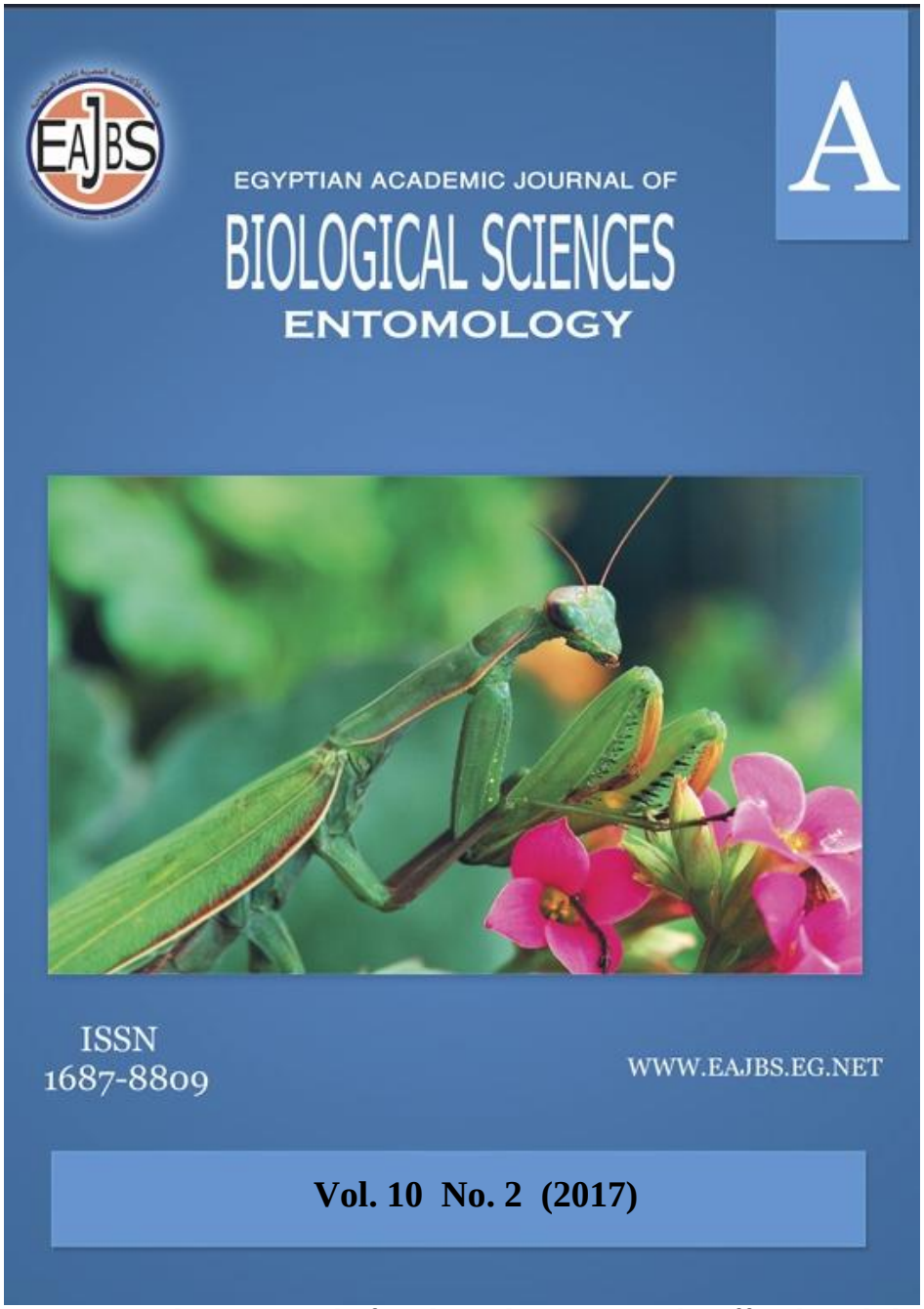

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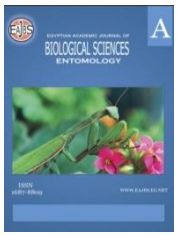

Impact of Infestation Different Percentages With Olive Fruit Fly, *Bactrocera oleae* (Rossi) (Diptera: Tephritidae) on Qualitative Changes of Olive Oil

