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To cite this article: Geovanna Tafurt García & Amner Muñoz Acevedo (2018) Volatile Secondary Metabolites in Cascarillo (Ocotea caparrapi (Sandino-Groot ex Nates) Dugand - Lauraceae), Journal of Essential Oil Bearing Plants, 21:2, 374-387, DOI: 10.1080/0972060X.2018.1465856

To link to this article: https://doi.org/10.1080/0972060X.2018.1465856

Published online: 09 May 2018.
Volatile Secondary Metabolites in Cascarillo (Ocotea caparapi (Sandino-Groot ex Nates) Dugand - Lauraceae)

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Abstract: In this work, the chemical analysis of the volatile fractions obtained by simultaneous distillation-extraction of aerial parts of a species of Ocotea aff. O. caparapi known as “Cascarillo” was carried out by GC-MS. The main components identified were: α-pinene (23.9 %) and β-pinene (14.7 %), in the resin; α-terpineol (26.6 %) and methyleugenol (14.7 %), in the leaves; elemicin (31.3 %) and methyleugenol (31.1 %), in the branch bark; myristicin (35.4-46.1 %), terpinen-4-ol (14.9-26.3 %), and α-terpineol (17.5-21.3 %), in stem bark. A high content of monoterpene hydrocarbons (82.6 % and 51.8 %) were found in the resin and leaves; and propenylbenzenes (66.5 %), in the branch bark. Oxygenated monoterpene hydrocarbons (44.5-57.3 %) and propenylbenzenes (52.3-38.7 %) constituted the stem bark. The identification of methyleugenol, elemicin and myristicin, in the volatile fractions, allowed us to establish a relationship between the Ocotea sp. of our study with O. caparapi and O. cymbarum.

Key words: Ocotea; Cascarillo; volatile fractions; propenylbenzenes; SDE-GC-MS.

Introduction

The Lauraceae family has ca. 55 genera and 3000 species, and is constituted by trees and shrubs, which grow in wet and dry tropical forests (0 m to 4000 m). It is widely distributed in America, Asia and Australia, and with a little representation in Africa 1-3. This family is important from the economic point of view by its woods, resins, essential oils (Camphor - Cinnamomum camphora), spices (cinnamon - Cinnamomum zeylanicum; laurel - Laurus nobilis), and fruits (avocado - Persea americana) 1.

Ocotea is the most diverse and abundant genus of the family, with about 350 species mainly distributed in the neotropics, from Mexico to Argentina, and also is found in Africa (Madagascar and Canary Islands) 2-5. This genus includes timbers, which for its fragrant features are a great source of essential oils (EO) constituted by terpenes, phenylpropanoids (e.g., safrole, asaricin, myristicin, phenols, aldehydes) or related compounds (e.g., caparratriene, caparapi oxide) 4, 6-8. Additionally, compounds belonging to classes: flavonoids, lignanes, neolignanes, and alkaloids (benzylisoquinolinics, aporfínics) are found in the Ocotea spp. 3, 9-12. However, it has been carried to endangered conditions due to the deforestation and unsustainable exploitation 4, 5, 13.

Some Ocotea species (O. quixos, O. puchury-major, O. longifolia, O. bullata, O. opifera, O. paulii) have pharmacological or therapeutic properties as anti-rheumatic, analgesic, anesthetic,
antidiarrheal, anti-inflammatory, antithrombotic, antiplaque, antioxidant, antmicrobial, anti-abscesses, gastroenteric, purgative, tonic, headache, nervous disorders, sedative and appetizer. Other species, O. pretiosa, O. sassafras, O. caudata, O. odorífera, O. caparrapi and O. cymbarum, have a recognized position in the market, specifically in perfumery. And, the others, O. bofo, O. austinii and O. corymbosa, have been used as flavoring, furniture and construction 4, 5, 7, 9-19.

