Evaluation of Six Mixtures of Food Additives on some Biological and Reproductivity Parameters of the Mulberry Silkworm *Bombyx mori* L.

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ADDITIONAL INDEX WORDS: Mulberry silkworm, food additives, biological and reproductivity parameters, fibroin.

ABSTRACT

The investigation aimed to study the effect of six mixtures of the following food additives potassium iodide, treacle, ascorbic acid, dry milk, Albumen and dry yeast on certain biological and reproductivity parameters of 5th instar larvae of the mulberry silkworm *B. mori* L. in trail to improve the reproductivity characters of eggs and silk.The results indicated that the treatments significantly increased all biological and reproductivity parameters than the control one.The results proved that the treatment contains (potassium iodide 20 µg/ml, treacle 0.2g, ascorbic acid 0.2g and dry yeast 0.2g/100 ml water) significantly gave the heaviest weights of larvae, silk glands, pupae, cocoon and cocoon shells. In addition, this treatment led to the higher weight and length of reproductive system as well as the increase of deposited eggs/female and hatchability. The same treatment gave the short periods of 5th larval instar and pupal stage durations in comparison to the control. The treatment contains (potassium iodide 20 µg/ml, treacle 0.2g, ascorbic acid 0.2g and Albumen 0.1g/100 ml water) gave the highest significant fibroin percentages in the cocoon shell.

INTRODUCTION

The improvement and increasing the nutritional values of mulberry leaves by using various food additives were studied by many invistigators.

Numerous of materials were examinéd as food additives, albumen, ascorbic acid, milk powder, potassium iodide, treacle and yeast some of these materials were used alone or in mixtures to know their positive effects on the silkworms, either the mulberry silkworm *Bombyx mori* or the ricinus silkworm *Philosamia ricini*. Such materials increased the weight of mature larvae, pupae, cocoons, cocoon shells and the number of deposited eggs. They also shortened the larval duration, affected the total protein, total lipids, total amino acids of the larval haemolymph and silk glands and some physiological characters when studied by Murthy, 1953, Bounhiol, 1960, Ito, 1961, Majumder, 1982, Govindan et al., 1989, El – Karaksy and Idriss. 1990, El – Karaksy et al, 1990, Saker et al 1995, Gad, 1996, Abd El – Aziz, 1997, Yehia, and Abd El – Aziz, 1998, Miranda et al ., 1998, El – Sayed, 1998 & 1999.

The present work aimed to study the effect of mixtures of potassium iodide, treacle, ascorbic acid, yeast, milk powder and albumen in different mixtures as food additives on some biological parameters which are considered indicators to silk and eggs production of the silkworm *B. mori*.

MATERIALS AND METHODS

The experiment was carried out on the Chinese F1 hybrid 9F7X of the silkworm *B. mori.* The insects were reared at hygrothermic conditions of 26 ± 2 °C and 75 ± 5 % R.H. The larvae were fed on fresh mulberry leaves until the fourth instar. The 5th instar larvae which moulted at the same day were selected from the stock culture and grouped in separate trays.

Six mixture were composed, based on using potassium iodide 20 µg/ml + ascorbic acid 0.2g/100ml + treacle 0.2g/100ml water were added to:

- Dry yeast: 0.1 g/100ml (T1) and 0.2g/100ml (T2).
- Milk powder: 0.1 g/100ml (T3) and 0.2 g/100ml (T4).
- Albumin: 0.1 g/100ml (T5) and 0.2 g/100ml (T6).

Every treatment represented one concentration which was replicated three times. Each replicate contained 50 individual of the fifth instar larvae. Fresh mulberry leaves were dipped in each prepared concentration of the tested nutritive mixtures. The treated leaves were introduced to the larvae after being dried in air. The larvae of the control treatment were fed on untreated leaves.

Daily examinations were carried out until the larvae reached the pre – pupal stage. The duration of larvae and pupae were considered. The fresh weights of mature larvae, silk glands, pupae, cocoons and cocoon shells were recorded. Female reproductivity was estimated by counting the number of deposited eggs per female and measuring the weight and length of the reproductive system. The percentage of hatchability were calculated. The fibroin of the silk glands were estimated according to Tashiro *et al* method (1968) and calculated as percentage of the cocoon shells.

The data were statistically analysed using "F" test and L.S.D. to check the significance between treatment. The obtained values as percentage were adjusted to angular transformation. (Snedcor and Cochran, 1978).

RESULTS AND DISSCUSION

Effect of the tested mixtures of food additives on some biological and reproductivity parameters:

Statistical analysis showed that all the run treatments significantly affected the studied biological parameters.

