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Consumption and utilization of food in different instars of muga silkworm *Antheraea assama* Westwood

A BARAH, M C GOSWAMI* and M V SAMSON
Regional Muga Research Station, Central Silk Board, Mirza 781 125, India

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Abstract. An investigation was carried out to find out the nutritional parameters viz. consumption, assimilation and tissue growth etc. of muga silkworm *Antheraea assama* Westwood (Lepidoptera: Saturniidae) by rearing it indoor on som twigs. During 32 days of its larval life, the total consumption of an individual was 33·925 g of which 21·295 g were assimilated by the insect. About 80·1% of the total consumption took place in the fifth instar alone. The weight of one full grown larva was computed at 13·9304 g. The assimilation and tissue growth were found positively correlated with the consumption as well as with the age of the larva. The approximate digestibility was negatively correlated to the amount of food consumed. Efficiency of conversion of ingested and digested food increased in the first 4 instars and declined in the fifth instar.

Keywords. *Antheraea assama*; consumption; approximate digestibility; conversion of ingested food; conversion of digested food.

1. Introduction

Study of nutritional parameters of sericigenous insects is considered to be an important field of work for better management and development of the sericulture industry apart from its physiological importance. Considerable literature is available in this field and special mention can be made of the works of Kapil (1963), Poonia (1978), Reddy and Alfred (1979), Joshi (1984, 1985) and Pant *et al* (1986) on *Philosamia ricini*, Horie and Watanabe (1983) on *Bombyx mori* and Yadava *et al* (1983) on *Antheraea proylei*. Works of Evans (1939) and Waldbauer (1964, 1968) are also noteworthy.

In this study, we tried to evaluate certain nutritional parameters such as consumption, assimilation and tissue growth and their relationship to the efficiency to convert the ingested as well as digested food to body substances during the entire larval life of muga silkworm *Antheraea assama*, an insect of immense sericultural importance, which produces the lustrous golden muga silk.

2. Materials and Methods

The present study of nutritional factors of muga silkworm *A. assama* was based on som plant (*Machilus bombycina* King), one of the two primary food plants of the insect. Rearing of the worms from first to fifth instar was done under indoor conditions on twigs of som plants kept in bottles containing water. A total of 150 larvae were transferred in 3 replications of 50 larvae each. In order to determine the loss of weight due to desiccation, a control batch of twigs with identical numbers of

*Since deceased.

replications were also maintained. Further, a reserved batch of worms were maintained in identical rearing conditions so as to replace the dead or, weak larvae whenever required. The twigs were changed daily and the weight gain by the larvae, loss of weight of the twigs due to desiccation/consumption and the weight of the egested matters were recorded. The gravimetric method of Waldbauer (1968) and the IPB formula of Petrusewicz and MacFayden (1970) were used for estimation of daily food consumption and calculation of food energy assimilation and respiration. The method of Evans (1939) was used for conversion of assimilation and the gain in weight data to coefficient of utilization and growth.

$$\text{Coefficient of utilization or approximate digestibility (AD)} = \frac{\text{Assimilation}}{\text{Consumption}} \times 100.$$

$$\text{Efficiency of conversion of ingested (ECI) food to body substances} = \frac{\text{Tissue growth}}{\text{Consumption}} \times 100.$$

$$\text{Efficiency of conversion of digested (ECD) food to body substances} = \frac{\text{Tissue growth}}{\text{Assimilation}} \times 100,$$

where, assimilation = weight of food ingested − weight of egested matters.

3. Results and discussion

Instarwise consumption of leaves (in dry gram weight basis) by an individual larva is presented in table 1. The total consumption of a larva is computed to be 33·925 g. There was a steady increase in consumption rate up to fourth instar stage, while the increase was quite steep in the fifth instar being 80·1% of the total consumption (figure 1). Corresponding to consumption, a similar pattern of increase was reflected in the rate of assimilation and tissue growth (figure 2). A bulk of 74·1% of the total assimilation and 75·9% of the total tissue growth occurred during the fifth instar stage alone. Though 33·925 g food is consumed by a larva during its entire larval life, the total assimilation is only 21·295 g, which amounts to 62·8% of the total consumption. When the results of the increase in body weight or tissue growth is computed, a direct correlation is observed with that of the age of the larva. Soon after hatching, the average larval weight is $0{\cdot}0059 \pm 0{\cdot}00014$ g. The weight of one full grown larva before spinning attains $13{\cdot}9304 \pm 0{\cdot}322$ g, which is about 2360 times of a newly hatched larva. The present findings on consumption, assimilation and tissue growth follow a pattern found in a number of Lepidopteran insects like *Philosamia ricini* (Reddy and Alfred 1979; Poonia 1978), *Pieris brassicae* (Yadava *et al* 1979; Evans 1939) and *Antheraea proylei* (Yadava *et al* 1983; Rana *et al* 1987).

Digestibility, ECI and ECD food to body substances are 3 primary parameters of nutrition physiology and are presented in table 2. The AD was found to be negatively correlated to the amount of food consumed. The highest AD (93·51%) was observed in first instar and the lowest (58·07%) in the fifth instar. Similar results were obtained with *P. ricini* (Kapil 1963; Poonia 1978), *A. proylei* (Yadava *et al* 1983; Rana *et al* 1987), *P. brassicae* (Yadava *et al* 1979) and certain other Lepidopteran insects (Waldbauer 1968). Selective feeding of tender leaves by the early instar larvae as suggested by Rana *et al* (1987) might be the cause of decline of AD in the late instars.

