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The essential oil composition of devil's club, *Oplopanax horridus* J. E. Smith Miq.

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ABSTRACT: The chemical composition of the essential oil of the stems and the roots of Devil's Club (*Oplopanax horridus* J.E. Smith Miq.) growing wild in British Columbia, Canada, was investigated. The oils were analysed by GC and GC/MS and (*E*)-nerolidol was found to be the major constituent in both the stems (54.5%) and the roots (54.6%).

KEY WORDS: *Oplopanax horridus*; devil's club; essential oil composition; (*E*)-nerolidol

Introduction

Oplopanax horridus (J. E. Smith) Miq. (syn. *Echinopanax horridus*), commonly called devil's club, belongs to the Araliaceae family. The native distribution of this species is predominantly along the Pacific West Coast of North America. It extends as far south as Oregon and to the north it can be found in Washington, British Columbia and as far north as Alaska. Separate populations occur on several islands in the Great Lakes region.[1–3] Devil's club is a dominant component of understories of various Pacific Northwest and Western boreal forests where moist to wet soil conditions prevail. It is commonly found near springs and streams and in drainage, seepage and wet bottom areas. The plant itself is a native, erect to slightly spreading, deciduous shrub from 1 to 3 m in height. It is sparsely branched with sharp, dense prickles on stems and prominent leaf veins. Greenish white flowers bloom around June to July, which turn into bright red berries in the fall and persist over winter. Both the stems and roots contain a strong aromatic essential oil in their bark. Very few studies on the natural products of this plant have been reported.[4,5] A study has described the presence of antimycobacterial polyynes in a methanol extract.[4] A recent publication reported the presence of some bioactive constituents in the root bark extracts of *O. horridus* from Alaska.[5] Silica gel chromatography of the extracts resulted in the isolation of certain essential oil constituents, such as (*E*)-nerolidol, the major component, followed by spathulenol, oplopanone and α-cubebene in lesser amounts.

Devil's club has been used in folk medicine by the native tribes of Alaska and British Columbia for centuries for the treatment of colds, fever, burns, stomach troubles and even tuberculosis.[4,5]

Experimental

Stems and roots of *O. horridus* were collected from the same plant stands on 30 December 2002 near Chilliwack, British Columbia, Canada, at about 200–300 m altitude. A voucher specimen (no. V219467) was deposited at the Herbarium of the University of British Columbia, Vancouver, Canada. Both oils, the one from the stem and the one from the root, were obtained by steam distillation using a low pressure system with an external steam source. The duration of each distillation was approximately 1 h.

The essential oils were analysed by GC on a gas chromatograph Hewlett-Packard 5890 (FID detector) equipped with a polar Supelcowax 10 column and a nonpolar DB-5 column (30 m × 0.25 mm × 0.25 μm). Analyses by GC/MS were performed on a Hewlett-Packard mass spectrometer 5972 at 70 eV coupled to an HP 5890 gas chromatograph using a DB-5 and a Supelcowax 10 column (same as above). The temperature program, used for both GC and GC/MS analyses, was 40 °C for 2 min, then 2 °C/min to 210 °C and held constant for 33 min. The identification of the components was done by comparison of their retention indices with standards and by comparison of their mass spectra with literature values[6] and with our data bank.

Results and discussion

A pale yellow oil was obtained from the roots in a yield of 0.22%, whereas the oil from the stems was a darker yellow and was obtained in a yield of 0.23%. The fragrance of both oils was quite similar. The chemical

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Table 1. Percentage composition[a] of stem and root essential oils of *Oplopanax horridus*

Compound	RI DB-5[b]	RI SPWAX[b]	Stem oil	Root oil
α-Pinene	939	1024	0.6	—
β-Phellandrene	1030	1209	0.3	—
Linalool	1111	1560	0.1	—
1,3,5-Undecatriene	1178	1399	2.1	0.6
1,3,5,8-Undecatetraene	1180	1469	0.1	—
α-Ylangene	1371	—	0.1	—
α-Copaene	1375	1488	0.2	0.3
β-Elemene	1389	1588	0.2	0.1
β-Caryophyllene	1414	1588	0.1	0.1
(*E*)-α-Bergamotene	1436	1585	0.1	
Aromadendrene	1436	1596	—	0.2
α-Humulene	1452	1665	0.2	0.1
Ishwarane	1460	1631	—	2.1
Allo-aromadendrene	1460	1637	0.2	—
(*E*)-β-Farnesene	1462	1679	0.9	—
γ-Muurolene	1479	1690	0.1	0.2
Germacrene D	1482	1707	1.0	0.3
Unidentified[c]	1486	1700	—	0.7
ar-Curcumene	1487	1777	0.2	—
Bicyclogermacrene	1498	1732	10.4	4.4
α-Zingiberene	1500	1728	1.6	—
α-Muurolene	1504	1727	—	0.3
Germacrene A	1504	1756	0.2	—
γ-Cadinene	1516	1756	4.0	6.4
α-Farnesene[d]	1516	1759	1.2	—
Endo-1-bourbonanol	1516	2048	—	0.4
δ-Cadinene	1526	1758	2.5	3.9
β-Sesquiphellandrene	1526	1771	1.0	—
α-Cadinene	1538	1786	0.1	0.2
Germacrene B	1555	1818	0.7	0.1
(*E*)-Nerolidol	1566	2054	54.5	54.6
Spathulenol	1573	2124	0.7	2.6
Germacrene D-4-ol	1573	2049	2.1	0.4
Gleenol	1586	2054	0.2	0.3
Guaiol	1592	2093	0.3	0.1
1,10-Di-epi-cubenol	1608	2054	1.2	1.7
τ-Cadinol	1637	2170	9.6	16.9
τ-Muurolol	1637	2184	0.2	—
α-Cadinol	1652	2228	0.6	0.4
α-Eudesmol	1655	2199	0.2	—
Bulnesol	1666	2207	0.4	0.2
% total identified			98.2	96.9

[a] Percentages were measured on the DB-5 column except for those of γ-cadinene, α-farnesene, δ-cadinene, β-sesquiphellandrene, spathulenol, germacrene-D-4-ol, τ-cadinol and τ-muurolol, which were measured on the Supelcowax column.
[b] RI, retention indices relative to C_8–C_{24} *n*-alkanes on both columns.
[c] Mass spectra: *m/z* 105(100), 91(85), 41(80), 189(65), 93(60), 79(50), 107(50); M.W. 204.
[d] Geometrical isomer not identified.

composition of stem essential oil of *O. horridus* is shown in Table 1. (*E*)-Nerolidol was by far the major constituent in the stem oil (54.5%) followed by bicyclogermacrene (10.4%) and τ-cadinol (9.6%). The root oil contained the same major constituent, (*E*)-nerolidol (54.6%), followed by τ-cadinol (16.9%) as an important minor constituent. All of the constituents identified in the essential oil of the stems and the roots were sesquiterpenes and oxygenated sesquiterpenes except for the five most volatile components. Three of these were the monoterpenes, α-pinene, β-phellandrene and linalool, and the other two were the conjugated polyenes 1,3,5-undecatriene and 1,3,5,8-undecatetraene. These minor constituents amounted to 3% in the stem oil. Oplopanone, identified in an extract of *Oplopanax horridus*,[5] was not detected as a component in the essential oil from the stems and roots of the plants used in this study. To our knowledge, this is the first detailed report of the chemical composition of the essential oil of devil's club.

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