In this work, we carried out the chemical analysis of an Ocotea aff. O. caparrapi, called “Cascarillo”. Gas Chromatography coupled to Mass Spectrometry (GC-MS) was used for the analysis the volatile fractions of this species. Simultaneous Distillation-Extraction technique (SDE) was used for obtaining volatile fractions of different parts of the plant material (resin, leaves, and branch and stem barks). The importance of this work lies in the commercial potential of this species for the production of essential oils, resins and wood; in addition, because for this endangered species there are few documented studies for Colombia 6, 20-25.

Methods
Reagent
The solvents employed were dichloromethane (ACS grade, Riedel-de Haën) and distilled water. Anhydrous sodium sulfate (Analytical grade, Biopack) was used as a dehydrating agent.

Plant material
“Cascarillo” (Ocotea aff. O. caparrapi, Nº 0.38 of Orinoquia’s Science Research Group) was collected in “El Porvenir” village, municipality of Toledo, Departamento de Norte de Santander (Colombia). Between 100 g and 1000 g of each part of the plant material was collected. The resin was obtained by drilling the stem of the tree to the marrow. The preliminary taxonomic identification of botanical sample was performed by Gerardo Aymard Antonio Corredor (UNELLEZ - Guanare - Venezuela), expert in Venezuelan forest. The plant collection was made under Resolution No. 739 of July 8, 2014, conferred by the Agencia Nacional de Licencias Ambientales (ANLA).

Simultaneous distillation - extraction solvent (SDE)
The volatile fractions of the different parts of fresh plant were isolated using a Likens & Nickerson microscale apparatus, modified by Godefroot et al. 26, for high density solvents. 10 g of vegetal material were used, the extraction solvent was dichloromethane (2 mL), and the process was carried out during 2 h. The extracts were dehydrated with anhydrous sodium sulfate. For the case of resin, 50 μL of pure resin were dissolved in 500 μL of acetone. Finally, 1 mL of the extracts was analyzed by GC-MS.

Gas chromatography-Mass spectrometry (GC-MS)
The separation and analysis of the components present in the SDE extracts were carried out in a Trace 1310 gas chromatograph coupled to a mass selective detector ISQ (Thermo Fisher Scientific, Inc.), with split/splitless inlet (ratio split 20:1), automatic injection system (AI/AS 1310 Thermo Scientific). Rxi®-1ms column (30 m x 0.25 mm I.D. x 0.5 μm d_j), with stationary phase of 100 % dimethyl-polysiloxane, was used for the separation. Helium (99.999 %) was the carrier gas (constant flow, 1.0 mL/min). Oven temperature programing was from 50°C (5 min) to 150°C (10 min) at a rate of 2°C/min, a second rate of 3°C/min to 250°C (5 min). Ion source and transfer line temperatures were maintained at 230°C and 250°C, respectively. Mass spectra were obtained by electron impact (EI, 70 eV) using quadrupole mass analyzer. Total ion currents (TIC) were acquired by full scan mode, with a mass range of m/z 40-350. Chromatographic and spectroscopic data were processed using by Thermo Xcalibur™ (Version 2.2 SP1.48, Thermo Fisher Scientific, Inc.) and AMDIS (Automated Mass Spectral Deconvolution and Identification System, 13 May 2011, Build 130.53, Version 2.70) softwares.

Linear temperature-programmed retention indices were calculated from the data of a homologous series of saturated aliphatic hydrocarbons (C_7-C_35) and analyzed under the same conditions that the extracts. The secondary metabolites were identified by comparing their mass spectra with those of the databases (NIST11, NIST Retention
Index and Wiley9), and with linear retention indices reported in the existing literature 23-29.

Results and discussion

Table 1 contains the identified compounds from the volatile fractions (VF) isolated of the resin, leaves, and branch and stem barks of Ocotea aff. O. caparrapi, along with their relative amounts and retention indices (calculated and literature). Figure 1 shows the total ion currents (TIC) obtained by GC-MS of each VF analyzed.

