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RESEARCH ARTICLE

Essential oils of Persian Musk rose (*Rosa moschata* Herrm.) as influenced by drying and harvest times

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Abstract

Persian musk rose (*Rosa moschata* Hermm.) is widely used in perfumes and cosmetics industries because of its medicinal properties and pleasant odour. Since synthesis and accumulation of volatile compounds affected by flower harvest time, the current study was conducted to evaluate and monitor the changes of volatiles in the essential oil (EO) of Persian Musk Rose petals harvested at different dates (May 11, May 21 and June 01). GC and GC-MS determined the compositions of EO. In addition, the EOs obtained from fresh and dried flowers harvested at different dates were compared to maximize yield and quality of EO. The highest EO yield was observed in the fresh and dried petals harvested at May11, which was significantly higher than the June samples; however, there was no significant difference between May 11 and May 21 samples. The EO composition at different harvest dates was significantly different in the fresh petals, and the highest phenyl ethyl alcohol (14.3%) was observed at the second harvest date. Monoterpenes increased from 2.4% in the first harvest to 8.5% in the third harvest. Aliphatic hydrocarbons showed an increasing pattern in the petals harvested at May 11 (78.6%) to June (86.4%). Concentration of oxygenated monoterpenes significantly reduced in the EO of the dried petals. After drying, phenylpropanoids reduced at the first and the second harvest dates and increased at the third harvest. However, the concentration of aliphatic hydrocarbons increased at the first and the second harvests and decreased at the third harvest date.

Keywords: *Rosa moschata*, drying, essential oils, harvest date

Introduction

Rosa has sixteen wild species in Iran of which *R. moschata* Herrm. with the common names of Persian Musk rose, Nastrane Shiraz and Rose Anbar is one of the most strongly scented rose species with characteristic floral scent molecules such as terpenoids, phenylpropanoids/benzenoids and fatty acid derivatives (Mozaffarian 2013; Jandoust & Karami, 2015). Persian Musk rose is distributed in many local regions of Iran; its wild origins are uncertain but are suspected to lie in the western Himalayas (Khosh-Khui 2014, Honarvar et al., 2011). As, Persian Musk rose has not been confirmed clearly in history, but the supposition is that it is a parent of Damask rose (Jandoust & Karami, 2015). In traditional medicine, hydrosol of Persian Musk rose has been used to strengthen heart muscles, stomach, liver, spleen, nerves, and gums and to strengthen intelligence (Honarvar et al., 2011; Jandoust & Karami, 2015). The quantity and composition of the rose oil distilled from the rose petals are strongly affected by the genotypes, the climatic conditions, diurnal variability, storage conditions, the time of rose petals harvesting, and the technology used for processing and distillation (Baydar & Baydar 2005; Carvalho-Filho et al., 2006; Baydaret al., 2008; Barbosa et al., 2011; Sharmaet al., 2012; Karami et al., 2013; Kumar et al., 2013; Jandoust & Karami, 2015). Therefore, in this research, the seasonal variations of EOs of fresh and dried flowers were studied by GC and GC/MS techniques.

Materials and Methods

Plant material

The fresh flowers of Persian Musk rose were collected from College of Agriculture gardens (Shiraz – 59° 35´E, 29°43´ N, Altitude 1810 m) during their flowering period (May 11, May 21 and June 01, 2014). A specimen (Collector Number: PC 87-23) has been deposited in the Herbarium of the Faculty of Sciences, Shiraz University.

