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Chemical Study of the Essential Oils of *Mischogyne elliotiana* (Engl. & Diels) (Annonaceae) and *Daniellia ogea* (Harms) Rolfe (Fabaceae), Obtained by Hydrodistillation and Steam Distillation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

The objective of this study was to determine, by GC/MS, the composition of the essential oil (EO) of two plants obtened by hydrodistillation and steam distillation. The main objective is to promote two Ivorian species. The organoleptic quality, yield and chemical composition of essential oils (EO)

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extracted from *Mischogyne elliotiana* and *Daniellia ogea* by hydrodistillation (HD) and steam distillation (SD) have been determined. EO yields are (HD: 0.012% - SD: 0.11%) for *Mischogyne elliotiana* and (HD: 0.06% - SD: 0.05%) for *Daniellia ogea*. Essential oils have been analyzed by Gas Chromatography-Mass Spectrometry. Essential oils obtained by hydrodistillation revealed more compounds than those obtained by steam distillation: *Mischogyne elliotiana* (HD: 32 compounds - SD: 24 compounds), *Daniellia ogea* (HD: 40 compounds - SD: 38 compounds). The essential oils of *Mischogyne elliotiana* consist mainly of sesquiterpenes. The hydrocarbon sesquiterpene content is: (HD: 87.18% - SD: 94.27%). Oxygenated sesquiterpenes: (HD: 9.98% - SD: 3.76%). *Daniellia ogea* EO is made up of oxygenated sesquiterpenes (HD: 34.14% - EV: 32.64%), diterpenes (HD: 2.07% - SD: 0.51%) and other compounds (HD: 7.15% - SD: 11.47%). Hydrocarbon monoterpenes (0.15%) are present only in the oil obtained by hydrodistillation. The main compounds in *Mischogyne elliotiana* EO obtained by hydrodistillation are α-gurjunene (58.14%) and β-guaiene (8.26%), while those obtained by steam distillation are α-gurjunene (50.60%) and β-guaiene (8.30%). In *Daniellia ogea* essential oils, the main compounds obtained by hydrodistillation are caryophyllene oxide (19.91%), β-caryophyllene (17.83%) and β-farnesene (15.56%), while those obtained by steam distillation are also caryophyllene oxide (18.92%) and β-caryophyllene (15.87%). The study on *Mischogyne elliotiana* essential oil is described for the first time.

Keywords: Mischogyne elliotiana; Daniellia ogea; essential oil; chemical composition hydrodistillation; Steam Entrainment (SD).

1. Introduction

African flora is an important reserve of aromatic and medicinal plants. The essential oils of some of these plants have been the subject of several studies (Bosson A.K. et al, 2025; Djié Bi et al., 2016; Kouassi et al., 2022; Kouassi et al., 2020). Modern medicine uses the therapeutic virtues of essential oils and their ingredients in the manufacture of medicines. To know the quality, toxicity and therapeutic properties (antiviral, antibacterial, antifungal, detoxifying, etc.) of essential oils, it is necessary to determine their chemical composition in order to identify the active ingredient(s) (Boutabia et al., 2016; Lehmann, 2013). This is a fundamental task, requiring the use of a wide range of essential oil extraction techniques to gain a better understanding of their constituents. For this purpose, two aromatic plants from the Ivorian floristic diversity, namely *Mischogyne elliotiana* (Gosline et al., 2019) and *Daniellia ogea* (Adjanohoun et al., 1989), and two extraction techniques (hydrodistillation and steam entrainment) have been our choice for the present study. The species *Mischogyne elliotiana* is a shrub that grows from 4 to 7 meters in height (Gosline et al., 2019). It is found in West Africa, particularly in Côte d'Ivoire, Ghana, Benin and Nigeria (Gosline et al., 2019; Keay, 1952). The leaves are used to clean bonnets and fabrics (Gosline et al., 2019). Crushed fruits and leaves of the genus are applied by scarification to snake bites (Gosline et al., 2019). *Daniellia ogea* is a large, dense forest tree that can reach 60 m in height (Adjanohoun et al., 1989). Names and morphological characteristics differ from one species to another (Adjanohoun et al., 1989). It is found in West and Central Africa from Senegal to Cameroon (Adjanohoun et al., 1989). The infusion of the leaf is traditionally used orally to treat dysentery (Asekun & Ekundayo, 2004). In Ghana and Nigeria, decoction or maceration of the root is prescribed against malaria and gonorrhea (Asekun & Ekundayo, 2004).

2. Materials and Methods

2.1 Plant Material

It is made up of fresh *Mischogyne elliotiana* leaves collected in a wooded forest at Akeikoi in Abobo commune (5° 25' 58.393" N 4° 2' 20.011" W) and those of *Daniellia ogea* also collected in a wooded forest at Djorobité in Cocody commune (5° 21' 22.792" N 3° 58' 3.706" W). These communes belong to the Autonomous District of Abidjan in Côte d'Ivoire. The plants have been identified in the herbaria of the Centre National Floristique de Côte d'Ivoire (CNF) of the Université Félix HOUPHOUËT-BOIGNY (Abidjan/Cocody) under numbers UCJ001244 for *Mischogyne elliotiana* and UCJ009285 for *Daniellia ogea*.

2.2 Methods

2.2.1 Extraction of Essential Oil

It was based on two extraction techniques.

- Extraction by hydrodistillation

In a Clevenger-type hydrodistiller, combined with a 10 L pressure cooker containing 3 L of water, 1000 g of plant material are placed on the grid. The mixture (plant material and water) is brought to the boil on a hot plate. A glass column is connected above the pot, through which the vapors condense in the cooler. After 4 h of heating, the essential oil obtained is separated by gravity on the surface of the water in a test tube after decantation. It is then dried on anhydrous MgSO4 and stored in a pillbox in the refrigerator at 4°C.

