Journal of Medicinal Plants Research Vol. 6(6), pp. 1046-1049, 16 February, 2012
Available online at http://www.academicjournals.org/JMPR
DOI: 10.5897/JMPR11.1189
ISSN 1996-0875 ©2012 Academic Journals

Full Length Research Paper

Fatty acid composition of wild growing rose species

Bobita Sharma[1], Bikram Singh[1]*, Devendra Dhyani[2], Praveen Kumar Verma[1] and Subramaniam Karthigeyan[3]

[1]Natural Plant Products Division, Institute of Himalayan Bioresource Technology (Council of Scientific and Industrial Research), Palampur, Himachal Pradesh 176 061, India.
[2]Floriculture Division, Institute of Himalayan Bioresource Technology (Council of Scientific and Industrial Research), Palampur, Himachal Pradesh 176 061, India.
[3]Crop Improvement Department, Indian Grassland and Fodder Research Institute, Dharwad, Karnataka, India.

Accepted 7 December, 2011

Fatty acid composition of seed oil obtained from fifteen domesticated accessions of four wild rose species, *Rosa moschata*, *Rosa brunonii*, *Rosa multiflora* and *Rosa alba* was determined by gas chromatography (GC). The composition was further confirmed by GC-MS and retention indices. Major fatty acids present in the seed oil were characterized as linoleic acid (LA) (45.38 to 54.58%), linolenic acid (LNA) (13.67 to 24.75%), oleic acid (11.97 to 21.08%) and palmitic acid (6.54 to 12.97%). The essential fatty acids ratio (LA: LNA) varied from 1.8:1 to 3.4:1 and oil content in seeds ranged from 1.3 to 9.0% in different accessions. These accessions can further be exploited for the development of new hybrid with improved seed oil quality and quantity through inter specific hybridization.

Key words: Fatty acids, hybridization, *Rosa moschata* Herrm., *Rosa brunonii* Lindl., *Rosa multiflora* Thunb., *Rosa alba* L.

INTRODUCTION

Rose species are well known for their medicinal and cosmetic properties. There are more than 120 species of Rose growing worldwide, mostly in the temperate regions. They are extensively distributed in the north temperate and subtropical parts of both the Eastern and the Western Hemispheres. Turkey has one of the most important germplasm centres for rose species. Twenty-five rose species have so far been reported to grow in Turkey, although, these 25 species are just widely spread throughout the country from sea level to altitudes as high as 3000 m (Ercisli, 2007). In India, ten rose species are reported to be growing truly wild, mostly in the Himalayan region (Kaul et al., 1999). The most common species found are *Rosa brunonii* Lindl., *Rosa clinophylla* Thory., *Rosa eglanteria* Linn., *Rosa foetida* Herrm., *Rosa gigantean* Collett., *Rosa leschenaultiana* Wight and Arnott., *Rosa longicuspis* Bertol., *Rosa macroghylla* Lindl., *Rosa multiflora* Thunb., *Rosa sericea* Lindl. and *Rosa webbiana* Wallich ex Royle (Frederick et al., 2002; Collett, 1984; Pal, 1991; Sabnis, 1986; Dhyani et al., 2004). Some of the species are reported to have become naturalized in certain hilly areas of Northern India (Pal, 1991).

Rose species are well known for their medicinal and cosmetic uses e.g. the roots of *R. brunonii* are used for the treatment of diseases related to eyes (Kaul et al., 1999); aqueous extract of *Rosa damascena* showed anti-HIV activity due to the presence of flavonoids content (Mahmood et al., 1996). Rosa species are reported to have antibacterial, anti-inflammatory and diuretic properties (Mahmood et al., 1996; Brinkworth et al., 1992; Basim and Basim, 2003). The commercial significance of *R. damascena* lies particularly in rose oil which has a high international demand, and in rose water, which is a distillation bi-product (Frederick et al., 2002). Rose hips also have market demand for their role in strengthening the body's defence against infections, and particularly the common cold. The fruits, leaves and even roots boiled in water are used as diuretics and as ingredients in common cold remedies in Turkey. Rose hips are also well known to have the highest vitamin C content (300-4000 mg/100 g) among fruits and vegetables. In addition, rose hips contain other vitamins and minerals,

