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Chemical Investigation of the Leaf and Peel Oil of *Citrus Maxima* (J. Burm.) Merr. from Bangladesh

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Abstract

Essential oils from leaf and peel of *Citrus maxima* (J. Burm.) Merr. were analyzed by gas chromatography mass spectroscopy (GC-MS). Thirty six compounds were identified from the leaf oil of which the major are citronellal (45.8%), citronellyl propionate (10.5%), citronellol (9.9%), α-pinene (6.8%), ocimene (6.6%) and limonene (5.00%). The peel oil contains limonene (92.7%) as an absolute major constituent among the seven compounds identified.

Key words: *Citrus maxima*, GC-MS, essential oil composition, citronellal, limonene.

I. Introduction

Citrus maxima (J. Burm.) Merr. synonyms *Citrus grandis* (L.) Osbeck and *C. decumna* L. of the family Rutaceae, native of Polynesia and Malaysia, grows throughout the Indian sub continent. It is a small to medium sized evergreen tree with leathery dark green leaves and fragrant pinkish white flowers. The fruits are either pyriform or oblate in shape and are larger than other citrus fruits. It is very coarse with a thick rind and thick leathery septa. Seeds are monoembryonic[1]. Fruit juice is refrigerant, nutritive and cardiotonic and is commonly used in influenza and catarrh.

The fresh leaves in combination with leaves from some other aromatic plants are used in treating coryza, influenza and headache by inhalation of the vapour from the boiling decoction. Massage with heated young leaves is effective for treating bruises. The essential oil from the leaves consists of dipentene, linalol, citral, limonene, flavonoids, vitamins A, C, B1, rhamnose, citric acid, pectin and fatty oil. Leaves are useful in epilepsy, convulsive coughs and also in headache and stomach pain [2,3,4,5]. Essential oil possesses antimicrobial properties[4]. Fruit peel contains essential oil rich in d-limonene (90-92%), α-pinene, linalool, geraniol and traces of geranyl acetate, linalyl acetate and citronellal [2,4]. Leaf oil contains 7-hydroxycoumarin geranyl ether and auraptene[4]. Gonzales *et al*.[6] reported linalool (50.3%) as the major constituent in the peel oil from Venezuela. Bar *et al*[7] reported the major components were limonene (18.2%), linalool (16.4%), nerolidol (29.3%) and farsenol (15.7%) and terpinolene[8]. There are no previous references in literature about these Bangladeshi oils. In this work we have determined the chemical investigation of leave and peel of *C. maxima*. These features allow it to be identified for medicinal use and classified among the other citrus oils available in the international market.

II. Material and Methods

Plant material: The plant materials of *C. maxima* were collected from the plants grown in the campus of BCSIR Laboratory, Chittagong during September, 2007. The specimen was identified by Dr. Mohammad Yusuf, Ex-Director-in-charge, BCSIR Labs. Ctg. One-voucher specimen (Y-265) was deposited in the herbarium of BCSIR Laboratory, Chittagong.

Extraction of essential oil: Samples of leaf was harvested from healthy, well-grown, five-year-old plants. Freshly harvested leaves (500 g) and fruit peel (250 g) were grounded in a blender seperately. The grounded leaves and rhizome were subjected to hydrodistillation using a modified Clevenger-type glass apparatus for 4 h for isolation of oils separately. The oil samples were stored at 0°C in air-tight containers after drying them over anhydrous sodium sulfate and filtered before going to GC-MS analyses.

GC-MS analysis: The essential oil from leaves and fruit peelof *C. maxima* were analyzed by GC-MS electron impact ionization (EI) method on GC-17A gas chromatograph (Shimadzu) coupled to a GC-MS QP 5050A Mass Spectrometer (Shimadzu); fused silica capillary column (30m x 0.25mm; 0.25 μm film thickness), coated with DB-5 ms (J&W); column temperature 100°C (2 min) to 250°C at the rate of 3°C/min; carrier gas, helium at constant pressure of 90Kpa. Acquisition parameters full scan; scan range 40-350 amu.