- Extraction with steam drive

A four-compartment stainless steel device has been used. The boiler (60 L capacity) is connected to a large tank by a stainless steel pipe. The large tank (height: 100 cm, internal diameter: 51 cm, i.e. a volume of 200 L) contains four grids attached to a removable rod. The grids hold 1.3 kg and 2 kg of plant material. From this tank, steam carries the volatile compounds into a third tank (height: 100 cm, internal diameter: 41 cm, volume: 130 L) which acts as a cooler. The essential oil is obtained in a fourth compartment, which serves as a recovery system. It is then dried on anhydrous MgSO4 for around 10 min, and stored in a pillbox in the refrigerator at 4°C.

2.2.2 Analysis of the Essential Oil

Analysis of the essential oil diluted in dichloromethane (1:100) has been carried out on a GC chromatograph (7890A, Agilent Technologies) coupled to a mass spectrometer (MS) (5975C, Agilent Technologies). A sample of the essential oil (1 µL) has been injected into an HP-5MS capillary column at 250°C. The oven temperature was programmed at 40°C for 5 min, then at 2°C/min for 15 min up to 250°C, with a flow rate of 10°C/min up to 300°C. Helium has been used as carrier gas at a flow rate of 1 mL/min. The MS detector has a temperature of 280°C and a voltage of 1.4 kV. Only ions with a mass-to-charge ratio between 40 and 500 can be detected. Identification of compounds has been carried out by comparing retention indices (Ir), calculated from retention times and mass spectra obtained, with those of the National Institute of Standards and Technology (NIST) database and the literature.

$\mathrm{Ri} = 100\left[\mathrm{n} + \frac{\mathrm{t_R(C_i)} - \mathrm{t_R(C_n)}}{\mathrm{t_R(C_{n+1})} - \mathrm{t_R(C_n)}}\right]$ (Konan et al., 2021; Paolini, 2005).

n: number of carbon atoms in the linear alkane preceding the unknown compound;

tR(ci): retention time of the unknown compound;

tR(cn): retention time of the linear alkane preceding the unknown compound;

tR(cn+1): retention time of the linear alkane following the unknown compound;

Ri: retention index of the unknown compound.

3. Results and Discussion

3.1 Results of Essential Oil Extractions

The organoleptic quality and yields of extracted essential oils according to extraction technique are shown in (Table 1).

Yields of essential oils extracted from *Mischogyne elliotiana* and *Daniellia ogea* are low and slightly different. Several referenced works have shown that the yield of an extracted essential oil may vary from one extraction method to another. Indeed, Aberchane and *al,* (2001) (Aberchane et al., 2001) showed that the yield of *Atlas cedar* essential oil obtained by hydrodistillation (2.6%) is slightly higher than that of oil obtained by steam entrainment (2.4%) after 8 h of extraction. Bosson and al 2025 showed that the extraction yield of *Emilia praetermissa* using HD (0.06±0.02%) was significantly higher than that obtained using SDn(0.04±0.02%). Kamli and *al,* (2017) (Kamli et al., 2017) also reported that the yield of essential oil obtained from *Rosmarinus officinalis* aerial parts by hydrodistillation is (2.41%) and that of oil obtained by steam entrainment is (2.25%). Thus, for the present study, we argue that in addition to the type of essential oil extraction (Pibiri, 2005) the low yields obtained could be explained by other factors, including species, genotype, environment, harvesting period and geographical origin (Deschepper R, 2017).

3.2 Chemical Composition of Essential Oils Obtained According to Extraction Technique

The chemical composition of essential oils from *Mischogyne elliotiana* and *Daniellia ogea* leaves has been determined by GC-MS.

3.2.1 The Case of *Mischogyne elliotiana* Essential Oils Obtained by Hydrodistillation and Steam Distillation

Table 2 shows the chemical composition of *Mischogyne elliotiana* essential oil obtained by hydrodistillation. Thirty-two (32) compounds representing (99.81%) of the total composition have been identified. The chemical composition is dominated by hydrocarbon sesquiterpenes (87.18%) and oxygenated sesquiterpenes (9.98%), respectively. Hydrocarbon monoterpenes (0.96%), oxygenated monoterpenes (0.05%) and other compounds (1.64%) are also present. The majority compounds are α-gurjunene (58.14%), β-guaiene (8.26%), caryophyllene oxide (5.96%) and α-cedrene (5.57%). In contrast, the essential oil of the same species obtained by steam stripping shows a chemical profile composed of 24 phytoconstituents representing (99.89%) of the total composition (Table 3). The chemical composition is predominantly sesquiterpene at 98.03%. Among the sesquiterpenes, hydrocarbon compounds represent the majority class at 94.27%, against 3.76% for oxygenated compounds. Hydrocarbon monoterpenes (1.25%) and other compounds (0.61%) are also present. We note that α-gurjunene (50.60%), β-guaiene (8.30%), β-caryophyllene (6.18%), β -cubebene (5.73%) and α-copaene (5.03%) have been identified as majority compounds.

Table 1. Organoleptic quality and yields of extracted essential oils according to extraction technique

Study plant	***Mischogyne elliotiana***		***Daniellia ogea***	
Color	Yellow-orange to pale yellow		Yellow	
Odor	Aromatic		Aromatic	
	HD	SD	HD	SD
Yield (%)	0.12%	0.11%	0.06%	0.05%

HD: hydrodistillation; SD: steam distillation

Table 2. Phytoconstituents of *Mischogyne elliotiana* essential oil obtained by hydrodistillation

