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Chemical composition and antibacterial activity of Algerian *Launaea nudicaulis* essential oils

Narjes FADJKHI[a], Samir HAMEURLAINE[a], Ouroud fellah[a], Mohamed DJERMANE[b], Amar ZELLAGUI[c], Abdenabi ABIDI[b] and Noureddine GHERRAF[a]

*[a]*Laboratory of Natural Resources and Management of Sensitive Environments, Larbi ben M'hidi university, Oum El Bouaghi, 04000, Algeria, [b]Laboratory of Organic Synthesis, Modeling and Optimization of Chemical Processes Department of Process Engineering, University Badji-Mokhtar of Annaba, Annaba, 23000, Algeria and [c]Laboratory of Biomolecules and Plant Breeding, Life Science and Nature Department, Faculty of Exact Science and Life Science and Nature, University of "Larbi Ben M'hidi", Oum Elbouaghi 04000 Algeria*

Abstract

The chemical analyses of *Launaea nudicaulis* essential oils by Gas chromatography–mass spectrometry (GC-MS)allowed the identification of 94.1 % of the crude oil containing 50 volatile compounds. The major components detected were haxadecanoic acid 17.3 %, β-caryophyllene 7.9 %, (E)-β-farnesene 7.6 %, β-selinene 9.9 %, Spathulenol 4.9 %, and α-cadinol 5.9 %.. The IC_{50} of their scavenging activity is found to be 1.94 mg/mL. Moreover, the extract reveals an average *in vitro* antimicrobial activity on some strains, confirmed by the inhibition zone diameter ranging from 6 to 14.5 mm depending on the microorganism being tested.

Keywords: Essential oils; Antibacterial activity; GC/MS analysis; *Launaea nudicaulis*; DPPH

Full length article **Corresponding Author*, e-mail: samirhameurlaine@yahoo.com

1. Introduction

Medicinal plants have been used for centuries in folk medicine as remedies for human diseases. A survey by the World Health Organization reported that the major part of the world's populations rely on nonconventional medicines, especially herbal sources, for their primary healthcare. In recent years, infection rates have greatly increased and multidrug-resistant bacteria has become an ever-increasing therapeutic problem. Therefore, screening for new, safe, and alternative bioactive agents from various sources such as medicinal plants has become an absolute necessity [1-6].

Despite the existence of potent antibiotic and antifungal agents, resistant or multi-resistant strains are continuously appearing, imposing the need for a permanent search and development of new drugs. There is an urgent need to systematically evaluate the plants used in traditional medicine. Nowadays, a renewed interest in traditional medicine is observed. This revival of interest in plant-derived drugs is mainly due to the current widespread belief that "green medicine" is safe and more dependable than the costly synthetic drugs many of which have adverse side effects [7].

Launaea is a relatively small genus consists of about 40 plant species growing in dry, saline, and sandy habitats. They belong to the tribe Lactucaea of the daisy family Asteraceae. *L. nudicaulis* is an important plant species of this genus. It is a perennial naked-stemmed herb containing yellow flowers about 2 cm wide with sweet scent and is frequently and popularly used in folk medicine by local people for the treatment of fever, itches, ulcers, cuts, swellings, toothache, eczema eruptions and rheumatism. Due to the wide applications of *L. nudicaulis* in traditional medicine and its various potent biological activities including insecticidal, cytotoxic, antimicrobial, hypoglycaemic and anti-inflammatory, this plant has been extensively investigated and reported to be a rich source of various classes of compounds such as flavonoids, terpenoids, acetylenes, shingolipids, steroids and their glycosides [8,17].

The study in hand deals with the essential oil composition which depends upon external and internal factors affecting the plant such as environmental and climate conditions, season of collection, age of plants, and the stage of ripening of the fruits or genetic data [18-20].

2. Materials and Methods

2.1 Extraction and isolation of essential oils

The essential oils were extracted from 100 g of the dry aerial parts by hydro-distillation using Clevenger-type apparatus for 2 h. The obtained oils were separated completely from water without adding any solvent and kept in sterilized dark glass bottles at 4 ˚C until they were used for gas chromatography and mass spectrometry (GC-MS) analysis and antibacterial activity assay and antioxidant activity. Essential oil extractions were done in three replications and the yields were calculated.

