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# Post-harvest storage effect on quantity and quality of rose-scented geranium (*Pelargonium* sp. cv. 'Bourbon') oil in Uttaranchal

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ABSTRACT: **Drying and storage of herbage for 5 days prior to distillation significantly reduced the essential oil recovery as well as oil quality. The study suggested that the geranium green biomass should be distilled afresh for better oil yield and quality in the conditions of Uttaranchal. Copyright © 2005 John Wiley & Sons, Ltd.**

KEY WORDS: *Pelargonium graveolens*; post-harvest storage effect; essential oil; oil yield; oil quality; rose oxide; 10-*epi*-$\gamma$-eudesmol

## Introduction

Rose scented geranium (*Pelargonium graveolens* L. Her. ex. Aiton.) is an important, high-value essential oil-bearing, perennial aromatic crop of South African origin. It was introduced into India during 1900–1915, first on the Shevory hills and subsequently on the Nilgiri and Pulney hills of South India.[1] Although the crop has since been under commercial cultivation, the annual oil production in the country is around 2 tonnes, the major part (1.5 tonnes) of which comes from the Nilgiris and Pulney hills of Tamil Nadu and the rest from Andhra Pradesh, Karnataka and Uttar Pradesh. The current international demand of about 600 tonnes of geranium oil is being met largely by China, Egypt, Morocco, Reunion Island and South Africa.[2–3] Therefore, most of the 145 tonnes requirement of geranium oil of the Indian industry is being met through imports. That oil yield and quality are influenced by several environmental factors, such as harvesting temperature, distillation time and condition of herbs prior to distillation has been reported in earlier studies.[4–7,10]

Herbs distilled after 12 h storage have been reported to yield better oil recovery while other reports recommend immediate distillation after harvest.[6–8] In the light of these conflicting reports, a study on the effect of storage of herbs on the oil recovery and quality was undertaken to evaluate the optimum storage period, keeping in view the oil content and quality.

## Experimental

### Planting Material and Agronomy

The raising of a crop on a pilot scale was done at the Central Institute of Medicinal and Aromatic Plants, Resource Centre, Pantnagar, US Nagar, Uttaranchal, in an area of 2500 $m^2$ during 2002. Three week-old rooted cuttings prepared from homogenous population of geranium cv. Bourbon were planted on 29 January 2002, at an inter- and intra-row spacing of $60 \times 45$ cm, with light irrigation immediately after planting ensuring proper establishment. Further irrigation and other cultural practices, coupled with plant protective measures against weeds, insects and pests, were followed from time to time for better growth and development of the crop.

### Isolation of Essential Oils

A total of 18 random samples from a 136 day-old geranium crop, weighing 200 g each (fresh weight basis), were collected and divided into six batches of three samples/batch. The first batch was distilled on the day of harvesting and the rest were kept in the shade and distilled consecutively over a period of 5 days, taking one batch/day. Oil distillation was done in a Clevenger apparatus after measuring the moisture loss. The oil content (v/w%) was estimated on a fresh weight basis and the oil

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samples obtained were stored in a cool place for chemical composition analysis.

### Gas Chromatography

The oils were analysed on a Perkin-Elmer Auto XL gas chromatograph using a capillary column (PE-WAX, 50 m × 0.32 mm i.d., 0.25 μm film thickness); carrier gas, $H_2$ at 6 p.s.i. inlet pressure; temperature programme, 60 °C to 220 °C at 4 °C/min, with a final hold of 2 min; injector/detector temperatures, 200 °C and 240 °C, respectively. The data from the FID output was processed by Turbochrom Navigator software.

