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Evaluating Attractency of Some Protein Derivatives for the Mediterranean Fruit Fly, *Ceratitis capitata* (Wiedmann) and the Peach Fruit Fly, *Bactrocera zonata* (Saunders)

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ABSTRACT

Mediterranean Fruit Fly (MFF), *Ceratitis capitata* and Peach Fruit Fly (PFF), *Bactrocera zonata* are the main insect pests in Egypt and because the monitoring process is done by sex attractant traps that is specialize for males only, while food baits extend to attract both male and female flies and thus, it can be used in monitoring fruit flies, especially female flies. Responding both MFF and PFF to food baits in field trials were studied as aim to evaluate the attraction to some protein derivatives; Cera Trap, Buminal and Bio Nal, in comparison with torula yeast, also effect of pH degree. Results indicated that the highest attractive material for MFF was Buminal bait, followed by Cera Trap and Bio Nal. While, the highest attractive material for PFF was Cera Trap bait, followed by Buminal and Bio Nal. Significant differences in attraction were obtained among different food baits, also between females and males attraction for both MFF and PFF. Number of captured flies for both species was related to pH degree. A significant negative correlation was obtained between concentrations of different food baits in pH degree. A significant negative correlation was obtained for Buminal baits in pH degree with elapsed time while non-significant negative and non-significant positive correlation were obtained for Cera Trap and Bio Nal baits in pH degree with elapsed time.

Key words: Mediterranean fruit fly, *Ceratitis capitata*, peach fruit flies, *Bactrocera zonata*, protein derivatives

INTRODUCTION

The Peach Fruit Fly (PFF), *B. zonata* and Mediterranean Fruit Fly (MFF), *C. capitata* (Diptera: Tephritidae) rated among the most damaging of fresh fruit and fruiting vegetables pests. Adult tephritids need for each of the sugar to continue to live and protein to mature ovaries and fecundity. Because of the strong need of Adult tephritids to protein, it is widely used for attracting the tephritid insect pests. Protein baits whose use in fruit fly monitoring and control is based on their attractiveness as a food source (Roessler, 1989). The standard trap for the trapped both of *Anastrepha* species and *Anastrepha suspense* (Loew) is the McPhail trap, an invaginated glass bottle baited with an aqueous protein (yeast) hydrolysate solution (Mcphail, 1939). Mcphail and Mcphail-type traps baited with hydrolyzed protein have been the standard traps for monitoring populations of most tephritidae species (Cunningham, 1989; Aluja, 1994). It must be planned a program detection to determine the initial infection using a minimum of 2 Jackson and Mcphail traps 2 km⁻², detection program, similar to that used in the suppression and the protection of fly free zones option, should be established prior to the implementation of the eradication (IAEA, 1999; Mwatawala *et al.*, 2009) used protein bait only for trapping *B. invadens* vs. *Ceratitis* sp. while for *B. cucurbitae* versus the re-establishes cucurbit infesters, protein bait and

Cue lure were used. The scent emitted by the host or food is an important factor for attract the female flies and thus used as a Lures for capturing female fruit flies. Historically, liquid protein baits have been used to catch a wide range of different fruit fly species (IAEA, 2003).

The purpose of this study was to evaluate the current food baits and extent of pH degree effect on attraction of both MFF and PFF, as target to detect these flies as well as improve their control programs.

MATERIALS AND METHODS

Area of experimental orchards: The study was carried out in two districts (Komhamada and Rashid) at El-Beheira governorate through 2011 season, through period from the first April with the beginning of the peach season until the last November with the post harvest of mango season.

The first location has a high density of PFF; 12 male/trap/day (Komhamada district) and other with a high density of MFF; 57 male/trap/day (Rashid district) according to collected data were obtained from sex pheromone traps (unpublished data).

