EFFET OF STERILIZATION ON QUALITY OF CARAWAY (*CARUM CARVI*, L.) FRUITS USING LASER AND SAFE RADIATION WAVES

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ABSTRACT

In this work, three types of light used for Caraway fruits sterilization namely helium-neon (He-Ne) green laser at wavelength 543.5 nm, ultraviolet (UV) light at wavelength 245 nm and helium-neon (He-Ne) red laser at wavelength 632.8 nm with exposure times (1 , 3 , 5 , 10 and 15 min.) with the aim of studying the effect for type of radiation, exposure time and their interaction on Caraway fruits. Investigated the measurements dimensions from length, width thickness, volume, diameter geometric, diameter area, frontal area, transverse area, sphericity with constant moisture to some of sterilization treatments for Carum Carvi, L. fruits. Also in this work studied the correlation for length/ width, length/ thickness, width/ thickness, frontal area/ transverse area, sphericity/ frontal area, sphericity/ transverse area, geometric diameter/ area diameter, sphericity/ geometric diameter and sphericity/ area diameter. The obtained results indicated that sterilization treatment by He-Ne red laser at doses of 3 and 10 min. recorded the significant effects as increased in essential oil percentage, moisture content. Also the sterilization treatment by ultraviolet radiation at dose of 10 min. recorded significant effect in carbohydrate. Meanwhile, concerning germination percentage, there was an observable increased in germination percent with wavelength 632.8 nm with dose of 3 min. and ultraviolet radiation (UV) at wavelength 245 nm with dose of 15 min. Finally, it is recommend that using sterilization by helium-neon green at 10 min. in order to eliminate the microbial load.

Key Word: *laser, Carum carvi , ; Sterilization; fruits; Bacteria and Fungi, UV.*

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The sterilization treatment by helium-neon (green & red) and ultraviolet recorded the controlling on microbial load, this means extended period of preservation. It was considered that the sterilization by this method eco-friendly and safe method.

INTRODUCTION

The importance of medicinal and aromatic plants and the trend of the world nations for using these plants in the curing and avoiding the chemical medicine which has harmful effect on the environment and the public health. Many of medicinal and aromatic products refused after its export, because its contamination and no according to world measurement specifics. Therefore, this study that ternd of sterilization of medicinal and aromatic plant. So it leads to the importance for sterilizing these products and keeping them for long time free from contamination.

Abou Donia (2008) in Egypt studied that representative figures for the microbial status of dried herbal materials including an aerobic bacterial count, coliform yeast and mold were 10^3 to 10^3), (10 to 10×10^3) and (3 to 10^2) CFU/g. Moreover, fungi were found in all of collected samples. *Aspergillus, Penicillium* genera were more frequently detected than other genera (*Alternaroia, Absidia spp., Rhizoctonia* and *Cladosporium spp.*). It was concluded that spices and medicinal plants may be high risk products and therefore, more studies are necessary to find methods of decontamination.

Several methods of sterilization initiated from heating, colding, drying, fermentation, chemicals, until irradiation which it considered as once of food preservation methods; **(Blanck, 1955).**

The sterilization with UV was method eco-friendly and safe for storage without the need for postharvest application; **(Hidaka, Y. and Kubota, K; 2006)**. As that the He-Ne laser was modern method for sterilization and achieve safely, as in who applied that the laser irradiation is safely utilized as new technology to inhibit growth of microorganisms **(Ouf and Abdel Hady,1999)**.

The aim of this study: 1- Determination of suitable radiation in process of the caraway fruits sterilization from the wavelength, the exposure times and the power which use to radiation.

2- Study of the radiation effect on component and elements of the materials of fruits. 3- Obtain on safe product valid for storage and the export according to the world standards.

MATERIAL AND METHODS

Source of samples: Fruits of caraway (*Carum carvi,* L.) were obtained from private farm in Qanater. The samples were analyzed directly after carrying out the sterilization process. The caraway fruits were irradiated in the dark. Three types of light used for caraway. fruits irradiation were He-Ne laser (green and red) and Ultraviolet light (UV) with different wavelengthes and different times were 1 , 3 , 5 , 10 and 15 min. The light source used was green helium/neon (He-Ne gas laser) NEC Japan that emits light corporation with output power 5 mw and the wavelength 543.5 nm with collimated beam diameter of 10 cm. While the light source used was red helium/neon (He-Ne gas laser) NEC Japan that emits light corporation with output power 30 mw and the wavelength 632.8 nm with collimated beam diameter of 10 cm. The light source used was red helium/neon (He-Ne gas laser) NEC Japan that emits light corporation with output power 30 mw. The wavelength 632.8 nm with collimated beam diameter of 10 cm. Resulting in an energy dose J and irradiation time was 1, 3, 5, 10, 15 min. As that the chamber utilized for UV irradiation it contains two lamps (20 Watts/ each); 115 VAC/ 60 Hz with length 60 cm), that emit 90% continuous UV light was mounted on chamber walls with equidistant (40 cm) from each other at 10 cm height from chamber bottom and wavelength 245 nm.

Physical properties analysis: The shape and size were studied in terms of caraway as moisture content "M.C", length "L" (mm), width "W" and thickness "T" (mm), volume "V" (mm^3), geometric diameter "Dg" (mm), arithmetic diameter "Da" (mm), sphericity " S " (%), frontal area "At" (mm^2) and transverse area "At" (mm^2) using the equations of **El-Raie, 1987**. Individual fruits as random sample of hundred fruits from the studied caraway fruits.

Microbiological analysis: Non-irradiated and irradiated samples (10 g each) were placed in a blender cup containing saline solution (90 ml,

.82%) and stirred for 5 min and used to prepare serial dilutions according to standard methods (Associaton od Official Analytical Chemists **(AOAC, 1990)**. The resultant solutions were used for the following microbial examinations: total plate counts, spore forming bacteria counts., total coliform and fecal coliform counts, staphylococcus aureus counts and total fungi.

Seed germination measurements: Germination percentage of caraway seeds was calculated according to the ISTA rules **(ISTA, 1999).** Also, the germination speed was calculated according to **Edmond *et al.*,(1977).**

Moisture content analysis (d.b): Determination of water percent of known weight of dry samples of caraway fruits (10 g.) was accurately weighed and dried in oven at 70 ° C until constant weight according to **A.O.A.C. (2000)**.

Essential oil analysis: The essential oil percentage of each treatment of caraway fruits was determined using water distillation method according to the **British pharmacopoeia (1963)**. Also, essential oil constituents were analyzed using gas liquid chromatography (GLC) to determine the main constituents according to **Hoftman (1967).**

Statistical analysis. The obtained experimental data was performed using One way Anova analysis. Results were displayed as the differences between the means treatments were tested using modified L.S.D. The means were significantly different if the value was = 0.5 according to **Snedecor and Cochran (1980).**

RESULTS AND DISCUSSION

1.Physical properties In this work investigated the measurements dimensions from length, width, thickness, volume, diameter geometric, diameter area, frontal area, transverse area, sphericity with constant moisture to some of sterilization treatments for caraway fruits, where the treatments was the helium-neon (He-Ne) green laser at wavelength 543.5 nm and at doses of (1 , 3 , 5 and 10 min.) as show in the table (1).

Table (1): Typical means of samples of 100 fruits, which sterilization by (He-Ne) laser with 543.5 nm for length (mm), width (mm), thickness (mm), volume (mm^3), diameter geometric (mm), diameter area (mm), frontal area (mm^2) , transverse area (mm^2), and sphericity (%).

