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A PRACTICAL EFFICIENT AND LOW COST DIET FOR REARING THE LARVAE OF MEDITERRANEAN FRUIT FLY, Ceratitis capitata (Wied.).

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ABSTRACT: Larvae of Mediterranean fruit fly (Med fly), Ceratitis capitata (Wied.) was reared on dry medical yeast diet and compared with Brewer's yeast diet. The results concluded that the larvae were developed faster in Brewer's yeast diet at the beginning and by the end the situation was adverse. Dry medical yeast diet produced higher number of pupae, bigger in size and higher in weight than Brewer's yeast diet. Also, the medical yeast diet produced lower percentage of adult emergence, shorter pre-oviposition period, longer oviposition period, higher number of eggs/female and higher percentage of egg hatch. About the longevity, at the beginning, males started to die earlier in case of dry medical yeast population and after the 10th day the number of dead males was higher in Brewer's yeast diet males. Females reared on dry medical yeast were faster to die. Number of pupae produced/ Kg of diet was higher in case of dry medical yeast diet than Brewer's yeast diet.

Key words: Med fly, Ceratitis capitata, diet, yeast.

INTRODUCTION

Mediterranean fruit fly (Med fly), Ceratitis capitata (Wied.) (Diptera: Tephritidae), is considered as one of the noxious pests in the tropical and subtropical countries, where it has more than 350 plant hosts belonging to 67 plant families (Liquido et al., 1991). It is widely distributed in Egypt, where it was recorded for the first time in 1904 (Efflatoun, 1924 and El-Ghawabi, 1928). Several trials were carried out to rear the Med fly with different methods in Egypt (Hafez et al., 1967, Mourad, 1976 and Foda et al., 1989). One of the important ingredients in the larval diet is the yeast, which is important for the Med fly development (Z¸mreoglu et al., 1979 and Zucoloto, 1987) and considered as the most expensive ingredients. Brewer's yeast

is often used in artificial diets for insects because it contains protein, vitamins and minerals (Vanderzant, 1974). Brewer's yeast is widely used in artificial diet of different fruit flies such as Mediterranean fruit fly (Hafez and Fares, 1967, El-Hakim and Awad, 1986 and Hashem et al. 1992), Oriental fruit fly and Melon fly (Sundarapperuma and Kawashita, 1999).

The aim of the present work was to study the effect of the Egyptian yeast product on certain biological aspects of Med fly in comparison to the Brewer's yeast..

MATERIAL and METHODS

The culture of the Med fly was obtained from the current strain in the Horticultural Insects Research Department, Plant Protection Research Institute, ARC. The colony has been maintained using the diet of Hashem et al (1992), which based on wheat bran, HCl, Sodium Benzoate, Brewer's yeast, tap water and the sugar molasses has been replaced with granulated sugar (Table 1). The stock was reared in the laboratory (26 °C and 60% Rh) continuously up to the experiment was started. Brewer's yeast has been replaced and compared with the Medical dry yeast (Table 1), which produced by Egyptian Company for starch, yeast and detergent in Alexandria. Medical dry yeast is consists of Protein (42%), Carbohydrates (35%), humidity (9%), Vitamin B1 (0.017%), and Vitamin B2 (0.004%). Med fly was examined during three successive generations, where all the larvae were exposed to the medical dry yeast and compared with Brewer's yeast in the following aspects:

Larval duration:

Diets were prepared and 500 gm diet was powered into each tray. Five trays of each diet were inoculated with 0.1 ml eggs of homogenous eggs (One hour laying). From each tray 100 individuals were examined every day after inoculation. Number of each stage was counted daily for 12 days.

Size of the pupae:

The width and length of 25 pupae of each treatment were measured using the stereoscope

Number of pupae/ml:

On the 5th day of pupal duration, pupae were sifted, washed with indirect tap water to remove the adhered sand and spread them to dry. 5 ml of each

treatment was counted and number of the pupae/ml was calculated. The treatment was replicated 5 times for each treatment.

Percentage of pupation

100 eggs of Med fly were inoculated to different types of diets (50 gm diet for each one). The treatment replicated 5 times. Number of pupae produced from each treatment was counted.

Days to pupation

500 gm of each diet was inoculated with 0.1 ml eggs. On the 7^{th} day of egg laying date the sand was sifted daily and volume of pupae produced was measured. Days to pupation period was calculated when 90% of the pupae was popped out of the diet. Experiment was replicated 5 times.

