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EFFECT OF LEAF SUPPLIMENTATION WITH SECONDARY METABOLITES ON ECONOMIC TRAITS OF MULBERRY SILKWORM

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ABSTRACT

Silkworms fed on supplemented leaves dipped in different lower and higher concentrations of three secondary metabolites to all the larval instars four times in a day. Lower concentrations of pectin, amino acid mixture and proline proved to be considerably effective showing higher shell ratio, weight of shell and cocoon was also noticed to be higher, reliability was significantly higher and lower renditta found to be superior in lower concentrations of secondary metabolites than the higher concentrations. These findings reported that economic traits was noticed and found to be superior in lower concentration of secondary metabolites, which performed best results amongst the treatments and natural diet, which showed that significantly, improved the silk production and they can recommend as leaf supplementation for increasing farmer's income as well.

Keywords: Fortifications, secondary metabolites, economic traits, silkworm.

INTRODUCTION

Nutrition plays an important role in improving the growth and development of *Bombyx mori* L. It is stated that silk production is dependent on the larval nutrition and nutritive value of mulberry leaves, which plays a very effective role in producing good cocoons (Legay, 1958). Significant seasonal variations occur in the nutritional value and composition of mulberry leaves depending on factors *viz*., weather, pests and disease as well as silkworm production (Ito, 1978), Leaf supplementation with secondary metabolites plays one of the important role by which cocoon and silk productivity can be increased and quality can be enhanced and maintained. Sengupta *et al*., (1972) revealed that *Bombyx mori* L. requires specific essential sugars, amino acids, proteins and vitamins for its normal growth of silkworm, survival and also for improvement in the growth of silkgland. Good quality cocoons can be obtained when silkworms fed on nutritionally supplementated leaves their results improved the silk production (Seki and Oshikane, 1959). In silkworms, silk fibroin is derived mainly from 4 amino acids: alanine, serine, glycine and tyrosine (Kirimura, 1962) which come from their dietary source of protein and amino acids (Ito, 1983). Silkworms obtain 72-86 % of their amino acids from mulberry leaves and more than 60 % of the absorbed amino acids are used for silk production (Lu and Jiang, 1988).The amino acid plays an important role in glucose, tryptophan and organic acid metabolism. Few studies have been conducted on amino acids supplementation; their results improved the silk production (Etebari and Matindoost, 2005). Thus, in the present study a comprehensive effort was made to determine whether mentioned secondary metabolites like lower concentrations of pectin, proline and amino acid mixture, supplementation influences the growth and development of silkworms along with their cocoon parameters.

MATERIALS AND METHODS

Silkworm Rearing: Eggs of Kolar Gold (PM x CSR_2) were reared in the Sectional Laboratory, Agriculture College, Pune under standard conditions of 29 ^{0}C with a RH of 75±5 % and a photoperiod of 16 L: 8D as described by Harizanis (2004). Fresh mulberry leaves were used for feeding the silkworms. Treatments: Amino acids was dissolved in distilled water and diluted to lower and higher concentrations of three amino acids *viz.,* pectin (0.5 %) and (1.0 %), proline (1 %) and (2 %) and amino acid mixture (0.01%) and (0.02 %) along with natural

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diet. Silkworms fed on supplemented leaves to all larval instars. Fresh mulberry leaves were dipped in different lower and higher concentrations of secondary metabolites and then after drying within 15 minutes under fan were fed to the all instars of silkworm larvae were fed five times a day during initial three instars at 6AM, 11AM, 14PM, 18PM and 22PM with succulent leaves whereas later two instars were fed four times a day at 6AM, 13AM, 17PM and 22PM with coarse leaves daily. A batch of 100 larvae was fed with untreated leaves as control. Experiment was accomplished using a completely random design with five replications for each of the treatment by using 100 silkworms per replication. Cocoon, pupa and shell weights; one week after pupation, the cocoon, pupa and shell weights, reelability and renditta were recorded as advocated by Rahmathulla *et al*. 2007 and calculated with the following formulae. Economic Traits: The ♂ and ♀ cocoons @ 10/replicate were randomly selected and observations were recorded on mean of single cocoon weight, pupal weight, shell weight, shell ratio, renditta and reelability; the details of which are given below.