The first experiment: Response of fruit flies to protein based bait: The tested potential attractant compounds were:

- Cera Trap with three concentrations; 5, 10 and 20% (Hydrolyzed protein 95% (p/p), Manufactured by Bioiberica, S.A. Plaza Francesc Macià 7 08029 Barcelona, Spain)
- Buminal with three concentrations; 5, 10 and 20% (Hydrolyzed Protein 39.78%, NABA GmbH)
- Bio Nal with three concentrations; 2, 4 and 8% (Hydrolyzed protein 44%, Bio Tec Company), compared with torula yeast (2%) under field conditions in fruit trees; mango fruit trees (8 feddans, 20 years-old) for PFF at Komhamada district while it was apricot fruit trees (5 feddans, 10 years- old) for MFF. Protein based baits were prepared for each compound using clear cylindrical plastic bottle with 4 holes evenly spaced on it's sides (4 mm diameter) and a wire hanger Plastic Bottle (PB) trap, contains 100 mL of solution for each concentration along fruit season period (the solution of protein baits have mixed with 1% of borax to slow down the decomposition of the captured insects). The PB traps were hanged at 1.5 to 2 m above the ground on the tree in randomize distribution every five trees in apricot trees and every three trees in mangoes and three replicates of each treatment were conducted. Trap positions was redistributed randomly every weekly to avoid effect of trap position on flight catch. Traps were weekly serviced the contents of traps were poured through wire screen sieve and returned to the traps for another week. Traps were then washed with water and reloaded with fresh baits. The flies were held in plastic tubes marked with code number and transferred to the laboratory, washed with fresh water, rowed on towel paper, sexed and counted and numbers of captured flies per day per trap (CTD) were recorded

The second experiment: determination of pH: For determination of pH degree, 50 mL of the three tested concentrations of each food bait compounds; 5, 10 and 20% of Cera Trap and Bio Nal and 2, 4 and 8% for Buminal were collected after one and two weeks from PB traps and transferred to lab of analysis of soil at El-Bohira Governorate. pH of these samples was measured by the Jenway 3505 pH meter.

Statistical analysis: The above mentioned experiments were planned as complete randomized design and the obtained data were statically analyzed according Duncan's multiple test and

(CoStat Software, 1990) in addition to the regression analysis was use to describe changes in trapped fruit flies and tested factors.

RESULTS

Response of fruit flies to protein baits: Field assessment of attracting both MFF and PFF, to three compounds of protein baits as food Attractants; Cera Trap, Buminal and Bio Nal, were compared with torula yeast in field trials conducted in Apricot fruit trees in Rashid district. Data presented in Table 1 illustrated that mean number of captured flies /trap/day (CTD) of MFF, *C. capitata* that Buminal bait at 2% was the superior attractive food bait (9.58±2.11), followed by Cera Trap 10% (5.97±1.39), Buminal 4% (4.39±1.44), Bio Nal 5% (4.32±1.39), Cera Trap 5% (3.84±1.56), Cera Trap 20% (3.54±1.09), Bio Nal 10% (2.90±1.43), Buminal 8% (2.24±0.57) and Bio Nal 20% (1.31±0.70) while it was (3.89±0.82) for torula yeast. Attracted flies of MFF to Buminal bait at 2% conc. were 1.6, 2.18, 2.22, 2.49, 2.71, 3.30, 4.28, 7.31 and 2.46 folds than Cera Trap 10%, Buminal 4%, Bio Nal 5%, Cera Trap 5%, Cera Trap 20%, Bio Nal 10%, Buminal 8%, Bio Nal 20% and torula yeast, respectively. Statistical analysis showed high significant differences in attractivity among various food baits attractive. Buminal bait at 2% was the most attractive food baits for female flies i.e. 22.3% of total mean number of attractive females for various tested food baits against MFF, so the same trend was obtained for males, where the percent was 22.3% of total mean number of attractive males for various tested food baits and so Buminal food bait at 2% conc. was attractive for 23% of total attractive flies of MFF for all tested food baits. General mean number of trapped flies revealed that the attracted females were 1.27 fold than males, where the percent attracted females per total attractive females and males for various tested food baits against MFF was 56.89%. Hence a significant difference in attraction was obtained between female and male flies. On the other hand, the test conducted at Komhamada district in mango fruit trees as

Table 1: Comparison of attraction mean numbers adult of MFF, *C. capitata*, respond to Cera Trap Buminal and Bio Nal as food-based attractants

