ANTIOXIDANT, ANTICHOLINESTERASE, AND ANTIBACTERIAL ACTIVITIES OF ESSENTIAL OILS AND METHANOL EXTRACT OF *CARDUNCELLUS PINNATUS* (DESF.)DC.GROWING IN ALGERIA

Belkassam, Abdelouahab[1], **Smaili,** Tahar[1], **Boukeloua,** Ahmed[2*], **Rebbas,** Khellaf[1], **Flamini,** Guido[3], **Ascrizzi** Roberta[3] , **Ertaş** Abdulselam[4], **Boğa** Mehmet[4]

[1]Department of Naturaland Life Sciences, Faculty of Sciences, university Mohamed Boudiaf of M'sila, Algeria. e-mail: belkassamabdou@yahoo.fr , abdelouahab.belkassam@univ-msila.dz
[1]Agro-Biotechnology and Nutrition Laboratory in Arid and Semi-Arid Zones / Natural Resources Management and Environment Research Team. Ibn Khaldoun University, Tiaret, Algeria.
[2]Department of Naturaland Life Science, Faculty of Exact Science and Life Science and Nature, University of Larbi Ben Mhidi Oum El Bouaghi, Algeria.
[3]Dipartimento di Farmacia, University of Pisa, Via Bonanno 6, 56126 Pisa, Italy.
[4]Department of Pharmacognosy, Faculty of Pharmacy, Dicle University, 21280 Diyarbakir, Turkey.
E-mail address: ahmedcte@yahoo.fr

Abstract
The essential oil was obtained by separate hydrodistillation from the aerial parts of Carduncellus pinnatus (Desf.) DC. (Asteraceae) and was analyzed by means of gas chromatography (GC) and gas chromatography–mass spectrometry (GC-MS). Hundred and four compounds were detected, accounting for 95.29 % of the total oil, which is characterized by a high content of non-terpene derivatives (33.39%) and oxygenated sesquiterpenes (32.03%). The main constituents of the essential oil from the aerial parts were caryophyllene oxide (23.12%), (E)-2-hexenal (8.35%), (E)-β-ionone (6.01%), (E)-geranylacetone (2.96%), and nonanal (2.65%). Additionally, β-Carotene-linoleic acid test system, DPPH free radical scavenging assay and ABTS cation radical scavenging assay were tested for the study of antioxidant activity of plant methanol extract and essential oil. The MeOH extract of aerial parts exhibited a strong antioxidant activity evidenced by the ABTS cation radical scavenging assay, with IC_{50} values of 44.509 ± 1.149 µg/ml. In the DPPH test the IC_{50} values were 61.147 ± 0.924µg/ml, while in β-carotene-linoleic acid test system, the IC_{50} values were 153.744 ± 3.39µg/ml. Essential oil extract of aerial parts showed 81.80 % inhibition against butyrylcholinesterase at 200 µg/mL. The highest antibacterial activity was evidenced for the aerial parts MeOH extracts, with inhibition zone medium diameters of 18.66±1.00 mm against Escherichiacoli ATCC25922 at 16 mg/ml and of and 18.00±1.15mm against Micrococcus luteus ATCC533 at 16 mg/ml. This is the first report about the potential for food and pharmaceutical industry due to the composition and the biological activities of Carduncellus pinnatus essential oils growing in Algeria.

Keywords: *Carduncellus pinnatus*, essential oil, anticholinesterase, antibacterial, antioxidant activities, GC-MS.

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INTRODUTION

Carduncellus is a genus of the Asteraceae family, subfamily of Tubuliflores and tribe Cynarées (Quezel and Santa, 1963; Ouarghidi at al., 2013). This tribe distributed from, the Mediterranean region, Africa and Asia (Ben Moumen et al., 2015; Toker and Keskin, 2008). Many members of this tribe are well known as aromatic plants, and some of them are utilized as pharmaceuticals and/or pesticides (Ouarghidi at al., 2013).

In Algeria the genus *Carduncellus* (Syn. *Carthamus*) is constituted by many species, *Carduncellus pinnatus* (Desf.) DC., (Syn. *Carthamus pinnatus* Desf.) distributed in the North Africa, Algeria, Tunisia, Marocco and Libya, in the clearings, pastures, Highlanders (Greuter, 2003).

