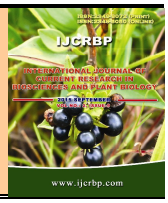
Int. J. Curr. Res. Biosci. Plant Biol. 2015, 2(9): 33-37

EXCELLENT PUBLISHERS

International Journal of Current Research in Biosciences and Plant Biology

ISSN: 2349-8080 Volume 2 Number 9 (September-2015) pp. 33-37

www.ijcrbp.com



Original Research Article

Evaluation of Essential Oil of Fresh and Dry Leaves of *Ruta graveolens* L.

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Abstract

Essential oils obtained from many aromatic plants have been recently gaining growing popularity and scientific interest. *Ruta graveolens* is important medicinal and aromatic plant of citrus family.The fresh and dry leaves of natural plant leaves of *R. graveolens* were used for extraction of oil. The essential oils were recovered by hydro-distillation with different percentage yield; it gave yellowish to yellowish orange oils with a yield of 0.6, 0.5 and , (v/w) for fresh, dry leaves of natural plants.The obtained essential oils were analyzed by GC–MS. The oil composition of different samples showed variation in terms of number of component and their percentage. The main composition of all analyzed oil showed 2-Undecanone, 2-Nonanone, 2-Heptanone, and 2-Dodecanone. A significant variation in the composition and their concentrations of the essential oil were observed. The identification of the components of *R. graveolens* essential oil should contribute to the understanding of the pharmacological activities of the plant.

Keywords

2-Undecanone

Essential oils

GC–MS

Ruta graveolens

Introduction

Production of large number of secondary metabolites is special characteristic of higher plant (Castello et al., 2002). The secondary metabolites are highly varied in structure; many are aromatic substances, most of which are phenols or their oxygen-substituted derivatives. Plant secondary metabolites have been concerned for most therapeutic activities. The beneficial medicinal effects of plant materials typically result from the combinations of secondary products present in the plant. Essential oils obtained from many plants have been gaining recently a growing popularity and scientific interest. They have been used as functional ingredients in food, drugs and perfumery (Magwa et al., 2005). Most of the chemical constituents of essential oils are terpenoids, characterized by a low molecular weight which allows easy transport across cell membranes to induce different biological activities, including antioxidant, anti inflammatory and anti cholinesterase effects (Bakkali et al., 2008). Essential oils are complex mixtures comprising many single compounds. Essential oils are products, generally, of rather complex composition comprising the volatile principles contained in the plants, and more or less modified during the preparation process (Bruneton, 1995). Each of these constituents contributes to the beneficial or adverse effects of these oils. Therefore, the intimate knowledge of essential oil composition allows for a better and specially directed application (Buchbauer, 2000). Considering all the aforementioned differences in essential oil composition, it is clear that only a detailed knowledge of the

constituents of an essential oil will lead to a proper use in cosmetics by perfumers and cosmetic chemists. *R. graveolens* (Rue) is an important aromatic plant of the family Rutaceae. Oil glands are principally present in leaves, having strong deterrent odors.

Physical and chemical properties of essential oils of *R. graveolens.*

Appearance	:	Pale yellow to orangish-amber viscous fluid.
Odor	:	Characteristic unpleasant odor.
Solubility	:	Soluble in organic solvents-alcohol, oils and insoluble in water.
Specific gravity	:	0.820-0.840@20^{o}C
Optical Rotation	:	0.0 ± 5@20^{o}C
Refractive index	:	1.425-1.435@20^{o}C

The medicinal and aromatic properties of *R. graveolens* are mainly because of its essential oils (Kuzovkina et al., 2004). Several investigations have been conducted on the chemical constituents of *R. graveolens* (Benazir et al., 2011). The essential oils of this species have been the subject of considerable studies. The aldehyde oxidase inhibitor effect of *Ruta* oil have shown by (Saieed et al., 2006) and antiandrogenic effect by (Khouri and El Kawi, 2005), cytotoxic effect of oil (Trovato et al., 1996), and antifungal activities (Oliva et al., 2003). The essential oil is also reported as central nervous system depressant and a narcotic at high doses by Miguel (2003). The essential oil of *R. graveolens* possesses phototoxical, bacteriostatical and anthelmentic activities (Petit-Paly et al., 1988). Due to the important medicinal properties of plant, it was thought to identify the chemical composition of oil of *R. graveolens*.

Though the quantitative and qualitative analysis of essential oil in this plant species is done by different workers, in this investigation, therefore efforts have been taken to focus more on quantitative and qualitative analysis of essential oils of *R. graveolens.*

Materials and methods

Plant material

The fresh and dry leaves of *R. graveolens* are collected from aromatic and medicinal plant garden of V. G. Vaze College Mulund, Mumbai and plant leaves were used for extraction of oil.

Isolation of the volatile oils and identification

One hundred gram of leaf material of each sample was subjected to hydro distillation for five hours with 500 ml of distilled water using a Clevenger-type apparatus. The oils obtained were separated from the distilled water. Essential oils are volatile and therefore stored in sealed glass vials in a refrigerator at 4-5°C in order to prevent changes in chemical composition for further use.