Exposure time (min.)	L/	W/	T/	V/	Dg/	Da/	At/	Af/	S/
1	5.993	2.399	1.410	10.514	2.692	3.267	2.652	11.244	45.944
3	5.842	2.340	1.332	9.586	2.606	3.171	2.468	10.712	45.475
5	5.933	2.365	1.320	9.651	2.622	3.206	2.457	10.917	45.250
10	5.869	2.406	1.332	9.841	2.637	3.202	2.510	11.095	45.802
Max- min.	5.993-5.842	2.406-2.340	1.410-1.320	10.514-9.586	2692-2.606	3.267-3.202	2.652-2.457	11.244-10.712	45.944-45.250

Where: L : length , W: width, T : thickness, V : volume, Dg : diameter geometric, Da : diameter area , At : transverse area, Af : frontal area and S : sphericity.

Regarding the comparsion between the sterilization treatments by the helium-neon (He-Ne) green laser at the wavelength 543.5 nm with doses of (1 , 3 , 5 and 10 min.) for 100 fruits recorded that the highest value in surface area measurement (Af) was at dose of 1 min. which recorded 11.244 mm^2, while the lower value in surface area measurement was at dose of 3 min. which recorded 10.712 mm^2. For the comparsion between the sterilization of all treatments by the helium-neon (He-Ne) green laser at the wavelength 543.5 nm with doses of (1 , 3 , 5 and 10 min.) for 100 fruits recorded that the highest value in width measurement (W) was at dose of 10 min. which recorded 2.406 mm, while the lower value in width measurement was at dose of 3 min. which recorded 2.340 mm. he table (2) show that the correlation between length/ width was (0.038, -0.137), length/ thickness was (0.030, -0.089), width/ thickness was (0.282, - 0.099), frontal area/ transverse area was (0.459, 0.257), sphericity/ frontal area was (0.430, - 0.0246),

sphericity/ transverse area was (0.651, - 0.470), geometric diameter/ area diameter was (0.878, 0.794), sphericity/ geometric diameter was (0.182, - 0.222) and sphericity/ area diameter was (- 0.0391, - 0641).

Table (2) : Correlation for different parameter of Caraway fruits, which sterilization by (He-Ne) laser with wavelength 543.5 nm between length/ width, length/ thickness, width/ thickness, frontal area/ transfere area, sphericity/ frontal area, sphericity/ transfere area, geometric diameter/ area diameter, sphericity/ geometric diameter and sphericity/ area diameter.

Exposure times (min.)	L/W	L/T	T/W	Af/At	S/Af	S/At	Dg/Da	S/Dg	S/Da
1 min.	-.134	-.089	-.035	.257	-.344	.626	.794	-.070	-.461
3 min.	-.072	-.033	.282	.459	-.246	.651	.822	.182	-.391
5 min.	-.137	-.089	.106	.419	.344	.626	.839	-.070	-.566
10 min.	.038	.030	-.099	.446	.430	-.470	.878	-.222	-.641

2.Microbiology:

The experiment showed that the effect of different sterilization treatments on total count microorganisms, fungi and spore former bacteria which were exposed to two types of lasers helium-neon (He-Ne (green & red)) and ultraviolet (UV) light.

The results of Table (3) experiment showed the effect of different sterilization treatments on total count of microorganismis which were exposed to two types of lasers helium-neon (He-Ne) (543.5 and 632.8 nm) and ultraviolet (UV) light.

Table (3) : Total count of microorganisms before and after sterilization process by different radiation wavelengths.

Exposure time (min.)	He-Ne (534.5 nm) laser	Ultraviolet (UV) (245 nm)	He-Ne (632.8 nm) laser
0	$>3 \times 10^7$	$>3 \times 10^7$	$>3 \times 10^7$
1	4×10^2	1×10^3	2.5×10^3
3	4×10^2	1×10^3	2×10^5
5	4×10^4	5×10^2	2×10^5
10	N.D	5×10^2	3×10^3

The results of table (4) experiment showed the effect of different sterilization treatments on sporeformer bacteria which were exposed

to two types of lasers helium-neon (He-Ne) (543.5 and 632.8 nm) and ultraviolet (UV) light (245 nm).

Table (4) : Sporeformer bacteria before and after sterilization process. by different radiations wavelengths.

Exposure time (min)	He-Ne (543.5 nm laser)	Ultra Violet 245 nm	He-Ne (632.8 nm laser)
0	$>3 \times 10^7$	$>3 \times 10^7$	$>3 \times 10^7$
1	4×10^3	1.5×10^4	5×10^3
3	4×10^2	1.5×10^4	2.5×10^5
5	N.D	4×10^3	N.D
10	N.D	N.D	4×10^3
15	N.D	4×10^2	2×10^3

The results of Table (5) experiment showed the effect of different sterilization treatments on fungi which were exposed to two types of lasers helium-neon (He-Ne lasers) and ultraviolet (UV) light.

Table (5) : Fungi before and after sterilization process by different radiation wavelengths.

Exposure time (min)	He-Ne(543.5 nm laser)	Ultra Violet 245 nm	He-Ne (632.8 nm laser)
0	$> 3 \times 10^7$	$> 3 \times 10^7$	$> 3 \times 10^7$
1	4 ×103	1.4×10^4	1×10^2
3	N.D	1×10^4	N.D
5	N.D	5×10^2	N.D
10	N.D	N.D	N.D
15	N.D	4 × 102	1×10^3

The results indicated that the caraway fruits sterilized by helium-neon (He-Ne) green laser at wavelength 543.5 nm with dose of 10 min. recorded to complete eliminate for all microorganisms which include (total count bacteria- fungi – spore former bacteria). As for that the Caraway fruits sterilized by helium-neon (He-Ne) green laser at wavelength 543.5 nm with doses of (3 , 5 , 10 and 15 min.) recorded to complete eliminate for all fungi, while the Caraway fruits sterilized by ultraviolet (UV) at wavelength 245 nm with doses of recorded