Treatment	Conc. (%)	Mean No. of captured flies/trap/day (CTD)		Total mean (FM)	Mean±SD (FM)
		F	M		
Cera Trap	5	4.36±1.21	3.31±1.95	07.76	3.84±1.56 ^d
	10	6.76±1.56	5.18±0.73	11.94	5.97±1.39 ^b
	20	3.48±1.21	3.59±1.22	7.07	3.54±1.09 ^e
Mean±SD		4.86±1.87 ^a	4.03±1.49 ^b	26.77	4.47±1.69 ^b
Buminal	2	10.94±1.59	8.22±1.77	19.16	9.58±2.11 ^a
	4	4.35±1.44	4.43±1.77	8.18	4.39±1.44 ^e
	8	2.56±0.70	1.91±0.08	4.47	2.24±0.57 ^e
Mean±SD		5.95±3.89 ^a	4.86±3.02 ^a	31.81	5.40±3.48 ^a
Bio Nal	5	4.92±1.05	3.71±1.63	8.63	4.32±1.39 ^e
	10	3.53±1.32	2.27±1.48	5.80	2.90±1.43 ^f
	20	1.54±0.02	1.06±0.14	2.60	1.31±0.70 ^b
Mean±SD		3.33±1.77 ^a	2.35±1.59 ^a	17.03	2.84±1.71 ^d
Torula yeast		4.56±0.57	3.22±0.41	7.78	3.89±0.82 ^{bc}
Total mean		47.00±0.00	36.89±0.00	83.89	
Mean±SD		4.70±2.51 ^a	3.69±2.20 ^b		4.19±2.27

Means followed by the same letter(s) are not significantly different according to LSD 0.05, LSD 0.05 for Treatment = 0.71, LSD 0.05 for sex = 0.07, LSD 0.05 for conc. = 0.16, MFF: Mediterranean fruit fly, M: Male, F: Female

Table 2: Comparison of attraction mean number adults of PFF, *B. zonata*, respond to Cera Trap, Buminal and Bio Nal as food-based attractants

Treatment	Conc. (%)	Mean No. of captured flies/trap/day (CTD)		Total mean (FM)	Mean±SD (FM)
		F	M		
Cera Trap	5	8.05±0.51	0.70±0.12	8.75	4.37±4.84 ^f
	10	14.44±1.56	0.70±0.20	15.14	7.57±0.38 ^a
	20	10.10±2.21	0.80±0.40	10.90	5.45±5.09 ^b
Mean±SD		10.86±2.83	0.73±0.10	11.59	5.79±5.56 ^a
Buminal	2	5.16±1.59	1.10±0.67	6.26	2.55±1.59 ^d
	4	3.93±0.44	0.70±0.12	4.63	2.31±1.86 ^e
	8	0.88±0.70	0.20±0.08	1.08	0.54±0.38 ^f
Mean±SD		3.32±1.61	0.66±0.40	3.99	1.99±1.63 ^b
Bio Nal	5	2.23±0.23	0.50±0.20	2.73	1.36±0.96 ^e
	10	0.96±0.60	0.20±0.04	1.16	0.58±0.42 ^f
	20	0.88±0.18	0.30±0.02	1.18	0.59±0.32 ^f
Mean±SD		1.35±0.66	0.33±0.19	1.69	0.84±0.71 ^b
Torula yeast		2.47±0.47	0.61±0.017	3.08	1.54±0.88 ^{ab}
Total mean		49.10±0.00	5.81±0.00	54.91	
Mean±SD		4.91±4.43 ^a	0.58±0.26 ^b		2.75±3.80

Means followed by the same letter(s) are not significantly different according to LSD 0.05, LSD 0.05 for Treatment = 0.22, LSD 0.05 for sex = 0.13, LSD 0.05 for Conc. = 0.24, PFF: Peach fruit fly, M: Male, F: Female

shown in Table 2 revealed that the higher mean number of trapped flies (females and males) of PFF, was recorded in Cera Trap at 10% conc. (7.57±0.38), followed by Cera Trap 20% (5.45±0.19), Cera Trap 5% (4.37±0.84) Buminal 2% (3.13±1.59), Buminal 4% (2.31±1.86), Bio Nal 5% (1.36±0.96), Bio Nal 20% (0.59±0.32), Bio Nal 10% (0.58±0.42) and Buminal 8% (0.54±0.38), compared with torula yeast (1.54±0.88). The attracted flies of PFF, to Cera Trap at 10% conc. were 1.39, 1.73, 2.41, 3.27, 5.57, 12.83, 13.05, 14.02 and 4.91 folds than Cera Trap 20, Cera Trap 5, Buminal 2, Buminal 4, Bio Nal 5, Bio Nal 20, Bio Nal 10, Buminal 8% and torula yeast, respectively. Statistical analysis showed high significant differences in attraction among various tested food baits. The data explained that the most attractive food bait for PFF females was Cera Trap bait at 10% Con, where it was 29.4% while Buminal bait at 2% was 10.5% of the total mean number of attractive females for various tested food baits against PFF and so Cera Trap bait at 10% was attractive for 27.5% of total PFF flies for all tested food baits while Buminal at 2% was attractive for 11% of total attractive flies. The general mean number of trapped PFF revealed that the attracted females was 8.47 folds than males, where the percent attracted females per total attractive females and males was 89.4%, hence a significant difference in attraction was obtained between female and male flies of PFF. Suggestion that females of PFF need protein source during adult stage, in contrast male flies maybe do not need protein source during adult stage.