*Corresponding author. E-mail: bikram_npp@rediffmail.com. Tel: 91-1894-230426. Fax: 91-1894230433.

carotenoids, tocopherol, bioflavonoids, fruit acids, tannins, pectin, sugars, organic acids, amino acids and essential oils. Rose hips are the rich source of phenolics and carbohydrates. Phenolics possess a wide spectrum of biochemical activities such as antioxidant, antimutagenic, anticarcinogenic, as well as the ability to modify gene expression (Ercisli, 2007). Some fatty acids present in the rose hip seed oil cannot be synthesized by human beings and must obtained through diet. These compounds regulate numerous body functions, including blood pressure, blood viscosity, immune and inflammatory responses (Ercisli et al., 2007).

Various reports on rose volatile oil composition have been published (Kaul et al., 1999; Frederick et al., 2002; Babu et al., 2002; Karawya et al., 1974; Baser, 1992; Kovats, 1987), but few reports exist on seed oil composition. To the best of our knowledge the chemical composition of seed oil has been reported only in case of *R. canina*, *R. dumalis* subsp. boissieri, *R. dumalis subsp. antalyensis, R. pulverulenta* and *R. pisiformis*. As for the reports available, dominant fatty acids in rose seeds are linoleic acid and linolenic acid (Ercisli et al., 2007; Ozsan, 2002; Szentmihalyi et al., 2002). The aggregate fruit of *R. canina* L. has long been used for medical purposes. A valuable ingredient of rose species, vitamin C, is used for the prevention of diseases in the form of rose hip tea, consumed during periods of common cold. Rose hip stands as an official entry in the European Pharmacopoeias. Total phenolics, ascorbic acid, total soluble solids, and microelements have also been reported. Various extraction methods including traditional solvent extraction, ultrasound, microwave, sub and supercritical fluid extraction have been conducted on seed oil of *R. canina* (Ercisli, 2007). The objective of the present investigation was the determination of oil content and fatty acid composition of seed oil from 15 different domesticated wild rose accessions belonging to four species, *R. moschata, R. brunonii, R. multiflora* and *R. alba* from Western Himalaya.

MATERIALS AND METHODS

Wild roses were collected from Palampur area of Kangra district of Himachal Pradesh, India, at an altitude of 1220 to 1500 m, longitude 76° 32′ 14.42 E and latitude of 32° 06′ 36.84 N. The collected accessions of different species were domesticated at the Institute of Himalayan Bioresource technology (IHBT) experimental farm.

Fifteen domesticated seed setting accessions of wild roses were selected in this study for their seed oil contents and fatty acid evaluation. These accessions were distributed in four groups (A to D): Group A contained the species of *R. moschata*; B, *R. brunonii*; C, *R. multiflora* and D, *R. alba*.

Extraction of rose seed oil

Rose seeds were ground and extracted with n-hexane (S D Fine-Chem Limited) at 60°C in a Soxhlet apparatus for 3 h. The extract was filtered, solvent evaporated under reduced pressure and then lyophilized.

Preparation of methyl esters

Saturated and polyunsaturated fatty acids present in rose seed oil were derivatised by methanol and sulphuric acid under nitrogen atmosphere as described (Adams, 1995; Christie, 1990) and methyl esters obtained were evaluated by Gas chromatography flame ionisation detector (GC-FID) and Gas chromatography mass spectrometry (GC–MS).

Determination of fatty acids composition by GC

The GC–FID analysis of fatty acid methyl esters was accomplished on a Shimadzu (GC-2010) and GC–MS on Shimadzu (QP 2010) both equipped with DB-5MS capillary column (30 m length, 0.25 mm ID, 0.25 µM film thickness) from Agilent Technologies, USA. For GC–FID, nitrogen was used as carrier gas with split ratio of 1:50 and flow rate of 1.1 ml/min. While for GC–MS, helium was used as carrier gas with split ratio of 1:50 and flow rate of 1.1 ml/min, ionization energy 70 eV and injection volume 2 µL. For both, the GC's oven temperature of column was programmed initially at 70°C for 5 min, rising at the rate of 4°C/min to 220°C and then held isothermal for 4 min. Injector and interface temperatures were 250°C for both. The spectrum was scanned from m/z 50 to 600 amu. The components were identified by comparison of retention indices and their mass spectral data with in-house built Library, Wiley, NIST, NBS and literature data (NIST/EPA/NIH, 1998; Adams, 2004 and 1995; Wiley, 2000; McLaffety, 1989; Jennings and Shibamoto, 1988).

