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Biological and Physiological Effects on Mulberry Silkworm Fed on Mulberry Leaves Treated with Yeast and Soybean

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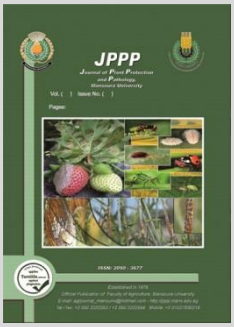

ABSTRACT

Silkworm larvae were fed on leaves of mulberry trees*(Morusnigra*) treated with three different concentrations (3%, 6% and 9%) of each yeast *Saccharomyces cerevisiae* and soybean. The highest weight of fifth instar larvae were when larvae fed on leaves treated with yeast than soybean at 9% concentration. The maximum total weights of consumed and digested leaves by larvae of fifth instar when larvae fed on leaves of *M. nigra*, treated with yeast at 9% concentration compared with soybean and control. The maximum efficiency of conversion of ingested and digested food to body substance was also obtained in fifth instar larvae fed onleaves treated with yeast at 9% concentration compared with soybean and control. The highest weights of cocoons and cocoon shells when the larvae fed on leaves of *M. nigra*, treated with yeast at 9% concentration compared with soybean and control. The highest fecundity occurred when larvae fed on mulberry leaves treated with soybean compared with yeast and control. The egg hatch was not affected by different treatments and different concentrations.

Keywords: yeast - *Saccharomyces cerevisiae* - soybean – consumed–digested-fecundity–silkworm–*Bombyxmori*

INTRODUCTION

Silkworms are important economic insects that are affected by the external environment in terms of temperature, humidity (Hussain *et al*, 2011, Khan, 2014 and Sisodia&Gaherwal, 2017)and the type of mulberry leaf that feed on it (Abdelmegeed, 2016). They are very sensitive insects to many diseases such as viral disease (Gani*et al*, 2017), bacterial and fungal diseases (Jansirani *et al*, 2016 and Isaiarasu *et al*, 2011), Pebrine disease (Chakrabarty & Bindroo, 2012) and different environmental factors. Most researches provide the right environment and regulate the temperature and humidity appropriate for the growth process, as well as use disinfectants to prevent infection (Rasool*et al.*, 2018). The production of cocoons suitable for solution and eggs with high fertility in large quantities must be interested in the nutrition on the types of leaves of berries with high nutritional value and choose the best varieties (Abdelmegeed 2016). In the absence of these varieties, other varieties can be used these varieties and increase their nutritional value using some food additives such aswheat flour, pollen powder, carrot powder, potato powder, brane, palm pollen, soya flour and starch (Salman *et al.*,2011).

The current study aims to use some dietary supplements such as yeast *Saccharomyces cerevisiae* (Masthan *et al,* 2017)and soybeans (Mahmoud,2013) on mulberry leaves*Morusnigra* at different concentrations to increase the productivity of silkworm worm cocoons and to study its effect on fecundity and fertility.

MATERIALSAND METHODS

Mulberry silkworm eggs were obtained from the Silk Research Department in Giza, and they are a monovoltine race and were cultured in a laboratory under optimal conditions (Krishnaswami, 1983).

When the silkworms reached the fifth instar larvae, 90 larvae were divided into two groups to feed on mulberry trees, *Morusnigra* treated with soyabean or yeast (*Saccharomyces cerevisiae*). Each group (45 larvae) divided into three concentrations (3,6 and 9% of soyabean or yeast), each concentration divided into three replicates(each replicate contain 5 larvae)as well as three replicates of control. The experiments were supplied daily with sufficient amount of treated mulberry leaves.First, leaves were cleaned and washed from dust, then treated with different concentrations of soybean and yeast and given to the 5th instar larvae. The larvae were reared under standard rearing conditions.

Estimated the mean weights of fresh consumed and digested food by 5th instar larvae were fed on different concentrations of treated mulberry leaves, according by Waldbauer (1964).

When the larvae reached the pupal stage and the cocoons are formed. The following data were recorded:

- Weight of larvae at the end of 5th instars
- Weight of cocoons and cocoon shells
- Fertility and fecundity

RESULTS AND DISCUSSION

Weight of larvae:

As shown in Table 1 the mean weight of 5th instars larvae were affected with different treatments and different concentrations. The highest weight of larvae when larvae were fed on leaves treated with yeast than soybean and the best concentration was 9% compared with control.

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Table 1. Mean weights of larvae at the end of the fifth instar larvae (g) fed on leaves of *Morus nigra* treated with different concentrations of yeast and soybean.