Degree of pH and protein baits: Data in Table 3 and 4 showed that degree of pH varied not only from treatment to another but also from concentration to another. Similarity, statistical analysis showed a significant difference in the degree of pH from treatment to another, also from concentration to another, where the pH degree was inversely proportional to the concentration of food baits ($r = -0.56$) and duration tested time ($r = -0.18$). The general mean of degree of pH was 7.89±0.63 at the first tested week, then decreased to 7.60±0.93 at the second tested week. Statistical analysis showed a non-significant difference in pH degree of food baits between tested periods, this

Table 3: The pH degree and numbers of MFF adult's, *C. capitata*, respond to Cera Trap, Buminal and Bio Nal as food attractants

Treatment	Conc. (%)	pH count	Mean No. of captured flies/trap/day (CTD)							
			1st week				2nd week			
			pH	F	M	FM	pH	F	M	FM
Cera Trap	5	8.25±0.11	8.40±0.09	24.00±3.05	30.33±3.10	27.16±4.27	8.26±0.03	18.33±2.03	5.66±5.2	12.16±7.05
	10	8.30±0.02	8.04±0.03	71.67±2.89	62.33±3.21	67.00±5.79	7.82±0.06	60.33±3.69	30.33±0.58	54.33±2.97
	20	8.02±0.10	7.62±0.20	41.67±2.89	25.00±0.14	33.33±2.33	7.52±0.27	30.66±2.08	21.33±0.58	26.00±5.36
Mean±SD		8.19±0.08	8.02±0.33	45.88±20.89	39.22±17.63	42.55±19.06	7.86±0.35	36.44±19.89	19.11±10.86	27.77±17.46
Buminal	2	8.25±0.13	7.88±0.01	74.33±4.04	73.00±3.60	73.66±3.27	6.52±0.22	62.00±3.07	50.00±3.01	56.00±7.48
	4	7.98±0.03	7.52±0.30	33.33±2.87	30.66±3.05	31.99±3.03	6.33±0.30	27.00±3.00	26.01±0.58	26.50±2.72
	8	7.50±0.01	7.28±0.03	29.00±1.00	22.00±0.57	25.83±2.23	6.26±0.02	20.66±1.52	20.33±2.51	20.50±1.87
Mean±SD		7.91±0.06	7.58±0.23	45.55±21.81	42.00±23.66	43.83±22.15	6.37±0.25	36.55±19.39	32.11±14.03	34.33±16.57
Bio Nal	5	8.36±0.02	8.62±0.081	35.33±4.16	33.00±3.00	34.17±4.31	8.57±0.10	20.66±0.57	13.00±2.57	16.83±4.62
	10	7.76±0.01	8.28±0.13	24.00±5.00	20.16±2.07	19.83±5.07	8.51±0.05	15.61±0.58	12.67±2.61	16.66±5.28
	20	6.52±0.10	6.53±0.76	15.02±2.00	11.00±2.64	13.00±3.04	7.54±0.74	12.33±2.00	9.67±0.58	11.00±1.67
Mean±SD		7.54±0.04	7.81±0.94	24.77±9.45	17.88±4.22	22.33±10.00	8.21±0.63	19.88±10.84	11.78±3.19	14.83±5.54
Torula yeast		8.75±0.03	8.64±0.01	34.02±3.61	20.03±5.58	27.00±8.60	8.63±0.01	54.00±1.73	40.00±12.12	47.00±10.89
General		7.97±0.05 ^a	7.89±0.63 ^a	38.23±19.27	32.36±19.45	35.30±19.43 ^a	7.60±0.93 ^a	32.66±18.23	22.80±14.12	27.78±16.89 ^b
Mean±SD										

