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# Effect of Food Components Deficiency on the Survive of Peach Fruit Fly *Bactrocera zonata* Saunders (Diptera: Tephritidae)

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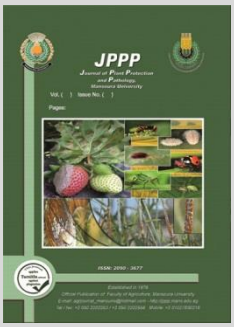


## ABSTRACT

Laboratory tests were conducted to investigate the ability of the peach fly *Bactrocera zonata* (Saunders) to tolerate the lack of some food components (water - sugar - protein). These tests performed in three groups. 1- Continuous feeding (from emergence till death). 2- Feeding for the first 24 hours after emergence. 3- Feeding for the second 24 hours after emergence. Each group composed of the following treatments: sugar only feeding, protein only feeding, water only feeding, sugar and water feeding, sugar and protein feeding, water and protein feeding, sugar solution (10%) feeding and protein solution (5% buminal) feeding .in addition to two control treatments, Complete starvation and complete meal composed of water, sugar and protein. Results revealed that for the three feeding groups, sugar was the most significant component in the diet and its absence led to obvious reduction of fly life span. Presence of sugar, either alone or in combination with water or protein or even as a 10 % solution, compared to the sugar – free treatments, followed by water comes in the second rank (either alone or in combination with sugar or protein), and protein (either alone or in combination with water or sugar or in the form of 5 % solution) is the least significance.

***Keywords***: *Bactrocera zonata;* food components; protein solution; sugar solution, starvation.

## INTRODUCTION

There is no doubt that fruit flies represent a great danger to the national economy, because of the fruit production loss they cause the limited distribution of the Peach Fruit Fly (PFF) lead to a great constrictions for fruit exportation to PFF – free countries, which causes problems for the farmer, the trader and the consumer, as well as exporters. Despite of about 100 years of researches to overcome Tephritidae fruit flies, still some data are missed, the feeding habits of the individual fly i.e., how long the fly can tolerate food elements deficiencies, living organisms need three main nutrient components in their meal to be a full diet: carbohydrate source, as energy to support different activities, protein source, as precursor for different anabolism processes and of course, water.

Adult flies get food in the form of fruit juices, extrafloral exudations, and nectar, in addition to honeydew produced by homopterous insects, as a source of carbohydrates and amino acids. (Gray, 1952 and Ewart & Metcalf, 1956). In nature, protein or its precursors may be acquired by feeding on protein-rich fruit (such as figs), bird feces, or colonies of bacteria found on leaf surfaces or on decomposing fruit (Hendrichs & Hendrichs, 1990 and Warburg & Yuval, 1997).

But, eliminating any of these components (carbohydrates, protein or water, partially or completely) will reflect negatively on the organism live. Organisms have evolved a wide range of physiological adaptations to increase their survival when food is scarce, including the ability to enter arrested states (1), draw on fat reserves (2), reduce metabolic rates (3), and postpone aging (4) (Carey *et al*., 1999)

Sometimes, the dietary requirements of an organism are not available, thereby reduce or arrest reproductive effort, thus, increasing the direct the resources to somatic upkeep and survival until conditions improve and reproduction can resume. (Weithoff, 2007 and Carey *et al*., 2008). Yuval *et al.* (1998) found that post-teneral protein feeding of both wild and laboratory-reared males, positively affects their ability to join leks. Also, their ability to copulate in leks was occurred (Kaspi *et al*., 2000). a 24 hours of starvation for mass reared sterile males causes a greater mortality in males fed on protein than those don't (Kaspi and Yuval, 2000).

The objectives of this study were two-fold, firstly, to evaluate the ability of lab strain of PFF to tolerate starvation (partially or totally), in the post-teneral period, during which, the insect is just released, lazy, very vulnerable, recently moulted and its exoskeleton is yet to harden and under natural conditions, food may be scarce or unavailable. The second, understanding the effects of nutritional state and responses of flies to food, will reflected on choosing appropriate management strategies of bait application in control of fruit flies.

## MATERIALS AND METHODS

Experiments were carried out in a 100 mL transparent plastic cub perforated from the base for fixing plastic blanks containing food and a piece of fiber net fixed to the top (in the lid) for supplying insects with water and aeration. Each treatment has ten

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replicates. The insects were placed individually as pupae inside a small plastic tube with a perforated stopper until emergence. The newly emerged adult flies then transferred individually to the cub supported with the nutrient elements according to the test wanted. A label is fixed to the cub to record the data (date of emergence, date of the beginning of feeding, date of the end of feeding and date of death). These dates help to calculate how long the fly can survive in different feeding conditions

**These tests divided into three groups**

1- Continuous feeding (from emergence till death)
2- Feeding for the first 24 hours after emergence.
3- Feeding for the second 24 hours after emergence.