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ABSTRACT

Olives, *Oleaeuropea* (L) (oleacea) are one of the main fruit crops, infested with olive fruit fly, *Bactrocera oleae* (Rossi). Trials were conducted in olive orchard at the a private farms , Ismailia Governorate (on Cairo- Ismailia roadway, Kilo 96), during 2016 season. The present study was aimed to determine effect of infestation different percentages of *Bacterocera oleae* to olive fruits on free acidity percentage as oleic acid, peroxide value (P.V.), rancimat, K232, 270 and Validity. The results illustrated that there are highly significant differences between infestation % and acidity percentage, peroxide value and rancimat. Also, the results indicated that there are positive correlation between infestation % and (acidity %, peroxide value) and acid % with peroxide value but there are negative correlation with other treatments. The obtained results revealed that the infestation percentage affect by 99.1, 95.2 and 88.4 %on rancimat, acidity % and peroxide value, respectively. Also, the obtained results showed that acidity percentage and peroxide value increased with increasing infestation %, but augmentation infestation % cause lowest rancimat and validity, where recorded peroxide value was 4.28 meqO^2/ kg. Oil in treatment olive fruit free from any infestation compared with olive oil extracted from olive fruits damage4.9 meq O_2/ kg. Wherever, the treatments recorded 4.48, 4.5, 4.51, 4.6, 4.64, 4.67, 4.7, 4.8, 4.85 and 4.9Meq O_2/ Kg. olive oil in case of 5, 15, 25, 35, 45, 55, 65, 80, 90 and 100 % infestation. Also, results of this study showed that K 232 value ranged between 0.15 to 0.23 low from 2.6, while in case of K 270 the values ranged between 1.8 to 2.33nm.

Recommendation: The paper recommended use decontrol to reduce injury rates whenever possible to maintain the quality of the oil and augmentation overstocking period.

INTRODUCTION

Olives *oleaeuropea* (L) (*oleacea*) are one of the main fruit crops in Egypt specially Sinai, Ismailia and Suez governorates. Olive trees are grown on 10 million ha in the world with 96% of production concentrated in the Mediterranean area (Faostat, 2010), where the key pest of olive orchards is *Bactrocera oleae* (Rossi) (Raspi and Viggiani, 2008), commonly known as the olive fruit fly. The presence of *B. oleae*, a *Tephritidae oligophagous* on the fruits of a few Olea species, has long been documented in Mediterranean countries (Daane and Johnson, 2010; Tzanakakis, 2006). Recently, the olive fruit fly was discovered in southern California from where itspread almost throughout the entire state, posing a serious threat to the local olive industry (Daane and Johnson, 2010; Rice *et al*., 2003).

Nowadays, *B. oleae* affects almost all the world olive production with few

exceptions in isolated areas or where low temperatures limit its occurrence. Olive fruit fly females lay their eggs in fruits of both cultivated and wild olives. Insect development occurs through three larval instars: the hatched larva feeds and grows as a fruit borer in the mesocarp and at the end of the third stage, either pupates in the olive or exit to pupate on the ground (Fletcher, 1987; Tzanakakis, 2003). In the field *B. oleae* larval development is largely temperature-dependent and the resulting number of annual generations depends on humidity as well as the availability and quality of olive fruits (Burrack and Zalom, 2008; Kounatidis *et al*., 2008). Oviposition punctures by *B. oleae* cause a marked depreciation of fruits for table consumption (Tzanakakis, 2006), whereas the detrimental effects on oil production consistmainly in premature fruit drop, larval consumption of fruit pulp (estimated to range from 50 to 150 mg per larva, depending oncultivar) (Neuenschwander and Michelakis, 1978), and oil quality deterioration (Angerosa *et al*., 1992; Gomez-Caravaca *et al*., 2008; Tamendjari *et al*., 2009). The extent of the decrease in oil quality depends on the type of infestation, the percentage of damaged fruits, the fruit developmental stage, and the cultivar (Evangelisti *et al*., 1994). With regard to the type of infestation, a key role is played by the presence of EH produced by the full grown larvae, which destroy cellular integrity and expose the fruit inner tissues to oxygen (Angerosa *et al*., 1992; Gomez-Caravaca *et al*., 2008; Kyriakidis and Dourou, 2002). The resulting acceleration of hydrolytic and oxidative processes determines an increase in free acidity and peroxide value P.V. (Gomez-Caravaca *et al*., 2008). Current limits of free acidity and peroxide value (PV) for virgin olive oil (V.O.O.) are 0.8% oleic acid and 20 mEq O_2/kg of oil, respectively (EU 1989/2003 modifying the ECC 2568/91; E.U. Off. J. Eur. Communities, 2003), whereas the concentration in phenolicco-mpounds is not taken into account for oil classification, yet the modern concept of oil quality is mainly based on phenolic composition (secoiridoids and lignans in particular), which is closely related to the sensory and health properties of VOO (Servili *et al*., 2004).Although it is well documented that the phenolic content and oxidative stability decrease in oils obtained from fruits damaged by *B. oleae* attack (Angerosa *et al*., 1992; Evangelisti *et al*., 1994; Gomez-Caravaca *et al*., 2008; Pereira *et al*., 2004; Tamendjari *et al*., 2009). Moreover, in previous studies, the effects of *B. oleae* damage affect on qualitative characteristics and quantify of oils, on addition to the many sources of sample variability (cultivar, orchard location, cultural practices, processing technology) (Gomez-Caravaca *et al*., 2008, Tamendjari *et al*., 2009). For instance, the high variability of samples conclude that phenolic content was not a good indicator of *B. oleae* effects on oil quality Gomez-Caravaca *et al*. (2008).

