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Composition of essential oil of *Ocimum basilicum* L., *minimum* and variability in antioxidant activity of essential oil of leaves and flowering tops of *Ocimum basilicum* L. *Genovese* following seasons of culture under arid climate (southeast of Algeria)

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Abstract

In this work we have studied the antioxidant activity of essential oils from leaves and flowering tops of *Ocimum basilicum* L., *genovese* (Lamiacea) from three different seasons, all were cultivated in southeast of Algeria (Ouargla) in a Saharan climate. According to the results obtained from the scavenger effect test of the DPPH radical, the essential oils tested have a significant antiradical potential especially for the essential oils of the flowers and autumn leaves with a IC_{50} of 19.696 ± 0.01 and 20.536 ± 0.03 µg/ml respectively. The study of the composition of the essential oil of *Ocimumbasilicum* L. *minimum,* by GC and GC-MS in FULLSCAN mode as well as in the SIM mode has allowed the identification of the chemotype linalool with a percentage of 43.5%, 86 compounds were also identified representing 98.7% of the oil composition.

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Introduction

The history of aromatic and medicinal plants is associated with the evolution of civilizations. In all regions of the world, peoples' history have shown that these plants have always occupied an important place in medicine, culinary preparations and perfumes.

The evaluation of the antioxidant properties of natural extracts is of a growing importance, in particular to find new sources of antioxidants and natural antimicrobials.

The study of the composition of the natural extracts of basil has captured the greatest interests in order to explain what are the active principles responsible for the different biological activities.

These studies have identified several chemotypes throughout the world, this wealth in the variability is due to the different parameters that can influence the composition as the variety itself, the geographical position, the seasons of culture, the parts of the plant material, the mode of culture used, the nature of the soil, the quality of the irrigation water, the harvest period, mode of extraction, extraction time ...ext. (Marotti *et al.*,1996, Zheljazkov *et al.*, 2008, Labra *et al.*, 2004, Telci *et al.*, 2006, Hussain *et al.*, 2008, Zheljazkov *et al.*, 2008, Javanmardi *et al.*, 2002).

Four major classes of chemotypes have been identified in the majority of these works: Linalool, eugenol, methyl chavicol and linalool/eugenol as chemotype hybrid. (Marotti *et al.*, 1996, Slougui *et al.*, 2015).

The antioxidant activity of the natural extracts of *Ocimum basilicum* L., has also been studied in several other works (Eriotou *et al.*, 2015, Avetisyan *et al.*, 2017, Pripdeevech *et al.*, 2010). These studies have used different methods of obtaining essential oils from plant material of different geographical origins.

Located in the Mediterranean basin with large variations in climate from north to south, Algeria presents a favourite field in the development of the cultures of aromatic and medicinal plants.

In Algeria, the basil has been the subject of a few studies: Slougui. B.N. *et al*, have studied the composition of 6 cultivars of basil grown in Mostaganem (Slougui *et al.*, 2015). Brada and HadjKhlifa have studied the composition of the essential oil of *Ocimum basilicum* L., of Ain Defla and they have evaluated its antioxidant activity. (Hadj Khelifa *et al.*, 2012, Brada *et al.*, 2011).

Our study supports the overall efforts of exploitation of the large areas of the Sahara by successfully introducing new crops of biological interest. For this we have studied the impact of the seasons of cultures as well as the impact of the different parts of the plant on the variability in the antioxidant activity of essential oils of *Ocimum basilicum* L *genovese.*, We also studied the composition of the essential oils of the aerial parts of *Ocimum basilicum* L *Ocimum basilicum* L *minimum* by gas chromatography (GC) and gas chromatography coupled with mass spectrometry (GC-MS) using Fullscan mode and Selected Ion Monitoring (SIM) mode.

Materials and methods

Plant material

1-Geographical location

The plant material used (*Ocimum basilicum* L.,*genovese* and *Ocimum basilicum* L., *minimum*) has been harvested in the wilaya of Ouargla (village of Oum-Erraneb) in the south-east of Algeria (Figure 1).

Oum-Erraneb (agricultural area) is a village of the commune of Sidi Khouiled located 18 km northeast of the wilaya of Ouargla, at a latitude of 32°03' 53.24 north and longitude 5°22' 33.34, is high to 129 m to the level of the sea.

The climate characteristics of the wilaya of Ouargla

According to Zatout *et al.* (2012), Ouargla belongs to the Saharan mild winter bioclimatic floor. It is characterized by an almost permanent drought and a very strong aridity.

