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CHEMICAL COMPOSITION AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL OF *ARAUCARIA EXCELSA* R. Br. CULTIVATED IN EGYPT

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ABSTRACT:

The essential oil of leaves, stem bark and wood of *Araucaria excelsa* were prepared by hydrodistillation. Analysis of the oils by GC and GC-MS resulted in the identification of 78 compounds. The diterpene; phyllocladene (37.86%) is the major compound of leaves oil, while α-pinene (16.46%) and caryophyllene oxide (15.71%) are the major components of bark oil. The diterpenoids, kaurene, isopimarol and phyllocladanol are the major constituents of wood oil in relative percentage of 18.59%, 12.09% and 10.73%, respectively. The major component of the leaves oil; phyllocladene was isolated and its structure was established by spectral data (UV, IR, MS, ^{1}H- and ^{13}C-NMR). All the prepared oils and phyllocladene exhibited marked antimicrobial and antifungal activities.

INTRODUCTION

Araucariaceae (Araucaria family, Monkey-Puzzle tree family) is characterized by ever-green resinous trees represented by only two genera Araucaria and Agathis comprising about 38 species[1,2]. *Araucaria excelsa* R. Br. (Norfolk – Island – Pine) is a pyramidal tree of height about 200 ft which introduced to Egypt and cultivated as an ornamental plant[1-3].

Chemical investigation of the oil obtained from the terminal leafy branchlets of *Araucaria excelsa* growing in New Zealand resulted in the isolation and identification of three compounds, α-pinene, phyllocladene and isophyllocladene[4,5]. Also, a number of known diterpenes were isolated from oleoresin of *Araucaria excelsa*[6,7].

Nothing is available in literature concerning the chemical constituents and the biological activity of the Egyptian species. Thus, it was deemed of interest to study the chemical constituents and the antimicrobial activity of *Araucaria excelsa* cultivated in Egypt.

In the present work, the volatile oils prepared from leaves, stem bark and wood were analyzed using GC and GC-MS. The main component of leaves oil was isolated and its structure was elucidated using different spectral analysis (UV, IR, MS, ^{1}H-, ^{13}C-NMR, APT, DEPT, HSQC and HMBC). The qualitative and quantitative variations of the different three oils have been recorded. Also, the antimicrobial activities of the oils were evaluated.

EXPERIMENTAL

Material and methods:

Plant material: The branches of *Araucaria excelsa* R. Br. (Araucariaceae) were collected in September 1999 from plants cultivated in Al-Montazah garden, Alexandria, Egypt. The plant was kindly identified by Dr. Nabil El-Hadidi, Professor of Plant Taxonomy, Faculty of Science, Cairo University. A voucher specimen is kept at the Pharmacognosy Department, Faculty of Pharmacy, Zagazig University, Egypt.

Melting point was determined on a digital melting point apparatus, electrothermal LTD, England and was uncorrected; UV spectrum was recorded on Shimadzu UV-260 (Japan) and IR on Beckham (IR) 4220 double beam spectrophotometer; EIMS was recorded on a Finnigan MAT 4500 spectrometer operating at 70 eV; ^{1}H- and ^{13}C-NMR spectra were obtained on a Varian MAT at 300 and 75 MHz, respectively; silica gel 60 (Merck, 0.015 – 0.040 mm) was used for column chromatography; precoated TLC sheets (silica gel 60 GF_{254}, Merck) were used.

Methods:

Preparation of oils:

The volatile oils were prepared from fresh leaves, stem bark and wood by steam distillation using E.P. method[8] and the percentage yield (v/w) was found to be 1.40%, 0.20% and 0.05%, respectively. The oils were dried with anhydrous sodium sulphate and kept at 4°C in sealed vials for analysis.

Analysis of oil:

GC analysis was carried out on a Varian 3400 Gas Chromatograph equipped with a fused silica column (DB5, 30 m × 0.25 mm I.D., 0.25 μm film thickness). J&w P/N: 122 – 5032 under the following conditions: carrier gas: He with flow rate 2 ml/min^{-1}; detector: FID; temp. 300°C; inj. temp.: 250°C; split ratio: 1 : 10, oven temp. program: initial temp.: 50°C for 4 min, 50 – 90°C at 4°C/min^{-1}, 90 – 300°C at 10°C/min^{-1} then hold for 10 min. Kovats retention indices (RI) were calculated using co-chromatographed standard n-alkane mixture (C-8 to C-24)[9]. Quantitation of the components was performed on the bases of their GC peak areas. For GC-MS analysis : GC conditions were mentioned above, and the capillary column was directly coupled with a quadrupole mass spectrometer (Finnigan MAT SSQ 7000). EIMS were recorded at 70 eV.

