

COMPARATIVE STUDY OF THE EFFECT OF CAMPHOR HONEY BEE AND CAMPHOR OIL ON SOME BIOLOGICAL AND PRODUCTIVITY CHARACTERS OF MULBERRY SILKWORM, *Bombyx mori* L.

Saad M. S. I.; Eman M. Hassan and I. A. I. Saad

Sericulture Research Department (SRD), Plant Protection Research Institute (PPRI), Agricultural Research Center (ARC), Egypt.

ABSTRACT

The effect of camphor honey and camphor oil (1, 2, 3, 4 and 5%) on the growth and silk production of mulberry silkworm *Bombyx mori* L. was investigated. It was found that camphor honey bee (5%) and camphor oil (1%) increased the grown larval weight, silk gland weight, cocoon weight, cocoon shell weight, silk content ratio, and represented by (3.78 and 4.076 gm); (0.872 and 1.050gm); (1.730 and 1.668 gm); (0.284 and 0.284 gm) and (1.204 and 1.216 %), respectively. Moreover, camphor honey bee 5% and camphor oil 1% increased also silk filament length, silk filament weight and silk filament size and represented by (1051.40 and 1059.80 m); (0.28 and 0.27 gm) and (3.39 and 3.39 dn.), respectively.

Keywords: Silkworm, *Bombyx mori*, camphor, antibiotic, biology, honey bee.

INTRODUCTION

Nutritional value of mulberry leaves plays an important role in the growth of larvae, as well as silk production Legay (1958). Some food additives to mulberry leaves were evaluated to improve the production and growth Sengupta *et al.* (1992). Also Zannoon (1994) reported that, various solutions of bee honeys increased the mean weight of the mature larvae, silk gland, fresh cocoons, cocoon cortex and the number of deposited eggs per female. Moreover, it gave heavier and longer filaments of reeled cocoons, but did not affect on cocoon silk content ratio and filament size. Eucalyptus oil (EO) has antibacterial, antiviral, and antifungal components and a long history of use against the effects of colds, influenza, other respiratory infections, rhinitis, and sinusitis, Angela and Davis, (2010). Using of camphor honey and camphor oil as nutritional additives for mulberry leaves to improve the production and a disinfectant against diseases that might infect the larvae at different ages because of its antiseptic effect against fungi and bacteria. There are many factors that influence the success of production of silk. In recent years, some antibiotic agents have been used for growth enhancement of silkworm larvae and improvement of production, Thilagavathi *et al.* (2013). Silkworm is affected by several diseases and at time causes heavy crop losses. Various chemicals (antibiotics) are extensively employed to prevent the attack of diseases to the silkworm thereby, help in, increasing the productivity of silk. Radha *et al.* (1980) and Anonymous (1980). The present study aimed to evaluate the effect of the camphor honey bee and camphor oil as nutritional additives on silkworm *B. mori* to improve its growth and productivity.

MATERIALS AND METHODS

The present experiments were carried out during spring season of 2013 in laboratories of Sericulture Research Department, Plant Protection Research of Sharkia Branch, Institute, Agriculture Research Center, Egypt to study the biological and technological effects of camphor honey bee and camphor oil as a nutritional additive on silkworm *Bombyx mori* larvae growth.

Materials:

- 1-The hybrid mulberry silkworm *Bombyx mori* (local hybrid).
- 2-Camphor honey bee prepared by dissolving 50 ml of camphor honey in 1000 ml ((50 ml honey/1000) × 100) of distilled water to prepare a concentration of 5%; 40 ml of honey to prepare a concentration of 4%; and so the remaining concentrations. Used concentration cleared at the following.
- 3- Camphor oil from *Eucalyptus* sp. leaves. Prepared by Harvey and John (1898).

Silkworm rearing technique:

Rearing of silkworm was carried out under laboratory conditions (28 ± 2°C and 70 ± 5% R.H.) without any adjustment or changes in temperature or relative humidity according to the technique of Krishnaswami (1978). The larval bed was cleaned daily. Cleaning net was used for removing the remained dried food and feces. Chicken egg cartons plates were used as montages for cocoon spinning Zannoon and Omera (1994).

