Effect of Certain Products of the Honey Bee on the Productivity of the Mulberry silkworm *Bombyx mori* L.

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ADDITIONAL INDEX WORDS Mulberry silkworm, bee products, biology, biochemistry, and productivity.

ABSTRACT

The present work aimed to study the effect of supplementing mulberry leaves with the honey bee (*Apis mellifera*) products, (honey, propolis, royal jelly, pollen, beebread and bees wax) at different concentrations, on certain biological, biochemical and reproductivity parameters of the 5th larval instar of the mulberry silkworm *Bombyx mori* L. for increasing the silk and egg production. The treatments of the honey bee products at different concentrations significantly increased the biological, chemical and productivity parameters in comparison to the control treatment.The results indicated that mulberry leaves that treated with the honey bee products especially royal jelly at concentrations of 6 and 8 mg/100 ml water, as well as pollen (60mg /100 ml water) resulted in pronounced significant positive effects of higher values of biometrics, effective rate of rearing (E.R.R.) and the total protein content of silk gland which reflected on improving silk and egg production.

INTRODUCTION

Thousands of years ago honey bees have been known in the all world's major religions. Since ancient times, people have thought about honey's properties. Chinese and Egyptians used honey to heal wounds and cure some diseases (Grout, 1970). Cheng and Wong (1996) concluded that the honey and propolis prevented tumors from occurring in rat and mice. In the field of sericulture to increase and improve the silk and egg production of silkworms, many investigators studied the effect of royal jelly, honey and propolis as supplementary nutrients to the leaves on silkworms *B. mori* and *Ph. ricini* (Singh, 1960, Hashida, 1961, Ito, 1961, Firu et al., 1968, Khier, 1968, Mahgoub, 1976 and El – Karaksy, 1979). They studied the effect of the addition of royal jelly on the biological parameters and reproductivity of eggs and silk production.

The importance of honey in the nutrition of the silkworm was reported by El – Hattab (1985), El – Karaksy et al. (1989) and El – Sayed (1999). The propolis is one of the most valuable bee products and characterized by an antibacterial effects. Cizmarik and Matel (1978), El – Maasarawy (1995), Dawoud et al. (1995) and Nour et al. (1997) found that supplementing mulberry leaves with propolis extract seems to have anabolic effect on the silkworm. Hassanein (1997) reported that the honey samples, propolis and bees wax were effective in reducing and inhibiting the tumor formation induced by *Agrobacterium tumefasciens* on cylinders of squash fruits. In ancient times bees wax was much more important to man and the pharmaceutical industries which use bees wax in the preparation of salves and dental trade in the form of impression wax (Grout, 1970).

The use of bee pollen and the products of the bee hive are deeply imbedded in the history of mankind. Devlin (1993) suggested that bee pollen and other products of the hive have potential to help the health of people. Also Robert (1994) found that bee pollen has certain biological, physiological and pharmacological effects in humans and animals.

The present work was designed to study the effect of the honey bee products and they were chosen for their for importance as different rich components, on the biological characters and certain physiological parameters of the silkworm *B. mori* larvae to improve the silk and egg production. Also, bee wax, pollen and beebread were used for the first time to study their effects on the above parameters of B.mori larvae .

MATERIALS AND METHODS

The Chinese hybrid 9F7X of the silkworm *B. mori* larvae were reared under the at hygrothermic conditions of 26 ± 2 °C and 78 ± 5% R.H. The larvae were fed on fresh clean mulberry leaves until the 4th instar. The fifth instar larvae, which moulted at the same day, were randomly selected and grouped in separate trays for the tests.

The honey bee products that have been used in this study were collected from the Department of Apiculture A.R.C. Alex., Egypt. The suggested concentrations of such products that have been used were as follows:

1- Royal jelly at concentrations of 4, 6 and 8 mg / 100 ml water.
2- Honey at concentrations of 400, 600 and 800 mg / 100 ml water.
3- Pollen at concentrations of 40, 60 and 80 mg / 100 ml water.
4- Beebread at concentrations of 40, 60 and 80 mg / 100 ml water.
5- Propolis at concentrations of 40, 60 and 80 mg / 100 ml water.
6- Bees wax at concentrations of 40, 60 and 80 mg / 100 water.