Concentration	Weight of larva/g	
	Soybean	Yeast
3%	2.86^{c} ±0.0163	2.93^{c} ±0.0205
6%	2.97^{b} ±0.0286	2.98^{b} ±0.0124
9%	3.16^{a} ±0.0432	3.19^{a} ±0.0124
Control	2.81^{c} ±0.0169	2.81^{d} ±0.0169
F.Value	58.06**	197.74**
L.S.D.	0.0912	0.0512

Weight of consumed and digested mulberry leaves by silkworm larvae when fed on leaves treated with yeast and soybean.

The obtained results in Tables 2 showed that the mean weights of consumed and digested leaves by larvae was affected with the different concentrations of mulberry leaves treated with yeast and soybean in fifth instars compared to control.

The maximum total weights of consumed and digested leaves by fifth instars larvae was when larvae fed on leaves of *M. nigra*, treated with yeast at 9% concentration compared with soybean and control.

Table 2. Mean weights of consumed and digested mulberry leaves (g) by the fifth instar larvae fed on leaves of *Morusnigra* treated with different concentrations of yeast and soybean.

Concentration	Weight of consumed leaves/g/larva		Weight of digested leaves/g/larva	
	Soybean	Yeast	Soybean	Yeast
3%	11.23^{c} ±0.0286	11.56^{c} ±0.0249	4.35^{c} ±0.0216	4.55^{c} ±0.0169
6%	11.81^{b} ±0.0408	12.41^{b} ±0.0489	4.74^{b} ±0.0368	5.03^{b} ±0.1189
9%	12.47^{a} ±0.0713	13.37^{a} ±0.1791	5.22^{a} ±0.0899	5.35^{a} ±0.0654
Control	10.91^{d} ±0.0329	10.91^{d} ±0.0329	3.88^{d} ±0.0573	3.88^{d} ±0.0573
F. Value	434.63**	251.75**	197.92**	148.89**
L.S.D.	0.1491	0.3046	0.184	0.2376

Efficiency of conversion of ingested and digested food (E.C.I. & E.C.D.) to body substance of silkworm larvae.

Data arranged in Tables 3 clearly showed (E.C.I. & E.C.D.) of fifth instar larvae when fed on leaves treated with yeast and soybean. (E.C.I. & E.C.D.) of the larvae was affected by using of mulberry leaves treated with yeast and soybean at different concentrations.

Table 3. Efficiency of conversion of ingested food (E.C.I. & E.C.D.) to body substance of the fifth instar larvae fed on leaves of *Morus nigra* treated with different concentrations of yeast and soybean.

Concentration	E.C.I. %		E.C.D. %	
	Soybean	Yeast	Soybean	Yeast
3%	15.55^{c} ±0.0368	16.42^{c} ±0.0410	46.60^{c} ±0.0418	48.64^{c} ±0.0579
6%	16.89^{b} ±0.0634	17.42^{b} ±0.0612	51.33^{b} ±0.0531	54.71^{b} ±0.0736
9%	17.88^{a} ±0.0758	18.60^{a} ±0.0492	55.82^{a} ±0.0573	60.24^{a} ±0.5028
Control	14.38^{d} ±0.1336	14.42^{d} ±0.0956	44.62^{d} ±0.2185	44.62^{d} ±0.2185
F. Value	648.28**	1473.26**	3618.21**	1215.15**
L.S.D.	0.2727	0.2089	0.3776	0.8906

The maximum (E.C.I. & E.C.D.) was obtained when fifth instar larvae fed onleaves treated with yeast at 9% concentration compared with soybean and control.

Mean weights of cocoons and cocoon shells of mulberry silk worm:

The obtained results in Table 4 showed that the mean weights of cocoons and cocoon shells were affected with the different concentrations of treated mulberry leaves with yeast and soybean in fifth instars compared with control.

The highest weights of cocoons and cocoon shells when the larvae fed on leaves of *M. nigra*, treated with yeast at 9% concentration compared with the treatment of soybean and control.

Table 4. Mean weights of cocoons and cocoon shells (g) when the larvae fed on leaves of *Morusnigra* treated with different concentrations of yeast and soybean.

Concentration	Weight of cocoons		Weight of cocoon shells	
	Soybean	Yeast	Soybean	Yeast
3%	1.189^{bc} ±0.0094	1.221^{c} ±0.0159	0.346^{c} ±0.0071	0.350^{bc} ±0.0081
6%	1.207^{b} ±0.0063	1.258^{b} ±0.0046	0.369^{b} ±0.0045	0.375^{b} ±0.0151
9%	1.237^{a} ±0.0036	1.288^{a} ±0.0030	0.386^{a} ±0.0026	0.411^{a} ±0.0069
Control	1.172^{c} ±0.0054	1.172^{d} ±0.0054	0.332^{c} ±0.0041	0.332^{c} ±0.0041
F. Value	36.05**	64.03**	48.05**	25.75**
L.S.D.	0.021	0.0284	0.0157	0.0304

Fecundity and fertility:

As shown in Table 5, the number of eggs was affected with the different concentrations of treated mulberry leaves with yeast and soybean in fifth instars compared with control.