Weight of the pupae

25 pupae of each treatment were weighed every day during the pupal duration, and the average weight was calculated.

Adult emergence

100 pupae of each treatment were poured into Petri dish. The pupae kept in 26°C and 65% Rh till emergence. Number of emerged flies for each treatment was counted. The experiment was replicated 5 times.

Longevity, Preoviposition and oviposition periods:

On the emergence day, the flies were sexed and 5 pairs of each treatment were poured into small cage which contains water, sugar and enzymatic yeast hydrolysate. The period precedes the egg laying as well as the oviposition period was estimated for each cage. 5 cages were used for each treatment. Number of eggs produced from each cage was counted every day. Number of dead flies in each cage was estimated daily.

Egg hatch

On the egg laying day, 100 eggs were counted, placed on black moisted filter paper in Petri dish. Each treatment was replicated 5 times. The dishes kept in 25°C and 65%Rh. The eggs examined for hatch every day until 95% of them was hatched.

Statistical analysis

Data for comparison tests were subjected to ANOVA and means were separated with Duncan's multiple range test at $P = 0.05$ level.

RESULTS and DISCUSSION

Referring to Fig. 1 and 2, It was found that eggs started to hatch on the 3rd day where 25 and 18 % were hatched, respectively. At the beginning of the larval duration larvae of the Brewer's yeast diet were faster in development, where by the 4th day 17% of larvae were in the 2nd larval stage and 83% were in the 1st larval stage, while there were 13 and 87% for the larvae reared on medical yeast diet, respectively. After the 7th day the results were ad versed where 100% of the larvae in Brewer's yeast diet were in the 2nd larval stage while 7.7% of the larvae of medical yeast diet were in the 3rd larval stage. On the 10th day 50.3% of larvae were pupated in medical yeast diet in comparison to 39% in case of the Brewer's yeast diet larvae.

As shown in Table (2), the medical yeast diet produced the higher number of pupae which were 69±8.7, 82.7 ±1.9 and 73.7 ±3.3 pupae during the three successive generations with an average of 73.6±5.3 pupae while the diet containing Brewer's yeast diet produced 59±7.5 pupae. Statistical analysis shows that there was no significant difference among diets.

Pupae produced from the medical yeast diet were bigger in size than the Brewer's diet where the number of pupae/ml was 56.4±0.5 and 65.5±0.2 pupae, respectively and the difference was significant (Table 2). These results are in close to Foda et al. (1989) and Hashem et al. (1992) who found that Number of pupae/ml was 55.2 and 51.9±0.6 pupae respectively. By measuring the size (length and width) the same results were concluded, where they were 4.51±0.01 and 2.1±0.01 mm for medical yeast diet and 4.47±0.02 and 2.1±0.02 mm for Brewer's diet, without any difference among the treatments.

About the pupal weight, it was higher (9.5 ± 1.7 mg) when the larvae exposed to the medical yeast than Brewer's yeast diet (8.4 ±1.8 mg), and lower than results of Bruzzone (1986), who found that the pupal weight was 9.2±0.0 mg. (Table 2).

The average of adult emergence in the 3 successive generations was lower when the larvae reared on medical yeast (94.6 ±0.6%) in comparison to the average of the Brewer's yeast diet (97.3±1.3%) (Table 2). Results are in coincidence with the findings of El-Hakim and Awad (1986), Bruzzone (1986) and Hashem et al (1992), who revealed that the percentage of adult emergence ranged from 89.2 % to 96.4%. There was no significant difference among the treatment.

About pre-oviposition and oviposition periods there was not significant deference among them. Where the preoviposition periods were 4±0.2 and 3.3±0.6 days in Brewer's and medical yeast diets, respectively. The oviposition periods were 14±1.8 and 14.3±0.9 days, respectively (Table 2).

Females reared on the medical yeast produced higher number of eggs, where average number of eggs during the 3 successive generations were 246.5±22.7, 336.2 ±8.3and 347.7±26.5 eggs, respectively with an average of 310.1±3.2 (Table 2), while females exposed to Brewer's yeast during larval duration produced 149.3±12.3 eggs in adverse to El-Hakim and Awad (1986) and Foda et al. (1989) and coincide with Hashem et al. (1992) According to Duncan's Multiple Range test, there was a highly significant difference among the treatments.