The aim of this study was to assess the effect of different levels of *B. oleae* damage, expressed as infestation percentage of olive fruits on free acidity as oleic acid, Peroxide value, Rancimat, K232, 270 and Validity.

MATERIALS AND METHODS

Plant materials:

Trial was conducted an irrigated olive (*Oleaeuropaea* L.) (Oleacea) orchard (density of 215 trees/feddan) at the a private farms, at Ismailia Governorate (Cairo-Ismailia roadway, Kilo 96), during 2016 season. Sample fruits were taken in period from first week of May till late week of November 2016 from different experiments. Cultural processes were carried out according to guidelines ministry of agriculture of Egypt. In brief, water was supplied during the summer by submergence irrigation. The

orchard floor was free from any grasses during times a year. The trees were 15 years in full production and yielded 22.5 kg per tree. The olive fruit fly pre-imaginable infestation was determined four times from the end of July until November to monitor infestation by sampling dragging 100 fruits from 25 trees. Fruits were harvested at date (23 Nov.) Fruits were taken to the laboratory and sectioned under a stereoscopic microscope to determine the infestation percentage of the *B. oleae*, healthy and damage fruits were recorded, study the effect infestation percent 5, 15, 25, 35, 45, 55, 65, 80, 90, 100% and healthy fruits (control or check) on olive oil quality.

Chemical analysis:

Each treatment (infestation %) consisted of three replicates, each replicate of 8 kg. fruits fresh weight (FW), take 24 kg./ treatment maturation fruits were randomly harvested from trees similar in size and productivity. Oil extraction and analysis was carried out at Food Technology Research Institute (FTRI), Agriculture Research Centre (ARC). To reduce potentially negative effects on oil quality resulting from olive fruit fly infestation, the experiments were carried out under optimal conditions for fruit storage and processing. In all experiments, the oil was obtained from the different fruit samples within 24 h from harvest using an Abencor system, consisting of ahammermill and a centrifugal machine. The fruit samples were washed with tap water, crushed with a hammer crusher and the paste mixed. The mixed paste was centrifuged at 1784 rm for 3 min and the oil separated by decantation in a glass cylinder within 8 min. To avoid any contamination from the water phase below, only the top layer of the oil was collected (150 mL) and stored at 4 ^{O}Cin the glass dark until analysis. Free acidity, peroxide value, K 232 nm, K 270 nm and rancimat. Table 1. Show that specific measurements to virgin olive oil.

Table 1: Specification measurement standards for Grades of Olive Oil

Grade	Acidity %	Peroxide No.	K 232 nm	K 270 nm
Extra virgin olive oil	≤ 0.8	≤ 20.0	≤ 2.6	≤ 0.22
Virgin olive oil	≤ 2.0	≤ 20.0	N/A	≤ 5.0
Lampante virgin o. o	>2.0	No limit	N/A	≤ 1.10
Ordinary olive oil	≤ 0.3	≤ 5.0	N/A	N/A

The equipment allowed determining both parameters rapidly (within 8 min) on small samples. An aliquot of oil sample (2.5 and 5.0 mL for free acidity and peroxide value, respectively, K 232 nm, K 270 nm, Rancimat at 110^{O}C and Validity were determined according to A. O. A. C (2005), Hardon and Zurche (1974) and I. O. O. C. (2005) of olive oil. Statistical analysis treatment means were separated by least significant differences at P # 0.05 after analysis of variance using a completely randomized design. Linear regression equations were calculated using (SAS Institute, 2007).