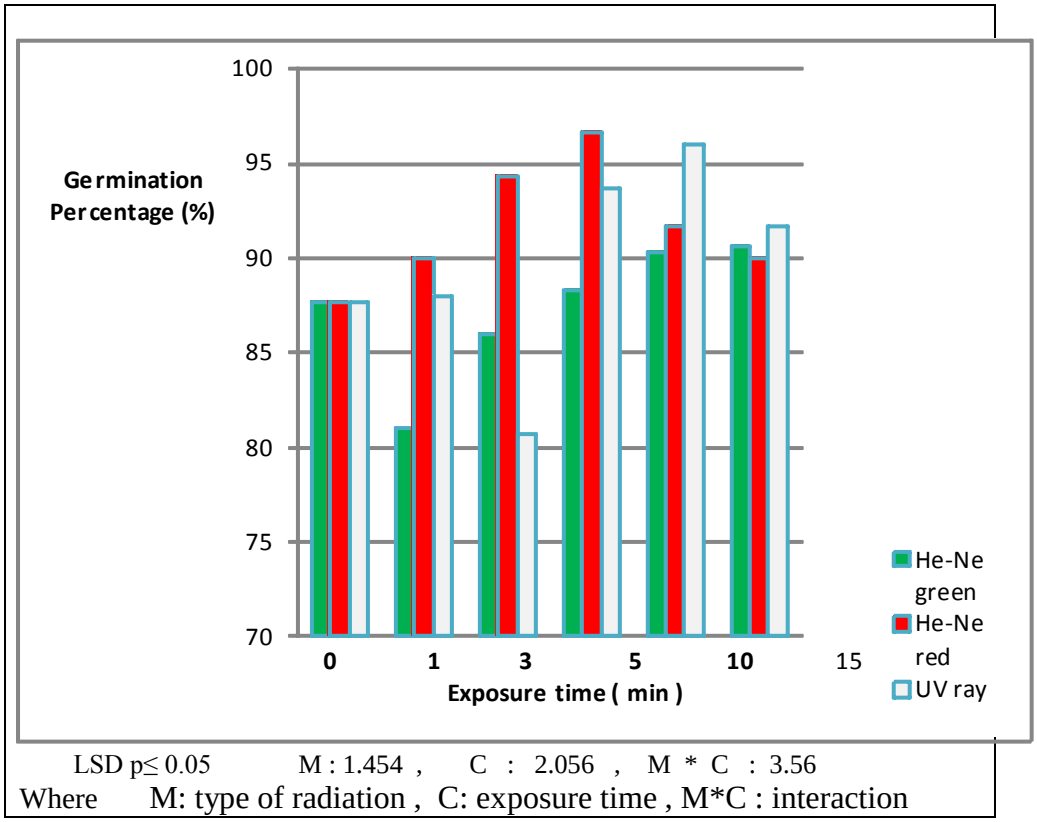
completely eliminate for all fungi. However, the sterilization treatments led to reduce of micro-organisms. This agreement with **Abou Donia (2008)** where found that sporeforming bacteria were detected in all the analyzed samples. Concluded that spices and medicinal plants may high risk products as it contained many pathogenic bacteria and fungi. For Caraway fruits detected different microorganisms such as aerobic bacteria 1.8 $x10^6$, sporeformer bacteria 1.8 x 10^2, coliform bacteria 2.1 x10, E.coli 1.5 x 10, yeast 3.0 x 10^2 and mold 1.0 x 10^3. CFU/g.

The He-Ne laser (red light) with wavelength 632.8 nm treatment could inactivation the bacteria, and agreement with **El-Adly *et al.* (2007)**, where they using toluidine blue O (TBO), essential oil of Fennel (*Foeniculum vulgare var.dulce*) and light from helium/neon (He-Ne) laser at wave length of 632.8 nm with output power 7.3 mw. The irradiation time was 5, 10 and 15 min for inhibit the Gram-positive and Gram-negative bacteria. They resulted that the growth in presence of photosensitizer (L+P+) present the lowest mean Cfu/ml value for all bacterial spices, indicating that the laser in presence of toluidine blue was able reduce the viability of these bacterial species. As it agrees with **Ouf and abdel – Hady (1999)** who found that laser irradiation of soybean seeds for- 3 min caused a clear reduction in number of seed borne fungi which became more as irradiation times was extended.

3. Germination percentage: The results shown in Table (6) and Fig. (1) showed that the germination % of Caraway fruits which were exposed to two types of lasers helium-neon (He-Ne (543.5 nm & 632.8 nm)) and ultraviolet (UV) light (245 nm).

Table (6) : Percentage of germination before and after sterilization process by different radiation wavelengths.

Exposure time (min)	He-Ne(543 nm laser)	Ultra Violet 245 nm	He-Ne (632.8 nm laser)	Mean
0	87.67	87.67	87.67	87.67
1	81	88	90	86.33
3	86.0	80.67	94.33	87.00
5	88.33	93.67	96.67	92.89
10	90.33	96	91.67	92.67
15	90.67	91.67	90	90.78
Mean	87.33	89.61	91.72	89.55



LSD p≤ 0.05 M : 1.454 , C : 2.056 , M * C : 3.56

Where M: type of radiation , C: exposure time , M*C : interaction

Fig. (1): Effect of different exposure times of He-Ne (543.5 nm & 632.8 nm) Lasers and UV light (245 nm) on germination percentage of *Carum carvi* dry fruits.

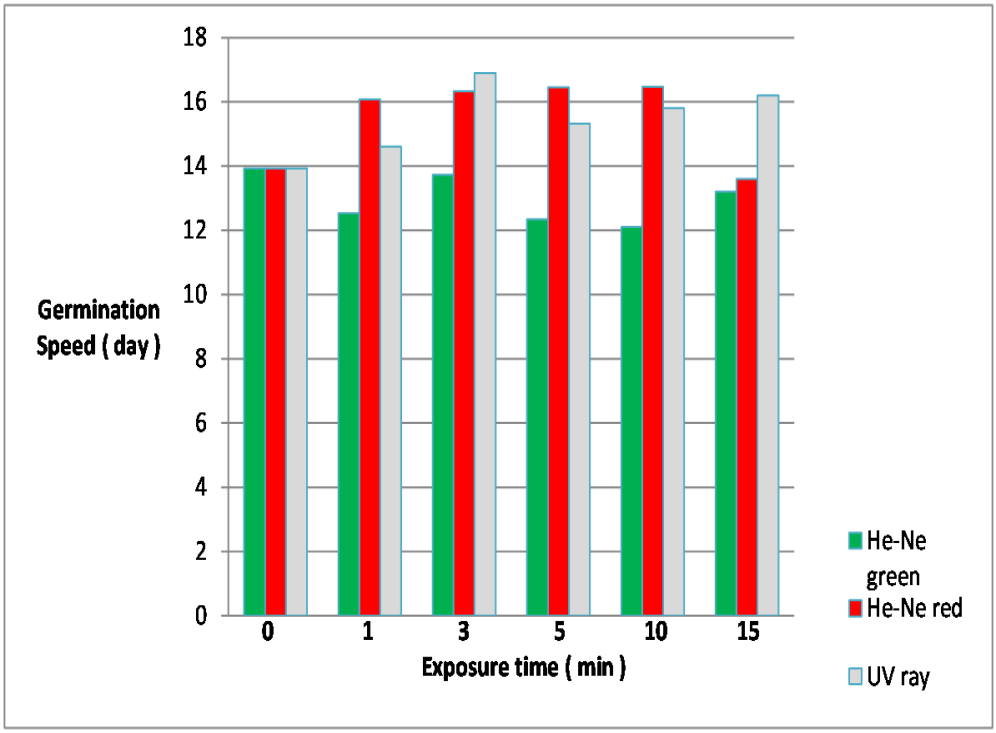
The results recorded that the increase in germination percentage for the irradiated fruits with the helium-neon (He-Ne) green laser at wavelength 543.5 nm, doses of (10 and 15 min), the helium-neon (He-Ne) red laser at wavelength 632.8 nm, doses of (1 , 3 , 5 , 10 and 15 min.), the ultraviolet (UV) light at wavelength 245 nm, dose of (5 , 10 and 15 min.) than the control (unirradiated fruits). While the results recorded the decrease in germination percentage for the irradiated fruits with the helium-neon (He-Ne) green laser at wavelength 543.5 nm, doses of (1 and 3 min.), the ultraviolet (UV) light at wavelength 245 nm, dose of 3 min. than the control (unirradiated fruits). Also the results agreement with **Kamuja *et al.* (1999)** who studies on the roles of phytochrome in light – stimulated seed germination. Results

were agreement with **Suchorska (1989)** who irradiated of dry or soaked seeds by laser neo-helium at 632 nm for 5 min. They found that the irradiated seeds, especially the soaked batches, of both specie gave about 75% germination whereas the controls gave only 25% .
They due these results to that irradiation stimulated the seed redox activity which was correlated with the germination capacity.