There was insignificant difference among egg hatch of females exposed to Brewer's yeast and medical yeast diets where the average percentages of egg hatch were 89.4±2.7 and 90.7±1.2, respectively (Table 2) These results are in coincidence with El-Hakim and Awad (1986) Foda et al (1989) and Hashem et al (1992) who found that the percentage of egg hatch ranged from 88.5 to 91%. On the contrary Hafez and Ezzat (19667) found that egg hatch was 80.4%.

In comparison between males of medical yeast diet and Brewer's yeast diet (Fig. 3), it was found that males of medical yeast started to die earlier, where on the 6th day 11.3 and 6% were dead, respectively. On the 10th day, the percentage was equal (30%). After that, the situation was adversed, where they were 52 and 62%, respectively. By the 18th day, the percentages were close to each other, where they were 80.7 and 82%, respectively.

In case of females, they started to die on the 3rd day but the majority persisted longer in comparison to males. (Fig. 4). On the 4th day, 6 and 2% of the females reared using medical and Brewer's yeast diet were dead, respectively. On the 8th day, the same results were concluded, where they were 24 and 8%, respectively. On the12th day the results were 42 and 30%, respectively and on the 16th, they were 76 and 58.7%, respectively.

The data presented in Table (3) concluded that the number of pupae produced from 1 Kg diet was higher in medical yeast diet (15042 pupae) while it was 13600.4 pupae in Brewer's yeast diet. The cost was also less (52.5 LE/Kg) in case of medical yeast diet as compared with Brewer's yeast diet (76.9 LE/Kg).

Table (1): Components and estimated costs of larval diet depend on Brewer's or dry medical yeast for rearing Mediterranean fruit fly (According to 2002 prices)

Ingredients	Unit cost (LE/Kg)	Brewer's yeast diet			Medical yeast diet		
		Amount/Kg diet		Value (LE)	Amount/Kg diet		Value (LE)
		Gram	%		Gram	%	
Wheat bran	0.8	330.4	33.04	0.264	372	37.2	0.30
Sugar	1.6	80	8	0.128	80	8	0.128
Brewer's yeast	7	83	8.3	0.581			
Medical yeast	7				40	4	0.28
Na Benzoate	13	3.3	0.33	0.043	4	0.4	0.052
H Cl	7.7	3.3	0.33	0.03	4	0.4	0.03
Water		500	50		500	50	
Total		1000	100	1.046	1000	100	0.79

Table (2): Influence of dry medical yeast in larval diet upon the performance of Mediterranean fruit fly larvae in comparison to the Brewer's yeast larval diet.

Biological characteristics		Type of yeast in larval diet				
		Brewer's	Medical yeast			
			1M‡	2M	3M	Average
Days to pupation (Days)		13	12	11	13	12
% pupation	Mean	59	69	82.7	73.7	73.6
	±S.E.	7.5	8.7	1.9	3.3	5.3
	Significance*	abd	ce	a	bc	de
# Pupal/ml	Mean	65.5	55.4	57.4	56.5	56.4
	±S.E.	0.2	1	0.6	0.4	0.5
	Significance		ab	ab	a	b
Pupal size (length) (mm)	Mean	4.468	4.504	4.511	4.513	4.509
	±S.E.	0.02	0.02	0.01	0.03	0.01
	Significance			a	a	
Pupal size (Width) (mm)	Mean	2.05	2.039	2.052	2.088	2.06
	±S.E.	0.02	0.01	0.01	0.02	0.01
	Significance		ab	cd	ac	bd
Pupal weight (mg)	Mean	8.356	8.992	8.653	10.043	9.529
	±S.E.	1.8	2.6	2.3	2.3	1.7
	Significance	a	bc	b	c	abc
Adult emergence (%)	Mean	97.3	96.7	92.3	94.7	94.6
	±S.E.	1.3	1.2	2.2	1.2	0.6
	Significance	ab	a	c	bc	ac
Pre-Oviposition period (Days)	Mean	4	4	3	3	3.3
	±S.E.	0.2	0.4	0.4	0.8	0.6
	Significance	a	a	a	a	a
Oviposition period (Days)	Mean	14	14	15	14	14.3
	±S.E.	1.8	0.9	0.6	1.1	0.9
	Significance	a	a	a	a	a
# Eggs/ Female	Mean	149.3	246.5	336.2	347.7	310.1
	±S.E.	12.5	22.7	8.3	26.5	3.2
	Significance	ab	c	ac		ab
% Egg hatch	Mean	89.4	90.8	90.4	91	90.7
	±S.E.	2.7	2.5	1.6	0.8	1.2
	Significance	a	a	ab	b	a

* Means followed by the same letter in the same row are not significantly different ($P > 0.05$) (Duncan's Multiple Range test).

