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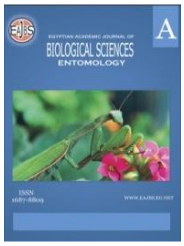

New Alternatives to The Artificial Diet Used for Mass Rearing of Peach Fruit Fly Larvae, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae)

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ABSTRACT

Bactrocera zonata (Saunders) a pest of great economic importance in South America, needs urgently to be controlled by environmentally friendly methods, as the sterile insect technique for which mass rearing of insects is required. The present study aimed to evaluate the biological and biochemical effect of wheat germ as a new alternative for the yeast used in the mass rearing of *B. Zonata* to reduce the high yeast cost. The action of incorporation wheat germ in the tested modified diets with three different weights against the standard diet on some biological and biochemical aspects of adults emerged from tested diets was evaluated. The nutritive value of identical modified wheat germ artificial diet and of standard artificial larval diet was analyzed. Using wheat germ in an artificial larval rearing diet played a great role in inducing some biological and biochemical characters as the wheat germ is therefore a unique source of concentrated nutrients, highly valued as a food supplement.

INTRODUCTION

Fruit flies are the most destructive pests since they infest fruits directly causing great damage to them. Fruit flies attack ripen fruits and inflict damage to the fruits either directly by larvae feeding on pulp or indirectly by causing blemished fruit, which reduced the marketing value of the fruits. The peach fruit fly, *B. zonata* is considered one of the most destructive fruit pests which are spread in several regions of the world. It is native to South and South-east Asia, where it attacks a wide variety of soft fruits, e.g. peach, guava, and mango (Allwood *et al*., 1999). The recent control intensive research is concerned mainly with avoiding the serious problems resulted from using harmful insecticides that cause harmful residues in the food chain and pollution of the surrounding natural enemies and pest resistance. Therefore, now it has become necessary to search for alternative means of pest control. among the most important control methods is (SIT) which is specific, safe, and need a high number of insects. Mass production of a fruit fly at a low cost for the male sterility technique is essential. Proteins are the essential nutrients for cellular growth of life on Earth. The main nutritional/protein component of diet used for mass-rearing of adults and larvae of fruit flies are yeast products (Rohlfs *et al*., 2005). The yeasts have a direct impact on the ultimate fecundity and fertility of the adult fruit flies. The used yeast contains all the vital microbial growth factors for fruit flies such as vitamins, high levels of amino nitrogen, peptides, and minerals (Schroeder *et al*., 2000). Yeast makes the mass rearing of fruit fly expensive due to its high cost. These are economical and good alternatives for yeast. Wheat germ is the name given to the embryo of the wheat kernel, representing approximately 2–3g/100g of the weight of the whole grain (Gili *et al*., 2017). Germ contains high protein (26%–35%), sugar (17%), and lipid (10%–15%) content, as well as dietary fibers (1.5%–4.5%), minerals (4%), and other bioactive compounds: tocopherols (300–740 mg/kg dry matter), phytosterols (24–50 mg/kg), policosanols (10 mg/kg), carotenoids (4–38 mg/kg) , thiamin (15–23 mg/kg), and riboflavin (6–10 mg/kg).Wheat germ is a concentrated source of severalessential nutrients,including vitaminE,protein,folate (folicacid), phosphorus, thiamin, zinc, and magnesium, as well as essential fatty acids and fatty alcohols. It is a good source of fiber. Weil, Andrew (2000). ingredients, such as wheat germ or its derivatives satisfy certain nutritional requirements of several insect species Cohen (2004). In fruit flies, wheat germ oil has been studied as a supply in the larval rearing medium Chang *et al*., (2010), Chang and Vargas (2007). The present study was, therefore, planned to work out effective, locally available and inexpensive formulations for the artificial diets for mass rearing of peach fruit fly and using easily available protein sources as an alternative for costly yeast used in (Shehata *et al*., 2006) diet for artificial diet used in mass rearing of the peach fruit fly.