According to the Table, α-pinene (23.9 %), β-pinene (14.7 %), p-cymene (7.8 %), and α-terpineol (7.3 %) were the main constituents of the resin sample; linalool (8.6 %), terpinen-4-ol (8.7 %), α-terpineol (26.6 %), methyleugenol (14.7 %), and bicyclogermacrene (6.7 %), were identified in the leaves sample; also, in the branch bark sample were found α-terpineol (12.6 %), methyleugenol (31.1 %), elemicin (31.3 %) and myristicin (2.9 %), as the most abundant compounds; on the other hands, the stem barks of the

| No. | Compound                  | Relative amount, % | I_R  |
|-----|---------------------------|-------------------|------|
|     |                           | Resin  | Leaves | Branch bark | Stem bark 1 | Stem bark 2 | Literature |
| 1   | α-Pinene                  | 23.9   | -      | -           | -           | -           | 936 | 930 |
| 2   | α-Fenchene                | 0.4    | -      | -           | -           | -           | 942 | 940 |
| 3   | Camphene                  | 3.5    | -      | -           | -           | -           | 943 | 943 |
| 4   | β-Citronellene            | 0.4    | -      | -           | -           | -           | 944 | 944 |
| 5   | Sabinene                  | 0.2    | -      | -           | -           | -           | 965 | 964 |
| 6   | β-Pinene                  | 14.7   | -      | -           | -           | -           | 969 | 970 |
| 7   | Myrcene                   | 1.1    | -      | -           | -           | -           | 983 | 981 |
| 8   | p-Menth-2-ene             | 0.7    | -      | -           | -           | -           | 990 | 982 |
| 9   | p-Cymene                  | 7.8    | -      | -           | -           | tr          | 1008 | 1011 |
| 10  | 1,8-Cineole               | 3.9    | 0.1    | -           | 0.2         | 0.2         | 1016 | 1020 |
| 11  | Limonene                  | 4.7    | -      | -           | -           | -           | 1018 | 1020 |
| 12  | γ-Terpinene               | 0.9    | -      | -           | -           | -           | 1046 | 1047 |
| 13  | cis-Sabinene hydrate      | -      | 0.6    | -           | -           | -           | 1048 | 1041 |
| 14  | Fenchone                  | tr     | -      | -           | 0.5         | 0.9         | 1062 | 1066 |
| 15  | Terpinolene               | 0.7    | -      | -           | -           | -           | 1075 | 1078 |
| 16  | trans-Sabinene hydrate    | -      | 1.2    | -           | -           | -           | 1077 | 1051 |
| 17  | Linalool                  | 0.2    | 8.6    | 4.6         | 0.2         | -           | 1082 | 1082 |
| 18  | Fenchol                   | 2.3    | -      | -           | 0.1         | 0.2         | 1092 | 1100 |
| 19  | α-Campholenal             | 0.2    | -      | -           | -           | -           | 1098 | 1102 |
| 20  | cis p-Menth-2-en-1-ol     | tr     | 0.4    | -           | -           | -           | 1101 | 1106 |
| 21  | Camphor                   | 0.7    | -      | -           | 2.4         | 3.2         | 1112 | 1115 |
| 22  | trans-Pinocarveol         | 0.9    | -      | -           | -           | -           | 1115 | 1117 |
| 23  | cis-Verbemon              | 0.2    | -      | -           | -           | -           | 1118 | 1127 |
| 24  | trans-Verbemon            | 2.0    | -      | -           | -           | -           | 1122 | 1122 |
| 25  | trans p-Menth-2-en-1-ol   | -      | 0.3    | -           | -           | -           | 1128 | 1123 |
| 26  | Camphene hydrate          | -      | -      | -           | 0.2         | 0.1         | 1124 | 1128 |
| 27  | 2,2,4-Trimethyl-3-cyclopentene-1-ethanol | - | - | 0.2 | 0.3 | 1140 | NR |
| 28  | δ-Terpineol               | -      | 3.8    | 0.6         | -           | -           | 1140 | 1142 |
| No. | Compound                  | Resin | Leaves | Branch | Stem bark | Stem bark | Calculated | Literature |
|-----|---------------------------|-------|--------|--------|-----------|-----------|------------|------------|
| 29  | Pinocamphone              | 2.5   | -      | 0.2    | -         | 0.3       | 0.3        | 1141       |
| 30  | Borneol                   | -     | 0.2    | -      | 0.2       | 0.3       | 0.3        | 1142       |
| 31  | Unknown                   | -     | -      | 0.4    | 0.1       | 1.1       | 1.1        | 1144       |