Means followed by the same letter(s) are not significantly different according to LSD 0.05 for pH = 0.68, LSD 0.05 for No. = 7.01, MFF: Mediterranean fruit fly, M: Male, F: Female

Table 4: The pH degree and mean numbers of PFF adult's, *B. zonata*, respond to Cera Trap Buminal and Bio Nal as food attractants

Treatment	Conc. (%)	pH count	Mean No. of captured flies/trap/day (CTD)							
			1st week				2nd week			
			pH	F	M	FM	pH	F	M	FM
Cera Trap	5	8.25±0.11	8.40±0.09	10.66±2.50	1.00±0.01	5.83±1.73	8.26±0.03	5.33±1.52	1.00±0.018	3.16±2.63
	10	8.30±0.02	8.04±0.03	8.33±1.68	1.33±1.52	4.83±1.34	7.82±0.06	5.66±2.07	1.33±1.15	3.50±4.54
	20	8.02±0.10	7.62±0.20	5.33±1.52	3.00±1.73	4.16±1.94	7.52±0.27	4.00±1.00	1.33±2.31	2.66±2.16
Mean±SD		8.19±0.08	8.19±0.08	8.11±2.96	1.77±1.56	4.94±2.83	7.86±0.35	7.86±0.35	1.22±1.39	3.11±3.10
Buminal	2	8.25±0.13	7.88±0.01	11.0±3.60	2.66±1.52	6.83±5.19	6.52±0.22	8.66±5.50	2.33±1.56	5.53±5.00
	4	7.98±0.03	7.52±0.30	8.00±2.64	1.33±0.57	4.66±4.03	6.33±0.30	3.33±2.08	2.00±2.64	2.66±2.25
	8	7.50±0.01	7.28±0.03	4.33±4.93	0.00±0.00	2.16±1.92	6.26±0.02	2.33±1.52	0.66±1.15	1.50±1.52
Mean±SD		7.91±0.06	7.58±0.25	7.58±0.23	1.33±1.41	4.55±3.59	6.37±0.21	6.37±0.25	1.66±1.80	3.22±3.54
Bio Nal	5	8.36±0.02	8.62±0.081	3.33±1.53	0.33±0.57	1.83±1.94	8.57±0.10	1.66±2.08	0.33±0.57	1.00±1.55
	10	7.76±0.01	8.28±0.13	2.66±2.51	0.00±0.00	1.33±2.16	8.51±0.05	1.67±1.52	0.00±0.00	0.83±1.32
	20	6.52±0.10	6.53±0.76	0.66±1.15	0.00±0.00	0.33±0.81	7.54±0.74	0.00±0.00	0.00±0.00	0.00±0.00
Mean±SD		7.54±0.04	7.81±0.94	7.81±0.94	0.11±0.33	1.16±1.75	8.21±0.63	8.21±0.63	0.11±0.33	0.61±1.19
Torula yeast		8.75±0.03	8.64±0.01	8.64±0.01	0.33±0.58	2.50±4.72	8.63±0.01	8.63±0.01	0.33±0.58	0.66±0.52
General Mean±SD		7.97±0.05 ^a	7.89±0.63 ^a	5.90±4.80 ^a	1.00±1.33	3.45±4.28 ^a	7.60±0.93 ^b	3.66±0.93 ^b	0.93±1.39	2.15±2.89 ^a

Means followed by the same letter(s) are not significantly different according to LSD 0.05, LSD 0.05 for pH = 0.68, LSD 0.05 for No. = 1.32, PFF: Peach fruit fly, M: Male, F: Female

was in corresponding with a non-significant negative correlation obtained between pH degree and duration of solution in traps and by regression with exponential models (pH: $b = -0.029$, $R^2 = 0.044$, $a = 8.028$, $p = 0.26$). Also, a significant negative correlation was obtained between

concentrations of different food baits in pH degree. The general mean number of captured MFF flies was decreased with increasing the time of food based solution in the traps, i.e. 35.30±19.43 and 27.78±16.89 captured flies/trap/week at the 1st and 2nd week, respectively, same trend was obtained for PFF, where it was 3.45±2.28 and 2.15±1.89 captured flies/trap/week at the 1st and 2nd week, respectively. Statistical analysis showed a higher significant difference was obtained between mean number of captured flies of MFF with tested time however, a non-significant difference was obtained between mean number of captured flies of PFF with tested time and this maybe regarding to low density of PFF population or pH degrees are in a short range that is preferable for population of PFF.

