FSL 5: Temporal variation of essential oils in dried flower of two genotypes of Damask rose (*Rosa damascena* Mill.)

Akbar Karami, Pouya Rousta, Abolfazl Jowkar

Department of Horticultural Science, Faculty of Agriculture, Shiraz University, Shiraz, Iran

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Abstract

Damask rose (*Rosa damascena* Mill.) is the most important species in the production of rose water, perfumes and essential oils (EOs), perfumery and pharmaceutical industry applications. In order to exploit the most of this precious Iranian flower, research was conducted on two damask rose genotypes (Fars 1 and Fars 2) in six development stages in terms of EOs content and composition analysis. Results showed that all development stages of damask rose genotypes had significant differences in the EOs content. The highest EOs content was obtained from "Fars 2" genotype. It was found that the oil obtained from the dried petals of Fars 2 genotype contained a higher percentage of citronellol (C), geraniol (G) and phenylethyl alcohol (PEA) as well as a suitable ratio of C/G with the value of 2.464 as compared with Fars 1 genotype (5.546). In the last stages of flower bud development in both genotypes, the sum of the main hydrocarbons increased while citronellol content decreased, therefore essential oil quality dramatically declined. EO quantity was lower in the middle stages of flower bud development (stages 3 and 4) as compared to the final stages (stage 5 and 6), but its quality was superior in the former stages. Generally, it seems that "Fars 2" damask rose, as a promising genotype, can be used for EO production.

Keywords: Damask rose, Developmental stage, Genotype, Essential oils.

Introduction

Damask rose (*Rosa damascena* Mill.) is the most important aromatic species in the Rosaceae family (BAYDAR AND BAYDER, 2013). It is widely distributed throughout Syria, Morocco, Iran to Australia. Its fragrant flowers are used in the foods as rose-water, marmalade and pastry while its precious essential oil has a worldwide growing demand (KARAMI et al., 2012). Two major rose oil production areas familiar to the world are rose cultivations in Isparta of Turkey and Kazanlik of Bulgaria (BAYDAR AND BAYDER, 2013). Besides those regions, Fars province of Iran is another leading producer of damask rose which 8598 tons of flowers are produced annually in 6149 hectares of gardens (Iranian Ministry of Agriculture, 2012). Generally, essential oil amount of rose flowers is very little (ca. 0.03-0.04 %). Approximately 3500 kg of fresh top-quality rose flowers are harvested in the early morning of harvesting time which yield just 1 kg rose oil following hydro-distillation in the distilleries (BAYDAR AND BAYDER, 2013). Traditionally, the full-bloom stage is the most suitable stage of flowering for rose water or rose oil extraction. However, recent investigations indicated that rose oil yield distilled from rose buds was the same or higher for the same weight of flower material when compared to fully blown flowers (RUSANOV et al., 2012).The objective of this research was to elucidate the effect of different genotypes of Fars damask roses and their floral development stages on quantity and quality of EO production.

Materials and Methods

Plant material

Flowers of two distinct genotypes of the Iranian damask rose were harvested during six stages of flower development from plants grown at the Estahban Agricultural Research Station in the Sothern of Iran. These two genotypes were recognized by genetic markers and other characterization as illustrated previously (KARAMI et al., 2013; BABAEI et al., 2007). The descriptions of PICONE et al. (2004) were used as a principle for each stage as temporally characteristics. The flowers of each

stage were dried in a dark room under room temperature conditions (25-30 °C) for a week and then packed in cardboard box and kept in a dark and cool place for further experiments.

Analysis of the oil

The aerial parts were air-dried at ambient temperature in the shade and hydrodistilled by using a Clevenger-type apparatus for 3 h. The oil was dissolved in n-hexane (Merck), dried over anhydrous sodium sulfate 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). GC-MS analysis was carried out by use of Agilent gas chromatograph equipped with fused silica capillary HP-5MS column coupled with 5975-C mass spectrometer. 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 was 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 (ADAMS, 2007).

