Leaf Essential Oil Composition of *Citrus japonica* from Biratnagar, Nepal

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Abstract: The essential oil from the leaves of *Citrus japonica*, collected from Biratnagar, Nepal, was obtained by hydrodistillation and analyzed by GC-MS. A total of 42 compounds were identified in the oil, accounting for 99.6% of the oil. The major components of the leaf oil were identified to be linalool (35.1%), eugenol (14.8%), geraniol (12.7%), and its aldehyde counterpart geranial (7.9%). The oil also contained smaller amount of nerol (5.3%), and (*Z*)-asarone (5.0%).

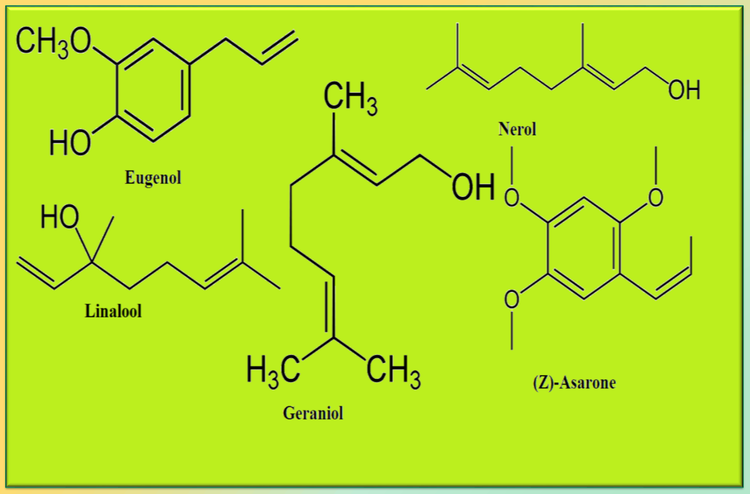
Introduction: *Citrus japonica* Thunb. or synonymously known as *Fortunella japonica* (Thunb.) Swingle belongs to the Rutaceae and is native to south Asia and Asia-Pacific regions[1]. Popular mainly for their raw fruits (kumquats), *C. japonica* has also been used for its medicinal and therapeutic effects[2]. *C. japonica* has been recognized for its antiphlogistic, antivinous, carminative, deodorant, and expectorant properties[3].

Although *Citrus* plants have been studied exhaustingly because of their essential oil and economic importance[4], very few works have been performed on *C. japonica*, and to our knowledge, this is the first examination of the leaf essential oil of this medicinal plant.

Table 1. Chemical composition of the leaf essential oil of *Citrus japonica* from Nepal.

RI[a]	Compound	%	RI[a]	Compound	%
981	1-Octen-3-ol	0.1	1385	geranyl acetate	0.7
1030	1,8-Cineole	0.4	1392	β-Elemene	0.5
1072	*cis*-Linalool oxide (furanoid)	0.1	1405	Methyleugenol	0.1
1088	*trans*-Linalool oxide (furanoid)	0.1	1419	(*E*)-Caryophyllene	1.3
1102	Linalool	35.1	1436	α-*trans*-Bergamotene	0.7
1143	Camphor	0.1	1453	α-Humulene	0.2
1153	Citronellel	1.0	1481	Germacrene D	0.4
1164	Borneol	0.2	1514	γ-Cadinene	0.8
1166	δ-Terpineol	0.1	1524	δ-Cadinene	0.1
1171	Menthol	0.2	1550	Elemol	1.6
1176	Terpinen-4-ol	0.9	1566	(*E*)-Nerolidol	0.3
1183	(*E*)-Isocitral	tr	1577	γ-Asarone	0.2
1189	α-Terpineol	0.5	1579	Caryophyllene oxide	0.3
1205	*n*-Decanal	0.1	1614	1,10-di-*epi*-Cubenol	0.4
1223	Citronellol	1.8	1619	10-*epi*-γ-Eudesmol	0.1
1239	Nerol	5.3	1623	(*Z*)-Asarone	5.0
1250	Geraniol	12.7	1641	τ-Cadinol	2.6
1271	Geranial	7.9	1650	β-Eudesmol	1.0
1285	Bornyl acetate	0.5	1653	α-Eudesmol	0.7
1299	Geranyl formate	0.1	1654	α-Cadinol	0.3
1353	Citronellyl acetate	0.2			
1357	Eugenol	14.8		Total Identified	99.6

[a] RI = Retention Index, determined with reference to a homologous series of normal alkanes on an HP-5ms column.

