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Chemical composition of essential oil from the leaves of *Cinnamomum camphora* (L.) J. Presl

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ABSTRACT

In the present study, the chemical composition of *Cinnamomum camphora* leaves collected from Algeria was studied. The chemical composition of the hydrodistilled essential oil of *C. camphora*, collected from Skikda (North Eastern Algeria), was analyzed by Gas Chromatography-Mass Spectrometry (GC-MS). The essential oil showed the presence of 17 major compounds representing 93.57% of total essential oil and the major compounds were camphor (36.81%), α-Pinene (9.91%), D-Limonene (8.63%) and Camphene (6.99%).

KEYWORDS: *Cinnamomum camphora*, Essential oil, Yield, Sensory characteristics, Chemical composition

INTRODUCTION

Cinnamomum camphora is a member of the Lauraceae family, it is a tree that can grow up to 40 meters high and 3 m in diameter and typically grow at 900-2500 m above sea level, and has longevity of around a thousand years. Its fruits are drupes, purple to black in color and with a diameter of around a centimeter (Mansard *et al.*, 2019). It grows in the humid forests of Madagascar and all parts of the plant are aromatic. The plant has various vernacular names viz., Camphor tree, Shiu wood, Chinese laurel or Ravintsara (in Malagasy) (Lee *et al.*, 2022). In Algeria, the camphor tree was introduced during the colonial period in 1893, where it was successfully cultivated and used, in particular as a reforestation tree but also for camphor production (Musso, 1926). The essential oil of *C. camphora* is contained in schizogenic pockets of the leaves. It has a variety of biological functions, including antibacterial, antioxidant, antifungal, anti-inflammatory, insecticidal and anthelmintic properties (Lahlou, 2007; Chen *et al.*, 2020; Du *et al.*, 2022). The aim of this study was to investigate the sensory characteristics, physico-chemical indices, spectrometric measurement of absorbance and antibacterial activity the *C. camphora* essential oil.

MATERIALS AND METHODS

Sample Collection and Essential Oil Extraction

Leaves of Cinnamomum camphora were collected from the botanical extension pole (Joint Research Service), University of August 20, 1955, Skikda, (geographical coordinates: N 36° 48' 50.6772", E 6° 54' 48.69"). The taxonomic identification of camphor tree was made by Dr. Sakhraoui Nora from the Department of Ecology and Environment, Faculty of Sciences, University of August 20, 1955, Skikda, and voucher specimen was deposited in the Herbarium of Plant Physiology Laboratory, Department of Natural Sciences, Higher School of Professors for Technological Education, Skikda, Algeria, (PPL 01/2023). The collected samples were shade dried with ventilation for 15 days at room temperature from the month of May 2023.

The essential oil from crushed dry leaves (100 g) was obtained by hydrodistillation for 03 hours using a Clevenger-type apparatus. The percentage content was calculated based on the dry weight of plant material [Essential oil% = (volume of the essential oil obtained × density/dried mass of leaves) × 100%]. The essential oils were stored in a freezer at 4 °C until analysis.

Chemical Composition Analysis

Camphor tree essential oil was diluted in n-hexane at a ratio of 1:50 v/v and analyzed on a GC-MS system. Identification of essential oil components was performed using GC-MS (TQ8040 NX, Shimadzu, Yokohama, Japan) equipped with an InertCap WAX capillary column (60 m length, 0.25 mm inner diameter, and 0.25 μm film thickness) and AOC-6000 autosampler (Shimadzu, Yokohama, Japan). The column temperature was initially set at 50 °C and then increased to 110 °C at a rate of

2 °C/min and then to 240 °C at a rate of 3 °C/min. Helium was used as carrier gas, the flow rate was 1 mL/min, and the injection volume in split mode (1:10) was 1 μL. The MS parameters are as follows: mass range 10~550, ion source temperature 230 °C, and interface temperature 250 °C.

The retention index (RI) of the components was determined using homologous n-alkanes (C7-C30) under the same operating conditions. Finally, essential oil components were identified by comparing their RI and experimental mass spectra with published data in the literature and mass spectral libraries.

