

FEASIBILITY OF USING PLANT OILS AS A CONTROL AGENTS AGAINST TWO-SPOTTED SPIDER MITE *Tetranychus urticae* KOCH (ACARI: TETRANYCHIDAE).

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ABSTRACT

Laboratory trials were carried out to evaluate the influence of seven plant oils on population of two-spotted spider mite *Tetranychus urticae* Koch (Acari: Tetranychidae) at 30±1°C and 70% ±5 RH. The tested plant oils were *Jatropha curcas* (Jatropha), *Eucalypts globulus* (Camphor), *linum vsitatissimum* (Flax or Linen), *Ricinus communis* (Castor), *Rophanus sativus* (Radish), *Lupinus termis* (Lupine) and *Allium sativum* (Garlic). The amounts of plant oils applied were 3, 4, 5, 6, 7, 8, 9 and 10ml. /liter. and sodium laurel sulfate (S.L.S) and Twen80 were used as solvents. The results revealed that, the Jatropha oil was the highest affective oil on the adult females of *T. urticae* in comparison with other six oils. The concentrations 8, 9 and 10ml. /l. gave high reduction percentages than the low concentrations for all plant oils. All oils were more effective after 72h. from spraying at high concentration. The S.L.S solvent was more effective than Twen80 and other seven tested oils at all concentrations.

INTRODUCTION

Two-spotted spider mite *T. urticae* Koch is an economic pest worldwide including Egypt, causing serious damage to vegetables, field and fruit crops. The number of confirmed resistant insect and mite species to synthetic pesticides has continued to rise, apart from risks associated with the use of these chemical (Ethag and Horn, 1983; Roysh and Mckenzie, 1987; Campos *et al.*, 1995; White, 1995). So using natural plant oils, might be suitable for controlling spider mite on the vegetables, because of its safety. Tunc and Sahinkaya (1998) obtained 100% mortality with vapors of essential oils from anise, cumin and oregano against the spider mite, *Tetranychus cinnabarinus* in exposure periods of 96h. and 2ml /l. air dose. A number of various chemical are used for this pest which cause important economic losses and environmental pollution in Egypt as well as in other countries. Furthermore, in greenhouse, the short harvest schedules of many crops limit the use of high residual acaricides, particularly during harvest period. Also, the unjustifiable and unsafe application of these pesticides on soils and plants causing accumulation of different undesirable chemicals in the crops constituent which may be a bigger un-direct factor in human diseases. Alternative these chemical pesticides by natural plant oils were studied. Recently, different research's were studying the replacement of chemical pesticides by natural components of deferent plant sources as bioagents (Nassar, *et al*, 1995) and acaricide agents (Nassar, *et al*, 1995; Iskkande, *et al*, 1996; Amer, *et al*, 2000 and Sanchez-Ramos, *et al*, 2001). These natural oils in addition to their lethal activities on pests, it also preserve the environment from pollution. Therefore, the present work aimed to evaluate the efficacy of some oil plants against two spotted spider mite under laboratory condition.

MATERIALS AND METHODS

Rearing technique of mite:

The two-spotted spider mite *Tetranychus urticae* Kock was collected from eggplant (*Solanum melongena*) at the farm of faculty of Agriculture Al-Azhar University, Assuit branch. A pure culture of the two-spotted spider mite were maintained on kidney beans plants (*Phaseolus vulgaris*) planted in pots 25cm. diameter in sunny place.

Toxicity test and treatments design:

To evaluate the effect of the plant oils on the adult females of *T. urticae* mite, twenty newly emerged adult females were transferred to the upper surface of Kidney beans leaf discs (3cm. diameter). Two leaf discs were kept on moist cotton pad in each Petri-dish (15cm. diameter), each dish was replicated four times, and continuously moistened during the experiment. The disc surface which caring the adult females was sprayed separately with plant oil using a manual atomizer, and the other one was covered with plastic paper, and the dishes were left about half hour to dry then transferred the known number of adult females of the two spider mite to the upper surface of the disks and kept at the incubator at 30 ± 1 °c and 70% ± 5 RH. The un-treated control was sprayed by water and additive solvent, Twen80 by rate (1cm. / l.) and Sodium lauryl sulfate (S.L.S.) by rate of (0.125g. / l.). Mortality percent was calculated after 24, 48 and 72hrs. of treatments, according to Abbot's formula (1925).