N°	**Compounds**	**Rt**	**Ri**	**m/z**	**Content (%)**
1	α-pinene	12.64	925	136	0.55
2	hept-2-en-1-ol	15.38	967	114	0.06
3	terpinolene	24.48	1098	136	0.37
4	camphor	27.16	1136	152	0.05
5	α-copaene	42.80	1368	204	0.13
6	β-elemene	43.93	1385	204	1.86
7	**α-cedrene**	**45.43**	**1409**	**204**	**5.57**
8	β-caryophyllene	46.94	1434	204	2.11
9	α-bergamotene	47.24	1439	204	0.26
10	humulene	47.55	1444	204	2.06
11	**α-gurjunene**	**47.98**	**1451**	**204**	**58.14**
12	γ-cadinene	48.93	1466	204	0.17
13	β-chamigrène	49.44	1475	204	3.30
14	**β-guaiene**	**49.95**	**1483**	**204**	**8.26**
15	α-selinene	50.66	1495	204	0.78
16	α- panasinsene	51.36	1507	204	3.77
17	calamenene	51.85	1515	202	0.27
18	patchoulane	53.43	1543	206	0.53
19	2-tridecenal	54.18	1556	196	0.09
20	**caryophyllene oxide**	**55.09**	**1572**	**220**	**5.96**
21	oplopanone	55.63	1581	238	0.22
22	3,7-dimethylnona-1,6-dien-3-ol	56.61	1598	168	1.02
23	γ-eudesmol	56.90	1603	222	0.09
24	epi - cubenol	57.60	1616	222	0.19
25	myristaldehyde	57.87	1621	212	0.31
26	2, 5,8-trimethyl-1-naphthol	58.54	1633	186	0.18

N°	Compounds	Rt	Ri	m/z	Content (%)
27	eudesma – 4(14) ,7(11) - diene	59.26	1646	204	1.71
28	α- cardinol	60.20	1663	222	0.28
29	santalol	60.43	1667	222	0.17
30	eudesm-7 (11) -en-4-ol	60.73	1673	222	1.13
31	α-cyperone	62.05	1697	218	0.09
32	β-atlantone	64.96	1753	220	0.13
Hydrocarbon monoterpenes					0.96
Oxygenated monoterpenes					0.05
Hydrocarbon sesquiterpenes					87.18
Oxygenated sesquiterpenes					9.98
Others					1.64
Total					99.81

Tr: retention time; Ir: retention index; m/z: mass on charge; EO: essential oil ; %: percentage

Table 3. Phytoconstituents of *Mischogyne elliotiana* essential oil obtained by steam distillation

N°	Compounds	Rt	Ri	m/z	Content (%)
1	α-pinene	12.63	924	136	0.85
2	myrcene	15.37	967	136	0.14
3	1,2-dimethyl-3-vinyl-1,4-cyclohexadiene	18.87	1019	134	0.14
4	β-phellandrene	19.11	1023	136	0.12
5	α -cubebene	41.20	1343	204	0.33
6	**α-copaene**	**42.80**	**1368**	**204**	**5.03**
7	**β -cubebene**	**43.78**	**1383**	**204**	**5.73**
8	**β-caryophyllene**	**45.44**	**1409**	**204**	**6.18**
9	α-cedrene	46.94	1434	204	2.33
10	humulene	47.54	1444	204	3.95
11	**α-gurjunene**	**47.99**	**1451**	**204**	**50.60**
12	germacrene D	49.19	1471	204	2.73
13	β-chamigrene	49.44	1475	204	3.00
14	**β-guaiene**	**49.95**	**1483**	**204**	**8.30**
15	α -selinene	50.63	1494	204	0.85
16	γ-cadinene	51.36	1507	204	3.88
17	δ -cadinene	51.88	1515	204	1.37
18	aromadendrene oxide	53.57	1545	220	0.20
19	caryophyllène oxide	55.10	1572	220	1.93
20	myristaldehyde	56.58	1597	212	0.61
21	epi-cubenol	57.75	1619	222	0.13
22	β -himachalol	58.83	1638	222	0.46
23	α -eudesmol	59.24	1646	222	0.58
24	eudesm-7 (11) -en-4-ol	60.72	1673	222	0.45
Hydrocarbon monoterpenes					1.25
Hydrocarbon sesquiterpenes					94.27
Oxygenated sesquiterpenes					3.76
Others					0.61
Total					99.89

Tr: retention time; Ir: retention index; m/z: mass on charge; EO: essential oil; %: percentage

The results show that *Mischogyne elliotiana* essential oil obtained by hydrodistillation contains more compounds (32) than that obtained by steam distillation (24). This shows that the chemical composition of the oil varies according to the extraction method. For example, hydrocarbon sesquiterpenes (HD: 87.18% - SD: 94.27%) are in higher proportions in the oil obtained by steam distillation than in that obtained by hydrodistillation. As for oxygenated sesquiterpenes (HD: 9.98% - SD: 3.76%), they are in low proportions in the oil obtained by steam distillation and high in that obtained by hydrodistillation. On the other hand, hydrocarbon monoterpenes (HD: 0.96% - SD: 1.25%) and other compounds (HD: 1.64% - SD: 0.61%) have very low and different proportions. It should be noted that oxygenated monoterpenes (0.05%) are present only in the oil obtained by hydrodistillation. For each extraction technique, we also record compounds that are present in one oil and absent in another (Table 4). These changes in the chemical composition of extracted essential oils according to the two extraction techniques would be due either to heat, or to interactions of the essential oil with water during the extraction process (Boukhatem et al., 2019; Kouassi, 2022; Bosson A. K. et al, 2025). We also note that some compounds convert under the effect of heat, according to (N'dri, 2025). This is therefore the case of γ-eudesmol detected in the oil obtained by hydrodistillation, which could be the conversion of α-eudesmol detected in that obtained by steam stripping. (Table 4) reports compounds common to both extraction methods and compounds specific to each extraction method. By comparing this content with that of the specific compounds, and taking into account the conversion of certain compounds from one method to the other, we can conclude that these two extraction methods complement each other (Table 4). We also note that *Mischogyne elliotiana* essential oil extracted by steam distillation is richer in hydrocarbon sesquiterpenes (94.27%) than that obtained by hydrodistillation (87.18%). This observation was also proven in the study by Noudjoub, (2010) (Noudjoub, 2010) where thyme oil extracted by steam distillation has a fraction rich in sesquiterpene compounds compared to that obtained by hydrodistillation. We can therefore deduce that the steam distillation technique is more advantageous for extracting the essential oil of *Mischogyne elliotiana*.