GC-MS analysis was carried out on a Hewlett-Packard 6890 gas chromatograph fitted with a fused silica HP-5MS capillary column (30 m × 0.25 mm; film thickness 0.25 µm). The oven temperature was programmed from 60°-280°C at 4°C/min. Helium was used as carrier gas at a flow rate of 2 mL/min. The gas chromatograph was coupled to a Hewlett-Packard 6890 mass selective detector. The MS operating parameters were ionization voltage, 70 eV; and ion source temperature, 200°C. The identity of oil components were assigned by comparison of their GC retention times and MS spectra with corresponding data of commercial available standards.

Results and discussion

The hydro distillation of leaves of *R. graveolens* gave yellowish to yellowish orange oils with a yield of 0.6% and 0.5% (v/w) for fresh, dry leaves of natural plants, respectively. The general chemical profiles of the tested oils, the percentage content of the individual components of the oil compounds are summarized in Table 1. The oil composition of different samples showed variation in terms of number. The main composition of all analyzed oil showed 2-Undecanone, 2-Nonanone, 2-Heptanone and 2-Dodecanone. Results of the study showed high content of aliphatic acids, alcohols and ketones in oil samples of *R. graveolens*.

The oil obtained from fresh leaves of naturally growing *R. graveolens* plants showed 2-Undecanone (44.84%), 2-Nonanone (15.88%), 1-Nonene (9.05%), 1-Docosanol (2.37%), 2-Dodecanone (3.27%) (Fig. 1); whereas, the oil profiling (Fig. 2) of dry leaves of *in vivo* plants consist of 2-Undecanone (51.50%), 2-Nonanone (20.55%), 1-Dodecanol (4.27%), N/i-tridecanol (3.96%), Phenol (3.21%), 2-Decanone (1.68%), 2-Dodecanone (2.12%), Phytol (0.32%), Nonadyl (0.21%), Myrtanol (0.66%), N-nonyl acetate (0.33%), β-ionone (0.16%).1-Nonene (9.05%),1-Docosanol(3.25%) found in fresh leaves oil was not present on dry leaves. However, 2-Heptanone was not reported in our both samples.

According to Mejri et al. (2010), that drying had a significant effect on the proportions of main components and in their study they found that the oxy-compounds proportions were decreased by drying in *Ruta chalepensis*. The major compounds in *R. chalepensis* were, 2-undecanone, 2-decanone and 2-dodecanone were respectively 77.18%, 8.96% and 2.37% in essential oils derived from fresh rue but they were respectively 69.23%, 2.41% and 2% in the case of essential oil of dried rue. But our investigation showed that the major components of oil are increased in dry leaves of *R. graveolens*. Literature survey on essential oil revealed that the predominate constituents of *R. graveolens* oils mainly consist of hydrocarbon ketones. Similar to our investigation, 2-Undecanone and 2-undecanol, 2–Nonane, were found as major components in other studied on essential oil of *R. graveolens* (De Feo et al., 2002; Solemani et al., 2009). The presence of terpenoids (elemol, myrcene, pregeijerene and geijerene) has also been reported in the essential oil of *R. graveolens.*

Table 1. Major components of essential oil of *R. graveolens*.

Sl. No.	Components oils	Fresh leaves Oil %	Dry leaves Oil %
1.	2-undecanone	44.84	51.50
2.	2-Nonanone	15.88	20.55
3.	Bicyclo,2,2,1,Hepta 2 in	-	1.89
4.	Bicyclo(8,2,2)Tetradeca-5,10,12	-	0.03
5.	2-Octanone	-	0.03
6.	2-Decanone	1.35	1.68
7.	2-Dodecanone	3.33	2.12
8.	2-Tridecanone	1.69	-
9.	1-Dodecanol	-	4.27
10.	Phytol	0.25	0.32
11.	Nanodyl	-	0.21
12.	1-Nonene	9.05	-
13.	1-Docosanol	3.25	-
14.	Methyl ethylcyclopentene	-	0.16
15.	Cyclohexane	-	0.24
16.	Myretenol	-	0.66
17.	n-Octadecane	-	-
18.	n-Nodyl acetate	0.14	0.33
19.	β-Ionone	-	1.6
20.	1,3-Benodioxole	-	2.86
21.	1-Dodecene	1.89	-
22.	Nonanal	0.11	-
23.	Alcohol C-12	1.34	-

Fig. 1: Essential oil profile of fresh leaves of *in vivo* plants.