Effect of tested factors on variance trapped flies of MFF and PFF: Different tested factors; Treatment, Concentration, Date and pH degree as showed by simple regression model Table 5a-d explained that 4.5, 10.4, 4.2 and 0.13% of variances of captured flies of MFF referred to treatments, concentration, date and pH degree, respectively. Multiple regression, as showed from data in Table 5e explained variance 26.7% of total variance of captured flies of MFF depended on total tested factors. It is appear from data in Table 5a-e 19.23 to 26.7% of the total

Table 5a: Regression coefficient value of treatments and variance in captured flies of MFF, *C. capitata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	40.50	4.075	9.91	0.0000***
Treatment	-4.03	1.69	-2.38	0.0187*

R² = 0.045, R²: Determination coefficient, MFF: Mediterranean fruit fly, *Low significant, ***High significant

Table 5b: Regression coefficient value of food concentrations and variance in captured flies of MFF, *C. capitata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	45.45	4.00	11.36	0.0000***
Concentration	-7.32	1.92	-3.79	0.0002***

R² = 0.104, R²: Determination coefficient, MFF: Mediterranean fruit fly, ***High significant

Table 5c: Regression coefficient value of date factor and variance in captured flies of MFF, *C. capitata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	42.82	5.25	8.14	0.0000***
Date	-7.52	3.32	-2.26	0.025*

R² = 0.042, R²: Determination coefficient, MFF: Mediterranean fruit fly, *Low significant, ***High significant

Table 5d: Regression coefficient value of pH degree and variance in captured flies of MFF, *C. capitata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	24.98	16.43	1.52	0.13 ^{ns}
pH	0.84	2.11	0.40	0.68 ^{ns}

R² = 0.0013, R²: Determination coefficient, MFF: Mediterranean fruit fly, ns: Non-significant

Table 5e: Regression coefficient values of tested Parameters and variance in captured flies of MFF, *C. capitata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	115.9889	21.350	5.43	0.0000***
Treatment	-5.13	1.560	-3.28	0.0013**
Concentration	-11.27	2.268	-2.18	0.0312*
Date	-8.94	3.016	-2.96	0.0037**
pH	-4.94	2.268	-2.18	0.0312*

R² = 0.267, R²: Determination coefficient, MFF: Mediterranean fruit fly, *Low significant, **Medium significant, ***High significant

Table 6a: Regression coefficient value of treatments and variance in captured flies of PFF, *B. zonata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	5.515	0.787	7.00	0.0000***
Treatment	-1.23	0.32	-3.77	0.0002***

R² = 0.107, R²: Determination coefficient, PFF: Peach fruit fly, ***High significant

Table 6b: Regression coefficient value of food concentrations and variance in captured flies of PFF, *B. zonata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	3.680	0.83	5.16	0.0000***
Concentration	-0.789	0.41	-1.96	0.051*

R² = 0.032, R²: Determination coefficient, PFF: Peach fruit fly, *Low significant, ***High significant

Table 6c: Regression coefficient value of date and variance in captured flies of PFF, *B. zonata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	4.75	1.05	4.50	0.0000***
Date	-1.3	0.66	-1.95	0.053*

R² = 0.031, R²: Determination coefficient, PFF: Peach fruit fly, *Low significant, ***High significant

Table 6d: Regression coefficient value of pH degree and variance in captured flies of PFF, *B. zonata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	3.68	3.28	1.12	0.26 ^{ns}
pH	-0.11	0.42	-0.27	0.78 ^{ns}

R² = 0.00061, R²: Determination coefficient, PFF: Peach fruit fly, ns: Non-significant

Table 6e: Regression coefficient values of tested Parameters and variance in captured flies of PFF, *B. zonata*

Parameter	Reg. coeff.	SE	t-value	p-value
Intercept (a)	16.628	4.394	3.78	0.0002***
Treatment	-1.370	0.320	-4.26	0.0000***
Concentration	-1.530	0.440	-3.47	0.0007***
Date	-1.510	0.620	-2.43	0.0165*
pH	-0.720	0.467	-1.55	0.1219 ^{ns}

R² = 0.22, R²: Determination coefficient, PFF: Peach fruit fly, *Low significant, ***High significant, ns: Non-significant

variations in trapped flies of MFF, whereas, 80.77 to 73.3% variance is referred to other factors not included in the present analysis. While, 10.7, 3.2, 3.1 and 0.061% of variance of captured flies PFF referred to treatments, concentration, date and pH degree, respectively. As shown in Table 6a-d. So, effect of total tested factors on captured flies of PFF expressed by multiple regression (Table 6e) explained 22% of variances. It is appear the data in Table 6a-e explained about 17.06 to 22% of the total variations in trapped flies of PFF while 82.93 to 78% variance is referred to other factors not included in the present analysis. According that it could be attributed to there is one or more strong effective factors on fruit flies attraction did not study here.