Methods:

Larvae under investigation were divided into two groups. Every group was divided to five subgroups to fed on mulberry leaves supplemented with camphor honey or camphor oil concentrations one meal at the first day of the 4th instar after molting and another time in the mid of the same instar. Three replicates (100 larvae) for each. Mulberry leaves were dipped in the concentrations of treated camphor oil and honey for 5 minute and left to dry then offered to larvae. The control group of leaves was treated only with distilled water.

The following parameters were studied:

Biological aspects: Larval weight (gm); Silk gland weight (gm).

Cocoon indices: weight of fresh cocoon (gm); Weight of cocoon shell (gm); Silk content ratio (%): Silk content ratio was calculated according to Tanaka (1964) formula:

$$\text{Silk content ratio (\%)} = \frac{\text{weight of cocoon shell (mg)}}{\text{weight of fresh cocoon (mg)}} \times 100$$

Filament characters: Length of reelable filament (m); Weight of reelable filament (gm); Size of reelable filament (dn), Tanaka (1964): Size of silk filament (dn.) = (Weight of filament (gm)/ Length of filament (m) × 9000.

Statistical analysis

Data obtained were statistically analyzed according to Snedecor and Cochran (1967) methods using computer software Costat program.

RESULTS AND DISCUSSION

Biological aspects:

According to biological aspects, results of using camphor honey and camphor oil revealed significant increase in biological aspects than control as follows:

Larval weight (gm.):

Data in Table (1) revealed that larvae fed on mulberry leaves supplemented with camphor honey(5%) and camphor oil(1%) showed a significant increases about (26.75%) and (30.67%) in larval weights, respectively. While a significant decrease about (3.70%) was caused when larvae fed on leaves treated with camphor honey (1%). Results showed that there are high significant differences between the treatments, as well as concentrations

Table (1): Effect of camphor honey and camphor oil on some biological characters of silkworm, *B. mori* L.

Treatment	Conc.	Larval weight (gm)	Changes (%)	Silk gland weight (gm)	Change (%)
Camphor honey	1%	2.872	-3.70	0.704	-8.81
	2%	3.468	16.29	0.712	-7.77
	3%	3.466	16.22	0.776	0.52
	4%	3.570	19.71	0.808	4.66
	5%	3.780	26.75	0.872	12.95
Mean		3.431		0.774	
Camphor oil	1%	4.076	30.67	1.050	36.10
	2%	3.704	24.19	0.942	28.02
	3%	3.428	14.20	0.990	28.23
	4%	3.274	9.78	0.978	26.68
	5%	3.322	11.93	0.976	26.45
Mean		3.539		0.952	
Control		2.982		0.772	
LSD*		0.310**		0.097**	
LSD**		0.377*		0.063**	

* L.S.D 0.05 for concentration ** LSD 0.05 for treatment

Silk gland weight (gm.):

Obtained data in Table (1) cleared that larvae fed on mulberry treated with camphor honey (5%) presented a significant increase of silk gland weight (12.95%) compared with control, while the low concentrations of 1 and 2% showed a negative values. On the other hand, camphor oil at all concentrations (especially 1, 2 and 3% recorded the highest significant values in comparison to control.

According to the obtained results, it could be concluded that feeding silkworm larvae on mulberry leaves treated with high concentrations of camphor honey and, lowest concentrations of camphor oil enhanced the Larval weight and silk gland weight of silkworm These results can be supported by Sengupta *et al.* (1992), Zannon (1994), El-Sayed *et al.* (1998), Khalil *et al.* (2006), Fathy *et al.* (2008), Zannon *et al.* (2008) and Gad (2013)

who reported that improvement of mulberry leaves with some concentrations of honey bee led to increase the larval growth.

Technological aspects:

Cocoon indices:

Cocoon indices represented the most important indices in silk production.

Cocoon weight (gm.):

The highest mean weight of cocoons was increasingly about 55.28% at 5% concentration of camphor honey, and about 49.20% at 1% concentration of camphor oil, respectively in comparison to the control (Table 2). Results showed that there are high significant differences between the treatments, as well as concentrations.