Each of the above mentioned materials were dissolved in distilled water, except the propolis and bees wax were prepared according to the technique of Ashour (1989) and Cheng and Wong (1996). The concentrations were chosen on the light of the previously mentioned reviewed studies.

The experiments included eighteen treatments and one control, each treatment represented one concentration and was replicated three times and each replicate contained fifty ecdysed fifth instar larvae. Fresh mulberry leaves were dipped in the prepared concentration and they were introduced to larvae after being dried. The larvae of control treatment were provided with untreated leaves.

Daily inspection was made until the larvae reached the pre – pupal stage. The fresh weights of mature larvae, silk glands, pupae, cocoons and cocoon shells were determined. The durations of larvae and pupae were recorded. Female reproductivity was estimated by measuring both the length and weight of the female reproductive system. The number of deposited eggs / female moth, percentages of hatchability and effective rate of rearing were considered. The total protein in the silk glands in each treatment was determined using the

Kjeldahle method described by Vogel (1961). Data were statistically analyzed using "F" test and least significant difference (L.S.D.) at 5% probability level. The obtained percentages were adjusted using the angular transformation (Snedecor and Cochran, 1978).

RESULTS AND DISCUSSION

Weights of mature larvae, silk glands and pupae:

The demonstrated results in Table (1) show that the heaviest larval, silk gland and pupal weights were gained for the treatment of royal jelly at concentration 6 mg/100 ml water (3.6996, 1.2257 and 1.3579 g, respectively), followed by the treatments of pollen at concentration 60 mg/100 ml water (3.6127, 1.1019 and 1.3036 g, respectively) and royal jelly at 8 mg/100 ml water (3.5181, 1.0516 and 1.2882 g, respectively). Among the other treatments, the lightest weights (2.4575, 0.7408 and 1.0366 g, respectively) were recorded for the treatment of beebread at 40 mg/100 ml water, but they were still significantly heavier than those of the control treatment (2.3062, 0.5797 and 0.9777 g, respectively).

Larval and pupal durations of larvae and pupae:

Data in Table (1) show that the shortest duration of either the fifth larval instar or/and pupal stage were 8.67 and 12.33 days, respectively and they were recorded for the treatment of royal jelly at 6 mg/ 100ml water. The longest durations (12.67 and 14.33 days, respectively) were obtained for the treatment of bees wax at 80 mg/ 100 ml water as well as the control treatment in which this durations were 11.67 and 14.67 days, respectively.

The Effective Rate of Rearing (E. R. R.):

The results in Table (1) show that the treatments of the honey bee products at different concentrations significantly increased the effective rate of rearing over the control. The highest E. R. R. was obtained for the treatment of royal jelly at 6 mg/ 100 ml water (83.5%), while the lowest E. R. R. was recorded for bees wax at 60 mg/ 100 ml water (70.3%).

Silk production:

The effect of the honey bee products at different concentrations on the silk production is illustrated in Table (2). It is noticed that the treatment of royal jelly at 6 mg/ 100 ml water significantly produced the heaviest weights of fresh cocoon and cocoon shells (1.6765 and 0.3188 g, respectively) followed by the treatment of pollen at 60 mg/ 100 ml water and royal jelly at 8 mg/ 100 ml water which gave 1.6099 and 1.5729 g, respectively of cocoon and 0.3062 and 0.2847 g, respectively of cocoon shells. The lightest weights of fresh cocoon (1.2616 g) and cocoon shell (0.2235 g) were recorded for the treatments of beebread used at 40 mg/ 100 ml water and propolis at 80 mg/ 100 ml water, but they were still higher than that of the control (1.1687 and 0.1910 g, respectively).