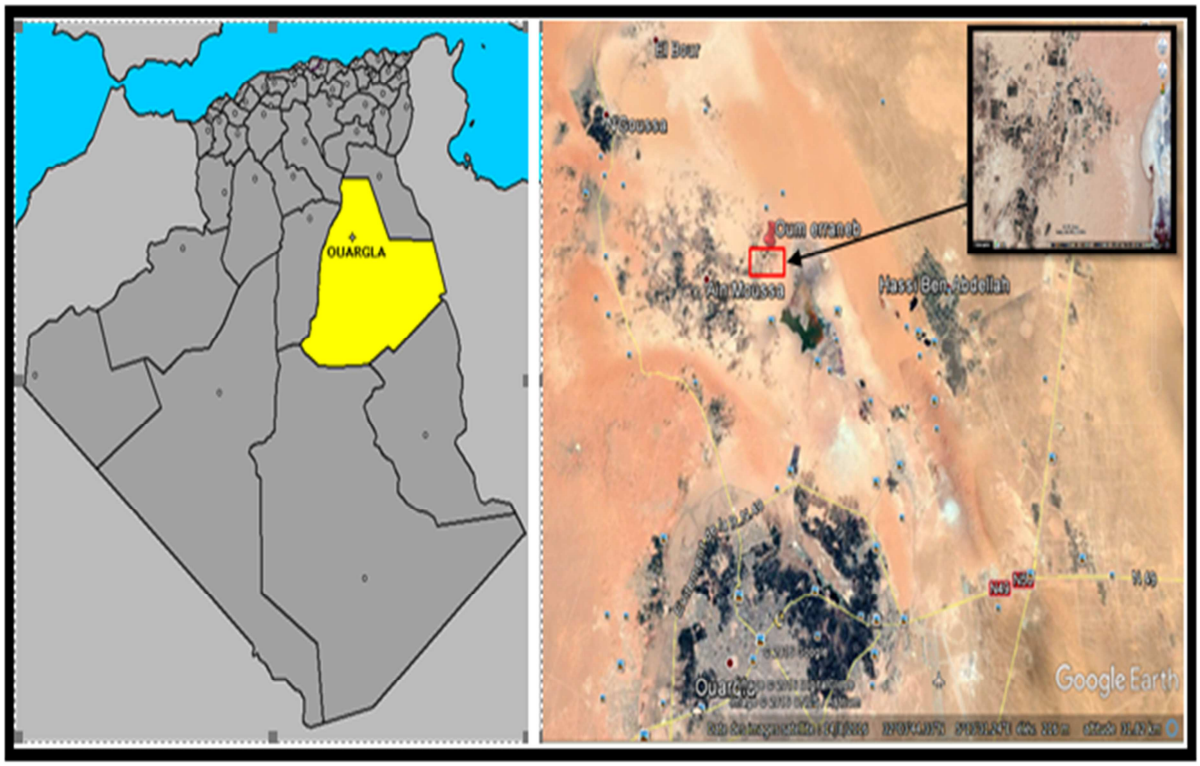

Fig. 1. Geographical location of the culture site (Google earth, 20/01/2017).

The average annual temperature is 23.82°C, the average minima is in the month of January with 4.47°C and the average maxima is in the month of July with 44.09 °C. The Annual thermal amplitude is therefore of 39.60 °C.

Culture conditions

The seeding has been made directly in the soil of the region. The plant has been in direct contact with the climate in an airy and sunny area. The micro-irrigation for this arid zone has been well developed by using local water of the region; the water was dripping slowly from the surface toward the roots of the plant. (Slougui *et al*., 2015).

Date of harvesting

The plant has been harvested during the period from June 2016 to April 2017 (Table01). Regular slices have been carried out according to a precise timetable in each season.

The plant material used for this study is represented by the different parties (leaves, flowers) of *Ocimum basilicum* L. *Genovese*, (Basil large green) and aerial parts of *Ocimum basilicum* L., *minimum*

Conservation of the plant

Before the storage of the plant, we have taken 200 g of fresh material and we have dried it up for the calculation of the rate of moisture. The plant material has been dried at an ambient temperature and in the shade during 7 days, in order to maximise the preservation of the constituents' integrity. Each dried part has been retained in paper bags and placed in hermetically sealed boxes. (Slougui *et al*., 2015).

Essential oil extraction

The technique used to obtain the essential oils is the hydrodistillation. This is an easy method to implement, not requiring a lot of material and only using distilled water. It can give very high yields and ensure a better quality of the oils. The device used for the hydrodistillation is of type Clevenger.

The Operating Conditions for Hydrodistillation are regrouped in table 02.

The six essential oils obtained HE_{11}, HE_{12}, HE_{21}, HE_{22}, HE_{31}, HE_{32}, were separated and dried with sodium sulphate. They were stored at 4°C in brown vials pending possible analyses.

HE_{sp}: S: Indicates the seasons, (1 = summer, 2 = autumns, 3 = winter). p: Indicates the parties, (1 = leaves, 2 = flowers).

GC and GC-MS analyses

Essential oil components were analysed using a 6890 Agilent gas chromatograph equipped with HP-1 capillary column (50m * 0.2mm, film thickness 0.33µm). Helium was the carrier gas, at a flow rate of 1ml/min.