The results of the biological parameters also show that there were no significant differences between T2 and T5. From Tables (1) and (2) the higher values were recorded by using the compounds of T2 (0.2g yeast + 20 µg/ml potassium iodide + 0.2g ascorbic acid + 0.2 g treacle/100ml water) of which the 5th larval instar duration represent the feeding time, that time was (9.67 days) which had been noticed to be less by 2 days than that of T5(11.67 days). T2 recorded the highest mean weights of larvae (2.918g), silk gland (0.787g), pupae (1.262g). cocoons (1.533g), cocoon shells (0.264g). Also T2 gave mean weight (0.658g) and length (11.86cm) of the reproductive system. The highest number of deposited eggs per female was recorded (537.5) eggs/female while percentage of hatchability was 80.08%. T2 and T5 gave more or less the same

positive effect on the studied biological characters and they were significantly differed from the other treatments (T1, T3, T4 and T6). On the other hand, T3 gave the lower weights of larvae (2.414g), silk gland (0.614g), pupae (1.068g), silk gland fibroin (0.159g) and percentage of fibroin in cocoon shell (69.8). Nevertheless T3 was still better than the control treatment.

The duration of the 5th larval instar for the control treatment was about 12.67 days.

Insignificant differences were found between the pupal duration for the all tested treatments and these durations were ranged between 12.33 days to 13 days, while the pupal duration of the control was prolonged to 14 days and that duration was longer by 1 – 1.67 days more than the other different treatments.

The estimation of the silk gland's fibroin:

The estimated fibroin of the silk gland by the method of Tashiro *et al.*, 1968 indicated that all treatments were significantly increased the fibroin of the silk gland than that of the control treatment. The highest mean weight of silk glands fibroin were recorded for T5 (0.197 g), T2 (0.194 g), T1 (0.186 g) and T4 (0.180 g). The lower values were obtained under T6 (0.169 g), T3 (0.159 g). the weight of silk gland fibroin in control was (0.131g). These values when expressed as percentage of the cocoon shell the highest percentage was obtained for T2 (76.54%) followed by T5 (76.1%), T1 (73.48%), T6 (70%), T3 (69.8%) and the control (67.7%). Abd El – Aziz, (2002) found that using some vegetable oils as food additives significantly increased the weight of silk gland fibroin than that of the control.

The obovementioned results in Tables, 1 and 2 indicated that the examined materials as food additives in different mixtures at definite concentrations of potassium iodide, ascorbic acid, treacle that added to different concentrations of yeast, milk and albumen increased the silk and eggs production of the silkworm *B. mori,* the obtained results were confirmed with those of the previous workers. Bouhniol (1960) found that adding dry milk, albumen and yeast lycopod powder to mulberry leaves decreased larval mortality and increased silk production of *B. mori.* El – Sayed and Mesbah (1992) when applied treacle and yeast and their mixtures to the castor bean leaves as food additives to the 5th larval instar of *Ph. ricini* found that the mixture of both treacle (4%) plus yeast (4%) and treacle (3%) plus yeast (1%) significantly increased the weights of larvae, silk glands, pupae, cocoon shell, number of deposited eggs/female and hatchability more than treacle or yeast when used alone. Majumder (1982) indicated that the lower dose of potassium iodide 25 µg/ml significantly increased body weight, silk weight and number of eggs/ female and shortened the larval duration of the saturniid silkworm *Samia cynthia ricini* and increased the weight of larvae, cocoons, pupae and cocoon shells. Saker *et al* (1995) found that mixture of soya milk + sugar + vitamins + potassium iodide salt increased larval weight, silk gland weight and total protein in silk gland. Abd El – Aziz (1997) reported that feeding 5th larval instar of

Philosamia ricini with castor leaves treated with 15% fresh chicken egg albumen increased the weight of cocoon shell by about 44% than larvae fed on untreated castor bean, and the use of potassium iodide at 20 µg/ml increased the silk production by 31% and highly significant positive results were recorded for the mean weights of mature larvae, cocoons, pupae and eggs production. Yehia, Wagiha and Abd El- Aziz (1998) found that mulberry leaves treated with 50 µg/ml potassium iodide or 0.005% potassium permanganate significantly enhanced all the tested biological and physiological parameters leading to the increase of the both silk and egg production.

Ascorbic acid as a food additive effectively increased the survival of *B. mori* (Murthy, 1953). Moreover, Ito (1961) proved that ascorbic acid is a strong phagostimulant. El – Karaksy et al. (1985), El – Karaksy and Idriss (1990) and Miranda *et al.* (1998) showed that ascorbic at different concentrations significantly increased the weights of larvae, pupae, fresh cocoons and fecundity of the emerged females of the silkworm *B. mori*. Their results were confirmed by Abd El – Lattif, (2000).

It is clear that the T2 and T5 mixtures significantly enhanced the silk and eggs production.

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Table 1. Effect of the tested mixtures of food additives on some biological parameters of *Bombyx mori* (Mean values ± S.D.)