2.2 DPPH radical scavenging activity

DPPH stable free radical method is an easy, rapid and sensitive way to survey the antioxidant activity of a specific compound or plant extracts [21]. The antioxidant activity of the crude extracts was assessed by the mean of 1,1-diphenyl-2-picrylhydrazyl (DPPH) colorimetric method [22-24]. This method depends on the reduction of purple DPPH to a yellow color diphenyl picrylhydrazine which showed maximum absorption at 517 nm. The mixture was shaken vigorously then incubated for 30 min in darkness at room temperature. Absorbance was measured at 517 nm. Methanol was used as blank; each experiment was performed in triplicate. The DPPH Radical scavenging activity was calculated according to the following equation:

$$I(\%) = [1-Ab_s/Ab_c]x100$$

Where Ab_s is the absorbance of the plant extracts containing DPPH and Ab_c is the absorbance of blank solution of DPPH without the sample

2.3 Antimicrobial screening

In recent years due to an upsurge in antibiotic-resistant infections, the search for novel archetype prescriptions to fight infections is an absolute need and in this regard, plant essential oils may offer a great potential and hope. Several studies have reported the efficacy of antibacterial obtained from the essential oils of various plant species [25]. In this study, antibacterial activity of essential oil extracted from aerial parts of *L. nudicaulis* was tested against different bacterial strains namely: *Escherichia coli, Staphylococcus aureus, Proteus sp, Klebsiella sp* and *Candida albicans*.

The antimicrobial tests were conducted against the microorganisms, grown on nutrient agar plates using disc diffusion technique. Five concentrations were prepared of essential oil including 8 mg/mL, 4 mg/ml, 2 mg/ml, 1 mg/ml and 0.5 mg/ml, using dimethyl-sulfoxide as a solvent and as a control.

3. Results and discussion

3.1 Scavenging effect

The IC_{50} of the antioxidant activity of *L. nudicaulis* essential oil using DPPH assay was assessed at 1.94 mg/mL, which was less effective than that of ascorbic acid taken as a positive control (0.13 mg/mL).

3.2 GC-MS analysis

The composition of the essential oil is presented in Table 1 where the compounds are listed in increasing order of retention index (RI). The compounds of aerial parts essential oil of *Launaea nudicaulis* are represented in the table 2. A total of 50 compounds were identified, representing 94.1% of the total oil. The sesquiterpene fraction represents the largest component of the oil (49.5%), (such as trans-b-bergamotene 1.8%, α-humulene 2.3%, (E)-β-farnesene 7.6%, β-selinene 9.9%, Kessane 1.2%, Spathulenol 4.9%, viridiflorol 2.4%, isospathulenol 1.8%, caryophylla-4(14),8(15)-dien-5-ol and α-cadinol 1.1%. 17.3% are fatty acids (hexadecanoic acid). 11.5% are monoterpene compounds such as 1,8-cineole 2.7%, linalool 2.7%, citranellol 2.1%, verbenone 3.2%. The other compounds are alkanes (5.6%). 3.5% are alcoholic compounds. 3.2% is phenylpropanoide, 1.8% are aldehydes, 0.9% esters and 0.8% are unsaturated aliphatic ketones. Another study dealing with essential oils of *Launaea nudicaulis* collected in Oman reported that the chemical composition involved mainly E-Citral, Z-Citral, DL-Limonene, Geranyl acetate, and trans-Caryophyllene at a percentage of 30, 22.2, 18.7, 8.4 and 6.7, respectively [26].

3.3 Antimicrobial activity

The results of the measurement of the inhibition zone of *Launaea nudicaulis* are shown in the table 2. The quantification of antimicrobial activity of *L. nudicaulis* essential oils was measured by the agar disk diffusion method. The essential oils showed some moderate activity against the selected strains with inhibition zones ranging from 6 to 14.5 mm. To the best of our knowledge no studies were reported about the antimicrobial activity of *L. nudicaulis* essential oils. Nonetheless, some reports were published about the activity of other extracts [26, 27].