RESULTS AND DISCUSSION

Yield and Sensory Characteristics

Hydrodistillation of the crushed dry leaves of *C. camphora* sample yielded 1% clear mobile liquid, colorless to pale yellow, with a fresh and intense aromatic, slightly camphorous odor.

The experiment reveals that the extraction yield of the essential oil of the camphor tree is proportional to the duration of the hydrodistillation, that is to say that when the duration of distillation increases, the extraction yield of the essential oil also increases. In the present study, the best essential oil yield was obtained at 90 minutes hydrodistillation.

This value is low compared to that obtained by Poudel *et al.* (2021) who found a value of 2.67% of essential oil obtained from the leaves of *C. camphora* from Nipale,

According to Zhang *et al.* (2022) the extraction rate of essential oils extracted by steam distillation is less than 0.5%, while supercritical CO_2 extraction at 25 MPa, 45 °C, and 2.5 h yielded 4.63%.

Extraction yield depends on different factors such as geographical variation, harvest time, extraction methods, extraction temperature and extraction (Getachew *et al.*, 2022).

Chemical Composition

Sixty-nine (69) components (Including seventeen (17) with a concentration greater than 1%) were detected in essential oil of *C. camphora* leaves from Algeria, representing 93.57% of the total composition (Table 1 and Figure 1), which differ from those reported previously in other studies (Table 2).

The essential oil showed the presence of 17 major compounds representing 93.57%, essential oil was dominated by Camphor (36.81%), α-Pinene (9.91%), D-Limonene (8.63%) and Camphene (6.99%) as major constituents.

Camphor (Figure 2), the main component of the essential oil studied, is a monoterpene ketone that many people know