Analysis of the oil

The aerial parts were air-dried at ambient temperature in the shade and air-dried and fresh flower hydrodistilled by using a Clevenger-type apparatus for 3 h. It was dissolved in*n*-hexane (Merck), dried over anhydrous sodium sulphate and stored at 4°C ± 2°C.GC analysis was performed using an Agilent gas chromatograph series 7890-A with a flame ionization detector (FID). The analysis was carried out on fused silica capillary HP-5 column (30 m × 0.32 mm *i.d.*; film thickness 0.25 mm). The injector and detector temperatures were kept at 250 ◦C and 280 ◦C, respectively. Nitrogen was used as carrier gas at a flow rate of 1 ml/min; oven temperature program was 60-210 ◦C at the rate of 4◦C/min and then programmed to 240 ◦C at the rate of 20 ◦C/min and finally held isothermally for 8.5 min; split ratio was 1:50. GC-MS analysis was carried out by use of Agilent gas chromatograph equipped with fused silica capillary HP-5MS column (30 m × 0.25 mm *i.d.*; film thickness 0.25 m) coupled with 5975-C mass spectrometer. Helium was used as carrier gas with ionization voltage of 70 eV. Ion source and interface temperatures were 230 ◦C and 280 ◦C, respectively. Mass range was from 45 to 550 *amu*. Oven temperature program was the same given above for the GC.

Identification of Compounds

The constituents of the essential oil were identified by calculation of their retention indices under temperature-programmed conditions for *n*-alkanes (C8-C25) and the essential oil on a HP-5 column under the same chromatographic conditions. Identification of individual compounds made by comparison of their mass spectra with those of the internal reference mass spectra library or with authentic compounds and confirmed by comparison of their retention indices with authentic compounds or with those of reported in the literature. For quantification purpose, relative area percentages obtained by FID were used without the use of correction factors.

Results and Discussion

In general, seasonal variation and drying had a significantly effect on the EOs contents and composition of Persian musk rose as discussed more below.

Essential oil content

The EO content of both fresh and dried Persian musk rose flowers extracted during their flowering period (May 11, May 21 and June 01). The highest EO content was observed in the fresh and dried petals harvested at May 11, which was significantly higher than the June samples; however, there was no significant difference between May 11 and May 21 samples.

GC-MS analysis

Seasonal variation

In the current study, at the selected time, EOs were collected for periods of 3hrs and analyzed by GC/MS. In this study, a total number of 79 EOs compounds were detected by GC/MS from FW and DW of *R. moschata* at different season (Table 1). In overall, identified components in the subsequent season was representing 97.4–99.9 % of total EOs. The major compounds at different season were identified as 1-nonadecene (5.90-34.80%), *n*-heneicosane (18.8-53.8 %), *n*-nonadecane (9.5-34.4) and phenyl ethyl alcohol (0.1-14.27 %). The EO composition at different harvest dates was significantly different in the fresh petals, and the highest phenyl ethyl alcohol (14.27 %) was observed at the second harvest date. Monoterpenes increased from 2.39% in the first harvest to 8.54% in the third harvest. Aliphatic hydrocarbons showed an increasing trend in the petals harvested at May 11 (78.6%) to June (86.4%). The yield and chemical composition of essential oils (EO) from medicinal plants are related to a variety of internal and external factors such as harvest time and postharvest processing, due to spontaneous conversions and their unstable nature. The effect of harvest time on yield and quality of EO has been widely investigated. Baydar & Baydar, 2005 reported that yield and EO composition of *R. damascena* flowers was significantly different on May 8 and 24. They obtained more EO on May 24, which was about 0.04%. Kumar et al., 2013 showed that harvesting *R. damascena* at different times might affect its EO composition and yield. The highest EO yield in *Thymus vulgaris* have been reported on December. However, the monoterpenic phenols, thymol and carvacrol were higher after blooming on summer (McGimpsey et al., 2006).