4.Germination speed Data presented in Table (7) and Fig. (2) indicated the germination speed of caraway fruits which exposed to types of the helium-neon (He-Ne) lasers (green & red) and ultraviolet (UV) light. In this exprement founded that the type of radiation with the different wavelengths which using for sterilization pointed on Caraway fruits, exposure time (speceific time) and their interaction was high significant. According to statistical analysis (One way Anova analysis), comprasion between the sterilization with the ultra violet at wave length 245 nm recorded (15.462), helium-neon (red light) at wavelength 632.8 nm recorded (15.477) high significant effect by increased in germination speed than the sterilization with helium-neon (He-Ne) green light at wavelength 632.8 nm which recorded (12.977).

Table (7) : Speed of germination before and after sterilization process by different radiation wavelengths.

Exposure time (min)	He-Ne(543.5 nm laser)	Ultra Violet 245 nm	He-Ne (632.8 nm laser)	Mean
0	13.933	13.933	13.933	13.933
1	12.530	14.607	16.083	14.407
3	13.729	16.897	16.327	15.651
5	12.347	15.330	16.453	14.710
10	12.110	15.803	16.467	14.793
15	13.210	16.597	13.597	14.336
Mean	12.977	15.562	15.477	
LSD p≤ 0.05 M : 0.699 , C : 0.990 , M * C : 1.714 Where M: type of radiation , C: exposure time , M*C : interaction				



(Fig. 2) Effect of sterilization with different types of radiation at different doses times on the speed of germination of *Carum carvi* fruits.

In this work these results recorded that the increasing in the germination speed for the sterilization Caraway fruits with the helium-neon (He-Ne) red laser at the wavelength 632.8 nm, doses of (1 , 3 , 5 and 10 min.), the ultra violet radiation (UV) at the wave length 245 nm at doses of (3 , 5 , 10 and 15 min.) than the control (unsterilization fruits). While these results recorded that decreased in the germination speed for the sterilization Caraway fruits with the He-Ne green laser at 543.5 nm, doses of (1 , 5 , 10 and 15 min.) than the control (unstereilization fruits).

5.Moisture percentage: Data presented in Table (8) and Fig. (3) and indicated the percentage of moisture of caraway fruits which were exposed to two types of He-Ne laser (green & red) and UV light and gave different percentages of fruits moisture. In this experiment founded that the type of radiation with the different wavelengths which using for

sterilization pointed, exposure time (specific time) and their interaction was high significant. According to Statistical analysis (One way Anova analysis), the comparison between the sterilization with the ultra violet (UV) at wavelength 245 nm and the helium-neon (He-Ne) red laser at wave length 632.8 nm have significant effect by increasing in moisture content recorded (5.348 %) and (5.311 %) than the helium-neon (He-Ne) green laser at wavelength 543.5 nm recorded moisture content (5.175 %).

Table (8): The percentage of moisture content (d.b) before and after sterilization process by different radiation wavelengths

Exposure time (min)	He-Ne(543.5 nm laser)	Ultraviolet 245 nm	He-Ne (632.8 nm laser)	Mean
0	5.327	5.327	5.327	5.327
1	5.067	5.467	4.733	5.089
3	5.387	5.453	5.327	5.389
5	5.533	4.600	4.927	5.020
10	4.597	5.180	6.187	5.321
15	5.140	6.060	5.367	5.522
Mean	5.175	5.348	5.311	
LSD p≤ 0.05 M : 0. 1358 , C : 0.1923 , M * C : 0.334 Where M: type of radiation , C: exposure time , M*C : interaction				

In this work these results recorded that increased in the moisture content for the sterilization Caraway fruits with the helium-neon (He-Ne) red laser at the wavelength 632.8 nm, doses of (5 and 10 min.), the ultraviolet(UV) radiation at the wavelength 245 nm, doses of (1 , 3 and 15 min.) than the control (unsterilization fruits). But the increased in the moisture content for the sterilization Caraway fruits with the helium-neon (He-Ne) green laser at the wavelength 543.5 nm, the exposure

time of 3 min., the ultraviolet (UV) light at the wavelength 245 nm, exposure time of 3 min. and the helium-neon (He-Ne) red laser at the wavelength 632.8 nm, the exposure time of 15 min. was insignificant increased compared with the control (unstereilzation fruits).

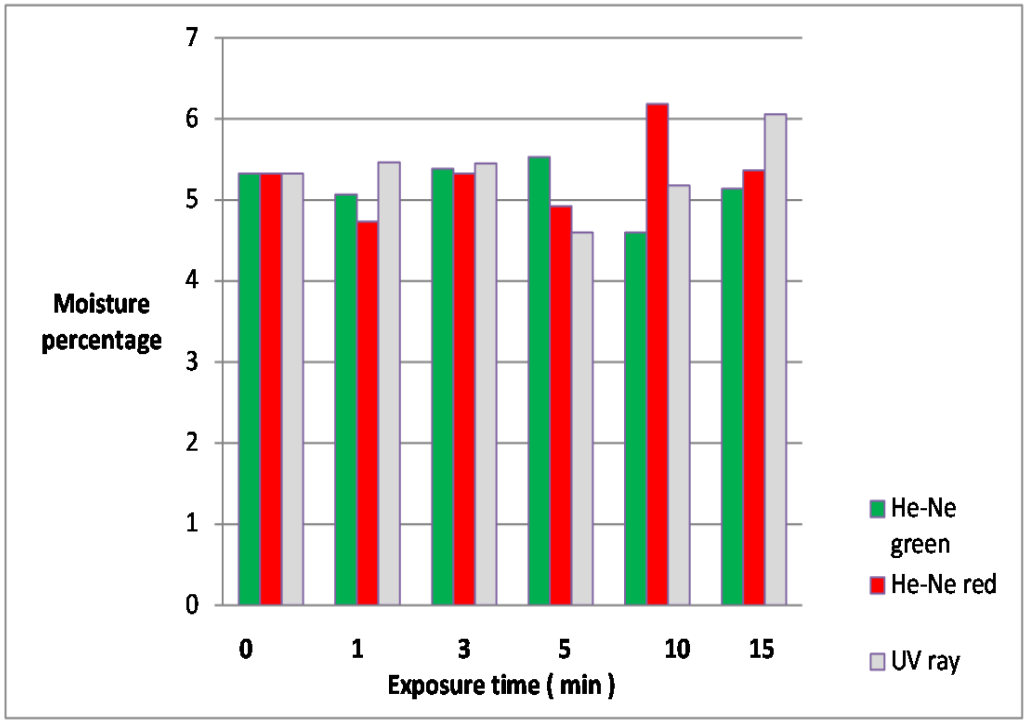


Fig. (3) Effect of different exposure times of He-Ne (green &red) laser and UV light on the percentage of moisture of Caraway fruits.

This result was in agreement with those recorded by **Romano *et.al.* (2010)** who found that the influence of drying banana on laser backscatter, the relationship between moisture content and relative laser area of banana slices was analyzed. A laser diode emmitig at 670 nm with 3 mW was used as light source. The backscattering relative laser area was used as an indicator for the light absorption into the tissue. The high result achieved on coefficient of determination R2 (>0.93) confirmed linear relationship between relative laser area and moisture content.

6. Essential oil percentage: Data represented in Table (9) and Fig. (4) indicated the essential oil percentage of Caraway dry fruits. These fruits which were irradiated with two types of helium-neon (He-Ne) laser (green & red light) and the ultraviolet (UV) light and had different percentages of essential oil. According to Satistical analysis (One way Anova analysis), the comprasion between the sterilization with the ultra violet at wavelength 245 nm have high significant effect by high increasing in essential oil content (2.046 %) than the helium-neon (He-Ne) red laser at wave length 632.8 nm (1.957 %) and the helium-neon (He-Ne) green laser at wavelength 543.5 nm (1.889 %). While the helium-neon (He-Ne) red laser at wave length 632.8 nm have the significant effect by increasing in essential oil content (1.957 %) than the helium-neon (He-Ne) green laser at wave length 543.5 nm (1.889 %).

