# The essential oil and its main constituents of *Origanum syriacum* ssp. *sinaicum* grown wild in Saint Katherine Protectorate, South Sinai, Egypt

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**ABSTRACT**

This work aims to study the essential oil and its main constituents of *O. syriacum* grown wild in 22 locations in Saint Katherine Protectorate. *Origanum syriacum* ssp. *sinaicum* plants collected during the summer season of 2014 from 22 locations in Saint Katherine Protectorate (SPK), South Sinai Egypt. Depending on location length, each location was divided into 2 stands to reach a total of 44 stands. Twenty compounds were identified as the main constituents of the essential oil which accounted for *ca* 97% from the total compounds of the essential oil. Carvacrol was the major constituent in all collected plants and ranged from 74.2% to 92.68% from the total compounds of the essential oil. Where, P-cymene was identified in the essential oil of all studied stands and ranged for 0.98% to 6.23%. The same was observed for $\gamma$-terpinene that was identified in the essential oil of all plants in the 44 stands and accounted for 1.37% as minimum percent up to 7.4% as maximum percent from the total compounds. The oxygenated compounds in the essential oil of *O. syriacum* were identified as carvacrol, terpienol-4, linalool, borneol, thymol, eugenol, and long pinenee poxid with relative percentage from 76.6%to 94.2%. The non-oxygenated compounds hydrocarbons ranged from 3.7% to18.4% in which *P*–cymene and ɣ-terpinene were the main non-oxygenated compounds. The relations between the essential oil%, as well as between carvacrol% in the essential oil in the different stands and calcium content, Cl and Na in the soil of the different stands were studied. In conclusion, the essential oil % of *O. syriacum* ssp. *sinaicum* and its main constituents changed according to the altitude and soil contents.

**Keywords:** *Origanum syriacum;* essential oil; carvacrol; GC-MS; Saint Katherine.

## INTRODUCTION

Medicinal plants and culinary herbs have long been known as one of the basis of traditional medicine in many countries such as Egypt. Some important medicinal wild plants suffered from unwise human manipulation which resulted in the extinction of some species. Projects to recover the genetic diversity of wild plants were carried out in Egypt accompanied with scientific research to evaluate their use based on traditional medicine in Bedouin communities. Indeed, there are a great number of rural jobs dependent on this sector (Viuda-Martos *et al*., 2010, 2011). *Origanum syriacum*. ssp. *sinaicum* (Boiss.) family Labiatae is a rare perennial wild herb endemic to Sinai. *O. syriacum* is represented by the following three varieties: ssp. *syriacum*, distribution Palestinian, Jordon, Syria; ssp. *bevanii*, Turkey, Syria, Lebanon, Cyprus; ssp. *sinaicum is* cultivated in Northern Sinai in Egypt and Palestinian. The plant was described by Ietswaat in his treatise on the taxonomy of the genus *Origanum* (Başer *et al*., 2003). The herbal parts of *Origanum* species were used by local people for herbal tea and as a spice in soups, salads, olives and meats. The remaining water after the plant water distillation is used orally to reduce cholesterol and glucose levels as well as to treat cancer (Kizil *et al*., 2008). It is also used as stimulant, analgesic, antitussive, expectorant, sedative, anti-parasitic and anti-helminthic (Dundar *et al*., 2008). Tepe *et al*., (2004) found that the plant's essential oil of *O. syriacum* could be used as a natural preservative in the food industry. Kamel *et al*., (2001), reported that *Origanum* plants have many different uses such as powerful disinfectants, flavoring agents, in perfumes and in scenting soaps. Some studies suggested that *Origanum* may have antioxidant effects which may be due to the oil components of some of the active substances, such as phenols carvacrol and thymol (Baricevic and Bartol, 2002). On the other hand, Sokovic *et al*., (2007), found that *Origanum* plant is a good source of antimicrobial compounds. Kalemba and Kunicka, (2003), indicated that this plant was used in ancient times as a natural food preservative and as a flavoring agent. Owlia *et al*., (2009), found that this plant was successful treatment of infectious diseases. Tackholm (1974) recorded that the *Origanum syriacum* plant was growing wild in the Sinai Desert of Egypt. Carvacrol and/or thymol represent the major constituents of *Origanum* essential oil

(Sarer *et al*. 1982, Skoula and Harborne, 2002, Loizzo *et al*., 2009; Zein *et al*., 2011). The oil quality is determined by its composition, which varies with genotype, plant development, climate, and soil type (Russo et al., 1998; Baydar et al., 2004). Elgindy *et al.* (2015) identified 46 compounds in the essential oil of *Origanum syriacum* plants which collected from Sinai, Egypt. They reported that Carvacrol was dominated in cultivated plants, while thymol, γ-terpinene, linalool and 4-terpineol were dominated in the wild plants. Shalaby *et al*., (2011), reported the high potentials of O. *syriacum* var. *sinaicum* plant as new crop in Egypt. Therefore, this work aims to study the essential oil and its main constituents of *O. syriacum* grown wild in 22 locations in Saint Katherine Protectorate, South Sinai, Egypt.

## MATERIALS AND METHODS

### Plant Materials:

*Origanum syriacum* plants were collected from 22 locations in Saint Katherine Protectorate (SKP), South Sinai, Egypt which includes Frosh, Wadis and Gorge systems during summer season (June) of 2014. Depending on location length, each location was divided into stands in total 44 stands. The geographical (latitudes, longitudes and alludes) data of the different studied stands are shown in Table (1). The plant samples were collected from the aerial parts of growing plants in the same time from all the stands of the study. The plant samples were separately air dried in the shades till the weight was constant and then kept in paper bags and kept in desiccators till essential oil extraction.

### Extraction of essential oil (EO):

The essential oil (EO) was extracted from the air-dried areal parts of *O. syriacum* by hydro-distillation using a Clevenger type apparatus for 3h according to Guenther (1961). The oily layer obtained on top of the aqueous distillate was separated and dried with anhydrous sodium sulfate. The extracted EOs were kept in sealed air-tight glass vials and covered with aluminum foil at 4◦ C until GC-MS analysis.

### Gas Chromatography–Mass Spectrometry (GC-MS):

The GC-MS analysis of the essential oil was carried out using Gas Chromatography-Mass Spectrometry instrument stands at the Department of Medicinal and Aromatic Plants Research, National Research Center, Egypt. Most of the compounds were identified using mass spectra of authentic chemicals (Wiley spectral library collection and NSIT library 2000). Further identifications were carried out using the MS literature data (Adams, 2004).

### Soil physical analysis:

The physical properties of the soil samples that collected from all stands were analyzed to determine water, sand, silt and clay contents according to Piper (1950). From these results the soil texture of each stand was determined as shown in Table (2).

### Soil chemical analysis:

Some chemical parameters i.e. pH, EC, organic matter, CaCO3, some cations (Ca, Mg, Na and K) and some anions ($HCO_3$, Cl and $SO_4$) were determined in the beasts of the soil samples according to Jackson (1967) and Allen *et al*. (1976). Oxidizable organic carbon (as indication of the total organic matter) was determined using Walkely and Black rapid titration method as described by Black (1965). The results of these parameters are shown in Table (3).

### Statistical Analyses:

Data were statistically analyzed using One-way ANOVA and Post hoc-LSD tests (the least significant difference) (SPSS Inc., 2009) at 0.05, 0.01 and 0.001 level of probability (Snedecor andCochran, 1982).

