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EFFECT OF MULBERRY LEAVES ENRICHED WITH THE AMINO ACID GLYCINE ON SOME BIOLOGICAL ASPECTS OF SILKWORM, *BOMBYX MORI* L.

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ABSTRACT: *The effect of amino acid glycine on the growth and silk production of mulberry silkworm Bombyx mori was investigated during the last larval instar. Different treatment (0.25, 0.50, 1 and 2%) of glycine supplementation were performed with compared of controls. The growth of the larvae, weight of fresh cocoon, pupae and cocoon shell significantly increased with glycine supplementation. It was observed that the cocoon parameters and economical parameters were enhanced by 0.1 % glycine treated larvae than control and other treated concentrations. This study indicated that the glycine supplement exhibits the presence of certain growth stimulant activity and can be used to increase the silk yield in commercial silkworm rearing.*

Key words: *Amino acid, glycine, silkworm, Bombyx mori.*

INTRODUCTION

The mulberry silkworm, *Bombyx mori* is a monophagous insect derives almost all the nutrients required for its growth from the mulberry leaf only. It has been well established that the silkworm requires certain essential sugars, proteins, amino acids, fatty acids, vitamins and micronutrients for its growth and higher production of good quality of silk. It is established that the last larval instar of *Bombyx mori* is the most responsive stage to the food additives (El-Karaksy 1979). Nutritive requirements of silkworm are almost exclusively covered by the use of mulberry leaves, due to the presence of morin (Vlaic *et al*., 2004). Silk production depends on the larval nutrition and health status. Feed with various food additives was found to increase the economic characters of silk production and play a vital role in the larval development (Kochi and Kaliwal, 2005). Silkworm nutritionists have always been searching for better food by supplementing the mulberry leaves with different nutrients such as B complex vitamins (El-Karaksy *et al*., 1983), ascorbic acid (El-Karaksy *et al.,* 1985 ; El-Karaksy and Idriss 1990 ; Babu *et al.,* 1992), various minerals (Ishtiaq and Akhtar,1992; Quader *et al*., 1993; Zaman *et al*., 1995; Nirwani and Kaliwal, 1996; Hugar *et al*., 1998; Etebari and Fazilati, 2003; Islam *et al*., 2004; Khan *et al*., 2010; Benţea *et al*., 2012; Essawy *et al.,* 2013), melatonin and vitamin B_6 (Sugden *et al*., 1987; Saad and Ghazy, 2008), Thyroxine (Saad, 2009) to achieve an increase in the productivity of the silk yield.

The present investigation was undertaken to study the effect of adding amino acid Glycine to the food supply of *Bombyx. mori* on economic parameters of the mulberry silkworm.

MATERIALS AND METHODS

1. Insects:

European univoltine race of silkworm, *Bombyx mori* L. was used in the present study. Silkworm eggs were obtained from the Sericulture Research Department (SRD) of Plant Protection Research Institute (PPRI), Agricultural Research Center (ARC), Giza, Egypt. Insect rearing was done in the laboratory under the hygro-thermic conditions of 28 ± 1 °C and 75 ± 5% RH, following the standard methodology of rearing in SRD according to Krishnaswamy (1978). The experimental study was performed on the last larval instar. All the larvae which molted to the last instar at the same time were grouped and used for the tests.

2. Chemicals:

Glycin ($C_2H_5NO_2$), or glycocoll or N-glycine, is N-substituted p-aminophenol product of Sigma Co. as powder package, molecular weight: 75.07 g/mol.

3. Treatments:

The amino acid glycine was dissolved in distilled water and the concentrations of 0.25, 0.50, 1 and 2% were prepared. The mulberry leaves were dipped in 500 ml of solution for 3 minutes then left to dry and offered to the silkworm larvae three times at the first day of the last instar. The carrier controls were fed with mulberry leaves soaked in distilled water. The observations recorded were: weights of twenty mature larvae, twenty fresh pupae, twenty pupae and twenty of the shell weight of cocoons. The data was statistically analyzed by Statistics Program Version 9.0 by using one way analysis of variance (ANOVA) followed by LSD test (SAS Institute, 2003).

RESULTS AND DISCUSSION

The effect of the amino acid glycine on the growth of the larvae and production of cocoon of the mulberry silkworm *Bombyx mori* was investigated under four concentrations in comparison with control as follow:

1- Effect of amino acid glycine on the mean weight of larvae.

Data in Table (1) revealed that larvae fed on mulberry leaves supplemented with the amino acid glycine showed a significant weight increase percentages of 46.5 and 29.3% at the concentrations of 1 and 2%, respectively, while insignificant weight decreases of 0.8 and 6.5% were produced when larvae fed on leaves treated with 0.25 and 0.50% concentrations, respectively. It was observed that the concentration of 1% enhanced the larval growth. Similar results have been reported by Kabila *et al.* (1994) who reported that adding aspartic acid at 1 and 2% concentrations to leaves increases the economic traits in silkworm, Sarkar *et al.* (1995) demonstrated that with utilizing alanine (0.5%) and glycine (0.5%) more than 14% weight increase in 5th instar larvae was detected, and Etebari *et.al.,* 2002 reported that 0.5% glycine when treated from the beginning of 5th instar larvae could cause a maximum of 12.3% weight increase. In the present study, a significant increase of 46.5% was observed in the larval weight with glycine treated larvae at 1% concentration may be due to the stimulatory effect or enhancement of food consumption of those amino acids on the larval growth (Chakrabarty and Kaliwal, 2012).

Table (1): Mean weights of mature larvae fed on mulberry leaves supplemented with glycine.