Results

In general, the investigated damask rose flowering stage (Temporal Variation) and genotypes had a significant effect on the essential oils contents and composition as discussed more below.

Damask rose Genotypes

Essential oil content

The EO content of dried flowers of damask rose was extracted from two distinct genotypes of damask rose. Statistical analysis demonstrated that damask rose genotypes had significant differences in the EOs content. The highest EOs content (0.208 % (w/w)) was obtained from "Fars 2" genotype (Table 1).

Essential oil composition

The EOs of each genotype were collected for periods of 3 hrs and analyzed by GC (FID) and GC/MS analysis (Table 2). The qualitative and quantitative composition of the EOs from the dried flower of each genotypes elucidated that the EOs was auxiliary affected by genotypes. ANOVA analysis confirmed that damask rose genotypes had differences in the EOs composition at 5 % level of significance using LSD test (Data was not shown). However in both genotypes, the sum of the main hydrocarbons increased while citronellol content decreased, therefore essential oil quality dramatically diminished. It was found that the oil obtained from the dried petals of Fars 2 genotype was be qualified for the higher percentage of citronellol (C), geraniol (G) and phenylethyl alcohol (PEA) and as well as a suitable ratio of C/G with the value of 2.464 as compared with Fars 1 genotype (5.546). This result could be endorsed by the role of genotypes in the EOs qualification.

Temporal Variation

Essential oil content

The results revealed that the effects of flowering stage (Temporal Variation) on EO content were significant ($p \leq 0.01$) during flower development. The maximum oil content was obtained from stage 5 (0.354 % (w/w).

Essential oil composition

The composition of the EOs from the dried flower of both genotypes clarified that the EOs was affected by flower development. In the last stages of flower bud development in both genotypes

the sum of the main hydrocarbons increased while citronellol content decreased, therefore essential oil quality dramatically declined. Although EO quantity was lower in the middle stages of flower bud development (stages 3 and 4) as compared to the final stages (stage 5 and 6). But its quality was superior in the former stages. The results of the present investigation revealed significant differences in the essential oil profiles of Iranian Damask rose. The differences in the oil compositions could be attributed to their genetic variability and flower stage. Generally, it seems that "Fars 2" damask rose, as a promising genotype, can be used for EO production and they could be selected as a good genetic source in breeding programs.

Tab. 1 The relative percentage of essential oils from two genotypes (Fars1 and Fars2) of Rosa damascena at six flower developmental stages used in this study.

Components	RI*	Genotype	Flowering Stage					
			1	2	3	4	5	6
Phenyl ethyl alcohol	1091	Fars 1	-	-	-	-	-	-
		Fars 2	-	-	0.302	0.061	0.167	0.041
Citronellol	1210	Fars 1	0.229	3.832	1.809	0.840	0.675	0.536
		Fars 2	0.694	3.284	3.704	1.004	2.201	2.737
Geraniol	1230	Fars 1	0.090	-	-	0.351	0.301	0.213
		Fars 2	0.045	0.197	0.605	0.029	3.530	1.120
Methyl eugenol	1390	Fars 1	-	-	4.171	-	-	-
		Fars 2	0.032	0.493	0.957	0.118	0.301	0.198
Heptadecane	1692	Fars 1	0.217	1.604	2.361	1.067	0.524	0.481
		Fars 2	2.368	3.349	2.377	1.274	1.572	0.424
Nonadecane	1911	Fars 1	1.322	1.616	3.498	0.545	0.187	0.233
		Fars 2	12.099	6.951	27.208	16.416	3.794	5.222
Heneicosane	2126	Fars 1	0.686	0.930	1.718	1.260	8.168	5.815
		Fars 2	26.202	17.849	22.032	19.217	23.072	7.999

*RI: Retention indices analyzed on HP-5 column -: not detected

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