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Evaluation effect of black seed (*Nigella satvia*) honey bee on the productivity of mulberry silkworm (*Bombyx mori* L.)

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Abstract
The effect of Black seed (*N. sativa*) honey (15, 30 and 45%) on the productivity of mulberry silkworms *B. mori L.* was evaluated. It was reported that treatments mulberry leaves with black seed (*N. satvia*) honey bee at concentration 45% (H_3) significantly differences both of, the total larval duration, larvae weight, silk gland weight, cocoon weight, cocoon shell weight, silk ratio % and cocooning % represented by (29.20 day, 3.84gm/ larvae, 1.08 gm/ silk gland, 2.07/ cocoon one, 0.52 gm/ one cocoon shell, 25.12% and 100%), respectively, compared with other treatments.

Keywords: Silkworm, *Bombyx mori* L, honey bee, black seeds, *Nigella*

Introduction
In sericulture, nutritional value of mulberry leaf considered as the backbone of silk industry (Legay 1958) [18]. For this silkworm *Bombyxmori L.* larvae should be fed with good quality mulberry leaves to produce a successful cocoon and high yield of silk (Masthan *et al*, 2011 and Bhattacharyya *et al*., 2016) [19, 4]. Some food supplements to mulberry leaf had an effect on the growth and production (Sengupta *et al*,1992 and Zannon,1994) [23, 29] also, (Rajab *et al*,2007; Tamaselvi *et al*, 2020) [21, 25] reported that. Natural honey bee produced by bees having high nutritional value and health benefits, contains vitamins (B and C), minerals, enzymes, amino acids, antibiotic and proteins (Bogdanov *et al*. 2008 and Ajibola *et al*., 2012) [6, 2]. The importance of honey bee in the nutrition of silkworm was reported by (El-Hattab,1985; El Karaksy *et al* 1989) [7, 8].
Nigella sativa, (black seeds) has many different chemical ingredients that possess many medical properties contains immune- modulatory activities, anti –inflammatory, antimicrobial and antioxidative effects (Ahmad *et al*., 2013; Ishtiaq *et al*.,2013 and Tembhuren *et al*, 2014) [1, 14].
El. Sayed 1999 [10] and Mona *et al*, 2012 [20] found that the mixture of honey and Black seed (BC) increased silk production and number of deposited eggs/ female. Feeding of silkworm larvae hybrids mulberry leaves with supplements honey bee resulted to increase larval weight, fresh cocoon weight, cocoon shell weight (gm) and silk ratio%, also decreased mortality % (Fathy *et al*., 2008; Gad.,2013; Kammel *et al*., 2016; Thangapandiyan and Dharanipriya,.2019 and Almojuel *et al*, 2022) [11, 12, 15, 28, 3].
The current study aim to effect of Black seed, (*N. sativa*) honey at different concentration on biological and economic properties of silkworm, *B. mori L.*

Materials and methods
The present study were carried out during spring season of 2022 in laboratories of Sericulture Research Department, Plant Protection Research of Mansoura to study the biological and economic effects of Black seed, (*N. sativa*) honey bee at different concentration (15, 30,45%) as a nutritional additives on silkworm, (*B. mori L.)* larvae growth.

Materials
1. Preparing of silkworm, (*B. mori L.*)
Stock culture of silkworm, *Bombyx mori L.* eggs of the local hybrid were obtained from Sericulture Research Department, Plant Protection Research Institute, Agriculture Research Center, Giza, Egypt. The larvae were reared in room disinfected with formalin solution 3%, left to dry before using.

2. Mulberry leaf
The mulberry *Morusalba* were collected for introduced as feed to larvae of silkworm, *B. mori L.* treated with Black seed, (*N. sativa*) honey bee at different concentration.

3. Black seed, (*nigella sativa*) honey
Nigell sativa honey has many elements and properties that raise its nutritional value on the one hand, and its therapeutic value on the other hand. Contains antioxidants, Nigel one elements, in addition to amino and fatty acids, fibers, protein and carbohydrates.
The bees extract from the natural bees inhaling the nectar of the flowers of the (Black seed), *N. sativa* plant, which is widely spread in the Mediterranean basin areas concentration was prepared as follows (Table 1):

Table 1: different treatment of Black seed, (*Nigella sativa*) honey used in the present study

Treatment	Description
Control	no honey only distilled water
H_1 (15%)	15%= 15ml honey + 85ml distilled water
H_2 (30%)	30%= 30ml honey + 70ml distilled water
H_3 (45%)	45%= 45 ml honey + 55ml distilled water

Silkworm rearing technique
After egg hatching larvae were reared in the laboratory condition at (at 25 ±2° C and 75-80% humidity according to the rearing techniques (Krishnaswami 1978) [17]. The larvae 1st, 2nd and 3rd instars feed on fresh and clean mulberry leaves four time daily. Chicken egg carton plates were used as mountages for cocoon spinning (Zannoon and Omera,1994).

Experimental design

In current study, *N. sativa* honey supplementation were given to silkworm, (*B. mori L.)* larvae by dipping mulberry leaves in the various concentration of Black seed, (*N. sativa*) honey solution to investigated effects on different parameters of larval growth and development of silk worm Table (1). The research work carried out at the beginning of the fourth stage. The larvae were divided into four groups including control group. Each one contains 100 larvae. Fresh mulberry leaves were dipped on each concentration Black seed, (*N. sativa*) honey solutions at various concentration (15, 30 and 45%) and left leaves of mulberry drying by fanning. The treated leaves were given to the larvae of wilkworm, (*B. mori L.)* from 4th to 5th instars, 4 time daily. The control larvae were feed on mulberry leaves dipped in distilled water only.