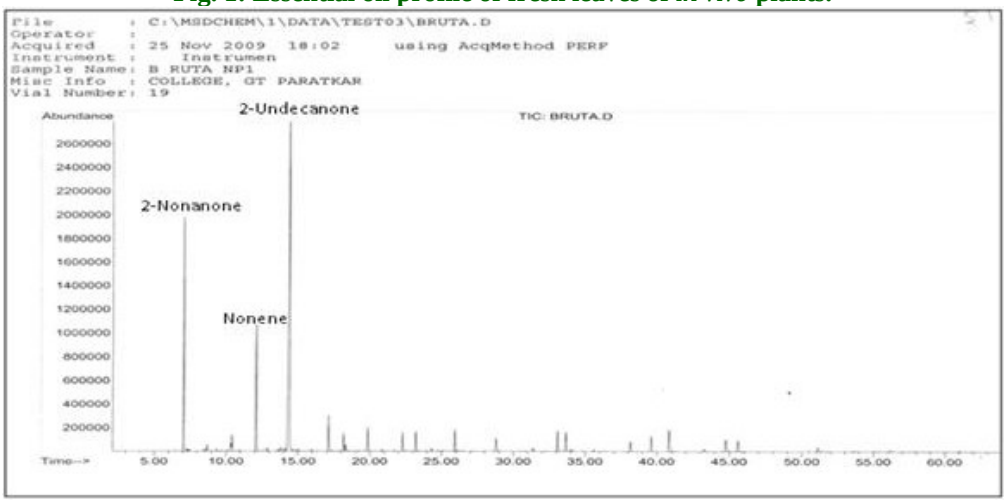
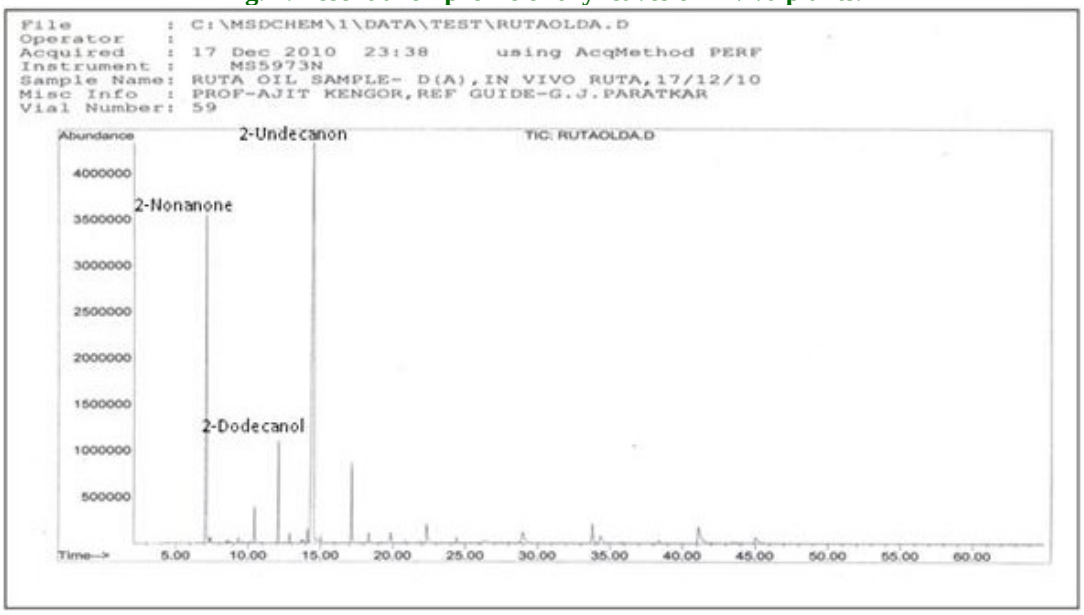


Fig. 2: Essential oil profile of dry leaves of *in vivo* plants.



From the above mentioned results it can be concluded that the 2-Undecanone and 2-Dodecanone are the major components present in both oil samples. Pino et al. (1997), identified 32 compounds in leaves of ***R.*** *graveolens* grown in Cuba and found that 2-undecanone (48.67%) was the major volatile compound, followed by curcuphenol (8.18) and 2-hexadecanoic acid (5.68%). The major constituents of essential oil of both leaves and flowers were the oxygenated compound, 2-undecanone, compromising about 53.69 and 70.80% in the oil of the leaves and flowers, respectively. In the second order, 2-Nonanone, 2- dodecanone and geyrene represent (15.26, 4.54 and 3.77% respectively) in leave oil, 2-Nonanone, geyrene and 1-undecene (5.58, 2.57 and 2.30% respectively) in flowers oil.

Stashenko et al. (2000) extracted essential oil from different parts of Colombian rue by subcritical-fluid extraction and analyzed by capillary chromatography and found that 2-Nonanone (8.9%), 2-Undecanone (13.4%), chalepensin (13.0%) and Geijerene (19.3%) were the main constituents in the extracts from rue leaves, flowers, stem and roots, respectively.

Conclusion

Evaluation of the composition of *R. graveolens* essential oils showed qualitative and quantitative differences and it can be due to drying effect and the present investigation helped to identify and compare major compounds by GC–MS.

Acknowledgement

Authors are thankful to the Management, Principal Dr.B.B. Sharma and Dr.S.S. Barve, Head of the Department of Botany and Mrs. Dakshayani Galgali (Head, Analytical Lab, S. H. Kelkar Co., Mumbai) and Dr. Soni Singh for providing facilities and support and We further extend our gratitude towards all colleagues for constant motivation and support. One of the author Dr. Ajit Kengar wishes to thank UGC for providing fellowship (Teacher Fellow).

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