

Essential Oil Constituents of *Boenninghausenia albiflora* Reichb. (Rutaceae) from Gangolihat, (Distt-Pithoragarh) Uttarakhand, India.

Deepak Chandra¹ and Kundan Prasad^{2*}

¹Department of Chemistry, K.S.K.G.I.C Maigari-Estate, Distt-Bageshwar, Uttarakhand.

²Department of Chemistry, G.I.C Garkha, Distt-Pithoragarh, Uttarakhand.

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*Corresponding author: Kundan Prasad, Department of Chemistry, G.I.C Garkha, Distt-Pithoragarh, Uttarakhand. Tel: 9690766978; Email: gicgarkha@gmail.com.

Abstract

Background and objective: *Boenninghausenia albiflora* belonging to the family Rutaceae and is well known for its medicinal properties in traditional system of medicine.

Methods: The plant *Boenninghausenia albiflora* Reichb including leaves, stem, and flowers were extracted by hydro distillation method for 6 hours using Clevenger apparatus. The hydro-distilled essential oil of *Boenninghausenia albiflora* Reichb has been examined by means of gas chromatography-mass spectrometry (GC-MS).

Results: A total of 54 components of the essential oil of *Boenninghausenia albiflora* Reichb. were identified, accounting for 97 % of the total oil. The main compounds found were cinnamyl propyl ether 22 %, linalool 22 %, (E)-cinnamaldehyde 15 %, (E) cinnamyl alcohol 5 %.

Keywords: *Boenninghausenia albiflora*; Essential oil; Gas Chromatography; Mass Spectrometry;

Introduction

Mother earth has gifted the humankind with lots of plants which has the ability for curing the health disorders of human being. These feature has been identified in the pre-historic times, and the world wide use of herbal therapies and health care preparations that are prescribed in ancient books like vedas and the bibles pave way for the discovering of natural products with medicinal values [1,2]. Traditional Indian medicines have been used for pharmaceutical and dietary therapy for several decades. During several periods, there is increasing interest to unlock the secrets of ancient herbal remedies. The increase in prevalence of multiple drug resistance has shown the development of new synthetic antibacterial, antioxidative and anti-inflammatory drugs. Phytochemicals from medicinal plants showing antimicrobial, antioxidant and anti-inflammatory activities have a potential of filling this need because their no side effects than synthetic drugs [3]. *Boenninghausenia albiflora* belonging to the

family Rutaceae and is well known for its medicinal properties in traditional system of medicine. In ethnobotanical literature, the aerial as well as the root part has been described as an antiseptic. The plant leaf has been used to apply on cuts and wounds whereas root powder is being used as antiseptic [4]. Sometimes its juice is also being given in vomiting and dysentery. Some workers also reported this plant to have flea repellent, as well as calcium blocking activity [5,6].

Essential oils and their volatile constituents are used to prevent and treat human disease. The possible role and mode of action of these natural products is discussed with regard to the prevention and treatment of cancer, cardiovascular diseases including atherosclerosis and thrombosis, as well as their bioactivity as antibacterial, antiviral, antioxidants and antidiabetic agents. The pharmaceutical properties of aromatic plants are partially attributed to essential oils [7].

Experimental

Plant Material

The plant *Boenninghausenia albiflora* Reichb was collected in the month of September, 2017 from Gangolihat, 80 km away from Pithoragarh, Uttarakhand, India. The plant was authenticated by Botanical Survey of India (BSI), Dehradun. A voucher specimen (No.114837) was deposited in the Herbarium Section at BSI, Dehradun, India. (Figure 1).

Isolation of essential oil

The plant *Boenninghausenia albiflora* including leaves, stem, and flowers extracted by hydro-distillation method for 3 hours using Clevenger-apparatus (Figure 2, 3 & 4). The oil was dried over anhydrous sodium sulphate and stored at 4 °C temperature in a sealed vial until analysis was performed. The percentage oil yield was calculated based on the dry weight of the plant. The oil yield was (0.08%).



Figure 1: Identification of plant from B.S.I Dehradun.



Figure 2: Plant of *Boenninghausenia albiflora*.



Figure 3: Plant of *Boenninghausenia albiflora* Flower.