(Table 9) Effect of sterilization with types of radiation at different doses times on the percentage of essential oil of *Carum carvi* fruits

Exposure time (min)	He-Ne (543.5 nm) laser	Ultra Violet (245 nm)	He-Ne (632.8 nm) laser	Mean
0	1.867	1.867	1.867	1.867
1	1.833	2.080	1.900	1.938
3	2.020	2.147	2.213	2.127
5	2.053	2.067	1.893	2.040
10	1.707	1.913	1.813	1.811
15	1.853	2.200	2.053	2.036
Mean	1.889	2.046	1.969	1.968
LSD $p \leq 0.05$ M : 0.0651 , C : 0.0933 , M * C : 0.1612 Where M: type of radiation , C: exposure time , M*C : interaction				

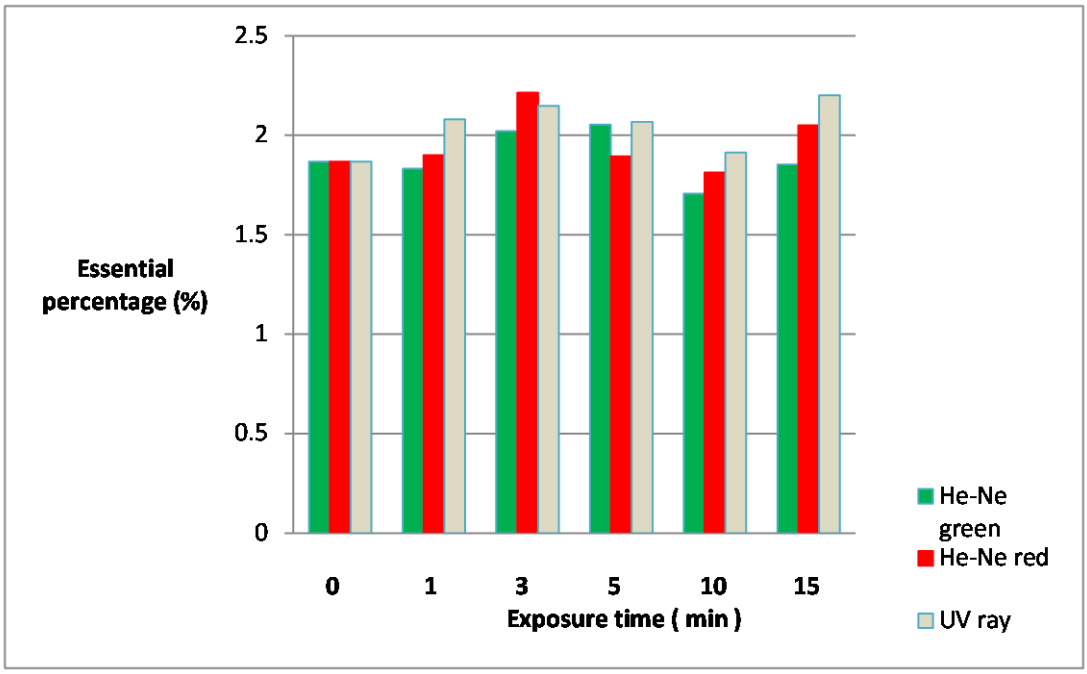


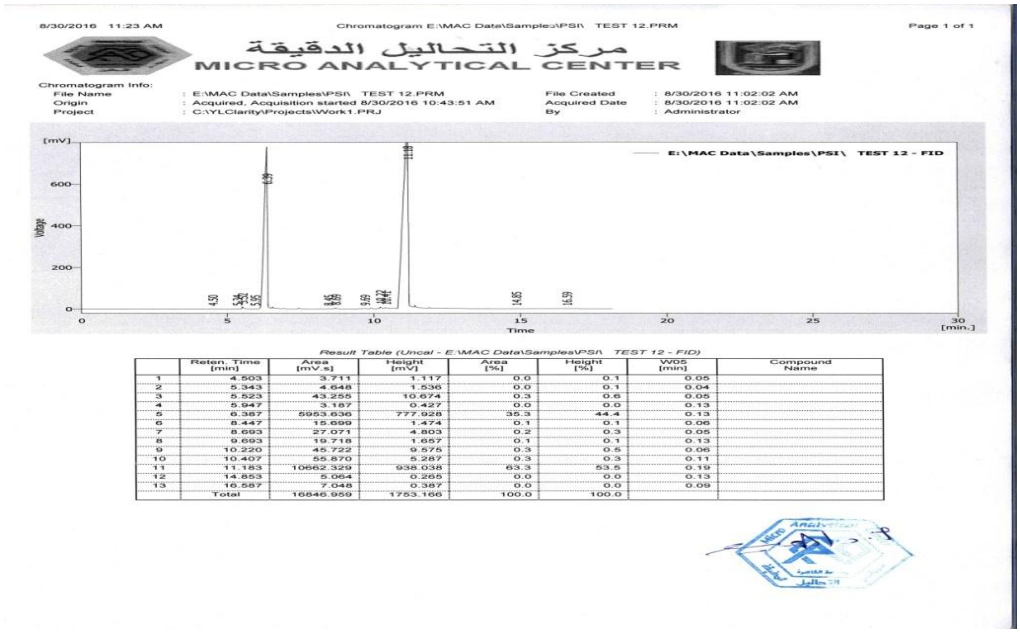
Fig. (4) : The percentage of essential oil before and after sterilization process by radiation wavelengths

In this work these results increased in the essential oil content for the irradiated Caraway fruits with ultraviolet (UV) light at wavelength 245 nm, exposure times of (1 , 3 , 5 and 15 min.), the helium-neon (He-Ne) red laser at wavelength 632.8 nm exposure times of (3 , 5 and 15 min.), the helium-neon (He-Ne) green laser at wavelength 543.5 nm, exposure times of (3 and 5 min.) than the control (unirradiated). While these results decreased in the essential oil content for the irradiated Caraway fruits with the helium-neon (He-Ne) green laser at wavelength 543.5 nm and exposure time of 10 min. than the control (unirradiated). **El – Kereti *et. al.* (2013)** who found that the combined foliar spray application Zno nanofertilizer with presowing He – Ne laser irradiation were more effectiveness than Zno nanofertilizer with pre – sowing He – Ne laser irradiation showed more effectiveness than Zno nanofertilizer alone and 20 mg/l concentration gave the highest results of all measured traits.

7. Essential oil constituents : Results presented in Table 10 and Figs. (5, 6, 7, 8, 9) indicated the essential oil constituents of Caraway fruits (as fractionated by GLC) as affected by the sterilization treatments (two types of helium-neon (He-Ne) lasers and the ultraviolet (UV) light).