Carduncellus pinnatus (Desf) used in traditional folk medicine, fumigation. This species is an annual; with short or no stem, monocephalic, radical leaves in rosette, briefly stalked, with lanceolate outline, pinnatipartites, with segments spinous on the edge, and ending in short and vulnerable spine, leathery, Flower head ovoid, large (5 cm by 3-4) blue corollas or

crimson, akènes large (7x4 mm), rough (Quezel and Santa, 1963).

This is the first report about the potential for food and pharmaceutical industry due to the composition of the essential oils obtained from the aerial parts of this species and of its antioxidant anticholinesterase and antibacterial activities. Furthermore, these activities were also evaluated for methanol extract of the same plant.

MATERIALS AND METHODS

Plant material and extraction

Aerial parts of *Carduncellus pinnatus* have been collected during April 2011 nearBordj Bou Arreridj city, approximately 240 km east of the capital Algiers, Algeria. Fresh aerial parts were dried to constant weight at room temperature (Figure 1). The plant was identified by Dr K. Rebbas and a voucher sample was deposited in the Laboratory of Biomolecules and Plant Breeding, University of Larbi Ben Mhidi Oum El Bouaghi, Algeria (*Carduncellus pinnatus* voucher number KR 203). Dried plant material (200 g for aerial parts) was hydrodistilled in a Clevenger-type apparatus for 2 h, and (150 g) was dried and powdered, and it was sequentially macerated with methanol (300 ml × 3). After filtration; solvents were evaporated to obtain crud extracts.

Gas chromatography – mass spectrometry

GC-MS analyses were performed with a Varian CP-3800 gas chromatograph equipped with a DB-5 capillary column (30 m × 0.25 mm; coating thickness 0.25 µm) and a Varian Saturn 2000 ion trap mass detector. Analytical conditions: injector and transfer line temperatures 220 and 240°C, respectively; oven temperature programmed from 60°C to 240°C at 3°C/min; carrier gas helium at 1 mL/min; injection 0.2 µL (10% *n*-hexane solution); split ratio 1:30. Identification of the constituents was based on comparison of the retention times with those of authentic samples, comparing their linear retention indices relative to the series of *n*-hydrocarbons, and by computer matching against commercial (NIST 98 and ADAMS) and homemade library mass spectra built up from pure substances and components of known oils and MS literature (Massada, 1976; Jennings and Shibamoto, 1980; Swigar and Silverstein, 1981; Davies, 1990; Adams, 1995).

Determination of total phenols and flavonoids

The concentrations of phenols and flavonoids in the crude extracts were expressed as pyrocatechol and quercetin equivalents, respectively, and they were calculated according to the following equations (Ertaş et al., 2014):

Absorbance = 0.0035 pyrocatechol(µg) + 0.045

Absorbance = 0.205 quercetin(µg) – 0.1528

Figure 1: *Carduncellus pinnatus* (Desf.)DC. (=*Carthamus pinnatus* Desf., photos: K. Rebbas,2017)

Antioxidant activity of the extracts

- B-Carotene bleaching method

0.5 mg of β-carotene in 1 mL of chloroform was added to a linoleic acid (25 µL) and Tween 40 emulsifier (200 mg) mixture. After evaporating the chloroform, 100 mL of distilled water saturated with oxygen were added, followed by shaking; 160 µL of this mixture were transferred into different test tubes containing 40µL of the sample solutions at different concentrations. The emulsion was added to each tube and the zero time absorbances of the values were measured at 470 nm. Mixture was incubated for 2 h at 50 °C (Slinkard and Singleton, 1977; Ertaş *et al*., 2014).

- Free radical scavenging activity method

160 µL of 0.1 mM DPPH solution in methanol were added to 40 µL of sample solutions in methanol at different concentrations. After 30 min the absorbance values were measured at 517 nm. DPPH free radical scavenging potential was calculated using the following equation: (Sarikurkcu et al., 2008; Ertaş et al., 2014).

DPPH scavenging effect (Inhibition %) = $A_{control}$-A_{sample} / $A_{control}$× 100

$A_{Control}$ is the absorbance of the initial solution of DPPH$^{\cdot}$

A_{Sample} is the absorbance of the remaining DPPH$^{\cdot}$ in the presence of the extracts or positive controls.