3.2.2 The Case of *Daniellia ogea* Essential Oils Obtained by Hydrodistillation and Steam Distillation

Forty (40) compounds representing (99.81%) of the total composition have been identified in the essential oil of *Daniellia ogea* leaves obtained by hydrodistillation (Table 5). These included hydrocarbon monoterpenes (0.15%), oxygenated monoterpenes (1.23%), hydrocarbon sesquiterpenes (55.07%), oxygenated sesquiterpenes (34.14%), diterpenes (2.07%) and other compounds (7.15%). The main compounds in the essential oil are: caryophyllene oxide (19.91%), β-caryophyllene (17.83%), β-farnesene (15.56%), bicyclosesquiphellandrene (4.03%) and α-caryophyllene (3.94%). However, in that extracted by steam stripping, 38 compounds representing (99.81%) of the total composition have been identified (Table 6). These include oxygenated monoterpenes (1.68%), hydrocarbon sesquiterpenes (53.51%), oxygenated sesquiterpenes (32.64%), diterpenes (0.51%) and other compounds (11.47%). The majority compounds are: caryophyllene oxide (18.92%), β-caryophyllene (15.87%), α-caryophyllene (6.45%), δ-cadinene (5.74%), β-sesquiphellandrene (5.67%), α-copaene (4.84%) and germacrene D (4.68%). We compared our majority compounds with those identified in the literature by Olayinka and *al* 2004. Analysis of *Daniellia ogea* essential oil obtained by hydrodistillation led to the identification of 31 compounds. The main compounds are: caryophyllene oxide (20.1%), humulene oxide (6.9%), α-humulene (3.8%) and β-selinene (3.8%) (Olayinka, 2004). This comparison shows that the compositions of these two oils vary differently. In fact, this variation could be due to certain parameters such as climatic conditions, soil type, harvesting period and plant origin (Angioni et al., 2006; Baydar H & Baydar N, 2005; Cole et al., 2007; Hassane et al., 2011 & Modzelewska et al., 2005; N'dri et al., 2026).

Examination of Tables 5 and 6 shows that *Daniellia ogea* essential oil obtained by hydrodistillation gave forty compounds (40), compared with that obtained by steam distillation (38). This difference in the number of aromatic molecules is due to the destruction of certain volatile compounds under the effect of heat (Boukhatem et al., 2019; Kouassi, 2022). Changes in the chemical composition of the essential oil between hydrodistillation and steam distillation were also observed. Hydrocarbon sesquiterpenes (HD: 55.07% - SD: 53.51%) and oxygenated sesquiterpenes (HD: 34.14% - SD: 32.64%) are in slightly higher proportions in the oil obtained by hydrodistillation than in that obtained by steam distillation. However, oxygenated monoterpenes (HD: 1.23% - SD: 1.68%) and diterpenes (HD: 2.07% - SD: 0.51%) are in low and different proportions, observed in each extraction technique. As for the other compounds (HD: 7.15% - SD: 11.47%), they are in higher proportions in the oil obtained by steam distillation than in that obtained by hydrodistillation. Hydrocarbon monoterpenes (0.15%) are only present in the oil obtained by hydrodistillation. In both techniques, we also observe compounds that are present in one oil and absent in the other (Table 7). These changes may be due to the fact that distillation generates new constituents through the high temperatures to which they are subjected; (Bosson A.K. et al, 2025; Kalamouni, 2010; samate, 2002). In the same context, it should be noted that γ-elemene detected in the oil obtained by hydrodistillation could be the conversion of δ-elemene detected in that obtained by steam distillation, also under the effect of heat (Boukhatem et al., 2019; Kouassi, 2022; N'dri et al., 2026). Still observing the (Table 7), we note that the total content (HD: 70.72%; SD: 77.70%) of compounds common to both extraction methods is in high proportion compared to that of specific compounds (HD: 29.09%; SD: 22.11%). As previously, by comparing this content to that of specific compounds and taking into account the conversion of certain compounds from one method to the other, we could say that these two extraction methods complement each other (Table 7). We also note that *Daniellia ogea* essential oil extracted by hydrodistillation and steam distillation is equally rich in hydrocarbon sesquiterpenes, with very similar proportions (55.07%) in the case of hydrodistillation and (53.51%) in the case of steam distillation, unlike *Mischogyne elliotiana*. We can therefore deduce that these two extraction techniques are advantageous for the extraction of *Daniellia ogea* essential oil (Owokotomo and Ekundayo 2012).

Table 4. Quantitative and qualitative variations in *Mischogyne elliotiana* essential oils