Table 1. Chemical composition of essential oils of *Launaea nudicaulis*

Peaks	Compounds	%	RI
1	(E)-2hexanal	0.6	851
2	1-octen-3-ol	3.5	979
3	6-methyl-5-hepten-2-one	0.8	984
4	(E,E)-2,4-heptadienal	0.1	1012
5	1,8-cineole	2.7	1030
6	Phenylacetaldehyde	0.1	1042
7	Linalool	2.7	1102
8	Nonanal	0.9	1103
9	Camphor	0.2	1143
10	Citranellol	2.1	1150
11	Terpinen-4-ol	0.1	1176
12	Methyl salicylate	0.6	1193
13	Verbenone	3.2	1206
14	(E,E)-2,4-nonadienal	0.1	1215
15	Geraniol	0.1	1256
16	Ethyl salicylate	0.3	1267
17	Vinylguaiacol	T	1319
18	Bicycloelemene	0.1	1334
19	eugenol	T	1360
20	α-copaene	0.2	1364
21	α-isocomene	0.8	1383
22	β -elemene	0.5	1389
23	Tetradecane	2.2	1400
24	(Z)-isoeugenol	0.3	1405
25	β -caryophyllene	7.9	1417
26	β -copaene	0.1	1431
27	trans-b-bergamotene	1.8	1435
28	g-elemene	0.5	1436
29	geranyl acetone	2.4	1453
30	α-humulene	2.3	1455
31	(E)-β-farnesene	7.6	1456
32	Germacrene-D	0.3	1482
33	β-selinene	9.9	1487
34	g-humulene	0.2	1492
35	7-epi-α-selinene	0.4	1512
36	d-cadinene	0.6	1524
37	(E)-g-bisabolene	0.3	1528
38	Kessane	1.2	1530
39	Oxide-β -caryophyllene	0.2	1547
40	Spathulenol	4.9	1576
41	oxidcaryophyllene	0.3	1582
42	viridiflorol	2.4	1590
43	hexadecane	2.7	1600
44	humulene epoxide II	0.2	1608
45	dillapiole	2.5	1624
46	isospathulenol	1.8	1627
47	caryophylla-4(14),8(15)-dien-5-ol	1.1	1639
48	α-cadinol	5.9	1652
49	heptadecane	0.7	1760
50	hexadecanoic acid	17.3	1978

Table 2. Inhibition zone diameter (mm) of the antimicrobial activity of essential oil of *L. nudicaulis*

Concentrations (mg/ml)	*E. coli*	*S. aureus*	*Proteus sp*	*Klebsiella sp*	*C. albicans*
8	14.5±0.07	13.45±0.07	13.45±0.49	9.40±0.56	11.15±0.21
4	12.85±0.21	12.20±0.14	12.55±0.07	8.30±0.14	10.05± 0.07
2	12.10±0.14	11.30±0.14	11.35±0.07	8.05±0.07	9.25±0.07
1	9.75±0.70	10.95±0.07	10.9±0.14	7.15±0.21	9.00±0.0
0.5	9.05±0.07	10.00±0.0	9.60±0.0	6.20±0.28	-

Conclusions

The present study exposes valuable information about the composition and antimicrobial activity of the essential oils of *Launaea nudicaulis* grown in Algeria. Fifty compounds were identified in the essential oil of the plant and the major constituents are haxadecanoic acid, β-selinene and β–caryophyllene. The antimicrobial activity assay exhibits a moderate effect especially against *E. coli*.

References

[1] M.C. Durate, E.E. Leme, C. Delarmelina, A.A. Soares, G.M. Figueira, A. Sartoratto. (2007). Activity of essential oils from Brazilian medicinal plants on *Escherichia coli*. J Ethnopharmacol, 111. 197–201.

[2] A. Nostro, M.P. Germanó, V. D'Angelo, A. Marino, M.A. Cannatelli. (2000). Extraction methods and bioautography for evaluation of medicinal plant antimicrobial activity. Lett Appl Microbiol 30. 379–84.

[3] H.M. Adamu, O.J. Abayeh, M.O. Agho, A.L. Abdullahi, A. Uba, H.U. Dukku, B.M. Wufem. (2005). An ethnobotanical survey of Bauchi State herbal plants and their antimicrobial activity. J Ethnopharmacol 99. 1–4.

[4] H. Laallam, L. Boughediri, S. Bissati, T. Menasria, Mohamed S. Mouzaoui, S. Hadjadj, R. Hammoudi, and H. Chenchouni. (2015). Modeling the synergistic antibacterial effects of honey characteristics of different botanical origins from the Sahara Desert of Algeria. Front Microbiol. 6. 1239.

[5] T. Essawi, M. Srour (2000). Screening of some Palestinian medicinal plants for antibacterial activity. J Ethnopharmacol 70. 343–9.

[6] R.A.A. Mothana, U. Lindequist (2005). Antimicrobial activities of some medicinal plants of the Island Soquotra. J Ethnopharmacol. 96. 177–81.

[7] L.L. Silver. (1993). Discovery and development of new antibiotics: the problem of antibiotic resistance. Antimicrob. Agents Chemother. 37. 377-383.

[8] S.I. Ali and M. Qaiser. (2002). "Flora of Pakistan", No. 207, Department of Botany, University of Karachi and Missouri Botanical Press, Missouri, USA.