### Gas Chromatography–Mass Spectrometry

The GC–MS analyses were done on a Perkin-Elmer Turbo Mass/AutoXL system, using the same column and temperature programmes; carrier gas, He at 6 p.s.i. inlet pressure; EI, 70 eV; source temperature, 200 °C. The identification of compounds is based on NIST and Wiley Libraries, followed by comparision of MS data with published literature.[9]

## Results and Discussion

Table 1 shows the oil recovery data corresponding to the different herb storage times. It is quite obvious that storage cannot be recommended because of loss in oil recovery on subsequent days of storage. Similar recommendation was given earlier.[6]

The chemical composition of the geranium oil samples analysed on GC is also shown in Table 1. The GC results of the essential oil extracted from the fresh herbs led to the identification of 16 chemical constituents, which made up of 89.3% of the oil. The major constituents in the fresh herb oil are citronellol (35.4%), geraniol (20.2%), citronellyl formate (9.4%), iso-menthone (7.3%), 10-*epi*-γ-eudesmol (6.5%), linalool (3.2%), geranyl formate (2.7%) and geranyl tiglate (1.2%); the minor constituents (<1%) of the essential oil are rose oxides, menthone, citronellyl acetate, geranyl acetate, citronellyl tiglate and phenyl ethyl tiglate, etc. The chemical composition of the oil samples from stored herbs shows a decrease in the citronellol and an increase in geraniol with storage. Such post-storage quality deterioration is not in conformity with reported results of no deterioration of oil quality after storage.[6–7] The same trend follows for esters as well. Reduction of rose oxides was followed by increase in 10-*epi*-γ-eudesmol. In considering the variations in the concentrations of 16 chemical constituents of fresh and stored herbs, it clearly stands that the two major oil constituents, citronellol and geraniol, are the most affected after storage of the herbs. Accordingly, the present study suggests that the citronellol:geraniol (C:G) ratio would be a potent indicator of change in oil composition in post-harvest storage. It is interesting to note that the C:G ratio decreases under post-harvest storage, as is evident from the present study, whereas this ratio increases with a decrease in the environmental temperature.[10] Finally, it is concluded that geranium herbs should be distilled afresh for better oil yield and quality. It is further recommended that distillation units of higher capacities should be installed, keeping in view the expected yield of herbs at a farm.

**Table 1.** Effect of post-harvest storage of geranium herbage on oil content (%) and quality

| Parameter (%) | Retention indices | Days after storage | | | | | |
|---|---|---|---|---|---|---|---|
| | | Fresh | 1 | 2 | 3 | 4 | 5 |
| Oil content* | — | 0.19 ± 0.01 | 0.15 ± 0.00 | 0.14 ± 0.01 | 0.15 ± 0.00 | 0.14 ± 0.01 | 0.15 ± 0.01 |
| Moisture loss | — | — | 29.0 | 52.0 | 56.0 | 73.0 | 73.0 |
| *cis*-Rose oxide | 1344 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| *trans*-Rose oxide | 1355 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Menthone | 1455 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Isomenthone | 1480 | 7.3 | 7.2 | 6.7 | 6.6 | 6.1 | 5.6 |
| Linalool | 1550 | 3.2 | 3.9 | 3.8 | 3.2 | 2.7 | 2.7 |
| Citronellyl formate | 1615 | 9.4 | 8.9 | 8.6 | 8.2 | 8.2 | 8.0 |
| Citronellyl acetate | 1655 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 |
| Geranyl formate | 1695 | 2.7 | 3.7 | 3.5 | 3.5 | 3.3 | 3.1 |
| Germacrene-D | 1721 | 1.2 | 1.0 | 1.6 | 1.8 | 2.1 | 2.1 |
| Geranyl acetate | 1753 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Citronellol | 1779 | 35.4 | 26.8 | 25.3 | 24.9 | 24.0 | 24.0 |
| Geraniol | 1857 | 20.2 | 28.4 | 28.7 | 29.1 | 29.2 | 29.8 |
| Citronellyl tiglate | 2010 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 | 0.4 |
| Geranyl tiglate | 2096 | 1.2 | 1.7 | 1.8 | 2.1 | 2.2 | 2.7 |
| 10-*epi*-γ-Eudesmol | 2112 | 6.5 | 7.4 | 8.2 | 8.2 | 8.4 | 8.5 |
| Phenyl ethyl tiglate | 2210 | 0.7 | 0.7 | 0.8 | 0.9 | 1.1 | 1.4 |
| Total | | 89.3 | 90.8 | 90.0 | 89.7 | 88.5 | 89.0 |

* Values are averages over three replications and presented as mean ± SEM.

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