Methods	Hydrodistillation (HD)	Steam drive (SD)
Specific compounds	hept-2-en-1-ol (0.06%), terpinolene (0.37%), camphor (0.05%), β-elemène (1.86%), α-bergamotene (0.26%), α-panasinsene (3.77%), calamenene (0.27%), patchoulane (0.53%), 2-tridecenal (0.09%), oplopanone (0.22%), 3,7-dimethylnona-1,6-dien-3-ol (1.02%), γ-eudesmol (0.09%), 2, 5,8-trimethyl-1-naphthol (0.18%),eudesma-4(14) ,7(11)-diene (1.71 %), α-cardinol (0.28%), santalol (0.17%), α-cyperone (0.09%), β-atlantone (0.13%) .	myrcene (0.14%), 1,2-dimethyl-3-vinyl-1,4-cyclohexadiene (0.14%), β-phellandrene (0.12%), α-cubebene (0.33%), β-cubebene (5.73%), germacrene D (2.73%), δ-cadinene (1.37%), aromadendrène oxide (0.20%), β -himachalol (0.46%), α –eudesmol (0.58%);
	Content (%) $_{\text{EO- HD/Me}}$ **=11.15%**	**Content (%)** $_{\text{EO- SD/Me}}$ **= 11.80%**
Common compounds	α-pinene (0.55% - 0.85%), α-copaene (0.13% - 5.03%), α-cedrene (5.57% - 2.33%), β-caryophyllene (2.11% - 6.18%), humulene (2.06% - 3.95%), α-gurjunene (58.14% - 50.60%), γ-cadinene (0.17% - 3.88%), β-chamigrene (3.30% - 3.00%), β-guaiene (8.26% - 8.30%), α-selinene (0.78% - 0.85%), caryophyllène oxide (5.96% - 1.93%), epi-cubenol (0.19% - 0.13%), myristaldehyde (0.31% - 0.61%), eudesm-7 (11) -en-4-ol (1.13% - 0.45%) .	
	Content (%) $_{\text{EO- HD/Me}}$ **= 88. 66%**	**Content (%)** $_{\text{EO- SD/Me}}$ **=88.09%**

Table 5. Phytoconstituents of *Daniellia ogea* essential oil obtained by hydrodistillation

N°	Compounds	Rt	Ri	m/z	Content (%)
1	β- ocimene	12.62	924	136	0.15
2	salicylaldehyde	24.48	1098	122	0.59
3	dihydrocarveol	30.68	1186	154	0.31
4	octyl acetate	31.37	1195	172	0.18
5	citral	34.28	1238	152	0.16
6	eugenol	40.46	1331	164	0.18
7	α-cubebene	41.98	1355	204	0.16
8	α- copaene	42.81	1368	204	0.61
9	jasmone	43.34	1376	164	0.31
10	(Z) -3-hexenyl hexanoate	43.59	1380	198	0.42
11	α-damascone	43.92	1385	192	1.34
12	**β-caryophyllene**	**45.44**	**1409**	**204**	**17.83**
13	γ-jasmolactone	46.07	1419	168	0.37
14	α-bergamotene	46.68	1429	204	2.40
15	γ-elemene	47.13	1437	204	0.24

N°	Compounds	Rt	Ri	m/z	Content (%)
16	**α-caryophyllene**	**47.52**	**1443**	**204**	**3.94**
17	**β -farnesene**	**48.18**	**1454**	**204**	**15.56**
18	**bicyclosesquiphellandrene**	**49.22**	**1471**	**204**	**4.03**
19	aromadendrene	49.60	1477	204	1.63
20	β-neoclavene	50.09	1485	204	0.75
21	β -cadinene	50.56	1493	204	1.97
22	α- farnesene	51.26	1505	204	1.75
23	δ -cadinene	51.90	1516	204	2.07
24	β -elemol	52.91	1534	222	0.17
25	α –selinene	53.61	1546	204	2.25
26	2-tridecenal	54.45	1560	196	1.99
27	**caryophyllene oxide**	**55.11**	**1572**	**220**	**19.91**
28	guaiol	55.63	1581	222	1.71
29	myristaldehyde	56.60	1598	212	2.32
30	γ -eudesmol	56.87	1602	222	0.58
31	epi - cubenol	57.87	1621	222	2.91
32	cis-cadine-4-en-7-ol	58.13	1625	222	1.03
33	cadinol T	58.54	1633	222	2.94
34	aromadendrene oxide	59.20	1645	220	1.73
35	(Z, E)-farnesol	59.75	1655	222	0.42
36	caryophylla-3,8(13)-dien-5- β- ol	60.17	1663	220	2.01
37	eudesm-7(11)-en-4-ol	60.89	1676	222	0.41
38	14-hydroxy-α-humulene	62.74	1710	220	0.25
39	farnesyl acetate	65.11	1756	264	0.16
40	phytol	82.07	2108	296	2.07
Hydrocarbon monoterpenes					0.15
Oxygenated monoterpenes					1.23
Hydrocarbon sesquiterpenes					55.07
Oxygenated sesquiterpenes					34.14
Diterpene					2.07
Others					7.15
Total					99.81

Tr: retention time; Ir: retention index; m/z: mass on charge; EO: essential oil; %: percentage

Table 6. Phytoconstituents of *Daniellia ogea* essential oil obtained by steam distillation

N°	Compounds	Rt	Ri	m/z	Content (%)
1	dihydrocarveol	30.71	1186	154	0.41
2	δ-elemene	41.20	1343	204	0.18
3	α-cubebene	41.99	1355	204	0.29
4	**α- copaene**	**42.79**	**1367**	**204**	**4.84**
5	α-damascone	43.92	1385	192	2.74
6	**β-caryophyllene**	**45.43**	**1409**	**204**	**15.87**
7	α -bergamotene	46.08	1420	204	1.10
8	γ-Jasmolactone	46.68	1430	168	1.25
9	**α-caryophyllene**	**47.52**	**1443**	**204**	**6.45**
10	**β-sesquiphellandrene**	**48.16**	**1454**	**204**	**5.67**
11	**germacrene D**	**49.21**	**1471**	**204**	**4.68**
12	α-curcumene	49.57	1477	202	2.90
13	β-neoclavene	50.08	1485	204	1.04
14	α-muurolene	50.53	1493	204	1.93
15	α- farnesene	51.23	1504	204	1.55
16	**δ-cadinene**	**51.90**	**1516**	**204**	**5.74**
17	α -calacorene	52.94	1534	200	0.95
18	γ -asarone	53.41	1542	208	0.38
19	linalyl isovalerate	53.65	1546	238	0.48