[9] P. Ozenda, (2004). Flore et Vegetation du Sahara. CNRS, Paris, p. 662.

[10] S.R. Baquar. (1989), Medicinal and Poisonous Plants of Pakistan, Printas Press, Karachi, p. 31.

[11] *S.* Collenette. (1985). An illustrated guide to the flowers of Saudi Arabia, Flora publication No.1, Scorpion Publishing Ltd, Buckhurst hill, Essex, p. 162.

[12] M.M. Bhandari. (1988). Flora of Indian. Desert. Mps Repros, Jodhpur, India, p. 182.

[13] S. Rashid, M. Ashraf, S. Bibi, R. Anjum, (2000). Antibacterial and antifungal properties of *Launea naudicaulis* and *Launea resedifolia* (Linn.), Pak. J. Boil. Sci., 3. 630-632.

[14] F. Mansoor and I. Anis. (2013) Chemical studies of *Launaea nudicaulis* Hook f. extracts with Antioxidant and Urease Inhibitory Activities J. Chem. Soc. Pak., 35. 233.

[15] S. Rashid, M. Ashraf, S. Bibi and R. Anjum. (2000). Insecticidal and Cytotoxic Activities of *Launaea nudicaulis* (Roxb.) and *Launaea resedifolia* (Linn.) Pak. J. Biol. Sci, 3 808.

[16] M. Saleem, S. Parveen, N. Riaz, M.N. Tahir, M. Ashraf, I. Afzal, M.S. Ali, A. Malik (2012). Isolation of DPPH free radical scavengers and butyrylcholinesterase inhibitors from *Launaea nudicaulis* growing in Cholistan Desert near Bahawalpur, Pakistan. Jabbar, Phytochemistry Lett., 5. 793.

[17] M.D. Carmona, R. Lorach, D.O. Rivera, (2005). "Zahraa", a Unani multicomponent herbal tea widely consumed in Syria: components of drug mixtures and alleged medicinal properties. J. Ethnopharmacol. 102, 344–350.

[18] J. Bernath, E. Nemeth, F. Petheo, E. Mihalik, K. Kalman, R. Franke. (1999). Regularities of the essential oil accumulation in developing fruits of fennel (*Foeniculum vulgare* Mill.) and its histological background, J. Essent. Oil Res, 11. 431-438.

[19] R. Piccaglia, M. Marotti. (2001). Characterization of some Italian types of wild fennel (*Foeniculum vulgare* Mill.), J. Agric Food Chem, 49 (1), 239-244.

[20] M. Belboukhari, A. Cheriti, N. Belboukhari. (2013). Structure-Antioxidant Activity Relationship of Some Flavonoids Isolated from *Warionia saharae* (Asteraceae) Asian J. Chem. 25(11). 4723-4725.

[21] M. Belboukhari, A. Cheriti, N. Belboukhari (2011). Total phenolic content and in vitro antioxidant activity of extracts from the endemic medicinal plant *Warionia saharae* NPAIJ: Natural Products an Indian Journal, 7(3).147-150.

[22] S. Tennyson, K. Balaraju, K. Park. (2012). In vitro antioxidant activity of *Ageratum houstonianum*

Mill. (Asteraceae) Asian Pac. J. Trop. Disease; 2 Supplement 2, s712-s714.

[23] L. Mouhssen (2001). Methods to study the photochemistry and bioactivity of essential oils. Phytother Res. 18.435-448.

[24] E. Derwich, Z. Benziane, B. Abdellatif. (2010). GC-MS analysis and antibacterial activity of the essential oil of *Mentha*. *Pulegium* grown in Morocco. Res J Agric Biol Sci 6(3). 191-198.

[25] A.G. Ponce, R. Fritz, C.E. del Valle, S.I. Roura. (2003). Antimicrobial activity of essential oils on the native microflora of organic Swiss chard. Lebensmittel-Wissenschaft und-Technologie, 36: 679–684.

[26] J.A. Al-Mahrezi, J.N. Al-Sabahi, M. S. Akhtar, D. Selim and A.M. Weli. Essential Oil Composition and Antimicrobial Screening of *Launaea Nudicaulis* Grown In Oman, IJPSR, 2011; Vol. 2(12): 3166-3169.

[27] S. Khatri, and A.K. Chhillar. (2015). Phytochemical Screening and Antibacterial, Analysis of *Launaea nudicaulis*, International Journal of Basic and Applied Biology. 2(6) 399-403.