## RESULTS AND DISCUSSION

Data in Table (4) represents the essential oil percentage of the aerial parts of *Origanum syriacum* ssp. *sinaicum* plants collected from the different stands which ranged from 2.25% in stand No.31 to 6.75% in stand No.1. It is clear that the minimum essential oil % was observed in the lowest altitude (1429), while the maximum % (6.75% and 6.5%) were determined in plants of the highest altitudes (2002 and 2016, respectively). Figs. (1a), (2a) and (3a) indicate the relation between essential oil % of *Origanum syriacum ssp. sinaicum plants* in the different stands and calcium, Cl and Na contents in the soil of the different stands. It is clear that the essential oil decreased with increasing calcium, Cl and Na contents. The opposite trend was observed with $CaCO_3$, in which the essential oil % increased with increasing $CaCo_3$content of the soil (Fig., 4b). The relation between essential oil percent of *O. syriacum* plant sand electrical conductivity (EC) in the different stands is presented in Fig. (5a). The results indicated that essential oil %decreased with increasing level of EC. The main oil compounds are shown in Table (5). Twenty compounds were identified as the main constituents of the essential oil and accounted for *ca* 97% from the total compounds of the oil. Carvacrol was found to be the major compound in all collected plants from different stands and ranged from 74.2% (stand 38) to 92.68% (stand10) from the total compounds of the essential oil. *P*-cymene was identified in the essential oil of all studied stands and followed like carvacrol in the relative percentages, since it ranged for 0.98% (stand 10) to 6.23% (stand 38). The same was observed for γ-terpinene which was identified in the essential oil of all plants in 44 stands and accounted for 1.37% (stand 6) as minimum percent to7.4% (stand 38) as maximum percent from the total compounds. The Oxygenated compounds in the essential oil of *O. syriacum* ssp. *sinaicum were* identified as Carvacrol, Terpienol -4, α-Terpineol,Linalool, Borneol, Thymol, Euginol and Long pineneepoxidl. They accounted from 76.6 % (stand 38) to 94.2% (stand 10), while the non-oxygenated compounds ranged from 3.7% (stand 10) to18.4% (stand 38). Thymol percentage failed to reach 1% in the essential oil of all *O. syriacum* ssp. *sinaicum in* all stands, which ranged from 0.0 % (stands 2, 18, 19, 33, 37) to 0.19% (stand 11). The maximum values of carvacrol (92.68., 91.74, and 91.41) were found in plants at the stands of Shak Musa 1, Wadi al-shak1 and Farsh Al-romana, respectively as shown in Table (5). While, the lowest percentage of carvacrol values (74.21, 79.68 and 79.86.) were found in stands at Wadi elarbain1, Taupq, and Seleebat, respectively.

Carvacrol % in the essential oil increased with increasing soil calcium content, Cl and Na in the different stands to reach its maximum values with 8-12meq, 60meq/and 175 pp, respectively as shown in Figs. (1b, 2b, 3b). On the other hand, carvacrol percent decreased with increasing $CaCO_3$ in the soil (Fig., 4b). Carvacrol increased with increasing EC values up to 3 then tended to decrease (Fig 5b). The essential oils composition depends on many factors such as climate, geographical location and vegetative stage (Abu Lafi *et al*., 2007, 2008; Baser *et al*., 2003and Lukas *et al*., 2009). Baydar *et al*., (2004), concluded that oil quality is determined by its composition, which varies with genotype, plant development, climate, and soil type. Sangwan *et al*., (2001), reported that, there are many factors influence the essential oil composition such as plant ontogeny, site of oil production, photosynthesis, light quality, seasonal and climatic variations, nutritional relationships, plant growth regulators, plant density, moisture, salinity, temperature and harvesting methods, seasonal and climate conditions such as temperature and rainfall, and thus the seasonal variation of the main essential oil components have great impact. Skoula and Harborne (2002), indicated that the essential oil of *Origanum* is contains of carvacrol and/or thymol as major components, followed by γ-terpinene, p-cymene, linalool, terpinen-4-ol and sabinene hydrate. Russo *et al*., (1998), found another chemo type between thymol and carvacrol which contains a high content of **γ-** terpinene or p-cymene. Shalaby *et al*., (2011), reported that the major constituents in the essential oil of *O. syriacum* var. sinaicum were dominated by thymol, γ-terpinene and p-cymene. Some studies indicate that the main component of *O. syriacum* oil differs according to the growing season (Soliman *et al*., 2007), which found carvacrol was the major component in summer season while thymol was the major component in autumn. On the other hand, Toncer *et al*. (2010) found that, the carvacrol levels varied from 0.73-8.9%, peaked in August (8.9%) and July (8.8%) and was low in January (0.73%). Also, some components such as α-pinene and β-caryophyllene decreased in winter months however terpinen-4-ol showed the opposite trend and increased in winter. Zein *et al*. (2011), also noticed a difference in the components of essential oil according to the different growing season, he reported that the thymol and carvacrol increased progressively from February to April, then, decreased in May. Our previous study shows comparative results, where the poor content of thymol and carvacrol in February and March was accompanied by an increased rate of γ-terpinene and p-cymene, which they are the precursors of thymol and carvacrol. This finding may help researchers and farmers about the optimal harvesting time, allowing yielding oil with high content of thymol and carvacrol. The optimal harvesting time was in April just before flowering. In this study, thymo quinone was detected as a trace amount only in samples harvested in February. This promising anticancer molecule was found in essential oil of *O. syriacum* in previous studies. Thymol, p-cymene, α-terpinene, γ-terpinene, carvacrol were found to be the major components in the oil, since monoterpenes, thymol, *p*-cymene and γ-terpinene, are biosynthetically related (Muller-Riebau *et al*., 1997). But the quantitative composition of the essential oil was changed during the 11-month sampling period. Thymol (25.3%) was the major component in summer and autumn plants, while *p*-cymene was a major component in the winter oils (Toncer *et al*., 2010).

## CONCLUSION

*Origanum syriacum* ssp. *sinaicum* grown wild in Saint Kathrin Protectorate, South Sinai, Egypt is a Carvacrol chemo type since the major component in its essential oil was carvacrol. The essential oil % of *O. syriacum* ssp. *sinaicum* and its main constituents changed according to the altitude and soil contents. No considerable differences were observed for the effect of soil texture neither on essential oil % nor on carvacrol %.

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**Table 1.** The geographical data (latitudes, longitudes and alludes) of different studied stands in SPK, south Sinai Egypt during June of 2014.

| No. of location | Location name | Stands No. | Stands name | E | N | Alt |
|---|---|---|---|---|---|---|
| 1 | Frosh jabal mousa | 1 | Farsh al-lozaa-1 | 33.97037 | 28.54838 | 2002 |
| | | 2 | Farsh al-lozaa-2 | 33:96912 | 28.54906 | 2016 |
| | | 3 | Farsh al-lozaa-3 | 33.97092 | 28.54835 | 1995 |
| | | 4 | Farsh al-lozaa-4 | 33.97164 | 28.54843 | 1992 |
| | | 5 | Farsh al-sofsafa | 33.96465 | 28.55447 | 1993 |
| 2 | Wadi egebal | 6 | Farsh al-romana-1 | 33.8826 | 28.35989 | 1801 |
| | | 7 | Farsh al-romana-2 | 33.88369 | 28.53947 | 1801 |
| 3 | Shak graginiah | 8 | Graginiah-1 | 33.9695 | 28.52221 | 1980 |
| | | 9 | Graginiah-2 | 33.97019 | 28.5235 | 1890 |
| | | 10 | Graginiah-3 | 33.96853 | 28.51985 | 1857 |
| 4 | Shak mousa | 11 | Shak mousa-1 | 33.96383 | 28.53001 | 1961 |
| | | 12 | Shak mousa-2 | 33.96734 | 28.53342 | 1976 |
| 5 | Wadi al-arbain | 13 | Wadi al-arbain -1 | 33.96139 | 28. 53936 | 1726 |
| | | 14 | Wadi al-arbain-2 | 33.96139 | 28.554026 | 1720 |
| | | 15 | Wadi al-arbain-3 | 33.85895 | 28. 54073 | 1731 |
| 6 | Wadi al-shak | 16 | Wadi al-shak-1 | 33. 93365 | 28.53454 | 1855 |
| | | 17 | Wadi al-shak-2 | 33.93315- | 28.5365 | 1844 |
| | | 18 | Wadi al-shak-1 | 33. 93257 | 28. 53860 | 1828 |
| 7 | Wadi itlah | 19 | Wadi itlah-1 | 33.9226 | 28.58395 | 1429 |
| | | 20 | Wadi itlah-2 | 33:92565 | 28.57904 | 1429 |
| | | 21 | Wadi itlah-3 | 33.93108 | 28.57148 | 1468 |
| 8 | Maen al-raian | 22 | Maen al-raian-1 | 33.88637 | 28.53771 | 1811 |
| | | 23 | Maen al-raian-2 | 33.84194 | 28.54008 | 1834 |
| | | 24 | Maen al-raian-3 | 33.89539 | 28.5423 | 1861 |
| 9 | Abu kasaba | 25 | Abu kasaba-1 | 33.89073 | 28.52291 | 1854 |