Tested plant oils:

- 1- Jatropha oil, *Jatropha curcas*
- 2- Camphor oil, *Eucalypts globulus*
- 3- Flax or Linen oil, *linum vsitatissimum*
- 4- Castor oil, *Ricinus communis*
- 5- Radish oil *Rophanus sativus*
- 6- Lupine oil, *Lupinus termis*
- 7- Garlic oil, *Alilum sativum*

Oil extracted:-

Samples:

The plant materials (seeds) of *J. curcas* were collected from the forest, of faculty of Agriculture, Al-Azhar University, Assuit branch in March 2014. Two hundreds gm. of seeds were dried at room temperature for two weeks and grinded after removed the shell of seeds using an electric blender (all oils were commercial oils except *J. curcas* was extracted).

Preparation of extracts:

The seeds of *J. curcas* were dried in shade at room temperature, homogenized to coarse powder, and stored in opaque screw tight jars until use. Powdered drug was charged into soxhlet

Statistical analysis:

Obtained data were statistically analyses according to procedures outlined by Gomez and Gomez (1984). The mean values were compared at 5 % level of Duncan's multiple range tests.

RESULTS

From table (1), it can be observed that, the Jatropha oil was significant mortality and has the highest effect on *T. urticae* (adult females). It gave 62.50, 73.69, 80.26, 92.76, 95.40, and 100% reduction percentages after 24hrs. when s.l.s. used as a solvent at concentration 5, 6, 7, 8, 9, and 10ml. /l. respectively, it was followed by Lupine oil, it gave 55.92, 63.16, 69.74, 73.03, 76.97 and 80.26% at same concentration respectively. Radish oil followed it, and gave 50.66, 60.53, 68.42, 70.40, and 75.00% reduction percentages, at concentrations 6, 7, 8, 9 and 10ml. /l. But the Garlic, Castor, Flax and Camphor oils were affected only on high concentrations. The reduction percentages of Garlic were 53.95, 58.55, and 65.13% at concentrations 8, 9, and 10ml./l., while the reduction percentages of Castor, Flax and Camphor oils at concentrations 9 and 10ml. /l. were (58.55 and 63.81%), (42.76 and 67.11%) and (40.79 and 56.58%) respectively. The concentrations 3 and 4ml /l. were slightly effected on *T. urticae* for all seven oils, on the other hand concentration of 10ml. /l. was the highest effected on *T. urticae* after 24hrs. Statistical analysis showed highly significant different between the concentration and kind of oils.

Table (1), Reduction percentages of the spider mite *T. urticae* Koch after 24hrs.from the plant oils spraying, at 30±1°C and 70% ±5 RH. with solvent S.L.S.

Tret. Conce	Jatropha oil	Camphor oil	Flax Oil	Castor oil	Radish Oil	Lupine oil	Garlic Oil	mean
3ml/l.	36.19 stu	11.84 z	9.21 z	14.48 yz	11.19 z	14.48 yz	1.32 z	14.10 H
4ml/l.	44.08 qrs	14.47 yz	20.40 xyz	14.47 yz	30.92 vwx	49.34 nop	19.08 xyz	27.54 G
5ml/l.	62.50 ghi	19.74 xyz	19.74 xyz	22.37 xyz	40.89 rst	55.92 klm	40.79 rst	37.41 F
6ml/l.	73.69 bcd	23.03 xyz	25.00 wxy	24.34 xyz	50.66 mno	63.16 ghi	44.74 pqr	43.52 E
7ml/l.	80.26 b	30.92 vwx	31.58 vwx	26.32 wxz	60.53 hij	69.74 def	47.37 opq	49.53 D
8ml/l.	92.76 a	35.53 tuv	36.84 stu	32.89 uvw	68.42 efg	73.03 cde	53.95 lmn	56.86 C
9ml/l.	95.40 a	40.79 yst	42.76 vst	58.55 ijk	70.40 def	76.97 bc	58.55 ijk	62.69 B
10ml/l.	100.00 a	56.58 jkl	67.11 efg	63.81 fgh	75.00 bcd	80.26 b	65.13 fgh	72.56 A
mean	73.11 A	29.11 E	31.58 E	32.15 E	50.99 C	60.36 B	41.37 D	