The oven temperature was held at 60°C for 2min and then increased from 60°C to 280°C at a rate of 3°C/min and maintained at 280°C for 5min. Injector and detector (FID) temperatures were 250 °C and 250 °C, respectively. Diluted samples (in dichloromethane) of 1µl were injected in the split/splitless (1:10 split mode).

GC-MS analysis was obtained with full scan mode and SIM mode. The analysis was performed using an HP5890 Series II equipped with Finnigan Mat TSQ7000 with non-polar capillary column HP-1 (50m * 0.2mm, film thickness 0.33µm). Helium was the carrier gas, at a flow rate of 1ml/min. The oven temperature was held at 60°C for 2min and then increased from 60°C to 280°C at a rate of 3°C/min and maintained at 280°C for 5min. For GC-MS detection, an electron ionization system with ionization energy of 70eV was used. Injector temperature was: 250°C. Diluted samples (in dichloromethane) of 1µl were injected in the split/splitless (1:10 split mode).

In scan or Full scan Mode the mass spectrum records all the ions, and the identification is done through databases.

While in SIM Mode (Selected Ion Monitiring), the mass spectrometer functions as a filter i.e. we can only detect one or a few ions (1 to 4, in our case we chosed the ions: M/z = 136, 154, 204 and 222). The greatest advantage of using this mode is that it allows a very significant sensitivity gain with a very substantial reduction of background noise (Identification of elements to the state of traces).

Identification of oil components analysed by non-polar capillary column was accomplished based on comparison of their retention index (Ir), calculated from GC-FID analysis, with those of literature (Adams, 2007)and by comparison of their mass spectral fragmentation patterns with those of WILEY 07 and NIST02 databases.

Evaluation of free radical scavenging activity

The solution of DPPH was prepared by the dissolving of 4mg of DPPH in 100ml of ethanol (90°) (it should t be kept in the dark and not more than 3 days at -5 C °). A volume of 100 µl of essential oil (at different concentrations; different parts, each season) was added to 2ml of the DPPH solution in dry test tubes, the colour changes from intense violet to light yellow, when the DPPH is reduced.

The reaction mixture was vigorously agitated and incubated 30min in the dark.

The absorbance were measured at 517nm against the control solution (solution DPPH/ethanol).The Ascorbic acid has been used as a synthetic antioxidant of reference, its absorbance was measured in the same conditions of the essential oil. (Espin*et al.*, 2000).

The percentage of inhibition (I %) is calculated according to the following formula:

$$I\,[\%] = \frac{(ABS - ABS_0) \times 100}{ABS}$$

ABS: absorbance of the solution DPPH without the sample (negative control).

ABS0: absorbance of the solution DPPH in the presence of the sample.

The median inhibitory concentration (IC_{50}), which is a measure of the efficacy of a given compound to inhibit a specific biological or biochemical function, is estimated by linear regression.

For all the experimentation, each test is repeated three times. The average of the three trials was calculated.

Results and discussion

Moisture content and essential oil yield

Table 3 summarizes the moisture content in the vegetal material and the essential oil yield of each sample.

Oil yield

The extraction results showed a variation in the content of the essential oil in the different organs:

The summer and autumn leaves provide a higher yield in essential oil compared to the other organs of the plant. This stagnation could be explained by the presence of epidermal secretory hairs found in the Lamiaceae, common to the leaves compared to other parts that combine the synthesis and accumulation of an essential oil. Winter flowers provide a higher yield in essential oil and this could be explained by leaf wilt in the cold climate, which is not conducive to the growth of Basil (the cold-sensitive basil has not resisted too low Temperatures in January and February). Climate change directly affects the essential oil content: Autumn provides a higher R% content than other seasons.

Table 1. Planning of crop in the Seasons.

Dates	Time	Climate
20-06-2016	18 :00	34° Sunny
19-10-2016	18 :00	~ 24° rather sunny
14-01-2017	10 :00	~ 7° heavy thinnings

This variation could also be explained by the moisture content of the plant material in each season.

These results are generally consistent with the literature data but above those reported in other countries for the same species. Extraction yields from Dakar-Hann in Senegal showed that for *Ocimum basilicum* L. Leaves are richer in essential oils (1.26%) than flowers (0.49%). (Ngom *et al*., 2012).In autumn, According to (Chalchat and Özcan, 2008) from Turkey, the yield of essential oils by the hydrodistillation of: leaves, flowers and stems of *Ocimum basilicum* L. are 1.0%, 0.5% and 0.05 respectively. In the spring from Khartoum in Sudan, according to the results of (Aburigal *et al*., 2014), leaf yield varies between 0.32 and 0.48% and in flowers between 0.29 and 0.33%, and no oil in stems.

Table 2. Operating Conditions for Hydrodistillation.