Effects of drying

The EO composition of dried petals was significantly dissimilar than the fresh ones at different harvest dates. Concentration of oxygenated monoterpenes significantly reduced in the EO of the dried petals (Table 1). After drying, phenylpropanoids reduced at the first and the second harvest dates and increased at the third harvest. However, the concentration of aliphatic hydrocarbons increased at the first and the second harvests and decreased at the third harvest date. Number of components and composition of the EO obtained from fresh and dried flowers harvested at different times were different. The GC-MS analyses revealed that Persian Musk rose EO is mainly rich of aliphatic hydrocarbons such as *n*-nonadecane, *n*-heneicosane, 1-nonadecane, *n*-tricosene; however, components such as geraniol, citronellol, nerol, comprise lower proportion of the EO. Aliphatic hydrocarbons in fresh petals of EO were about 78.6%, 75.3%, and 86.4% in May 11, May 21 and June. Therefore, aliphatic hydrocarbon increased from first harvest to third harvest. On the other hand, the highest phenyl ethyl alcohol (14.2%), which causes the odor of the rose flowers, was obtained from the fresh tissues harvested in May 21. Hence, it can be concluded that efficiency of EO extraction and quality of EO obtained from flowers harvested on May 21 is significantly higher. Although phenyl ethyl alcohol, or 2-phenylethanol, is the major scent compound of the fresh flower, its content is around 1% in the hydrodistilled rose oil due to the high solubility in residue water or rose water, by-products of hydrodistillation (Baydar et al., 2008). It appears that such investigations are useful for optimizing EO extraction and obtain products with established composition as a market demand. On the other hand, postharvest processing and preserving methods may also influence amount and composition of EO of the harvested material. Drying is widely used for controlling microbial infections, insect pest management and preserving the medicinal plant tissues for long time (Schweiggert et al., 2007). However, drying may influence the amount and composition of essential oil. Barbosa et al., 2006 reported that the citral level in *Lippia alba* dried leaves was significantly increased, however nerol

content showed a significant decrease and geraniol oxidized into geranial after drying. Carvalho-Filho et al., 2006 showed significant changes in the *Ocimum basilicum* L. EO composition during drying.

Table 1. Seasonal changes in essential oil compounds (%) of *Rosa moschata* Herrm.

Components	**RI**	**May 11**		**May 21**		**June**	
		FW	**DW**	**FW**	**DW**	**FW**	**DW**
α-Pinene	930	t	t	-	-	t	-
Myrcene	988	t	-	-	-	-	-
n-Octanal	1001	-	-	-	-	t	-
p-Cymene	1021	-	t	-	-	t	0.2
trans-Rose oxide	1124	-	-	-	-	t	-
Limonene	1025	t	t	-	-	t	0.2
1,8-Cineole	1028	-	t	-	-	-	-
(*Z*)-β-Ocimene	1033	t	-	-	-	-	0.3
Benzene acetaldehyde	1040	t	0.2	-	-	t	-
(*E*)β-Ocimene	1044	t	-	-	-	-	-
dihydro-Tagetone	1048	-	-	-	-	-	3.1
γ-Terpinene	1055	-	t	-	-	-	-
n-Octanol	1066	t	t	-	-	t	-
Linalool	1066	0.1	0.2	-	-	0.1	-
n-Nonanal	1097	0.2	0.7	-	-	0.5	-
Terpinene-4-ol	1174	-	-	-	-	t	-
Phenylethyl alcohol	1110	1.9	1.3	14.3	1.7	0.1	0.8
Camphor	1141	-	t	-	-	-	-
(2*E*)-Nonen-1-al	1155	-	0.3	-	-	t	-
n-Nonanol	1167	t	0.1	-	-	t	0.7
α-Terpineol	1187	t	t	-	-	t	-
n-Dodecane	1196	-	-	-	-	t	-
n-Decanal	1202	0.1	0.5	-	-	0.1	0.5
Citronellol	1225	0.9	0.2	4.1	-	7.6	5.4
Pulegone	1235	-	0.1	-	-	-	-
Neral	1237	0.1	-	-	-	t	-
Geraniol	1251	1.1	0.2	0.4	-	0.7	-
2-Phenylethyl acetate	1253	0.3	0.1	0.3	-	0.2	-
Geranial	1267	0.1	-	-	-	t	-
Nonanoic acid	1267	-	-	-	-	-	6.4
Undecanal	1303	0.1	0.4	-	-	0.1	1.4
Methyl geranate	1320	-	-	-	-	t	-
Citronellyl acetate	1350	-	-	-	-	0.1	-
Eugenol	1353	2.2	1.5	1.2	-	0.4	3.0
Geranyl acetate	1381	-	-	-	-	0.1	-
β-Elemene	1388	-	-	-	-	t	-
n-Decanoic acid	1364	-	0.9	-	-	-	3.0
n-Tetradecane	1396	-	-	-	-	t	-