**Each group composed of the following treatments:**

**Sugar:** the cubs are supported with granulated white sugar.

**Protein:** the cubs are supported with dried protein hydrolyzate.

**Water:** the cubs are supported with water as a wet piece of artificial sponge (2 x 2 x 1 cm).

**Sugar and water:** the cubs are supported with granulated white sugar and water as a wet piece of artificial sponge.

**Sugar and protein:** the cubs are supported with granulated white sugar and dried protein hydrolyzate.

**Water and protein:** the cubs are supported with a wet piece of artificial sponge and dried protein hydrolyzate.

**Sugar solution (10%):** a piece of artificial sponge saturated with 10 % sugar solution.

**Protein solution**: a piece of artificial sponge saturated with 5% buminal solution.

**Complete starvation:** no nutritional element were added

**Control:** complete meal composed of water, sugar and protein (4:1).

Life span estimated from emergence time till death by hours (approximately) and checking the flies was carried periodically every 4 hours. The records were taken for ten days.

**Hint:** control and some treatments record a life span that exceeded the tests time (10 days), but a life span of 10 days (240 hours) only were recorded.

## RESULTS AND DISCUSSION

**Results**

**A. Continuous feeding**

**A.1. Sugar – dependent food**

As shown in Table (1), there is no significant differences in fly longevity among control, sugar solution and water - sugar fed flies with 240 hrs., for each. While they differ significantly from sugar fed flies (68.8 hrs.) and sugar - protein fed flies (74.2 hrs.) with no significant difference between them. The least longevity was recorded by food deprived flies with mean longevity of 47.8 hrs.

**A.2. Protein – dependent treatments**

Results in Table (2), revealed that control feeding flies differ significantly from the rest of the cases with mean longevity of 240 hrs., in the second rank, flies fed on protein water and those fed on protein sugar with no significant difference in between with mean longevity of 69.8 and 74.2 hrs. respectively, differing significantly from both protein feeding flies whose record the least surviving period with mean of (46.0 hrs.) and food deprived feeding (47.8 hrs.).

**Table 1. Effect of sugar dependent continuous feeding on survival period of *B. zonata* adults**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | Sugar solution | 240.0 ± 0.0 a |
| 3 | Sugar | 68.8 ± 4.3 b |
| 4 | Food deprived | 47.8 ± 2.1 c |
| 5 | Water sugar | 240. ± 0.0 a |
| 6 | Protein sugar | 74.2 ± 4.4 b |

**Table 2. Effect of protein dependent continuous feeding on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | protein solution | 57.6 ± 1.8 cd |
| 3 | protein | 46.0 ± 4.2 d |
| 4 | Food deprived | 47.8 ± 2.1 d |
| 5 | Water protein | 69.8 ± 3.0 bc |
| 6 | Protein sugar | 74.2 ± 4.4 b |

**A.3. water– dependent treatments**

Data presented in Table (3), showed that control fed flies, water-sugar fed flies and sugar solution fed flies with no significant differences in between and highest longevity periods of 240 hrs., but they differ significantly from both protein - water and protein solution treatments with longevity periods of 69.8 and 57.6 hrs. respectively and they also differ significantly from both water only fed flies and food deprived flies whose recorded 52.2 and 47.8 hrs., respectively.

**Table 3. Effect of water dependent continuous feeding on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | protein solution | 57.6 ± 1.8 bc |
| 3 | Water sugar | 240.0 ± 0.0 a |
| 4 | Sugar solution | 240.0 ± 0.0 a |
| 5 | Water protein | 69.8 ± 3.0 b |
| 6 | water | 52.2 ± 2.9 c |
| 7 | Food deprived | 47.8 ± 2.1 c |

**B - 24 hours feeding**

**B.1. Sugar – dependent treatments**

In Table (4), results assured that, there was no significant difference between control fed flies and sugar solution fed flies as the highest longevity with means of 240 hrs., for both. While they differ significantly from both sugar fed flies and sugar – water fed flies that's both come in the second rank with mean longevity of 111.8 and 105.8 hrs., respectively. Also, they differ significantly from sugar – protein treatment (98.6 hrs.). Food deprived flies significantly differed from the rest and recorded the least longevity of 47.8 hrs.