Plant material	leaves	flowers
Quantity of the plant material is dried	1 kg (5x200 g)	1 kg (5x200 g)
Quantity of water (liters)	1	
Temperature (°C)	80	
Duration of hydrodistillation (h)	2,5	

The rate of humidity

The results obtained revealed a rate of moisture between 48.80% in winter and 88.55% in the summer. The comparison of the moisture content of thedifferent samples to each season highlights that the evolution of this parameter is not proportional to the evolution of the performance of extraction; the lowest rate of moisture corresponds to the highest yield, with the exception of the winter where the plant already presents a very important state of stress.

This stagnation could be explained by: The sweating,

which is the process by which plants absorb water by the roots and emit water vapour by the pores of their leaves.

The dryer is the air (in the case of the summer and fall), the higher its temperature and the fastest is the transpiration rate of the plant (Bourkhiss *et al.,* 2009).

GC and GC-MS analyses

The essential oil chromatograms, obtained by GC-MS in SIM mode and in FULLSCAN mode, are illustrated in Figure 2.

Table 4 includes the detailed composition of the essential oil, its quantification as well as the ' hit ' and CAS number values of the data bank. 86 compounds were identified representing 98.7% of the oil (table 4). In this sample, the oxygenated monoterpenes (53%) constitute the majority of the oil (Figure 4).

The linalool is the main constituent (43.5%), accompanied by 1.8-cineol (3%) and terpinene-4-ol (2.3%) (Figure 3). The aromatic compounds (20.6%) are represented by the eugenol (16.9%) and the methyl cinnamate (E) (2.8%). to be noted the little content in oxygenated sesquiterpenes (5.9%).

Table 3. Moisture content and yield of essential oils.

Variety of basil	Growing season	Moisture content		yield of essential oils	
		leaves	flowering tops	leaves	flowering tops
Ocimumbasilicumgenovese	The summer	88,55±0.68 %	78.84±0.24 %	0.5667±0.0332 %	0.4048±0.0445 %
	The Fall	77,56±1.03 %	75.20±0.49 %	1.2035±0.0106 %	0.7782±0.0485 %
	The winter	48,80±0.28 %	46.95±0.54 %	0.3120±0.0084 %	0.7352±0.0091 %
Ocimum minimum (aerial parts)	The spring	83.1±0.3 %		0.40±0.01	

The sesquiterpene hydrocarbons (14.2%) are represented by the β-elemene (2.5%), the β-cubebene (2%) and the γ-cadinene (2.3%).

Vina *et al*., 2003, have analysed the essential oil of 12 varieties of basil grown in Colombia, including *Ocimum basilicum* L. *minimum*. They have found that it is mainly composed of methyl cinnamate (E) (31.64%) and Linalool (20.6%). Also, Dolatabad *et al*., 2014,found that the essential oil of *Ocimum* L. *minimum f*rom Iran consists mainly of geranyl acetate (45.6%) and linalool (25.6%).

Svecova *et al.,* 2010 analysed the essential oil of the compact dwarf Basil of the Czech Republic, which was essentially 18.1% of linalool and 15.8% of eucalyptol.

Pandey*et al*., 2014 reported that *Ocimum* L. *minimum* of Turkey contains geranyl acetate (69.48%) and that of northeastern Brazil contains methyl chavicol (52.20%) and linalool (16%). After, Beatovic *et al*., 2015 found that the *O. basilicum*L. *minimum* cultivated in Serbia contains the linalool as a majority compound with a rate of 34.2% followed by α-trans-bergamoten with a rate of 14.1%. The composition of our oil does not resemble any of the oils quoted and they are differences between them, which leads us to conclude that the identification of this variety cannot be made based solely on the composition of its essential oil.

Free radical scavenging activity

The colour change of the solution DPPH of staining intense violet to a pale yellow, this already shows the presence of an antioxidant activity. Our series of dilution was analysed by a spectrophotometer at a wavelength of 517 nm, the results of the antioxidant activity of essential oils of *Ocimum basilicum* L. as well as that of the ascorbic acid are presented in table 5. The antioxidant activity of the extracts of leaves and flowers of *O. Basilicum* L. *genovese* is less than that of the control for all concentrations used. For the concentrations of 32 µg/ml and 8 µg/ml in essential oil the DPPH radical trapping % exceeds 66.14 %. For all concentrations used, ascorbic acid has the highest antioxidant strength compared to essential oil, this power is 92.53 % at a concentration of 100µg/ml.

Table 4. Composition of the essential oil of *Ocimum basilicum* L., *minimum* cultivated in southeast of Algeria.