F. value:

A = 151.1**

B =173.0**

AB =3.573**

The results in Table (2) showed that, the using of solvent (Tween80) caused the lowest mortality percentages which observed at all

concentrations after 24 h. of spring oils cooperative with S.L.S solvent. The first affected oil was Jatropha oil it recorded reduction percentages of 60.05, 70.36, 74.87, 86.47, 90.34 and 97.42% at concentrations 6, 7, 8, 9 and 10ml/l. respectively. The second oil was Lupine oil by reduction percentages of 55.54, 63.27, 69.07, 74.87, 78.74 and 78.74% at the previous concentration respectively. The Radish was the 3rd oil it recorded 50.39, 61.99, 68.34, 72.29 and 74.23% reduction percentages at concentrations 6, 7, 8, 9 and 10ml. /l. respectively. But concentrations of 9 and 10ml./l. gave 58.55 and 60.05% reduction for Garlic oil, while the reduction percentages of Castor oil were 57.47 and 62.58% at concentrations 9 and 10ml./l. respectively. But the Camphor and Flax oils were affected at concentration of 10ml./l. only by reduction percentages 52.96 and 63.27% respectively. Statistical differences were registered for oil sand concentrations.

Table (2), Reduction percentages of the spider mite *T. urticae* Koch after 24hrs.from the plant oils spraying, at 30±1° C and 70% ±5 RH. with solvent twen80.

Tret. Conce.	Jatroph a oil	Camphor oil	Flax oil	Castor oil	Radish oil	Lupine oil	Garlic oil	mean
3ml/l.	21.39 tuv	5.29 wx	13.02 vwx	13.55 tuv	12.37 vwx	14.95 uvw	0.77 x	11.73 H
4ml/l.	34.28 qrs	12.38 vwx	16.24 uvw	14.31 vwx	30.14 rst	49.74 klm	14.95 uvw	26.36 G
5ml/l.	60.05 hij	17.53 uvw	16.88 uvw	21.29 tuv	46.52 lmn	55.54 ijk	37.50 opq	36.49 F
6ml/l.	70.36 efg	22.68 tuv	22.68 tuv	22.58 tuv	50.39 klm	63.27 ghi	42.01 mno	42.01 E
7ml/l.	74.87 cde	25.90 tuv	29.12 stu	23.87 tuv	61.99 ghi	69.07 fgh	47.16 lmn	47.44 D
8ml/l.	86.47 abc	30.41 yst	36.86 pqy	30.32 vst	68.43 fgh	74.87 cde	49.74 klm	53.88 C
9ml/l.	90.34 ab	37.50 opq	40.72 nop	58.06 hij	72.29 def	78.74 bcd	52.32 jkl	61.34 B
10ml/l.	97.42 a	52.96 jkl	63.27 ghi	62.58 ghi	74.23 def	78.74 bcd	60.05 hij	69.90 A
mean	66.90 A	25.58 F	29.85 E	30.82 E	52.08 C	60.62 B	38.06 D	