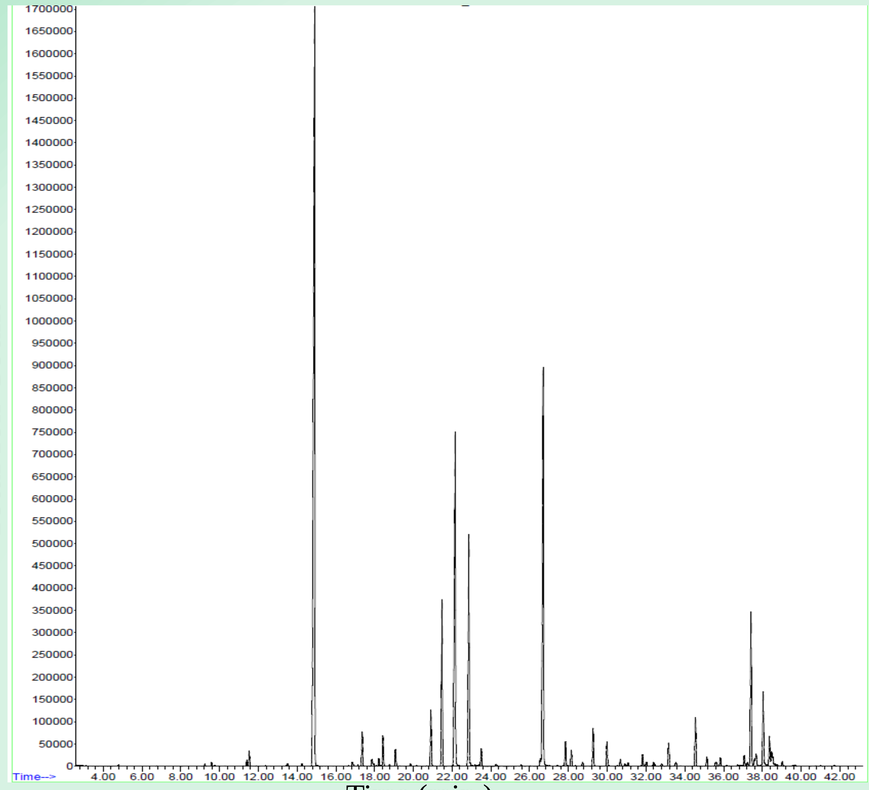


GC-MS Spectroscopy:

The leaf essential oil of *Citrus japonica* was analyzed by GC-MS using an Agilent 6890 GC with Agilent 5973 mass selective detector [MSD, operated in the EI mode (electron energy = 70 eV), scan range = 45-400 amu, and scan rate = 3.99 scans/sec], and an Agilent ChemStation data system. The GC column was an HP-5ms fused silica capillary with a (5% phenyl)-polymethylsiloxane 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 48.7 kPa and a flow rate of 1.0 mL/min. Injector temperature was 200˚C and detector temperature was 280˚C.

Results: The *C. japonica* leaf essential oil from Nepal significantly differed from the peel oils of the fruit which is reported to be mostly consisting of the cyclic monoterpene limonene (93.7%) and smaller amounts of myrcene (1.8%), a dehydrated counterpart of geraniol[3,6]. Major components of the leaf oil were found to be present in trace amounts in the peel oil such as linalool (0.1%), geraniol (0.05%), and eugenol (trace). α-Terpineol was found in similar percentages between the leaf and the peel oil, 0.5% and 0.4% respectively[6].

GC-MS spectra of *C. japonica*



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