N°	Retention indice	M/Z	Identification	Hit	Formule	CAS	%
001	921	136	3-Thujène	902	C10H16	99-83-2	0,1
002	927	136	Alpha-pinène	904	C10H16	80-56-8	0,3
003	941	136	Camphène	909	C10H16	79-92-5	0,1
004	955	106	Benzaldehyde	848	C7H6O	100-52-7	0,0
005	967	136	Sabinène	890	C10H16	28634-89-1	0,1
006	969	136	Beta-pinène	904	C10H16	18172-67-3	0,3
007	987	136	Beta-myrcène	859	C10H16	123-35-3	0,3
008	1001	136	Alpha-phéllandrène	891	C10H16	99-83-2	0,0
009	1005	136	3-carène	794	C10H16	13466-78-9	0,0
010	1012	136	4-carène	874	C10H17	29050-33-8	0,0
011	1021	134	m-cymène	872	C10H14	527-84-4	0,2
012	1026	154	Eucalyptol	905	C10H18O	470-82-6	3,0
013	1032	136	Cyclofenchène	789	C10H16	488-97-1	0,2
014	1045	136	Ocimène	886	C10H16	502-99-8	2,1
015	1053	136	Gamma-terpinène	880	C10H16	99-85-4	0,2
016	1062	154	Z, beta-terpinéol	895	C10H18O	7299-41-1	0,3
017	1082	136	Terpinolène	851	C10H16	586-62-9	0,2
018	1127	154	Linalol	901	C10H18O	78-70-6	43,5
019	1133	194	Acétate de myrtényle	739	C12H18O2	nist-149856	0,0
020	1134	152	Alcoolpéryllique	546	C10H16O	536-59-4	0,0
021	1137	134	2,6-diméthyl-1,3,5,7-octatétraène, E	782	C10H14	460-01-5	0,0
022	1147	152	Camphre	882	C10H16O	464-48-2	0,9
023	1161	150	Bicyclo[2.2.1]heptan-3-one...	750	C10H14O	16812-40-2	0,0
024	1167	154	Bornéol	920	C10H18O	464-45-9	0,8
025	1181	154	Terpinène-1-ol-4	913	C10H18O	20126-76-5	2,3
026	1185	150	Thymol	783	C10H14O	89-83-8	0,0
027	1191	154	Alpha-terpinéol	900	C10H18O	98-55-5	0,4
028	1196	148	Chavicol methyl ether	760	C10H12O	140-67-0	0,1
029	1202	170	8-Hydroxylinalol	746	C10H18O2	nist-131834	0,0
030	1205	150	Verbénone	748	C10H14O	80-57-9	0,0
031	1209	152	2,6-dimethyl-3,5,7-octatriène-2-ol, E	838	C10H16O	nist-141118	0,0
032	1212	172	Acétated'octyle	743	C10H20O2	112-14-1	0,1
033	1248	196	Terpinylacétate	758	C12H20O2	80-26-2	0,0
034	1252	273	Anthranilate de linalyle	814	C17H23NO2	7149-26-0	0,0
035	1261	154	Trans-Géraniol	829	C10H18O	106-24-1	0,0
036	1266	134	Chavicol	752	C9H10O	501-92-8	0,1
037	1281	196	Bornyl acetate	929	C12H20O2	76-49-3	1,5
038	1289	194	Acétate de trans-chrysantenyl	672	C12H18O2	50764-55-1	0,0
039	1300	162	Cinnamate de méthyle	844	C10H10O2	103-26-4	0,1
040	1319	204	Gamma-élémène	817	C15H24	30824-67-0	0,0
041	1329	205	Elixene	907	C15H25	3242-08-9	0,3
042	1341	204	Copaène	872	C15H24	3856-25-5	0,1
043	1374	164	Eugénol	925	C10H12O2	97-53-0	16,9
044	1382	204	Beta-élémène	849	C15H24	515-13-9	0,1
045	1390	162	Cinnamate de méthyle	744	C10H10O2	103-26-4	2,1
046	1394	204	Beta-élémène	917	C15H24	515-13-9	2,5
047	1405	178	Eugénolméthyl ether	842	C11H14O2	93-15-2	0,2
048	1413	204	Isocaryophyllène	889	C15H24	nist-140072	0,4
049	1422	204	Beta-cubébène	874	C15H24	13744-15-5	0,1