DISCUSSION

Evaluation of protein baits achieved by PB traps was hanged at 1.5 to 2 m above the ground and this method agree with Mahmood *et al.* (2002) who Hanged cylindrical plastic traps about 6 feet above the soil with sex attractant to monitor seasonal fluctuation of male flies of peach fruit fly. So, Hasyim *et al.* (2007) used mineral water bottles baited with different lures at 1.5 m from the ground level to attract male flies of *Bactrocera tau*. Present results of the tested food baits

showed significant differences in attraction for both of MFF and PFF. These results agree with Gopaul and Price (1999), who found significant difference in attraction for all species of fruit flies for all tested trials commercial protein hydrolysate baited traps (Protein Hydrolysate Beer Autolysate Guinness Autolysate Beer "Debris" Guinness "Debris") when compared with control (water baited) traps and Latif *et al.* (2002) revealed that least melon fruits infestation by melon flies was achieved by bait spray of protein hydrolyzate followed by molasses, compared with dust formulation of insecticides Females of PFF and MFF were more attracted than male flies to tested protein food baits, so tested fruit flies varied in attraction to different tested food baits and it's concentrations. Buminal was the most attractive bait for MFF while Cera Trap was the most attractive bait for PFF. Moustafa (2009) found that females and males of MFF and PFF have different degrees of preferability for the different tested food attractants Pro-lure 2%, Glan, Agrisense, Bioprox, Pro-lure 5%, Amadene, Buminal, Norlan and Agrinal. These results disagree with Ghanim (2009) who mentioned that Buminal was the main food attractant for fruit flies. Results of the present work for tested food baits showed a high interaction between sex and food bait concentration, also a significant difference in attraction was obtained between both of females and males of MFF and PFF. These results are in agreement with Gopaul and Price (1999) who stated that protein baits trapped more females than male flies. Epsky *et al.* (2008) mentioned that traps baited with liquid protein solutions or synthetic lures based on chemical cues from protein are used worldwide for detecting both females and males of many fruit fly species, Moustafa and Ghanim (2008) reported that females of MFF and PFF were more attracted to food attractants than males and Moustafa (2009) mentioned that females of MFF and PFF were obviously more attracted to all the tested food attractants than males.

The presented results revealed that the decrease of pH degree from the 1st week to the 2nd week the decrease was in the number of captured flies. These results agree with Bateman and Mdortan (1981) who mentioned that attractancies of solutions of ammonium bicarbonate were found to be strongly dependent on concentration and pH, Mazor *et al.* (1987) who mentioned that the elevation of the pH of the liquid commercial baits, Buminal and Naziman, increased the latter's efficacy as medfly baits but the increased stimulation could not be strictly correlated with the increased rate of ammonia release, Epsky *et al.* (1993) mentioned that the addition of borax 1-10 to 10% NuLure solution increased bait pH and this increase was directly correlated with increase in number of female flies trapped of Caribbean fruit fly, *Anastrepha suspensa* (Loew). The properties of solution in traps were changed along the tested time and statistical analysis revealed that there was a significant negative correlation was obtained for both Buminal baits and torula yeast in pH degree with elapsed time while non-significant negative correlation was obtained for Cera Trap in pH degree, whereas non-significant positive correlation was obtained for Bio Nal baits in pH degree with tested time. Present results agree with Heath *et al.* (2009) who mentioned that resultant pH affected by factors such as the age of the bait solution while, Moustafa (2009) illustrated that the tested food attractants exhibited high stability by the time passed, where the passed time had not any significant effect on the potentiality of the tested preparations.

CONCLUSION

Present results recommending Buminal bait 2% conc. to attract MFF while Cera Trap bait 10% conc. and then Buminal bait 2% to attract PFF, when used in food bait traps. So, food bait solution retained for one week and renew.

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