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## **Impact of Supplementation of Amway Protein on the Economic Characters and Energy Budget of Silkworm *Bombyx mori* L.**

<sup>1</sup>G. Amala Rani, <sup>1</sup>C. Padmalatha, <sup>2</sup>R. Sorna Raj and <sup>3</sup>A.J.A. Ranjith Singh

<sup>1</sup>Department of Advanced Zoology and Biotechnology, Rani Anna Government College for Women, Gandhinagar, Tirunelveli 627 008, India

<sup>2</sup>Research Department of Zoology, Kamaraj College, Tuticorin-628 003, India

<sup>3</sup>Sri Paramakalyani College, Alwarkurichi, 627 412, India

*Corresponding Author: G. Amala Rani, Department of Advanced Zoology and Biotechnology, Rani Anna Government College for Women, Gandhinagar, Tirunelveli 627 008, India*

### **ABSTRACT**

Nutrition plays a pivotal role in sericulture by improving the commercial characters of silkworm. Silkworm being a monophagous insect derives almost all the nutrients required for its growth from the mulberry leaf itself. Amway is the best supplement protein for the production of good qualified cocoon and silk. The nutrition of Amway for the mulberry influence the larval growth of silkworm which ultimately reflect in the economic traits. The influence of Amway nutrilit, protein supplement enrichment with mulberry leaves on the energy budget and economic characters of the silkworm *Bombyx mori* L. was traced. Larvae fed with mulberry leaves enriched with Amway protein showed significant enhancement in larval weight, cocoon weight, shell weight, shell ratio, filament length, filament width, denier and fibroin content. Amway protein with a concentration of 10% was very effective, when compared to control. Mulberry leaves treated with Amway protein (10%) fed larvae recorded a maximum cocoon length (3.69±0.12), cocoon width (1.98±2.4) shell ratio (18.25±0.14) filament length (888±7.2) filament weight (3.2±0.57) Denier (2.87±0.02) and fibroin content (43.99±0.02). Shell ratio in this treatment (10%) showed an increase of 9.38% over control, filament length 21.64% of increase over control and denier 76.07% increase over control. Various growth parameters like Relative Consumption Rate (RCR) Relative Growth Rate (RGR), weight gain, Approximate Digestibility (AD), Efficiency of Conversion of Digested Food (ECD) and Efficiency of Conversion of Ingested Food (ECI) were enhanced by the Amway supplementation. Amway Nutrilit is a protein supplement and it contains a balanced amount of important amino acids. The present study was therefore undertaken to study the effect of Amway protein on the quantitative traits and energetics of *B. mori*.

**Key words:** Amway priotien, *Bombyx mori*, economic parameter, energy budget

### **INTRODUCTION**

Nutrition plays a pivotal role in sericulture by improving the commercial characters of silkworm. Silkworm being a monophagous insect derives almost all the nutrients required for its growth from the mulberry leaf itself (Nasreen *et al.*, 1999). Though the silkworm nutrients are balanced in mulberry leaf, the quantity available is not sufficient for the larval growth due to variation in mulberry plant cultivable soil (Ito, 1978). The intake of nutrient by the larvae is also proportional to the availability of feed. The silkworm nutrition is considered as a major area of research in

sericulture (Legay, 1958). Nutrition study on silkworm is an essential prerequisite for its proper commercial exploitation. Nutrition of silkworm is sole factor which almost individually augments quality and quantity of silkworm (Laskar and Datta, 2000). In recent year's attempts have been made in sericulture with nutrients such as proteins, carbohydrates, amino acids, vitamins hormones antibiotics etc. for better performance and to get high yield and quantity cocoons (Sannapa *et al.*, 2002; Etebari *et al.*, 2004). The salt significantly enhanced the growth of developmental stages and decreased the developmental period. Nickel chloride significantly increased the growth of larvae (Islam *et al.*, 2004). In addition to mulberry leaves feed supplements are also given to silkworm to enhance economic characteristics (Jeyapaul *et al.*, 2003; Sheeba *et al.*, 2006). Amway Nutrilite is a protein supplement and it contains a balanced amount of important amino acids. The present study was therefore, undertaken to study the effect of Amway protein on the quantitative traits and energetics of *B. mori*.