MATERIALS AND METHODS

A-Rearing Technique:

B. zonata used in this study were obtained from the laboratory of Plant Protection Research Institute, Dokki, Giza, reared under laboratory conditions of 25±3 ºC and 60±5% R.H. (Shehata *et al*., 2006).

B-Artificial Diet Preparation:

An artificial diet with different weights of the wheat germ was made. The proportions of various ingredients used in the preparation of these diets are shown in (Table 1). The diets were prepared by weighing all the diet ingredients and mixing by hand using a plastic rod to obtain a homogenous diet. In this experiment, the effect of a modified artificial diet with various weights of wheat germ on the development parameters of fruit fly *B. zonata* from egg hatching to egg-laying were studied. The standard rearing artificial diet was used to compare with the diet with different weights of wheat germ.

Table 1: Composition of experimental diets for *Bactrocera zonata* larvae

Ingredients	Diet 1 (Standard)	Diet 2 (modified)	Diet 3 (modified)	Diet 4 (modified)
1- tap water	500 ml	500 ml	500 ml	500 ml
2- sodium benzoate	3 gm	3 gm	3 gm	3 gm
3-3 gm citric acid	3 gm	3 gm	3 gm	3 gm
4-84.5gm sugar	84.5gm	84.5gm	84.5gm	84.5gm
5-330 gm wheat bran	330 gm	330 gm	330 gm	330 gm
6-yeast	84.5gm			
6-wheat germ		84.5gm	42.3 gm	21.13 gm

C. Biological Effects:

1-Hatchability of Parental Egg:

After preparation, diets were weighed (150 g) and placed into rearing trays. A small piece of black tissue paper was soaked with water and placed across the middle of each tray of the diet. Then ten sets of, 100 eggs (one day old) were seeded onto the wet tissue paper.

The trays were covered and incubated under laboratory conditions of 25±3 ºC and 60±5% R.H.

2- Percentage of Pupae Formation:

The tested trays were transferred to plastic boxes that contain 1cm of sand layer for larvae to jump and pupate in. the formed pupae from each treatment were sieved and counted.

3-Pupal Weight:

Form each tested larval tray three replicates of 50 newly formed pupae were collected and weighed after one day (one day old pupae) according to Chang *et al* (2006).

4-Adult Emergence:

Three sets of 100 pupae were transferred to adult rearing cages that contain sugar and protein hydrolysate at a ratio of 3:1, respectively in a petri dish. Water was added in a plastic bottle then it was observed until adult emergence.

5-Adult Fliers and Rate of Fliers:

Was determined to the corresponding methods of FAO/IAEA/USDA (2003).

6-Fecundity of Female:

Soon, after adult emergence normally adults were transferred by glass aspirator to small cages. Five pairs of adults were confined in each cage in three replicates. Cages were provided with a 3:1 mixture of white cane sugar: yeast hydrolysate as food70 mL plastic jar of water with a cotton wick inserted into a plastic vial. Ten days after emerging as adults, small plastic perforated oranges were provided as oviposition substrates. Small plastic oranges were checked and changed daily to determine the first egg-laying day of the flies. Eggs (not observed before 14 days) were collected and counted for all the oviposition period. Pre-oviposition and post-oviposition periods were estimated.

7-Longevity:

Adult mortality was daily recorded to estimate the longevity of adults that emerged from a modified diet compared to adults who emerged from standard diet ones.

8- F1 Egg Hatchability:

Three sets of 100 eggs from flies that reared on several tested larval diets were chosen randomly and counted under a stereo-microscope, seeded on small black wet tissue paper. The trays were covered and incubated under laboratory conditions of 25±3 ºC and 60±5% R.H.

9- F1 Larval Duration:

Larval duration (days) was determined by collecting and recording all larvae observed exiting from the larval diet for up to 5 days of pupal collection, and from these data mean larval period was calculated.

10-F1pupal Duration:

Pupal duration (days) was determined by collecting sets of 100 one day old pupae exiting from the different larval diet and observance it until emergence. from these data mean pupal period was calculated.

11 – F1 Adult Emergence:

Three replicates of 100 pupea emerged from different tested artificial rearing diet were observed until adult emergence.