Identification of the compounds: Compound identification was done by comparing the NIST library data of the peaks with those reported in literature, mass spectra of the peaks with literature data. Percentage composition was computed from GC peak areas on DB-5 ms column without applying correction factors.

III. Results and Discussion

Thirty six compounds were identified from the leaf oil and seven from the peel oil (Table-1). The major constituents in the leaf oil are α-pinene (6.83%), citronellal (45.82%), citronellol (9.93%), citronellyl propionate (10.52%), limonene (4.99%) and ocimene (6.61%). Other constituents are α-bergamotene (2.45%), phytol (1.24%) and sabinene (1.77%). The peel oil contains limonene (92.72%) as an absolute major constituent, followed by β-myrcene (2.42%). Results showed that the oils were complex mixture of numerous compounds, many of which were present in trace amounts. It is worth mentioning here that there is great variation variation in the chemical composition of leaves and peels oils. Citronellal and limonene are the main component in leaves and peels oils. α-pinene, β-myrcene, limonene, ocimene were observed as the four versatile common compounds present in both the oils with variations

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in percent content (Table 1). On the other hand, comparison of our oils composition with those reported from different places in the world earlier showed that our oil is especially different to others. But it is very interesting to note that comparison of our results reported on the leaf oil composition from the different places showed different results in the percentage content of some of the major and minor constituents. Linalool, d-limonene and α-pinene, which have been reported as major constituents in our oils as well as in almost all the leaves and peels oils of the world were either absent or present in trace amounts in the oil reported [2,4,7,8]. This confirms that the variations in the cultivar reported is not due to geographic divergence and ecological conditions but that is due to different chemotype than ours. On the basis of above fact it may be concluded that *C. maxima*, growing widely in Bangladesh, may be utilized as a source for the isolation of natural citronellal and limonene respectively. As a result of this study, the essential oil of *C. maxima* has been extracted and its components identified. The high concentration of citronella and limonene in leaf and peel oil makes it respectively potentially useful in the medicines.

Table. 1. Constituents (in %) of the leaf and peel oil of *C. maxima.*

Sl. No.	Name of Chemical Constituents	Leaf (%)	Peel (%)
1.	α-thujene	0.04	--
2.	α-pinene	6.83	0.58
3.	Camphene	0.04	--
4.	Lilac alcohol	--	0.20
5.	Sabinene	1.77	--
6.	β-pinene	0.54	--
7.	β-myrcene	0.82	2.42
8.	δ-selinene	--	0.96
9.	4-hexen-1-ol, acetate	0.04	--
10.	Germacrene D	--	0.85
11.	Z-ocimene	0.61	--
12.	Methyl ursolate	--	0.64
13.	o-cymene	0.14	--
14.	Limonene	4.99	92.72
15.	Trans-ocimene	0.03	--
16.	Ocimene	6.61	0.29
17.	γ-terpinene	0.45	--
18.	Dihydrocarveol	0.05	--
19.	Terpinolene	0.07	--
20.	Linalool	0.37	--
21.	Isopulegol	0.45	--
22.	Citronellal	45.82	--
23.	Menthol	0.72	--
24.	4-terpineol	0.20	--
25.	Citronellol	9.93	--
26.	1,6-octadiene, 2,5-dimethyl (E)	0.68	--
27.	Citronellyl isobutyrate	0.26	--
28.	Citronellyl propionate	10.52	--
29.	Geranyl propionate	0.14	--
30.	Caryophyllene	0.77	--
31.	α-bergamotene	2.45	--
32.	γ-elemene	0.34	--
33.	β-bisabolene	0.79	--
34.	δ-cadinene	0.43	--
35.	Spathulenol	0.12	--
36.	Caryophyllene oxide	0.90	--
37.	α-cadinol	0.16	--
38.	Verbenol	0.11	--
39.	α-bisabolol	0.17	--
40.	Phytol	1.24	--

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