| No. of location | Location name | Stands No. | Stands name | E | N | Alt |
|---|---|---|---|---|---|---|
| | | 26 | Abu kasaba-2 | 33.88952 | 28.52474 | 1850 |
| `10 | Abu towatah | 27 | Abu towatah-1 | 33.89023 | 28.572827 | 1800 |
| | | 28 | Abu towatah-2 | 33.89052 | 28.57717 | 1808 |
| 11 | Abu walia | 29 | Abu walia-1 | 33.40772 | 28.53904 | 1921 |
| | | 30 | Abu walia-2 | 33.90899 | 28.53624 | 1902 |
| 12 | Wadi al-Talah | 31 | Wadi al-talah-1 | 33.9226 | 28.58395 | 1429 |
| | | 32 | Wadi al-talah-2 | 33:92565 | 28.57904 | 1451 |
| | | 33 | Wadi al-talah-3 | 33.93108 | 28.57148 | 1479 |
| 13 | Tunea elkalabia | 34 | Tunea elkalabia | 33.90809 | 28.56388 | 1850 |
| 14 | Shak tunea | 35 | Shak tunea | 33.90157 | 28.57951 | 1766 |
| 15 | Tobok | 36 | Tobok | 33.93287 | 28.54076 | 1825 |
| 16 | Shakef tobok | 37 | Shakef tobok | 33.93272 | 28.54271 | 1842 |
| 17 | Taupq | 38 | Taupq | 33.87923 | 28:55097 | 1804 |
| 18 | Meslh | 39 | Mesalh | 33.88888- | 28.27527 | 1804 |
| | | 40 | Nakp mesalh | 33.87785 | 28.56882 | 1853 |
| 19 | Shake saker | 41 | Shake saker | 33.90013 | 28.57801 | 1779 |
| 20 | Sakarkiah | 42 | Sakarkiah | 33.91119 | 28.55866 | 1540 |
| 21 | Naqb al-zawateen | 43 | Naqb al-zawateen | 33.9338 | 28.54524 | 1882 |
| 22 | Seleebat | 44 | Seleebat | 33.92359 | 28.54021 | 1882 |

**Table 2.** Soil Physical properties of different Stands in SPK, south Sinai Egypt during June of 2014.

| No. | Stand name | Texture % | | | | | | Texture |
|---|---|---|---|---|---|---|---|---|
| | | Water content | Fine grave | Coarse sand | fine sand | Silt | clay | |
| 1 | Farsh al-lozaa-1 | 1.4 | 20 | 59 | 11 | 6 | 4 | loamy sand |
| 2 | Farsh al-lozaa-2 | 1.09 | 37 | 50 | 5 | 4 | 4 | loamy sand |
| 3 | Farsh al-lozaa-3 | 1.95 | 16 | 50 | 12 | 12 | 10 | sandy loam |
| 4 | Farsh al-lozaa-4 | 1.2 | 31 | 46 | 7 | 10 | 6 | sandy loam |
| 5 | Farsh al-sofsafa | 1.07 | 15 | 44 | 15 | 15 | 11 | sandy loam |
| 6 | Farsh al-romana-1 | 1.7 | 2 | 88 | 8 | 1 | 1 | Sand |
| 7 | Farsh al-romana-2 | 1.9 | 21 | 72 | 5 | 1 | 1 | Sand |
| 8 | Graginiah-1 | 0.64 | 35 | 45 | 6 | 6 | 8 | sandy loam |
| 9 | Graginiah-2 | 0.8 | 13 | 45 | 10 | 15 | 17 | sandy loam |
| 10 | Graginiah-3 | 0.5 | 12 | 56 | 12 | 8 | 12 | sandy loam |
| 11 | Shak muosa-1 | 1.7 | 26 | 55 | 8 | 5 | 6 | loamy sand |
| 12 | Shak muosa-2 | 1.65 | 10 | 34 | 9 | 7 | 40 | sandy clay |
| 13 | Wadi elarbain-1 | 1.54 | 23 | 45 | 10 | 12 | 10 | sandy loam |
| 14 | Wadi elarbain-2 | 0.96 | 22 | 52 | 10 | 8 | 8 | sandy loam |
| 15 | Wadi elarbain-3 | 1.8 | 15 | 50 | 12 | 12 | 11 | loamy sand |
| 16 | Wadi al-shak-1 | 1.2 | 30 | 50 | 5 | 9 | 6 | sandy loam |
| 17 | Wadi al-shak-2 | 1.32 | 30 | 54 | 7 | 6 | 3 | loamy sand |
| 18 | Wadi al-shak-3 | 1.52 | 12 | 55 | 13 | 11 | 9 | sandy loam |
| 19 | Wadi itlah-1 | 1.46 | 26 | 45 | 9 | 10 | 10 | sandy loam |
| 20 | Wadi itlah-2 | 1.65 | 21 | 65 | 9 | 4 | 1 | Sand |
| 21 | Wadi itlah-3 | 1.8 | 10 | 42 | 17 | 22 | 9 | sandy loam |
| 22 | Maen al-raian-1 | 1.68 | 25 | 67 | 5 | 2 | 1 | Sand |
| 23 | Maen al-raian-2 | 1.78 | 7 | 35 | 18 | 25 | 15 | sandy loam |
| 24 | Maen al-raian-3 | 1.46 | 19 | 65 | 9 | 5 | 2 | Sand |
| 25 | Abu kasaba-1 | 1.2 | 16 | 66 | 7 | 7 | 4 | loamy sand |
| 26 | Abu kasaba-2 | 1.12 | 24 | 62 | 9 | 2 | 3 | Sand |
| 27 | Abu towatah-1 | 1.42 | 25 | 50 | 11 | 9 | 5 | loamy sand |
| 28 | Abu towatah-2 | 1.7 | 31 | 60 | 6 | 2 | 1 | Sand |
| 29 | Abu walia-1 | 1.67 | 19 | 38 | 11 | 14 | 18 | sandy clay loama |
| 30 | Abu walia-2 | 1.32 | 16 | 67 | 8 | 6 | 3 | Sand |
| 31 | Wadi al-Talah-1 | 1.46 | 13 | 54 | 17 | 11 | 5 | loamy sand |
| 32 | Wadi al-talah-2 | 1.6 | 22 | 48 | 11 | 12 | 7 | sandy loam |
| 33 | Wadi al-talah-3 | 1.9 | 13 | 44 | 17 | 18 | 8 | sandy loam |
| 34 | Tunea elkalabia | 1.14 | 24 | 62 | 6 | 5 | 3 | Sand |
| 35 | Shak tunea | 1.3 | 15 | 60 | 13 | 5 | 7 | loamy sand |
| 36 | Tobok | 0.5 | 35 | 44 | 8 | 7 | 6 | loamy sand |
| 37 | Shakef tobok | 0.6 | 9 | 53 | 15 | 13 | 10 | sandy loam |
| 38 | Taupq | 0.76 | 48 | 37 | 4 | 5 | 6 | sandy loam |
| 39 | Shakef meslh | 1.82 | 42 | 54 | 2 | 1 | 1 | Sand |
| 40 | Nakp mesalh | 0.8 | 13 | 48 | 17 | 16 | 6 | sandy loam |
| 41 | Shakef saker | 1.42 | 16 | 67 | 9 | 5 | 3 | Sand |
| 42 | Sakarkiah | 1.12 | 25 | 51 | 8 | 6 | 10 | sandy loam |
| 43 | Naqb al-zawateen | 1.2 | 2 | 91 | 1 | 4 | 2 | Sand |
| 44 | Seleebat | 0.64 | 16 | 59 | 12 | 7 | 6 | loamy sand |
| LSD at (0.05) | | 0.17 | 6.87 | 6.87 | 3.42 | 2.98 | 2.90 | |
| LSD at (0.01) | | 0.23 | 8.16 | 9.11 | 4.54 | 3.95 | 3.85 | |