D-Preparation of Insects for Biochemical Analysis: -

Adults emerged from diets 1(standard) & 2 **(**modified with the best weights of wheat germ) were homogenized separately in distilled water (1 g / ml) using a chilled glass–Teflon tissue homogenizer. Each homogenate was centrifuged at 8000 rpm for 15 min at 4 °C. The supernatant was stored at -20 °C for further biochemical analyses.

1-Total protein was determined according to Bradford (1976).

2-Total carbohydrates were determined according to Dubois *et. al*. (1956).

3-Total lipids were determined according to Knight *et al.* (1972).
4-Transaminases were determined according to Reitman and Frankle (1957).
5-Acid Phosphatase was determined according to Laufer and Schin (1971).

E-Tested Artificial Diet Components Analysis:

This experiment was carried out at the bread technology centre to study the best tested modified artificial (diet2) components comparing with the standard artificial (diet1) components (crude protein%, crude fats%, Crude fiber%, moisture %, ash % and carbohydrates %).

1-Crude Protein %, crude fats%, Crude fiber%, moisture %, and ash % were determined according to A.O.A.C (2000).

2-Determination of Total Carbohydrate:

Percentage carbohydrate was estimated according to Shumaila *et.al.* (2009).

Statistical Analysis:

All tested biological parameters were statistically analyzed by SAS version 9.1. Differences in diet batch/treatment data were analyzed by one-way analysis of variance (ANOVA) or Ttest followed post hoc by Turkeys honestly significant difference (HSD) test for group mean comparisons**.** (SAS Institute 2002).

RESULTS

A- Effect of Different Artificial Larval Diet on Some Biological Activities of *B. zonata*:

Results presented in Table (2) show the measurement of some quality parameters for peach fruit fly reared on different larval diets.

1-Hatchability of Parental Egg:

Among all different tested diets. Parental egg hatch insignificantly different for diet 2, 3(91&86.67), respectively compared with the standard diet1 (92.67).

2-Percentage of Pupae Formation:

The number of pupae exciting from modified artificial larval diet2 in significantly increase than standard diet1 and diet3. On the other hand, the number of pupae significantly decreases for diet4 comparing with the standard diet.

3-Pupal Weight:

The pupal weight was not different for pupae recovered from diet 1&2 (0.66). All other produced pupae from diets 3&4 were with an intermediate weight that was significantly different comparing with the other tested diet.

4-Adult Emergence:

There was an insignificant increase in the percentage of emerged adults exciting from diet 1 (89.67) against emerged adults from diets 2&3 (88.67&81.33), respectively.

5-Adult Fliers and Rate of Fliers:

The percentage of Adult fliers and rate of fliers was significantly high for adults who emerged from different tested artificial diets 1, 2 & 3. (100%) for the percentage of adult fliers and for the rate of fliers. The percentage of adult fliers and rate of fliers reached 90.67 and 92.69, respectively for diet 4.

5- Latency of Egging:

The pre oviposition period was insignificantly shortened for females emerged from diet 2(14.67) than the females emerged from diet 1&3 but it was elongated for females emerged from diet 4. The oviposition and post oviposition period was longer in females emerged from diet 2(65) (14.33) comparing with females emerged from other different diets 1, 2 & 3 (61, 46.67 & 46.67) (12.33, 11.67 & 5), respectively

6-Fecundity of Female:

The number of eggs collected from the tested diets are summarized in Table (2). High fecundity was observed for the females that emerged from larvae that fed on diet 2 (740.67) than females emerged from larvae that fed on diet 1 (725.33). there's no significant effect in the number of eggs of the females that emerged from larvae that fed on diet 3or diet 4(612&606), respectively.

7-Longevity:

Male longevity was affected by the different concentrations of the tested diets (92.2, 74.1&73.26) against 87.73 for standard diet. With regard to female longevity, it is clear that the mass rearing of larvae of the peach fruit fly on diet 2 significantly longed the mean life span of adult females (94 days) against control standard diet 1 (89.33 days). The other tested diets 3&4 insignificantly affected the life span of male or female emerged from these tested modified artificial diets comparing with diet 1.