F. value:

A= 110.9**

B = 131.8**

AB = 3.573**

It is clear from Table (3) that, the using of S.L.S as a solvent and after 48 h., the concentration of 3ml. /l. reached 54.73% for Jatropha oil only, while the remaining six oils were not reached 50.00% mortality for adult female of *T. urticae*. At concentration 4ml. /l. the reduction percentages were 71.62, 59.46 and 59.46% for Jatropha, Castor and Lupine respectively; but at concentrations 5, 6 and 7ml. /l. the reduction percentages were (72.69, 79.73

and 83.78%), (62.16, 64.19 and 66.89%) and (68.92, 72.97 and 77.70%) for previously mentioned oils. All oils reached more than 50.00% mortality at concentrations 8, 9 and 10ml. /l. with reduction percentages 97.30, 97.97 and 100% for Jatropa oil, 52.43, 57.35 and 79.73% for Camphor oil, 54.05, 61.49 and 79.73% for Flax oil, 70.27, 74.32 and 80.41% for Castor oil, 79.73, 80.41 and 84.46% for Radish oil, 79.73, 83.78 and 86.49% for Lupine oil and 64.86, 66.89 and 87.16% for Garlic oil at the above mentioned concentrations. The high concentration and the long period led to increase mortality. Statistical analysis showed the importance of variation among oils.

Table (3), Reduction percentages of the spider mite *T. urticae* Koch after 48hrs.from the plant oils spraying, at 30±1° C and 70% ±5 RH. with solvent S.L.S.

Tret. Conce.	Jatroph a oil	Camphor oil	Flax oil	Castor oil	Radish oil	Lupine oil	Garlic oil	mean
3ml/l.	54.73 opq	27.03 xyz	18.92 z	42.57 stu	29.73 wxy	39.87 uvw	1.35 z	30.60 G
4ml/l.	71.62 hij	36.49 vwx	31.76 wxy	59.46 nop	45.95 rst	59.46 nop	25.00 yz	47.10 F
5ml/l.	72.69 hij	41.89 tuv	33.78 wxy	62.16 mno	59.46 nop	68.92 jkl	52.70 pqr	55.79 E
6ml/l.	79.73 def	45.95 rst	39.19 uvw	64.19 lmn	68.92 jnl	72.97 ghi	57.43 nop	61.20 D
7ml/l.	83.78 bcd	50.68 qrs	46.62 rst	66.69 klm	75.00 fgh	77.70 efg	58.11 nop	65.54 C
8ml/l.	97.30 a	52.43 qrs	54.05 opq	70.27 ljk	79.73 def	79.73 def	64.86 ijk	72.78 B
9ml/l.	97.97 a	57.35 nop	61.49 nop	74.32 fgh	80.41 cde	83.78 bcd	66.89 klm	73.65 B
10ml/l.	100.00 a	79.73 def	79.73 def	80.41 cde	84.46 bc	86.49 b	87.16 b	85.42 A
mean	82.09 A	48.82 E	45.69 E	65.03 C	65.46 C	71.11 B	52.36 D	

F. value:

A = 129.50**

B = 192.40**

AB =4.361**

The results in Table (4) indicated that, the reduction percentages were slightly reduced after 48h. when Twen used as a solvent. From results note that, the oils of Jatropa and lupine were the best oils. They recorded mortality of 61.44, 67.42, 74.73, 77.39, 88.70, 94.68 and 99.34% for Jatropa and 58.11, 66.76, 72.74, 76.73, 79.39, 84.71 and 85.37% for Lupine at concentration 4, 5, 6, 7, 8, 9 and 10ml. /l. respectively. While the lower oil was Camphor oil as it reached 50.80% mortality at 9ml./L. and 76.06% at 10ml./l. But the oils of Radish ,Castor ,Garlic and Flax were moderately effected on adult female of *T. urticae* with reduction percentages 78.72, 80.05, and 83.38% for Radish oil ,69.41 ,73.40 ,and 78.72% for Castor oil,

59.44 ,61.44 and 77.39% for Garlic oil and 52.13 ,57.45 and 74.73% for Flax oil at concentrations of 8, 9 and 10ml./l. respectively. Statistically there were high difference between oils effective and concentrations.

Table (4), Reduction percentages of the spider mite *T. urticae* Koch after 48hrs.from the plant oils spraying, at 30±1.C and 70% ±5 RH. with solvent twen80.