Cocoon shell weight:

Data obtained in Table (2) showed that, the larvae fed on mulberry leaves treated with camphor honey(5%) and camphor oil (1%) caused increases in produced cocoon shells weight about 26.79 and 26.78%, respectively higher than control. While, decreases observed at low concentrations (1 and 2%) of camphor honey and highest concentration (5%) of oil treatments.

Table (2): Effect of camphor honey and camphor oil on cocoon indices of silkworm, *B. mori* L.

Treatment	Conc.	Cocoon weight (gm)	Changes (%)	Cocoon Shell weight (gm)	Changes (%)	Silk ratio (%)	Changes (%)
Camphor honey	1%	1.152	3.04	0.216	-3.57	0.976	2.95
	2%	1.302	16.46	0.222	-0.89	1.046	10.34
	3%	1.328	18.78	0.232	3.57	1.076	13.50
	4%	1.354	21.11	0.244	8.93	1.182	24.68
	5%	1.736	55.28	0.284	26.79	1.204	27.00
Mean		1.374		0.240		1.097	
Camphor oil	1%	1.668	49.20	0.284	26.78	1.216	22.41
	2%	1.350	20.75	0.250	11.01	1.152	20.14
	3%	1.334	19.32	0.242	8.03	1.136	19.65
	4%	1.274	13.95	0.236	5.35	1.118	19.48
	5%	1.194	6.80	0.222	-0.89	0.988	19.19
Mean		1.366		0.246		1.118	
Control		1.118		0.224		0.948	
LSD*		0.088**		0.035**		0.065**	
LSD**		0.225*		ns		0.101**	

* L.S.D 0.05 for concentration ** LSD 0.05 for treatment

Silk content Ratio:

The results obtained in (Table 2) showed positive increases between the used concentrations of treatments and silk ratio ranged from 2.95 % to 27.00% and from 22.41% to 19.19% when fed on leaves treated with camphor honey and camphor oil, respectively. Results showed that there are high significant differences between the treatments, as well as concentrations.

The present results agree with, Radha *et al.* (1980), Shoukry *et al.* (1998) and El-Sayed and Mosbah (1992) who stated that, volatile oils as nutritional additives improved the biological and technological characters of

silkworm. Wang and Johnson (2001), Panfili *et al.* (2003) and Hassan and Saad (2012) investigated the efficiency of different concentrations of germ wheat oil as a nutritional additive offered to silkworm larvae. Mulberry leaves supplemented with wheat oil were offered to larvae 4th instar enhanced significantly all biotechnological characters. Also, Saad *et al.* (2012) and Thilagovathi *et al.* (2013) who reported that there are many factors that influence the success of production of silk. In recent years, some antibiotic agents have been used for growth enhancement of silkworm larvae and improvement of production. Moreover, Konala *et al.* (2013) reported that the using bovine milk to feed silkworm larvae has led to observes increase about 82% for larval weight compared to the control, as well as cocoon indices up to 8%. In the same trend, Saad *et al.* (2014) found that the growth of the larvae, the weight of fresh cocoon, pupae and cocoon shell were significantly increased with glycine supplementation.

Filament Characters:

Filament length (m.):

Data tabulated in Table (3) cleared that the filament length was higher than control by (25.60 and 26.60%) when larvae fed on leaves treated with camphor honey and camphor oil at concentration of 5% and 1%, respectively. Results showed that there are high significant differences between the treatments, as well as concentrations.

Table (3): Effect of camphor honey and camphor oil on silk filament characters of silkworm, *B. mori* L.