Table 2: Biological influences of different tested artificial diets on parental *Bactrocera zonata* adult**.**

Conc.	% Hatchability ± SE	Men No. of %Pupation ± SE	Pupal weight ± SE	Adult emergence (%) ± SE	Flying ability ± SE	Flying rate ± SE	Mean of oviposition periods			Men No. of eggs / female ± SE	Longevity	
							pre- ovipostion period ± SE	ovipostion period ± SE	post- ovipostion period ± SE		Male ± SE	Female ± SE
Diet 1	92.67 ± 1.45a	89.67 ± 0.33a	0.66 ± 0.02a	89.67 ± 0.33a	100 ± 0.0a	100 ± 0.0a	16 ± 0.0 ab	61 ± 1.53a	12.33 ± 0.33a	725.33 ± 16.02a	87.73 ± 1.27ab	89.33 ±1.86a
Diet 2	91 ± 1a	90 ± 0.0a	0.66 ± 0.01a	88.67 ± 0.67ab	100 ± 0.0a	100 ± 0.0a	14.67 ± 0.33 a	65 ± 2.52a	14.33 ± 1.67b	740.67 ± 6.36b	92.2 ± 7.4a	94 ± 1.73a
Diet 3	86.67 ± 4.4a	83.67 ± 3.76a	0.56 ± 0.02b	81.33 ± 3.5b	100 ± 0.0a	100 ± 0.0a	18 ± 1.15 b	46.67 ± 2b	11.67 ± 0.88a	612 ± 32.08c	74.1 ± .46b	75.33 ± 2.9b
Diet 4	65.67 ± 5.49b	62.33 ± 5.78a	0.55 ± 0.0b	61.33 ± 5.8b	90.67 ± 2.4b	92.69 ± 1.19b	21 ± 0.0 c	46.67 ± 1.76b	5 ± 3.21a	606 ± 30.79c	73.27 ± 1.19b	72.67 ± 3.92b

Means with the same capital letter are not significantly different (ANOVA, Tukey test, $P > 0.05$).

8- F1 Egg Hatchability:

Egg hatchability percentage was insignificantly highest for insects reared on diets 1, 2 & 3 (99, 99.76 & 99), respectively. The lowest percentage in egg hatchability was noticed in insects reared on diet4 Table (3).

9-F1 Larval Duration:

Latency from egg-laying until pupation was insignificantly different between flies emerged from diet1 (7.33) and flies emerged from the modified artificial larval diet (7, 7.33&7.33), respectively Table (3).

10-F1 Pupation:

Using different tested diets 1, 2&3 insignificantly affects the percentage of F1 larval pupation Table (3).

10-F1pupal Duration:

Feeding of larvae o artificial diet1&2 effects insignificantly on the F1 duration of pupae (7&7.33), respectively Table (3).

11- F1 Adult Emergence:

The mean percentage of adult emergence of adult flies produced from rearing on artificial diet 2(96.67) insignificantly increase than those adults emerged from diets 1&3(96.3&94.67), respectively Table (3).

Table 3: Biological influences of different tested artificial diets on F1& F2 adult progeny of *Bactrocera zonata*

Conc.	% F1 Hatchability ± SE	F1 Larval duration (days) ± SE	% F1 Pupation of the second generation ± SE	F1 pupal duration (days) ± SE	% F2 Adult emergence of the second generation ± SE
Diet 1	99 ± 1ab	7.33± 0.33a	96 ± 0.58a	7 ± 0.58a	96 ± 0.58a
Diet 2	99.76 ± 0.33b	7± 0.0a	96.67 ± 0.88a	7.33 ± 0.33ab	96.67 ± .88a
Diet 3	99 ± 0.58ab	7.33± 0.58a	96.33 ± 0.88a	9 ± 0.0bc	94.67 ± 0.67a
Diet 4	94 ± 2.1a	7.33± 0.58a	89.33 ± 2.33b	9.67 ± 0.33c	87.33 ± 1.5b

Means with the same capital letter are not significantly different (ANOVA, Tukey test, $P > 0.05$).

