

# Essential Oil Composition of Leaf and Rhizome Oil of *Alpinia nigra* (Gaertner) B.L.Burt. from Northeast India

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## Abstract

The essential oils of the leaves and rhizomes of *Alpinia nigra* (Gaertner) B.L.Burt., family Zingiberaceae, were obtained by hydrodistillation and yielded 0.02% and 0.4%, respectively. The oils were analyzed for their chemical composition by capillary GC and GC/MS. A total of 18 compounds were identified representing about 96.4% of leaf and 97.8% of rhizome oils, respectively. 1,8-cineole was the major component in both leaf (25.4%) and rhizome (34%) oils. In addition,  $\beta$ -pinene (15.1%), camphor (15.3%), carotol (7.3%),  $\alpha$ -pinene (7.8%) and camphene (7.0%) were also present in leaf oil, whereas in the rhizome oil  $\alpha$ -fenchyl acetate (13.1%),  $\alpha$ -terpineol (9.6%),  $\beta$ -pinene (8.1%) and camphene (7.0%) were the other main constituents.

## Key Word Index

*Alpinia nigra*, Zingiberaceae, essential oil composition, 1,8-cineole,  $\beta$ -pinene, camphor.

## Introduction

*Alpinia nigra* (Gaert.) B.L.Burt. (family Zingiberaceae) is an aromatic medicinal plant found in China, Bhutan, India, Sri Lanka and Thailand at an altitude of 900–1,100 m (1). It is a herbaceous medicinal plant. The medicinal applications of *A. nigra* have also been reported in stomach problems related to gastric diseases, gout and colic. The shoot of this plant has traditional usage among the native tribes of Tripura, Northeast India who consume the raw juice of the green shoot for its presumed anthelmintic, antioxidant properties (2). The rhizomes of this plant are also used as vegetables in Thailand. In Thailand, the people are confused between *Alpinia galanga* and *A. nigra*, the rhizomes of which are used for the same purpose and which are both called Kha (3). The molecular phylogenetic analysis suggests that *A. galanga* is closely related to *A. nigra* in sec *A. allughas* (with tubular bracteoles) (4). Rhizomes of *A. nigra* are also closely related to the galangal, curcuma and zinger. It is an inferior variety of galangal and sometimes used for adulterating true galangal. The leaf and rhizome oil of the different species of *Alpinia* (5–7), particularly *A. galanga*, have been widely investigated (8,9) and reviewed (10). However,

no information is available on essential oil constituents of *A. nigra* which grows wild in northeastern India.

## Experimental

**Plant material:** The leaves and rhizomes of *A. nigra* (family Zingiberaceae) were collected from Tripura and cultivated in NEIST (formerly RRL) Jorhat experimental farm. The species was identified by Botanical Survey of India, Shillong, and the voucher specimen was deposited in NEIST, Jorhat Herbarium.

**Isolation of volatile components:** Five-hundred grams of young and mature fresh leaves and rhizomes were subjected to separate hydrodistillation in a Clevenger-type apparatus for 5 h. The distilled oils were collected and dried over anhydrous sodium sulphate and analyzed by GC and GC/MS. The percentage of oils in the mature leaves was found to be 0.15–0.02% and in the rhizomes were 0.3–0.4% w/w.

**GC/MS:** Analysis of the oil was carried out by a combination of capillary GC and GC/MS using Shimadzu GC 17A and GC and GC-MS-QP5000 instruments. The capillary column used for analysis was a CP-Sil 5CB fused silica column,

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**Table I Chemical constituents (%) of the leaf and rhizome oils of *Alpinia nigra***

Compound	Leaf oil (%)	Rhizome oil (%)
$\alpha$ -pinene	7.8	5.7
camphene	7.0	7.0
$\beta$ -pinene	15.1	8.1
myrcene	1.5	t
1,8-cineole	25.4	34.0
(E)- $\beta$ -ocimene	0.7	t
$\gamma$ -terpinene	0.8	t
fenchone	t	1.3
$\alpha$ -fenchone	t	t
camphor	15.3	5.5
borneol	2.2	t
terpinen-4-ol	1.3	2.3
$\alpha$ -terpineol	3.1	9.6
$\alpha$ -fenchyl acetate	0.0	13.1
bornyl acetate	1.4	t
daucene	2.1	1.5
methyl cinnamate	5.4	4.5
carotol	7.3	5.2
<b>Total</b>	<b>96.4</b>	<b>97.8</b>

\* t: trace (&lt; 0.1%)

25 m x 0.25 mm, film thickness 0.25  $\mu$ m. The initial oven temperature was held at 35°C for 25 min, then programmed at 5°C/min to 280°C; split ratio, 50:1; carrier gas, He at a flow rate of 30 cm<sup>3</sup>/s. The injector and detector (FID) temperature were maintained at 280°C. For GC/MS analysis, a quadrupole mass analyzer with an electron ionization (EI) system was used. The mass spectra acquired was in the range 10–400 Da, with a scanning rate of 4 spectra/s. The transfer line temperature was kept at 280°C and the He flow rate was 40 cm<sup>3</sup>/s.

The percentage composition of the oil was calculated from electronic integration measurements using FID detection without response factor correction. Liner retention indices of the components were determined relative to n-alkanes. The constituents of the oil were identified by matching their mass spectra and retention indices using NIST library search facility available with the instrument.

## Results and Discussion

The chemical composition of volatile oil of leaf and rhizome of *A. nigra* are shown in Table I. The oil yield varied from 0.15% to 0.02% for the leaves and 0.3% to 0.4% for the rhizomes on a fresh weight basis (w/w). Eighteen compounds were isolated, accounting for 96.4% oil from leaf, and 97.8%

from rhizome oil. 1,8-Cineole was the major compound in both the leaf (25.4%) and rhizome oils (34%). Out of 96.4% of total leaf oil, 1,8-cineole (25.4%), camphor (15.3%) and  $\beta$ -pinene (15.1%) were the major compounds, followed by  $\alpha$ -pinene (7.8%), camphene (7.0%), carotol (7.3%) and methyl cinnamate (5.4%). The rhizome oil contained 1,8-cineole (34%),  $\alpha$ -fenchyl acetate (13.1%),  $\alpha$ -terpineol (9.6%),  $\beta$ -pinene (8.1%) and camphene (7.0%) as major compounds. The results of the quantitative comparative analyses of the oils of the leaves and rhizomes have shown significant differences.  $\alpha$ -Fenchyl acetate (13.1%) and fenchone (1.3%) were observed only in the rhizome oil. Quantitatively camphor (15.3%) was found in higher levels in the leaf oil than rhizome oil (5.5%). Because of the fresh camphoraceous aroma the authors believe that this oil has immense potential in cosmetics, soap and other bath products.

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