Qualitative analysis of the oil constituents was performed by comparing their retention indices and mass fragmentation patterns with the published data (10-14) and also by the aid of the computer library search. The results of GC and GC-MS analysis are recorded in Table 1.

Isolation of the major compound:

The fresh leaves of *Araucaria excelsa* (1.5 Kg) was subjected to hydrodistillation to give 20 ml of yellowish-white fragrant oil. On cooling this oil, white precipitate was separated. TLC investigation of the precipitate (light petroleum – EtOAc, 9.5 : 0.5) revealed one major spot (R_f 0.43). About 1.1 g of the precipitate was packed on silica gel column (80 g, 2.5 × 50 cm) eluted with n-hexane and the polarity was increased in gradient manner with light petroleum then with benzene. White needle-shaped crystals (730 mg) were successfully isolated from the fractions eluted with light petroleum/benzene (9:1). The isolated compound showed melting point 96-97°C; UV: λ_{max} MeOH 227 nm; IR: ν_{max}^{KBr} 3070, 2900, 2850, 1650, 1440, 1380, 1360 and 870 cm^{-1}; EIMS m/z (rel. abund %): 272 (M^+, 100), 257 (59), 230 (36), 229 (87), 228 (16), 187 (24), 175 (18), 148 (23), 147 (24), 137 (19), 133 (63), 131 (18), 123 (39), 121 (18), 119 (33), 109 (31), 108 (26), 107 (27), 106 (26), 105 (46), 95 (35), 93 (37), 91 (71), 81 (45), 79 (47), 77 (28), 69 (51), 67 (45), 55 (69) and 53 (24). ^{1}H- and ^{13}C-NMR data are recorded in Table 2.

Antimicrobial Activity

The antimicrobial activity of the oils of different plant parts as well as the isolated compound phyllocladene was carried out, adopting the agar diffusion method[15]. Each cup was accurately filled with 70 µl of 10% of each oil and the isolated compound in dimethylformamide (DMF). The potency was tested against *Staphylococcus aureus*, *Sarcina lutea* and *Bacillus subtilis* (Gram +ve bacteria), *Escherichia coli* (Gram -ve bacteria), *Candida albicans* and *Aspergillus* spp (fungi). The microorganisms used were obtained from stock cultures of the Department of Microbiology, Faculty of Pharmacy, Zagazig University. The plates were incubated overnight at 37°C in case of bacteria and at 30°C in case of fungi. The diameters of inhibition zones were measured (mm) against Penicillin (150 µg/ml) and Nystatin (250 µg/ml) as reference antibiotic and antifungal, respectively. The results are recorded in Table 3.

RESULTS AND DISCUSSION

Results of the qualitative and quantitative analysis of the essential oils of leaves, stem bark and wood of *Araucaria excelsa* are recorded in Table 1.

The previous work on the New Zealand species *Araucaria excelsa* established identification of α-pinene, phyllocladene and isophyllocladene[4,5]. In the present work, we have identified altogether 78 compounds from the oils of the studied organs (leaves, stem bark and wood). Diterpenoidal compounds compose the main constituents of leaves oil (53.99%) and wood oil (49.69%), while sesquiterpenoids constitute the major constituents of stem bark oil (41.36%).

From the volatile oil of leaves (pale yellow, aromatic odour) 38 compounds were identified constituting 97.0%. Phyllocladene (37.86%) was isolated and its structure was elucidated by different spectral methods. In addition, γ-cadinene (9.14%), α-himachalene (5.03%) (sesquiterpene hydrocarbons), limonene (6.43%) and *p*-mentha-1(7),8-diene (5.66%) (monoterpene hydrocarbons) were the submajor components.

