

**COMPOSITION OF THE ROOT OIL OF *CUNNINGHAMIA KONISHII*  
HAYATA, GROWING WILD IN NGHE AN PROVINCE, VIETNAM**Nguyen Thi Thanh Nga<sup>1</sup>, Nguyen Anh Dung<sup>1</sup>, Tran Huy Thai<sup>2,3</sup><sup>1</sup>Vinh University<sup>2</sup>Institute of Ecology and Biological Resources,  
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The genus *Cunninghamia* is originated in China, Taiwan, Laos and Vietnam. In Vietnam, *Cunninghamia lanceolata* (Lamb.) Hook. var. *lanceolata* imported from China has been grown for nearly 100 years. It has been used as a landscaping tree and an important forest tree for last 20 years in Lai Chau, Lao Cai, Ha Giang, Cao Bang, Lang Son. *Cunninghamia lanceolata* (Lamb.) Hook. var. *konishii* (Hayata) Fujita - *Cunninghamia konishii* Hayata growing wild concentrates to form nearly pure populations or mixed broadleaf trees - conifer moist evergreen subtropical forest in Ha Giang, Son La, Thanh Hoa, Nghe An. Nghe An Province is the largest distribution of *Cunninghamia konishii* in Vietnam, it is mainly concentrated along part of the border between Lao PDR and Vietnam (Loc et al. (2013)). In Vietnam, its vernacular name is Sa moc que phong, Sa mu dau, May lung linh, May lang lenh.

This species is a valued timber species because of its high quality wood (*i.e.*, straight and decay resistant), conifers is over-exploited. This species is threatened at global and national levels, according to the IUCN (2015) is Endangered (EN) - A2cd; B2ab (ii, iii, v), Near Threatened (VU) - A1a, d, c1 in Vietnam Red Data Book (2007).

There have been some literature suggested of *Cunninghamia konishii* essential oil. However, these reports are mainly focused on stems and characterized compounds in the wood itself (Cedrol) (Dai & Hung (2012), Su et al. (2012), Thai et al (2007), Thai et al. (2015)). Cedrol is natural antifungal agents (Cheng et al. (2011); Cheng et al (2012), Cheng et al (2014)). It lures some insects, disrupts their reproduction and development, especially for mosquitoes (Cheng et al. (2013); Lindh et al. (2015)). But there is no study on the essential oil roots of *Cunninghamia konishii*.

In this study, the essential oil composition of the roots of *Cunninghamia konishii* Hayata in Tuong Duong district, Nghe An Province, Vietnam was investigated.

**I. MATERIALS AND METHODS****1. Plant collection**

Roots of *Cunninghamia konishii* were harvested from Tuong Duong district, Nghe An Province, Vietnam (19°04.505'N, 104°21.275'E), in June 2015. A voucher specimen, TD 020, was deposited at the Botany Museum, Vinh University, Vietnam.

**2. Extraction of essential oil**

1 Kg of the plant sample was minced and the oil was obtained by hydrodistillation for 3 h at normal pressure, according to the Vietnamese Pharmacopoeia (1997). The yield content of essential oil was 0.25% (v/w; light yellow) calculated on a dry weight basis.

### 3. Analysis of the oil

About 15 mg of oil, which was dried with anhydrous sodium sulfate, was dissolved in 1 mL of hexane (for spectroscopy or chromatography). Gas chromatography (GC) analysis was performed on an Agilent Technologies HP 6890 Plus Gas chromatograph equipped with a FID and fitted with HP-Wax and HP- 5MS columns (both 30 m × 0.25 mm, film thickness 0.25 μm). The analytical conditions were: carrier gas H<sub>2</sub> (3 mL/min), injector temperature (PTV) 250 °C, detector temperature 260°C, column temperature programmed from 40°C (2 min hold) to 220°C (10 min hold) at 4°C /min. Samples were injected by splitting and the split ratio was 10:1. The injected volume was 1.0 μL. Inlet pressure was 6.1 kPa.

An Agilent Technologies HP 6890N Plus Chromatograph fitted with a fused silica capillary HP-5 MS column (30 m × 0.25 mm, film thickness 0.25 μm) and interfaced with a mass spectrometer HP 5973 MSD was used for the GC/MS analysis, under the same conditions as those used for GC analysis. The conditions were the same as described above with He (1mL/min) as carrier gas.

### 4. Identification of the constituents

The identification of constituents was performed on the basis of retention indices (RI) determined with reference to a homologous series of n-alkanes (C<sub>4</sub>-C<sub>30</sub>), under identical experimental conditions, co-injection with either standards (Sigma-Aldrich, St. Louis, MO, USA) or known essential oil constituents. The essential oil constituents of *Cunninghamia konishiii*, MS library search (NIST 08 and Wiley 9<sup>th</sup> Version), and by comparing with MS literature data (Adams R. P. (2007), Joulain & Koenig (1998), NIST (2011)). GC and GC/MS analysis were both conducted at the Vinh University.

## II. RESULTS AND DISCUSSION

The 31 identified compounds represent 91.29% of the total oil contents of the root *Cunninghamia konishiii*. The major components were cumin α-cedrol (23.31%), α-eudesmol (19.34%), (E)-nerolidol (13.48%), γ-eudesmol (6,34%), α-cadinol (4,26%), and dimethyl tetramethyl succinate (4.17%). The other components are less than elemol (3.92%), δ-cadinene (2.36%), α-cederen (2.09%), (E, E)-α-farnesen (1.60%), thujopsene (1.19%), manool (1.08%), and α-amorphene (1.06%). The remaining compound containing by weight from 0.16% to 0.97% (Table 1).

