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GC-MS Composition of Rose Oil (*Rosa damascena*) of Different Agro Climatic Regions of North India†

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The essential oil composition of rose oil (*Rosa damascena*) obtained from different agro climatic region of north India has been evaluated by GC, GC-MS and relative retention time in the oils. The rose oil have been distilled from the different regions of Pantnagar, Lucknow, Moradabad and Kashmir. The major components of rose oil mainly citronellol, nerol, geraniol, nonadecane and heneicosane have been identified. A total of 32 components amounting to 93.1, 88.79, 88.37 and 95.47 % of rose oils of Pantnagar, Lucknow, Moradabad and Kashmir, respectively have been identified.

Key Words: *Rosa damascena*, Rosaceae, Essential oil composition, Citronellol, Nerol, Geraniol, Nonadecane and Heneicosane.

INTRODUCTION

Rosa damascena Mill commonly known as Buussorah or Fasli Gulab in Hindi belonging to the family Rosaceae is an important ornamental and high rich perfumery plant found widely grown in India[1]. Rose oil is one of the oldest and most valuable perfumery raw material. The rose often referred to as the "Queen" of flowers, is used for purposes of decoration during festivals and for personal adornment. The flowers are strung into garlands and offered in temples during workshop. The bulk of Damask Rose flowers, amounting roughly to 60-70 % of total production in India, is used for the production of rose water. Smaller quantities are consumed in preparing attars, gulkand and hair oils[1]. Among all the perfumery materials of natural origin used in expensive perfumes, rose oil is unsurpassed due to its deep, sweet and rich fragrance. *Rosa damascena* is a perennial, erect, climbing shrub with a life span up to 50 years. The plant reaches a height of 2.5 to 3.0 m. Commercial cultivation of rose in India dates back to Moghul times and its history and development have been well documented[2]. Rose is basically a temperate plant, indigenous to Europe and Middle-East countries specially Iran, Afghanistan and Turkey. The main rose growing areas in the India are Aligarh and Ghazipur in Uttar Pradesh and Haldighati in Rajasthan. Rose is also being cultivated on smaller scale at Kannauj and Varanasi in Uttar Pradesh, India and also in different parts of India such as Kashmir, Himachal Pradesh, Pushkar in Rajasthan.

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A similar study was carried out by Naqvi and Mandal[3] in which rose oils from different places in India including Kashmir, Himachal Pradesh, Aligarh, Lucknow and Kodaikanal was analyzed for the major constituents namely citronellol, nerol and geraniol by capillary GC. Studies on the composition of the *Rosa damascena* oil of the variety Noorjahan grown in CIMAP experimental farm, Lucknow has been reported by Gupta *et al.*[4]. In their studies the main components of the oil have been identified as citronellol (20.8 %) and nonadecane (8.5 %). An improved technology for the production of rose oil was reported by Kahol *et al.*[5] in 1983, in which rose flowers from Hasayan region was distilled in a CIMAP improved technology and oil was analyzed. The main constituents identified were citronellol 23.9 %, nerol (12.4 %), geraniol (34.9 %) and phenyl ethyl alcohol (7.4 %). In an article of Ranade[6], a survey of the rose oil industry with emphasis on processing techniques and chemistry of roe oil and absolutes. Baser[7] reported GC/MS analysis of the Turkish rose oil over different climatic seasons. The compounds were found in different years citronellol (26.74-43.54 %), nerol 95.26-10.58 %) and geraniol (10.18-25.83 %).

In a review article by renowned perfumery expert Lawrence[8] detailed chemical investigation of the chemical constituents of the rose oils, concretes, absolutes, ottos have been nicely compiled[8]. In another report Dimov and Tsoutsoulova[9] examined the chemical composition of a number of samples of rose oil in which the mean quantitative data used for the components selected for used in the mathematical model were citronellol (22.50 %) and geraniol (22.20 %). Constituents of rose oil from the Kangra valley have been investigated by Sood *et al.*[10] in which 32 compounds were identified. Similarly several studies on the GC GCMS composition of the rose oils of different areas and growing conditions have been reported in literature[11-14]. In a recent study, the chemical composition of the rose concrete and absolute being grown in northern India region has been reported by Tandon *et al.*[15].

In the present investigation, rose oils obtained from different agro climatic regions in India (Pantnagar, Lucknow, Moradabad and Kashmir), have been evaluated for the variation in their chemical constituents using gas chromatography and gas chromatography-mass spectrometry.

EXPERIMENTAL

The rose oil of the Damask variety was distilled from the different agro climatic regions of Pantnagar, Lucknow, Moradabad, Kashmir and in a CIMAP designed directly fired type improved cohobation type distillation unit. The oil from the Himalayan range of Kashmir was distilled in the unit from the fresh damask rose flowers growing in Allahapura area in District Pulwama in the month of May. The unit was designed and installed by CIMAP for the Directorate of Horticulture under technology transfer. The yield of the rose oil was 0.036 % (w/v). Similarly the rose oil from Gangetic Plains of Moradabad area was freshly distilled in the month of April by CIMAP scientists through a CIMAP unit installed at Bharat Electroplaters

under technology transfer. Yield of rose oil in this unit was recorded as 0.032 % (w/v). The oil from Pantnagar was freshly distilled in a similar unit from flowers being grown in the CIMAP resource center of Pantnagar in the Tarai area of the foothill of Uttarakhand with an yield of 0.034 % in the month of April. The rose oil from Lucknow was again distilled in a CIMAP improved distillation unit installed at CIMAP farm with an yield of 0.032 % (w/v) in the month of March. All oils were collected and stored in glass tubes. All the oils were dried over anhydrous sodium sulphate and stored in a sealed glass vial prior to analysis.