**Table 3.** Soil chemical properties of different stands in SPK, south Sinai Egypt during June of 2014.

| No. | Stand name | pH | T.D.S ppm | EC us/cm | Org. matter % | CaCo3 % | Cations | | | | Anions (meq/L) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | $Ca^{++}$ meq/L | $Mg^{++}$ meq/L | $Na^{++}$ PPM | $k^{+}$ PPM | $HCO_3^-$ | $Cl^-$ | $SO_4^-$ |
| 1 | Farsh al-lozaa-1 | 8.10 | 72.00 | 111.67 | 2.99 | 27.00 | 1.33 | 4.17 | 6.05 | 9.12 | 5.00 | 21.47 | 20.33 |
| 2 | Farsh al-lozaa-2 | 7.87 | 113.00 | 176.67 | 1.84 | 23.17 | 2.33 | 5.50 | 6.80 | 5.70 | 5.00 | 37.33 | 41.00 |
| 3 | Farsh al-lozaa-3 | 8.47 | 53.00 | 83.33 | 4.00 | 23.17 | 1.33 | 2.50 | 3.00 | 5.88 | 5.00 | 48.53 | 50.67 |
| 4 | Farsh al-lozaa-4 | 8.70 | 69.00 | 106.67 | 3.27 | 25.50 | 1.33 | 4.83 | 4.63 | 6.68 | 5.00 | 24.73 | 77.67 |
| 5 | Farsh al-sofsafa | 7.90 | 116.33 | 180.00 | 2.07 | 28.83 | 6.33 | 5.17 | 5.88 | 4.23 | 5.00 | 44.80 | 15.67 |
| 6 | Farsh al-romana-1 | 8.73 | 67.67 | 103.33 | 7.91 | 25.33 | 2.33 | 0.17 | 3.38 | 8.00 | 5.00 | 27.53 | 47.00 |
| 7 | Farsh al-romana-2 | 8.80 | 62.33 | 93.33 | 8.00 | 23.00 | 1.33 | 1.83 | 4.32 | 12.28 | 5.00 | 31.27 | 23.33 |
| 8 | Graginiah-1 | 7.97 | 145.00 | 226.67 | 0.69 | 30.50 | 3.33 | 5.83 | 6.38 | 6.90 | 5.00 | 56.47 | 41.00 |
| 9 | Graginiah-2 | 8.13 | 55.67 | 86.67 | 0.69 | 29.83 | 2.00 | 4.50 | 16.53 | 3.53 | 5.00 | 46.20 | 35.67 |
| 10 | Graginiah-3 | 8.43 | 53.67 | 83.33 | 0.50 | 29.00 | 1.67 | 2.17 | 11.43 | 14.50 | 5.00 | 36.40 | 42.67 |
| 11 | Shak muosa-1 | 8.07 | 120.00 | 186.67 | 4.30 | 28.17 | 2.33 | 6.17 | 6.13 | 4.50 | 5.00 | 48.07 | 60.67 |
| 12 | Shak muosa-2 | 7.97 | 87.67 | 135.00 | 2.76 | 30.00 | 3.00 | 2.83 | 8.87 | 6.23 | 5.00 | 35.93 | 24.33 |
| 13 | Wadi elarbain-1 | 7.73 | 136.67 | 210.00 | 3.45 | 31.00 | 3.67 | 8.17 | 12.40 | 12.58 | 5.00 | 18.67 | 31.00 |
| 14 | Wadi elarbain-2 | 7.70 | 76.33 | 113.33 | 1.84 | 27.33 | 2.33 | 4.50 | 10.97 | 12.85 | 5.00 | 15.40 | 10.33 |
| 15 | Wadi elarbain-3 | 7.73 | 73.33 | 106.67 | 4.37 | 29.33 | 3.33 | 6.83 | 7.38 | 6.92 | 5.00 | 19.13 | 11.33 |
| 16 | Wadi al-shak-1 | 8.53 | 174.00 | 266.67 | 3.68 | 27.00 | 4.33 | 7.50 | 26.32 | 16.50 | 5.00 | 12.60 | 15.67 |
| 17 | Wadi al-shak-2 | 7.73 | 516.67 | 800.00 | 3.22 | 31.83 | 8.67 | 16.50 | 25.58 | 37.40 | 5.00 | 13.53 | 71.00 |
| 18 | Wadi al-shak-3 | 7.90 | 95.33 | 150.00 | 3.91 | 25.33 | 2.33 | 4.83 | 10.10 | 20.50 | 5.00 | 19.13 | 16.00 |
| 19 | Wadi itlah-1 | 8.07 | 79.67 | 116.67 | 6.90 | 26.67 | 2.33 | 2.17 | 3.12 | 10.07 | 5.00 | 33.60 | 12.33 |
| 20 | Wadi itlah-2 | 8.10 | 121.33 | 189.33 | 7.36 | 27.33 | 2.33 | 3.17 | 6.82 | 9.05 | 5.00 | 31.03 | 19.33 |
| 21 | Wadi itlah-3 | 8.27 | 92.00 | 143.33 | 6.67 | 26.67 | 2.00 | 4.50 | 4.60 | 3.92 | 5.00 | 18.20 | 14.67 |
| 22 | Maen al-raian-1 | 9.43 | 228.00 | 350.00 | 8.05 | 29.50 | 4.33 | 7.83 | 16.82 | 19.78 | 5.00 | 9.80 | 26.67 |
| 23 | Maen al-raian-2 | 8.03 | 139.33 | 219.67 | 5.06 | 28.00 | 3.67 | 5.83 | 8.00 | 12.58 | 5.00 | 16.57 | 26.33 |
| 24 | Maen al-raian-3 | 8.07 | 60.33 | 89.33 | 4.60 | 28.00 | 1.67 | 4.83 | 3.60 | 6.57 | 5.00 | 14.47 | 24.33 |
| 25 | Abu kasaba-1 | 7.97 | 97.67 | 150.00 | 3.68 | 27.83 | 6.00 | 4.83 | 10.18 | 14.92 | 5.00 | 20.53 | 21.67 |
| 26 | Abu kasaba-2 | 8.47 | 62.00 | 100.00 | 4.78 | 28.00 | 3.33 | 6.83 | 3.17 | 5.12 | 5.00 | 34.07 | 51.33 |
| 27 | Abu towatah-1 | 8.37 | 45.67 | 66.67 | 10.58 | 30.00 | 2.00 | 2.83 | 3.33 | 3.32 | 5.00 | 17.27 | 15.00 |
| 28 | Abu towatah-2 | 8.63 | 138.67 | 213.33 | 4.60 | 36.67 | 2.67 | 5.17 | 3.75 | 11.48 | 5.00 | 24.27 | 62.00 |
| 29 | Abu walia-1 | 7.93 | 139.33 | 213.33 | 5.52 | 31.33 | 2.67 | 2.67 | 13.53 | 12.37 | 5.00 | 23.80 | 14.17 |
| 30 | Abu walia-2 | 7.97 | 111.33 | 173.33 | 5.75 | 30.67 | 3.33 | 6.17 | 2.03 | 4.50 | 5.00 | 12.60 | 51.67 |
| 31 | Wadi al-Talah-1 | 7.90 | 85.00 | 132.67 | 4.37 | 32.33 | 2.67 | 6.83 | 9.95 | 11.33 | 5.00 | 19.60 | 19.33 |
| 32 | Wadi al-talah-2 | 8.07 | 74.00 | 106.67 | 5.06 | 28.00 | 2.00 | 2.50 | 5.00 | 7.25 | 5.00 | 21.47 | 19.33 |