Table 1

Chemical composition of the essential oils of the root *Cunninghamia konishiii* from Nghe An province

No	Compounds	RI (Lit.)	Percent (%) composition
1	α-Pinene	939	0.24
2	Dimethyl tetramethyl succinate	1167	4.17
3	β-Cubebene	1351	0.20
4	Neryl acetate	1362	0.21
5	β-Elemene	1391	0.22
6	α-Cederen	1412	2.09
7	β-Caryophyllene	1419	0.73
8	Thujopsene	1431	1.19

9	Aromadendrene	1441	0.24
10	$\alpha$ -Humulene	1454	0.28
11	Azulol	1472	0.26
12	$\gamma$ -Muurolene	1480	0.52
13	Germacren D	1485	0.59
14	$\alpha$ -Amorphene	1485	1.06
15	$\beta$ -Selinene	1486	0.16
16	$\delta$ -Cadinene	1459	2.36
17	$\alpha$ -Muurolene	1497	0.97
18	1,2,2-Trimethyl-1-(p-totyl)-cyclopentane	1500	0.38
19	(E,E)- $\alpha$ -Farnesen	1508	1.60
20	$\alpha$ -Cadinene	1513	0.23
21	Calacorene	1538	0.55
22	Elemol	1550	3.92
23	(E)-Nerolidol	1563	13.48
24	$\beta$ -Oplopenone	1600	0.40
25	$\alpha$ -Cedrol	1601	23.31
26	$\gamma$ -Eudesmol	1629	6.34
27	Alloaromadendrene	1639	0.54
28	$\alpha$ -Eudesmol	1652	19.34
29	$\alpha$ -Cadinol	1654	4.26
30	$\beta$ -Maaliene	1732	0.37
31	Manool	1989	1.08
	<b>Total</b>		<b>91.29</b>

RI: Retention indices on HP-5 MS capillary column

Comparison of the main component of oil sample of *Cunninghamia konishii* in Tuong Duong, Nghe An Province in the present work with those reported in the literature in Nghe An Province (Pu Mat National Park) and Son La Province (Thai et al.(2007)), Ha Giang Province (Dai & Hung (2012)), Thanh Hoa Province (Thai et al.(2015)), showed that only the present oil sample of *Cunninghamia konishii* contains (E)-nerolidol .This may be a new chemotyp (chemotyp (E)-nerolidol) of *Cunninghamia konishii* in Vietnam (Table 2).

Table 2

**The main chemical components of *Cunninghamia konishii* essential oil in Vietnam**

No	Compounds	Tuong Duong (Nghe An)	Pu Mat (Nghe An)	Xuan Lien (Thanh Hoa)	Tay Con Linh (Ha Giang)	Xuan Nha (Son La)
1	$\alpha$ -Cedrol	23.31	30.0	11.2	29.8	37.0
2	$\alpha$ -Eudesmol	19.34	-	8.8	-	-
3	(E)-Nerolidol	13.48	-	-	-	-
4	$\gamma$ -Eudesmol	6.34	-	-	-	-
5	$\alpha$ -Cadinol	4.26	1.35	-	1.0	1.37
6	$\alpha$ -Cedrene	2.09	15.3	18.4	3.4	4.5

8	$\alpha$ -Terpineol	-	-	9.6	36.6	-
9	cis- $\alpha$ -Dehydro terpineol	-	-	-	5.6	-
10	Borneol	4.6	4.2	4.4	4.6	8.3

### III. CONCLUSIONS

Oil content in the roots of *Cunninghamia konishii* Hayata in Tuong Duong district, Nghe An province, Vietnam is 0.25% on dry weight basis.

Studying the chemical composition of oil by gas chromatography/mass spectrometry (GC / MS) has identified 34 compounds, accounting for 91.29% of the total oil. The main compounds are  $\alpha$ -cedrol (23.31%),  $\alpha$ -eudesmol (19.34%), (E)-nerolidol (13.48%),  $\gamma$ -eudesmol (6.34%),  $\alpha$ -cadinol (4.26%) và Dimethyl tetramethyl succinate (4.17%).

Comparison of the main components in the essential oil of *Cunninghamia konishii* in different ecological regions (Son La, Ha Giang, Thanh Hoa, Nghe An (Pu Mat NP)) showed that the compound (E)-nerolidol is a new chemotyp *Cunninghamia konishii* in Vietnam.

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**THÀNH PHẦN HÓA HỌC CỦA TINH DẦU RỄ LOÀI SA MỘC DẦU  
(*CUNNINGHAMIA KONISHII* HAYATA) Ở NGHỆ AN, VIỆT NAM**

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**TÓM TẮT**

Nghiên cứu thành phần hóa học tinh dầu rễ loài Sa mộc dầu (*Cunninghamia konishii* Hayata), thu tại huyện Tương Dương, tỉnh Nghệ An vào tháng 6 năm 2015. Bằng phương pháp sắc kí khí (GC) và sắc kí khí khối phổ liên hợp (GC/MS) đã xác định được 34 hợp chất (chiếm 91,29% tổng hàm lượng tinh dầu). Thành phần chính tinh dầu của rễ là  $\alpha$ -cedrol (23,31%),  $\alpha$ -eudesmol (19,34%), (E)-nerolidol (13,48%) và  $\gamma$ -eudesmol (6,34%). So sánh với thành phần chính trong tinh dầu cùng loài *Cunninghamia konishii* ở các vùng sinh thái khác nhau thì (E)-nerolidol có thể là một chemotype mới của loài này tại Việt Nam.