Tret. Conce.	Jatropha oil	Camphor oil	Flax oil	Castor oil	Radish oil	Lupine oil	Garlic oil	Mean
3ml/l.	34.18 uvw	22.87 wxy	16.89 y	41.59 stu	29.52 vwx	40.16 stu	3.59 z	26.96 G
4ml/l.	61.44 klm	34.84 tuv	26.86 wxy	54.79 nop	46.15 rst	58.11 mno	20.88 xy	43.29 F
5ml/l.	67.42 ijk	40.16 stu	31.52 vwx	58.78 lum	56.78 nop	66.76 ijk	40.83 stu	51.75 E
6ml/l.	74.73 efg	41.49 stu	38.83 stu	61.44 klm	68.09 hij	72.74 fgh	50.13 pqr	58.21 D
7ml/l.	77.39 def	46.81 qrs	45.48 rst	64.10 jkl	74.07 efg	76.73 def	55.46 nop	62.86 C
8ml/l.	88.70 abc	49.47 pqr	52.13 opq	69.41 ghi	78.72 def	79.39 def	59.44 klm	68.37 B
9ml/l.	94.68 ab	50.80 pqr	57.45 nop	73.40 fgh	80.05 cde	84.71 bcd	61.44 klm	71.60 B
10ml/l.	99.34 a	76.06 efg	74.73 efg	78.72 def	83.38 bcd	85.37 bcd	77.39 def	82.14 A
mean	74.73 A	45.31 D	42.98 D	62.77 C	64.59 C	70.50 B	46.14 D	

F. value:

A = 97.31**
 B =150.20**
 AB =2.322**

Data presented in table (5) showed that, the reduction percentages after period of 72h. from spraying were the highest results, when S.L.S used as a solvent. The concentration of 3ml. /l. wasn't affected in all oils except the Jatropha oil it gave 69.35% reduction. On the other hand all oils gave high reduction percentages after 72h. at concentrations 5 to 10ml./l. They were 85.41, 89.05, 90.51, 97.81, 99.27 and 100% for Jatropha oil, 74.46, 78.11, 81.76, 85.41, 89.05 and 93.43% for Lupine oil, 65.70, 74.46, 85.41, 89.78, 88.32 and 91.24 for Radish oil, 71.54, 75.92, 78.11, 81.76, 86.86 and 91.24% for Castor oil , 59.87, 62.79, 64.97, 71.54, 78.11 and 86.86% for Camphor oil, 66.43, 63.52, 70.81, 74.46, 77.38 and 83.95%, for Flax oil and 59.14, 63.51, 65.71, 71.54, 70.08 and 96.35%, for Garlic oil, at the former concentrations 5, 6, 7, 8, 9 and 10ml./L. respectively. Statistical differences were found between concentrations and kind of oil.

Table (5), Reduction percentages of the spider mite *T. urticae* Koch after 72hrs. from the plant oils spraying, at 30±1°C and 70% ±5 RH. with solvent S.L.S.

Tret. Conce.	Jatropha oil	Camphor oil	Flax oil	Castor oil	Radish oil	Lupine oil	Garlic oil	mean
3ml/l.	69.35 mno	34.33 qr	34.33 s	48.92 y	32.14 s	43.08 r	1.49 t	37.66 G
4ml/l.	79.57 hjk	51.11 qr	48.92 y	63.51 nop	51.84 qs	64.97 nop	34.33 s	56.32 F
5ml/l.	85.41 ghi	59.87 opq	66.43 nop	71.54 lmn	65.70 nop	74.46 klm	59.14 pq	68.93 E
6ml/l.	89.05 efg	62.79 nop	63.52 nop	75.92 jkl	74.46 klm	78.11 ijk	63.51 nop	72.48 D
7ml/l.	90.51 def	64.97 nop	70.81 lmn	78.11 ijk	85.41 ghi	81.76 hij	65.71 nop	76.75 C
8ml/l.	97.81 abc	71.54 lmn	74.46 klm	81.76 hij	89.78 def	85.41 ghi	71.54 lmn	81.76 B
9ml/l.	99.27 ab	78.11 ijk	77.38 ijk	86.86 fgh	88.32 efg	89.05 efg	70.08 lmn	84.15 B
10ml/l.	100.00 a	86.86 rgh	83.95 hjk	91.24 def	91.24 def	93.43 cde	96.35 bcd	91.87 A
mean	88.87 A	63.70 D	64.97 D	74.73 CB	72.36 C	76.28 B	57.77 E	