| No. | Stand name | pH | T.D.S ppm | EC us/cm | Org. matter % | CaCo3 % | Cations | | | | Anions (meq/L) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | $Ca^{++}$ meq/L | $Mg^{++}$ meq/L | $Na^{++}$ PPM | $k^{+}$ PPM | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{-}$ |
| 33 | Wadi al-talah-3 | 8.20 | 72.00 | 110.00 | 8.51 | 29.67 | 3.00 | 3.83 | 6.22 | 5.47 | 5.00 | 24.27 | 18.00 |
| 34 | Tunea elkalabia | 8.60 | 99.67 | 156.67 | 2.30 | 26.00 | 2.67 | 7.17 | 5.95 | 12.63 | 5.00 | 23.80 | 65.67 |
| 35 | Shak tunea | 8.77 | 55.67 | 86.67 | 3.31 | 24.83 | 0.33 | 5.83 | 6.97 | 14.20 | 5.00 | 32.20 | 73.33 |
| 36 | Tobok | 8.77 | 60.33 | 96.67 | 0.50 | 27.00 | 1.67 | 3.50 | 13.67 | 12.23 | 5.00 | 57.87 | 41.33 |
| 37 | Shakef tobok | 8.30 | 77.67 | 120.00 | 1.38 | 29.17 | 1.33 | 3.17 | 9.22 | 3.85 | 5.00 | 41.53 | 50.00 |
| 38 | Taupq | 7.97 | 74.67 | 110.00 | 0.92 | 31.25 | 2.83 | 3.33 | 6.17 | 5.62 | 5.00 | 53.67 | 13.33 |
| 39 | Shakef meslh | 8.17 | 53.00 | 80.00 | 4.14 | 29.33 | 1.67 | 6.83 | 7.23 | 2.80 | 5.00 | 18.67 | 11.67 |
| 40 | Nakp mesalh | 8.73 | 151.00 | 233.33 | 1.84 | 29.83 | 4.67 | 7.83 | 6.43 | 5.55 | 5.00 | 22.87 | 59.67 |
| 41 | Shakef saker | 7.93 | 73.00 | 113.33 | 4.32 | 23.17 | 0.33 | 4.17 | 4.98 | 9.10 | 5.00 | 35.93 | 29.67 |
| 42 | Sakarkiah | 8.30 | 73.67 | 116.67 | 3.63 | 24.33 | 3.00 | 3.17 | 10.63 | 4.90 | 5.00 | 44.33 | 56.00 |
| 43 | Naqb al-zawateen | 8.23 | 78.00 | 120.00 | 4.14 | 25.67 | 2.33 | 8.50 | 11.98 | 8.05 | 5.00 | 41.53 | 70.00 |
| 44 | Seleebat | 8.13 | 58.33 | 90.00 | 2.07 | 30.00 | 1.33 | 3.83 | 7.08 | 10.67 | 5.00 | 14.47 | 28.00 |
| | LSD at (0.05) | 0.26 | 26.18 | 41.11 | 1.81 | 3.90 | 1.36 | 1.98 | 1.98 | 2,38 | Ns | 6.78 | 5.14 |
| | LSD at (0.01) | 0.34 | 34.70 | 54.50 | 2.40 | 5.17 | 1.80 | 2.62 | 2.62 | 3.16 | Ns | 8.99 | 6.81 |

**Table 4.** Essential oil percentage of O. *syriacum* plants in different stands in SPK, south Sinai Egypt during June of 2014.

| NO. | Stands | V. O ml\100g | NO. | Stands | V. O ml\100g |
|---|---|---|---|---|---|
| 1 | Farsh al-lozaa1 | 6.75 | 23 | Maen al-raian2 | 5.50 |
| 2 | Farsh al-lozaa2 | 6.50 | 24 | Maen al-raian3 | 2.75 |
| 3 | Farsh al-lozaa3 | 5.00 | 25 | Abu kasaba1 | 5.00 |
| 4 | Farsh al-lozaa4 | 3.50 | 26 | Abu kasaba2 | 5.00 |
| 5 | Farsh al-Sofsafa | 3.50 | 27 | Abu towatah1 | 4.50 |
| 6 | Farsh al-romana1 | 4.00 | 28 | Abu towatah2 | 5.25 |
| 7 | Farsh al-romana2 | 2.50 | 29 | Abu walia1 | 5.25 |
| 8 | Graginiah 1 | 5.75 | 30 | Abu walia2 | 4.50 |
| 9 | Graginiah 2 | 3.00 | 31 | Wadi al-Talah1 | 2.25 |
| 10 | Graginiah 3 | 4.50 | 32 | Wadi al-Talah2 | 5.57 |
| 11 | Shak mousa1 | 3.25 | 33 | Wadi al-Talah3 | 4.75 |
| 12 | Shak mousa2 | 3.75 | 34 | Tunea elkalabia | 3.50 |
| 13 | Wadi elarbain1 | 5.50 | 35 | Shak tunea | 5.00 |
| 14 | Wadi elarbain2 | 5.25 | 36 | Tobok | 3.75 |
| 15 | Wadi elarbain3 | 3.50 | 37 | Shakef tobok | 6.25 |
| 16 | Wadi al-shak1 | 4.00 | 38 | Taupq | 4.50 |
| 17 | Wadi al-shak2 | 3.25 | 39 | Shakef meslh | 4.00 |
| 18 | Wadi al-shak3 | 3.50 | 40 | Nakp mesalh | 4.50 |
| 19 | Wadi itlah1 | 5.75 | 41 | Shakef saker | 3.50 |
| 20 | Wadi itlah 2 | 5.00 | 42 | Sakarkiah | 5.25 |
| 21 | Wadi هtlah3 | 5.00 | 43 | Naqb al-zawateen | 5.00 |
| 22 | Maen al-raian1 | 3.50 | 44 | Seleebat | 6.00 |

**Table 5.** The main constituents of essential oil of *O. syriacum* plants grown in stands in SPK, south Sinai Egypt during june of 2014