B-Changes in Total Protein, Carbohydrates, Lipids, GOT, GPT, and Acid Phosphatease Content of Adult *B. Zonata* Emerged from Diets 1&2:

The results obtained in Table (4) indicated that total protein insignificantly increased in female insects emerged from diet 2. Lipid and carbohydrates content differed significantly between insects that emerged from diet 2 against adults emerged from rearing on diet 1. Lipids and carbohydrates significantly increased in male and female insects reared on diet 2 (461.81 & 605.26) (343.59 & 351.64) than those reared on diet 1 (438.60&263.16) (294.23 & 355.77) for male and female respectively. Acid phosphatases, GOT and GPT activity significantly increased after rearing larvae of peach fruit fly on diet containing wheat germ (diet 2) comparing with adult insects emerged from standard artificial diet1.

Table 4: changes in total protein, carbohydrates, lipids, GOT, GPT and acid phosphatease content of adult *B. Zonata* emerged from diets 1&2.

Components mg%	Total protein ± SE		Total carbohydrates ± SE		Total lipids ± SE		GOT ± SE		GPT ± SE		Acid phosphatases ± SE	
Sex	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Adult emerged from standard diet1	10.616 ± 0.363 a	10.977 ± 0.638 a	343.59 ± 2.591 a	294.23 ± 2.581 A	438.60 ± 1.025 a	263.158 ± 0.00067 a	15.0 ± 0.0 a	15.0 ± 0.0 a	109.0 ± 0.0 A	100.33 ± 8.67 a	30.82 ± 1.637 a	22.894 ± 0.252 a
Adult emerged from modified diet2	10.399 ± 0.158 a	11.377 ± 0.958 a	351.64 ± 0.766 b	355.77 ± 2.402 B	461.81 ± 0.436 b	605.26 ± 0.0015 b	34.33 ± 4.33 b	23.0 ± 0.0 b	128.0 ± 0.0 B	121.67 ± 6.33 b	33.24 ± 0.612 b	30.877 ± 0.304 B

Means with the same capital letter are not significantly different (ANOVA, Tukey test, $P > 0.05$).

C- Artificial Diet Components Analysis:

Table (5) shows the chemical composition of different tested artificial diets (1&2). The moisture contents of diet 1 were found to be in the range of 34.235% which were significantly lower than the moisture content of diet 2 (34.822%). The fat content of diet1 was 4.635%. Diet 2 contained a lower level of fat (2.452%). The crude protein content of diet 1 insignificantly higher than level of protein in diet 2. The fiber content of diet 1 was a significantly higher level than diet 2. The ash content of diet 1 was found to be 2.499% while in diet2 reached to 2.456. The level of' ash was insignificantly different in diets 1&2. Diet 2 showed a higher level of carbohydrates (38.285%) while diet 1 contained a significantly lower level of carbohydrates (34.751%) since carbohydrate content of wheat germ is higher than that of the yeast and this is due to the high protein and oil contents in the wheat germ.

Table 5: Changes in protein, fats, fibers, moisture, ash, and carbohydrates content of diets 1&2.

Components %	% Crude protein ± SE	% Crude fats ± SE	% Crude fiber ± SE	% Moisture ± SE	% Ash ±SE	% Protein carbohydrate ± SE
DIET1	22.162 ± 0.011a	4.635 ± 0.003a	1.719 ± 0.008a	34.235 ± 0.315a	2.499 ± 0.0101a	34.751 ± 0.335a
DIET2	21.226 ± 0.012b	2.452 ± 0.003b	0.765 ± 0.010b	34.822 ± 0.086b	2.456 ± 0.0102b	38.285 ± 0.079b

Means with the same capital letter are not significantly different (ANOVA, Tukey test, $P > 0.05$).

DISCUSSION

SIT is a very important control technique used for the management of insects. So it's important to find a way for mass rearing of peach fruit fly that at low cost in laboratories as recently used larval diet costs too much. So this study is an attempt to find a larval diet that is available and costs low. The results based on the effect of three different concentrations of wheat germ on different biological and biochemical aspects.

