

EFFECT OF FEEDING WITH THREE MULBERRY VARIETIES AND THEIR SEMI SYNTHETIC DIETS ON THE SILKWORM *Bombyx mori* L.

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ABSTRACT

The study was carried out during Spring 2009 in the Cairo University Department of the Economic Entomology and Pesticides. The effect of the leaves of three mulberry varieties (1- *Morus rubra* 1 L. 2 - *Morus rubra* 2 L. 3-*Morus nigra* L.) and the mixed of the three varieties without propolis and with Propolis and their three different semi artificial diets of food on the grown fourth and fifth instars larvae of *Bombyx mori* L. Larvae on their rate of growth, duration, pupal weight, silk cocoon, sex ratio, number of egg laying and the coefficient of digestibility was all determined .

Larvae fed on leaves of *Morus rubra* 1 L. and the mixed of the three varieties with propolis were showed a significant different characters .

INTRODUCTION

The silkworm *Bombyx mori* L. has been considered as a monophagous insect and only the mulberry leaves were known as the silkworm natural food for a long time . It is quite versatile unique species due to its domestication for a centuries , its adaptability to artificial diet is not difficult (Chowdhary , 1996).

Feeding of late instars (4th and 5th larval instars) by natural mulberry leaves, cost lot of money and labor workers . So, instead of using the natural leaves the semisynthetic diets may be more promising to save money ,time and labor . As detected by Eid *et al.* , 2007, Hiro *et al.* 1997 and Jian –Hu *et al.* 1998 .

In the sericulture industry , the improvement of the cocoon quality as well as quantity , which is affected by silkworm food , is very important (Matsura,1994) and the development of natural silk industry largely depends upon the use of improved of silkworm production of high quality leaves through better mulberry varieties and method of rearing (Tayade and Jawal, 1984). According to Choudhary *et al.* (1991) the quality of mulberry leaves play an important role on success of sericulture and directs its economics .

The principal components of mulberry leaves are water and dry matter which is consisted of protein, carbohydrates, fats, inorganic salts and vitamins . All of these elements are essential nutrients for the physiological function of the silkworm .The nutritional value of the leaves varies greatly according to different factors such as variety of mulberry leaves , position and maturity of leaves, soil texture, fertilization, photoperiod and season (Wu-Pang Chuan and Chen Da-Chuang , 1987 , Horie *et al.*, 1978, Mahmoud, 2000). And there for the present investigation deal with three kinds of mulberry *Morus rubra* 1 L. ,*Morus rubra* 2 L., and *Morus nigra* L. and their effects on some biological aspects on *Bombyx mori* L.

Propolis is one of the valuable apicultural products . Propolis has an activity against many pathogens (Hegazi *et al.*, 2000 , Ftayeh *et al.*,2003) the antibacterial, antifungal and antiviral effects of Propolis were observed by

(Cheng and Wong, 1996, El-Maasarawy, 1995, Shub *et al.*, 1981 and Giurgea *et al.*, 1983) . Propolis can be used in scientific medicine . Also, microscopic examination appeared that no flacherie disease was observed among treated larvae of *Bombyx mori* L. with Propolis (Nour *et al.*, 1996) . Studies on rate of growth ,duration ,pupal weight , silk cocoon , sex ratio , number of egg laying and the coefficient of digestibility were carried out by Blattacharya and Waldbawer , 1969 .

The aim of the present work is to evaluate the leaves of the three mulberry varieties , the mixed of the three varieties without propolis and with propolis and their semi-artificial diets on the grown fourth and fifth instars larvae .

MATERIALS AND METHODS

1-Silkworm Resource :

The silkworm race used was S A 105 ; eggs of silkworm race were obtained from the Sericulture Research Department of Plant Protection Research Institute , Ministry of Agriculture ,Giza –Egypt . The study was carried out during Spring 2009 in the Cairo University Department of the Economic Entomology and Pesticides .

2 – Rearing Technique :

Rearing silkworm and experimental technique were carried out under laboratory condition (26 °C ± 20 °C and 65 ± 5 R. H .) .