| Composite Name | Stand No. | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% |
| Thujene | 0.66 | 0.55 | 0.66 | 0.56 | 0.64 | 0.31 | 0.69 | 0.51 | 0.77 | 0.18 | 0.72 | 0.66 | 0.82 | 0.72 | 0.64 | 0.63 | 0.51 | 0.76 | 0.29 | 0.73 | 1.08 | 1.00 |
| α-pinen | 0.27 | 0.25 | 0.33 | 0.31 | 0.32 | 0.17 | 0.35 | 0.14 | 0.34 | 0.07 | 0.34 | 0.34 | 0.43 | 0.35 | 0.34 | 0.31 | 0.22 | 0.36 | 0.13 | 0.38 | 0.52 | 0.51 |
| Comphere | 0.02 | 0.00 | 0.04 | 0.03 | 0.03 | 0.02 | 0.04 | 0.02 | 0.04 | 0.00 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.02 | 0.03 | 0.00 | 0.05 | 0.05 | 0.05 |
| α-myrcene | 0.02 | 0.05 | 0.01 | 0.01 | 0.00 | 0.00 | 0.02 | 0.01 | 0.02 | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.02 | 0.03 | 0.02 | 0.02 | 0.00 |
| Octanol | 0.02 | 0.00 | 0.03 | 0.03 | 0.00 | 0.01 | 0.04 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.03 | 0.06 | 0.01 | 0.00 |
| α-Tirpenene | 0.78 | 0.49 | 0.60 | 0.50 | 0.69 | 0.33 | 0.76 | 0.60 | 1.16 | 0.27 | 0.92 | 0.94 | 1.00 | 0.79 | 0.65 | 0.70 | 0.54 | 0.57 | 0.28 | 0.86 | 1.12 | 1.32 |
| P – Cymene | 3.06 | 2.12 | 2.94 | 2.20 | 2.75 | 2.01 | 2.75 | 2.13 | 2.92 | 0.98 | 3.52 | 3.02 | 4.10 | 3.47 | 3.26 | 2.80 | 2.33 | 2.62 | 1.71 | 3.80 | 4.85 | 4.10 |
| Di –limonene | 0.14 | 0.10 | 0.00 | 0.00 | 0.13 | 0.00 | 0.14 | 0.00 | 0.17 | 0.04 | 0.00 | 0.15 | 0.00 | 0.16 | 0.00 | 0.00 | 0.10 | 0.00 | 0.10 | 0.17 | 0.00 | 0.19 |
| α-phyllanderen | 0.11 | 0.10 | 0.09 | 0.10 | 0.09 | 0.06 | 0.10 | 0.11 | 0.12 | 0.03 | 0.12 | 0.12 | 0.11 | 0.14 | 0.11 | 0.08 | 0.08 | 0.07 | 0.05 | 0.14 | 0.15 | 0.15 |
| γ-terpinene | 4.11 | 2.85 | 2.28 | 2.06 | 3.24 | 1.37 | 3.66 | 2.56 | 5.93 | 1.73 | 4.13 | 4.29 | 4.78 | 3.36 | 2.84 | 3.21 | 2.59 | 2.16 | 1.67 | 3.89 | 5.20 | 6.29 |
| Trams – sabinen hydrate | 0.35 | 0.03 | 0.49 | 0.58 | 0.48 | 0.46 | 0.55 | 0.57 | 0.59 | 0.32 | 0.48 | 0.62 | 0.61 | 0.57 | 0.66 | 0.49 | 0.50 | 0.24 | 0.60 | 0.62 | 0.95 | 0.59 |
| Linalool | 0.16 | 0.20 | 0.15 | 0.22 | 0.18 | 0.20 | 0.21 | 0.16 | 0.15 | 0.30 | 0.32 | 0.28 | 0.11 | 0.21 | 0.16 | 0.32 | 0.17 | 0.10 | 0.16 | 0.26 | 0.20 | 0.21 |
| Borneol | 0.10 | 0.06 | 0.11 | 0.09 | 0.12 | 0.08 | 0.11 | 0.10 | 0.19 | 0.14 | 0.19 | 0.21 | 0.20 | 0.25 | 0.23 | 0.23 | 0.14 | 0.12 | 0.13 | 0.25 | 0.27 | 0.22 |
| Terpieol -4 | 0.63 | 0.29 | 0.55 | 0.42 | 0.40 | 0.42 | 0.48 | 0.42 | 0.11 | 0.09 | 0.11 | 0.09 | 0.11 | 0.13 | 0.13 | 0.12 | 0.08 | 0.08 | 0.08 | 0.16 | 0.16 | 0.15 |
| α-Terpieol | 0.15 | 0.05 | 0.13 | 0.11 | 0.12 | 0.14 | 0.15 | 0.10 | 0.11 | 0.12 | 0.15 | 0.11 | 0.11 | 0.16 | 0.14 | 0.21 | 0.13 | 0.08 | 0.11 | 0.17 | 0.16 | 0.16 |
| Carvone | 0.02 | 0.17 | 0.02 | 0.02 | 0.04 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.05 | 0.04 | 0.04 | 0.05 | 0.06 | 0.06 | 0.02 | 0.03 | 0.03 | 0.07 | 0.06 | 0.06 |
| Thymol | 0.14 | 0.00 | 0.15 | 0.13 | 0.15 | 0.14 | 0.16 | 0.16 | 0.15 | 0.10 | 0.19 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.01 | 0.00 | 0.00 | 0.02 | 0.03 | 0.02 |
| Carvacroal | 86.35 | 89.10 | 88.53 | 89.58 | 87.48 | 91.74 | 86.27 | 89.26 | 82.35 | 92.68 | 84.71 | 84.44 | 83.54 | 85.08 | 86.59 | 86.53 | 89.31 | 90.03 | 91.41 | 83.66 | 79.68 | 79.86 |
| Euginol | 0.10 | 0.12 | 0.06 | 0.11 | 0.05 | 0.09 | 0.11 | 0.12 | 0.18 | 0.08 | 0.25 | 0.09 | 0.07 | 0.08 | 0.11 | 0.21 | 0.09 | 0.05 | 0.11 | 0.16 | 0.10 | 0.11 |
| Long pinene epoxid | 0.53 | 0.69 | 0.52 | 0.63 | 0.70 | 0.64 | 0.69 | 0.82 | 1.62 | 0.75 | 0.89 | 1.35 | 0.84 | 0.88 | 0.82 | 0.77 | 0.57 | 0.38 | 1.00 | 0.86 | 0.87 | 0.94 |
| Total of oxyginated compounds | 88.18 | 90.51 | 90.24 | 91.32 | 89.23 | 93.47 | 88.22 | 91.16 | 84.9 | 94.26 | 86.85 | 86.63 | 85.04 | 86.86 | 88.25 | 88.45 | 90.52 | 90.87 | 93 | 85.59 | 81.52 | 81.72 |
| Total of non oxyginated compounds | 9.54 | 6.71 | 7.45 | 6.37 | 8.38 | 4.77 | 9.11 | 6.67 | 12.1 | 3.65 | 10.3 | 10.18 | 11.91 | 9.61 | 8.58 | 8.28 | 6.94 | 6.83 | 4.92 | 10.74 | 13.96 | 14.21 |
| Total | 97.72 | 97.22 | 97.69 | 97.69 | 97.61 | 98.24 | 97.33 | 97.83 | 97.00 | 97.91 | 97.15 | 96.81 | 96.95 | 96.47 | 96.83 | 96.73 | 97.46 | 97.70 | 97.92 | 96.33 | 95.48 | 95.93 |

**Table 5.** cont.

| Composite Name | Stand No. | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% | A% |
| Thujene | 0.74 | 0.17 | 0.84 | 0.91 | 1.06 | 0.75 | 0.43 | 0.80 | 0.84 | 0.87 | 0.49 | 0.75 | 0.79 | 0.64 | 0.28 | 0.85 | 0.91 | 0.52 | 0.20 | 0.38 | 1.03 | 0.48 |
| α-pinen | 0.36 | 0.00 | 0.39 | 0.43 | 0.51 | 0.40 | 0.20 | 0.41 | 0.39 | 0.42 | 0.00 | 0.45 | 0.39 | 0.39 | 0.17 | 0.50 | 0.41 | 0.28 | 0.14 | 0.23 | 0.52 | 0.21 |
| Comphore | 0.03 | 0.02 | 0.05 | 0.04 | 0.05 | 0.04 | 0.02 | 0.04 | 0.04 | 0.05 | 0.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.04 | 0.03 | 0.02 | 0.03 | 0.06 | 0.03 |
| α-myrcene | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 |
| Octanol | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.02 | 0.04 | 0.04 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 | 0.12 | 0.03 | 0.02 | 0.00 | 0.00 |
| α-Tirpenene | 0.88 | 0.54 | 0.87 | 0.74 | 1.11 | 0.64 | 0.55 | 1.12 | 0.94 | 1.04 | 0.70 | 0.89 | 0.91 | 0.69 | 0.48 | 1.49 | 1.16 | 0.63 | 0.59 | 0.61 | 1.08 | 0.71 |
| P – Cymene | 2.85 | 2.21 | 3.38 | 3.30 | 3.80 | 3.22 | 1.90 | 3.33 | 3.93 | 3.13 | 2.29 | 3.98 | 3.84 | 3.36 | 2.29 | 6.23 | 3.60 | 2.52 | 4.40 | 3.16 | 4.07 | 3.31 |
| Di –limonene | 0.14 | 0.00 | 0.17 | 0.00 | 0.18 | 0.00 | 0.00 | 0.16 | 0.00 | 0.17 | 0.16 | 0.00 | 0.19 | 0.00 | 0.00 | 0.26 | 0.18 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| α-phyllanderen | 0.10 | 0.07 | 0.12 | 0.12 | 0.17 | 0.13 | 0.06 | 0.13 | 0.15 | 0.12 | 0.08 | 0.12 | 0.15 | 0.10 | 0.05 | 0.23 | 0.15 | 0.09 | 0.07 | 0.07 | 0.15 | 0.09 |
| γ-Terpinene | 4.47 | 2.73 | 4.08 | 2.93 | 5.05 | 2.30 | 2.75 | 5.30 | 4.09 | 5.06 | 3.09 | 3.95 | 4.09 | 2.75 | 2.74 | 7.40 | 5.41 | 2.61 | 2.67 | 3.08 | 4.64 | 3.35 |
| Trams – sabinen hydrate | 0.73 | 0.50 | 0.69 | 0.61 | 0.65 | 0.53 | 0.68 | 0.82 | 0.44 | 0.53 | 0.49 | 1.20 | 0.73 | 0.67 | 0.74 | 1.32 | 0.73 | 0.78 | 0.92 | 0.76 | 0.58 | 0.56 |
| Linalool | 0.16 | 0.16 | 0.28 | 0.22 | 1.84 | 0.25 | 0.18 | 0.25 | 0.29 | 0.31 | 0.09 | 0.16 | 0.20 | 0.11 | 0.00 | 0.31 | 0.18 | 0.29 | 0.22 | 0.28 | 0.25 | 0.29 |
| Borneol | 0.27 | 0.26 | 0.25 | 0.22 | 0.00 | 0.32 | 0.22 | 0.30 | 0.22 | 0.20 | 0.18 | 0.41 | 0.24 | 0.27 | 0.22 | 0.42 | 0.27 | 0.29 | 0.42 | 0.37 | 0.26 | 0.25 |
| Terpienol -4 | 0.17 | 0.12 | 0.22 | 0.11 | 0.12 | 0.12 | 0.14 | 0.16 | 0.14 | 0.16 | 0.12 | 0.16 | 0.13 | 0.14 | 0.16 | 0.32 | 0.17 | 0.16 | 0.16 | 0.13 | 0.17 | 0.15 |
| α-Terpineol | 0.14 | 0.11 | 0.15 | 0.14 | 0.11 | 0.15 | 0.17 | 0.15 | 0.17 | 0.16 | 0.12 | 0.18 | 0.12 | 0.11 | 0.07 | 0.18 | 0.18 | 0.13 | 0.15 | 0.21 | 0.16 | 0.21 |
| Carvone | 0.07 | 0.05 | 0.08 | 0.06 | 0.05 | 0.06 | 0.07 | 0.06 | 0.05 | 0.05 | 0.05 | 0.09 | 0.06 | 0.05 | 0.00 | 0.07 | 0.06 | 0.06 | 0.08 | 0.06 | 0.07 | 0.07 |
| Thymol | 0.02 | 0.01 | 0.03 | 0.02 | 0.01 | 0.02 | 0.04 | 0.02 | 0.03 | 0.02 | 0.00 | 0.03 | 0.04 | 0.01 | 0.00 | 0.03 | 0.02 | 0.05 | 0.03 | 0.03 | 0.02 | 0.03 |
| Carvacroal | 84.05 | 89.34 | 83.68 | 85.83 | 80.66 | 86.86 | 88.01 | 82.17 | 83.38 | 83.13 | 85.60 | 82.78 | 83.55 | 86.99 | 90.22 | 74.21 | 81.49 | 87.39 | 85.78 | 86.41 | 81.60 | 85.63 |
| Euginol | 0.14 | 0.08 | 0.09 | 0.11 | 0.11 | 0.10 | 0.13 | 0.09 | 0.14 | 0.05 | 0.10 | 0.16 | 0.13 | 0.05 | 0.08 | 0.10 | 0.10 | 0.08 | 0.16 | 0.12 | 0.12 | 0.13 |
| Long pinene epoxid | 1.28 | 0.89 | 0.92 | 0.82 | 0.72 | 0.93 | 1.34 | 0.88 | 1.02 | 0.88 | 0.67 | 0.77 | 0.97 | 0.56 | 0.44 | 1.02 | 0.70 | 0.86 | 0.98 | 0.79 | 0.96 | 0.89 |
| Total of oxyginated compounds | 86.26 | 90.99 | 85.67 | 87.51 | 83.62 | 88.79 | 90.25 | 84.06 | 85.43 | 84.96 | 87.29 | 84.65 | 85.38 | 88.24 | 91.19 | 76.65 | 83.15 | 89.28 | 87.92 | 88.37 | 83.6 | 87.61 |
| Total of non oxyginated compounds | 10.34 | 6.27 | 10.64 | 9.12 | 12.6 | 8.03 | 6.66 | 12.13 | 10.86 | 11.43 | 7.45 | 11.47 | 11.18 | 8.65 | 6.75 | 18.37 | 12.63 | 7.61 | 9.1 | 8.37 | 12.35 | 8.78 |
| Total | 96.60 | 97.26 | 96.31 | 96.63 | 96.22 | 96.82 | 96.91 | 96.19 | 96.29 | 96.39 | 94.74 | 96.12 | 96.56 | 96.89 | 97.94 | 95.02 | 95.78 | 96.89 | 97.02 | 96.74 | 95.95 | 96.39 |