- ABTS cation radical decolorization assay

7 mM of ABTS in H_2O wereadded to 2.45 mM potassium persulfate to produce ABTS$^{\cdot+}$ and the solution was stored in the dark at 25 °C for 12 h. The prepared solution was diluted with ethanol to get an absorbance of 0.700 ±0.025 at 734 nm. ABTS$^{\cdot+}$ solution (160 μL) was added to each sample solution at different concentrations. After 30 min, the percentage inhibition at 734 nm was measured for each concentration relative to a blank absorbance (methanol). The following equation was used to calculate the scavenging capability of ABTS$^{\cdot+}$ (Zengin *et al*., 2010; Ertaş*et al*., 2014):

ABTS$^{\cdot+}$scavenging effect (Inhibition %) = $A_{control}$-A_{sample} / $A_{control}$× 100 *Acontrol*

- Cupric reducing antioxidant capacity (CUPRAC) method

The methanol extract and EO of leaves and flowers were dissolved in methanol. to prepare their stock solution at 1000 μg/mL concentration. Aliquots of 61 µl of 1.0 $\times 10^{-2}$M copper(II) chloride, 61 μL of NH4OAc buffer (1 M, pH 7.0), and 61μL of 7.5 × 10^{-3} M neocuproine solution were mixed; $x\mu$L of sample solution (2.5, 6.25, 12.5, and 25μL) and (67 -*x*) μL of distilled water were added to make the final volume 250 μL. The tubes were stopped, and after 1h the absorbance at 450 nm was measured against a reagent blank (Zengin *et al*., 2010; Ertaş *et al*., 2014).

Anticholinesterase activity of the extracts

All samples were dissolved in ethanol to prepare their stock solution at 4000 μg/mL concentration. Aliquots of 150 μL of 100 mM sodium phosphate buffer (pH 8.0), 10 μL of sample solution, and 20 μL BChE (or AChE) solution were mixed and incubated for 15 min at 25°C, and DTNB (10 μL) was added. The reaction was then initiated by the addition of butyrylthiocholine iodide (or acetylthiocholine iodide) (10 μL). The final concentration of the tested solutions was 200μg/mL(Ellman et al., 1961). The hydrolysis of these substrates was monitored using a BioTek Power Wave XS at 412 nm.

Antimicrobial activity of the extracts

The extracts were tested using the disk diffusion method against gram-positive bacteria (*Staphyloccocus aureus* ATCC25923, *Micrococcus luteus* ATCC533) and gram-negative bacteria (*Escherichia coli* ATCC25922, *Klebsiella pneumonia* ATCC2242), obtained from Department of SNV, University M'sila. The bacterial strains were first grown on Muller Hinton medium (MHI) at 37 °C for 24 h prior seeding onto the nutrient agar. The essential oil and MeOH extracts were mounted on sterile filter paper discs (6 mm in diameter) at the following

concentrations: 16, 8, 4, and 2 mg/ml. Discs were placed on the inoculated agar media. Treated Petri discs were kept at 4°C for 1h, and incubated at 37 °C for 24h. Antibacterial activity was assessed by measuring the growth inhibition zone surrounding the discs. Each experiment was carried out in triplicate.

RESULTS AND DISCUSSION

Essential oils composition of aerial parts is reported in Table 1. 104 compounds were detected, representing 95.29 % of the whole oil. This essential oil (yield 0.02%, w/w) was mainly composed of non-terpene derivatives (33.39%) and oxygenated sesquiterpenes (32.03%), with caryophyllene oxide (23.12%) as the major constituent.

Other important classes of chemicals were apocarotenoids (12.54%), oxygenated monoterpenes (7.89%), sesquiterpene hydrocarbons (4.7%), monoterpene hydrocarbons (3.66%), some phenylpropanoids were also detected (1.06%).

Main constituent of essential oil from aerial parts was caryophyllene oxide (23.12%), followed by (*E*)-2-hexenal (8.35%), (*E*)-*β*-ionone (6.01%), (*E*)-geranylacetone (2.96%), and nonanal (2.65%) (Figure 2, Table 1).

Many phytochemical studies have been conducted so far to investigate chemical composition of essential oils of *Carduncellus* species from different origins. Essential oil of aerial parts of *Carduncellus helenioides* produced in Algeria contains 85.57% of the total oil. Major constituents were diepicedrene-1-oxide (10.6%), isoaromadendrene epoxide (7.1%), caryophyllene oxide (6.20 %) and *β*-eudesmol (6.17%), aromadendrene oxide (1.3 %) (Meratate et al.,2016).