The First Experiment :

Young larvae (first, second and third instars)were reared on fresh mulberry leaves of *Morus alba* Var Kukoso, 27. Experimental treatments were carried out on the grown fourth and fifth instars larvae. Five treatments each contained 30 larvae of (4th and 5th instars). Leaves of the three mulberry were harvested and separately fed to the larvae during the grown larval stage. (1- *Morus rubra* 1 L., 2– *Morus rubra* 2 L., 3– *Morus nigra* L . (Fig.1), 4-mixed of 1, 2, 3 , and 5 – mixed of 1 , 2 , 3 ,with solution of 0 ,02 propolis). An equal amount of leaves was given to each batch four times a day .

The Second Experiment :

The same mulberry varieties leaves used in the previous experiment were used in three treatments of semi-artificial diets as the following ingredients:

- Powder of dried leaves 55 % (1- *Morus rubra* 1 L. 2 - *Morus rubra* 2 L. 3- *Morus nigra* L.) , Casein 10 % , Agar – Agar (powder) 15 % , Sucrose 10 % Ascorbic Acid 3 % , Propolis 2 % , Sodium benzoate 0.2 % and water to terminate the soft quality diet which represent the best tasty food for larvae. .

Larvae were fed during the fourth instar only on artificial diet then followed during the fifth instar by natural leaves from the same kind in the diet .

Diet 1- Powder of dried leaves *Morus rubra* 1 L.

Diet 2 – Powder of dried leaves *Morus rubra* 2L.

Diet 3 – Powder of dried leaves *Morus nigra* L .

The Thhrd Experiment :

The same previous technique used were followed only for 5 days feeding in the grown 5th larval instar semi artificial diet then the rest of days were fed naturally on their fresh leaves .

Three replicates of each treatment were used , each replicate containing 30 larvae .The diet was introduced to larvae as one meal per day and then the remainder kept in the refrigerator. the coefficient of digestibility were calculated according to the equation of Blattacharya and Waldbawer , 1969 .

$$\frac{\text{Weight of food ingested} - \text{weight of faece voided}}{\text{weight of food ingested}} \cdot 100$$

weight of food ingested

Data were recorded for different parameters as fifth instars duration in days , total larval duration in days, larval body weight in mg. , larval mortality percentage , weight of silk gland in mg. , pupal weight and silk cocoon weight in mg. sex ratio and number of egg laying were also detected .

The data obtained were analysed following t- test and Fisher test according to Snedecor and Cochran., 1967 .

RESULTS AND DISCUSSION

The larval duration 4th and 5th instars which represent the long feeding period for this insect seemed to be shortened after the feeding by *M rubra* 1 L . leaves and their artificial diet contained mixed leaves with Propolis (34.3 and 35.6 days) in comparison with the other treatments (Table 1, 2 and 3). these results confirmed these found by Eid *et al.*, 2007 , El-Maasarawy , 1995 and Mahmoud , 2000 .

Larvae fed on diet 1 (*Morus rubra* 1 L .) and leaves of *Morus rubra* 1 L . reveal best results compared with other varieties (Table1, 2, 3) in weight of silk gland and silk cocoon weight with significant difference . These results emphasize the finding of Horie *et al.*(1978), who noticed that elevation of dietary protein results in acceleration of growth and silk yield . Also , nearly 70 percent of silk protein produced by silkworm are directly derived from the proteins of the mulberry leaves Bariet *et al.* (1985) , that mean , the protein content of *M. rubra* may be the best .

Accumulation of protein in larvae depends largely upon the concentration of carbohydrate (soluble sugar and starch) in the leaves (Sastri, 1962). Hence a comparatively higher carbohydrate content of leaves may prove a beneficial in growth of the silkworm. Moreover, the average digestibility or soluble carbohydrate content of mulberry leaf may have beneficial effect on the growth of silkworm . Larvae fed on mixed leaves 1,2,3 with propolis 2 % reveal the best result compared with other variety (Table 1) for the minimum duration days of larvae .

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Larval body weight , weight of silk gland , pupal weight , silk cocoon weight and number of egg laying . These results emphasize the finding of El-Maasarawy,(1995) when Propolis extract was used , He found a high increase in the weight of pupa and effect on productivity of silk , and anabolic effect on silkworm larvae and such results have a lot of benefits for the production of eggs as an economic phase of silkworm rearing .



