AGRICULTURAL SCIENCE AND TECHNOLOGY, VOL. 13, No 1, pp 76-78, 2021
Published by Faculty of Agriculture, Trakia University, Bulgaria
ISSN 1313-8820 (print)
ISSN 1314-412X (online)
http://www.agriscitech.eu
DOI: 10.15547/ast.2021.01.014

Product Quality and Safety

Main parameters of essential oil of two species from genus *Pelargonium*, cultivated in laboratory conditions

V. Badzhelova*

Institute of Roses, Essential and Medical Cultures, 6100 Kazanlak, Bulgaria

Manuscript received 24 July 2020; accepted for publication 20 January 2021

Abstract. *The objective of this study is to determine the quantity and parameters of the obtained essential oil of two species from genus Pelargonium (Pelargonium graveolens L'Her. and Pelargonium radens H.E.Moor) in Bulgaria. This research was conducted using the microdistillation method and gas chromatography. As a result significant difference in the quantity of obtained essential oils has been found and the number of the main components and the ratio of the dominant ingredients have been determined. In general, they represent the main part of the oils - from 45.23 % in Pelargonium radens to 47.60 % in Pelargonium graveolens, respectively. The highest is the content of citronellol+nerol in both species, 38.88 % for Pelargonium radens and 37.97 % for Pelargonium graveolens.*

Keywords: distillation, essential oil, gas chromatography, *Pelargonium graveolens* L'Her., *Pelargonium radens* H.E.Moor

Introduction

Pelargonium is a perennial evergreen plant from family Geraniaceae. It is believed to have originated from South Africa where it is still encountered in natural habitats. From the distant past people knew about the healing effect of *Pelargonium* and that is why it is widely used in folk medicine. It has antioxidant, antiseptic and anti-inflammatory action (Fayed, 2009; Saraswathi et al., 2011; Boukhatem et al., 2013; Asgarpanah and Ramezanloo, 2015) and contains substances with insulin-like action (Sandhya, 2015). Its fragrance is fresh, soft and reminiscent of the scent of the oil-bearing rose. Geranium essential oil is rich in chemical compounds with high variability of the chemical profile (Juliani et al., 2006; Sharopov et al., 2014). The basic ingredients in the composition of the oil are citronellol, geraniol, linalool, eugenol, etc. The oil obtained by different distillation processes is used in various spheres of modern life, like perfumery, cosmetics, medicine, aromatherapy and the food industry.

In Bulgaria there are different forms and varieties of *Pelargonium*, but they are used primarily for ornamental purposes and until now no experiments with industrial purposes related to selection and breeding of it have been carried out and yield and composition of essential oil have not been studied. The growing demand of organic products requires research of plants rich in bioactive substances, including essential oils.

The objective of this study is to determine the main characteristics of the obtained essential oil in two *Pelargonium* species (*Pelargonium graveolens* L'Her. and *Pelargonium radens* H.E.Moor), cultivated in Bulgaria.

Material and methods

Plant material

This experiment uses two species from genus *Pelargonium* - *Pelargonium graveolens* L'Her and *Pelargonium radens* H.E. Moor. The donor plants are old local forms with unknown origins, collected from private gardens in the area of Kazanlak, a town situated in the central part of the country. The source material has been vegetatively propagated by means of nodal segments under laboratory conditions and the obtained plant material has undergone microdistillation.

Distillation

The experiment was carried out in 2019 in the period of active vegetation of the plants, and was conducted in 2 variants, with 4 repetitions for each of the studied species. Stems, petioles and leaves were used for distillation and a comparison between the characteristics and quantity of the essential oil from the two Pelargonium species was made.

To determine the obtained essential oil quantity, *"Clevenger"* device was used, modified by Balinova and Diakov (1974), with returning the distillation waters of the following parameters:

- raw material 200 g;
- hydromodule 1:4;
- time duration 2.0 h.

*e-mail: veselina.nenova@abv.bg

Gas Chromatographic analysis

The chemical composition of essential oils was determined by gas chromatograph *"Agilent Technologies 7820 A GC System"* with flame ionization detector (FID) under the following work conditions:

- capillary column – non-polar 30 m long, internal diameter 320 μm and film thickness 0.25 μm;
- temperature mode: from 60°C to 300°C at a rate of 5°C/min;
- injector temperature - 250°C;
- detector temperature - 300°C;
- carrier gas: hydrogen with carrier flow rate - 0.5 ml/min.

Results and discussion

Distillation

Organoleptic characteristics

Both tested genotypes have similar organoleptic qualities of the essential oils. Pale yellow colour, typical Pelargonium scent combined with floral notes. Initially the scent is strong and persistent, with time it becomes delicate and ethereal. Essential oil quantity has been measured for each of the species included in the study. The results have been summarized in Figure 1, as mean values for each genotype.

