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INFLUENCE OF MEDICAL YEAST LEVEL ON THE BIOLOGICAL PARAMETERS OF MEDITERRA NEAN FRUIT FLY, Ceratitis capitata (Wied.) IN EGYPT.

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ABSTRACT: Dry medical yeast level in larval diet of Mediterranean fruit fly was examined by increase and decrease two levels than the standard level to study the influence on the biological aspects of the different stages. The results concluded that the increase in the amount of yeast reflected by significant decrease in the days to pupation as will as the larval duration, number of pupae/ml, preoviposition and oviposition periods, insignificant increase in pupal size (length and width), adult emergence and significant increase in percentage of pupation, pupal weight, number of eggs/ female and percentage of egg hatch. About the longevity, flies (Both sexes) of the least amount of yeast, started to die earlier than the others and by the increase the yeast level they persisted longer. Males were started to die earlier than females.

INTRODUCTION

Mediterranean fruit fly (Medfly), Ceratitis capitata (Wiedemann) is one of noxious pests, that consumes huge number of horticultural hosts. Different studies have been succeeded to rear Medfly round the world (Bateman, 1972 and Steiner and Mitchell, 1966) and also in Egypt (Hafez *et al.*, 1967; Mourad, 1976 and Foda *et al.*, 1989). Mass rearing of Medfly in a good quality is an important prerequisite for biological behavior studies as will as biological control and Sterile Insects Technique programs. The nutritional requirements of Tephritids are fulfilled by nutrients from the diet they ingested, and/or by transfer of nutrients from earlier stages (Funke, 1983).

Brewer's yeast is an important constituent in the larval diet of Medfly, (Zümreoglu *et al.*, 1979 and Zucoloto, 1987) but unfortunately it is the most expensive material and it has to be exported from foreign countries. During previous studies (Under publication), dry medical yeast, which produced by Egyptian companies was studied as a replacement of Brewer's yeast and the

study concluded that Medical yeast is efficient for the Medfly larval development. During this work the influence of the medical yeast level on the biological parameters of Medfly is going to be studied.

MATERIALS AND METHODS

The culture of the Medfly 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), but the molasses was replaced with granulated sugar and the Brewerís yeast was replaced with the dry medical yeast. The stock was reared in the laboratory (26°C and 60% RH) continuously up to the experiment was started. Medical yeast is produced by Egyptian Company for starch, yeast and detergent in Alexandria. Medical yeast level was compared by increase and decrease two levels in comparison to the standard level (Table 1). Comparison has been done among the five treatments in the following parameters:

Larval duration:

Diets were prepared and 500 gm diet was powered into each tray. Each treatment was represented with 5 trays. Each tray was inoculated with 0.1 ml eggs of homogenous eggs (One hour laying). From each tray 100 individuals were examined on the 3^{rd}, 5^{th}, 7^{th}, 9^{th} and 11^{th} day after egg inoculation. Using binocular stereoscope, stages were differentiated and counted.

Size of the pupae:

The pupae were sifted, washed with indirect tap water to remove the adhered sand and spread them to dry. The pupal size was measured using stereoscope to measure the width and length of 25 pupae of each treatment.

Number of pupae/ml:

On the 5^{th} day of pupal duration, the 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 pupae/ml was calculated. The treatment was replicated 3 times for each treatment.

Percentage of pupation

100 eggs of Medfly were inoculated to different types of diets (50 gm diet for each replicate). 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 7th 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 petridish. 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 recorded daily and longevity was calculated for male and female.

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 hatch finished.

Statistical analysis:

Data for comparison tests were subjected to ANOVA and means were separated with Duncan's Multiple Range Test at the P=0.05 level.

RESULTS AND DISCUSSION

However, Zucoloto (1987) found that protein is the most necessary component in the diet. The quantity of dietary protein is an important factor for proper development of the fruit flies. When the larvae of Medfly exposed to different levels of yeast in diet, the larval duration changed (Fig. 1). Where by the 3rd day 20% of the eggs were hatched in the standard diet and the

results of the other treatments were not so far from the standard diet. By the time, the situation was adverse, where on the 5th day, the stages started to be prolonged by decreasing the yeast level and vice versa. On the 7th day, the result was confirmed, where the 2nd larval stage was represented as 85% in Y1 (the lowest yeast level), 90% in Y2, 90% in Y3, 70% in Y4 and 69% in Y5. The development was fastened and the difference among the treatments increased on the 9th day where the 3rd stage was represented with 36% in Y1, 79% in Y2, 82% in Y3, 64% in Y4 and 59% in Y5. By the 11th day, all the individuals pupated in Y3, Y4 and Y5 while just 18 and 2% pupated in Y2 and Y1, respectively. This result concedes with Zucoloto (1987) on Medfly and Mohamed (1997) on the Oriental fruit fly.