| 32  | Terpinen-4-ol             | 1.3   | 8.7    | 3.2    | 14.9      | 26.3      | 26.3       | 1158       |
| 33  | p-Cymen-8-ol              | 1.3   | -      | -      | -         | -         | -          | 1158       |
| 34  | Myrtenal                  | 0.2   | -      | -      | -         | -         | -          | 1161       |
| 35  | α-Terpineol               | 7.3   | 26.6   | 12.6   | 17.5      | 21.3      | 21.3       | 1169       |
| 36  | Myrtanol                  | 1.1   | -      | -      | -         | -         | -          | 1172       |
| 37  | Verbenone                 | -     | -      | 3.5    | 1.8       | 1.8       | 1.8        | 1173       |
| 38  | cis-Piperitol             | -     | 0.2    | -      | -         | -         | -          | 1174       |
| 39  | Borneol formate           | -     | -      | -      | 0.9       | 0.7       | 0.7        | 1180       |
| 40  | trans-Piperitol           | 0.3   | -      | -      | -         | -         | -          | 1184       |
| 41  | trans-Carderol            | -     | -      | 0.7    | 0.3       | 0.3       | 0.3        | 1192       |
| 42  | 2-Hydroxy-1,8-cineole     | -     | -      | -      | 1.0       | 1.0       | 1.0        | 1201       |
| 43  | Fenchol acetate           | 0.2   | -      | -      | -         | -         | -          | 1201       |
| 44  | Isoborneol formate        | 0.2   | -      | -      | -         | -         | -          | 1203       |
| 45  | Nerol                     | -     | -      | 0.5    | 0.2       | -         | -          | 1206       |
| 46  | 2,5-Bornanedione           | -     | -      | 0.4    | -         | 0.4       | 0.4        | 1207       |
| 47  | cis-Myrtanol              | -     | -      | -      | 0.3 tr    | -         | -          | 1214       |
| 48  | Piperitone                | -     | -      | 1.0    | 1.0       | 1.0       | 1.0        | 1218       |
| 49  | trans-Myrtanol            | -     | -      | 0.5    | -         | -         | -          | 1233       |
| 50  | Safrole                   | -     | -      | 0.3    | -         | -         | -          | 1256       |
| 51  | p-Cymen-7-ol              | -     | -      | 0.3    | -         | -         | -          | 1258       |
| 52  | Borneol acetate           | 1.5   | 0.2    | -      | -         | -         | -          | 1264       |
| 53  | Unknown                   | 0.8   | -      | -      | -         | -         | -          | 1271       |
| 54  | Unknown                   | 0.5   | -      | -      | -         | -         | -          | 1274       |
| 55  | Unknown                   | 0.2   | -      | -      | -         | -         | -          | 1277       |
| 56  | Terpinen-4-ol acetate     | 1.1   | -      | -      | -         | -         | -          | 1279       |
| 57  | Unknown                   | 0.6   | -      | -      | -         | -         | -          | 1286       |
| 58  | Unknown                   | 0.2   | -      | -      | -         | -         | -          | 1291       |
| 59  | α-Terpineol acetate       | 4.3   | 0.9    | -      | 0.2       | 0.7       | 0.7        | 1328       |
| 60  | Carvyl acetate            | 1.0   | -      | -      | -         | -         | -          | 1337       |
| 61  | Nerol acetate             | -     | -      | 0.2    | -         | -         | -          | 1341       |
| 62  | Methyleugenol             | -     | 14.7   | 31.1   | 0.6       | 0.2       | 0.2        | 1366       |
| 63  | β-Bourbonene              | -     | 0.2    | -      | -         | -         | -          | 1374       |
| 64  | β-Elemene                 | -     | 0.3    | -      | -         | -         | -          | 1380       |
| 65  | β-Caryophyllene           | -     | 4.4    | 0.4    | -         | -         | -          | 1405       |
| 66  | Nerylacetone              | -     | -      | 0.2    | 0.3       | -         | -          | 1424       |
| 67  | Unknown(178 molecular ion)| -     | -      | 0.4    | 0.2       | -         | -          | 1431       |
| 68  | α-Humulene                | -     | 0.5    | -      | -         | -         | -          | 1438       |
| 69  | 4,5-di-epi-Aristolochene   | -     | 0.3    | -      | -         | -         | -          | 1454       |
alive and death trees were characterized respectively by terpinen-4-ol (14.9 % and 26.3 %), α-terpineol (17.5 % and 21.3 %), and myristicin (46.1 % and 35.4 %).