- Cocoon weight: Single cocoon weight was calculated by the formula, Cocoon weight (g) = (♂10 cocoon weight + ♀10 cocoon weight) ÷ 20 x100
- Shell weight: Single shell weight was estimated by the formula, Shell weight (g) = (♂10 shell weight + ♀ 10 shell weight) ÷ 20 x100
- Shell ratio: Calculated by the following formula, Shell ratio (%) = (Single shell weight ÷ Single cocoon weight) × 100
- Effective rearing rate by number: Calculated by the formula, ERR (by number) = (Total harvested cocoons ÷ Total number of larvae retained after last moult) × 100
- Effective rearing rate by weight (Kg): Estimated as quantity of cocoons harvested for 10,000 larvae retained after last moult that was calculated by the following formula, ERR (by weight in kg) = (Weight of harvested cocoons ÷ Total number of larvae retained after last moult) × 100
- Reelability: Indicates easiness in unwinding of silk filament from cooked and brushed cocoons with the help of reeling machine to obtained raw silk of desire thickness. Ratio of unbroken filament to the whole filament length during reeling was estimated by formula, Reelability (%) = (Unbroken filament ÷ Whole filament length) x 100.
- Renditta: Represents actual silk prevailing in cocoons to be reeled out; practically, it is quantum of cocoons that produces 1 kg silk. Its lower and higher value denotes more and less silk content within the cocoon, respectively. It was estimated by the formula, Renditta (kg) = Constant (K) ÷ Shell ratio wherein, the constant was 165, 150 and 133 for 14-16, 17-20 and 21-23 per cent shell ratio as recommended by Ganga and Chetty (1991).

Statistical Analysis: Data were subjected to analysis of variance to determine if the differences found among treatments and the differences between treatments and the untreated control (Natural diet) were significant.

RESULTS

The results of the present investigations on effect of leaf supplementation with secondary metabolites on economic traits of Kolar Gold (PM x CSR_2) are summarized in Table 1. It seems positive effects of lower concentrations of pectin (0.5%) and amino acid mixture (0.01%) were noticeable as compare with untreated natural diet and other higher concentrations of secondary metabolites. Feeding of larvae with leaf supplementation along with lower and higher concentrations of secondary metabolites. In the natural diet significantly lowest weight of single-cocoon (1.736 g), shell weight (0.305 g), shell ratio (17.56 %), reelability (86.40 %) and renditta (8.54 kg) were observed. Significantly higher single cocoon weight was noticed in 0.5 per cent pectin (1.930 g). Next higher cocoon weight in order of statistically significance was observed as 0.02 per cent amino acid mixture (1.908 g) and 0.01 per cent amino acid mixture (1.899 g); 1.0 per cent pectin (1.864 g), 1.0 per cent proline (1.847 g) and 2.0 per cent proline (1.817 g). Single shell weight was recorded significantly higher in 0.5 per cent pectin (0.424 g) that was followed by 0.01 per cent amino acid mixture (0.408 g), 1.0 per cent pectin (0.390 g), 1.0 per cent proline (0.387 g), 0.02 per cent amino acid mixture (0.382 g) and 2.0 per cent proline (0.363 g). Significantly higher shell ratio was recorded in 0.5 per cent pectin (21.97 %), which was found at par with 0.01 per cent amino acid mixture (21.46 %) and 1.0 per cent proline (20.95 %), whereas, 1.0 per cent pectin (20.94 %) followed by 0.02 per cent amino acid mixture (20.02 %) and 2.0 per cent proline (19.99 %). Amongst test treatments, reelability was observed in the range of