F. value:

A = 91.25**

B =227.90**

AB =4.55**

Table (6), indicated that, the concentration of 3ml. /l. wasn't affected in all oils after period of 72h. from spraying when Twen80 was used as a solvent. While concentration of 4ml. reached 50% reduction in all oils except Garlic oil was 31.94% reduction. But at concentrations of 5, 6, 7, 8, 9, and 10ml. /l. all oils gave the highest mortality. The oil of Jatropha was more effective than the other six oils; it recorded 78.47, 79.17, 81.94, 90.97, 94.44 and 100% reduction percentages at concentrations of 5, 6, 7, 8, 9, and 10ml. /l. respectively. While the reduction percentages of other oils at same concentrations were 75.00, 77.08, 81.94, 85.42, 89.58 and 92.36% for Lupine oil, 65.28, 73.61, 84.03, 87.50, 88.89 and 89.58% for Radish oil, 72.22, 74.31, 76.39, 80.56, 84.72 and 89.58% for Castor oil, 57.64, 61.11, 61.11, 65.28, 80.56 and 84.03% for Camphor oil, 59.72, 63.20, 69.45, 70.84, 77.78 and 78.47% for Flax oil and 58.33, 58.33, 61.11, 63.20, 65.97 and 87.50% for Garlic oil respectively. Statistically there were significant difference between the concentrations and oils.

Table (6), Reduction percentages of the spider mite *T. urticae* Koch after 72hrs. from the plant oils spraying, at 30±1° C and 70% ±5 RH. with solvent twen80.

Tret. Conce.	Jatropha oil	Camphor oil	Flax oil	Castor oil	Radish oil	Lupine oil	Garlic oil	mean
3ml/l.	43.75 uv	33.33 w	35.42 vw	49.31 stu	34.03 vw	47.22 tu	4.86 x	35.42 G
4ml/l.	74.31 jkl	50.00 stu	50.00 stu	61.11 pqr	53.47 stu	65.28 nop	31.94 w	55.16 F
5ml/l.	78.47 ghi	57.64 rst	59.72 qrs	72.22 klm	65.28 nop	75.00 ijk	58.33 rst	66.67 E
6ml/l.	79.17 ghi	61.11 pqr	63.20 opq	74.31 jkl	73.61 jkl	77.08 hij	58.33 rst	69.54 E
7ml/l.	81.94 fgh	61.11 pqr	69.45 mno	76.39 ijk	84.03 efg	81.94 fgh	61.11 pqr	73.71 D
8ml/l.	90.97 bcd	65.28 nop	70.84 lmn	80.56 ghi	88.89 cde	85.42 efg	63.20 opq	77.88 C
9ml/l.	94.44 ab	80.56 ghi	77.78 ghi	84.72 efg	87.50 def	89.58 cde	65.97 nop	82.94 B
10ml/l.	100.00 a	84.03 efg	87.47 ghi	89.58 cde	89.58 cde	92.36 abc	87.50 def	88.79 A
mean	80.38 A	61.63 D	63.11 D	73.52 BC	72.05 C	76.74 B	53.91 E	

F. value:

A = 60.43**

B =170.20**

AB =2.377**

DISCUSSION

The main effective oil from these seven oils was the Jatropha oil, it gave high reduction on the population of *T. urticae* at low concentration 3 or 4ml. /L., but other six were different in its effect on the population of spider mite and they need to more concentration than 5ml./L. The results in this work emphasize that, the period of 72h. was appropriate to oils to give high reduction percentage. The solvent of S.L.S was affected with all oils, but it may be not safe for human and animals. while the twen80 solvent gave low reduction with oils but it is not harmful.