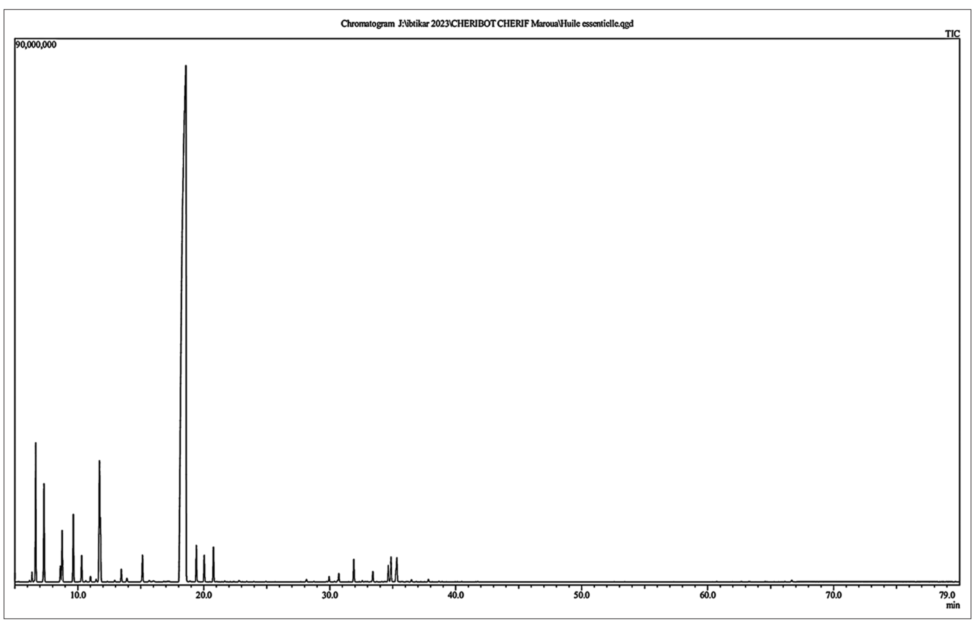

Figure 1: GC-MS of *Cinnamomum camphora* essential oil

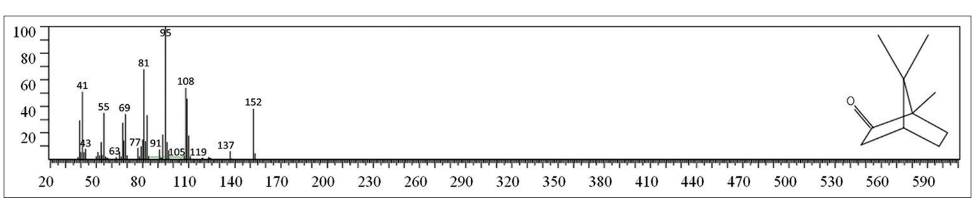

Figure 2: Structure of Camphor

Table 1: The major compounds in *Cinnamomum camphora* essential oil from Algeria

S. No.	Compound	R. Time	Ret. Index	Molecular Formula	%
1	Tricyclo[2.2.1.02,6]heptane, 1,7,7-trimethyl-	6.169	714	$C_{10}H_{16}$	Trace
2	Bicyclo[3.1.0]hex-2-ene, 2-methyl-5-(1-methylethyl)-	6.365	718	$C_{10}H_{16}$	Trace
3	3-Hexenoic acid, methyl ester, (Z)-	6.541	721	$C_7H_{12}O_2$	Trace
4	α-Pinene	6.660	724	$C_{10}H_{16}$	9.91
5	Camphene	7.316	737	$C_{10}H_{16}$	6.99
6	Bicyclo[3.1.0]hexane, 4-methylene-1-(1-methylethyl)-	8.613	764	$C_{10}H_{16}$	1.15
7	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-, (1S)-	8.759	767	$C_{10}H_{16}$	3.68
8	*β*-Myrcene	9.645	785	$C_{10}H_{16}$	4.80
9	*2-Carene*	10.111	794	$C_{10}H_{16}$	Trace
10	α-Phellandrene	10.305	798	$C_{10}H_{16}$	1.88
11	3-Carene	10.637	804	$C_{10}H_{16}$	Trace
12	1,3-Cyclohexadiene, 1-methyl-4-(1-methylethyl)-	11.009	811	$C_{10}H_{16}$	Trace
13	o-Cymene	11.459	818	$C_{10}H_{14}$	Trace
14	D-Limonene	11.724	823	$C_{10}H_{16}$	8.63
15	Eucalyptol	11.800	824	$C_{10}H_{18}O$	4.58
16	(3E)-3,7-dimethylocta-1,3,7-triene	12.353	834	$C_{10}H_{16}$	Trace
17	1,3,6-Octatriene, 3,7-dimethyl-, (E)-	12.932	844	$C_{10}H_{16}$	Trace
18	γ-Terpinene	13.456	853	$C_{10}H_{16}$	Trace
19	5-Isopropyl-2-methylbicyclo[3.1.0]hexan-2-ol	13.894	860	$C_{10}H_{18}O$	Trace
20	4-Isopropylidene-1-cyclohexene	15.133	882	$C_{10}H_{16}$	1.91
21	5-Isopropyl-2-methylbicyclo[3.1.0]hexan-2-ol	15.680	891	$C_{10}H_{18}O$	Trace
22	Linalool	16.007	897	$C_{10}H_{18}O$	Trace
23	4-Octenoic acid, methyl ester, (Z)-	16.830	912	$C_9H_{16}O_2$	Trace
24	2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)-, cis-	17.120	917	$C_{10}H_{18}O$	Trace
25	2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)-, trans-	17.213	919	$C_{10}H_{18}O$	Trace
26	1,7,7-Trimethylbicyclo[2.2.1]hept-5-en-2-ol	17.265	920	$C_{10}H_{16}O$	Trace
27	Camphor	18.584	944	$C_{10}H_{16}O$	36.81
28	Citronellal	18.894	950	$C_{10}H_{18}O$	Trace
29	Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S-endo)-	19.407	959	$C_{10}H_{18}O$	2.59
30	3-Cyclohexen-1-ol, 4-methyl-1-(1-methylethyl)-, (R)-	20.037	971	$C_{10}H_{18}O$	1.90
31	α-Terpineol	20.768	984	$C_{10}H_{18}O$	2.47
32	2-Cyclohexen-1-ol, 3-methyl-6-(1-methylethyl)-, trans-	21.017	989	$C_{10}H_{18}O$	Trace
33	2-Cyclohexen-1-ol, 3-methyl-6-(1-methylethyl)-, trans-	21.667	1000	$C_{10}H_{18}O$	Trace
34	2,6-Octadien-1-ol, 3,7-dimethyl-, (Z)-	22.790	1023	$C_{10}H_{18}O$	Trace
35	dl-Menthol	22.855	1024	$C_{10}H_{20}O$	Trace
36	Neral	23.411	1035	$C_{10}H_{16}O$	Trace