The previous results was confirmed when the egg-larval duration was examined (Table 2). In case of Y1 diet, the egg-larval duration extended for 14 ±0.4 days and by increasing the yeast level the duration was shortened where it elapsed 11 ± 0.4 days in Y5 diet (Table 2) and these results agreed with Chan *et al.* (1990). Highly significant differences were obtained between treatments.

Table (1): Components of larval diet of Mediterranean fruit fly with varying yeast levels.

Ingredients	Yeast levels				
	Y1	Y2	Y3(Standard)	Y4	Y5
Wheat bran	372	372	372	372	372
Sugar	80	80	80	80	80
Medical yeast	20	30	40	50	60
Na Benzoate	4	4	4	4	4
H Cl	4	4	4	4	4
Water	500	500	500	500	500

When 100 eggs were inoculated in 50 gm diet, the highest number of pupae was produced in Y5 diet (82.3±2 pupae) whereas the lowest number synchronized with the lowest amount of yeast (Y1) (63.3 ±4.8 pupae). As for Y2, Y3 and Y4, 67±2.5, 73.7±3.2 and 82±3 pupae were produced, respectively. The differences among the treatments were moderately significant. According to Duncanís Multiple Range Test, the differences was not significant between Y1, Y2 and Y3 or between Y3, Y4 and Y5.

Statically, significant differences were obtained between pupal sizes on different treatments. The increase of yeast level in larval diet reflected by slight increase in the pupal size. Larvae exposed to the higher amount of Yeast (Y5) had the lowest number of pupae/ml (51.6±2.8 pupae) whereas Y4, Y3, Y2, and Y1 diets produced 52.6±4.9, 56.4 ±1.8, 57.2±2.9 and 57.4±4.1 pupae, respectively. Nearly, same results were concluded by measuring the length and width of the pupae, where they were 4.56±0.02 and 2.2±0.05 mm respectively for pupae of Y5. Whereas they were for pupae of Y1, 4.51±0.03 and 2.08±0.04 mm, respectively. The difference among the treatments was not significant.

Also, significant differences were found among the average weight of pupae. The average weight of the pupae was directly proportional with the yeast level (Table 2). Where it was 9.7±0.2, 10.1±.03, 10.5±0.3, 10.9±0.3 and 10.7±0.4 mg for Y1, Y2, Y3, Y4 and Y5 respectively. The difference among the treatments was significant. According to Duncanís Multiple Range Test, there was not significant difference between Y1 and Y2 or between Y2, Y3 and Y4 or between Y3, Y4 and Y5. This result agreed with Chan *et al.*, (1990).

Emergence of adults was mild influenced by yeast level but with insignificant difference. Y5 adults were the highest emergence (99±0.6) in comparison to Y4, Y3, Y2 and Y1, which were 96.7±1.7, 94.3±3.2, 92.7±1.2 and 96.3±0.03 respectively (Table 2). This result coincides with Brozzone (1986), Cocoreli et al., (1988) and close to Hashem *et al.*, (1992).

Preoviposition and oviposition periods prolonged by decreasing the level of yeast in larval diet (Table 2). Preoviposition periods in Y1 and Y5 were 4±0.5 and 2± days respectively. While the oviposition periods were 17±1 and 13±0.9 days respectively. There was significant difference among the treatments.

There was highly significant difference among the numbers of eggs produced from females exposed to different levels of yeast. Females of Y4 produced the highest number (384±12.5 eggs) followed by Y5 (380.3±3.4 eggs), Y3 (347.7±17.6 eggs), Y2 (186±10.6 eggs) and Y1 (134±6.4 eggs). According to Duncanís Multiple Range Test, there was not significant difference between egg numbers of Y1 and Y2 and also between Y3, Y4 and Y5. Average number of eggs/female reared on the standard diet close to the number produced by Foda *et al.*, (1989) (356.8 eggs).