## MATERIALS AND METHODS

In the present study was carried out from the month of March to April 2010. Fresh disease free laying of (LXCSR2multivoltine) race purchased from Government Sericulture farm, Nannagaram, Tirunelveli district, Tamilnadu, India. Amway protein nutraceutical was used for the present investigation as the feed supplement different concentration of Amway protein such as 2, 4, 6, 8 and 10% were prepared from the stock solution. Fresh mulberry leaves were cleaned with a sterile cloth. Weighed quantities of leaves were separately with Amway protein of different concentrations by using a hand atomizer. The nutraceutical coated leaves were allowed to dry in shade for 15 min prior to feeding.

Treated leaves were given as the first feed for the day, beginning from the first day of third instar till it begins to spin the cocoon. Control worms were given normal leaves. The temperature in the rearing chamber was maintained at  $28\pm 2^{\circ}\text{C}$  and the RH was  $73\pm 5\%$ . All the rearing operations were carried out according to Krishnaswami *et al.* (1973) by maintaining 3 replications. During rearing the worms were grouped into 6 batches with 150 larvae in each batch and one as control. The weight of the larvae was monitored for control and Amway treated groups. The observations on economic parameters such as mature larval weight, cocoon weight, pupal weight, shell weight, shell percentage, filament length width, denier, sericin and fibroin content were determined. Consumption and growth parameters were measured on dry weight basis (Waldbauer, 1968; Kumar *et al.*, 2009). All the values were statistically analyzed and are presented as Mean $\pm$ SD.

## RESULTS AND DISCUSSION

In the present study the result indicates the, impact of Amway protein on economic parameters of silkworm *Bombyx mori*. Different concentration of Amway treatments like (2, 4, 6, 8 and 10%) fed to the III Instar larvae of silkworm. Average length of cocoon was found highest in the 10% concentration ( $3.69\pm 0.12$ ), followed by 8% ( $3.61\pm 2.3$ ), 6% ( $3.33\pm 0.12$ ), 4% ( $3.22\pm 5.1$ ), 2% ( $3.20\pm 0.13$ ) and control ( $3.19\pm 1.2$ ) (Table 1). Filament length resulted maximum length ( $888\pm 7.2$  m). Sericin content was found to be higher ( $45.2\pm 3.12$ ) over the control ( $28.2\pm 2.00$ ). The highest assimilation efficiency (96.72%) and conversion of digested food (50.73%) was observed in 10% of Amway protein. Maximum food consumption was significantly increased (97.30%), assimilation efficiency (96.72%), AD (94.75%), ECD (36.30%) and ECI (34.40%) were observed when 10% Amway protein was administrated to the larvae (Table 2).

Table 1: Reeling performance of silkworm *Bombyx mori* fed with mulberry leaves coated with amway protein

Feed	Concentration of amway protein (%)	Length of the cocoon (Mean)	Width of the cocoon (Mean)	Shell ratio (%)	Filament length (m)	Filament width (g)	Denier (g)	Sericin content	Fibroin content	Renditta
Control		3.19±1.2	1.74±0.21	16.75±0.02	769±1.1	1.3±0.05	1.63±0.02	28.2±2.00	28.2±0.22	11.21
Amway protein	2	3.20±0.13 (0.33)	1.76±0.56 (1.18)	16.85±0.04 (0.60)	787±1.2 (3.20)	1.50±0.05 (0.20)	1.79±0.21 (10)	32.1±2.13 (15.60)	30.85±0.32 (9.39)	11.52
	4	3.22±5.1 (1)	1.77±0.67 (1.76)	16.89±0.05 90.87	817±2.5 (8.60)	1.51±0.07 (0.20)	1.88±1.22 (15)	34.1±1.00 (23.60)	34.87±0.14 (24.36)	10.98
	6	3.33±0.12 (4.6)	1.76±0.75 (2.94)	17.48±0.05 (4.55)	820±5.3 (9.27)	1.7±0.1 (0.40)	2.83±0.52 (75.62)	38.6±5.2 (41.60)	37.72±0.15 (33.76)	10.21
	8	3.61±2.3 (14)	1.96±2.1 (12.29)	17.52±0.28 (4.82)	875±6.5 (19.27)	2.3±0.33 (1)	2.84±0.52 (75.62)	41.2±1.32 (52)	40.22±0.08 (42.62)	9.96
	10	3.69±0.12 (16.6)	1.98±2.4 (14.12)	18.25±0.14 (9.38)	888±7.2 (21.64)	3.2±0.57 (1.90)	2.87±0.02 (76.07)	45.2±3.12 (68)	43.99±0.02 (56)	8.89