37	2-Cyclohexen-1-one, 3-methyl-6-(1-methylethyl)-	23.981	1046	$C_{10}H_{16}O$	Trace
38	Citral	24.930	1065	$C_{10}H_{16}O$	Trace
39	Cyclohexane, 1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene)-	28.152	1131	$C_{15}H_{24}$	Trace
40	α-Cubebene	28.745	1144	$C_{15}H_{24}$	Trace
41	Ylangene	29.740	1165	$C_{15}H_{24}$	Trace
42	Copaene	29.947	1169	$C_{15}H_{24}$	Trace
43	Bicyclo[4.3.0]nonane, 7-methylene-2,4,4-trimethyl-2-vinyl-	30.387	1179	$C_{15}H_{24}$	Trace
44	cis-Muurola-4 (15),5-diene	30.623	1184	$C_{15}H_{24}$	Trace
45	1-Methyl-1-ethenyl-2,4-bis (1'-methylethenyl) cyclohexane	30.721	1186	$C_{15}H_{24}$	Trace
46	Caryophyllene	31.911	1212	$C_{15}H_{24}$	1.61
47	1,5-Cyclodecadiene, 1,5-dimethyl-8-(1-methylethylidene)-, (E, E)-	32.586	1227	$C_{15}H_{24}$	Trace
48	Alloaromadendrene	32.781	1232	$C_{15}H_{24}$	Trace
49	(1S,4aR,7R)-1,4a-Dimethyl-7-(prop-1-en-2-yl)-1,2,3,4,4a, 5,6,7-octahydronaphthalene	32.895	1235	$C_{15}H_{24}$	Trace
50	(1R,3aS,8aS)-7-Isopropyl-1,4-dimethyl-1,2,3,3a, 6,8a-hexahydroazulene	33.002	1237	$C_{15}H_{24}$	Trace
51	Germacrene D	33.264	1243	$C_{15}H_{24}$	Trace
52	α-Humulene	33.422	1247	$C_{15}H_{24}$	Trace
53	Valerena-4,7 (11)-diene	33.739	1254	$C_{15}H_{24}$	Trace
54	(4S,4aR,6R)-4,4a-Dimethyl-6-(prop-1-en-2-yl)-1,2,3,4,4a, 5,6,7-octahydronaphthalene	34.136	1263	$C_{15}H_{24}$	Trace
55	γ-Muurolene	34.462	1270	$C_{15}H_{24}$	Trace
56	(-)-Germacrene D	34.647	1275	$C_{15}H_{24}$	1.18
57	Naphthalene, decahydro-4a-methyl-1-methylene-7-(1-methylethenyl)-, [4aR-(4aα,7α,8aβ)]-	34.864	1280	$C_{15}H_{24}$	1.77
58	cis-Muurola-4 (15),5-diene	35.105	1285	$C_{15}H_{24}$	Trace
59	(1S,2E,6E,10R)-3,7,11,11-tetramethylbicyclo[8.1.0]undeca-2,6-diene	35.328	1290	$C_{15}H_{24}$	1.71
60	α-Muurolene	35.506	1294	$C_{15}H_{24}$	Trace
61	1-Methyl-1-ethenyl-2,4-bis (1'-methylethenyl) cyclohexane	35.687	1298	$C_{15}H_{24}$	Trace
62	δ-Cadinene	35.782	1301	$C_{15}H_{24}$	Trace
63	(3R,3aR,3bR,4S,7R,7aR)-4-Isopropyl-3,7-dimethyloctahydro -1H-cyclopenta[1,3] cyclopropa[1,2]benzen-3-ol	36.101	1308	$C_{15}H_{26}O$	Trace
64	(2S,4aR,8aR)-4a, 8-Dimethyl-2-(prop-1-en-2-yl)-1,2,3,4,4a, 5,6,8a-octahydronaphthalene	36.203	1311	$C_{15}H_{24}$	Trace
65	Naphthalene, 1,2,4a, 5,8,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-, [1S-(1.alpha.,4a.beta.,8a.alpha.)]-	36.486	1318	$C_{15}H_{24}$	Trace
66	1,5-Cyclodecadiene, 1,5-dimethyl-8-(1-methylethylidene)-, (E, E)-	37.838	1351	$C_{15}H_{24}$	Trace
67	1H-Cycloprop[e] azulen-7-ol, decahydro-1,1,7-trimethyl-4-methylene-, [1ar-(1a.alpha.,4a.alpha.,7.beta.,7a.beta.,7b.alpha.)]-	38.674	1371	$C_{15}H_{24}O$	Trace
68	Humulane-1,6-dien-3-ol	40.460	1415	$C_{15}H_{26}O$	Trace
69	Neointermedeol	41.746	1448	$C_{15}H_{26}O$	Trace