Gas chromatography was performed on Perkin-Elmer AUTOXL gas chromatograph using PE-Wax, fused silica capillary column (50 m × 0.32 mm, film thickness 0.25 μ) and FID detector. Oven temperature was programmed from 1000 to 2500 at 3 ºC/ min; injector temperature 220 ºC; detector temperature 280 ºC; carrier gas hydrogen with inlet pressure of 8.5 psi. The data processed on Turbochrom work station.

Gas chromatography-mass spectrometry data were obtained on a Shimadzu QP-2000 instrument at 70 ev and 250 ºC. GC column: ULBON HR-1 (unless otherwise specified) equivalent to OV-1, fused silica capillary column- 0.25 mm × 50 M with film thickness-0.25 μ. The other conditions are given on the GC MS trace. An entry such as 100-6-10-250 means that initial temperature was 100 ºC for 6 min and then heated at the rate of 10 ºC per minute to 250 ºC. Carrier gas (helium) flow was 2 mL/min.

RESULTS AND DISCUSSION

The volatile oils were obtained by the hydro distillation of fresh rose flowers of *Rosa damascena* Mill. from the different regions of Pantnagar, Lucknow, Moradabad and Kashmir in CIMAP improved directly fired type distillation units. The average yield of the rose oil in each case was 0.036, 0.034, 0.032 % and 0.032 v/w on a fresh weight basis, respectively. It can be observed from Table-1 that the oil content of the rose being grown in Kashmir and Pantnagar regions is slight higher than those being grown in the plain areas of Lucknow and Moradabad. The GC and GC-MS analysis has resulted in the identification of 32 constituents from the fresh flowers accounting to 88.80, 93.10, 88.37 and 95.47 % of the oils of Pantnagar, Lucknow, Moradabad and Kashmir, respectively. The relative concentrations of the volatile components identified are presented in Table-1 according to their elution order on a PE-Wax fused silica capillary column. The major components identified in all oils are citronellol, nerol, geraniol, nonadecane and heneicosane. It can be observed that the citronellol (33.44 %) content is higher in Kashmir variety as compared to Lucknow (13.51 %) and Pantnagar (27.07 %) oils. Moradabad rose oil is observed to be more rich in γ-terpenine and nonadecane contents whereas the geraniol content is on a slightly lower side (19.48 %). No major variation in the minor constituents like rose oxide, PEA and *cis*-3-hexanol is observed in all the four oils. The olfactory value of all the four oils have also been evaluated and have acceptable notes as per the perfumery standards.

TABLE-1
COMPARATIVE PERCENTAGES OF THE IDENTIFIED COMPOUNDS IN ROSE OILS OF DIFFERENT REGIONS

Constituents (%)	Pantnagar	Lucknow	Moradabad	Kashmir
α-Pinene	0.03	0.09	0.52	0.30
Sabinene	0.02	0.03	0.37	0.02
β-Pinene	0.03	0.16	0.02	0.04
β-Ocimene	0.02	0.06	0.10	0.20
γ-Terpinene	0.02	0.04	1.89	0.01
Linalool	1.19	0.45	0.28	1.80
cis-Roseoxide	0.20	0.67	0.58	0.14
trans-Roseoxide	0.21	0.06	0.18	0.17
Phenyl ethyl alcohol	0.05	0.99	0.13	0.20
Isomenthone	0.20	0.19	0.19	0.08
cis-3-Hexenol	0.09	0.29	0.03	0.06
4-Terpineol	0.04	0.08	0.06	0.07
α-Terpineol	0.09	0.10	0.09	0.07
Citronellol	27.07	13.51	28.22	30.44
Nerol	12.91	13.09	7.54	11.87
Terpen-4-ol	0.50	0.40	0.60	0.74
Neral (citral a)	0.20	0.57	0.28	0.30
Geraniol	29.84	31.74	19.48	31.29
Phenyl ethyl acetate	0.11	0.21	0.61	0.31
Geranial (citral b)	0.80	0.70	0.04	0.89
Citronellyl acetae	0.28	0.46	0.34	0.21
Neryl acetate	0.69	0.22	0.25	0.36
Eugenol	0.80	0.91	1.90	0.70
Geranyl acetate	2.69	4.16	1.23	0.36
β-Caryophyllene	0.70	0.67	0.05	0.20
α-Guanine	0.60	0.50	1.03	0.40
α-Humulene	0.34	0.44	1.05	0.33
Farnesol	1.05	2.06	1.58	2.23
Nonadecane	5.98	8.94	11.43	5.90
Eicosane	0.90	1.25	1.52	1.22
Heneicosane	5.45	5.76	6.78	4.56
Total (%)	93.10	88.80	88.37	95.47

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