Characterization of Essential Oil of Local Varieties of *Citrus paradisi* Peel

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Summary: The essential oil from *Citrus paradisi* peel was analyzed for its chemical composition. The GC and GC/MS studies of the essential oil revealed the presence of 23 constituents; out of which 15 constituents were identified as: *α-Pinene* (0.4405 %), *β-Pinene* (2.5129 %), *Limonene* (81.862 %), *p-Cymene* (3.6917 %), *Linalyl acetate* (5.206 %), *Sabinene* (1.025 %), *4-Terpineol* (0.389 %), *α-Terpineol* (0.3181 %), *α-Thugene* (0.2813 %), *Octanol* (0.2698 %), 1,8-*Cineol* (0.4255 %), *Geraniol* (0.2106 %), *Decanal* (0.1679 %).

Introduction

Citrus is the most important arboreal plant which comprises of trees, shrubs, and herbs of various sizes and uses [1, 2]. *Citrus paradise* is one of the most important member of the genus citrus (Rutaceae), as a group it ranks third in citrus production worldwide [3]. It is not definitely known where *Citrus paradisi* came from or when it was called grapefruit. It apparently originates in the West Indies. Webber *et al.*, expressed the opinion that *Citrus paradisi* is very closely related to the pummelo and was seemingly derived from it or from a common ancestral type [4].

Citrus paradisi is a popular fruit in Pakistan and its production is increasing day by day due to its considerable commercial importance. The most significant byproduct of this massive processing industry are the several essential oils, which are of consumer and economic importance [5, 6]. It is also used as an ingredient for cosmetics, perfumes, soaps and detergents [7]. The approximate yield of essential oil from *Citrus paradisi* is 3.9%, which contains open chain hydrocarbons, alcohols, aldehydes, ketones, esters and α-terpenoids [8, 9].

Aromatic plants and herbs have been of considerable interest to both, modern and ancient civilization. They have been directly related with Islamic tradition of culture and court [10].

The use of plant extracts as a source of fragrance are known as long as existence of mankind. Due to their well-known disinfectant properties, they were considered good remedy against infectious and epidemic diseases [11].

Therefore it is not astonishing that the medieval practice of utilization of aromatic plants for the recovery of these components has now been converted into a flourishing modern industry due to advancement in the field of science and technology [12]. The Arabians have discovered the best techniques for the extraction of these nice smelling agents from naturally occurring organic materials [13].

Results and Discussion

The peels of *Citrus paradisi* contained 3.9% essential oil. Twenty-three major and minor compounds were found in the essential oil, out of which 15 were identified. Physico-chemical characteristics were determined by standard methods [14] (Tables-1 and 2).

Table-1: Physico-chemical properties of essential oil of *Citrus paradisi* peels.

Yield	3.9%
Colour	Yellow
Specific gravity at 20 °C	0.08676
Refractive Index at 20 °C	1.4716

The oil content and percentage composition of the essential oil of a species depends upon the soil,

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Table-2: Chemical composition of essential oil of *Citrus paradisi* peels.

Peak #	Retention Time	Compound Identified	Percentage
01.	3.918	α-Thujene	1.2813
02.	7.154	α-Pinene	0.4405
03.	8.554	β-Pinene	0.4079
04.	9.84	Limonene	81.862
05.	10.924	ρ-Cymene	2.389
06.	11.339	α-Terpineol	0.3181
07.	11.62	Octanol	1.2098
08.	14.03	1,8-Cineol	0.4255
09.	14.353	Geraniol	0.2106
10.	14.642	Decanol	0.1679
11.	15.608	4-Terpineol	3.6917
12.	26.424	Sabinene	1.025
13.	26.116	Linalyl Acetate	5.206
14.	27.012	Nootkatone	T
15.	27.015	Bicyclogermacrene	T

T= traces

climatic conditions, degree of maturity of plant material [15], harvest time, drying procedure, storage and extraction time [16, 17].

Identification of the major and minor components of the essential oil was made by correlation of retention time and composition of GC/MS spectral data with authentic available references in literature [18]. Essential oil obtained from the peels of *Citrus paradisi* was found to contain linalyl acetate (5.206 %), ρ-cymene (3.6917 %), 4-terpineol (0.389 %), α-thugene (1.2813 %), octanol (1.2098 %), and 1,8-cineol (0.4255 %) as new components, but nonanol, linalool, *cis*-limonene oxide, *trans*-limonene oxide, citronellal, neral reported earlier [19, 20] were found absent.

The analysis of essential oil obtained from peels of *Citrus paradisi* gives information about the presence of limonene, linalyl acetate, ρ-cymene, 4-terpineol, octanol, sabinene, α-thugene, α-pinene, 1,8-lineol, β-pinene, α-terpineol, geraniol as major components and decanal, nootkatone, bicycle-germacrene as minor components.

The hydrocarbon fraction (88.7084%) was found to contain monoterpenes as major fraction, while oxygenated components *e.g.* linalyl acetate, 4-terpineol, α-terpineol, 1, 8-cineol were the second major fraction, which contribute to the citrus flavor, were also present.

There is a slight variation in the chemical composition of the essential oil from peels of *Citrus paradisi*, which may be due to differences in regional, climatic and edaphic conditions available for the plant to grow.

No doubt limonene is the major hydrocarbon in the essential oil, which hinders its use as flavouring agent in beverages; it may be used as cheap perfuming agent in rubber and leather product. After deterpination [21] the oil obtained from *Citrus paradisi* could be useful in baking products, squashes, beverages, ice creams and chewing gums [22, 13]. The deterpinated citrus oil could also be utilized for blending flavors for soft drinks, nectars and fruit juices.

Experimental

Extraction of Oil

Fresh fruits of *Citrus paradisi* were collected from citrus gardens near Sargodha and Renala Khurd. They were peeled off. The peels were cut into small pieces in order to rupture the cells to obtain maximum yield of oil. The finely divided (1 Kg) peels were subjected to hydro-distillation to obtain essential oil fraction [23]. The oil was extracted with ether: hexane (1:4), the solvent mixture was dried over anhydrous sodium sulfate and filtered. Distillation process was continued until no further increase in the volume of oil was noted (~ 9 hrs.). The yield of oil was about 3.9 %. The oil obtained was yellow in color.

Gas Chromatography- Mass Spectrometery

Jeol model JMS AX505H mass spectrometer, in combination with Hewlett Packard 5890 gas chromatograph was used for the GC-MS analysis. Oil sample was injected into a 250m x 0.22 mm WCOT BPS (5% phenyl, 95% dimethylsiloxane) fused silica column. Using helium as the carrier gas with the split ratio of 1:100, EI positive mode, electron energy 70 eV, ionization current 300 μA, ionization source temperature 250 °C, interface temperature 230 °C, column temperature programmed at 60 °C for min. with a 6 °C / min. rise at 220 °C. Data acquisition and processing were performed by JEOL JMA-DA 5000 system. Various components were identified by their retention time and peak enhancement with standard samples in gas chromatographic mode and MS library search from the obtained fragmentation pattern of the various components of essential oil.

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