In the stem bark oil (yellow, aromatic odour), oxygen containing sesquiterpenes constitute (31.13%), the major compound is caryophyllene oxide (15.71%), while 14-hydroxy-9-epi-(E)-caryophyllene constitute (8.26%) and khusinol (6.94%). From monoterpene hydrocarbon (24.22%) α-pinene was found to be 16.46%. Oxygenated monoterpenes constitute only 2.14%. Abietadiene (8.49%), isokaurene (4.44%), kaurene (2.59%) and a mixture of abietatriene and manool (10.07%) were the major diterpenoid components. Abital was identified in leaves and bark oils (2.86% and 3.56%, respectively).

Oil of the wood (pale yellow, aromatic odour) was richer in the delayed compounds than the earlier eluted ones; in particular, oil is rich with diterpenes; kaurene (18.59%), isopimarol (12.09%) and phyllocladanol (10.73%). α-Copaene (8.57%), γ-muurolene (4.31%) and γ-cadinene (2.37%) are the major sesuiterpene hydrocarbons, while caryophyllene oxide (6.90%) and 1-epi-cubenol (3.06) are the major components of oxygen - containing sesquiterpenes group. Monoterpene hydrocarbons constitute 4.87%; the major component is tricyclene (3.75), while oxygen containing monoterpenes constitute 4.30% and borneol (1.71%) is the major one.

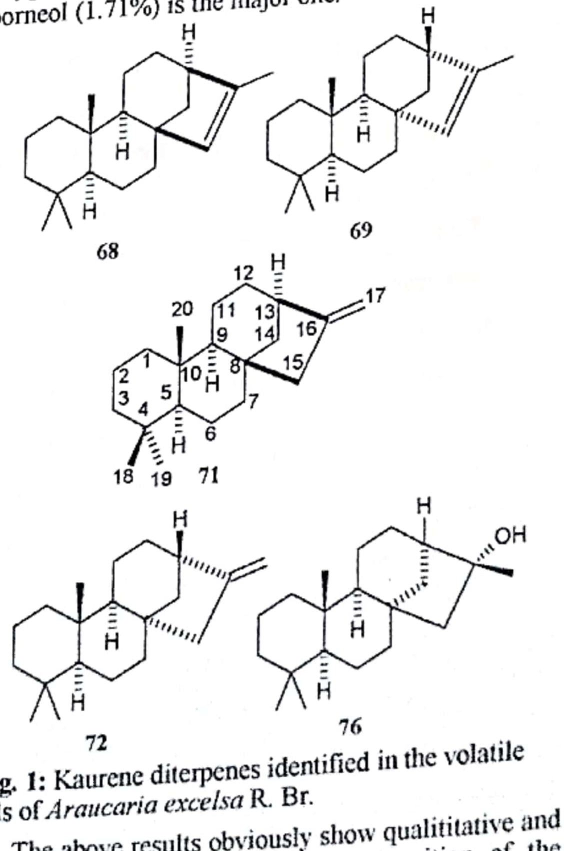

Fig. 1: Kaurene diterpenes identified in the volatile oils of *Araucaria excelsa* R. Br.

The above results obviously show qualititative and quantitative differences in the composition of the essential oils obtained from the different plant parts of

Zagazig J. Pharm. Sci., June 2003
Vol.12, No. 1, pp. 36-43

Araucaria excelsa.

The major component of leaves oil was identified as phyllocladene; previously identified in the oil of the New Zealand species; by comparing its retention index (2009) and mass fragmentation pattern with the published data[10]. Phyllocladene (Fig. 1) was isolated and its structure was confirmed through different spectral data. EIMS showed M^+ at m/z 272 for molecular formula $C_{20}H_{32}$. IR spectrum displayed absorption bands at 3070 cm^{-1} (=CH_2), 1650 cm^{-1} (C=C) and 870 cm^{-1} (=CH_2 bending)[16]. ^{13}C-NMR data (Table 2) showed the presence of 20 carbons; three methyls, ten methylene, three methines and four quaternary carbons through APT and DEPT experiments. ^{1}H-NMR spectrum (Table 2) displayed the characteristic exocyclic methylene protons (H-17) at 4.70 ppm (1H, d, J = 1.2 Hz) and 4.74 ppm (1H, d, J = 1.2 Hz) and three methyl singlets at 0.86, 0.81 and 0.92 ppm for H-18, 19 and 20, respectively.