Fig.1 – The three shapes of the types of mulberry leaves.
a – *Morus rubra* 1 b – *Morus rubra* 2 c – *Morus nigra*.

From Table 1, the treatment of mixed leaves from the three varieties with propolis range in the first, resulted the heavier fed larvae (390.0mg.) followed by larvae fed on the variety of *M. rubra* 1 L. (368.6 mg.) but larvae fed on *M. rubra* 2 L. leaves showed the lowest larval body weight (221.0 mg.) compared with the rest of treatments . These results emphasize the finding of Mahmoud, (2000) These variation in larval growth and silk yield are due to the difference nutrient composition of the different mulberry varieties . This agrees with Bhaskar *et al.* (1999). Who concluded that the nutritional status of mulberry leaf offered to silkworm largely influenced the growth and development .

Generally natural feeding results the best economic characters produced . Otherwise artificial feeding for necessity and shortage of labor and leaves may be a nice option to save economic breeding continuity .

The results of weight of silk gland , pupal weight , silk cocoon weight number of egg laying and coefficient of digestibility percentage they all go in line with the same trend obtained previously (El-Maasarawy,1995 , Mahmoud, 2000, Hosny *et al.*, 2002, Rahatulla *et al.*, 2005, Eid *et al.*, 2007)

As a general conclusion from the obtained results , the treatment of feeding larvae on the *Morus rubra* 1 L. variety showed excellent results in all parameters estimated. And deposited eggs produced from this treatment

were kept under the laboratory, condition (28 C, 50 % R.H) during the spring season (2009) for 15 days and suddenly they hatched successfully for about 95 %. Therefore ,this case may explain the importance of this variety of leaves for the silk production as a second silk yield in the same spring season because these larvae were followed by feeding on the artificial diet which contained about 55% from their constituents of dried leaves of the variety *M. rubra* 1 L. and continued till the end of the larval stage . This result may lead to continue the breeding of these larvae on fresh leaves found and still fresh and useful for feeding such larvae.

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تأثير تغذية دودة الحرير *Bombyx mori* L. على ثلاثة أصناف مختلف من أوراق التوت وبيئات نصف صناعية على إنتاجيتها .

هشام الرز

قسم وقاية النبات - كلية الزراعة - جامعة دمشق - سوريا

تمت دراسة تأثير تغذية دودة الحرير *Bombyx mori* L. على ثلاثة أصناف مختلفة من التوت روبرا 1 *Morus rubra* 1 L. , روبرا 2 (الياباني) *Morus rubra* 2 L. و المصري *Morus nigra* L. على ثلاثة بيئات نصف صناعية مركبة من نفس الأصناف وذلك في كلية الزراعة بجامعة القاهرة قسم الحشرات الاقتصادية والمبيدات عام ٢٠٠٩ على إنتاجيتها من حيث طول مدة العمر اليرقي , وزن جسم اليرقة , نسبة الموت , وزن غدة الحرير , وزن حرير الشرنقة , وزن العذراء , النسبة الجنسية , كمية وضع البيض والنسبة المؤية لمعامل الهضم .

أظهرت نتائج البحث أن أحسن الأصناف سواء في التغذية الطبيعية و الصناعية من الصنف *Morus rubra* 1 L. واتضح هذا في جميع القياسات المختبرة . وأيضاً بعد فقص البيض المفاجئ ونسبة ٩٥ % للمتغذية على هذا الصنف من الأوراق و لنفس الموسم تابعت اليرقات جميع أعمارها على التغذية النصف صناعية . وهذا يؤكد أن التغذية على هذا الصنف من صالح مربى ديدان الحرير اقتصادياً لإمكانية الحصول على محصول ثاني من الشرائق في فترة الربيع .