From the data in Figure 1, notably differences can be seen in the amount of distilled essential oil from the two species. Significantly greater is those for *Pelargonium graveolens*, respectively 0.74 ml on average from all samples, and only 0.48 ml in *Pelargonium radens*. Regarding the presented data for this experiment, it can be concluded that *P. graveolens* synthesizes greater quantities of essential oil than *P. radens* under equal all other conditions of the distillation process.

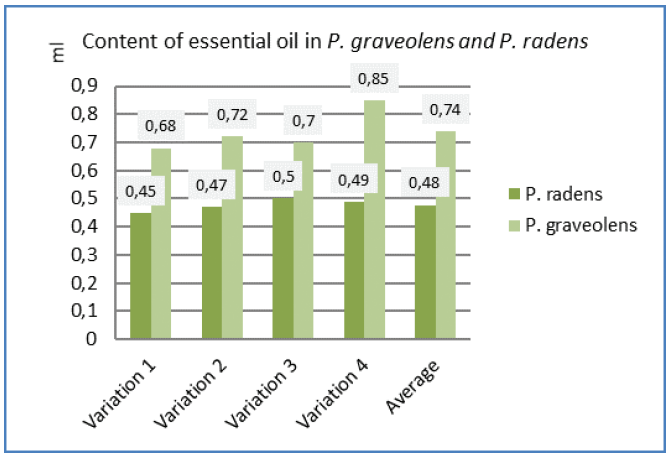

Figure 1. Distillation results comparison

Results from GC test

The obtained essential oil was subject to gas chromatographic analysis to determine the qualitative and quantitative composition of the main ingredients. The result from the analysis is presented in Table 1.

Table 1. Identified components in essential oil from *Pelargonium graveolens* and *Pelargonium radens*, %

Main components	*P. graveolens*		*P. radens*	
	Retention time, s	Content, %	Retention time, s	Content, %
Ethanol	5.07	0.01	4.95	0.01
Limonene	22.61	0.02	22.55	0.12
Linalool	25.64	2.95	25.40	1.54
Phenyl ethanol	25.89	0.03	25.66	0.06
Cis-rose oxide	26.39	0.86	26.16	0.77
Trans-rose oxide	27.33	0.29	27.10	0.20
Citronellol+Nerol	32.40	37.97	32.23	38.88
Geraniol	33.48	5.82	33.27	4.01
Eugenol	38.29	1.45	38.07	1.05
Methyl eugenol	39.56	0.65	39.35	0.51
Heptadecane	55.32	0.19	55.17	0.26
Farnesol	55.64	0.16	55.46	0.13
Nonadecene	62.12	0.20	61.98	0.24
Nonadecane	63.00	0.63	62.87	0.91
Eicosane	66.02	0.07	65.91	0.11
Heneicosane	68.59	0.26	68.50	1.20
Tricosane	72.87	0.17	72.80	0.17
Pentacosane	76.48	0.21	76.41	0.14
Heptacosane	80.58	0.08	80.48	0.11
Total components	-	52.02	-	50.42

The analysis shows oils rich mainly in oxygenated monoterpenes. Of all the isolated components, the largest is the amount of the main wanted ingredients – citronellol+nerol, geraniol, cis-rose oxide and linalool. In total, they comprise the basic part of oils from 45.23% in *P. radens* to 47.60% in *P. graveolens*. The highest is the citronellol+nerol content, 38.88% for *P. radens* and 37.97% for *P. graveolens,* respectively. The area part of citronellol+nerol in both genotypes is very close in

values, the difference being as little as 0.91%, and the difference in retention time is insignificant. Both peaks of citronellol and nerol practically overlap in the two oil samples. Linalool and geraniol have higher values for *P. graveolens*, linalool being almost twice more, while geraniol is 5.82% for *P. graveloens* and 4.01% for *P. radens* (Table 1). A characteristic feature of the presented oils is the high citronellol+nerol content, as well as the optimum geraniol content 4.01% and 5.82% in the two samples.

Good levels of cis-rose oxide and trans-rose oxide have been reported in the two species studied, these values being slightly higher in *P. graveolens*. From the secondary components group, methyl eugenol has the highest percentage in the two samples, 0.65% in *P. graveolens* and 0.51% in *P. radens,* respectively.The delicate rose fragrance, the good ratio between citronellol+nerol and geraniol, places Bulgarian oils in the group of oils with typical features and high commercial value.