Female moth reproductivity and hatchability:

Table (2) shows the evaluation of female moth reproductivity by measuring the length and weight of reproductive system and counting the

number of deposited eggs/female moth. The maximum increase of reproductive system length and weight were significantly obtained for the treatment of royal jelly at 6 mg/ 100 ml water (13.72 cm and 0.7014 g, respectively), meanwhile, the lowest measurement of reproductive system (length and weight) (11.56 cm and 0.4890 g, respectively) were recorded for the treatment of beebread at 40 mg/ 100 ml water. Also, the treatment of royal jelly at 6 mg/ 100 ml water significantly increased the number of deposited eggs / female up to 663.6 eggs / female, followed by the treatment of pollen (60 mg /100 ml water) and royal jelly at 8 mg /100 ml water, (605.3 and 599.9 eggs/female, respectively) in comparison with the untreated control which produced 379 eggs / female. The trend of the hatchability were more or less the same in the treatments of royal jelly at 6, 8 and 4 mg/100 ml water, and pollen at 60 ml/100 ml water. These later treatments were significantly raised the hatchability to 81.52, 80.38, 80.08 and 80.08%, respectively, while the hatchability of the control treatment was 71.96%.

Total silk gland protein:

The performed chemical analysis showed significant effects of all used honey bee products at different concentrations on the estimated total protein of the larval silk gland. The higher values of 14.17, 14.07 and 13.8% were recorded for the treatment of royal jelly at 6, 8 and 4 mg/ 100 ml water, respectively, followed by 13.4, 13.17 and 13.07% for those treatments of pollen at 60 and 80 mg and honey at 600 mg/ 100 ml water, respectively. The lower values of 12.33 and 12.1% were observed using propolis at 40 and 80 mg/ 100 ml water, respectively, and these values were still higher than those of the control treatment (11.5%) Table (1).

The results obtained in the present work indicating the effect of the honey bee product that have been used at different concentrations on the biological, chemical and productivity parameters are in agreement with the findings of Singh (1960) and Ito (1961). They recorded an increase in the larval weight and survival period due to the use of the royal jelly as a supplementing agent to the food of *B. mori*. Hashida (1961) stated that royal jelly decreased the percentage of mortality of the silkworm *B. mori*, and increased the weight of larval body and cocoons. He also found that honey is a valuable agent that can be add to mulberry leaves. Khier (1968) and Mahgoub (1976) reported that the castor leaves treated with royal jelly or injecting the larvae with the prepared concentrations of royal jelly, shortened the larval and pupal duration of the eri – silkworm *Ph. ricini*, increased the weights of larvae, pupae, cocoon, cocoon shells and adult emergence. Also, such treatments increased ovaries weight, number of deposited eggs and eggs hatchability. El – Karaksy (1979) concluded that the use of royal jelly with yeast as food additives gave the heaviest weights of larvae, cocoon cortices, silk gland and increased the number of deposited eggs / female of *B. mori* and *Ph. ricini*. El – Hattab (1985) found that the weights of *Ph. ricini* larvae, cocoons, cocoon cortices and silk gland were heavier for those larvae fed on semi - artificial diet containing honey, giving higher number

of deposited eggs / female and an increase in the efficiency of diet. El – Karaksy et al. (1990) found that use of honey at different concentrations of 2 and 4 % enhanced both, the silk production and female fecundity. El – Sayed (1999) reported that the mixture of honey and black cumin seeds increased silk production and number of deposited eggs / female and gave heaviest weight of larvae, pupae, dry silk gland and higher the percentage of total protein of the silk gland. Cheng and Wong (1996) reported that honey and propolis have antibacterial, antifungal, antiviral and antitumor effects. Nour *et al.* (1997) found that treatment with propolis extract have yielded heavier cocoons, cocoon shells, higher the percentage of silk content and increaed the number of eggs/female than those obtained from control.