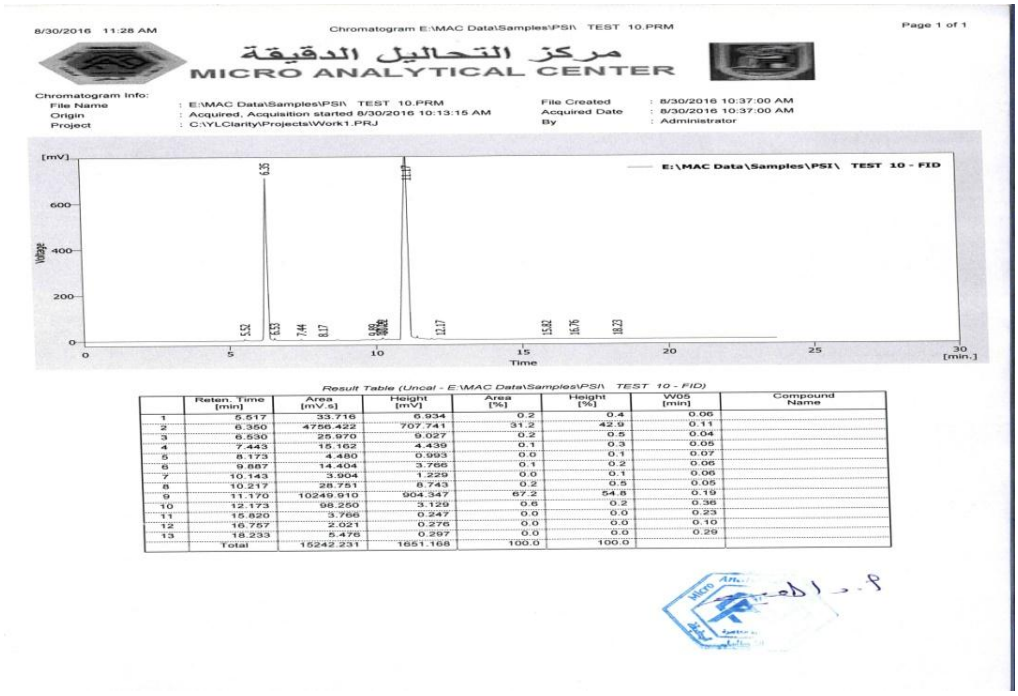
Table (10) : Percentage of essential oil constituents before and after sterilization process by different radiation wavelengths

	Essential oil constituents	
Sterilization treatments	Limonene %	Carvon %
He-Ne (543.5 nm) 1 min.	32.0	66.4
UV (245 nm) 3 min.	26.9	71.8
UV (245 nm) 15 min.	31.2	67.2
He-Ne (632.8 nm) 1 min.	35.3	63.3
Control(uniradiated) 0 min	31.7	67



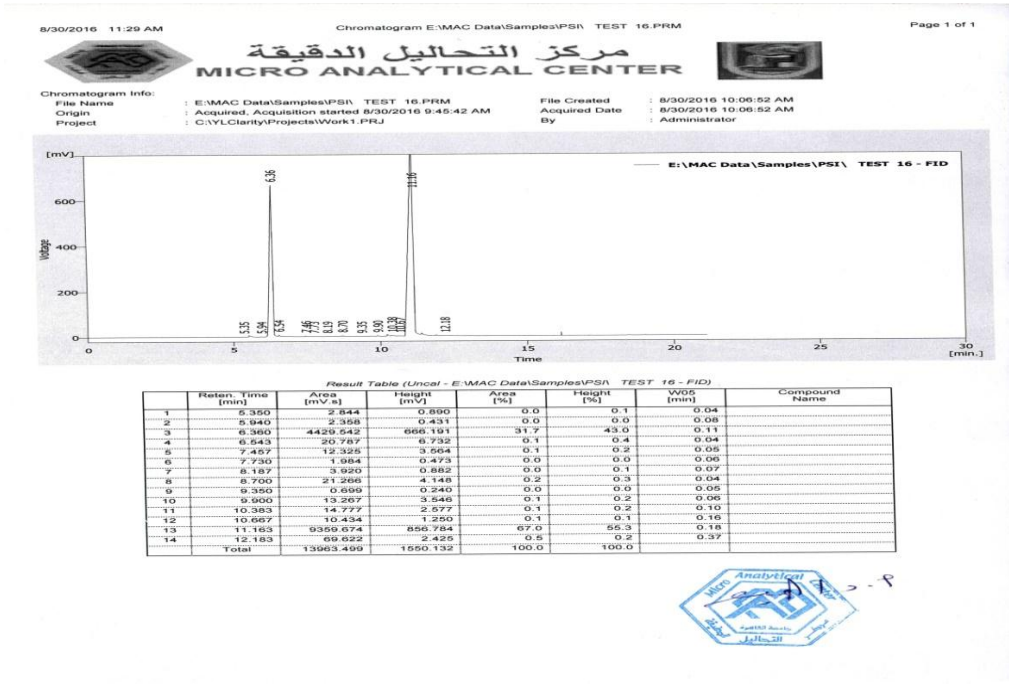
	Reten. Time [min]	Area [mV.s]	Height [mV]	Area [%]	Height [%]	W05 [min]	Compound Name
1	4.503	3.711	1.117	0.0	0.1	0.05	
2	5.343	4.648	1.536	0.0	0.1	0.04	
3	5.523	43.255	10.674	0.3	0.6	0.05	
4	5.947	3.187	0.427	0.0	0.0	0.13	
5	6.387	5953.636	777.928	35.3	44.4	0.13	
6	8.447	15.899	1.474	0.1	0.1	0.06	
7	8.693	27.071	4.803	0.2	0.3	0.05	
8	9.693	19.718	1.657	0.1	0.1	0.13	
9	10.220	45.722	9.575	0.3	0.5	0.06	
10	10.407	55.870	5.287	0.3	0.3	0.11	
11	11.183	10662.329	938.038	63.3	53.5	0.19	
12	14.853	5.064	0.265	0.0	0.0	0.13	
13	16.587	7.048	0.387	0.0	0.0	0.09	
	Total	16846.959	1753.166	100.0	100.0		

Fig.(5) Effect of sterilization by He-Ne (632.8 nm) laser at 3 min. on essential oil constituents



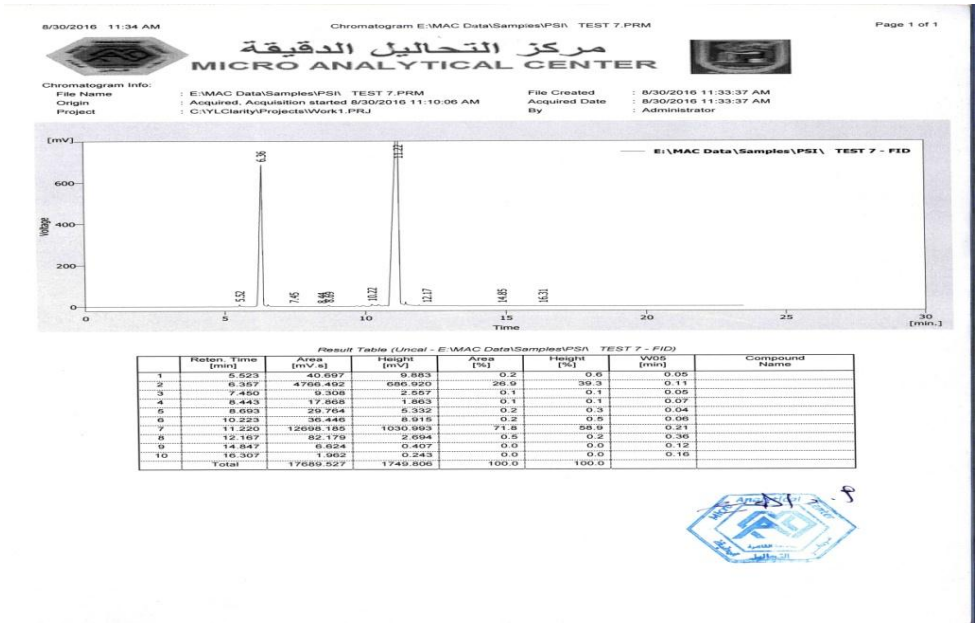
	Reten. Time [min]	Area [mV.s]	Height [mV]	Area [%]	Height [%]	W05 [min]	Compound Name
1	5.517	33.716	6.934	0.2	0.4	0.06	
2	6.350	4756.422	707.741	31.2	42.9	0.11	
3	6.530	25.970	9.027	0.2	0.5	0.04	
4	7.443	15.162	4.439	0.1	0.3	0.05	
5	8.173	4.480	0.993	0.0	0.1	0.07	
6	9.887	14.404	3.766	0.1	0.2	0.06	
7	10.143	3.904	1.229	0.0	0.1	0.08	
8	10.217	28.761	8.743	0.2	0.5	0.05	
9	11.170	10249.910	904.347	67.2	54.8	0.19	
10	12.173	98.250	3.129	0.6	0.2	0.36	
11	15.820	3.766	0.247	0.0	0.0	0.23	
12	16.757	2.021	0.276	0.0	0.0	0.10	
13	18.233	5.476	0.297	0.0	0.0	0.29	
	Total	15242.231	1651.168	100.0	100.0		