Values are presented as Mean±SD, percentage change over control is given in parenthesis

Table 2: Influence of amway protein on the energy budget of *Bombyx mori* L.

Stadium	Different concentration of amway protein	Weight of the larvae (mg dry wt/animal/day) (X±SD)	Consumption index (%)	Assimilation efficiency (%)	A.D (%)	ECD (%)	ECI (%)
III	Control	84.40±3.45	86.51	57.75	93.22	66.22	58.93
	2%	88.00±3.11	86.55	72.12	92.44	66.56	61.53
	4%	88.00±2.32	87.01	76.87	92.84	62.23	57.70
	6%	91.00±2.50	87.23	78.62	92.34	60.34	55.72
	8%	92.90±3.21	87.37	78.43	90.23	63.24	57.06
	10%	94.80±2.00	90.37	80.43	90.55	61.00	55.24
IV	Control	94.07±1.36	88.66	91.27	88.71	40.98	36.36
	2%	124.00±2.25	90.03	91.42	88.34	51.30	45.32
	4%	127.00±1.55	92.11	92.11	88.28	51.83	45.76
	6%	130.18±3.62	93.36	92.94	87.69	52.64	46.09
	8%	133.50±1.11	93.45	93.33	88.97	49.68	44.20
	10%	138.00±1.53	94.42	93.45	88.54	50.73	44.92
V	Control	164.00±1.48	95.15	94.72	94.80	28.80	27.30
	2%	168.00±0.48	96.86	95.15	94.86	27.48	26.00
	4%	171.00±1.25	96.91	95.75	94.65	27.76	26.27
	6%	192.00±3.07	97.05	96.04	94.46	30.90	29.80
	8%	196.00±1.21	97.40	96.40	94.26	31.40	29.60
	10%	231.00±1.36	97.30	96.72	94.75	36.30	34.40

The growth and development of silkworm is under the continuous influence of factors operating within and outside the body (Murugan *et al.*, 1998). Ascorbic acid had effect on the growth of silkworm (Javed and Gondal, 2002) and combination of 0.2% of N which enhances the growth of silk production (Hussain and Javed, 2002). It is evident from the mean data of the experiments that, Amway protein treated leaves fed larvae showed a significant enhancement in reeling performance and bioenergetics. Maximum cocoon length (3.69±0.12) was observed in 10% amway protein fed larvae. The cocoon length of (3.19±1.2) was recorded in control. The control and the percentage of change over control is 16.6%. The data pertaining to the shell width are highly significant. Maximum shell width (1.98) was recorded on 10% Amway treatment. Whereas shell width (1.74) was observed in control. The results were found to be statistically significant. Shell ratio found to be maximum in larvae treated (18.25±0.14). This was followed by treatment of 8% (17.52).

Shell ratio of worms treated with 6% amway protein resulted (17.48) value and those with 4% got (16.89) shell weight. These results are in accordance with the finding of Sengupta (1972). Murugan *et al.* (1998) concluded that 10% amway protein supplemented mulberry leaf significantly improved larval growth and economic characters of silkworm.