In accordance with Figure 2, the resin of *Ocotea aff. O. caparrapi* was represented by a high percentage of monoterpenes (hydrocarbons and oxygenated, ~ 51.2 % and 31.4 %); sesquiterpenes and propenylbenzenes contributed with a low percentage (5.3 % and ~ 0.8 %). The leaves were characterized by oxygenated monoterpenes (~ 51.8 %), in conjunction with propenylbenzenes (19.8 %) and sesquiterpenes (hydrocarbons and oxygenated, ~ 15.5 % and 11.3 %). The branch

| No. | Compound | Relative amount, % | I<sub>R</sub> | Literature |
|-----|----------|--------------------|--------------|------------|
|     |          | Resin | Leaves | Branch | Stem | Bark 1 | Bark 2 | Calculated | |
| 70  | Germacrene D | - | 2.4 | 0.5 | - | - | 1464 | 1480 |
| 71  | 4-epi-Cubebol | - | 0.3 | - | - | - | 1476 | 1489 |
| 72  | Bicyclogermacrene | - | 6.7 | - | - | - | 1479 | 1482 |
| 73  | Myristicin | 0.8 | - | 2.9 | 46.1 | 35.4 | 1485 | 1482 |
| 74  | γ-Amorphene | - | 0.5 | 0.2 | - | - | 1495 | NR |
| 75  | δ-Cadinene | - | 0.3 | 0.5 | - | - | 1504 | 1514 |
| 76  | Elemicin | - | 5.2 | 31.3 | 5.6 | 3.1 | 1512 | 1518 |
| 77  | *cis*-3-Hexenol benzoate | - | 0.3 | - | - | - | 1532 | 1540 |
| 78  | *trans*-Nerolidol | 5.3 | - | - | 1.7 | 3.5 | 1538 | 1548 |
| 79  | Spathulenol | - | 5.7 | 0.2 | - | - | 1545 | 1564 |
| 80  | Unknown | - | - | 0.2 | - | - | 1547 | - |
| 81  | Caryophyllene oxide | - | 2.4 | 1.8 | 0.2 | - | 1550 | 1575 |
| 82  | Methoxyeugenol | - | - | 1.2 | - | - | 1551 | 1560 |
| 83  | Globulol | - | 0.2 | - | - | - | 1554 | 1570 |
| 84  | Unknown | - | 0.3 | - | - | - | - | - |
| 85  | Viridiflorol | - | 0.2 | 1.1 | - | - | 1562 | 1592 |
| 86  | Guaiol | - | - | 0.8 | - | - | 1569 | 1582 |
| 87  | Humulene epoxide II | - | 0.5 | 0.6 | - | - | 1574 | 1596 |
| 88  | 1-epi-Cubenol | - | - | 0.4 | 0.1 | - | 1600 | NR |
| 89  | allo-Aromadendrene | - | 1.3 | - | - | - | 1606 | NR |
| 90  | τ-Cadinol | - | - | 0.7 | - | - | 1610 | 1628 |
| 91  | τ-Muurolol | - | 0.3 | 0.7 | - | - | 1611 | 1627 |
| 92  | δ-Cadinol | - | - | 0.4 | - | - | 1614 | 1640 |
| 93  | Unknown | - | 0.4 | 0.3 | - | - | 1619 | - |
| 94  | α-Cadinol | - | 0.3 | 1.8 | - | - | 1622 | 1637 |
| 95  | Unknown | - | - | 0.3 | - | - | 1636 | - |
| 96  | Shyobunol | - | - | 1.3 | - | - | 1658 | NR |
| 97  | Unknown | - | - | - | 0.3 | - | 1781 | - |