Table 1. Average consumption, egestion, assimilation, tissue growth and respiration in different instars of *A. assama* fed on som leaves (in dry gram weight basis).

Instar	Duration of instar (days)	Consumption	Egestion	Assimilation	Tissue growth	Respiration
I	5	0·169 ± 0·003 (0·5)	0·011 ± 0·001	0·158 ± 0·003 (0·7)	0·0261 ± 0·0015 (0·2)	0·1323 ± 0·0013
II	5	0·475 ± 0·010 (1·4)	0·051 ± 0·002	0·423 ± 0·008 (2·0)	0·1352 ± 0·0067 (1·0)	0·2882 ± 0·0049
III	6	1·480 ± 0·026 (4·4)	0·215 ± 0·004	1·265 ± 0·023 (6·0)	0·5998 ± 0·0039 (4·3)	0·6652 ± 0·0272
IV	6	4·617 ± 0·180 (13·6)	0·955 ± 0·014	3·662 ± 0·167 (17·2)	2·5942 ± 0·0406 (18·6)	1·0681 ± 0·1730
V	10	27·184 ± 0·299 (80·1)	11·397 ± 0·035	15·787 ± 0·268 (74·1)	10·5693 ± 0·3046 (75·9)	5·2180 ± 0·0366

Instarwise per cent of consumption, assimilation and tissue growth are given in parentheses.

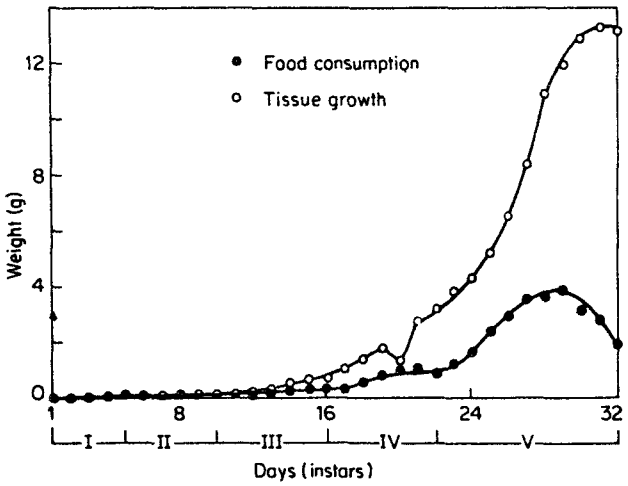

Figure 1. Daily food consumption and larval weight in *A. assama.*

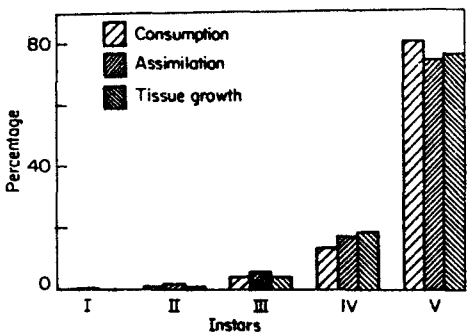

Figure 2. Instarwise per cent of consumption, assimilation and tissue growth in *A. assama.*

Table 2. Mean efficiency of food utilization by the larvae of *A. assama* fed on som leaves.

Instar	Approximate digestibility (%)	Efficiency of conversion of ingested food (%)	Efficiency of conversion of digested food (%)
I	93·51 ± 0·36	15·38 ± 0·64	16·45 ± 0·72
II	89·19 ± 0·21	28·46 ± 1·03	31·92 ± 1·19
III	85·47 ± 0·13	40·54 ± 0·99	47·44 ± 1·19
IV	79·30 ± 0·53	56·28 ± 2·42	70·99 ± 3·52
V	58·07 ± 0·35	38·87 ± 0·70	66·93 ± 0·80

As regards to ECD and ECI the values increased from first to fourth instar and declined thereafter in the fifth stage (table 2). A number of workers supported this trend of rise and fall in ECD and ECI in different insects (Bailey 1976; Yadava *et al* 1979; Rana *et al* 1987). Mukherji and Guppy (1970) and Latheef and Harcourt (1972) also supported this trend of ECD in different insects. Contrary to the above pattern, Vats and Kaushal (1982) reported gradual rise of ECD from first to the fifth instar in *P. brassicae.* The mean value of ECD and ECI are calculated to be 47

and 36% respectively in *A. assama*, while ECD and ECI of *A. proylei* and *B. mori* were reported to be 34 and 23% (Rana *et al* 1987) and 52–53 and 22–23% (Horie and Watanabe 1983) respectively. Bailey (1976) established a correlation of variation in ECI within and between the instars in respect of food plants indicating involvement of nutritional value and digestibility of different food plants.

From the above findings it is observed that both ECD and ECI decline in the fifth instar, while maximum tissue growth takes place in the same stage. Perhaps, the longer larval life and maximum consumption of food (80·1% of the total consumption) during the instar is responsible for the high rate of tissue growth inspite of the decline in ECD and ECI. The fall of ECD and ECI in the fifth instar may be due to the fact that the higher amount of digested or ingested food is metabolised for maintenance of the body and lesser amount is used for tissue growth.

The present findings on consumption and utilization of food will form an index to identify the effective strains among the primary food plants. It can also be used as a tool for selection of suitable secondary host plant varieties for further improvement.

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