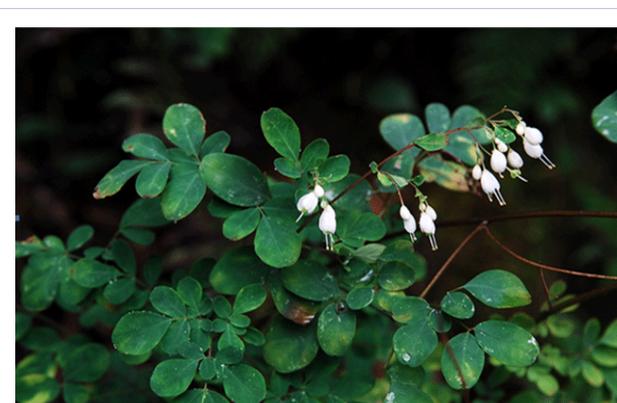


Figure 4: Plant of *Boenninghausenia albiflora* Flower.

GC and GC/MS Analyses and Identification

Essential oil analyses were performed by GC-MS and GC-FID on a Shimadzu QP-2010 instrument, equipped with FID, in the same conditions. The percentage composition of the oil sample was computed from the GC peak areas without using correction for response factors. The oil was analyzed using a Shimadzu GC/MS Model QP 2010 Plus, equipped with a Rtx-5MS (30 m × 0.25 mm; 0.25 mm film thickness) fused silica capillary column. Helium (99.999 %) was used as a carrier gas adjusted to 1.21 ml/min at 69.0 K Pa, split less injection of 1 mL, of a hexane solution injector and interface temperature were 270 0C, oven temperature programmed was 50–280 0C at 3 0C/min. Mass spectra were recorded at 70 eV. Ion source temperature was 230 0C.

The identification of the chemical constituents was assigned on the basis of comparison of their retention indices and mass spectra with those given in the literature. Retention indices (RI) were determined with reference to a homologous series of normal alkanes, by using the following formula [7,8].

$$KI = 100 \left[n + (N - n) \times \frac{\log t_R^i(\text{unknown}) - \log t_R^i(C_n)}{\log t_R^i(C_N) - \log t_R^i(C_n)} \right]$$

t_R^i – the net retention time ($t_R - t_0$)

t_0 – the retention time of solvent (dead time)

t_R – the retention time of the compound.

C_N – Number of Carbons in longer chain of alkane

C_n – number of Carbons in shorter chain of alkane

n - Is the number of carbon atoms in the smaller alkane

N - Is the Number of carbon atoms in the larger alkane

Results and Discussion

The GC and GC-MS analysis of leaf oil of *Boenninghausenia albiflora* resulted in the identification of 54 constituents. The compounds, together with their retention index and relative percentage concentration are presented in table 1. The 0.10% v/w of pale yellow colour oil of *Boenninghausenia albiflora* was extracted by steam distillation methods. The main compounds found were cinnamyl propyl ether 22.61 %, linalool 22.56%, (E)-cinnamaldehyde 15.06 %, (E) cinnamyl alcohol 5.65 %. The monoterpenes and sesquiterpene hydrocarbons found in the oil as major components while diterpenes were minor components.