Until now, a lot of studies over the chemical composition of essential oils and the genetic characteristics of different species of *Pelargonium* from other parts of the world have been conducted. In their publication Juliani et al. (2006) characterized the quality of *Pelargonium sp*. essential oil for different countries in South and East Africa. The organoleptic evaluation and chemical profile (citronellol 13%, linalool 18% and geraniol 35%), showed that these oils were not suitable for international markets. In an attempt to upgrade essential oil industry to higher standards, new plant species of the *Bourbon* type have been introduced in the South and East African economy. The newly introduced variety produces essential oils with suitable organoleptic and chemical profile (citronellol 31%, linalool 3% and geraniol 7%). With this study of theirs scientists prove that the right selection of a genotype is in the basis of obtaining high-quality essential oils.

The values of the main components in the improved African oils coincide largely with the results presented in this study. The citronellol+nerol quantity in Bulgarian oils is higher than in the African ones for both Bulgarian genotypes, while linalool has almost equal quantities 2.95% for *P. graveolens* and slightly lower for *P. radens* 1.54%.

Probably in a more extensive chemical analysis it is possible to isolate ingredients, specific of other members of the *Pelargonium* family, such as (guaia-6,9-diene, isomenthone, p-Cymene, viridiflorol and spathulenol), already described by Lalli et al. (2006). It has been claimed that the ingredients of *Pelargonium* essential oil are closely related to genotype, habitat and growing conditions (Rajeswara, 2002; Mosta et al., 2006).

In Tajikistant, Sharopov et al. (2014) studied the parameters of the main components in *Pelargonium graveolens* essential oil. They published values (citronellol 37.5%, geraniol 6.0%, linalool 3.0%), which are very similar to the results in the present study. According to some authors, quantity and percentage ratio of the main components of *Pelargonium* essential oil vary in different seasons (Mosta et al., 2006; Boukhatem et al., 2013). This necessitates the conduction of profound studies in the future to establish this correlation under Bulgarian conditions.

Conclusion

For the first time a study with two *Pelargonium* genotypes from Bulgaria has been conducted and the genotype with better economic parameters has been identified. It has been established that: (i) *P. graveolens* species synthesizes more essential oil than *P. radens*; (ii) the essential oil of *P. radens* is of better quality than *P. graveolens*, as it contains a larger amount of citronellol+nerol; (iii) 19 dominant components were isolated, which characterizes the *Pelargonium* essential oil in Bulgaria; (iv) of all the isolated components, the content of citronellol+nerol, geraniol, cis-rose oxide and linalool is the highest; in total, they represent a major part of the quality characteristics of oils from 45.23% in *P. radens* to 47.60% in *P. graveolens*, which classifies it to the group of oils with high commercial value.

References

Asgarpanah J and Ramezanloo F, 2015. An overview on phytopharmacology of *Pelargonium graveolens* L. Indian Journal of Traditional Knowledge, 558-563

Balinova A and Diakov G, 1974. On improved apparatus for microdistillation of rose flowers. Plant Science, 11, 79-85 (Bg).

Boukhatem M, Kameli A, Ferhat M, Saidi F and Mekarnia M, 2013. Rose geranium essential oil as a source of new and safe anti-inflammatory drugs. Libyan Journal of Medicine, 8, 22520. doi: 10.3402/ljm.v8i0.22520

Fayed SA, 2009. Antioxidant and Anticancer Activities of *Citrus reticulate* (Petitgrain Mandarin) and *Pelargonium graveolens* (Geranium) essential oils. Research Journal of Agriculture and Biological Sciences, 5, 740-747.

Juliani H, Koroch A, Simon J, Hitimana N, Daka A, Ranarivelo L and Langenhoven P, 2006. Quality of Geranium Oils (Pelargonium Species): Case Studies in Southern and Eastern Africa. Journal of Essential Oil Research, 18, 116-121.

Lalli JYY, Viljoen AM, Hüsnü K, Baser C, Demirci B and Özek T, 2006. The essential oil composition and chemotaxonomical appraisal of South African Pelargoniums Geraniaceae. Journal of Essential Oil Research, 18, 89-105.

Mosta NM, Soundy P, Steyn JM, Learmonth R A, Mojela N and Teubes C, 2006. Plant shoot age and temperature effects on essential oil yield and oil composition of rose-scented geranium (*Pelargonium sp*.) grown in South Africa. Journal of Essential Oil Research, 18, 106-110.

Rajeswara Rao BR, 2002. Correct identity and nomenclature of rose-scented geranium genotypes grown in India. Journal of Medicinal and Aromatic Plant Sciences, 24, 936-937.

Sandhya R, 2015. Essential oils in the management of diabetes mellitus. International Journal of Science and Research (IJSR), 2319-7064.

Saraswathi J, Venkatesh K, Nirmala B, Hilal MH and Rani AR, 2011. Phytopharmacological importance of Pelargonium species. Journal of Medicinal Plants Research, 5, 2587-2598.

Sharopov FS, Zhang H and Setzer WN, 2014. Composition of geranium (*Pelargonium graveolens*) essential oil from Tajikistan. American Journal of Essential Oils and Natural Products, 2, 13-16.