N°	Compounds	Rt	Ri	m/z	Content (%)
20	γ -calacorene	54.17	1555	200	0.25
21	2-tridecenal	54.46	1561	196	1.46
22	**caryophyllène oxide**	**55.10**	**1572**	**205**	**18.92**
23	guaiol	55.76	1583	222	0.52
24	myristaldehyde	56.62	1598	212	4.41
25	epi - cubenol	57.89	1621	222	1.41
26	cis-cadine-4-en-7-ol	58.15	1626	222	0.43
27	cadinol T	58.54	1633	222	1.56
28	aromadendrene oxide	59.14	1644	220	2.66
29	caryophylla-3,8(13)-dien-5- β -ol	60.16	1663	222	3.30
30	eudesm-7(11)-en-4-ol	60.89	1676	220	0.74
31	farnesyl acetate	65.02	1754	264	0.30
32	khusenic acid	67.43	1800	234	1.28
33	myristyl acetate	67.89	1809	256	0.54
34	dihexyl azelate	68.65	1825	356	0.79
35	cis- (Z) - α –bisabolene epoxide	69.53	1842	220	1.28
36	nerolidol isobutyrate	70.93	1870	292	0.29
37	heptadecanal	71.96	1891	254	0.51
38	phytol	82.10	2109	296	0.71
Oxygenated monoterpenes					1.68
Hydrocarbon sesquiterpenes					53.51
Oxygenated sesquiterpenes					32.64
Diterpenes					0.51
Others					11.47
Total					99.81

Tr: retention time; Ir: retention index; m/z: mass on charge; EO: essential oil ; %: percentage

Table 7. Quantitative and qualitative variation of *Daniellia ogea* essential oils

Methods	Hydrodistillation (HD)	Steam drive (SD)
Specific compounds	β- ocimene (0.15 %), salicylaldehyde (0.59 %), octyle acetate (0.18 %), citral (0.16 %), eugenol (0.18 %), jasmone (0.31 %), (Z) -3-hexenyl hexanoate (0.42 %), γ-elemene (0.24 %), β –farnesene (15.56%), bicyclosesquiphellandrene (4.03 %), aromadendrene (1.63 %), β- cadinene (1.97 %), β –elemol (0.17 %), α –selinene (2,25 %), γ-eudesmol (0.58 %), (Z, E)-farnesol (0.42 %), 14-hydroxy-α-humulene (0.25 %),	δ-elemene (0.18 %), β-sesquiphellandrene (5.67%), germacrene D (4.68 %), α-curcumene (2.90 %), α-muurolene (1.93 %), α -calacorene (0.95 %), γ –asarone (0.38 %), linalyl isovalerate (0.48 %), γ –calacorene (0.25 %), khusenic acid (1.28 %), myristyl acetate (0,54 %), dihexyl azelate (0.79 %), cis- (Z) - α –bisabolene epoxide (1.28 %), nerolidol isobutyrate (0.29 %), heptadecanal (0.51 %),
	Content (%) $_{EO-HD/Do}$ **=29.09%**	**Content (%)** $_{EO-SD/Do}$ **= 22,11%.**
Common compounds	dihydrocarveol (0.31 % - 0.41 %), α-cubebene (0.16 % - 0.29 %), α- copaene (0.61 % - 4.84 %), α-damascone (1.34 % - 2.74 %), β-caryophyllene (17.83 % - 15.87 %), γ-jasmolactone (0.37 % - 1.25), α-bergamotene (2.40 % - 1.10 %), α-caryophyllene (3.94 % - 6.45 %), β-neoclavene (0.75 % - 1.04 %), α- farnesene (1.75 % - 1.55 %), δ –cadinene (2.07 % - 5.74 %), 2-tridecenal (1.99 % - 1.46 %), caryophyllene oxide (19.91 % - 18.92 %), guaiol (1.71 % - 0.52 %), myristaldehyde (2.32 % - 4.41 %), epi-cubenol (2.91 % - 1.41 %), cis-cadine-4-en-7-ol (1.03 % - 0.43 %), cadinol T(2.94 % - 1.56 %), aromadendrene oxide (1.73 % - 2.66 %), caryophylla-3,8(13)-dien-5- β- ol (2.01 % - 3.30 %), eudesm-7(11)-en-4-ol (0.41 % - 0.74 %), farnesyl acetate (0.16 % ; - 0.30 %), phytol (2.07 % - 0.71 %) .	
	Content (%) $_{EO-HD/Do}$ **= 70. 72%**	**Content (%)** $_{EO-SD/Me}$ **=77.70%**

EO: essential oil, HD: hydrodistillation, EV: steam distillation, Do: Daniellia ogea

4. Conclusion

This study highlighted the influence of two extraction techniques on the yields and chemical compositions of the extracted essential oils. The extraction yields of *Mischogyne elliotiana* and *Daniellia ogea* essential oils obtained by hydrodistillation were slightly higher than those obtained by steam distillation. These are 0.12% and 0.11% respectively for *Mischogyne elliotiana* extracts. They are 0.06% and 0.05% for *Daniellia ogea* extracts. GC/MS analysis of these extracts showed that Mischogyne elliotiana oils consist mainly of hydrocarbon monoterpenes (HD: 0.96% - SD: 1.25%), hydrocarbon sesquiterpenes (HD: 87.18% - SD: 94.27%), oxygenated sesquiterpenes (HD: 9.98% - SD: 3.76%), oxygenated monoterpenes (0.05%) and other compounds (HD: 1.64% - SD: 0.61%). Those of *Daniellia ogea* are made up of oxygenated monoterpenes (HD: 1.23% - SD: 1.68%), hydrocarbon sesquiterpenes (HD: 55.07% - SD: 53.51%), oxygenated sesquiterpenes (HD: 34.14% - SD: 32.64%), diterpene (HD: 2.07% - SD: 0.51%), hydrocarbon monoterpenes (0.15%) and other compounds (HD: 7.15% - SD: 11.47%). The main compounds in *Mischogyne elliotiana* essential oil obtained by hydrodistillation are: α-gurjunene (58.14%), guaiene (8.26%), caryophyllene oxide (5.96%) and α-cedrene (5.57%). Those derived by steam distillation are: α-gurjunene (50.60%), β-guaiene (8.30%), β-caryophyllene (6.18%), β-cubebene (5.73%) and α-copaene (5.03%). In contrast, the main constituents of *Daniellia ogea* essential oil obtained by hydrodistillation are: caryophyllene oxide (19.91%), β-caryophyllene (17.83%), β-farnesene (15.56%) bicyclosesquiphellandrene (4.03%) and α-caryophyllene (3.94%). Those derived by steam distillation are: caryophyllene oxide (18.92%), β-caryophyllene (15.87%), α-caryophyllene (6.45%), δ-cadinene (5.74%), β-sesquiphellandrene (5.67%), α-copaene (4.84%), germacrene D (4.68%). *Mischogyne elliotiana* essential oil extracted by steam distillation is richer in hydrocarbon sesquiterpenes (94.27%) than that obtained by hydrodistillation (87.18%). On the other hand, *Daniellia ogea* extracted by hydrodistillation and steam distillation are rich in hydrocarbon sesquiterpenes in very similar proportions: (55.07%) in the case of hydrodistillation and (53.51%) in the case of steam distillation. Both extraction techniques are therefore advantageous for extracting *Daniellia ogea* essential oil. Whereas steam distillation is more advantageous for the extraction of *Mischogyne elliotiana* essential oil.