‡ 1M, First generation; 2M, Second generation; 3M, third generation.

Table (3): Costs of Mediterranean fruit fly production using Brewer's and dry medical yeast in larval diet.

Item	Type of diet	
	Brewer's yeast diet	Dry medical yeast diet
Cost of 1 kg diet (LE)	1.046	0.79
Number of pupae / Kg diet	13600.4	15042
Cost of Million pupae (LE)	76.9	52.5

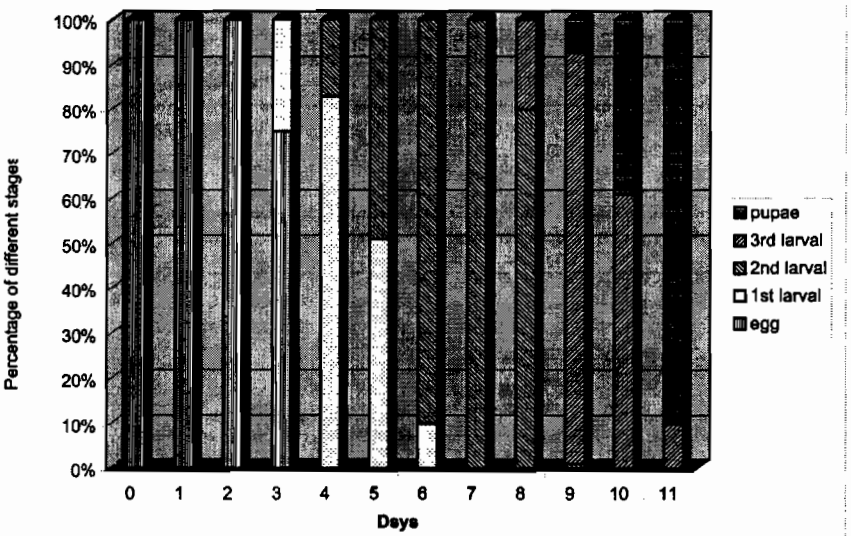

Fig. 1: Distribution of different stages in 100 indiveduals of Mediterranean fruit fly exposed to Brewer's yeast during larval stages.

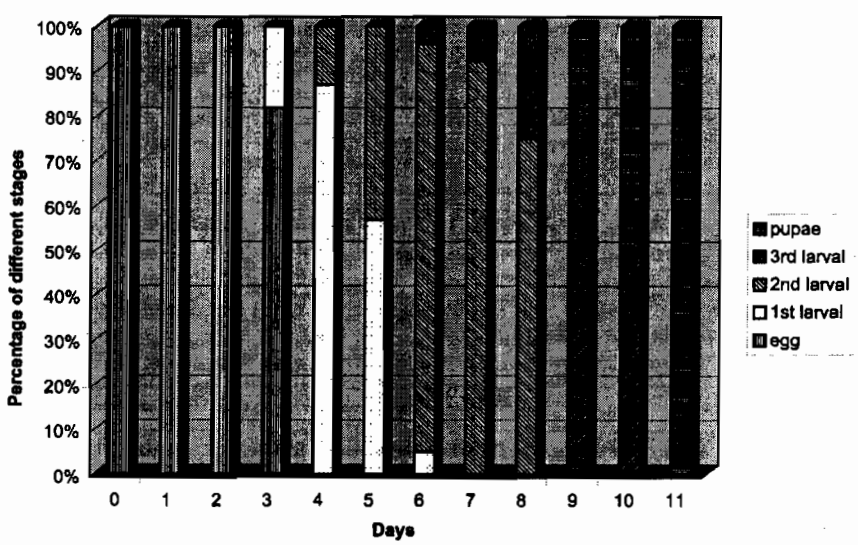

Fig. 2: Distribution of different stages in 100 indiveduals of Mediterranean fruit fly exposed to medical yeast during larval stages.