The results showed that the percent of hatchability of eggs was insignificantly different in diet 2 &3 comparing with diet1 (standard). similar results are obtained by Khan (2013) who tested different larval diets for mass rearing of Queensland fruit fly, *Bactrocera tryoni*, and stated that diet has wheat germ oil has a significant effect on parental and F1 egg hatching. Also, Chang and Vargas (2007) proved that the addition of wheat germ oil to the larval rearing diet of oriental fruit fly caused a significant increase in egg hatch.

Diets containing wheat germ in our study showed better results in the number of formed pupae and in pupal weight. The effect of five larval diets for the rearing of *ceratitis capitata* was observed by Paskova (2007) who revealed that the *M.sexta* and the new agar-based diets (wheat germ) had a great effect on larval pupation and on the weight of the formed pupae. Fay and Wornoayporn (2002) replaced wheat bran with different inert substrates in a diet, observed recovery for pupae and reduced pupal size by 10% or more This indicates that wheat germ contain some important nutrients for the growth of reared larvae.

High levels of adult emergence, adult fliers, and rate of fliers were obtained from flies reared on artificial tested larval diet 1, 2&3.comparing with other studies Pascacio-Villafán *et.al.*(2015) observed that The diet with the highest nutrient and energy content was Xal2 followed by Met2 and Met1 have a great equal effect on adult emergence of the Mexican fruit fly, *Anastrepha ludens*. Also, results are in agreement with sookar *et.al.*(2014) There were no significant differences in pupation (.97%), adult emergence (.90%) and fliers (.85%) between larvae reared on the Hawaiian liquid diet that contains wheat germ oil and those reared on the control diet that contains Waste brewer's yeast in both generations. Flight ability is of paramount importance in flies used for SIT Collins and Taylor (2010), and this represents one of the most sensitive and informative quality control parameters Rull *et al*. (2012). Wheat germ to have a high content of protein, and also contains lipids and carbohydrates that are rich in phytosterols and fatty acids Cohen (2004). Fatty acids in wheat germ could contribute to energy levels required for flight muscle functioning Arrese and Soulages (2010), and its absence may have induced overexpression of the flightless-I protein Cho *et al*. (2013), and so reduced the prevalence of flight-capable adults. Indeed, the flight ability of *B. dorsalis* increased with the amount of wheat germ oil in the larval diet, and Chang and Vargas (2007) suggested that fatty acids and vitamin E were involved in this effect. Similarly, *Ceratitis capitata* (Wiedemann) reared without fatty acids had a flight capacity of only ∼20%, in contrast to ∼90% when reared on a diet containing fatty acids Cho *et al*. (2013**)**. In addition to fatty acids, vitamins also influenced *C. capitata* flight ability Chang *et al*. (2001). If true for *A. ludens*, we suggest that Met1 (with the lowest cost and nutrient content, and overall high fly performance) could serve as a base diet to evaluate the effect of wheat germ and vitamins on flight capacity. This should be done estimating the cost: benefit ratio of incorporating both ingredients into the diet and analyzing any tradeoffs between flight capacity and other traits such as male sexual competitiveness Marden (2000).

A high number of eggs/female/days was obtained from flies emerged from different tested larval diets these results are in harmony with those obtained by Khan (2013) who stated that adding of wheat germ oil to the standard liquid diet formulation may increase the fertility of female. Wheat germ oil contains three saturated and three unsaturated fatty acids that may increase female fertility.

Goane *et.al.* (2019) evaluated different ratios of wheat germ on ovary maturation, fecundity, and fertility as well as their association with the nutrient content of females. The addition of wheat germ in the adult diet improved fecundity .

