host plants nutritional status, and *A. mylitta* rearing behaviour it was revealed that the Kendujuani is the most conducive site for tasar silkworm rearing followed by Mudrajodi and Kuliana. Mudrajodi shows the moderate trend so, in order to achieve targeted productivity of tasar cocoons with good silk content, nutrient management in the plant needed to be adopted properly. The leaf parameters at different altitudes may have some effect on leaf nutrition, i.e., leaves may have different nutritional status at different places. So, nutrient management is required at lower altitude, i.e., Kuliana for gainful tasar cultivation.

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