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Relationship between proximate composition of food plants and Eri silkworm (*Samia ricini)* larvae: Implication in rearing and productivity

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Abstract

The nutritional status of food plants used for rearing of eri silkworm (*Samia ricini*) has a crucial impact on the development and economic parameters of the larvae. In this study, we investigated the nutritional composition of three different food plants - Castor (*Ricinus communis*), Tapioca (*Manihot esculenta*), and Papaya (*Carica papaya*) and their influence on the nutritional content of eri silkworm larvae through proximate analysis. Our results showed significant variations in the moisture, crude fibre, ash content, total fat, carbohydrate, and crude protein contents of the three food plants. A marked difference in the nutritional content of silkworm larvae reared on selected food plants have also been observed in present investigation. These findings provide scientific evidence of a significant relationship between the quality of food plants used for rearing and the nutritional indices of eri silkworm larvae. The results from current investigation might provide a reference for future works in different species and could give information regarding selection of appropriate food plant for the commercial production of eri silk, or formulation of artificial diet with proper nutritional composition towards the future improvements of silk industry.

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Introduction

Eri silkworms (*S. ricini*) are economically significant silk-producing insects endemic to the north-eastern regions of India particularly Assam with widespread distribution in almost all the districts of Assam (De and Das, 2010). These insects feed on a wide variety of food plants, with castor (*R. communis*) being the principal feeding plant due to its ability to support the formation of high-quality cocoons. However, during unfavorable seasons or periods of scarcity, eri silkworms also rely on secondary and tertiary host plants, such as *Manihot esculenta, Heteropanax fragrans*, *Carica papaya*, *Evodia fraxinifolia*, *Jatropha curcas*, *Gmelina arborea*, etc., as alternative food sources (Hazarika *et al.*, 2003; Kumar and Elangovan, 2010). Leaf morphological features and nutritional qualities of food plants vary greatly among varieties and locations (Kedir *et al.*, 2014). Studies have shown that the food plants used for rearing silkworms are the main determinant of silkworm growth and development, as well as the synthesis of silk fibre (Mwchahary and Brahma, 2023). As herbivorous insects, eri silkworm relies entirely on their host plant leaves for their nutritional requirements. Different food plants contain varying proportions of secondary metabolites and nutritional components that can have a profound effect on eri silkworm growth, development and the economic characteristics of the resulting cocoons (Hazarika *et al.*, 2005).

Additionally, eri silkworm pupae have been consumed as a nutritive food source. Therefore, the current study aims to provide scientific evidence of the relationship between the nutritional quality of different food plants used for rearing eri silkworm and the proximate composition of eri silkworm larvae. The findings of this study could give information regarding the selection of appropriate food plant for the commercial production of eri silk, or formulation of artificial diet with proper nutritional composition towards the future improvements of silk industry, as well as contribute towards our understanding of the ecology and biology of eri silkworm and their interactions with their food plants.

Material and methods

Rearing of silkworm

Healthy disease-free eggs of eri silkworm, *S. ricini* were collected from Directorate of sericulture, Kokrajhar, Assam and the rearing was carried out following the standard rearing methods. The silkworms were separated into three groups viz. T1, T2 and T3, which were fed with separate food plants i.e., castor, tapioca and papaya respectively (Fig. 1).

a

b

c

Fig. 1. Rearing of eri silkworm larvae on the leaves of selected food plants: (a) castor, (b) tapioca and (c) papaya.

Collection of Food plants

The leaves of food plants used for rearing were collected from the locality within the Kokrajhar district.

Sample preparation for proximate analysis

The fifth instar larvae of eri silkworm were selected for the present study. The silkworm and harvested leaves of host plants were cleaned, dried and homogenized for the preparing sample.

Proximate analysis

Moisture, Crude fibre, fat and ash contents of the food plants and larvae from three groups were assayed following the protocol described by Association of Official Analytical Chemists (AOAC, 2006) methods 925.10, 942.05, 920.85 and 923.03 respectively. Protein content (N *6.25) was analyzed by AOAC Kjeldahl method 984.13. Total Carbohydrate contents of both food plants and larvae reared on different food plants were determined by using formula, Carbohydrate (%) =100-(Moisture + Crude fibre + Fat +Ash content + Crude protein).

Statistical analysis

The data were collected in triplicates and the proximate values were presented as Mean±SD.

Result and discussion

The growth, development and economic characteristics of silkworms are significantly influenced by the nutritive contents of foliage and the food plants provided for consumption (Singh and Das, 2006). In the present investigation, we have recorded variation in the proximate composition of three different food plants as well as proximate composition of larval samples. Similar findings were also reported by Deuri *et al.* (2017) who observed variations in the nutrient composition of castor and papaya food plants of eri silkworm. The results of proximate analysis of larval groups showed that the moisture content of silkworm larvae fed on papaya leaves was comparatively higher (8.02 g/100g) than those fed with castor (6.39g/100g) and tapioca (7.83g/100g). This can be attributed to the higher moisture content in papaya leaves (Table 1) than other two food plants. Additionally, the crude fiber content was higher in tapioca fed larvae (5.56g/100g), followed by castor (5.30g/1100g) and papaya leaves (3.31g/100g), which can be attributed to the higher crude fiber content in tapioca leaves (Table 1).