RESULTS AND DISCUSSION

Olives *Oleaeuropea* (L) (Oleacea) are one of the main fruit crops in Egypt especially Sinai, Ismailia and Suez Governorate, infested with pest of olive orchards is *Bactr oceraoleae* (Rossi). *Bactr oceraoleae* affect on quality oil as acidity %, peroxide value, rancimat, K232, 270 and validity. The results illustrate that there are significant differences between infestation %, acidity% (as Oleic acid), peroxide value (meq/Kg oil) and rancimat. The results illustrate that positive correlation between Infestation % + acidity %(r= 0.972), infestation percent + peroxide value (r= 0.940) and acidity % + peroxide value (r= 0.898), but there are negative correlation with other treatments.

Impact of infestation percentage with *B. oleae* on acidity percentage (as oleic acid) of olive oil.

From Fig.1statistical analysis shows that there are highly significant differences between infestation % and oleic acid % at L.S.D. 0.05 (0.153). Acidity percentage as oleic acid in olive oil increase with increasing infestation %, where the lowest acidity % in case check free from any infestation record 0.7 acidity % compared with (up 0.8% codex alimentary) followed by 0.72, 0.9, 1.0, 1.1, 1.4, 1.5, 1.5, 1.65, 1.8 and 1.9% acidity with 5, 15, 25, 35, 45, 55, 65, 80, 90 and 100% infestation, respectively.

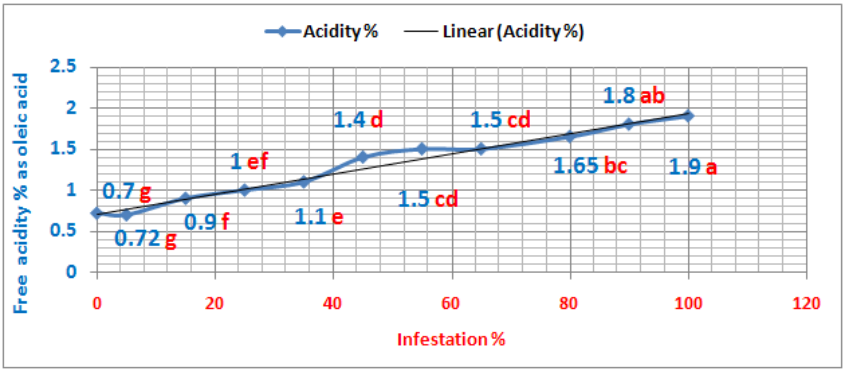

Fig.1: Impact of infestation percentage on free acidity % (oleic acid) of olive oil.
Probability ***, L. S. D $_{0.05}$= 0.153.

Increase oleic acid % in olive oil than 0.8 accrue to increase infestation percentage with *B. olea*e (larvae).

Impact of infestation percentage on peroxide value of olive oil.

Data in Fig. 2 Show highly significant differences between infestation percentage and peroxide value. The results reported that peroxide values increase with increasing infestation %, where peroxide value was low to 4.28 meq O_2/ kg.oil in treatment olive fruit free from any infestation compared with olive oil extracted from olive fruits100% damage 4.9 meq O^2 / kg oil. On the other hand, other treatments record 4.48, 4.5, 4.51, 4.6, 4.64, 4.67, 4.7, 4.8 and 4.85 Meq O_2/ Kg. olive oil in case 5, 15, 25, 35, 45, 55, 65, 80 and 90% infestation.

