Research Paper

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Biopotentiality of Waste Pupae Bioprotein as Nutritional Supplement to Improve the Economic Traits in *B. Mori.*

Biotechnology

KEYWORDS : Waste pupae protein, mulberry leaves, silkworm, economic traits

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ABSTRACT

The objective of the present study was to investigate the effect of waste pupae soluble protein aqueous extract fortified mulberry leaves on the various economical parameters of silkworm B. mori, with special reference to cocoon and post cocoon parameters. Mulberry silkworm is the most successful commercial silkworm accounting about 80 % of all silk production all over the world. The main experimental groups comprised with and without pupae protein extract supplementation and sub groups includes five different concentration of pupae protein extract (100 , 200, 300, 400 and 500 ppm). The protein extracts treated leaves fed on 1st feeding of 2nd, 3rd and 4th days of the Vth instar larvae. The result showed a significant improvement in the economical traits in the all protein extract treated subgroups over the control. The most significant result was recorded in the group treated with 200 ppm. These waste pupae can be recycled and used as nutritional supplement on the mulberry leaves, for better quality cocoon production and quality silk.

INTRODUCTION

Sericulture is one of the environment friendly, agro-based rural industry which fits into integrated farming system for improved economical and social status of faming commune. In recent years awareness about reutilization of bio-waste is increasing and priority has been given to utilization of environmentally acceptable bio-waste material at various industries. The spend pupae are a one of the major by-product of silk production (2). For 1 kg of raw silk, 8 kg of wet pupae (2kg of dry pupae) is produced (13). In sericulture almost all bio-waste materials are recycled and reused. Appropriate volume of work has been done on various silk waste e.g. silkworm excrement, in contrast less work has been done on pupae waste except few.

Some reports revealed that due to its high protein content, silkworm pupae meal found suitable as a livestock feed, notably in monogastric species (poultry, pigs, fish), but also in ruminants (19). It had been reported that the pupae contains crude protein, soluble proteins, essential amino acids, valuable oil and carbohydrate along with some essential micronutrients (4, 14). Because of high nutritional value silkworm pupae have long been part of human food in Asian silk-producing countries like China (8), Japan (10), Thailand (21), India (6).

The positive roles of various amino acids (17), vitamins (3), protein (12, 18) and hormones (9) in induction of larval growth and cocoon characters have been observed in B. mori. Since the references on the use of waste pupae bio-protein for boosting cocoon parameters was not found in review of literature. Furthermore in view of the potential application and the improved cocoon economical traits, need for the development of economical method, recycling of protein rich pupae waste could be an excellent supplement substrate. Therefore, the present investigation was carried out with the objective of assessing the effect of waste silkworm pupae protein extract on the economical traits of silkworm.

MATERIALS AND METHODS

Silkworm

To perform the experiment, the disease free layings (eggs) of BAIF developed local multi-voltine *B. mori* Varity were employed. Dfl's were collected from the Germ-plasm Bank of the BAIF Sericulture Division. They were disinfected with a 2% formalin solution.

Brushing and Rearing

The present study was conducted in spring season at Sericulture laboratory, BAIF Central Research Station, Pune, India. Disinfected dfls were incubated and black boxed properly for synchronized hatching. Further silkworms were reared under the ideal rearing condition prescribed by (5).

The Vth in-star silkworm larvae were selected and grouped into six treatment including control. Each treatment was replicated with three times to have 100 worms/replica to check the effect of waste silkworm pupae protein extract on economic traits.

Experiment design

Selection of effective concentration of Pupae protein

To study the effect of waste silkworm pupae protein extract on economical traits of B. mori, the experiment was performed with different concentration of pupae protein aqueous extract on V instar larvae. Aqueous extract of pupae protein was obtained by following method (7). One gram of pupae protein contains 46.5% protein.

Aqueous (distilled water) extract of pupae protein 100 ppm (T1), 200 ppm (T2), 300 ppm (T3), 400 ppm (T4), 500 ppm (T5) and control (T6) were prepared. Sprayed leaves were shade dry and fed on 1st feeding of 2nd, 3rd and 4th days of the Vth instar larvae.

The control group was fed with mulberry leaves sprayed with distilled water. The control and pupae protein treated V1 mulberry (Morus Alba) leaves were fed to silkworm B. mori, four feeding /day. Mature larvae were collected and mounted on an improved mountage developed by BAIF.