In the HMBC spectrum (Fig. 2, Table 2) H-13 resonance at 2.52 ppm gave long range correlation with carbon signals at δ 34.01 (C-14), 50.35 (C-15), 157.63 (C-16) and 102.32 (C-17) supporting kaurene structure. The exact chemical shift of (C-3) and (C-1) was confirmed through long range correlation between (H_2-1) and carbon signals at δ 56.93 (C-9) and δ 15.11 (C-20).

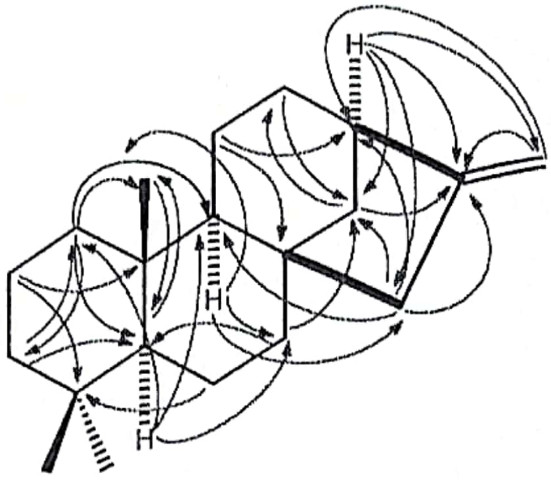

Fig. 2: HMBC of phyllocladene

The obtained results as well as the available literature of the related compounds[17-22] confirmed the structure of phyllocladene (8β, 13β-kaur-16-ene). To the available knowledge, ^{1}H- and ^{13}C-NMR assignments of phyllocladene are addressed herein for the first time.

Concerning the antimicrobial activity (Table 3), the volatile oils of stem bark and wood showed strong antimicrobial activity against the tested strains for both bacteria and fungi. The leaves oil and its major component (phyllocladene) exhibited significant activity against the tested strains for both bacteria and fungi except *sarcina lutea* (Gram +ve cocci).

Table 1: GC-MS Analysis of the essential oils of leaves, stem bark and wood of *Araucaria excelsa R. Br.*

No.	Compound	RI*	Parent ion (M^+)	Base peak (B.p)	Major peaks	Percentage		
						Leaves	Bark	Wood
1	Tricyclene	933	136	93	91,77,41,121,105,67	0.24	1.61	3.75
2	α-Thujene	938	136	93	91,77,41,121,105,51,65	0.20	1.69	--
3	α-Pinene	945	136	93	91,92,79,77,41,121,105	0.13	16.46	--
4	Verbenene	972	134	91	41,119,77,65,51,105	--	0.67	--
5	Sabinene	982	136	93	41,91,77,79,51,65,121,107	--	1.00	--
6	β-Pinene	985	136	93	79,69,53,121,105,107	--	0.45	--
7	Myrcene	994	136	41	93,69,79,53,81,107	--	0.16	--
8	p-Mentha-1(7),8-diene	1001	136	93	41,91,77,79,53,121,105,67	5.66	--	--
9	α-Phellandrene	1006	136	93	91,77,41,79,69,53,65,121	3.47	--	--
	Unidentified	1008	136	93	41,69,79,91,77,53,121,107	1.55	--	--
10	Isosylvestrene	1011	136	93	121,79,67,41,107,53	0.19	--	--
11	p-Cymene	1030	134	119	91,41,67,77,53,65,105	--	1.45	1.12
12	Limonene	1036	136	68	93,67,79,53,41,107,121	6.43	0.61	--
13	γ-Terpinene	1067	136	93	91,77,121,41,105,65	1.01	--	--
14	Terpinolene	1085	136	93	121,91,79,41,77,105,53,67	1.27	--	--