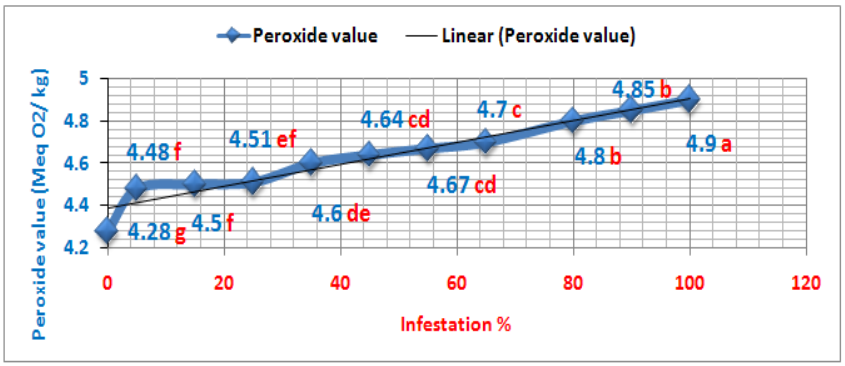

Fig. 2: Impact of infestation level on peroxide value of virgin olive oil.
P ***, L. S. D $_{0.05}$ = 0.097

Impact of infestation percentage on rancimat and validity on rack of olive oil.

The rancimat is most commonly applied to measure the oxidation stability of vegetable and animal oils and fats , to examine the effectiveness of antioxidants.Data in Fig.3.and Table 2 indicate that olive fruits free from infestation with *Bactrocera oleae* give virgin olive oil have 26 month validity on rack and rancimat 13at 110 ^{O}C, on the reverse in case of virgin olive oil extracted from olive fruit infested with

Bactrocera oleae 100% infestation, record lower validity on rack 17.5 month and rancimat 8.77. These results agreement with Nikolaos, B.K. 2002, founded that Olive oil extracted from olive fruits attack with *B. oleae* had higher initial values and a higher rate of increase of the parameters measured. The only parameter affecting oil quality was K270. Maximum storage time within legal limit for K270 was 16 days for fly uninfected and 10 days for fly infected olives and Mraicha *et al*. 2010.Results showed that both attacks by *B. oleae* and maturity process affected the quantitative and qualitative composition of the oil. These analyses demonstrated that the degree of fly attack was positively correlated with free acidity. The olive fly, *Bactrocera oleae* (Gmelin) affects on the quantitative and qualitative production of olive oil, (Stefano *et al*. 2004)

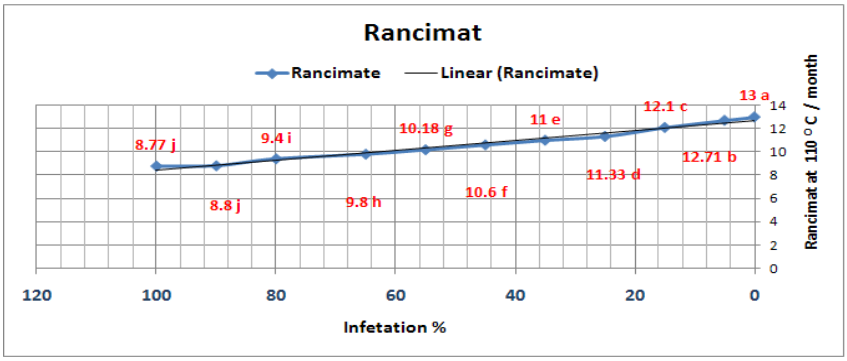

Fig. 3: Impact of infestation percentage on rancimat of olive oil.
P ***, L.S.D $_{0.05}$= 0.185

Data in Table (2) illustrate that effect of infestation olive fruit with *B olea* on K232 and K 270 nm . In case of , K 232, the results show that K 232 value ranged between 0.15 and 0.23 low from 2.6 , while in case of K 270 the values ranged between 1.8 to 2.33 increase than ≤ 0.22 according to E.U. Off. J. Eur. Communities. 2003.

Table 2: Rancimat, validity, K 232 and K 270 nm of olive oil.

Infestation %	**K232 nm**	**K 270 nm**	**Rancimat at 110^{O}C**	**Validity above Rack by month = (Rancim.X2)**
Zero Infestation	0.16	2.01	13	26.0
5 %	0.17	2.02	12.7	25.4
15 %	0.18	2.08	12.1	24.2
25 %	0.20	2.9	11.33	22.7
35 %	0.21	2.18	11	22.0
45 %	0.23	2.28	10.6	21.2
55 %	0.22	2.33	10.18	20.4
65 %	0.19	2.1	9.8	19.6
80 %	0.18	1.9	9.4	18.8
90 %	0.16	1.8	8.8	17.6
100 %	0.15	1.62	8.77	17.5

Simple correlation and regression between infestation percentage and acidity %, peroxide value and rancimat.