Table- 1: Essential oil composition of *Boenninghausenia albiflora* Reichb

S.N.	Compound	Area %	Mol. formula	RI	Mode of identification
1.	α -Thujene	0.10	C ₁₀ H ₁₆	927	a,b
2.	α -Pinene	2.24	C ₁₀ H ₁₆	936	a,b
3.	Benzaldehyde	3.02	C ₇ H ₆ O	946	a,b
4.	Camphene	1.35	C ₁₀ H ₁₆	953	a,b
5.	β -Pinene	1.10	C ₁₀ H ₁₆	978	a,b
6.	1-Propylcyclopentanol	0.08	C ₈ H ₁₆ O	1010	a,b
7.	δ -3-Carene	0.12	C ₁₀ H ₁₆	1012	a,b
8.	p-Cymene	2.12	C ₁₀ H ₁₄	1015	a,b
9.	Limonene	0.54	C ₁₀ H ₁₆	1030	a,b
10.	Salicylaldehyde	0.16	C ₇ H ₆ O ₂	1044	a,b
11.	4-Methyl-4-vinylbutyrolactone	0.13	C ₇ H ₁₀ O ₂	1050	a,b
12.	Cineole	0.81	C ₁₀ H ₁₈ O	1058	a,b
13.	Acetophenone	0.11	C ₈ H ₈ O	1068	a,b
14.	cis-Linalool oxide	3.74	C ₁₀ H ₁₈ O ₂	1069	a,b
15.	Trans-Linalool Oxide	3.62	C ₁₀ H ₁₈ O ₂	1075	a,b
16.	β -Linalool	22.56	C ₁₀ H ₁₈ O	1082	a,b
17.	α -Campholenal	0.10	C ₁₀ H ₁₆ O	1125	a,b
18.	Nopinone	0.15	C ₉ H ₁₄ O	1138	a,b
19.	t-Pinocarveol	0.18	C ₁₀ H ₁₆ O	1140	a,b
20.	t-Verbenol	0.05	C ₁₀ H ₁₆ O	1145	a,b
21.	Linderol	0.44	C ₁₀ H ₁₈ O	1149	a,b
22.	Hydrocinnamaldehyde	0.45	C ₉ H ₁₀ O	1165	a,b
23.	pyranoid	0.93	C ₁₀ H ₁₈ O ₂	1170	a,b
24.	α -Terpineol	0.36	C ₁₀ H ₁₈ O	1176	a,b
25.	3,7-Dimethyloct-1,5-dien-3,7-diol	0.56	C ₁₀ H ₁₈ O ₂	1192	a,b
26.	(Z)-Cinnamaldehyde	0.17	C ₉ H ₈ O	1218	a,b
27.	Bornyl formate	0.07	C ₁₁ H ₁₈ O ₂	1275	a,b
28.	(E)-cinnamaldehyde	15.06	C ₉ H ₈ O	1280	a,b
29.	Bornyl acetate	1.31	C ₁₂ H ₂₀ O ₂	1285	a,b
30.	(E)-Cinnamyl alcohol	5.65	C ₉ H ₁₀ O	1308	a,b
31.	cis-2,3-Pinanediol	0.33	C ₁₀ H ₁₈ O ₂	1321	a,b
32.	ethyl-Hydrocinnamate	0.24	C ₁₁ H ₁₄ O ₂	1351	a,b
33.	Cinnamyl formate	0.39	C ₁₀ H ₁₀ O ₂	1352	a,b
34.	cis-Cinnamic acid	0.44	C ₉ H ₈ O ₂	1357	a,b
35.	α -Copaene	0.36	C ₁₅ H ₂₄	1375	a,b
36.	Hydrocinnamyl acetate	0.77	C ₁₁ H ₁₄ O ₂	1377	a,b
37.	Cinnamyl propyl ether	22.61	C ₁₂ H ₁₆ O	1380	a,b
38.	(Z)-ethyl-Cinnamate	0.30	C ₁₁ H ₁₂ O ₂	1381	a,b
39.	Isopropyl 3-phenylpropanoate	0.17	C ₁₂ H ₁₆ O ₂	1390	a,b
40.	α - Amorphene	0.19	C ₁₅ H ₂₄	1477	a,b
41.	β -selinene	0.26	C ₁₅ H ₂₄	1486	a,b
42.	Guaia-1(10),11-diene	0.10	C ₁₅ H ₂₄	1490	a,b
43.	α -Muurolene	0.08	C ₁₅ H ₂₄	1497	a,b

44.	γ -Cadinene	0.07	$C_{15}H_{24}$	1512	a,b
45.	Trans-Calamenene	0.07	$C_{15}H_{22}$	1527	a,b
46.	Spathulenol	0.09	$C_{15}H_{24}O$	1536	a,b
47.	Caryophyllene oxide	1.59	$C_{15}H_{24}O$	1580	a,b
48.	Humulene epoxide II	0.23	$C_{15}H_{24}O$	1610	a,b
49.	Caryophylla-4(12),8(13)-dien-5-alpha-ol	0.30	$C_{15}H_{24}O$	1642	a,b
50.	Cadin-4-en-10-ol	0.07	$C_{15}H_{26}O$	1659	a,b
51.	α - Costol	0.28	$C_{15}H_{24}O$	1770	a,b
52.	Kaur-16-ene	0.75	$C_{20}H_{32}$	2030	a,b
53.	Linalyl cinnamate	0.06	$C_{19}H_{24}O_2$	2115	a,b
54.	9-Dodecynyl 3-phenylpropanoate	0.14	$C_{21}H_{30}O_2$	2370	a,b
		97.17			

a=Retention Index (RI), b=MS (GC-MS).

Essential oils are valuable natural products, which are used as raw materials in many fields including perfumes, cosmetics, aromatherapy, phytotherapy, spices and nutrition [9]. Aromatherapy is the therapeutic use of fragrances or at least mere volatiles to cure diseases, infections and indispositions by means of inhalation [10]. This has recently attracted the attention

of many scientists and encouraged them to screen plants to study the biological activities of their oils from chemical and pharmacological investigations to therapeutic aspects. Hopefully, this will lead to new information on plant applications and new perspective on the potential use of these natural products (Figure 5).