Table 1: *continued*

15	*α*-Pinene oxide	1093	152	41	43,67,53,55,109,93,83	--	0.36	--
16	*cis*-Thujone	1096	152	41	67,53,55,109,81,95	--	0.46	--
17	*trans*-Thujone	1096	152	41	67,55,82,81,109,95	0.25	--	--
18	*α*-Campholenol	1126	152	108	93,67,41,81,55,119	1.01	0.12	--
19	*trans*-Pinocarveol	1139	152	41	55,91,79,109,70,119,134	0.26	0.15	--
20	*cis*-Verbenol	1141	152	41	94,109,79,67,59,119,137	0.30	0.37	--
21	Camphor	1143	152	95	41,81,55,108,109,67,137	--	--	0.58
22	*trans*-Verbenol	1144	152	41	55,91,81,67,109,119,137	1.75	--	--
23	*p*-Menth-8-en-1-ol**	1148	154	43	93,71,79,55,121,107,139	1.85**	--	--
24	*p*-Menthan-8-ol**	1148	n.d*	59	43,81,123,67,155	-	--	--
25	Borneol	1163	154	95	41,43,110,55,67,136,121,111	--	--	1.71
26	3-Thujanol**	1165	n.d.	43	95,55,121,67,81,107,136	0.32**	--	--
27	*α*-Phelandrene-8-ol**	1165	n.d.	59	79,91,94,43,109,119		--	--
28	*p*-Menth-1-en-8-ol	1191	n.d.	59	43,136,121,93,81,67,107	0.72	--	0.86
29	Myrtenol	1210	152	79	91,41,108,107,67,119,121, 136	0.11	--	--
30	Verbenone	1215	150	107	41,91,135,79,55,67,122	0.26	--	--
31	*trans*-Carveol	1223	152	109	41,84,55,91,69,119,137,123	0.25	--	--
32	*trans*-Ocimenone	1245	150	41	91,135,107,79,55,67,95,83	--	0.53	--
33	2-Ethylmenthone	1276	182	55	41,69,83,97,111,125,140,153,167	0.25	--	1.15
34	Methyl nerolate	1284	182	41	69,83,91,109,95,123,139,151	--	0.15	--
35	*α*-Cubebene	1355	204	41	105,119,161,81,91,55,65,133	--	--	0.26
36	Cyclosativene	1373	204	41	105,119,161,91,79,55,133, 189,147	--	4.88	--
37	*α*-Copaene	1379	204	161	119,105,41,91,81,77,55,67, 133,189,147	1.59	--	8.57
38	*β*-Bourbonene	1388	204	81	80,123,41,161,105,91,53,133	--	--	1.13
	Unidentified	1412	202	43	41,55,91,118,131,105,81,77,159,1 61,175	--	--	0.17
39	*β*-Caryophyllene	1420	204	41	91,79,53,105,133,67,119,161,189	--	2.33	--
40	*β*-Cedrene	1420	204	161	41,120,91,105,79,133,69,147	--	--	0.29
41	*β*-Gurjurene	1433	204	161	41,91,105,119,77,133,147, 189	--	--	0.52
42	*α*-Himachalene	1446	204	41	93,79,91,133,105,119,161, 189	5.03	--	--
43	Seychellene	1456	204	41	91,79,133,105,161,119,147, 189,175	0.39	2.13	--
44	*γ*-Muurolene	1478	204	161	41,105,119,91,79,133,189, 149,147	--	--	4.31
45	*α*-Muurolene	1500	204	105	161,41,93,79,119,133,189, 147	--	--	1.81
46	*trans*-*β*-Guaiene	1510	204	41	105,91,161,119,133,189,147,175	--	0.37	--
47	*γ*-Cadinene	1519	204	161	91,41,105,79,119,133,147, 189,175	9.14	0.52	2.37

