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# Bark Essential Oil Composition of *Cedrela tonduzii* C. DC. (Meliaceae) from Monteverde, Costa Rica

**Hannah M. Eason and William N. Setzer***

*Department of Chemistry, University of Alabama in Huntsville, Huntsville, AL 35899, USA*

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**Abstract:** The bark essential oils from two different individuals of *Cedrela tonduzii* were obtained by hydrodistillation and analyzed by gas chromatography-mass spectrometry (GC-MS). The chemical compositions of the two oils were qualitatively similar, but showed quantitative differences. One sample had abundant quantities of $\alpha$-selinene (32%) and germacrene-D (17%), while the second sample was rich in $\alpha$-humulene (34%), $\beta$-caryophyllene (13%) and germacrene-D (13%).

**Keywords:** *Cedrela tonduzii*; essential oil composition; $\alpha$-selinene,; germacrene-D; $\beta$-caryophyllene; $\alpha$-humulene.

## 1. Introduction

*Cedrela tonduzii* C. DC. (Meliaceae), "cedro dulce", is native to Central America, ranging from southern Mexico to Panama. It is a large canopy tree, to 20-40 m tall [1]. The leaves are large (0.5-1 m long), alternate, pinnately compound with 10-15 pairs of opposite leaflets, 50-20 cm long. The flowers are small and yellow-green with a garlic odor. The fruit is a five-valved woody capsule, 6 cm long, that opens to release numerous flat-winged seeds. In this work, we present the chemical compositions of the bark essential oils from two different individuals collected from Monteverde, Costa Rica. Leaf extracts of C. *tonduzii* have shown antimalarial activity [2], but to our knowledge, there have been no previous reports on the essential oil characterization of this plant.

* Corresponding author: E-Mail: wsetzer@chemistry.uah.edu, Phone: +1-256-824-6519. Fax: +1-256-824-6349

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## 2. Materials and Methods

### *2.1. Plant Material*

The bark of *C. tonduzii* was collected from two different individual trees in May, 2007, from Monteverde, Costa Rica (10° 18.7' N, 84° 48.6' W, 1350 m asl). The trees were identified by W. A. Haber (Missouri Botanical Garden). A voucher specimen (Haber 465) has been deposited in the Missouri Botanical Garden Herbarium. The fresh bark was chopped and hydrodistilled for 4 h using a Likens-Nickerson apparatus.

### *2.2 Gas Chromatography-Mass Spectrometry*

The bark essential oils of *C. tonduzii* were subjected to GC-MS analysis on an Agilent system consisting of a model 6890 gas chromatograph, a model 5973 mass selective detector (EIMS, electron energy, 70 eV), and an Agilent ChemStation data system. The GC column was an HP-5ms fused silica capillary with a (5% phenyl)-methylpolysiloxane stationary phase, film thickness of 0.25 μm, a length of 30 m, and an internal diameter of 0.25 mm. The carrier gas was helium with a column head pressure of 8.28 psi and flow rate of 1.0 mL/min. Inlet temperature was 200°C and MSD detector temperature was 280°C. The GC oven temperature program was used as follows: 40°C initial temperature, hold for 10 min; increased at 3°/min to 200°C; increased 2°/min to 220°C. The sample was dissolved in $CHCl_3$ to give a 1% w/v solution; 1 μL injections using a splitless injection technique were used. Identification of oil components was achieved based on their retention indices (RI, determined with reference to a homologous series of normal alkanes), and by comparison of their mass spectral fragmentation patterns with those reported in the literature [3] and stored on the MS library [NIST database (G1036A, revision D.01.00)/ChemStation data system (G1701CA, version C.00.01.08)].

## 3. Results and Discussion

The chemical compositions of the bark essential oils are summarized in Table 1. The chemical profiles were qualitatively similar, but showed notable quantitative differences. Both samples had only small amounts of α-pinene, the only monoterpenoid detected; large amounts of sesquiterpenoids, and small amounts of the diterpenoid (3*E*)-cembrene A. Sample 1 was dominated by α-selinene (32%) and germacrene-D (17%), with lesser amounts of β-elemene (9%) and α-eudesmol (8%). Sample 2, on the other hand, was rich in α-humulene (34%), β-caryophyllene (13%), and germacrene-D (13%).

Chemical compositions of the bark essential oils of *C. odorata* [4-7] and *C. fissilis* [8] have been reported. These bark oils are, like *C. tonduzii*, dominated by sesquiterpenoids, with little if any monoterpenoid content. Of the sesquiterpenoids, neither α-selinene nor germacrene-D was abundant in any of these other *Cedrela* bark oils. *β*-Caryophyllene (up to 17%) and α-humulene (up to 8%), however, were relatively abundant in *C. odorata* [6]; less abundant (4.5% and 1.2%, respectively) in *C. fissilis* bark oil [8].

**Table 1.** Chemical composition of *Cedrela tonduzii* bark essential oils.

| RI | Compound | Percent Composition | |
|---|---|---|---|
| | | Sample 1 | Sample 2 |
| 945 | α-Pinene | 1.9 | 0.1 |
| 1337 | δ-Elemene | t | - |
| 1376 | α-Copaene | 5.5 | t |
| 1393 | β-Elemene | 8.5 | 6.5 |
| 1418 | β-Caryophyllene | 2.0 | 13.4 |
| 1436 | α-*trans*-Bergamotene | 1.7 | t |
| 1453 | α-Humulene | 4.0 | 33.6 |
| 1459 | Alloaromadendrene | 0.8 | 0.1 |
| 1477 | γ-Muurolene | 0.3 | t |
| 1481 | Germacrene-D | 16.5 | 12.7 |
| 1486 | β-Selinene | 5.8 | 8.3 |
| 1487 | δ-Selinene | 0.7 | - |
| 1491 | *trans*-Muurola-4(14),4-diene | 0.4 | t |
| 1497 | α-Selinene | 31.9 | 4.3 |
| 1500 | α-Muurolene | 1.0 | - |
| 1504 | Germacrene-A | 4.2 | 2.3 |
| 1513 | γ-Cadinene | 0.4 | t |
| 1523 | δ-Cadinene | 3.5 | t |
| 1531 | *trans*-Cadina-1,4-diene | 0.2 | - |
| 1580 | Caryophyllene oxide | 0.2 | 2.0 |
| 1607 | Humulene epoxide II | 0.6 | 7.1 |
| 1631 | Unidentified sesquiterpenoid | - | 0.9 |
| 1635 | Caryophylla-4(12),8(13)-dien-5-β-ol | - | 0.8 |
| 1641 | τ-Cadinol | 0.8 | - |
| 1645 | Torreyol (= α-Muurolol) | 0.2 | - |
| 1653 | α-Eudesmol | 8.1 | 3.9 |
| 1951 | (3*E*)-Cembrene A | 0.8 | 3.8 |
| | Total identified | 100 | 99.1 |
| | Monoterpenoids | 1.9 | 0.1 |
| | Sesquiterpenoids | 97.4 | 96.1 |
| | Diterpenoids | 0.8 | 3.8 |

t: trace

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