Impact of prolactin on the feed conversion efficiency of the silkworm, Bombyx mori L.

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Abstract— The effect of prolactin on the feed conversion efficiency has been investigated in control and prolactin treated fifth instar larvae of silkworm, Bombyx mori L. The ingestion, digestion, ingestibility and digestibility gradually increased over the control from the first day to the seventh day of the fifth instar silkworm larvae. The increase could be attributed to enhanced metabolic activities, production of digestive enzymes and in turn resulting in enhanced larval growth, early pupation and synthesis of silk

Index Terms— *Bombyx mori L., Digestion, Ingestion, Prolactin*

1 INTRODUCTION

Fortification of mulberry leaf with certain materials has been successfully used as a prophylactic measure in certain races of silkworms (Sidhu et al., 1968 and Bongale and Krishna, 1996). The effect of feed addition on silk productivity has been reported earlier as one of the growth indices, which will lead to the realization of two most important economic parameters, namely reduced larval duration and increased shell weight (Babu, 1994 and Prasad et al., 1994). Horie and Watanabie (1983) carried out studies on the digestion and daily utilization of mulberry leaves in Bombyx mori larvae. The poly-voltine breeds vary in their growth, development, economic characters and food consumption, utilization and conversion efficiencies (Rema Devi et al., 1992).

The physiology of silkworm has been shown to be dependant on the nutritional supply (Morohoshi, 1976). Studies on consumption and utilization of food by the silkworm, Bombyx mori have been reported by many workers (Horie and Watanable 1983; Naik and Delvi, 1987 and Anantha Raman et al., 1993). Food utilization efficiency in some poly-voltine mulberry silkworms has been evaluated (Benchamin and Jolly, 1984; Rema Devi et al., 1992) and a mutual relationship among the nutritional and economic characters of the multi-voltine silkworm has been worked out (Rema Devi et al., 1993). Effect of thyroxine on food utilization by Silkworm, Bombyx mori L. has been studied (Hemavathi and Bharathi, 2003). The impact of Indole-3-acetic acid (IAA) on feed conversion efficiency of the silkworm Bombyx mori L. has been investigated. (Lakshmikantham and Bharathi, 2009).

The present study examines the effect of prolactin on ingestion, digestion, ingestibility and digestibility in control and treated fifth instar larvae of Bombyx mori L

2 MATERIALS AND METHODS

Disease free layings of the silkworm were obtained from the P1 station at Punganur, Chittoor district, Andhra Pradesh. The larvae were maintained as groups, with 500 worms in each group. Topical application of ovine prolactin (NIH, Bethesda, USA) of 100µgm/ml of physiological saline daily from first to fifth instar on a group of 500 larvae.The control larvae were sprayed with physiological saline (0.9% Nacl in distilled water). Optimal conditions were maintained throughout the rearing period. Formulae for calculation of feeding behaviour:

Fifth instar larvae were used to collect the quantitative data for calculating different feeding indices, because of the fact that about 70% of the total leaf quantity is consumed during the fifth instar by the silkworm.

Total ingestion /day = Total leaf supplied –Leaf left over /day

$$\text{Ingestibility (\%)} = \frac{\text{Amount of ingested leaf}}{\text{Total leaf supplied}} \times 100$$

Total digestion /day = Total leaf ingested- Excreta ejected/day

$$\text{Digestibility (\%)} = \frac{\text{Total amount of leaf digested}}{\text{Total leaf ingested}} \times 100$$

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3 RESULTS AND DISCUSSION

The data presented in tables 1 to 4 reveal the changes in ingestion, digestion, ingestibility and digestibility of the control and prolactin treated fifth instar larvae of Bombyx mori L.

Leaf consumption of the fifth instar mulberry silkworm amounts to more than 75% of the total consumption by all the instars. The high intake of food by the fifthe instar

larva is to accumulate sufficient energy resources to support its metabolism during non-feeding pupal-adult development. Digestive enzymes may play a major role in the body of the insects by converting complex food materials into micro-molecules necessary to provide energy and metabolites for growth, development and other vital functions (Wigglesworth, 1972a, 1972b). In silkworm, the food consumption has a direct relevance to weight of larva, cocoon, pupa and shell.

Day- to-day levels of ingestion, digestion, ingestibility and digestibility after treatment were found to increase significantly over control in the present study. The increase is attributable to increased food utilization efficiency following treatment withprolactin. Food consumption has direct relevance to the weight of the larva, cocoon and shell. The increase in ingestibility and digestibility over the control may be due to increased metabolic activities resulting in enhanced larval growth and early pupation.