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امكانية استخدام الزيوت النباتية كوسيلة لمكافحة العنكبوت الأحمر ذو البقعين

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بحسباً عن بدائل آمنة يمكن استخدامها في مكافحة العنكبوت الأحمر عوضاً عن المبيدات الأكاروسية تم إجراء هذه الدراسة وقد استخدم فيها سبع أنواع من الزيوت النباتية الطبيعية وهي زيت الجثروفا، زيت الكافور، زيت الكتان، زيت الخروع، زيت الفجل، زيت الترمس، زيت الثوم. وقد تم اختبار كل زيت من هذه الزيوت معملياً على الإناث الكاملة للعنكبوت الأحمر *Tetranychus urticae* باستخدام ثمان تركيزات مختلفة وهي ٣ سم^٣/لتر، ٤ سم^٣/لتر، ٥ سم^٣/لتر، ٦ سم^٣/لتر، ٧ سم^٣/لتر، ٨ سم^٣/لتر، ٩ سم^٣/لتر، ١٠ سم^٣/لتر وأخذت النتائج بعد ٢٤، ٤٨، ٧٢ ساعة، وقد استخدم في الدراسة اثنان من المذيبات العضوية وهما مذيب التوين ٨٠ ومذيب صوديوم لاوريل سلفات (S.L.S.) وكانت النتائج كما يلي.

١. أعطى زيت الجثروفا أعلى النتائج خاصة مع مذيب SLS حيث أعطى نسب خفض بلغت ٦٩.٣٥%، ٨٩.٨٥%، ٨٥.٤١%، ٧٩.٠٥%، ٩٠.٥١%، ٩٧.٨١%، ٩٩.٢٧%، ١٠٠% بعد ٧٢ ساعة من المعاملة وبيانات التركيزات ٣ سم^٣/لتر، ٤ سم^٣/لتر، ٥ سم^٣/لتر، ٦ سم^٣/لتر، ٧ سم^٣/لتر، ٨ سم^٣/لتر، ٩ سم^٣/لتر، ١٠ سم^٣/لتر على الترتيب.
٢. كل الزيوت حققت نسب خفض أقل من ٥٠% على التركيز ٣ سم^٣/لتر بعد ٧٢ ساعة من المعاملة وباستخدام مذيب التوين، أما باستخدام مذيب SLS فلم يحقق إلا زيت الجثروفا نسبة أعلى من ٥٠% (٦٩.٣٥%) أيضاً بعد ٧٢ ساعة من المعاملة.
٣. أعطى مذيب SLS نتائج أعلى من مذيب التوين، حيث تخطت كل الزيوت نسبة خفض أعلى من ٦٠% عند تركيز ٦ سم^٣/لتر. أما عند استخدام مذيب التوين تخطت كل الزيوت نسبة خفض أعلى من ٦٠% عند التركيز ٧ سم^٣/لتر.
٤. أعطت كل الزيوت نسب خفض اقتربت من ١٠٠% على التركيز ١٠ سم^٣/لتر، حيث نسب الخفض ١٠٠%، ٨٦.٨٦%، ٨٣.٩٥%، ٩١.٢٤%، ٩٣.٤٣%، ٩٦.٣٥% باستخدام المذيب SLS، وباستخدام مذيب التوين كانت نسب الخفض ١٠٠%، ٨٤.٠٣%، ٨٧.٤٧%، ٨٩.٥٨%، ٩٢.٣٦%، ٨٧.٥٠% بعد ٧٢ ساعة من المعاملة وباستخدام الزيوت الآتية زيت الجثروفا، زيت الكافور، زيت الكتان، زيت الخروع، زيت الفجل، زيت الترمس زيت الثوم على الترتيب.