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Table 1- Effect of feeding larvae of silkworm bombyx mori L. on different mulberry varieties

Treatments	Larval duration in (days)	Larval body weight (mg.)	Mortality %	Weight of silk gland (mg.)	Pupla weight (mg.)	Silk cocoon weight (mg.)	Sex Ratio %		Number of egg laying
							Male	Female	
1 <i>Morus rubra</i> 1 L.	34.3± 0.14 ^a	368.6± 30.57 ^a	0	658.3± 35.11 ^a	1206.7±211.6 ^{ca}	393.3±11.88 ^a	37	63	535.9± 22.67 ^a
2 <i>Morus rubra</i> 2 L.	37.5± 0.42 ^b	221.0± 42.45 ^{cb}	0	466.7± 39.28 ^b	1170.0±207.0 ^a	353.3±10.64 ^b	43	57	577± 14.96 ^a
3 <i>Morus nigra</i> L.	36.9± 0.30 ^a	263.8± 40.86 ^{cb}	0.03	558.3± 35.11 ^{ab}	1043.3±237.3 ^b	293.1±15.92 ^c	46	54	494.3± 12.46 ^a
4 Mixed of (1,2,3)	36.9± 0.28 ^b	294.8± 39.02 ^{ac}	0	525.0± 22.73 ^a	1070.4±315.8 ^{ab}	323.3±12.61 ^a	60	40	526.1± 3232 ^a
5 Mixed of (1,2,3)+ propolis 0.02	35.6± 0.27 ^a	390.0± 34.56 ^{ac}	0	650.0± 45.45 ^b	1313.3±222.4 ^c	413.3±9.42 ^b	50	50	654.8± 30.12 ^b

Values in a column followed by the same small letter are not significantly different (P< 0.05)

Table 2- Effect of feeding the grown 4th instars larvae on semi-artificial diets, then continued the 5th instar on their fresh leaves:

Treatments	Larval duration in (days)	Larval body weight (mg.)	Mortality %	Weight of silk gland (mg.)	Pupla weight (mg.)	Silk cocoon weight (mg.)	Sex Ratio %		Number of egg laying Female	Coefficient of digestibility percentage
							Male	Female		
Diet1 <i>Morus rubra</i> 1	37.1± 0.18 ^b	70.6± 15.7 ^a	10.0 ^a	583.3± 19.91 ^a	1004.3±69.38 ^a	271.4±20.14 ^a	54.55	45.45	500.7± 22.02 ^a	84.6± 0.57 ^a
Diet2 <i>Morus rubra</i> 2	40.8± 0.46 ^a	63.0± 22.0 ^a	16.5 ^a	391.3± 24.01 ^a	957.1±69.95 ^a	207.1±22.99 ^b	45.55	54.55	426.8± 40.82 ^a	77.2± 0.82 ^b
Diet 3 (<i>Morus nigra</i> L)	39.8± 0.39 ^a	83.4± 23.7 ^a	13.3 ^a	483.3± 19.90 ^{ab}	914.3±84.81 ^a	270.2±13.00 ^a	60	40	502.3± 24.43 ^a	75.4± 0.56 ^a

Values in a column followed by the same small letter are not significantly different (P< 0.05)

Table 3- Effect of feeding the grown 5th instars larvae on semi-artificial diets, then continued on their fresh leaves:

Treatments	Larval duration in (days)	Larval body weight(mg.)	Mortality %	Weight of silk gland (mg.)	Pupla weight (mg.)	Silk cocoon weight (mg.)	Sex Ratio %		Number of egg laying Female	Coefficient of digestibility percentage
							Male	Female		
Diet 1 <i>Morus rubra</i> 1	35.2± 0.16 ^a	898.0± 33.39 ^a	10	570.8± 27.53 ^a	1103.1±135.32 ^a	344.5±15.11	47	53	515.2± 21.32 ^a	95.0± 1.97 ^a
Diet 2 <i>Morus rubra</i> 2	38.6± 0.40 ^a	1122.0± 53.84 ^a	10	431.0± 32.41 ^b	1060.5±149.65 ^a	295.3±16.01	43	57	509.3± 24.89 ^a	94.8± 0.42 ^a
Diet 3 <i>Morus nigra</i>	37.7± 0.32 ^a	994.0± 49.70 ^a	10	523.4± 23.51 ^a	986.3±151.73 ^b	285.4±14.32	51	49	498.2± 16.54 ^a	94.9± 0.41 ^a

Values in a column followed by the same small letter are not significantly different (P< 0.05)