050	1433	204	Di-epi-alpha-cedrène	876	C15H24	nist-156133	1,0
051	1435	204	Alpha-guaiène	918	C15H24	3691-12-1	0,5
052	1437	204	Gamma-gurjunène	880	C15H24	22567-17-5	0,0
053	1440	204	Isolédène	873	C15H24	nist-156108	0,0
054	1448	204	Alpha-caryophyllène	923	C15H24	6753-98-6	1,2
055	1456	204	(Z)-Beta-farnésène	900	C15H24	28973-97-9	1,1
056	1477	204	Beta-cubébène	887	C15H24	13744-15-5	2,0
057	1479	204	Alloaromadendrène	870	C15H24	25246-27-9	0,2
058	1490	204	Gamma-élémène	895	C15H24	30824-67-0	0,9
059	1501	204	Delta-guaiène	925	C15H24	3691-11-0	1,3
060	1513	204	Gamma-cadinène	907	C15H24	39029-41-9	2,3
061	1517	204	Calaménène	880	C15H24	483-77-2	0,2
062	1518	204	Delta-cadinène	774	C15H24	483-76-1	0,0
063	1524	222	Cubénol	759	C15H26O	21284-22-0	0,1
064	1530	204	Alpha-muurolène	896	C15H24	31983-22-9	0,0
065	1537	204	Alpha-Himachalène	801	C15H24	3853-83-6	0,0
066	1542	222	Elémol	849	C15H26O	639-99-6	0,0
067	1559	222	Trans-nérolidol	926	C15H26O	40716-66-3	0,2
068	1569	220	Spathulénol	927	C15H24O	77171-55-2	0,5
069	1580	220	Isoaromadendrèneepoxyde	832	C15H24O	nist-159366	0,0
070	1596	220	Caryophyllèneoxyde	791	C15H24O	1139-30-6	0,1
071	1606	222	Cubénol	855	C15H26O	21284-22-0	0,7
072	1642	222	Tau-cadinol	845	C15H26O	5937-11-1	4,5
073	1646	222	Beta-eudésmol	836	C15H26O	473-15-4	0,2
074	1649	222	Alpha-cadinol	898	C15H26O	481-34-5	0,2
075	1663	220	Isoaromadendrèneepoxyde	837	C15H24O	nist-159366	0,1
076	1678	222	Alpha-bisabolol	838	C15H26O	515-69-5	0,2
077	1699	220	Isoaromadendrèneepoxyde	825	C15H24O	nist-159366	0,1
078	1712	220	Isoaromadendrèneepoxyde	826	C15H24O	nist-159367	0,1
079	1949	278	Dibutylphtalate	930	C16H22O2	84-74-2	0,1
080	1965	256	Acidehexadecanoique	870	C16H32O2	57-10-3	0,1
081	2108	296	Phytol	883	C20H40O	150-86-7	0,1
082	2328	312	Benzylbutylphtalate	877	C19H20O4	85-68-7	0,1
083	2348	281	9-Octadecenamide (Z)	889	C18H35NO	301-02-0	0,1
084	2533	390	Bis(2-ethylhexyl) phtalate	917	C24H38O4	117-81-7	0,5
085	2687	380	Heptacosane	803	C27H56	593-49-7	0,1
086	2786	408	Nonacosane	773	C29H60	630-03-5	0,0

The IC_{50} values determined in µg/ml express the effective concentration of the antioxidant extract required for trapping and the reduction of 50% of the DPPH molecules in ethanol solution. (Table 5).

According to the recorded results, we note that the extract of the winter flowers obtained has a low antioxidant strength (IC_{50} = 27,327 ± 0.04 µg/ml), but the essential oils of the autumn flowers presented a high antioxidant power with a IC_{50} = 19.696 ± 0.01 µg/ml. The essential oils of the other organ of *O. basilicum* L exhibited IC_{50} of 20,536 ± 0.03; 20,867 ± 0.03; and 23,660 ± 0.08 for autumn leaves; Summer leaves and winter leaves respectively.

Whereas the IC_{50} of ascorbic acid is 22,913 ± 0.09 µg/ml.

The essential oils of basil sheets have an antioxidant power superior to that of flowers, with the exception of autumn when this order is reversed. By taking each organ separately, winter is the season that has the weakest antioxidant ability; this can be explained easily by the state of stress of the plant.

Table 5. IC_{50} of essential oils and ascorbic acid (each value represents the average of three ± SD tests).

	HE_{11}	HE_{12}	HE_{21}	HE_{22}	HE_{31}	HE_{32}	Ascorbic acid
IC_{50} [µg/ml]	20,867±0,03	24,162±0,06	20,536±0,03	19,696±0,01	23,660±0,08	27,327±0,04	22,913±0,09

The results obtained are similar to those reached previously in a research project in the biogeochemistry laboratory of desert environments (Benzid *et al.*, 2017). The essential oil of *O. Basilicum* L. *Genovese* was found to have an anti-radical activity with a value of IC_{50} = 320.96 ± 0.0969 µg/ml from the region of Ouargla.