Treat-ments	Weight of larvae (g)	Larval duration (days)	Weight of silkglands (g)	Weight of pupa (g)	Pupal duration (days)	Weight of silkgland fibroin (g)	% Fibroin in cocoon shell
T1	b 2.6575 ±0.096	c 8.67 ±0.577	b 0.7083 ±0.011	b 1.1636 ±0.071	b 12.33 ±0.577	a 0.1856 ±0.01	73.48
T2	a 2.9177 ±0.165	b 9.67 ±0.577	a 0.7872 ±0.049	a 1.262 ±0.103	b 12.67 ±0.577	a 0.1935 ±0.01	76.54
T3	c 2.4142 ±0.116	b 10.33 ±0.577	c 0.6140 ±0.020	c 1.0687 ±0.058	b 12.33 0.577	c 0.1591 ±0.01	69.8
T4	b 2.5978 ±0.091	a 11.67 ±0.577	b 0.6925 ±0.019	b 1.1591 ±0.043	b 12.67 ±0.577	ab 0.1795 ±0.01	75.5
T5	a 2.8837 ±0.135	a 11.67 ±0.577	a 0.7550 ±0.042	a 1.2433 ±0.087	b 12.67 ±0.577	a 0.1968 ±0.01	76.1
T6	b 2.6182 ±0.126	a 12.33 ±0.577	b 0.6915 ±0.039	b 1.146 ±0.061	b 13 ±0.577	b 0.1694 ±0.01	70.0
Control	d 2.2518 ±0.115	a 12.67 ±0.577	d 0.5143 ±0.030	d 1.0086 ±0.038	a 14 ±0.577	d 0.1313 ±0.01	69.7
L.S.D.	0.0782	1.03	0.0428	0.0512	0.8701	0.0172	-----

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

Table 2. Effect of the tested mixtures of food additives on silk and egg production of the silkworm *Bombyx mori* L. (Mean values S.D.).

Treatments	Weight of fresh cocoon (g)	Weight of cocoon shell (g)	Weight of reproductive system (g)	Length of reproductive system (cm)	No. of deposited eggs/female	Hatchability %	
						Observed	Corrected
	b	b	b	b	b		b
T1	1.4134 ±0.066	0.2431 ±0.011	0.5409 ±0.018	10.84 ±0.270	484.1 ±27.11	96.4 ±0.537	78.22 ±0.626
	a	a	a	a	a		a
T2	1.5332 ±0.093	0.2644 ±0.011	0.6579 ±0.027	11.86 ±0.305	537.5 ±35.78	97.55 ±0.521	80.08 ±1.207
	c	c	c	d	c		c
T3	1.2968 ±0.053	0.2281 ±0.009	0.4425 ±0.033	9.6 ±0.367	446.6 ±19.94	95.258 ±0.407	76.58 ±0.712
	b	b	b	c	b		bc
T4	1.3839 ±0.057	0.2379 ±0.014	0.5412 ±0.024	10.0 ±0.337	498 ±30.53	95.81 ±0.452	77.66 ±0.767
	a	a	a	a	a		a
T5	1.495 ±0.092	0.2586 ±0.017	0.6418 ±0.029	11.78 ±0.550	527.2 ±31.73	97.64 ±0.436	80.46 ±1.450
	b	b	b	c	b		b
T6	1.3942 ±0.063	0.2421 ±0.010	0.5299 ±0.025	10.14 ±0.384	474.6 ±29.16	96.54 ±0.526	78.52 ±1.026
	d	d	d	e	d		d
Control	1.1971 ±0.036	0.1885 ±0.013	0.4547 ±0.011	9.04 ±0.207	394 ±20.95	91.82 ±0.627	72.94 ±0.603
L.S.D.	0.061	0.0092	0.0326	0.4747	25.8589	—	1.2672

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

الملخص العربى

تقييم ستة مخاليط من المواد الغذائية الإضافية على بعض الصفات البيولوجية و الإنتاجية لدودة الحرير التوتية

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مركز البحوث الزراعية – الإسكندرية

استهدف البحث دراسة تأثير ستة مخاليط مجهزة من ستة من المواد الغذائية الإضافية على بعض المقاييس البيولوجية و الإنتاجية لدودة الحرير التوتية. حيث تم معاملة أوراق التوت المقدم لغذاء يرقات العمر الخامس بالمخاليط المختلفة و المكونة من المواد التالية : أيوديد البوتاسيوم، العسل الأسود، حمض الأسكوربيك، اللبن الجاف، البومين البيض و الخميرة الجافة. و ذلك بغرض تحسين الصفات الإنتاجية لكل من البيض و الحرير. و قد أدت جميع المعاملات إلى زيادة معنوية فى قيم القياسات البيولوجية عنها فى حالة تغذية اليرقات على أوراق التوت الغير معاملة (الكنترول). و أوضحت النتائج أن المعاملة التى تحتوى على (ايوديد البوتاسيوم ٢٠ ميكروجرام/ مل، ٠,٢جم لكل من حمض الأسكوربيك و العسل الأسود و الخميرة الجافة / ١٠٠ مل ماء أعطت أعلى متوسطات لأوزان اليرقات، غدة الحرير، العذارى، الشرانق، و قشرة الشرنقة، و كل من وزن و طول الجهاز التناسلى و أيضا أعلى متوسط لعدد البيض لكل أنثى و أعلى نسبة فقس. كما أدت إلى قصر فترة العمر اليرقى الخامس و طور العذراء بالمقارنة بالكنترول. كما أدت المعاملة التى تحتوى على (أيوديد البوتاسيوم، ٠,٢ جم لكل من حمض الأسكوربيك و العسل الأسود، و٠,١ جم البومين /١٠٠ مل) إلى أعلى وزن للفيبروين بالنسبة لوزن الشرنقة.