The enhanced digestibility and metabolic rate were attributed to multiple biological roles of thyroxine in the gastric function, oxygen consumption and protein synthesis (Hemavathi, 2001). The observed increase in ingestion and digestion of treated worms over control suggests the possibility of increased accumulation of organic constituents such as carbohydrates, proteins and lipids in the body tissues (Ito, 1967 and Tazima, 1978).

The ingestion, digestion, ingestibility and digestibility rates gradually increased over the control from the first day to the seventh day of the fifth instar. The increase may be due to increased metabolic activities, resulting in enhanced larval growth and early pupation.

CONCLUSION

The rate of feeding in silkworm larva is dependent on the rate of enzymes in mid-gut and the effect of prolactin plays an important role in enhancing the enzyme activity. The enhanced food intake of larva after treatment with prolactin could indirectly influence the cocoon and silk production.

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Table 1: Day-to-day changes in the total ingestion (g) in control and experimental (Prolactin treated) larvae of the fifth instar silkworm, Bombyx mori L. Values are the means of 10 individual observations + Standard Deviation (S.D.), followed by percent changes and student's 't' test.

S.No	Day of fifth instar	control	Experimental (Prolactin treated)
1	First day	56.79 ± 4.72	64.84 ± 5.60 +14.18 P<0.001
2	Second day	81.75 ± 6.98	98.36 ± 7.22 +20.32 P<0.001
3	Third day	88.23 ± 7.02	109.67 ± 5.49 +24.30 P<0.001
4	Fourth day	94.10 ± 5.36	117.93 ± 8.81 +25.32 P<0.001
5	Fifth day	110.71 ± 9.27	140.66 ± 11.60 +29.39 P<0.001
6	Sixth day	121.48 ± 7.18	162.84 ± 10.84 +34.05 P<0.001
7	Seventh day	133.62 ± 12.54	182.10 ± 12.36 +36.28 P<0.001

Table 2: Day-to-day changes in the ingestibility (%) in control and experimental (Prolactin treated) larvae of the fifth instar silkworm, Bombyx mori L. Values are the means of 10 individual observations + Standard Deviation (S.D.), followed by percent changes and student's 't' test.

S.No	Day of fifth instar	control	Experimental (Prolactin treated)
1	First day	3.24 + 2.82	37.68 + 3.06 +17.99 P<0.001
2	Second day	38.73 + 2.76	46.22 + 3.62 +19.34 P<0.001
3	Third day	42.17 + 2.18	51.76 + 4.64 +22.74 P<0.001
4	Fourth day	48.65 + 3.68	60.54 + 5.84 +24.44 P<0.001
5	Fifth day	52.38 + 4.63	66.41 + 5.74 +26.79 P<0.001
6	Sixth day	57.83 + 2.16	74.09 + 6.49 +28.12 P<0.001
7	Seventh day	61.65 + 4.88	83.26 + 6.38 +35.05 P<0.001

S.No	Day of fifth instar	control	Experimental (Prolactin treated)
1	First day	45.62 + 2.46	53.86 + 4.83 +18.06 P<0.001
2	Second day	59.37 + 5.29	71.51 + 6.54 +20.45 P<0.001
3	Third day	63.78 + 4.84	79.92 + 6.83 +25.31 P<0.001
4	Fourth day	66.26 + 4.37	84.18 + 6.99 +27.04 P<0.001
5	Fifth day	69.17 + 5.73	90.34 + 8.06 +30.61 P<0.001
6	Sixth day	72.42 + 3.84	98.76 + 7.28 +36.37 P<0.001
7	Seventh day	77.98 + 5.46	106.28 + 8.36 +37.88 P<0.001

Table 3: Day-to-day changes in the total digestion (g) in control and experimental (Prolactin treated) larvae of the fifth instar silkworm, Bombyx mori L. Values are the means of 10 individual observations + Standard Deviation (S.D.), followed by percent changes and student's 't' test

S.No	Day of fifth in-star	control	Experimental (Prolactin treated)
1	First day	61.24 + 3.82	68.85 + 5.70 +12.43 P<0.001
2	Second day	63.75 + 6.89	73.74 + 7.02 +15.67 P<0.001
3	Third day	68.03 + 5.45	80.56 + 7.38 +18.42 P<0.001
4	Fourth day	72.58+ 4.84	88.37 + 7.82 +21.76 P<0.001
5	Fifth day	76.34 + 5.13	93.73 + 7.68 +22.78 P<0.001
6	Sixth day	78.71 + 6.24	98.42 + 5.29 +25.04 P<0.001
7	Seventh day	82.49 + 7.85	108.83 + 6.42 +31.93 P<0.001

Table 4: Day-to-day changes in the digestibility (%) in control and experimental (Prolactin treated) larvae of the fifth instar silkworm, Bombyx mori L. Values are the means of 10 individual observations + Standard Deviation (S.D.), followed by percent changes and student's 't' test.