Treatment	Conc.	Silk filament Length (m)	Changes (%)	Silk filament Weight (gm)	Changes (%)	Silk filament Size (dn.)	Changes (%)
Camphor honey	1%	894.60	6.87	0.21	4.57	2.27	0.00
	2%	920.00	9.90	0.21	4.57	2.29	1.32
	3%	920.60	9.98	0.21	7.61	2.31	2.03
	4%	977.40	16.76	0.24	19.79	2.96	30.80
	5%	1051.40	25.60	0.28	43.15	3.39	49.69
Mean		952.80		0.23		2.65	
Camphor oil	1%	1059.80	26.60	0.27	39.08	3.39	49.69
	2%	972.60	16.18	0.25	25.88	2.59	14.47
	3%	958.60	14.51	0.23	17.76	2.47	9.00
	4%	946.00	13.00	0.20	3.55	2.40	6.00
	5%	941.00	12.41	0.19	-3.55	2.35	3.62
Mean		971.80		0.23		2.64	
Control		837.10		0.197		2.27	
LSD*		32.471**		0.013**		0.204**	
LSD**		63.258**		ns		ns	

* L.S.D 0.05 for concentration ** LSD 0.05 for treatment

Filament weight (gm):

The obtained results indicated also that the weight of the silk filament increased (43.15 and 39.08%) when larvae fed on mulberry leaves treated with camphor honey and camphor oil at concentration of 5% and 1%, respectively. Statistical analysis revealed that there are high significant

differences between the concentrations, while no significant differences between treatments.

Silk filament size (dn.):

Silk filament size presented an increase (49.69%) comparing control when the larvae fed on mulberry leaves treated with camphor honey and camphor oil at concentration of 5% and 1%, respectively. All used concentrations enhanced the silk filament size (Table, 3). Statistical analysis cleared high significant differences between the concentrations, while no significance was recorded between treatments.

The results obtained show that the effect of camphor on larval growth that led to a significant increase due to being a disinfectant against bacterial, viral and fungi, which works to improve the performance of larvae which will be reflected on the production.

These results can be supported by Radha *et al.* (1980), Shoukry *et al.* (1998) and El-Sayed and Mosbah (1992) who stated that, volatile oils as nutritional additives improved the biological and technological characters of silkworm. Also, Sengupta *et al.* (1992), Zannon (1994), El-Sayed *et al.* (1998), Khalil *et al.* (2006), Fathy *et al.* (2008), Zannon *et al.* (2008) and Gad (2013) reported that improvement of mulberry leaves with some concentrations of honey bee leading to increase the silk filament characters. Wang and Johnson (2001), Panfili *et al.* (2003) and Hassan and Saad (2012) found that mulberry leaves supplemented with wheat oil offered to 4th larval instar enhanced significantly all biotechnological characters. In the same trend, Saad *et al.* (2014) found 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 enriching mulberry leaves with the camphor honey and camphor oil can be used to increase the silk yield in commercial silkworm rearing.

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**دراسة مقارنة تأثير عسل الكافور وزيت الكافور على بعض الصفات البيولوجية
والإنتاجية لديدان الحرير التوتية
محمود سعد إبراهيم سعد ، إيمان محمود حسان و
إبراهيم عبدالعظيم إبراهيم سعد
قسم بحوث الحرير، معهد بحوث وقاية النباتات، مركز البحوث الزراعية، الدقى، مصر.**

تم دراسته تأثير اضافته عسل الكافور وكذا زيت الكافور بتركيزات 1، 2، 3، 4، 5 % لأوراق التوت لتغذية يرقات ديدان الحرير التوتية خلال العمر اليرقى الرابع على نمو اليرقات وإنتاجها من الحرير ومقارنه ذلك بالكنترول. وقد أدى التركيز 5% ، 1% من عسل وزيت الكافور على التوالي مقارنه بالكنترول الى زيادة وزن اليرقات الناضجة ووزن غدة الحرير ووزن الشرنقة وقشرة الشرنقة ونسبة الحرير فى الشرنقة حيث سجلت (3.78 و 4.076) ، (0.872 و 1.050 جم) و (1.736 و 1.668) ، (0.284 و 0.284 جم) و (1.204 و 1.216 %) على التوالي. بالاضافة الى ان عسل الكافور 5% وزيت الكافور 1% ادى الى زيادة طول خيط الحرير ، ووزن خيط الحرير و سمك خيط الحرير مسجلة (1051.40 و 1059.80 متر) ، (0.28 و 0.27 جم) و (3.39 و 3.39 دنير) على التوالي.