85.96 to 87.49 per cent, lowest and highest being in 2.0 per cent proline and 0.5 per cent pectin respectively. In descending order reelability was observed to be 0.01 per cent amino acid mixture (87.22 %) that was at par with 1.0 per cent pectin (86.79 %), 0.02 per cent amino acid mixture (86.45), 1 per cent proline (86.43), natural diet (86.40 %) and 0.02 per cent amino acid mixture (86.45), respectively. Significantly highest renditta was observed in natural diet (8.54 kg) and lowest in 0.5 per cent pectin (6.05 kg). Next lowest was recorded in 0.01 per cent amino acid mixture (6.20 kg), which was followed by 1.0 per cent pectin, 1.0 per cent proline and 0.02 per cent amino acid mixture were recording as 6.35 kg, which were followed by 2.0 per cent proline (7.50 kg). These findings indicated that reelability and renditta were noticed and found to be superior in 0.5 per cent pectin and 0.01 per cent amino acid mixture which performed best results amongst the treatments and natural diet. The results in respect of economic traits, pointed out that lower concentrations of the test treatments were found more promising than their higher concentration. Findings reported that economic traits was noticed and found to be superior in 0.5 % pectin and 0.01 per cent amino acid mixture which performed best results amongst treatments and natural diet.

Table 1: Effect of secondary metabolites on economic traits.

Treatment	Cocoon Wt (g)	Shell Wt (g)	Shell ratio (%)	Reelability (%)	Renditta (Kg)
Pectin (0.5 %)	1.930	0.424	21.97 (27.90)	87.49 (69.30)	6.05
Pectin (1.0 %)	1.864	0.390	20.94 (27.20)	86.79 (68.70)	6.35
Proline (1 %)	1.847	0.387	20.95 (27.20)	86.43 (68.36)	6.35
Proline (2 %)	1.817	0.363	19.99 (26.56)	85.96 (67.94)	7.50
Amino acid mixture (0.01 %)	1.899	0.408	21.46 (27.63)	87.22 (69.04)	6.20
Amino acid mixture (0.02 %)	1.908	0.382	20.02 (26.56)	86.45 (68.36)	6.35
Natural diet	1.736	0.305	17.56 (24.73)	86.40 (68.36)	8.54
SE ±	0.016	0.003	0.24	0.766	0.060
C.D. at 5 %	0.048	0.010	0.69	2.221	0.175

(Figures in parenthesis are the mean arcsin transformed values.)

DISCUSSION

The present findings were in conformity with the findings of Chapman, 1998 reported that in order to have best larval growth, insect needs optimum level of amino acids, being used for structural purposes such as enzymes and transport-receptors. Under the studies, lower concentration of each of pectin and amino acid mixture were found promising than their higher concentration. Kabila et al. (1994) reported that lower concentrations of aspartic acid increased cocoon characteristics. Tazima (1978) reported that alanine played important role in glucose, tryptophan and organic acid metabolism wherein, aspargine was used as aspartic acids, constituting two groups of essential amino acids and its deficiency leads to growth retardation. Radjabi (2010) observed that lower concentration of aspargine and alanine recorded positive effect of effective rearing rate and had negative effect on shell ratio, therefore not be recommended for commercial silk production. However, Joshi (1985) and Radjabi (2009) found encouraging results with their higher concentration of amino acids. In the present investigations, aspartic acid and aspargine were not incorporated however, pectin and amino acid mixture were found to be promising; at their lower concentration, higher reelability, shell ratio and lower renditta; were found comparatively higher depicted better silk quality. Literature in respect of these amino acids being scanty on the whole the results are unable to discuss further. In conclusion, supplementation of silkworm with selected lower concentrations of amino acids at certain levels may be effective for improved growth, but a higher level of supplementations doesn't have a positive effect on silkworm growth and development. Supplementations of dietary nutrients with the aforesaid promising complementary additives increased content of leaf moisture that might have lead to higher consumption rate. This might have proportionately increased apparent digestibility that in turn resulted into enhanced digestion, absorption, assimilation and utilization of food energy in to larval bio-mass and thereby the cocoon. This might have induced upgrading economic parameters as suggested by Rahamathulla (2007). Further, conversion rate of leaf into silk was also found to be promising depicting higher silk content that represented superiority of silk quality as pointed out earlier by Trivedy (2003).

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