The highest fecundity occurred when larvae fed on mulberry leaves treated with soybean compared with the treatment of yeast and control.

The egg hatch was not affected with different treatments and different concentrations.

Table 5. Fecundity and fertility of eggs/female of mulberry silk worm when the larvae fed on leaves of *Morusnigra* treated with different concentrations of yeast and soybean.

Concentration	Fecundity of eggs/female		Fertility of eggs/female	
	Soybean	Yeast	Soybean	Yeast
3%	376.6^{b} ±4.9216	353.0^{c} ±4.0824	99.43 ±0.3182	99.48 ±0.1883
6%	394.3^{a} ±3.2998	370.6^{b} ±2.4944	99.73 ±0.1283	99.71 ±0.2298
9%	404.3^{a} ±3.2998	387.0^{a} ±4.5460	99.65 ±0.0939	99.56 ±0.2053
Control	346.0^{c} ±4.3204	346.0^{c} ±4.3204	99.50 ±0.2098	99.50 ±0.2098
F. Value	81.00**	43.64**	0.87	0.51
L.S.D.	12.876	12.63		

The purpose of the nutrition additives is to obtain yield of the cocoons and at the same time increasing the quality of the silk filament and numbers of eggs and fertility. Two types of dietary supplements were selected: yeast *Saccharomyces cerevisiae*and soybeans.

Al-Tawaha (2011) extracted the isoflavone from yeast and soybeans and used it as treatment of soil to increase soil fertility. Mahmoud (2013) found that 100g soybeans are rich in high nutritional value, which is 446 kcal,36.49g protein, 19.94g fat, 30.16g carbohydrate, 704mg phosphor, 277mg calcium, 15.7mg iron and vitamins (B2, C and K), and added that soybeans are very richuseful materials for the living organism.

Present results showed the treatment of mulberry

leaves with soybeans and yeast increased the weight of the larvae. Rahul *et al*.(2017) and Yadav&Bagdi(2016) also found that when the mulberry leaves were treated with the yeast extract, it affected the weight of the larvae, as well as rearing rate. Rathinam& Krishnan(1998) found that soybean also affected the increase in larval weight.

In addition,Esaivani*et al*.(2014)found that the yeast increased the activity of the enzyme amylase and invertase in the digestive juice, which helps digestion and thus increased the weight of the larvae and the efficiency of the conversion of digested food to body substance.

Recently, Masthan*et al*.(2011 & 2017) found that the yeast has a role in increasing the weight of the cocoons and the length of the silk filament in addition to the content of the silk filament of the fibroin, which leads to an increase in the quality of the silk filament.

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التأثيرات البيولوجية والفسيولوجية على ديدان الحرير التوتية التى تغذت على أوراق توت معاملة بالخميرة والفول الصويا

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تم تغذية ديدان الحرير التوتية على أوراق التوت العمانى المعاملة بأحد من الثلاث تركيزات مختلفة (3% ، 6% و 9%) لكل من الخميرة والفول الصويا.وكانت أعلى أوزان لليرقات فى العمر الخامس عندما تغذت على أوراق التوت المعاملة بالخميرة ثم الفول الصويا عند تركيز 9% .وكان أعلى وزن للغذاء المتناول والمهضوم لليرقات فى العمر الخامس والتى تغذت على أوراق التوت العمانى المعاملة بالخميرة عند تركيز 9% مقارنة بالفول الصويا والكنترول.وكان أعلى كفاءة تحويل الغذاء المتناول والمهضوم الى مواد جسمية فى العمر اليرقى الخامس والتى تغذت على أوراق التوت المعاملة بالخميرة عند تركيز 9% مقارنة بالفول الصويا والكنترول.وتم الحصول على أعلى وزن للشرانق وقشرة الشرنقة لليرقات التى تغذت على أوراق التوت العمانى المعاملة بالخميرة مقارنة بالفول الصويا والكنترول.وعلى الصعيد الأخر كان أعلى معدل لوضع البيض للحشرات الكاملة عندما تكون يرقاتها تغذت على أوراق التوت العمانى المعاملة بالفول الصويا مقارنة بالخميرة والكنترول. ولم تتأثر خصوبة البيض بالمعاملات أو التركيزات المختلفة.