Filament length is considered to be more important for the reeling parameters. The cocoon of *Bombyx mori* is made up of a single long thread. The result indicated that, the treatment with supplementation of 10% amway protein showed maximum length ( $888 \pm 7.2$  m). Maximum fibroin content was observed in silkworm larvae fed with 10% of supplemented food (43.99) and provides a good reelability. The percentage of change over control is 56% and it is highly significant. This was followed by 8% concentration ( $40.22 \pm 0.08$ ), 6% ( $37.72 \pm 0.15$ ) and 2% ( $30.85 \pm 0.32$ ) as against the control ( $28.2 \pm 0.22$ ). Sericin content was found to be higher in cocoons derived from larvae fed with mulberry leaves coated with 10% concentration of amway protein supplement ( $45.2 \pm 3.12$ ) whereas, the Sericin content of the cocoons derived from larvae kept as control was  $28.2 \pm 2.0$ .

In the present study, denier was calculated for the filament produced by control and treated worms. Denier was found to be the maximum in worms treated with 10% amway protein supplement ( $2.87 \pm 0.02$ ). It was followed by worms treated with 8% of supplementary food ( $2.84 \pm 0.52$ ) and worms treated 2% protein food ( $1.79 \pm 0.21$ ). The percentage of change over control is highly significant in all the treatments.

Renditta value resulted significant differences in the control and treated worms. Renditta value was gradually decreased from 11.21 (control) to 10.98, 10.21, 9.96 and 8.89 and 10% amway protein supplementary food, respectively. The present investigation clearly resulted that fortification of mulberry leaves with extra nutrients increased the larval growth, cocoon characters. Sarkar *et al.* (1995) reported that growth of larvae *B.mori* significantly improved when they were fed on mulberry leaves supplemented with different nutrients such as Soya milk, Milk powder, Sugars, vitamins and amino acids.

The overall energy budget of the *Bombyx mori* in relation to the amway protein treatment are presented in Table 2. Significant increase in food consumption rate was noticed in all the concentration of amway protein treatment over the control. Lower food consumption in the control category reflects the low silk production ability as feeding influences the synthesis of total DNA, RNA and protein synthesis (Chavancy and Fournier, 1979). According to Soo-Hoo and Frankel (1966) the diminishing consumption rate of less preferred food was partially compensated by increased assimilation efficiency. However, according to Mathavan and Krishnan (1976) assimilation efficiency did not vary significantly as a function of reduced food consumption. Verma and Atwal (1963) observed that feeding leaves supplemented with distilled water alone slightly increased the weights of larva, pupa and silk shells.

The highest assimilation efficiency (96.72%) was observed in 10% concentration of amway protein for V Instar larvae, followed by (93.45%) in IV Instar larvae and (80.43%) in III Instar larvae when compared with control. An analysis of Approximate Digestibility (A.D) showed no significant difference. Significant differences were noticed in efficiency of conversion of digested food in the IV and V Instar larval periods. Highest efficiency of conversion of digested food (50.73%) was noticed in 10% concentration of amway protein for IV Instar larvae when compared with the control (40.8).

Efficiency of conversion of Ingested food was highly significant in IV and V Instar treated worms. The highest efficiency of conversion of ingested food (44.92%) in 10% concentration of

amway protein in IV larval stadium when compared with the control (36.36%). The same trend was followed in V larval stadium also. However, the efficiency of conversion of ingested was lower in V instar larvae (34.40%) in 10% concentration and control (27.30%). There was a tremendous increase in the weight of the larvae in treated groups in all the Instar stages. Highest weight gain (94.8±2) was observed in 10% concentration of Amway protein in III Instar larvae (138±1.53 mg dry wt/animal/day) in IV Instar larvae and (231±1.36 mg dry wt/animal/day) in V Instar larvae against the control 84.4±3.45, 94.07±1.36 and 164±1.48 mg dry wt/animal day respectively. The results of the present study recommend supplementation of amway protein along with mulberry leaf for feeding *Bombyx mori* L. It also indicated that 10% amway protein is the optimum dose for the better performance of rearing and reeling parameters of silkworm *Bombyx mori*.

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