Generally, the supplementation of the honey bee products caused significant positive effects on the all studied biological and chemical parameters. It could be concluded that these materials which have been used as feeding stimulants enhanced the feeding behavior of larvae which reflected on the fitness components and increased the effective rate of rearing and the total protein content of the silk gland, Finally, such treatments led to a great increase in the productivity of the mulberry silkworm *B. mori.*

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Table 1. Effect of certain honey bee products on the studied biological parameters and total protein of the silk gland of *Bombyx mori* L.

Treatment mg/100ml	Weight of larva (g)	Larval duration (days)	Weight of silk gland (g)	Weight of pupa (g)	Pupal duration (days)	Silk gland total protein %		Effective rate of rearing %	
						Observed	Corrected	Observed	Corrected
Honey									
400	2.9761 ef	9.67 def	0.8417 fg	1.1894 d	13.33 bc	4.9729	12.87 e	95.26	77.13e
600	3.1655 d	9.33 ef	1.025 cd	1.2673 bc	12.33 d	5.1188	13.07 d	96.79	79.5 cd
800	2.9235 fg	10.33 cde	0.783 g	1.0978 ef	13.67 ab	4.8417	12.73 e	94.01	75.86 ef
Propolis									
40	2.843 g	11.33 bc	0.8463 fg	1.0894 ef	13.33 bc	4.5793	12.33 i	93.01	74.7 fg
60	3.051 e	10.33 cde	0.9225 ef	1.1982 d	12.33 d	4.7248	12.57 fg	95.22	77.13 e
80	2.747 h	11.67 ab	0.7505 g	1.0425 f	13.67 ab	4.4188	12.1 j	91.72	73.23 gh
Bees wax									
40	3.3675 c	10.67 bcd	0.983 cde	1.2207 cd	12.67 cd	4.944	12.83 e	92.06	73.6 gh
60	3.2188 d	11.33 bc	0.891 f	1.1024 e	13.33 bc	4.842	12.73 e	88.85	70.3 I
80	2.9351 fg	11.67 ab	0.84 fg	1.049 f	14.33 a	4.808	12.7 ef	91.1	72.57 h
Royal jelly 4	3.3648 c	9.67 def	0.9022 f	1.2017 d	13.33 bc	5.6147	13.8 b	97.75	81.27 bc
6	3.6996 a	8.67 f	1.2257 a	1.3579 a	12.33 d	5.9937	14.17 a	98.67	83.5 a
8	3.5131 b	9.33 ef	1.0516 bc	1.2882 b	13.33 bc	5.8773	14.07 a	98.42	82.77 ab
Pollen									
40	3.2011 d	9.67 def	0.8661 fg	1.0696 ef	13.33 bc	4.9584	12.83 e	94.89	76.67 e
60	3.6127 a	8.67 f	1.1019 b	1.3036 b	13 bc	5.3808	13.4 c	97.75	81.27 bc
80	3.4180 c	9.33 ef	0.9823 de	1.2078 d	13.33 bc	5.2063	13.17 d	96.51	79.0 d
Beebread									
40	2.4575 i	10.33 cde	0.7408 g	1.0366 f	14.33 a	4.6084	12.43 hi	91.1	72.57 h
60	2.7081 h	9.67 def	0.8053 g	1.0778 ef	13.67 ab	4.6959	12.5 gh	89.19	70.63 I
80	2.9333 fg	9.33 ef	0.9085 f	1.1975 d	13.33 bc	4.8125	12.73 e	93.01	74.7 fg
Control	2.3062 j	12.67 a	0.5797 h	0.9777 g	14.67 a	4.0388	11.5 k	85.03	67.2 j
L.S.D.	0.0998	1.0076	0.0699	0.0506	0.9442	——	0.1416	——	1.7771

No significant differences among the means followed by the same letter(s).

Table 2. Effect of certain honey bee products on the productivity of silk and eggs of *Bombyx mori* L.