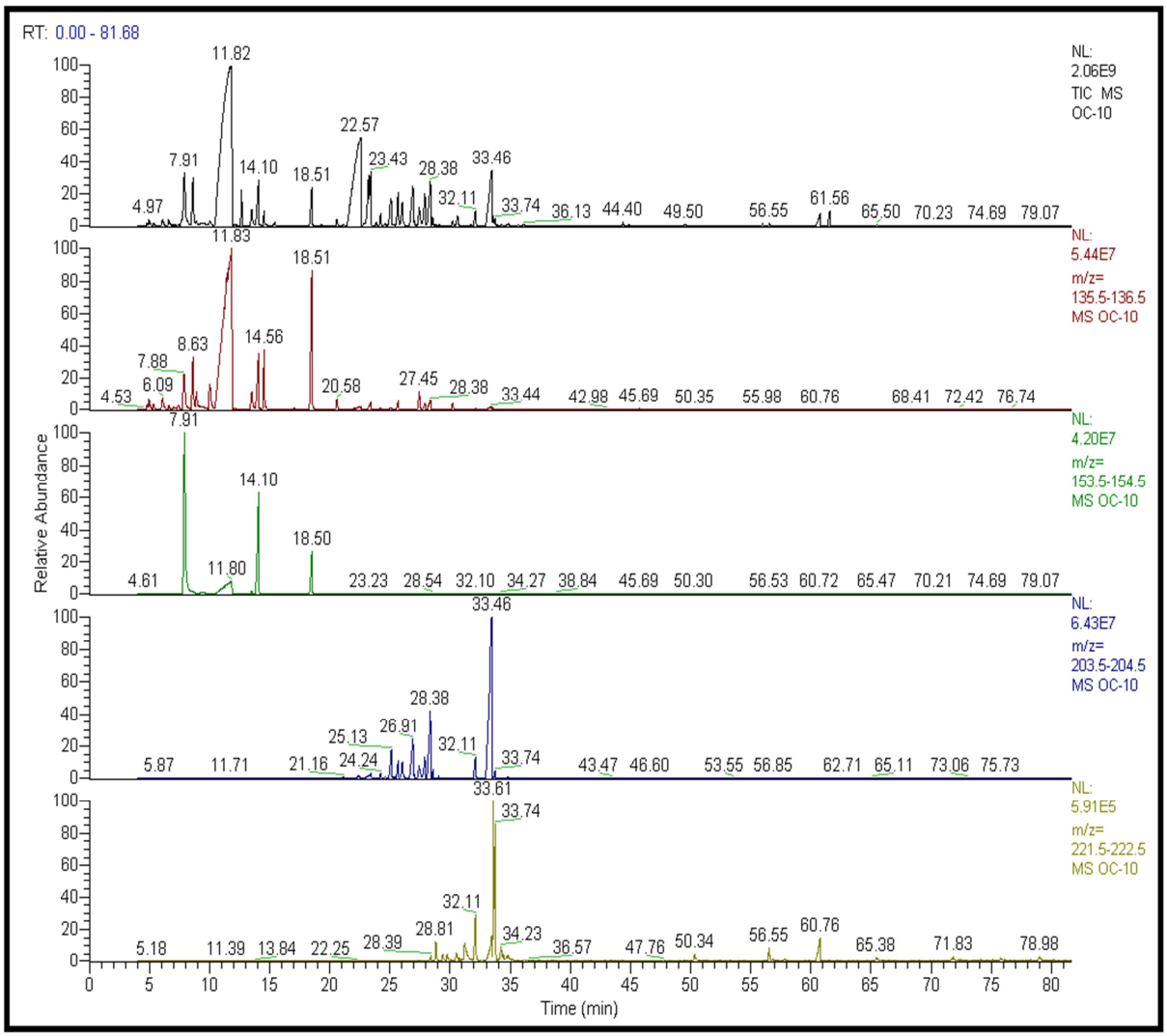

Fig. 2. GC-MS chromatograms in FULLSCAN mode and in SIM mode.

Comparing our results with those obtained by Hadj Khelifa *et al.*, 2012, who reported that the essential oil of *O. Basilicum* of Khemis Miliana, located in northern Algeria, has a very important antioxidant activity.

The results showed that the value of IC_{50} was 83.54 mg/ml.

The same finding was reported by Ouibrahim, 2015, the overall antiradical potential of the essential oils tested was lower than that of BHT with a IC_{50} of 0.17 ± 0.02 mg/ml and the essential oil of *Ocimum basilicum* L., had a value of 2.0 ± 0.04 mg/ml.

The essential oil of *Ocimum Basilicum* L., has been the subject of many works with variety in results.