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript. This manuscript is the result of the work of a research team.

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Competing Interests

Authors have declared that no competing interests exist.

References

Aberchane, M., Fechtal, M., Chaouch, A., & Bouayoune, T. (2001). Influence de la durée et de la technique d'extraction sur le rendement et la qualité des huiles essentielles du cèdre de l'atlas (Cedrus atlantica Manetti). Ann.Rech.For.Maroc., 34, 110-118.

Adjanohoun, E., Adjakidjé, V., Ahyim, M., Aké, L., Akoé, A., Almeida, J., Apova, F., Boukef, K., Chadare, M., Cusset, G., Dramane, K., Eyme, J., Gassita, J., Gbaguidi, N., Goudote, E., Guinko, S., Houngnon, P., Lo, I., Kéita, A., Kiniffo, H., Koné, B., Musampa, N., Saadou, M., Sodogandji, T., Souza, S., Tchabi, A., Zinsou, D., Zohoun, T., 1989. Médecine *traditionnelle et pharmacopée: contribution aux études ethnobotaniques et floristiques en République Populaire du Bénin,* Paris, ACCT, p.595. https://www.sudoc.fr/001500000

Angioni, A., Barra. A., Coroneo. V., Dessi S., Cabras, P., 2006. Chemical composition, seasonal variability, and antifungal activity of *Lavandula stoecha*s L. ssp. stoechas essential oils from stem/leaves and flowers. *Journal of Agricultural and Food Chemistry*. 54, 4364-4370. https://doi.org/10.1021/jf0603329

Asekun, OT, and Ekundayo, O., 2004. The leaf oil of *Daniellia ogea. Journal of essential oil research*. 16 (4), 282-283. https://doi.org/10.1021/jf0603329

Baydar, H. and Baydar N.G., 2005. The effects of harvest date, fermentation duration and Tween 20 treatment on essential oil content and composition of industrial oil rose (*Rosa damascena* Mill.). Industrial Crops and Products. 21(2), 251-255. https://doi.org/10.1016/j.indcrop.2004.04.004

Bosson, A.K., Kouame, S.K., Janath, A.M.B., Yves, A.B., 2025. Chemical composition, antioxidant and antimicrobial activities of essential oils from *emilia praetermissa* Milne-Redh from Cote D'Ivoire: A comparative analysis of hydrodistillation and steam drive methods. Journal of Pharmacognosy and Phytochemistry. 14(5):460-465. DOI:https://www.doi.org/10.22271/phyto.2025.v14.i5f.15606

Boukhatem, MN, Ferhat. A., Kameli, A., 2019. Méthodes d'extraction et de distillation des huiles essentielles : *Revue de littérature.* 9(2), 1653-1659. http://agrobiologia.net/online/wp-content/uploads/2020/01/18-1653-1659_-Boukhatem-et-al_.pdf

Boutabia, L., Telailia, S., Bouguetof, I., Guenadil, F., Chefrou,r A., 2016. Composition chimique et activité antibactérienne des huiles essentielles de *Rosmarinus officinalis* L. de la région de Hammamet (Tébessa-Algérie). *Bulletin de la Société Royale des Sciences de Liège.* 85, 174-189. https://doi.org/10.25518/0037-9565.6050

Cole, R., Haber, W., Setzer, W., 2007. Chemical composition of essential oils of seven species of *Eugenia* from Monteverde, Costa Rica. *Biochemical Systematics and Ecology*. *35*(12), 877-886. https://doi.org/10.1016/j.bse.2007.06.013

Deschepper R., (2017). Variabilité de la composition des huiles essentielles et intérêt de la notion de chémotype en aromathérapie. Thèse de Doctorat de l'Université d'Aix-Marseille, Faculté de Pharmacie : 172 p. https://www.sudoc.fr/220600000

Djié Bi,M.G., Kabran, G.R.M., Quattara, Z.A., Kadja AB, Mamyrbekova- Békro J A, Békro YA., 2016. Variabilité de la composition organique des huiles essentielles extraites d'organes de *Monodora tenuifolia* provenant de trois sites de récolte en Côte d'Ivoire. *Bulletin de la Société Royale des Sciences de Lièg.,* 85, 17-29. https://doi.org/10.25518/0037-9565.5085

Gosline, G., Marshall, A.R., Larridon, I., 2019. Révision et nouvelles espèces du genre africain *Mischogyne* (Annonaceae). Kew Bulletin. 74(28). 23. https://doi.org/10.1007/s12225-019-9804-7