Treatment mg/100ml	Weight of fresh cocoons (g)		Weight of cocoon shell (g)		Weight of reproductive system (g)		Length of reproductive system (cm)		No.of deposited Eggs/female		Hatchability % Observed	Hatchability % Corrected	
Honey													
400	1.4351	c	0.2472	h	0.6135	c	13.06	cd	532.1	eg	94.9	76.36	f
600	1.5423	b	0.2750	d	0.6623	ab	13.48	ab	561.3	cd	95.77	77.4	ef
800	1.3340	f	0.2352	ij	0.5336	gh	12.84	de	493.0	hij	93.71	74.92	g
Propolis													
40	1.3199	f	0.2304	jk	0.5566	efg	12.46	fg	465.5	jk	93.12	74.48	g
60	1.4548	de	0.2566	fg	0.6093	c	12.78	de	504.3	gh	94.98	76.62	f
80	1.266	g	0.2235	k	0.4903	i	12.16	hi	435.9	I	93.06	74.26	gh
Bees wax													
40	1.4900	c	0.269	de	0.6138	c	12.74	ef	503.7	gh	93.82	75.18	g
60	1.3458	f	0.2435	hi	0.5607	ef	12.24	gh	473.7	ij	93.00	74.26	gh
80	1.2739	g	0.2245	k	0.5053	hi	11.86	j	443.8	kl	92.30	73.2	h
Royal jelly													
4	1.4665	cde	0.2651	ef	0.6062	cd	12.92	cde	551.3	cdef	97.47	80.08	b
6	1.6758	a	0.3188	a	0.7014	a	13.72	a	663.6	a	98.32	81.52	a
8	1.5729	b	0.2847	c	0.6484	bc	13.2	ab	599.9	b	97.74	80.38	ab
Pollen													
40	1.3167	f	0.2479	gh	0.5476	g	11.86	j	525.4	fg	96.49	78.8	cd
60	1.6099	a	0.3062	b	0.637	bc	13.0	cde	605.3	b	97.57	80.08	b
80	1.4802	cd	0.2727	de	0.5663	de	12.26	gh	556.9	cde	92.17	79.4	bc
Beebread													
40	1.2616	s	0.2252	k	0.4890	i	11.56	k	495.5	hi	95.21	77.12	ef
60		g	0.2444	h	0.5163	ghi	11.9	ij	533.4	def	96.21	77.94	de
80	1.3223	f	0.2659	e	0.5515	fg	12.34	gh	568.2	c	95.92	77.94	de
	1.4638	cde											
Control	1.1687	h	0.1910	l	0.4424	j	10.02	l	379	m	91.00	71.96	i
L.S.D.	0.034		0.0088		0.0422		0.2981		29.1237		——	1.1674	

No significant differences among the means followed by the same letter(s).

الملخص العربى

تأثير بعض منتجات نحل العسل على إنتاجية ديدان الحرير التوتية

سامية محمد صفر الحطاب

قسم بحوث الحرير – معهد وقاية النباتات

مركز البحوث الزراعية – إسكندرية

يهدف هذا البحث دراسة تأثير بعض منتجات النحل (عسل النحل – البربوليس – غذاء الملكات – خبز النحل – شمع النحل) بإضافتها إلى أوراق التوت بتركيزات مختلفة و ذلك على بعض القياسات البيولوجية و الكيماوية و الإنتاجية للعمر اليرقى الخامس لديدان الحرير التوتية بالتغذية على أوراق التوت المعاملة و ذلك لزيادة إنتاجيتها من الحرير و البيض. و قد أدت إضافة و معاملة أوراق التوت بالتركيزات المختلفة لمنتجات النحل إلى زيادة معنوية في القياسات البيولوجية و الكيماوية و الإنتاجية بالمقارنة بالكنترول. و أوضحت النتائج ان معاملة أوراق التوت بمنتجات النحل و خاصة غذاء الملكات بتركيز ٦، ٨ مجم / ١٠٠ مل ماء و أيضا حبوب اللقاح بتركيز ٦٠ مجم / ١٠٠ مل ماء إلى تأثيرات معنوية موجبة فى القياسات البيولوجية، معدل كفاءة التربية و قيم البروتين الكلى فى غدد الحرير مما أدى إلى زيادة فى تحسين إنتاج الحرير و البيض.