* Stem bark<sub>1</sub>: alive three
* Stem bark<sub>2</sub>: death three (without branch)
* I<sub>R</sub>: Calculated o experimental, and literature retention indices 27-29
* tr: Trace (< 0.1 %)
* NR: not reported
bark was constituted by propenylbenzenes (66.5 %), oxygenated monoterpenes (~ 21.2 %), and sesquiterpenes (hydrocarbons and oxygenated, ~ 1.6 % and 9.8 %). Finally, the stem barks of alive and death trees were represented by a high percentage of oxygenated monoterpenes (~ 44.5 % and 57.3 %), and propenylbenzenes (methyleugenol - 0.6 % and 0.2 %, myristicin - 46.1 % and 35.4 %, elemicin - 5.6 % and 3.1 %).

The specific chemical composition of the volatile metabolites determined in the different parts of *Ocotea aff. O. caparrapi* of interest, differed of the reports found about the others Colombian *Ocotea* spp. (*O. caparrapi, O. longifolia, O. macrophylla*), which were rich in nerolidol (92 %), caparrapi oxide (43 %), α-terpinolene (81 %), spathulenol (16 %), and γ-murolene (15 %) 6, 22- 24. However, the composition of the resin has some similarities with the reported by Delgado *et al.* 25, from the oil of Cascarillo acquired in the market of the city of Arauca, (Colombia). α-Pinene (47.2 %), camphor (21.4 %), β-phellandrene (8.1 %), β-myrcene (7.2 %), and β-pinene (4.2 %) were the main components reported by Delgado *et al.* 25, who indicated that the plant known as Cascarillo could be related to the species *O. barcellensis* (synonymy of *O. cymbarum*).

Myristicin (35.4-46.1 %), and methyleugenol (0.2-0.6 %), determined in the VF of stem bark from *Ocotea aff. O. caparrapi* were also detected in the EO from wood of *O. caparrapi* studied by O. González 30. In addition, nerolidol, caparrapi oxide, and caparrapiol, have also been detected as biomarker compounds for this species 4, 6, 20, 31.

A distinctive constituent of some *Ocotea* spp., e.g., *O. puchury-major*, and *O. pretiosa* (*Sasafras albidum*), has been safrole, which is found in high percentage in these plants (above 30 %) 5, 19, 32-34. However, in the species of interest (*Ocotea aff. O. caparrapi*), safrole was determined only at trace level in the volatile fraction of
Figure 2. Types of compounds present in resin, and VF of leaves, and branch and stem barks of Ocotea aff. O. caparrapi.

Monoterpenes (MT), Oxygenated monoterpenes (O-MT), Alkyl benzenes (AKB), Oxygenated alkyl benzenes (O-AKB), Propenylbenzenes (Oxygenated allyl benzenes O-ALB), Oxygenated allyl benzenes-benzodioxole (O-ALB-BD), Sesquiterpenes (ST), Oxygenated sesquiterpenes (O-ST), not identified compound (UND), (Stem bark1: alive three; Stem bark2: death three (without branch)).

Moreover, methyleugenol was the main component of leaves and branch bark for Ocotea aff. O. caparrapi (14.7 % y 31.1 %); nevertheless, the ethanol extract of wood from O. cymbarum contained some eugenol derivatives as dehydroeugenol, mono-o-methyldehydrodieugenol and dehydrodieugenol, which were the majority components.