Table 1: *continued*

48	*cis*-Calamenene	1525	202	159	41,131,91,105,115,144,172	--	--	0.26
49	*Δ*-Cadinene	1528	204	161	119,105,41,91,134,81,189, 145	0.30	--	--
50	*α*-Calacorene	1547	200	157	142,41,115,91,55,105,77,129	--	--	0.26
51	Caryophyllene oxide	1588	220	41	79,91,67,55,107,121,135,149,161, 177,187	0.63	15.71	6.90
52	Humulene-1,2-epoxide	1608	220	43	138,67,109,96,81,123,161, 149	--	--	1.29
53	*β*-Oplopenone	1610	220	43	177,91,79,107,121,159,135, 205,187	--	--	0.81
54	1-epi-Cubenol	1630	222	41	161,119,105,95,55,81,133, 149	--	--	3.06
55	Cedr-8(15)-en-9-α-ol	1646	220	43	121,79,55,159,69,135,177, 187,205	--	--	1.97
56	14-Hydroxy-9-epi(β)-caryophyllene	1665	220	41	91,55,79,105,119,133,149, 159,177,189	--	8.26	1.81
57	Khusinol	1674	220	41	91,55,79,105,159,121,133, 177,187,202	--	6.94	1.44
58	Cedr-8(15)-en-9-α-ol acetate	1740	262	43	220,91,105,55,131,177,81, 69,187,202	--	--	1.10
59	*β*-Acoradienol	1760	220	41	55,91,79,67,105,135,119,147,159, 177,189	--	0.22	--
60	(*Z*)-Lanceol	1766	220	43	55,93,67,159,119,105,79,134,148, 173,202	--	--	0.35
61	*trans*-Dihydro-occidentalol acetate**	1785	264	43	81,109,67,55,163,191,149, 135,177,206	--	--	0.23**
62	Hinesol acetate**	1785	264	43	161,119,105,91,147,79,55,189,20 4,133	--	--	
63	Laurenene	1877	272	41	91,55,79,105,76,257,133,148,159, 187,173,201,216	3.35	--	--
64	Oplopanonyl acetate	1887	280	43	81,91,55,107,121,135,150,67,177, 220,205	--	--	0.29
65	epi-Laurenene	1895	272	41	91,55,105,79,67,119,257,133,161, 201,216	0.38	--	--
66	Isopimar-9(11),15-diene	1904	272	41	55,91,79,105,272,161,119, 133,175,230	0.31	--	0.35
	Unidentified	1915	272	43	41,55,256,91,121,69,145,159,257, 185,175	--	--	0.35
	Unidentified	1923	272	41	91,69,55,95,105,123,137,229,257, 133,148,187,159,175, 201	4.04	--	--
	Unidentified	1925	n.d.	43	41,121,55,95,256,80,107,135,159, 175	--	--	0.49
67	Sclarene	1965	272	41	91,55,79,67,105,119,133,257,187, 175,161,201	3.08	--	--
68	Isophyllocladene	1969	272	120	41,106,105,91,67,79,257,133,161, 187,230	--	--	0.90

Table 1: *continued*

69	Isokaurene	1990	272	41	91,55,79,67,105,119,147,131,229, 187,175,163	0.80	4.44	0.38
70	epi-13-Manoyl oxide	2007	n.d.	43	55,81,95,257,123,109,161, 177,275,137,191	--	--	3.40
71	Phyllocladene	2009	272	41	55,91,79,67,105,123,119,133,145, 229,257,175,187,201	37.86	0.48	--
72	Kaurene	2031	272	41	55,91,79,69,105,123,119,133,147, 229,257,175	5.12	2.59	18.59
73	Abietatriene**	2053	270	255	41,173,159,55,69,185,213, 143,199	--	10.07**	0.40
74	Manool**	2058	272	43	55,81,95,71,137,257,123,109,161, 177,229	--		3.20
	Unidentified	2062	286	81	41,55,93,107,135,120,147, 187,257,161,177,230,243, 201, 271	--	--	0.41
75	Abietadiene	2086	272	41	55,81,91,105,133,229,257, 145,187,173,201	--	8.49	--
	Unidentified	2141	**n.d.	43	257,55,95,161,81,105,133, 286,171,213,237	--	--	0.41
76	Phyllocladanol	2215	290	43	41,123,95,232,109,134,81,69,55,1 47,272,257,191	0.23	-	10.73
77	Isopimarol	2314	288	257	41,105,81,67,91,55,119,133,147,1 61,175,243,201,274	--	--	12.09
78	Abital	2315	286	187	131,43,105,51,55,79,145,243,255, 117,159,215,197	2.86	3.56	--
	Unidentified	2390	286	43	55,91,81,105,159,123,185, 251,201,241,271	--	2.46	--
	Total					97.00	97.23	97.89
	Monoterpene hydrocarbon					18.60	24.10	4.87
	Oxygen containing monoterpenes					7.33	2.14	4.30
	Sesquiterpene hydrocarbons					16.45	10.23	19.78
	Oxygen containing sesquiterpenes					0.63	31.13	19.25
	Diterpenes					53.99	29.63	49.69

RI* = retention index, data were measured relative to n-alkanes on DB5 column under conditions listed in the experimental section.