Hassane, O.S., Ghanmi, M., Satrani B., Mansouri, N., Mohamed, H., El Hajaji, H., Chaouch, A., 2011. Composition chimique et activités antibactériennes, antifongiques et antioxydante de l'huile essentielle de *Pelargonium asperum* Ehrh. *ex* Wilde des Comores. *Acta Botanica Gallica*. 158 (2), 225-23. https://doi.org/10.1080/12538078.2011.10516269

Kalamouni, E.C, 2010. Caractérisations chimiques et biologiques d'extraits de plantes aromatiques oubliées de Midi-Pyrénées. Thèse de doctorat de l'université de Toulouse, p.263. https://www.theses.fr/s100000

Kamli, T.E., Errachidi, F., Eloutassi, N., Majid, H., chabir, R., Bour, A., 2017. Comparaison Quantitative Et Qualitative Des Huiles Essentielles De *Rosmarinus Officinalis* Obtenues Par Différentes Méthodes. *Revue Scientifique Européenne*. 21(13), 172 https://doi.org/10.19044/esj.2017.v13n21p172

Keay, R., 1952. Revision of the "Flora of West Tropical Africa": I. *Kew Bull.* 7,149 – 165. https://doi.org/10.2307/4109256

Konan, N.S., Yéo, S.O., Kassé, J-H., Kouamé, B.A., Mamyrbékova, J.A., Békro, Y-A., 2021. Chemical Composition and Antioxidant Activity of the Essential Oil of Cardiospermum grandiflorum Sw Harvested in Kokumbo in Ivory Coast. *International Research Journal Pure Applied Chemistry*. 22(09), 31-38. https://doi.org/10.9734/irjpac/2021/v22i930432

Kouassi K.S., Kouamé B., Mamyrbekova- Békro J. A., Békro Y.A., Fofié N.B.Y. (2020). Chemical Composition and Antibacterial Activities of the Essential Oils from the Leaves of *Premna angolensis* and *Premna quadrifolia,* Two. Lamiaceae from Côte d'Ivoire, *International Journal of Innovative*

Science and Research Technology 5 (8), p. 681-686.

Kouassi K.S., Kouamé B., Mamyrbekova- Békro J. A., Békro Y.A. (2020). Chemical Composition And Antimicrobial Activity Of The Essential Oils Of *Porophyllum Ruderale* (Jacq.) Cass. (Asterales ; Asteraceae) Harvested In Côte d'Ivoire. *European Scientific Journal* 16 (27), p. 268-276.

Kouassi, K.S., 2022. Composition chimique, activités antioxydante et antimicrobienne des huiles essentielles de cinq plantes aromatiques et medicinales de la côte d'ivoire: Etude comparative dans le cas de l'hydrodistillation et de l'entraînement à la vapeur d'eau. These de doctorat de l'Université Nangui Abrogoua, p.203. https://hdl.handle.net/20.500.12177/10706

Lehmann, H., 2013. Le médicament à base de plantes en Europe. Statut, Enregistrement, contrôle. Thèse pour l'obtention du grade de docteur de Strasbourg. 1, 229. https://www.theses.fr/2013STRAD001

Modzelewska, A., Sur, S., Kumar, K., Khan, S., 2005. Sesquiterpenes: Natural products that decease cancer growth. Current Medicinal Chemistry - Anti-Cancer Agents. 5, 477-499. https://doi.org/10.2174/1568011054866973

N'dri K., Atsain M., Kouame B., KOUAME E., Kouassi K., Mamyrbekova-Békro J.A., Békro Y.A. (2025). Chemical composition and antioxidant activity of essential oils from *Cinnamomum camphora* (L.) J. Presl (Lauraceae) and *Allanblackia parviflora* A. Chev (Clusiaceae), *Journal of Pharmacognosy and Phytochemistry*, 14, p.657- 661.

N'dri K., Kouame B., Kouassi K., Kouao T., Mamyrbekova-Békro J.A., Békro Y.A. (2026). Chemical composition, antioxidant and antibacterial activity of the essential oil of *Harungana madagascariensis* Lam. Ex Poiret (Hypericaceae). 27(1): p.168-175. *International Research Journal of Pure and Applied Chemistry*

Noudjoub, M., 2010. Extraction des huiles essentielles de *thymus fontanesii* et application à la formulation d'une forme médicamenteuse – antimicrobienne. Magister de l'Université M'Hamed Bougara Boumerdes, p.185. https://dspace.univ-boumerdes.dz/handle/123456789/178

Olayinka, T., Olusegun, E., 2004. The leaf oil of *Daniellia ogea* L. Journal of Essential oil research. 16 (4), 282 - 283. https://doi.org/10.1080/10412905.2004.9698730

Owokotomo, I.A., Ekundayo, O., 2012. Comparative study of the essential oils of *Monodora myristica* from Nigeria. *European Chemistry Bulletin.* 1, 263-265. https://www.bibliomed.org/journals/european-chemical-bulletin/ecb-2012-17-263-265/

Paolini, J., 2005. Caractérisation des huiles essentielles par CPG/Ir, CPG/SM (IE et IC) et RMN du carbone-13 de Cistus albidus et de deux Asteraceae endémiques de Corse: *Eupatorium cannabinum subsp*. *corsicum* et *Doronicum corsicum*. Chimie, Université de Corse, p.342.

Pibiri, M. C. (2005). Assainissement microbiologique de l'air et des systèmes de ventilation au moyen d'huiles essentielles. (Doctoral thesis, École polytechnique fédérale de Lausanne). https://infoscience.epfl.ch/record/53000

Samate, D.A., 2002. Compositions chimiques d'huiles essentielles extraites de plantes aromatiques de la zone soljdanienne du burkina faso: valorisation. Thèse de doctorat de l'Université de Ouagadougou, p.264. https://www.beep.ird.fr/greenstone/collect/uouaga/index/assoc/M08512.dir/M08512.pdf

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