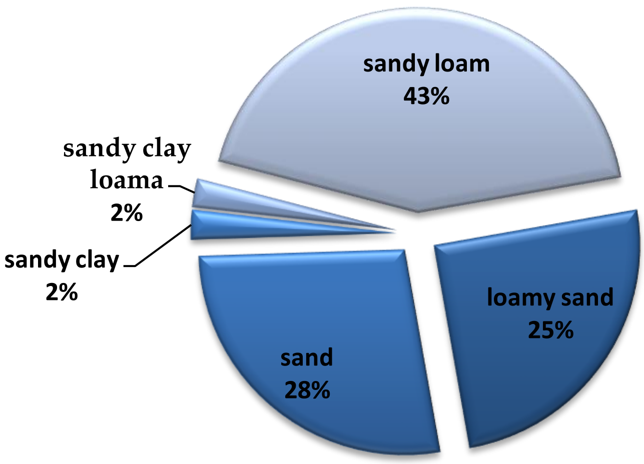


**Fig.1.** Texture types of soil and their percentages.

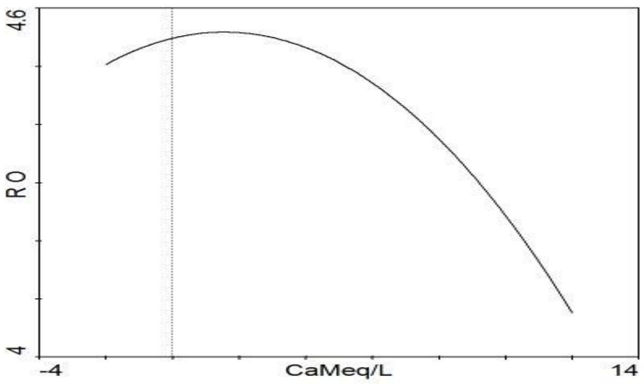


**Fig. 1a**. Relation between essential oil percentages of *O. syriacum* and calcium content in the soil.

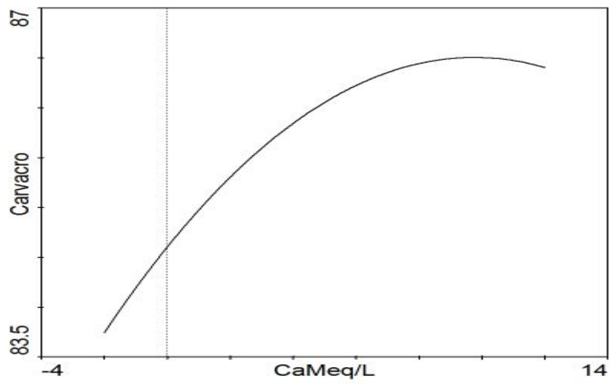


**Fig. 1b.** Relation between carvacrol content (%) of *O. Syriacum* essential oil and calcium content in the soil.

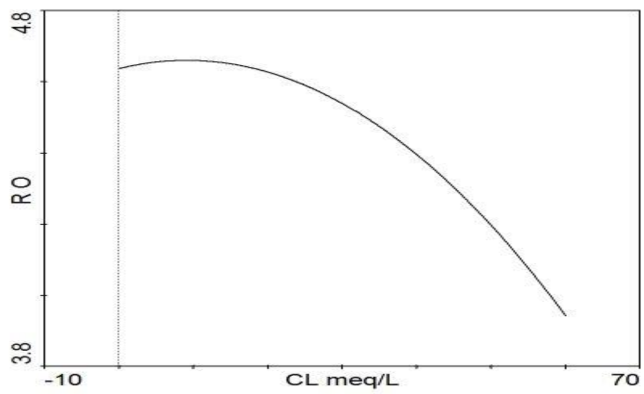


**Fig. 2a.** Relation between essential oil percentages of *O. syriacum* and chloride content in the soil.

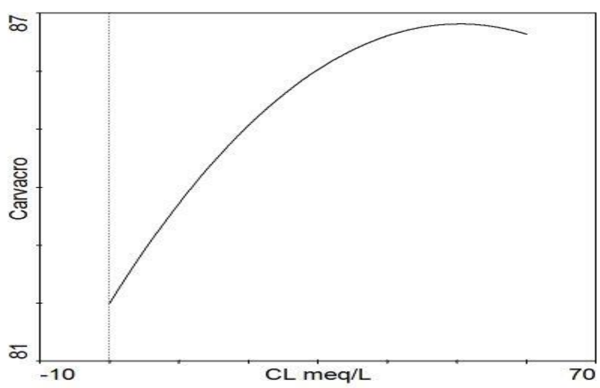


**Fig. 2b:** Relation between carvacrol content (%) in the essential oil of *O. syriacum* and chloride content in the soil.