Fig. (6) Effect of sterilization by ultraviolet light (245 nm) at 15 min. on essential oil constituents



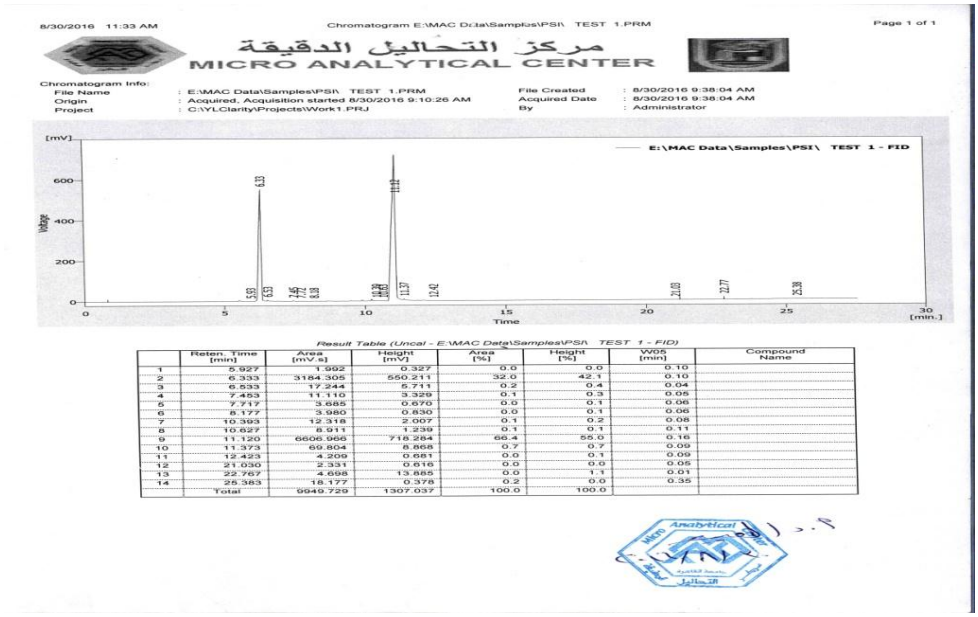
	Reten. Time [min]	Area [mV.s]	Height [mV]	Area [%]	Height [%]	W05 [min]	Compound Name
1	5.350	2.844	0.890	0.0	0.1	0.04	
2	5.940	2.358	0.431	0.0	0.0	0.08	
3	6.360	4429.542	666.191	31.7	43.0	0.11	
4	6.543	20.787	6.732	0.1	0.4	0.04	
5	7.457	12.325	3.564	0.1	0.2	0.05	
6	7.730	1.984	0.473	0.0	0.0	0.06	
7	8.187	3.920	0.882	0.0	0.1	0.07	
8	8.700	21.266	4.148	0.2	0.3	0.04	
9	9.350	0.699	0.240	0.0	0.0	0.05	
10	9.900	13.267	3.546	0.1	0.2	0.06	
11	10.383	14.777	2.577	0.1	0.2	0.10	
12	10.667	10.434	1.250	0.1	0.1	0.16	
13	11.183	9359.674	856.784	67.0	55.3	0.18	
14	12.183	69.622	2.425	0.5	0.2	0.37	
	Total	13963.499	1550.132	100.0	100.0		

Fig.(7) Essential oil constituents of Unsterilized Caraway fruits (control)



	Reten. Time [min]	Area [mV.s]	Height [mV]	Area [%]	Height [%]	W05 [min]	Compound Name
1	5.523	40.697	8.883	0.2	0.6	0.05	
2	6.357	4766.492	686.920	26.9	39.3	0.11	
3	7.450	9.308	2.557	0.1	0.1	0.05	
4	8.443	17.868	1.563	0.1	0.1	0.07	
5	8.693	29.764	5.332	0.2	0.3	0.04	
6	10.223	36.446	8.915	0.2	0.5	0.06	
7	11.220	12698.185	1030.993	71.8	58.9	0.21	
8	12.167	82.179	2.694	0.5	0.2	0.36	
9	14.847	6.624	0.407	0.0	0.0	0.12	
10	16.307	1.962	0.243	0.0	0.0	0.16	
	Total	17689.527	1749.806	100.0	100.0		

Fig.(8) Effect of sterilization by ultraviolet (245 nm) at dose of 3 min. on essential oil constituents



	Reten. Time [min]	Area [mV.s]	Height [mV]	Area [%]	Height [%]	W05 [min]	Compound Name
1	5.927	1.992	0.327	0.0	0.0	0.10	
2	6.333	3184.305	550.211	32.0	42.1	0.10	
3	6.533	17.244	5.711	0.2	0.4	0.04	
4	7.453	11.110	3.329	0.1	0.3	0.05	
5	7.717	3.685	0.670	0.0	0.1	0.06	
6	8.177	3.980	0.830	0.0	0.1	0.06	
7	10.393	12.318	2.007	0.1	0.2	0.08	
8	10.827	8.911	1.239	0.1	0.1	0.11	
9	11.120	6606.966	718.284	66.4	55.0	0.16	
10	11.373	69.804	8.868	0.7	0.7	0.09	
11	12.423	4.209	0.681	0.0	0.1	0.09	
12	21.030	2.331	0.616	0.0	0.0	0.05	
13	22.767	4.698	13.885	0.0	1.1	0.01	
14	25.383	18.177	0.378	0.2	0.0	0.35	
	Total	9949.729	1307.037	100.0	100.0		

Fig. (9) Effect of sterilization by He-Ne (543.5 nm) laser at dose of 1 min.

For fruits sterilization recorded that the values highest was ultraviolet (UV) at wavelength 245 nm with dose of 3 min. which recorded (71.8 %) carvon and at 15 min. which recorded (67.2%) carvon than the control (unsterilized) which recorded (67 %).

CONCLUSION

The sterilization by helium-neon laser at wavelength 632.8 nm recorded higher values in elimination completely for spore former bacteria and fungi, also increased in essential oil %, germination %, moisture % with exposure times of 3, 5, 10, 3, 5 and 10 min. For the sterilization by ultraviolet radiation at wavelength 245 nm recorded higher values in elimination completely for fungi, also increased in germinated speed (day), with exposure times of 10 , and 3 min. As for helium-neon laser at 534.5 nm recorded higher values in elimination completely for all microorganisms, spore former bacteria and fungi with exposure times of 10 , 3, 5, 10 and 15 min. The sterilization of fruits by ultraviolet and helium-neon lasers was eco-friendly, modern method and safe utilized as new technology to removed or inhibit for microorganisms.