**B.2. Protein – dependent treatments**

Results obtained in Table (5), cleared that, the protein dependent treatments and showed that control fed flies come as the superior longevity (240 hrs.) and significantly differed from the rest of the treatments while protein – sugar fed flies and protein solution fed flies come in the second rank with mean longevity of 98.6 and 96.4 hrs. with no significant differences in

between. While they differ significantly from protein fed flies (62.6 hrs.). Finally, protein – water and food deprived fed flies got the least survivor periods of 49.6 and 47.8 hrs. respectively, with no significant differences in between.

**Table 4. Effect of sugar dependent 24 hours feeding on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | Sugar solution | 240.0 ± 0.0 a |
| 3 | Sugar | 111.8 ± 3.14 b |
| 4 | Food deprived | 47.8 ± 2.03 d |
| 5 | Water sugar | 105.8 ± 2.3 bc |
| 6 | Protein sugar | 98.6 ± 2.2 c |

**Table 5. Effect of sugar dependent 24 hours feeding on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | protein solution | 96.4 ± 2.02 b |
| 3 | protein | 62.6 ± 3.9 c |
| 4 | Food deprived | 47.8 ± 2.03 d |
| 5 | Water protein | 49.6 ± 1.36 d |
| 6 | Protein sugar | 98.6 ± 2.2 b |

**B.3. water– dependent treatments**

In Table (6), results revealed that, there was no significant difference between control fed flies and sugar solution fed flies as the highest longevity with means of 240 hrs., for both. While they differ significantly from both sugar – water fed flies and protein solution fed flies who's come as the second rank with mean of 105.8 and 96.4 hrs., respectively. Also they differ significantly from both water fed flies, water – protein fed flies and food deprived flies with mean longevity of 53.8, 49.6 and 47.8 hrs., respectively.

**Table 6. Effect of water dependent 24 hours feeding on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | protein solution | 96.4 ± 2.02 b |
| 3 | Water sugar | 105.8 ± 2.3 b |
| 4 | Sugar solution | 240.0 ± 0.0 a |
| 5 | Water protein | 49.6 ± 1.36 c |
| 6 | water | 53.8 ± 2.47 c |
| 7 | Food deprived | 47.8 ± 2.03 c |

**C - 24 hours feeding after 24 hours starvation**

**C.1. Sugar – dependent treatments**

Results in Table (7), revealed that control feeding flies differ significantly from the rest of the cases with mean longevity of 240 hrs., in the second rank, flies fed on sugar - water and those fed on sugar with no significant difference in between with mean longevity of 131.8 and 137.6 hrs., respectively, with significant difference with food deprived flies whose mean longevity of 47.8 hrs.

**C.2. Protein – dependent treatments**

Data presented in Table (8), showed that control feeding flies differ significantly from the rest of the cases with mean longevity of 240 hrs., followed by flies fed on sugar - protein with mean survival period of 119.0 hrs. and differ significantly with both of protein fed flies, protein – water fed flies and protein solution fed flies with no significant difference in between with mean longevity of 63.4, 68.8 and 71.0 hrs., respectively, also, they differ significantly from food deprived flies whose mean longevity of 47.8 hrs.

**Table 7. Effect of sugar dependent 24 hours feeding after 24 hours starvation on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | Sugar solution | 113.4 ± 1.83 c |
| 3 | Sugar | 137.6 ± 2.6 b |
| 4 | Food deprived | 47.8 ± 2.0 d |
| 5 | Water sugar | 131.8 ± 2.5 b |
| 6 | Protein sugar | 119.0 ± 2.67 c |

**Table 8. Effect of protein dependent 24 hours feeding after 24 hours starvation on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | protein solution | 71.0 ± 2.05 c |
| 3 | protein | 63.4 ± 0.25 c |
| 4 | Food deprived | 47.8 ± 2.04 d |
| 5 | Water protein | 68.8 ± 2.13 c |
| 6 | Protein sugar | 119.0 ± 2.67 b |

**C.3. water– dependent treatments**

In Table (9), Control fed flies (mean of 240 hrs.) differ significantly from the water – sugar fed flies (131.8 hrs.), that differ significantly from sugar solution fed flies (113.4 hrs.). Sugar solution fed flies also differ significantly from both of protein solution fed flies, protein – water fed flies and water only fed flies with mean longevity of 71.0, 68.8 and 66. 0 hrs., respectively. Finally with the least longevity is the food deprived flies with mean longevity of 47.8 hrs.