From oil yield of *Carthamus tinctorius* L. flowers growing in Kazakhstan, 20 components were identified, which represented about 99.81% of the total detected constituents, major compounds were heptocosane (34.75%), nonanoic acid (17.94%) and dec-2-en-1-ol (14.30%) (Turgumbayeva et al., 2015).

In Turkey, the oils of *Carthamus glaucus* gave 23 compounds representing 83.3% of the oil with linalool (38.5%), longifolene (6.8%) and caryophyllene alcohol (6.2%) (Toker and Keskin, 2008).

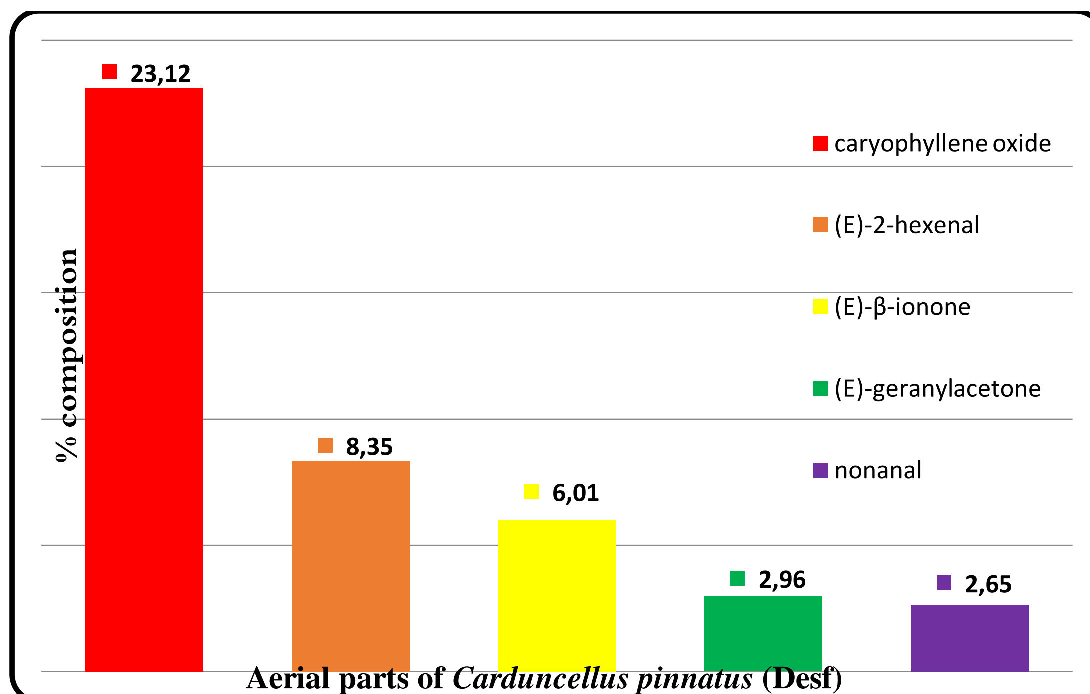

Figure 2: Percentages of the main representative compounds in the essential oil isolated from aerial parts of *Carduncellus pinnatus*

Table 1: Composition of the essential oils of the aerial parts of *Carduncellus pinnatus* from Algeria

Compound name	I.r.i.[a]	Content (%)
Furfural	830	0.20
(*E*)-2-hexenal	856	**8.35**
1-hexanol	871	0.24
Cyclofenchene	-	0.26
2-heptanone	889	Tr
Heptanal	899	0.89
(*E,E*)-2,4-hexadienal	913	0.22
Tricyclene	932	0.41
Benzaldheyde	963	0.45
(*E*)-2-heptenal	967	0.68
1-heptanol	971	Tr
1-decene	991	Tr
1-octen-3-ol	980	0.40
3-octanone	988	0.63
6-methyl-5-hepten-2-one	989	1.48
2-carene	1001	2.07
(*E*)-3-hexenol acetate	1004	2.20
α-phellandrene	1005	1.18
(*E,E*)-2,4-heptadienal	1015	2.27
Limonene	1031	Tr
Benzyl alcohol	1036	Tr
Benzeneacetald	1045	1.86
Bergamal	1055	0.36
meta-tolualdehyde	1068	0.33
cis-sabinene hydrate	1070	1.73
1-octanol	1072	0.70
p-tolualdehyde	1081	Tr
trans-Linalool oxide	1088	0.39
tetrahydrolinalool	1099	0.49
Linalool	1100	1.13
Nonanal	1103	2.65
β-Thugone	1117	0.18
Isophorone	1118	0.20
(*Z*)-myroxide	1132	0.20
cis-Limonene oxide	1134	Tr
(*E,Z*)-2,6-nonadienol	-	0.68
cis-Chrysanthenol	1164	0.39
Isopinocampheol	1181	0.23
Naphthalene	1182	Tr
p-Cymen-8-ol	1185	