REFERENCES

Abou Donia, M.A. (2008). Microbiological quality and flatoxinogenesis m of Egyptian spices and medicinal plants. Global Veterinaria 2(4): 175-181.

AOAC (1990). Association of Official Analytical Chemists 15 edn Washington D.C., U.S.A, pp. 951-960.

AOAC (2000). Official Methods of Analysis of the Association of Official Analysis Chemists Revision 1, International 17 Ed. Washington D.C., U.S.A., pp. 1012-1021.

Blanck, F. (1955). Handbook of Food and Agriculture; p 335 -336.

British Pharmacopeia (1963). Determination of Volatile Oils in Drugs the Pharmaceutical Press, 17 Bloomsbury Square, London, and WCI.

Edmond, B., T.; Senn, L.; Andrews, F. S. and R. G. Halfacre (1977). Fundamentals of Horticulture. Tata-McGeaw-Hill Publishhing company LTD, New Delhi, India.

El-Raie, A.E. (1987). Some physical characterstics of Egyptian wheat concerning the design and selections of separating devices. Res. Bull. No.(358).

EL-Adly, A.E.; Emad, Abada, A. Fatma a. gharib (2007). Antibacterial Effects of low power laser light and volatile oil of Fennel (*Foeniculum Vulgare var. dulce*) on Gram-positive and Gram-negative bacteria. Laser Microbiology Laboratory, National Institute Enhanced Science, Cairo University , Cairo, Egypt, Botany and Microbiology Department, Faculty of Science, Helwan University, Ain Helwan, Cairo, Egypt. Int. J. Agriculture Biology; 9(1) : 22 -26.

El – Kereti M.A.; Elfery, S.A., Khater, M.S., Osman and Y.A. El – Sherbini el – S.A. (2013), Zno nanofertilizer and He – Ne laser irradiation for promoting growth and yield of sweet basil plant. Recent Pat Food partment of Laser Applications in Metrology, Photochemistry and Agriculture. National Institute of Laser Enhanced Science (NLLES) Cairo University, Egypt.

Ouf, S.A and Abdel-Hady, N.F. (1999). Influence of He-Ne laser irradiation of Soybean seeds on seed mycoflora, growth, nodulation, and resistance to *Fusarium Solani*. Folia Microbiol (Praha); 44 (4): 388-96.

Hidaka, Y and Kubota, K. (2006). Study on the sterilization of grain surface using UV radiation-Development and evaluation of UV irradiation & equipment. Japan Agricultural Research Quarterly;40(2) :157-161.

Hoftman, E. (1967): Chromatography. Reinhold publ. crop., 2nd ed., 208-515.

ISTA (1999). International Rules for Seed Testing. Seed Science and Technology, 27:1-333 pp.

Kamiya, Y., Jose, L. and Martunez, G. (1999). Regulation of gibberelin biosynthesis by light. Current opinion in plant biology, 2 : 398-403 ref.

Romano, G.; Argyropoulos, D.; Gottschalk, K.; Cerruto, E. and Muller J (2010). Influence of colour changes and moisture content during banana drying on laser backscattering. International Journal of Agricultural and Biological Engineering; 3/2 : pp. 46 – 51.

Snedecor, G.W. and Cochran, W.G. (1980). Statistical methods. 7 ed. Iowa Stat. Univ. Press Ames. Iowa, U.S.A. 124p.

Suchorska, K. (1989). Laser radiation of factor stimulating Datura innoxia Mill. and Atropa belladonna L. seed germination. Annals – of – warsaw – Agricultural – University – SGGWAR, Horticulture. No. 15, 9 – 12; ref.

الملخص العربى

تأثير التعقيم على جودة ثمار الكراوية باستخدام الليزر و الموجات الاشعاعية الآمنة

أحمد الراعى امام سليمان * ، حلمى السيد حسن محمد ** ، محاسن عبد الغنى صدقى * و مروة توفيق ابراهيم عبد الكريم *****

تعتبر النباتات الطبية و العطرية من أهم النباتات التى تزرع فى مصر و العالم لما لها من أهمية اقتصادية تتمثل فى استخدامها فى صناعة الدواء و اتجاه العالم لاستخدامها بصورتها الطبيعية و تجنب الادوية الكيماوية التى تؤثر على البيئة و الانسان، لذلك يوصى بالمحافظة عليها فى أعلى جودة حتى تطابق المواصفات القياسية

تمت دراسة تأثير تعقيم ثمار الكراوية بأنواع مختلفة من الأشعة [الهليوم-نيون ليزر الأخضر ذو الطول الموجى ٥٤٣,٥ نانوميتر - الهليوم –نيون ليزر الأحمر ذو الطول الموجى ٦٣٢,٨ نانوميتر - الأشعة فوق البنسفجية ذو الطول الموجى ٢٤٥ نانوميتر] ، و عند أوقات تعرض مختلفة (١ دقيقة – ٣ دقيقة – ٥ دقيقة – ١٠ دقيقة -١٥ دقيقة)] ، و تتضمن الدراسة نوع الاشعة و وقت التعرض و التفاعل بينهما.

و من أهم المشاكل التى تواجه النباتات الطبية هى انخفاض الجودة و ارتفاع الحمل الميكروبى

* **الهندسة الزراعية – كلية الزراعة – جامعة القاهرة**
** **تطبيقات الليزر فى الهندسة الزراعية – المعهد القومى لعلوم الليزر – جامعة القاهرة**
*** **النباتات الطبية و العطرية – معهد بحوث البساتين – مركز البحوث الزراعية**

و تم اجراء التحليلات التالية على ثمار الكراوية المعقمة بالاشعة و الغير معقمة: قياس الخصائص الفيزيائية للثمار (الطول- العرض- السمك - الحجم- الكروية– القطر الهندسى – القطر الحسابى – المساحة السطحية – المساحة الأمامية ، معامل الارتباط بين الطول/العرض – الطول/السمك –العرض/السمك- المساحة السطحية/ المساحة الأمامية – المساحة السطحية/الكروية- المساحة الامامية/ الكروية- القطر الهندسى/القطر الحسابى- القطر الهندسى/الكروية- القطر الحسابى/الكروية)، التحليل الميكروبى (العد الكلى للميكروب – الفطريات – البكتريا) ، نسبة الانبات للثمار (نسبة الانبات (%)- سرعة الانبات (يوم)) ، نسبة الرطوبة % ، نسبة الزيت الطيار و مكوناته الأساسية (الليمونين – الكارفون) % ، أوضحت النتائج أن الثمار المعقمة باستخدام ليزر الهيليوم-نيون ذو الطول الموجى ٥, ٥٤٣ نانوميتر و جرعات تعرض ١٠ دقيقة سجلت ازالة كاملة للميكروبات (العد الكلى للميكروبات الدقيقة – الفطريات – البكتريا) و أشارت النتائج أن أعلى نسبة للزيت الطيار فى الثمار المعقمة باستخدام ليزر الهيليوم-نيون ذو الطول الموجى ٨, ٦٣٢نانوميتر و جرعات تعرض ٣ دقائق سجلت (٢١٣ , ٢ %) و الثمار المعقمة بالاشعة فوق البنفسجية ذات الطول الموجى ٢٤٥ نانوميتر و جرعة تعرض ١٥ دقائق سجلت (٢٠٠, ٢ %) مقارنة بالثمار الغير معقمة (الكنترول)