Furthermore, the fat content was higher in papaya leaves (5.21g/100g) and least fat content was observed in tapioca leaves (1.12g/100g). However, the high fat content in papaya leaves was not associated with higher larval fat. In contrast, eri larvae reared on castor leaves were recorded with higher fat content (14.14g/100g) compared to larvae reared on papaya (11.40g/100g) and tapioca (13.02g/100g).

Such deviations could be due to variation in the time of harvest of leaf samples, physiological status of the host plant and larvae. Different food plants showed variation in the ash content of their leaves and higher ash content was found in papaya leaves (13.66g/100g) followed by castor (14.14g/100g) and tapioca (11.02g/100g). Similar trend in the ash content was also observed in silkworm larvae reared on these food plants respectively.

The crude protein content of silkworm larvae was found to be influenced by the food plants used for rearing. The crude protein content of castor leaves (33.90g/100g) and the larvae reared on them (60.78g/100g) were comparatively higher than those of tapioca and papaya leaves and the silkworms reared on them (Table 1 & 2). The carbohydrate content of tapioca fed larvae was recorded highest (13.22g/100g) followed by Papaya (12.79g/100g) and castor 8.92g/100g) fed larvae (Table 2).

Table 1. Proximate analysis of Castor, Tapioca and Papaya food plants leaves.

Components	Castor leaves (g/100g)	Tapioca leaves (g/100g)	Papaya leaves (g/100g)
Moisture	5.22±0.03	5.69±0.17	6.11±0.08
Crude fibre	8.40±0.06	15.42±0.17	12.65±0.31
Fat	2.17±0.2	1.12±0.16	5.21±0.38
Ash	10.52±0.07	8.24±0.04	13.66±0.09
Crude protein	33.90±0.31	30.37±0.47	28.61±0.46
Carbohydrate	39.79±0.14	39.16±0.49	33.73±0.38

N.B. Values are presented as Mean ± SD

Table 2. Proximate values of eri silkworm larvae reared on castor (T1), tapioca (T2) and papaya (T3) leaves.

Components	T1 (g/100g)	T2 (g/100g)	T3 (g/100g)
Moisture	6.39±0.14	7.83±0.20	8.02±0.03
Crude fibre	5.30±0.06	5.56±0.04	3.31±0.28
Fat	14.14±0.18	11.02±0.113	12.40±0.37
Ash	4.47±0.39	4.39±0.46	6.80±0.10
Crude protein	60.78±0.27	57.98±0.73	56.68±0.22
Carbohydrate	8.92±0.57	13.22±0.53	12.79±0.71

N.B. Values are presented as Mean ± SD

In the present investigation it has been seen that proximate components of the food plants i.e., castor, tapioca and papaya varies in their moisture, crude fibre, fat, ash content and have exerted their variable influences on the overall proximate composition of the larvae subsequently affecting larval growth parameters. This report is in agreement with the statement of Ravikumar (1988) who reported that the quality of leaves provided to silkworms for feeding is considered a primary factor affecting the production of high-quality cocoons. Leaves with superior quality enhance the likelihood of producing good quality cocoons. In the present investigation the crude protein of the larvae has been recorded at highest percentage among all other nutrients. Similar trend of result was reported by Longvah *et al.* (2011) and Hirunyophat *et al.* (2021) in which percentage of protein and fat content in dry weight of pre-pupae and pupae stage was comparatively higher than other nutrient components in eri silkworm. This result is may be due to the fact that eri silkworm larvae undergo several transitional stages during their development, which requires significant energy and nutrient reserves. The high concentration of lipids and proteins in their bodies may allow them to sustain these growth phases and complete their life cycle successfully.

Overall the nutritional value of food plants, either alone or in combination, plays a crucial role in the growth and silk productivity of silkworms. Since the quality of leaf has got a direct influence on the health, growth and survival of silkworm, selection of the food plants possessing superior nutritive value is of importance for the healthy development of silkworms and in obtaining quality cocoon crops (Dutta *et al.,* 1997).

Conclusion

The findings of this study have indicated that biochemical composition of different food plants differs, leading to varying impacts on the nutritional status of the larvae. Our findings have provided scientific evidence supporting a correlation between the proximate compositions of the food plants used for rearing eri silkworms and the overall nutritional composition of the larvae. This information can be utilized to optimize ericulture practices and enhance the development of eri silkworm.

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Conflict of interest

Authors declare no conflict of interest.

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