The longevity of males or females reared on tested artificial diet 2 is insignificantly longer than control diet 1that don’t significantly different than the Longevity of males reared on tested artificial diet 2. These results are similar to those obtained by Bindu *et.al.*(2014) who examined the effect of the addition of wheat germ as a protein source in larval diet teak defoliator moth, *Hyblaea puera*. The mean larval-life span was 12.7 days in the control group and 13.8 in the wheat-germ diet

According to the present study, using wheat germ caused a high percentage of egg hatchability, pupation for larvae and adult emergence for F1 of the peach fruit fly, as described by Khan (2013) Chang’s 2006 liquid diet containing wheat germ oil seemed the most promising for mass rearing of Q-fly under laboratory condition. A comparatively higher F1 egg hatch was recorded for Q-fly reared in this liquid diet. Also, it was found that it caused larval and pupal duration elongation

In this experiment, the total main metabolites (protein, carbohydrates, and lipids) in male and female insects emerged from diet 2 that include wheat germ significantly increased than in male and female emerged from control standard diet. Proteins are the most characteristic of living matter they are present in all viable cells Kyung and Kim (1990). Carbohydrates contribute to the structure and functions of all insect tissues, Carbohydrates reserved as glycogen and trehalose. Lipids are essential structural compounds of the cell membrane and cuticle. Lipid is the main fat body component, and more than 90% of the lipid stored is triglyceride Canavoso *et.al* (2001). Triglyceride is synthesized from dietary carbohydrates, fatty acids, or proteins. The transaminases (GOT&GPT) are key enzymes in the formation of non-essential amino acids, in the metabolism of nitrogen waste and gluconeogenesis Mordue and Gold worthy (1973). Acid phosphatases associate nutrition, gonad maturation, metamorphic moults and tissue histolysis radha & priti (1969).

The obtained results showed insignificantly change in % of protein, moisture, and an ash content of diet 1 & 2 while there is a significant change in % fats and carbohydrates content of diet 1 & 2. Diet 2 with wheat germ contains high % of carbohydrates since the carbohydrate content of wheat germ is higher than that of the yeast and this is due to the high protein and oil contents in the wheat germ. but a low amount of fats and this may be attributed to the low-fat content in the wheat seed.

The impact of wheat germ on fecundity was evident regardless of the yeast derivative. As far as we know, this is the first report evaluating the direct impact of incorporating wheat germ into the adult diet of fruit flies. Yet, the addition of wheat germ oil in the larval diet increases pupal recovery as well as flight ability, egg production, and egg hatch of the emerged adults in *Bactrocera dorsalis* Chang and Vargas, (2007). and enhances the expression of genes encoding enzymes needed for energy production when provided in the larval diet of *B. dorsalis* Chang *et al.*, (2010). Wheat germ contains certain fatty acids, which serve as a metabolic fuel in the moth *Manduca sexta* when provided in the adult diet Levin *et al*., (2017). Wheat germ also provides amino acids that contribute to oviposition in Drosophila Grandison *et al*., (2009) representing an additional protein source.

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ARABIC SUMMARY

بدائل جديدة للبيئة الغذائية المستخدمة لتربية يرقات ذبابة الخوخ باكتروسيرا
زوناتا- ديبترا- تفريتيدي

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معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الدقي.

ذبابة الخوخ آفة ذات أهمية أقتصاديه كبيره تحتاج الي مكافحه بطرق صديقه للبيئه. أحد الطرق هي أستخدام تعقيم الذكور الذي يتطلب تربيه الافه باعداد كبيره. تهدف الدراسه الحاليه الي تتبع التاثير البيولوجي والبيوكمستري لاستخدام بدائل جديده للخميره مثل جنين القمح في البيئه الصناعيه لتربيه يرقات ذبابه الخوخ لتقليل التكلفه العاليه لاستخدام الخميره. جنين القمح منتج من الدقيق يعتبر مصدر جيد للبروتين للانسان ولفيتامين بي والزيوت. تم دراسه تأثير اضافه جنين القمح كبديل للخميره بثلاث تركيزات مختلفه في البيئه الصناعيه لتربيه يرقات الذبابه علي بعض الصفات البيولوجيه للحشرات اليافعه الخارجه من البيئه المضاف اليها جنين القمح بالتركيزات المختلفه. أثر استخدام جنين القمح على الحشرات اليافعه. تم دراسه القيمه الغذائيه بتحليل للبيئه المضاف اليها جنين القمح بافضل تركيز ضد البيئه المستخدمه في تربيتها في المعمل.