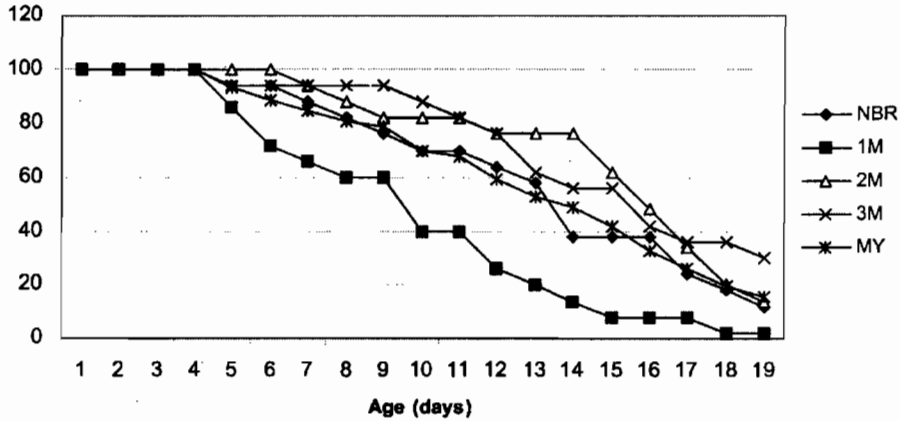

Fig. 3: Influence of yeast (Brewer's or Dry medical) in larval diet on the survivorship rates of Mediterranean fruti fly males

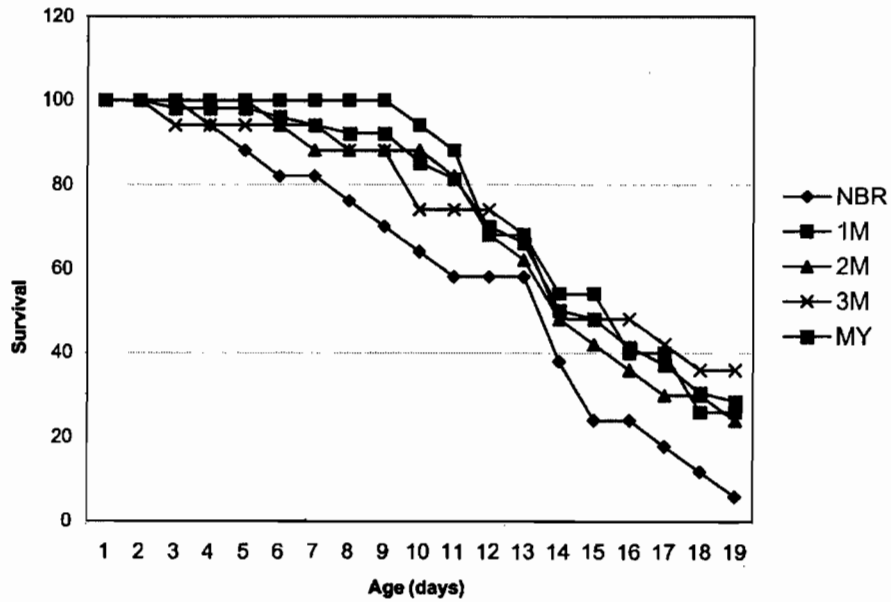

Fig. 4: Influence of yeast (Brewer's or Dry medical) in larval diet on the survivorship rates of Mediterranean fruti fly females

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بيئة عملية فعاله ورخيصة لتربية يرقات ذبابة فاكهة البحر المتوسط

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عند تربية ذبابة فاكهة البحر المتوسط على بيئة خميرة طبية جافة ومقارنتها ببيئة خميرة بريور، أثبتت الدراسة النتائج التالية: أن اليرقات التى ربيت على بيئة خميرة بريور كانت أسرع فى النمو فى البداية ولكن تغير الحال مع نهاية العمر اليرقى. وأن بيئة الخميرة الطبية الجافة أنتجت عدداً أكبر من العذارى ذات حجم ووزن أكبر وذات نسبة خروج أقل وكذلك أقصر فترة ماقبل وضع البيض وأطول فترة وضع بيض وأكبر عددا من البيض وأعلى نسبة فقس للبيض. وبالنسبة إلى طول عمر الحشرة الكاملة بدأت ذكور بيئة الخميرة الطبية الجافة فى الموت مبكرا فى بداية الحياة ثم تغير الموقف بعد اليوم العاشر. وبالنسبة إلى الإناث كانت إناث بيئة الخميرة الطبية الجافة أسرع إلى الموت وأقل فترة حياة. وكان عدد العذارى الناتج من كيلو جرام من البيئة أكبر فى حالة بيئة الخميرة الطبية الجافة.