Methyl eugenol	1401	-	-	-	-	0.4	-
Dodecanal	1405	0.1	0.4	-	-	t	0.5
(*E*)-Caryophyllene	1415	0.8	0.3	-	-	0.2	-
dihydro-β-Ionone	1434	0.5	-	1.1	-	-	-
α-Guaiene	1434	-	-	-	-	0.1	-
α-Humulene	1449	-	-	-	-	0.2	-
Geranyl acetone	1449	0.4	0.7	-	-	-	0.8
(*E*)-β-Farnesene	1453	0.5	-	-	-	-	-
Germacrene D	1476	-	-	-	-	0.1	-
(*E*)-β-Ionone	1482	-	2.0	-	-	0.1	-
n-Pentadecane	1495	-	0.5	-	-	0.4	-
(*E,E*)-α-Farnesene	1505	-	-	-	-	0.1	-
Tridecanal	1506	-	0.2	-	-	-	1.2
(*E*)-Nerolidol	1560	-	-	-	-	0.1	-
Caryophyllene oxide	1577	-	0.2	-	-	t	2.8
2-Phenylethyl tiglate	1581	-	-	-	-	t	-
n-Hexadecane	1595	0.1	0.2	-	-	0.1	-
Tetradecanal	1608	-	-	-	-	t	-
β-Eudesmol	1645	-	-	-	-	0.1	-
α-Eudesmol	1648	-	-	-	-	0.1	-
1-Heptadecene	1695	2.4	1.1	1.2	-	0.4	2.7
(6Z,9E)-Heptadecadiene	1719	1.2	-	-	-	-	-
n-Heptadecane	1695	2.7	4.1	1.6	1.0	3.2	-
(*Z,Z*)-Farnesol	1717	-	-	-	-	0.4	-
Benzyl benzoate	1758	-	0.9	-	0.3	0.3	-
n-Octadecane	1795	-	0.4	-	0.1	0.6	-
Phenylethyl octanoate	1846	-	2.7	-	2.5	0.4	-
1-Nonadecene	1868	34.8	19.6	21.3	7.6	8.6	5.9
n-Nonadecane	1892	12.7	16.6	13.0	9.5	27.4	30.4
2-Phenylethyl phenyl acetate	1902	-	0.8	-	0.5	-	-
1-Eicosene	1970	0.7	0.3	0.7	-	0.5	-
Ethyl palmitate	1995	-	-	-	-	0.3	-
n-Eicosane	1999	0.8	1.4	-	0.9	4.5	2.1
n-Octadecanol	2073	6.1	2.8	3.0	1.7	1.4	-
n-Heneicosane	2103	21.1	32.7	30.9	53.9	26.1	18.8
n-Docosane	2197	0.3	0.6	0.4	1.8	1.5	-
1-Tricosene	2287	0.2	0.2	-	0.5	0.8	-
n-Tricosane	2296	1.6	2.7	5.1	10.5	7.8	-
n-Tetracosane	2400	-	-	-	0.5	0.5	-
n-Pentacosane	2500	0.2	0.4	0.7	1.9	2.9	-
Total		97.4	98.5	99.3	98.9	99.9	99.8

*RI: Retention indices analysed on HP-5; " – ": not detected; t: trace amount; DW: Dry weight; FW: Fresh weight

Conclusion

In general, it is clear that during seasonal variation and emission timing, Persian musk rose EOs varied significantly over time. GC/MS analysis was performed to define both similarities and differences across different seasons and fresh and dried flower in Persian Musk rose. Therefore, drying of plant material and seasonal variations of EOs has essential function and application in agriculture. Consequently, it can be concluded that efficiency of EO extraction and quality of EO obtained from flowers of this plants harvested on May 21 is significantly higher than other harvest times.

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