α-Terpineol	1191	0.29
trans-dihydrocarvone	1200	0.20
Verbenone	1205	0.88
Decanale	1204	0.82
4-methylene-isophorone	1216	0.30
trans-Carveol	1219	0.25
β-Cyclocitrat	1222	1.62
Isobornyl formate	1233	0.24
methyl Carvacrol	1240	Tr
Neral	1241	0.18
cis-Myrtanol	-	Tr
Chavicol	1253	0.44
Piperitone	1255	Tr
Geraniol	1257	0.19
(*E*)-2-decenal	1263	0.17
(*E*-*Z*)-2,4-decadienal	1293	0.27
trans-Verbenyl acetate	1294	0.20
n-Tridecane	1299	Tr
Carvacrol	1300	0.39
Edulan I	-	0.24
(*E*,*E*)-2,4-decadienal	1316	0.68
Undecanal	1305	Tr
α-cubebene	1351	0.70
α-Terpinyl acetate	1352	Tr
Eugenol	1358	29
(*E*)-*β*-Damascenone	1383	2.11
1-undecanol	1367	0.16
β-Cubebene	1390	0.31
β-Elemene	1391	0.28
1-Tetradecane	1392	0.16
Dodecanal	1408	0.22
β-Caryophyllene	1418	2.23
γ-Elemene	1432	Tr
Aromadendrene	1442	Tr
(*E*)-Geranylacetone	1454	**2.96**
γ-Curcumene	1480	Tr
(*E*)-*β*-ionone	1485	**6.01**
(*Z*,*E*)-α-Farnesene	-	1.18
1-pentadecene	1491	2.57
(*Z*)-3-hexenyl benzoate	1570	0.88
Spathulenol	1576	0.16
Caryophyllene oxide	1581	**23.12**
Cedrol	1597	0.32
n-Hexadecane	1600	0.23

Humulene oxide II	1606	0.86
Tetradecanal	1611	0.29
β-Acorenol	1634	0.21
T-Muurolol	1645	0.82
α-Muurolol	1648	0.17
β-Eudesmol	1649	0.59
α-Cadinol	1654	0.19
14-hydroxy-9-*epi*-(E)-caryophyllene	1666	2.49
(*Z*)-α-Santalool	1677	0.68
(*E*)-Asarone	1678	0.33
(*E*)-Nerolidol acetate	1716	Tr
(E,E)-Farnesol	1720	Tr
n-Octadecane	1800	Tr
(*E,E*)-a-Farnsesyl acetate	1843	0.33
6,10,14-trimethylpentadecanone	1845	1.21
n-Nonadecane	1900	0.19
Hexadecanoic acid	-	Tr
n-Heneicosane	2100	1.31
n-Docosane	2200	0.24
n-Tricosane	2300	0.35
Total identified (%)		**95.29**
Number of compounds		**104**
Number of compounds		**104**

I.r.i.[a] = Linear retention indices (HP-5 column); **tr** = traces (< 0.1 %) ; - = not detected.

Total phenolic and total flavonoid contents of the extracts were determined as pyrocatechol (PEs) and qurcetin (QEs) equivalents, respectively. As shown in Table 2, the phenol contents of the methanol extract of aerial parts of *C. pinnatus* was 364.29±0.10 µg pyrocatechol eguivalents/mg extract and the flavonoid content was 15.80±1.26µg quercetin equivalents/ mg extract (Table 2).

These values are comparable to the value reported in literature for other *Carthamus* species as *C.tinctorius* L. the phenolic content of of MeOH extract was 2.12 mg/100g DW and Aqueous extracts was 1.32 mg/100g DW and major pytochemicals is flavonoids (chalcones: carthamin,carthamone), lignans (Yizhong et al., 2003).

The seeds of plants *C. tinctorius* cultivated in north-eastern of Morocco were rich in phenolic constituents and demonstrated good antioxidant activity, major types of phenolic compounds were tyrosol, bebzoic acid, vanillin, sinapic acid, naringin, rutin, pinoresinol, trans-cinnamic acid and trans-chalcon (Ben Moumen, al., 2015).