Treatments	Mature larvae Mean Weight (g)±SD	Increase or decrease %
Glycine (2%)	3.910 ± 0.205 b	+ 29.3
Glycine (1%)	4.430 ± 0.531 a	+ 46.5
Glycine (0.50%)	2.830 ± 0.220 c	- 6.5
Glycine (0.25%)	3.000 ± 0.169 c	- 0.8
Control	3.025 ± 0.331b c	-

Means at column followed by the same letter are not significantly different at 5% level.

2- Effect of amino acid glycine on the mean weight of fresh cocoon.

Data in Table (2) revealed that larvae fed on mulberry leaves supplemented with amino acid glycine showed significant increases percentages in fresh cocoon weights of 19.8, 24.2 and 17.9% at the concentrations of 0.25, 1 and 2%, respectively. While a slight and insignificant decrease (0.02%) was observed at the concentration of 0.50%. The concentration of 1% gave the highest percentage in fresh cocoon weight by 24.2%, comparing with control.

3- Effect of amino acid glycine on the mean weight of pupae.

As shown in Table (3) larvae fed on mulberry leaves treated with amino acid glycine at concentrations of 0.25, 1 and 2% displayed a significant increase in pupal weights higher than control which was calculated as 22.0, 22.4 and 15.7%, respectively. While a slight and insignificant decrease (1.2%) was observed at a concentration of 0.50%. Glycine supplementation at 1% significantly enhanced the pupal weight by 22.4% more than control. Similar findings were obtained using vitamins supplementation (Saad and Ghazy 2008), ascorbic and amino acid (El-Karaksy and Idriss, 1990; Radjabi, 2010; Thulasi and Sivaprasad, 2013)

4- Effect of amino acid glycine on the mean weight of cocoon shell.

The larvae fed on mulberry leaves treated with glycine at concentrations of 0.25, 1 and 2% presented an increase percentages in cocoon shell weight of 5.0, 25.9 and 21.8% higher than untreated, respectively. The highest significant increase was gained at a concentration of 1%, while a significant decrease of 9.6% was observed when larvae were fed on glycine supplemented at 0.50%. The highest cocoon shell ratio was observed at high concentrations of 1 and 2% while the low concentration gave the lowest ratios as shown in (Table 4).

Table (2): Mean weights of fresh cocoon after larvae fed on mulberry leaves supplemented with glycine.

Treatments	Mature larvae Mean Weight (g)±SD	Increase or decrease %
Glycine (2%)	1.443 ± 0.127 a	+17.9
Glycine (1%)	1.520 ± 0.199 a	+24.2
Glycine (0.50%)	1.199 ± 0.200 b	-0.02
Glycine (0.25%)	1.466 ± 0.146 a	+19.8
Control	1.224 ± 0.215 b	-

Means at column followed by the same letter are not significantly different at 5% level.

Table (3): Mean weights of pupae after larvae fed on mulberry leaves supplemented with glycine.

Treatments	Mature larvae Mean Weight (g)±SD	Increase or decrease %
Glycine (2%)	1.152 ± 0.130 a	+15.7
Glycine (1%)	1.219 ± 0.198 a	+22.4
Glycine (0.50%)	0.984 ± 0.181 b	-1.2
Glycine (0.25%)	1.215 ± 0.129 a	+22.0
Control	0.996 ± 0.178 b	-

Means at column followed by the same letter are not significantly different at 5% level.

Table (4): Mean weights of cocoon shell after larvae fed on mulberry leaves supplemented with glycine.

Treatments	Mature larvae Mean Weight (g)±SD	Increase or decrease %	Treatments
Glycine (2%)	291 ± 0. 6 a	+21.8	20.2
Glycine (1%)	301 ± 0. 1 a	+25.9	19.8
Glycine (0.50%)	216 ± 4. 6 c	-9.6	18.0
Glycine (0.25%)	251 ± 2.6 b	+5.0	17.1
Control	239 ± 5. 3 b	-	19.6

Means at column followed by the same letter are not significantly different at 5% level.

Cocoon shell and cocoon shell ratio were enhanced by glycine supplementation at 1 and 2%. The study results were in agreement with the administration of thiamine (Nirwani and Kaliwal, 1996; Rai *et al*., 2002), ascorbic acid (El-Karaksy and Idriss, 1990; Babu *et al*.,1992; Etebari *et.al.*, 2002; Thulasi and Sivaprasad, 2013), glycine (Chakrabarty and Kaliwal, 2012).

It could be concluded that treatment of amino acid glycine at the concentration of 1% may have beneficial effects on the silk production and economic traits like larval weight, pupal weight, shell weight, shell ratio, and also increased the quantity of silk by enhancing the silk production over the control. So, this glycine supplementation could be described to the farmers to get more quantity of silk.

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تأثير إضافه الحامض الامينى الجليسين لأوراق التوت على بعض النواحي البيولوجية والإنتاجية لدودة الحرير التوتية بومبكس مورى

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الملخص العربي

تمت دراسة تأثير إضافة الحامض الأميني جليسين للغذاء الورقى لدوده الحرير التوتية بومبكس موري على نمو وإنتاج الحرير خلال الطور اليرقي الأخير حيث تم إضافه الجليسين بعده تركيزات هي (٠.٠٢٥، ٠.٠٥٠، ١، ٢ %) مقارنه بالكنترول. وقد زاد معدل نمو اليرقات وكذلك أوزان العذارى والشرانق الطازجة وقشره الحرير عند اضافه الجليسين. في هذه الدراسة لوحظ تحسن انتاج الشرانق والصفات الاقتصادية عند معاملة اليرقات بالتركيز ٠.١٪ من الجليسين مقارنه بالتركيزات الاخرى. وأوضحت هذه الدراسة أن الجليسين كمكمل غذائى يسلك سلوك بعض منشطات النمو ويمكن استخدامه لزيادة انتاج الحرير بشكل تجارى.