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		Medical yeast level					Significance level ☼
		Y1‡	Y2	Y3	Y4	Y5	
Days to pupation (Days)	Mean	14	13.8	13	11.4	11	***
	±S.E.	0.4	0.4	0.4	0.5	0.4	
	Significance■	a	a	a	b	b	
% pupation	Mean	63.3	67	73.7	82	82.3	*
	±S.E.	4.8	2.5	3.2	3	2	
	Significance	a	a	ab	b	b	
Number of Pupae/ml	Mean	57.4	57.2	56.4	52.6	51.6	**
	±S.E.	4.1	2.9	1.8	4.9	2.8	
	Significance	a	a	a	a	a	
Pupil size (length) (mm)	Mean	4.51	4.53	4.53	4.54	4.56	NS
	±S.E.	0.03	0.02	0.05	0.02	0.02	
	Significance	a	a	a	a	a	
Pupil size (Width) (mm)	Mean	2.08	2.08	2.2	2.23	2.2	NS
	±S.E.	0.04	0.04	0.05	0.06	0.05	
	Significance	a	a	a	a	a	
Pupil weight (mg)	Mean	9.7	10.1	10.5	10.9	10.7	**
	±S.E.	0.2	0.3	0.3	0.3	0.4	
	Significance	a	ab	bc	bc	c	
Adult emergence (%)	Mean	96.3	92.7	94.3	96.7	99	NS
	±S.E.	0.03	1.2	3.2	1.7	0.6	
	Significance	a	a	a	a	a	
Pre-Oviposition period (Days)	Mean	4	4	3	3	2	NS
	±S.E.	0.5	0.6	0.8	0.2	0.4	
	Significance	a	a	a	a	a	
Oviposition period (Days)	Mean	17	15	14	13.5	13	**
	±S.E.	1	0.9	1.1	1.8	0.9	
	Significance	b	a	a	a	a	
Number of Eggs/ Female	Mean	134	186	347.7	384	380.3	***
	±S.E.	6.4	10.6	17.6	12.5	3.4	
	Significance	a	a	b	b	b	
% Egg hatch	Mean	78.7	81	91	95.7	96.3	**
	±S.E.	2	1.5	4.7	0.7	1.4	
	Significance	a	a	b	b	b	

‡ Y1= Lowest yeast level, Y3 = Standard yeast level, Y5=highest yeast level.

☼ Means of the same row are not significant (NS), Moderately significant (*), Significant (**), or highly significant (***)

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

Eggs showed a direct correlation between the yeast level and hatchability (Table 2), where the percentage of egg hatch of the normal strain (Y3) was 91±4.7 and by increase the level of the yeast to Y4 and Y5, it was 95.7±0.7 and 96.3±1.4 respectively. While the decrease of yeast to Y2 and Y1 reflected by decrease in the hatch which were 81±1.5 and 78.7±2 respectively. The difference among the treatments was significant, while according to

Duncan's Multiple Range Test, there was not significant difference between the egg hatch of Y1 and Y2 and also between Y3, Y4 and Y5. El-Hakim and Awad (1986), Foda *et al.*, (1989) and Hashem *et al.*, (1992) found that the hatchability of Medfly/eggs were 88.9, 91 and 88.5% respectively.

About the longevity of Medfly, it was found that yeast has a correlated influence on the adult survivorship. In case of males and on the 5^{ht} day there was 20% of males were dead from Y1 while 100% of the Y5 were still alive (Fig. 2). The same result was obtained on the 9th day where the number of alive males were 53.3 and 66.7% of the Y1 and Y5 respectively whereas on the 12th day they were 13.3 and 33.3% respectively (Fig.2). About the females, the same result was concluded where on the 9th day, all of them were alive and by the 10th day females of Y1 started to die. On the 13th day, 33.7% of Y1 were dead in comparison to 80% for all the other treatments. By the 17th day number of alive females were 0, 33.4, 30, 55.6 and 55% of Y1, Y2, Y3, Y4 and Y5 respectively (Fig. 3). This result coincides with that of Chan *et al.*, (1990).

From the forgoing results, it could be concluded that medical yeast can be used as a replacement of Brewer's yeast in rearing diet and it is efficient for the med fly larval development.

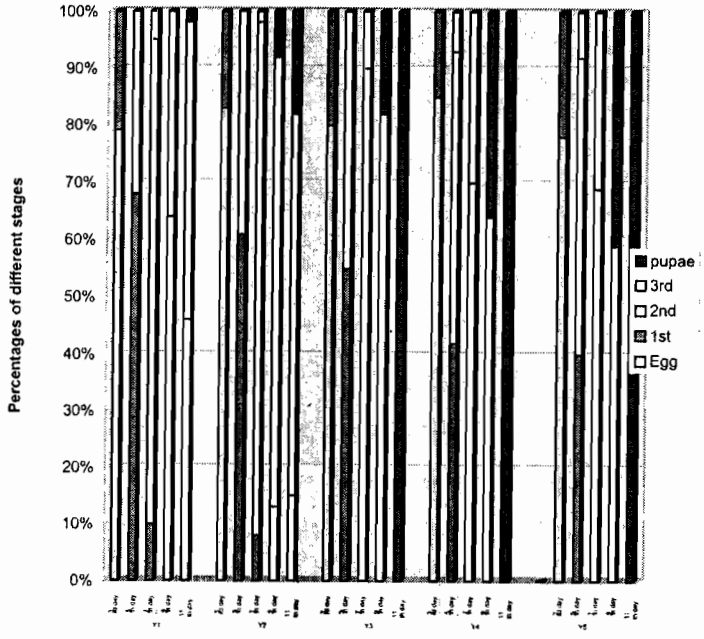

Fig. (1): Distribution of different stages in 100 individuals of Mediterranean fruit fly exposed to different levels of medical yeast during the larval stage.