** = co-eluted components

n.d*. = not detected

Zagazig J. Pharm. Sci., June 2003
Vol.12, No. 1, pp. 36-43

Table 2: ^1H-, ^{13}C-NMR and HMBC data of phyllocladene ($CDCl_3$, TMS as internal stander).

No.	δH	δC	DEPT	HMBC
1	0.77, 1H, dd, *J* = 14, 4 Hz 1.63, 1H, dd, *J* = 14, 9 Hz	41.06	CH_2	3, 5, 9, 20
2	1.38, 2H, dm, J = 13 Hz	19.00	CH_2	1, 3, 4, 10
3	1.79, 1H, dd, J = 17, 4.8 Hz 2.77, 1H, dd, J = 17, 1.8 Hz	42.03	CH_2	1, 5
4	--	41.47	Cq	--
5	0.84, 1H, m	56.54	CH	1, 3, 7, 9, 18, 20
6	1.28, 1H, m 1.54*, 1H	20.31	CH_2	4, 5, 7
7	1.52*, 2H	37.85	CH_2	5, 9, 14
8	--	43.64	Cq	--
9	1.10, dd, J = 7.5, 4 Hz	56.93	CH	1, 7, 15, 20
10	--	39.49	Cq	--
11	1.54*, 2H	18.48	CH_2	8, 13
12	0.88, 1H, m 1.44, 1H, m	33.19	CH_2	14
13	2.52 (brs)	42.70	CH	14, 15, 16, 17
14	1.54*, 1H 1.52*, 1H	34.01	CH_2	12, 16
15	1.15, 1H, dd, J = 11, 2.4 Hz 1.53*, 1H	50.35	CH_2	9, 13, 14, 16
16	--	157.63	Cq	--
17	4.70, 1H, d, J = 1.2 Hz 4.74, 1H, d, J = 1.2 Hz	102.32	CH_2	13, 16
18	0.86, 3H, s	33.67	CH_3	3, 5, 19
19	0.81, 3H, s	21.88	CH_3	3, 5, 18
20	0.92, 3H, s	15.11	CH_3	5, 9, 10

Assignments were made by 2D(^1H-^1H COSY, ^1H-^{13}C HSQC and HMBC) spectra, APT and DEPT experiments and comparison with related compounds(17-22).
* Overlapping signals.

Table 3: Antimicrobial screening of volatile oils from leaves, stem bark, wood and phyllocladene of *Araucaria excelsa* R. Br.

Material	Diameter of inhibition zone in mm					
	Gram +ve bacteria			Gram -ve bacteria	Fungi	
	S. aurens	*Sarcina lutea*	*B. subtilis*	*E. coli*	*C. albicans*	*Asper. sp.*
Volatile oil of leaves	15	-	24	16	10	13
Volatile oil of bark	17	25	30	26	16	17
Volatile oil of wood	19	17	35	22	16	15
Phyllocladene	18	-	28	24	19	14
Penicillin	10	15	25	25	-	-
Nystatin	-	-	-	-	20	22

- = No zone of inhibition.

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التركيب الكيميائى والفاعلية المضادة للميكروبات للزيت الطيار لنبات أروكاريا إكسلسا آر.بر المنزرع فى مصر

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قسم العقاقير – كلية الصيدلة – جامعة الزقازيق – الزقازيق – مصر

تـم فـى هذا البحث فصل الزيت الطيار من الأجزاء المختلفة (الأوراق وقلف وخشب الساق) لنبات أروكاريا إكسلسـا آر.بـر (شـجرة عـيد الميلاد) من الفصيلة الأروكارية وتحديد مكونات الزيت المستخلص من كل جزء باسـتخدام كروماتوجرافيا الغاز الشعرية المتصلة بمطياف الكتلة وقد أمكن التعرف على ثمانية وسبعون مركب من مكونـات الـزيوت ووجـد اختلافاً كيفياً وكمياً بين محتويات كل جزء ، وتبين أن مركب الفيلوكلادين هو المركب الرئيسى فى زيت الأوراق (٣٧,٨٦%) وقد تم فصله والتعرف عليه بالطرق الطيفية المختلفة.

كمـا تـم اختـبار فاعلـية الزيوت ضد بعض الميكروبات وثبت أن لها تأثيراً قوياً وشاملاً لكل من البكتريا والفطريات المختارة.