Chemical composition reported for O. quixos was different of Ocotea sp. under study; thus, the essential oil of the flower calices from O. quixos was constituted by trans-cinnamaldehyde (28 %), cinnamic acid methyl ester (22 %), β-caryophyllene (15 %), acetic acid cinnamyl ester (11 %), and sabinene (8 %). This species has been evaluated about the antiplatelet, anticoagulant, anti-inflammatory, antioxidant, antimicrobial and antifungal properties.

On the other hand, methyleugenol and elemicin, the main components detected for branch bark of Ocotea aff. O. caparrapi were also identified in other species such as Laurus nobilis (Lauraceae), Asiasarum sieboldi and Asarum cordifolium (Aristolochiaceae), Artemisia dracunculus (Asteraceae), Pseudoarlica mulgraveana (Annonaceae), Croton malambo (Euphorbiaceae) and Ocimum campechianum (Lamiaceae). Likewise, elemicin and myristicin were found in Ferula heuffelii, Heracleum pastinacifolium, and Heracleum transcaucasicum (Asteraceae), Piper krukoffii (Piperaceae), and Aristolochia acutifolia (Aristolochiaceae).

Finally, the pharmacological properties and uses of the most abundant compounds identified in the
volatile fractions from *Ocotea aff. O. caparrapi* have been previously determined and reported in the scientific literature. Thus, the monoterpenoids terpinen-4-ol and α-terpineol are mildly irritating and non-sensitising, diuretics, antibacterial, sedatives, antiseptics and antiallergics. These compounds are used as ingredients in the flavor, perfumery and food industries.\(^{50-52}\)

The 2-propenylbenzene derivatives methyleugenol and elemicin are “suspected” of genotoxicity and carcinogenicity. However, methyleugenol has antinociceptive, antiseptic and insect attractant properties. This compound has been used as an ingredient in the flavor and perfumery industries. Meanwhile, elemicin has insecticide, antifeedant and hypotensive activities and is used as starting material for the synthesis of antibacterial drug (trimethoprim), and in topic analgesic formulations.\(^{53-62}\)

The last compound, myristicin, a safrole derivative with a methoxy group attached at carbon 4, has interesting properties such as insecticide, wound healing, anticancer and psychodelic activities, and hepatoprotective function; and this compound has application as food flavoring. Some synthetic analogs from myristicin resulted more potent than the natural product podophyllotoxin.\(^{62-69}\)

**Conclusions**

In conclusion, this work is the first report on the chemical composition of the resin and the volatile fractions of aerial parts of “Cascarillo”, an *Ocotea* sp. from Toledo (Norte de Santander, Colombia). Furthermore, the high content of methyleugenol (31 %), elemicin (31 %) and myristicin (35 % - 46 %) determined in the branch/stem barks allowed us to estimate the potential of this species as a possible source of raw materials (compounds) for industries related (flavor, perfumery and food). Finally, the *Ocotea* sp. of our study would have unique features due to the presence and content of elemicin (without previous reports), which are attributable to the exceptional ecological conditions of the geographical area of collection.

**Acknowledgements**

The authors thank to Gerardo Aymard, Botanical Forest-Venezuelan, for their support in the preliminary taxonomic identification of botanical samples. A-MA thanks to Universidad del Norte, for the financial support through of the Strategic Area “Biodiversidad, Servicios Ecosistémicos y Bienestar Humano”. The authors thanks to the support of Colciencias (Patrimonio Autónomo Fondo Nacional de Financiamiento para la Ciencia, la Tecnología y la Innovación, Francisco José de Caldas), through the Grant RC-0572-2012; and thanks to Instituto de Estudios de la Orinoquia.

**Abbreviations**

Agencia Nacional de Licencias Ambientales (ANLA); Essential Oils (EO); Gas Chromatography coupled to Mass Spectrometry (GC-MS); Simultaneous Distillation-Extraction Technique (SDE); Total Ion Currents (TIC); Volatile Fractions (VF).

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