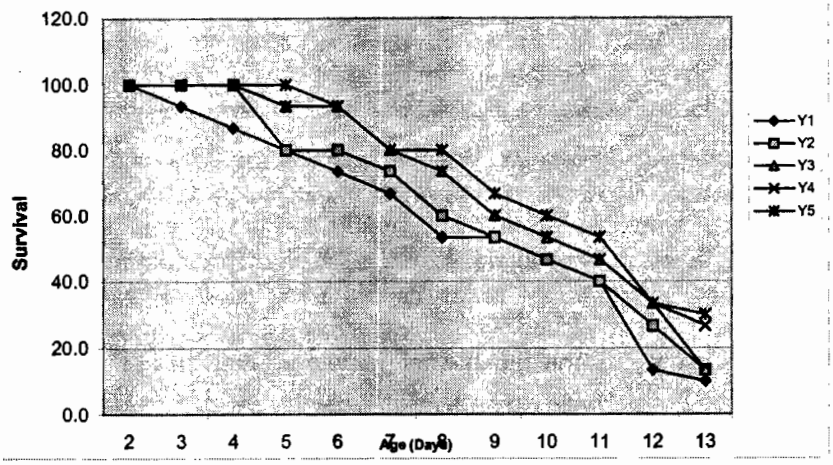

Fig. (2): Influence of yeast level in larval diet on the survivorship rates of Mediterranean fruit fly males

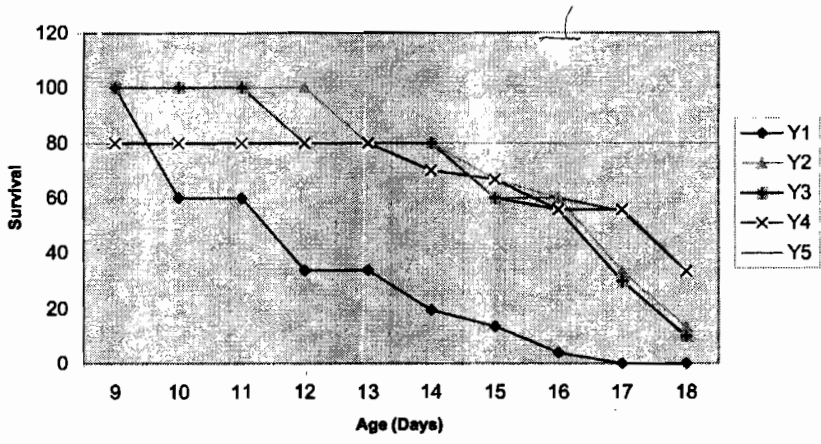

Fig. (3): Influence of yeast levels in larval diet on the survivorship rates of Mediterranean fruit fly females

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تأثير مستوى الخميرة الطبية على السمات البيولوجية لذبابة فاكهة البحر المتوسط فى مصر

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تم إختبار تأثير مستوى الخميرة الطبية فى بيئة يرقات ذبابة فاكهة البحر المتوسط على بعض الصفات البيولوجية وذلك بالزيادة والنقصان لمستويين أعلى وأقل من المستوى المقياس. خلصت نتائج التجربة إلى أن الزيادة فى كمية الخميرة تنعكس بنقص ذى أهمية فى عدد الأيام من البيضة حتى التعذير وخاصة خلال العمراليرقى، وعدد العذارى/مل، وفترة ماقبل وضع البيض، وفترة وضع البيض وبالزيادة الطفيفة غيرذات الأهمية عليحجم العذارى (طول وعرض)، وخروج الحشرات. وزيادة ذات أهمية على نسبة التعذير، ووزن العذارى وعدد البيض/أنثى ونسبة فقس البيض. أما بالنسبة إلى طول عمر الحشرة فقد بدأت ذكور البيئة ذات الكمية الأقل من الخميرة فى الموت مبكرا(فى اليوم الثالث) فى مقابل بدء الحشرات التى عرضت لأعلى نسبة من الخميرة فى الموت فى اليوم السادس واستمر الفارق حتى نهايةعمرالحشرات. وأما بالنسبة للإناث فقد بدأ موتها متأخرا مقارنة بالذكور حيث بدأ موتها فى اليوم العاشر وكانت إناث البيئة ذات الكمية الأقل من الخميرة هى الأسرع إلى الموت من الإناث المعرضة للنسب الأكبر من الخميرة.