Table 2: Total phenolic and flavonoid contents of the aerial parts of *C. pinnatus* MeOH extracts[a]

Extracts		Phenolic content (µg PEs/mg extract)[b]	flavonoid content (µg QEs/mg extract)[c]
Methanol extracts	aerial parts	364.29±0.10	15.80±1.26

[a] Values are expressed asmeans±S.D. of three parallel measurements ($p<0.05$)
[b] PEs, pyrocatechol equivalents (y = 0,0035 + 0.045)
[c] QEs, quercetin equivalents (y = 0.205X – 0.1528)

The methanol extracts and the essential oils of the aerial parts of *C. pinnatus* were screened for their possible antioxidant activity using four complementary methods, namely *β*-carotene bleaching, DPPH free radical scavenging, and ABTS cation radical decolorization assays. In Table 3, the IC_{50} values calculated from the graph plotting inhibition percentage against extract concentration are reported. The IC_{50} value is inversely related to the antioxidant ability of extracts (Mukherjee et al., 2007). In the present study, both the antioxidant activity of the methanol extracts and essential oils increased dose-dependent way.

In ABTS assay, the MeOH exerted a greater antioxidant activity (IC_{50}=44.50±1.14µg/mL) than that of the same extract of the essential oils. BHT and α-tocopherol were used as referencesin the assay. The scavenging effectiveness of the methanol extracts, essential oils and standards with the ABTS radical was: α-tocopherol > BHT > MeOH > EO of aerial parts.

In the DPPH assay (Table 3), the MeOH exerted a greater antioxidant activity (IC_{50}=61.14±0.92µg/mL) than essential oils. Again, they resulted in lesser activity than the reference standards BHT and α-tocopherol: α-tocopherol > BHT > MeOH > EO of aerial parts.

A similar trend was also observed in the β-carotene/linoleic acid system (Table 3), with the MeOH more active than essential oils(IC_{50}=153.74±3.39µg/mL). Also this time the effectiveness was as above: BHT > α-tocopherol >MeOH L > EO of aerial parts.

As shown in (Table 3), the results of the CUPRAC (cupric reducing antioxidant capacity) of both the MeOH extract and the essential oils of the aerial parts of *C. pinnatus*. BHT and α-tocopherol were used as references in the assay. Again, they resulted lesser active: α-tocopherol > BHT > MeOH > EO of aerial parts.

In the previous study, the antioxidant activity of the crude extract from the *Carthamus tinctorius* collected in the month of April from the Hingoli district of Maharashtra India. Was found to be an effective antioxidant in different *in vitro* assays including reducing power, DPPH radical, ABTS radical, superoxide anion radical scavenging and hydrogen peroxide scavenging when it is compared to standard antioxidant compounds such as BHA, BHT and tocopherol (Mondadeet al., 2011).

The ethyl acetate fraction of the methanol extract of *Carthamus lanatus* L. exhibited a higher antioxidant activity than the butanol fraction measured by the (DPPH) free radical scavenging assay(Taskova et al., 2003). The seeds of *C.tinctorius* growing in Morocco were demonstrated good antioxidant activity(Ben Moumen et al., 2015).

As shown in (Table 4), the anthicholinesterase activity of the essential oils and methanol extracts of aerial parts of *C. pinnatus*, against BChE enzymes. Galantamine was the standard drug used for comparison. The essential oils extracts of aerial parts of *C. pinnatus* as high inhibition (81.80 %) while the methanol extracts poses moderates activity against butyrylcholinesterase enzyme at 200 µg/ mL.

In the previous study, the AchE inhibition of the MeOH extract of flowers from *Carthamus tinctorius* L. was (30.33%) (Mukherjee *et al.*, 2007; Adewusi *et al.*, 2010; Dhivya *et al.*, 2014).