**Table 9. Effect of water dependent 24 hours feeding after 24 hours starvation on survival period of *B. zonata* adults.**

| | treatment | Mean ± S. E |
|---|---|---|
| 1 | Control | 240.0 ± 0.0 a |
| 2 | protein solution | 71.0 ± 2.05 d |
| 3 | Water sugar | 131.8 ± 2.5 b |
| 4 | Sugar solution | 113.4 ± 1.83 c |
| 5 | Water protein | 68.8 ± 2.13 d |
| 6 | water | 66.0 ± 0.0 d |
| 7 | Food deprived | 47.8 ± 2.04 e |

## CONCLUSION

It is concluded that, for the continuous feeding groups, sugar is the most significant component in the diet and its absence led to obvious reduction of fly life span. Presence of sugar, either alone (68.8 hrs.) or in combination with water (240 hrs.) or protein (74.4 hrs.) or even as a 10 % solution (240 hrs.), compared to the sugar – free treatments, protein only (46 hrs.), protein solution (57.6 hrs.), protein water (69.8 hrs.), water alone (52.2 hrs.) and food deprived treatment (47.8 hrs.), followed by water comes in the second rank (either alone or in combination with sugar or protein), and protein (either alone or in

combination with water or sugar or in the form of 5 % solution) is the least significance.

For the first 24 hours after emergence feeding groups, sugar is the most significant component in the diet and its absence led to obvious reduction of fly life span. Presence of sugar, either alone (111.8 hrs.) or in combination with water (105.8 hrs.) or protein (98.6 hrs.) or even as a 10 % solution (240 hrs.), compared to the sugar – free treatments, protein only (62.6 hrs.), protein solution (96.4 hrs.), protein water (49.6 hrs.), water alone (53.8 hrs.) and food deprived treatment (47.8 hrs.), followed by water comes in the second rank (either alone or in combination with sugar or protein), and protein (either alone or in combination with water or sugar or in the form of 5 % solution) is the least significance.

For feeding for the second 24 hours after emergence groups, sugar was the most significant component in the diet and its absence led to obvious reduction of fly life span. Presence of sugar, either alone (137.6 hrs.) or in combination with water (131.8 hrs.) or protein (119 hrs.) or even as a 10 % solution (113.4 hrs.), compared to the sugar – free treatments, protein only (63.4 hrs.), protein solution (71 hrs.), protein water (68.8 hrs.), water alone (66 hrs.) and food deprived treatment (47.8 hrs.), followed by water comes in the second rank (either alone or in combination with sugar or protein), and protein (either alone or in combination with water or sugar or in the form of 5 % solution) is the least significance.

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## تأثير المكونات الغذائية على بقاء ذبابة ثمار الخوخ *Bactrocera zonata* (Saunders)


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أجريت الاختبارات المعملية للتحقيق في قدرة ذبابة الخوخ على تحمل نقص بعض المكونات الغذائية (الماء - السكر - البروتين). تمت الاختبارات في ثلاث مجموعات: 1- التغذية المستمرة (من الخروج من العذراء وحتى الموت) 2- التغذية لمدة 24 ساعة الأولى بعد الخروج من العذراء. 3- التغذية لمدة 24 ساعة بعد الخروج من العذراء. تتكون كل مجموعة من ا لمعاملات التالية: تغذية بالسكر فقط ، تغذية بالبروتين فقط ، تغذية بالماء فقط ، تغذية بالسكر والماء ، تغذية بالسكر والبروتين ، تغذية بالماء والبروتين ، تغذية بمحلول السكر (10٪) تغذية بمحلول البروتين (5٪ بومينال) التغذية. بالإضافة إلى معاملتين للمقارنة ، صيام كامل عن اى مكون غذائي وغذاء كامل يتكون من الماء والسكر والبروتين. أظهرت النتائج أنه بالنسبة لمجموعات التغذية الثلاث ، فإن السكر هو العنصر الأكثر أهمية في النظام الغذائي وغيابه أدى إلى انخفاض واضح في العمر الافتراضي للذباب (بمفرده أو مصحوبا بالماء أو بالبروتين أو حتى كمحلول 10٪ ) مقارنة بالمعالجات الخالية من السكر. يليها الماء الذى يأتي في المرتبة الثانية (إما بمفرده أو بالاشتراك مع السكر أو البروتين) ، والبروتين (إما بمفرده أو بالاشتراك مع الماء أو السكر أو في شكل محلول 5٪) هو الأقل أهمية.