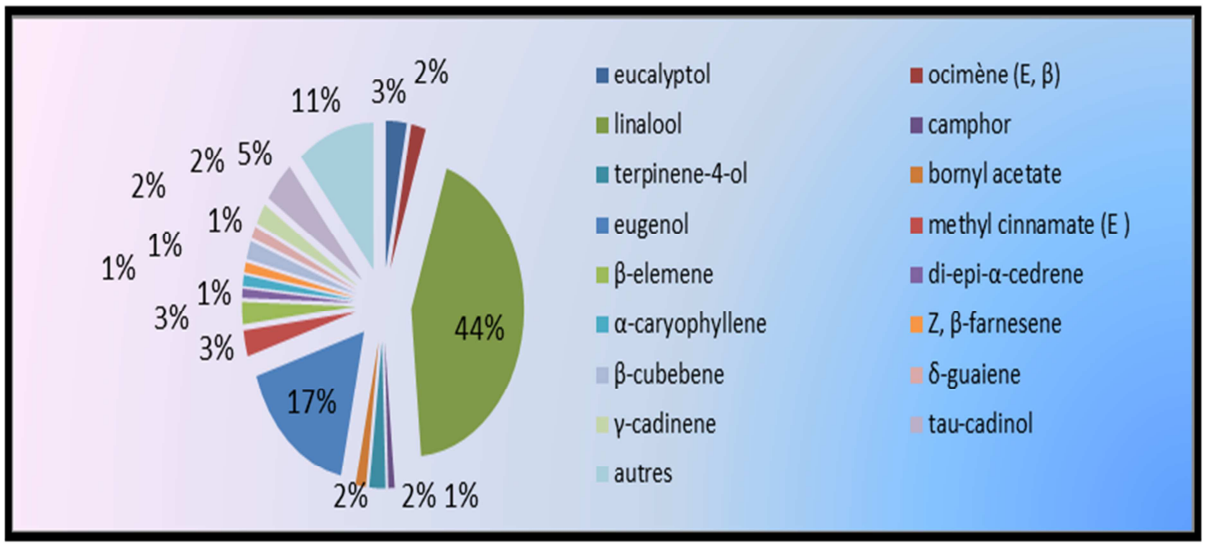

Fig. 3. Percentage distribution of major compounds Essential oil of O. *Minimum*.

The work of Hussain *et al.,* 2008 demonstrated that the essential oil of the winter and spring period enjoys greater antiradical activity compared to that of autumn and summer, presenting respective values of IC_{50}:4.8, 5.3, 6.0 and 6.7 µg/ml. This variability is due to the impacts of environmental factors on the chemical composition of essential oil and their biological activities (Boutabia *et al.*, 2016).

As the content of linalool in essential oil decreases, the IC_{50} value increases implicating a decrease of antioxidant extracts activity according to results of Filip *et al.*, 2016.

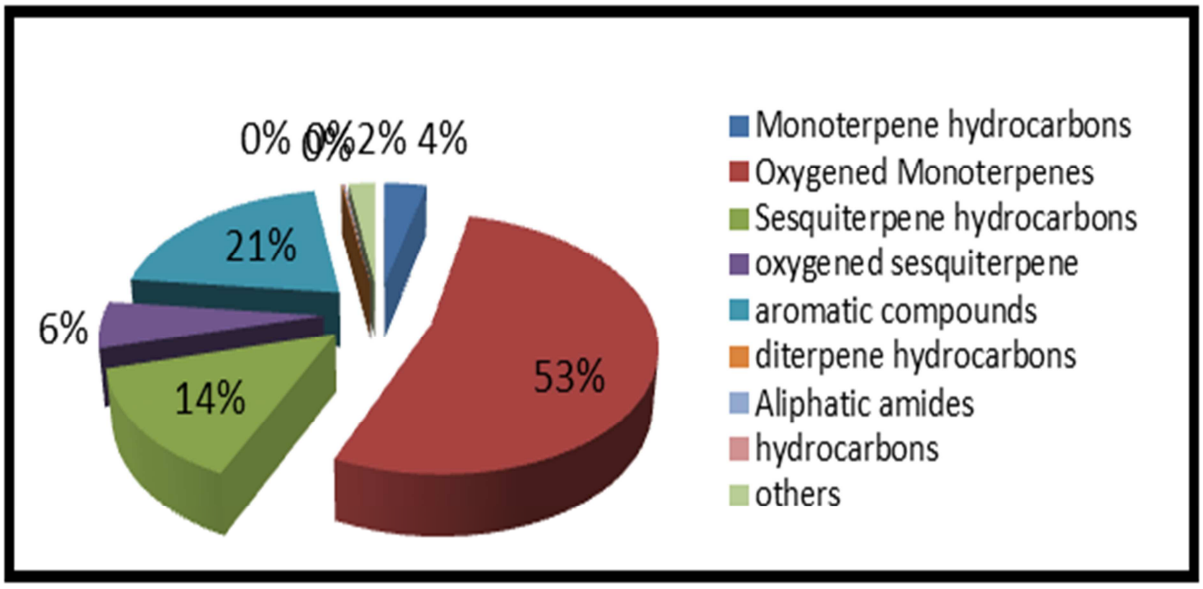

Fig. 4. Percentage distribution of major families of the essential oil of O. *Minimum*.

According to the previous results of other studies, we can judge our essential oils as good antioxidant agents.

Conclusion

Climate change impacts directly on the content of essential oil: the fall provides a content of R % higher than for the other seasons. This variation could also be explained by the moisture content of the plant material in each season. We have identified 87 compounds representing 98.7% of the oil of *Ocimum basilicum minimim* with linalool as major compound

using the Selected Ion Monotoring mode which has enabled the identification of elements in states of trace.

The essential oils of the leaves of *Ocimum basilicum L., genevose* grown under arid climate offer an antioxidant activity higher than the flowering tops. And winter is the season that offers the lowest antioxidant activity for leaves and flowering tops.

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