Table 3: Antioxidant activity of the aerial parts MeOH extracts of *C. pinnatus*

Extracts	IC_{50} (µg /mL)			
	β-carotene	DPPH	ABTS	CUPRAC
Methanol extracts	153.74 ± 3.39	61.15 ± 0.92	44.51 ± 1.15	217.15 ± 0.33
Essential oils	IC50>1000	IC50>1000	IC50>1000	IC50>1000
α-Tocopherol	13.42 ± 0.727	19.61 ± 0.09	9.92 ± 0.17	12.73 ± 0.15
BHT	9.95 ± 0.19	47.09 ± 0.12	10.90 ± 0.16	39.93 ± 0.12

Table 4: Anticholinesterase activity of the aerial parts of *C. pinnatus* extracts and galantamine at 200 µg/mL.[a]

Extracts	Inibition % against BChE
Methanol extracts	32.86 ± 0.71
Essential oils	81.80 ± 0.71
Galanthamine [b]	81.87 ± 0.81

[a] Values expressed are means ± SD of 3 parallel measurements and they were calculated according to negative control.
[b] Standard drug.

The two essential oil samples and MeOH extracts were screened for their antibacterial activity against four bacteria strains. The results showed a strong activity against both Gram positive and Gram-negative bacteria. The two samples prevented the growth of all of the tested microorganisms, with an inhibition zone diameter increasing proportionally with the concentrations of the tested samples (Table 5). The inhibition diameters varied from 6.00 to 18.66 mm, with the highest value recorded for *E.coli* ATCC25922 at 16 mg/ml. The methanol extract of the aerial parts of *C. pinnatus*, measured by the respective inhibition zones, was established: *E.coli* ATCC25922 >*M.luteus* ATCC533>*K.pneumoniae*ATCC2242>*S.aureus* ATCC25923. In the case of the essential oils, the susceptibility was: *E.coli* ATCC25922 > *K.pneumonia* ATCC2242 >*M.luteus* ATCC533> *S.aureus* ATCC25923. In the literature for other *Caduncellus* species. The essential oil of *Caduncellus helenioides* (Desf.) showed antimicrobial activity against *Streptococcus aureus* ATCC 25923 was was sensitive microorganisms with diameters of inhibition of 11 mm lower than the standard Gentamicin 27mm. The essential oil did not display any antibacterial activity against *Enterococcus faecalis* , *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 (Meratate et al., 2016). In Algeria the extracts of root and leaf from *Carthamus caeruleus* L. showed significant effects on bacteria: *Staphylococcus aureus*, *Bacillus cereus* and *Acinetobacter bowii*; and human pathogenic fungus: *Candida albicans.Carthamus sp* could be used as a potential source of natural antimicrobial agents with beneficial therapeutic effects (Saffidineet al., 2013).
The ethyl acetate and methanol extracts, of *Carthamus tinctorius* L growing in Kazakhstandisplayed in vitro antimicrobial properties against different test organism. The fact that the ethyl acetate extracts of this medicinal plant were very active against the test organisms (Turgumbayevaet al., 2014).

Table 5: Antibacterial activity of the aerial parts of *Carduncellus pinnatus* extracts.

Microorganisms	Extracts	Inhibition zone diameter (in mm)			
		Concentration (mg/mL)			
		2	4	8	16
E.coli ATCC25922	E.O	6±00	10.33±14.66±1.001.15	12±0.30	
	MeOH	7±00	11±18.66±1.000.66	15.5±0.33	
K.pneumoniae ATCC2242	E.O	00	7 ±9.66±1.000.66	8.33±0.33	
	MeOH	7±00	8±13±1.000.66	11.5±0.33	
S.aureus ATCC25923	E.O	00	00	00	00
	MeOH	00	7±12.66±1.000.66	8.5±0.33	
M.luteus ATCC533	E.O	00	00	00	00
	MeOH	7±1.00	9±18±1.150.66	15±0.33	

CONCLUSION

The study of the composition and the biological activities of *Carduncellus pinnatus* essential oils harvested in Algeria shows that the main constituents of the essential oil of the aerial parts were caryophyllene oxide (23.12%), (*E*) - 2-hexenal (8.35%), (*E*) -*β*-ionone (6.01%), (*E*) –glyanyl acetone (2.96%), and nonanal (2.65%).

The MeOH extract from aerial parts showed a strong antioxidant activity demonstrated by the cationic trapping test ABTS. Extracts of essential oils from aerial parts showed an inhibitory activity of 81.80 % against butyrylcholinesterase at 200 µg / mL. The essential oils extracts of aerial parts of *C. pinnatus* as high inhibition (81.80 %) while the Methanol extracts posses moderats activity against butyrylcholinesterase enzyme at 200 µg/ mL. The highest antibacterial activity was found for MeOH extracts from aerial parts.

It's very important to study other species of the genus *Carthamus* existing in Algeria in order to know their chemical compositions and to study their biological activities.

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