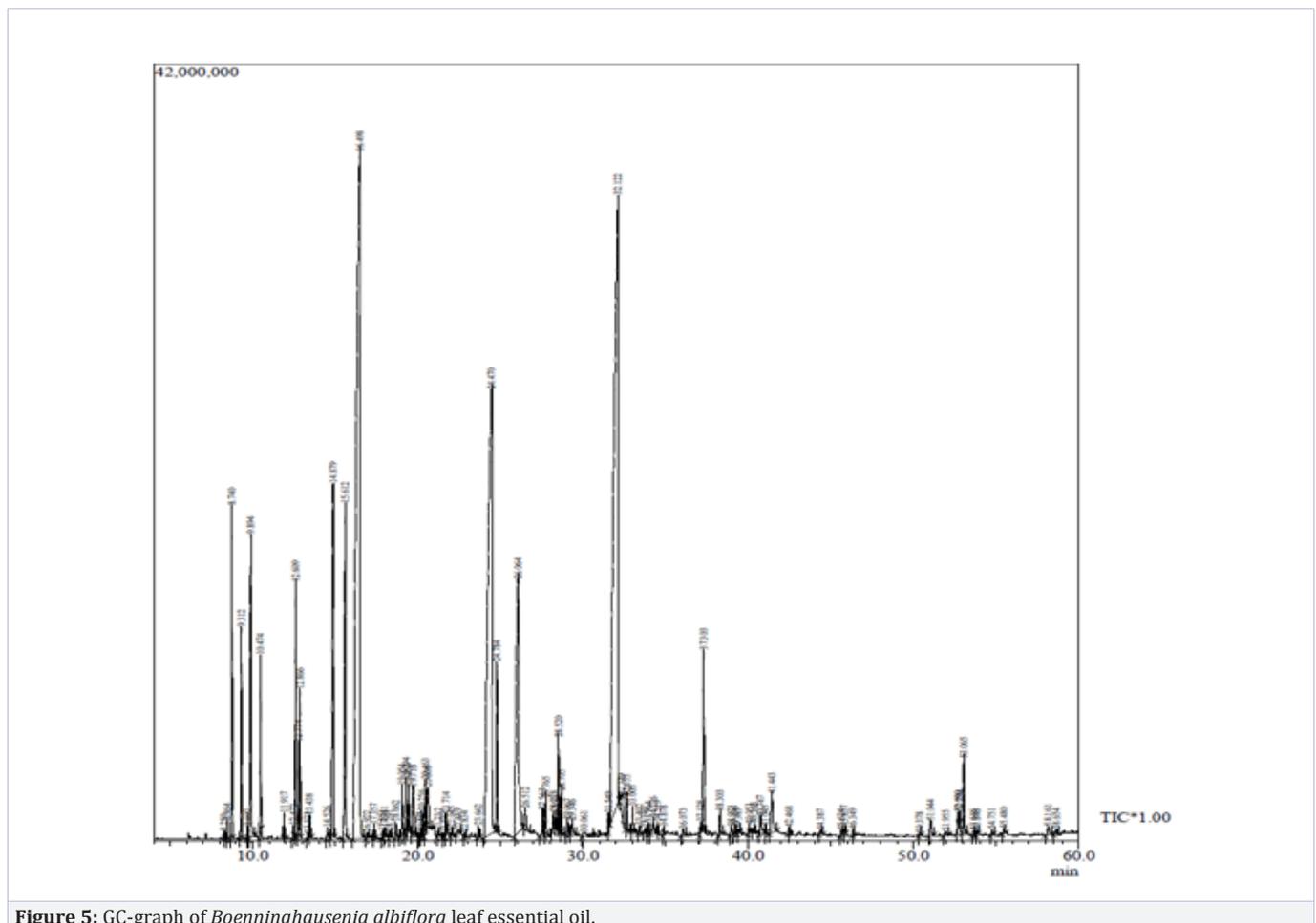


Figure 5: GC-graph of *Boenninghausenia albiflora* leaf essential oil.

Conclusions

The essential oil from *Boenninghausenia albiflora* showed a qualitative and quantitative make-up of constituents. Clinically, this plant can be used as a good source of herbal medicine for the treatment of diseases indigenously. The study will also help to generate a database of species which can be exploited scientifically and judiciously in the future by local people and so that ecological balance is maintained. The results obtained in the present study suggest that the essential oil of *Boenninghausenia albiflora* Reichb possesses medicinally active compounds.

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Author Contributions

The first author, Dr Deepak Chandra, carried out all the experimental work and prepared the manuscript. Dr Kundan Prasad, the second author, designed all the experiments, analyzed the data and prepared the manuscript. Both authors read and approved the final manuscript.

Conflicts of Interest

The authors declare that there is no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript.

- GC-MS Gas Chromatography-Mass Spectrometry.
- GC-FID Gas Chromatography-Flame Ionization Detector.
- RI: Retention Index.

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