Data collection and analysis

Statistical Analysis

Obtained data were attest analyzed using the factorial design. f- subjected was estimated for each analysis. The data were compared according to Duncan multiple range test by SAS.

Larval w eight, silk gland weight, cocoon weight and cocoon shell weight were recorded with the Electronic Balance (Hussain *et al*.,2011) [13].

Cocoon silk ratio% was calculated according Tanaka (1994) [26]

* Silk ratio % = cocoon shell weight (g) / cocoon weight (g)

Results and discussion

larval stage

The effect of *N. sativa* honey on growth of silkworm larvae and cocoon was investigated in the current work. Data on larval weight and food consumption was recorded during 5th instar, also cocoon characteristics were determined after cocoon spinning.

1. Total larval duration

Data in (Table 2) showed the effect fed larvae on mulberry treated with different concentration of Black seeds honey on total larval duration of (*B. mori*). Results explained that, there were significant differences between treatment. Better total larval duration was found for H3 (45%) comber with other treatments. (F= 9.363**; df=2; P<0.001)

2. Larval weight (5th instar)

Data explained that reared *B. mori* larvae on mulberry leaves fortified with (*N. sativa*) honey during spring season was presented in Table (2). Larvae weight (gm) were recorded at the end of 5thinstar before cocoon spinning, there were highly significant differences between different concentration of (*N. sativa*) honey. The high weight of larval weight was recorded for concentration H45% and followed by H30% then H15% represented by (3.84, 3.72 and d3.55 gm) respectively. While the control treatment was recorded the lower weight (F=1016.07**; df= 2: P<0.001).

Table 2: Effect of *N. sativa* honey on Total larval duration, larval weight and silk gland weight of silkworm, *B. mori L.* (Local hybrid) during spring season 2022.

Concentration of *N. sativa* honey	Total larval duration	Body weight (gm)	Silk gland weight
H3	29.20 a	3.84a	1.08 a
H2	30.10b	3.72b	0.950b
H1	31.91 c	3.55c	0.875c
Control	32.15 d	2.95 d	0.650d

Table 3: Effect of *N. sativa* honey on Cocoon weight, Cocoon shell weight (gm), Silk ratio % and Cocooning % of *B. mori L.* (Local hybrid) during spring season 2022.

Concentration of *N. sativa* honey	Cocoon Weight (gm)	Cocoon shell weight(gm)	Cocooning %
H3	2.07a	0.52a	100a
H2	1.94b	0.48b	98.30b
H1	1.75c	0.43c	98.15c
Control	1.60d	0.39d	97d

3. Silk gland weight (gm)

Obtained data in Table (2) cleared that larva fed on mulberry treated with black seed, (*Nigella sativa*) honey presented clarify that there was highly significant d difference between concentration

(F= 318.16**; df= 2 p<0.001). Best weight of silk gland weight was found in H3 H2 and H1 (0.875, 0.950 and 1.08) consequently. compared with control (0.65)

Cocoon character

1. Cocoon weight (gm)

Cocoon weight (gm)recorded in Table (3) after the completion of cocoon spinning gave high significant variations between treatments in cocoon weight i.e. (1.60, 1.75, 1.94 and 2.08 gm) in control, H1, H2 and H3 respectively. (F=260.44**; d f=2 P<0.001)

2. Cocoon Shell Weight (gm)

Data in Table (3) Calculated cocoon shell weight after removing pupa, result showed that significant increase in mean weight i.e. (0.39, 0.432,

0.48 and 0.52 gm) in control, H1, H2 (f=1023.40**; d f=2; P<0.001).

3. Silk ratio %

The results explained that, there were highly significant differences between concentration (F=1690.997**; DF=2;p<0.001). Higher average of silk ratio were observed for H 3 then H2 and H1 (25.12, 24.74 and 24.57). While control have lower value of silk ratio.

4. Cocooning percentage (%)

Data in Table (3) showed the effect of different concentration of *N. sativa*) honey on cocoon percentage of *Bombyxmori L.* Results presented that, cocoon percentage was significantly differences between concentration (F=1303**; df=2; P<0.001). Feeding larvae on mulberry treated with H3 concentration.

Discussion

Gave (100%) so, it was better than other The effects of honey and its allied products on silk worm (*Bombyx mori* L.) have been extensively. Studied to improve larval growth and silk productivity. Studies found that honey increment

the weight of larvae, pupae, cocoon, cocoon shell and silk gland (El-Sayed *et al* 1998 [9]; Fathy *et al*., (2008) [11]; Gad (2013) [12]; Saed *et al.,* (2014); Sivaprasad and Thulasi (2014) [24]; Bhatti *et al,* (2019) [5] and Almojuela *et al*., (2022) [3] also validated that honey played a vital role in silkworm, (*B. mori L.*) growth and metabolism and its impact seemed to be concentration dependent and tissue-specific.

Black seeds oil extracted shows effective antibacterial activity against bacteria (Ishtiaq *et al*. 2013) [14]. Moreover, (Karthikairaj *et al*., 2013) [16] who demonstrated that applying antibacterial activity to mulberry leaves to fed mulberry silkworm, *B. mori L.* improved silk production.

El-Sayed (1999) [10] who founded that the tested Black seed (BC) honey dilutions at 10and 20% gave the heaviest weight of larvae, silk gland and male, female pupae of the mulberry silkworm. Also, Mona *et al*., 2012 [20] reported that the Black seeds, *N sativa* honey bee significantly increased the biological parameters of mulberry silkworm.

Conclusion

It is clear from the present study that supplemention of silkworm *Bombyx mori* L. with different concentration Black seeds, (*N. sativz*) honey significantly enhanced the economic traits of *B. mori* larvae. Amang the different concentration it was revealed that honey at H3(45%) showed high performance in optimization the growth, development as and economic parameters for silkworm, (*B. mori L.*) larvae.

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