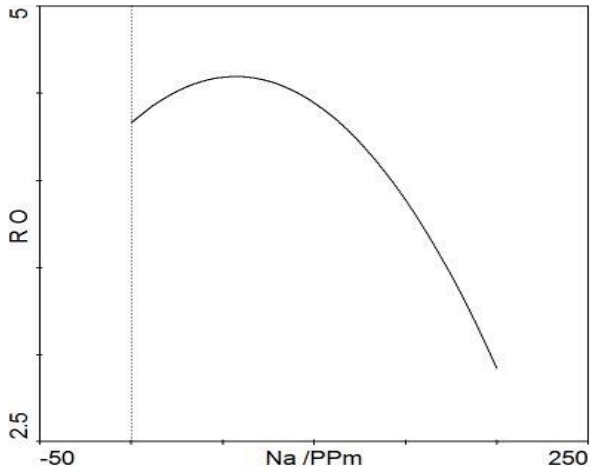


**Fig. 3a.** Relation between essential oil percentages of *O. syriacum* and sodium content in different stands.

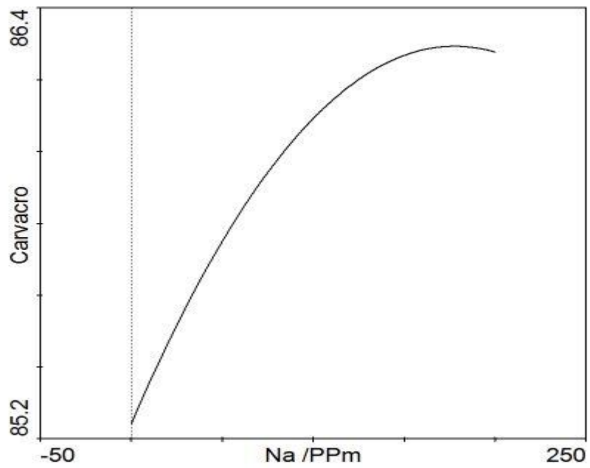


**Fig. 3b.** Relation between carvacrol content (%) of *O. syriacum* and sodium content.in different stands.

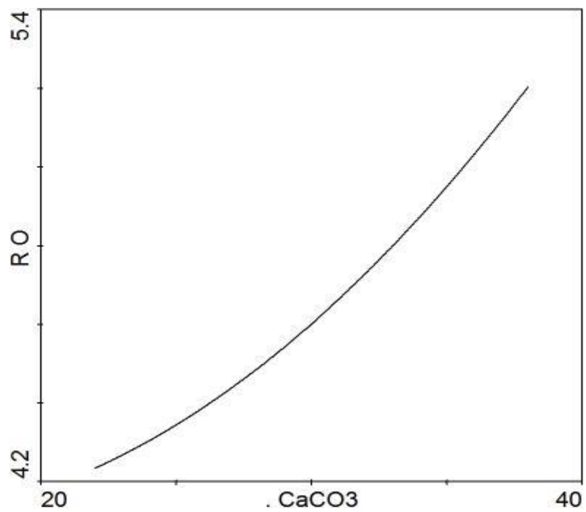


**Fig. 4a.** Relation between essential oil percentages of *O. syriacum* and calcium carbonate in different stands.

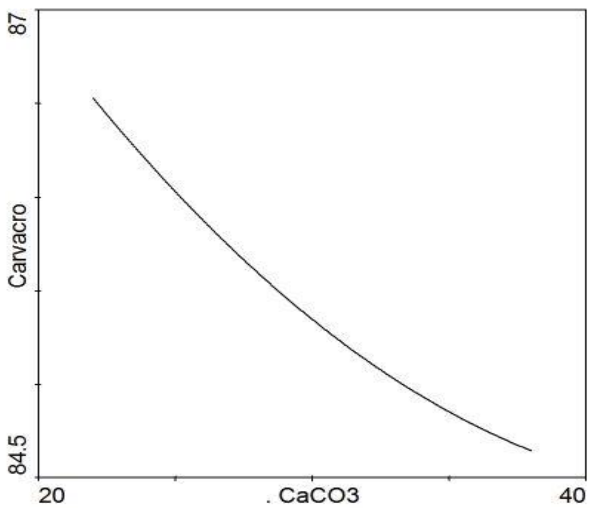


**Fig. 4b.** Relation between carvacrol content (%) of *O. syriacum* and calcium carbonate in different stands.

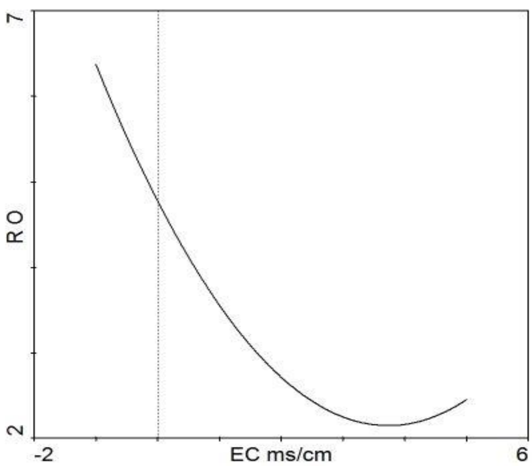


Fig. (5a). Relation between essential oil percentages of *O. syriacum* and electrical conductivity in different stands.

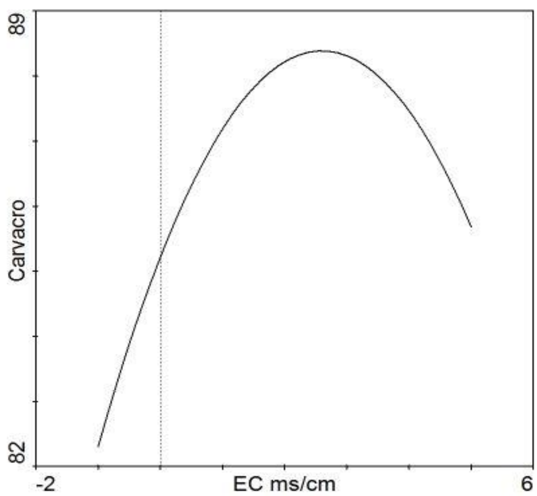


Fig. (5b). Relation between carvacrol content (%) of *O. syriacum* and the electrical conductivity in different stands.

# المكونات الأساسية للزيت الطيار لزعتر كاترين النامي برياً بمحمية كاترين بجنوب سيناء مصر

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**الملخص العربي**

تهدف هذه الدراسة إلى دراسة تركيب زيت نبات زعتر كاترين النامي في مواقع مختلفة في سانت كاترين. تم تجميع النباتات برياً بمحمية سانت كاترين التابعة لمحافظة جنوب سيناء مصر من 22 منطقة. تمت الدراسة في صيف 2014 حيث تمثل هذه المناطق لبيئات الفروش والوديان والشقوق الجبلية. تم عمل 44 وقفة بمنطقة الدراسة واعتمد عدد الوقفات على طول الوادي. تم إستخلاص الزيت من نباتات زعتر كاترين (البردقوش) التي تم تجميعها من جميع وقفات مناطق الدراسة. تم تحليل عينات الزيت على جهاز GC-MS تم تعريف 20 مركب كيميائى من مكونات الزيت الطيار لنبات زعتر كاترين، حيث مثلت تلك المركبات بأكثر من 97% من مكونات الزيت الطيار، وكان المكون الرئيسى للزيت الطيار بنبات الزعتر الجبلى هو مركب الكارفاكرول، حيث تراوحت نسبة مركب الكارفاكرول في الزيت الطيار من 74.2 % إلى 92.68% من مجموع مكونات الزيت الطيار التي تم تعريفها. وكانت النسبة الأعلى بعد الكارفاكرول يلية بيتا- ثايمين وتمثل من 0.98 % إلى 6.23 % وكانت نسبة المركبات الأكسجنية فى مكون الزيت الطيار لزعتر كاترين (البردقوش) من 76.6 %- 94.2 %، وكذلك كانت نسبة المركبات الغير أكسجنية من 3.7 % 18.4 % من قيمة المركبات التي تم تعريفها. ونستنتج من هذا أن مكونات الزيت تختلف بتنوع التربة والموقع الجغرافي.

**الكلمات المفتاحية**: زعتر كاترين، الزيت الطيار، (GC-MS)، الكارفاكرول، سانت كاترين.