Table 2: Chemical composition of essential oil of *Cinnamomum camphora* growing in different regions of the world

Author's	Region	Major constituent
Satyal *et al.*, 2013	Makwanpur, Nepal	Camphor (36.5%), camphene (11.7%), and limonene (9.0%), with lesser amounts of sabinene (6.3%) and β-pinene (6.3%)
Chen *et al.*, 2014	Suzhou City, Jiangsu Province, China	D-camphor (40.54%), linalool (22.92%), cineole (11.26%), and 3,7,11-trimethyl-3-hydroxy-6,10-dodecadien-1-yl acetate (4.50%)
Guo *et al.*, 2016	Suzhou City, Jiangsu, China	D-camphor (51.3%), 1,8-cineole (4.3%), and α-terpineol (3.8%), while D-camphor (28.1%), linalool (22.9%), and 1,8-cineole (5.3%)
Chen *et al.*, 2020	China	Linalool (26.6%), eucalyptol (16.8%), α-terpineol (8.7%), isoborneol (8.1%), β-phellandrene (5.1%), and camphor (5.0%)
Xu *et al.*, 2020	China	Eucalyptol (53.49%), β-terpinene (17.44%), α-terpineol (9.45%), and 1R-α-pinene (4.71%)
Bhandari *et al.*, 2022	Doon Valley, Garhwal region of Uttarakhand	D-camphor (46.06%), limonene (9.74%), α-pinene (9.71%), β-myrcene (4.91%) and camphene (4.37%)
Rawat *et al.*, 2023	India	1,8-cineole (55.84 %), sabinene (14.37 %), and α-terpineol (10.49%)

as a key ingredient in topical home remedies for a variety of symptoms. Its use is widespread among populations around the world, with a long tradition as an antiseptic, antipruritic, abortifacient, aphrodisiac, contraceptive, and lactation inhibitor (Zuccarini, 2009). The presence of significant amounts of camphor suggests that the essential oil studied may be a good source of this compound and possess relevant biological properties, including insecticidal, antibacterial, analgesic and anti-inflammatory effects (Aminkhah & Asgarpanah, 2017).

The chemical composition of *C. camphora* essential oil has been thoroughly investigated, and the diversity in the composition from plants grown in different localities in the same country and even those from different countries have led to the many oil-dependent chemotypes assigned to the plant.

CONCLUSION

In order to discover new natural molecules of therapeutic uses, it is of great scientific importance to study simultaneously the chemical composition and the bioactivity of various essential oils. This study provided interesting data on the chemical composition of the essential oil of Algerian camphor tree.

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