The results in Table 3 illustrate relationship simple correlation and polynomial between infestation % and other measurements. There are positive correlation between infestation %, acidity % and peroxide value, also acidity %and peroxide, but there are negative correlation with infestation % with rancimat, acidity with rancimat and peroxide with rancimat record- 0.986- 0.971 and 0.925, respectively. In addition,

polynomial, infestation % affect on acidity, peroxide and rancimat as follow 95.2, 88.1 and 99.1%, respectively.

Table 3: Correlation and regression between infestation percentage and acidity % , peroxide value and rancimat.

Treatments	**Correlation**			**Polynomial**				
	r	SE	P	R^2	X 100	coefficient	SE	P
Infestation+acidity%	0.972	0.041	***	0.952	95.2	0.665	0.037	***
Infes+Peroxide	0.940	0.061	***	0.884	88.4	4.37	0.027	***
Infes+rancimat	-0.986	0.028	***	0.991	99.1	12.97	0.054	***
Acid+Peroxide	0.898	0.078	***	0.807	80.7	4.09	0.176	***
Acid +rancimat	-0.971	0.042	***	0.953	95.3	16.41	0.635	***
Peroxide + rancimat	-0.925	0.068	***	0.889	88.9	137.11	31.53	***

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ARABIC SUMMERY

تاثيرالنسب المئوية المختلفة للاصابة بذبابة ثمار الزيتون على التغيرات فى جودة زيت الزيتون

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يعتبر الزيتون من اهم المحاصيل الثمرية التى يصاب بذبابة ثمار الزيتون . نفذت التجارب فى مزارع زيتون خاصة , فى محافظة الاسماعيلية, طريق القاهرة الاسماعيلية الكيلو ٩٦ سنة ٢٠١٦ . يهدف البحث الى تقدير تاثير النسب المئوية المختلفة للاصابة بذبابة ثمار الزيتون على جودة زيت الزيتون وذلك بتقدير النسبة المئوية للحموضة الحرة كحمض الاوليك وقيم البيروكسيد والتزنخ وتاثير التعرض للاشعة فوق البنفسجية ٢٣٢،٢٧٠ نانوميتر, وعلى التخذين .أوضحت النتائج وجود فروق معنوية عالية بين النسب المئوية للاصابة والنسبة المئوية للحموضة ورقم البيروكسيد والتزنخ كما بينت النتائج وجود علاقة ارتباط موجبة بين النسبة المئوية للاصابة والنسبة المئوية للحموضة والنسبة المئوية للاصابة و قيم البيروكسيد ولكن توجد علاقة ارتباط سالبة مع باقى المعاملات . كما بينت النتائج المتحصل عليها ان النسبة المئوية للاصابة أثرت بنسبة ٩٩,١, ٩٥,٢, ٨٨,٤ % فى التزنخ والنسبة المئوية للحموضة ورقم البيروكسيد, على التوالى. كما ان النتائج المتحصل عليها بينت ان النسبة المئوية للحموضة وقيم البيروكسيد زادت بزيادة النسبة المئوية للاصابة , ولكن كلما زادت النسبة المئوية للاصابة سببت خفض الـ rancimat والفترة اللازمة لصلاحية الزيت على الرف . سجلت قيمة البيروكسيد ٤,٢٨ مليم كافىء اكسجين / كجم زيت زيتون فى حالة زيت الزيتون المستخرج من ثمار خالية من الاصابة بذبابة ثمار الزيتون بالمقارنة مع زيت مستخرج من ثمار مصابة و سجلت المعاملات ٤,٤٨, ٤,٥, ٤,٥١, ٤,٦, ٤,٦٤, ٤,٦٧, ٤,٧, ٤,٨, ٤,٨٥, ٤,٩ مليم كافىء اكسجين / كجم زيت فى حالة النسبة المئوية للاصابة ٥, ١٥, ٢٥, ٣٥, ٤٥, ٥٥, ٦٥, ٨٠, ٩٠, ١٠٠% اصابة, على التوالى .

أظهرت نتائج الدراسة ان قيم K232 تراوحت بين ٠,١٥ الى ٠,٢٣ وكانت اقل من المسموح به وهى ٢,٣ نانوميتر بينما فى حالة K270 تراوحت القيم بين ١,٨ الى ٢,٣٣ نانوميتر .

التوصية : يوصى البحث بضرورة المكافحة لخفض نسب الاصابة كلما امكن للحفاظ على جودة الزيت وزيادة الفترة اللازمة للتخزين .