The study was focused on economical traits. Data on cocoon weight (gm), shell weight (gm), silk ratio (%), and filament length (m) was recorded.

STATISTICAL ANALYSIS:

Values of the measured parameter were expressed as Mean ± SEM. The statistical analysis was performed using the one-way analysis of variance in factorial arrangement with the computations being performed with the statistical program DB-State. The fisher's least significance difference (L.S.D.) was used to compare treatment means at ***p= 0.001, **p=0.01 and *p= 0.05 level of significance.

RESULTS AND DISCUSSION

Silkworm economical characteristics influenced by supplementation of silkworm pupae protein are hypothesized. The present study demonstrates positive effect of supplementation of waste

pupae protein extract to 5th instar larvae on all economical parameters. It was observed that cocoon weight, shell weight, shell ratio, filament length have shown as increased trend with treatment of pupae protein aqueous extract when compare that of untreated control (Table 1). The group of silkworm fed with treated mulberry leaf with pupae protein extract at 200 ppm concentration shown the highest cocoon weight (1.03 ± 0.314 gm), shell weight (0.168 ± 0.020 gm), shell ration (16.36 ± 0.676 %) and filament length (735.47 ± 0.416 m). ANOVA revealed significant ($p<0.001$) increase in cocoon weight, shell weight, shell ratio and filament length by 13.26 %, 23.33%, 9.01% and 28.96% respectively (Table.1).

Table-1 Economic traits of control and different concentration of pupae protein treated *Morus alba* leaves for V instar larvae of B. mori produced cocoon

Pupae protein Treatment	Cocoon wt (gm)	Cocoon shell wt (gm)	Cocoon shell ratio (%)	Filament length (m)
Control (C)	0.91 ± 0.125	0.136 ± 0.013	15.00 ± 0.070	570.00 ± 2.646
100 ppm (T1)	0.97 ± 0.189** (6.64%)	0.153 ± 0.006*** (12.39%)	15.81 ± 0.235* (5.41%)	639.90 ± 0.985*** (6.06%)
200 ppm (T2)	**1.03 ± 0.314***** (13.26 %)	0.168 ± 0.020*** (23.33%)	16.36 ± 0.676*** (9.01%)	735.47 ± 0.416*** (28.96%)
300 ppm (T3)	0.98 ± 0.013** (7.69%)	0.156 ± 0.013*** (14.07%)	15.89 ± 0.123* (5.92%)	658.76 ± 0.507*** (5.30%)
400 ppm (T4)	1.01 ± 0.299*** (11.11 %)	0.158 ± 0.052*** (15.81%)	15.64 ± 0.272* (4.23%)	675.60 ± 1.682*** (6.82%)
500 ppm (T5)	1.02 ± 0.164*** (12.37%)	0.159 ± 0.038*** (16.75%)	15.59 ± 0.409 (3.90%)	682.18 ± 0.952*** (7.58%)

Values presented as means ± SD; * significant at $p < 0.05$.
** Significant at $p < 0.01$, *** significant at $p < 0.001$
% increase in economical parameters over control

The increase in larval weight may be due to the presence of maximum amount of essential amino acids, minerals, bioprotein, and other active elements which may determines the specificity for various metabolic activities in silkworm.

Venkatesh kumar et al. (2009) recorded improvement of the economical characters of silk cocoon by feeding the silkworm with mulberry leaves treated with Spirulina. The result obtained by Pallavi et al. (2012) revealed that supplementation of Amway protein resulted in significant increase in all cocoon weight, shell weight, shell ratio and filament length compare to control group. Dietary supplementation of extract of pupae protein led to increase in the silk production of *Antheraea assama* observed by Saikia (2012). In the present study, cocoon weight, shell weight, shell ratio and filament length were found to be increase significantly over control by treatment with waste pupae bioprotein extract.

CONCLUSIONS

In summary, the significant improvement of economical traits caused by feeding of mulberry leaves fortified with aqueous extract of waste pupae protein. The improvement in economical traits was probably rich protein; micro and other nutrient content of spend pupae of reeling waste. From the present study it was evident that 200 ppm concentration of pupae extract can be used as optimum dose for the better performance of rearing and reel economical parameters of silkworm *Bombyx mori*. Hence, the reuse of waste pupae protein as supplement should be encouraged as it is cost effective and Eco-friendly.

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