RESULTS AND DISCUSSION

The percentage oil yield for the fifteen rose accessions ranged from 1.3 to 9.0% (Table 1). The highest yield, 9.0%, was recorded for accession no. 21 (group D) followed by 6.30% for accession no. 28 (group C). The GC and GC–MS analysis of the seed oil from those 15 accessions indicated the presence of seven fatty acids (Table 1). Characterization of different methyl esters was carried out by comparing the retention indices with homologues series of n-alkanes (C8-C32; Sigma-Aldrich, Saint Louis, Missouri USA). The identified fatty acids were linoleic acid (C18:2) 45.38 to 54.58%, linolenic acid (C18:3) 13.67 to 24.75%, oleic acid (C18:1) 11.97 to 21.08%, palmitic acid (C16:0) 6.54 to 12.97%, stearic acid (C18:0) 3.37 to 8.54% and arachidic acid (C20:0) 0.85 to 1.99%. Highest percentage (54.58%) of linoleic acid in accession no. 14 and lowest (45.38%) in accession no. 24 was recorded. Accession no. 17 contained the higher essential fatty acid (LA: LNA) ratio (3.4:1) along with higher oleic acid content (21.08%). However, the oil composition of accession no. 21 was found to be devoid of linoleic and linolenic acid. Moreover, the presence of other fatty acids was recorded as: oleic acid (20.83%), palmitic acid (12.97%), stearic acid (8.54%) and arachidic acid (1.99%) in this accession of *R. brunonii*. GC analysis of the seed oil from 15

Table 1. Chemical composition of identified fatty acids in different accessions of rose species.

Groups	AN	Oil yield (%)	Identified fatty acids							LA:LNA
			PA (%)	MA (%)	SA (%)	OA (%)	LA (%)	LNA (%)	AA (%)	
A	6	4.7	7.03	0.08	4.12	12.55	46.74	24.75	1.24	1.8:1
	11	2.0	6.60	0.08	3.69	13.39	51.88	19.44	0.98	2.6:1
	14	2.1	6.72	0.09	3.37	12.50	54.58	18.97	0.85	2.8:1
	22	1.9	7.91	0.11	4.01	12.10	46.04	24.10	1.11	1.9:1
B	15	1.3	7.49	0.12	4.04	15.25	46.12	23.65	0.95	1.9:1
	16	2.1	7.16	0.11	4.59	12.80	47.30	21.98	1.26	2.1:1
	17	3.8	7.44	0.12	5.36	21.08	47.10	13.67	1.24	3.4:1
	49	3.5	6.54	-	3.72	12.77	51.28	21.90	1.00	2.3:1
C	3	2.6	7.29	0.11	4.45	15.02	47.95	20.57	1.12	2.3:1
	18	2.0	7.14	0.14	5.32	14.19	48.97	20.31	1.25	2.4:1
	24	5.3	7.59	0.10	5.79	17.81	45.38	18.71	1.29	2.4:1
	28	6.3	7.44	0.11	4.63	16.05	48.48	18.33	1.13	2.6:1
	43A	1.8	7.66	0.12	4.27	13.18	50.02	17.55	1.12	2.8:1
	50	3.7	6.67	0.10	3.96	11.97	53.72	20.01	0.99	2.6:1
D	21	9.0	12.97	0.12	8.54	20.82	-	-	1.99	-

AN = Accession number; PA = palmitic acid; MA = margaric acid; SA = stearic acid; OA = oleic acid; LA = linoleic acid; LNA = linolenic acid; AA = arachidic acid.

accessions indicated the ratio of essential fatty acids varied from 1.8:1 to 3.4:1 (Table 1).

The presence of specific proportion of fatty acids is considered to have high nutritional value (Lagerstedt et al., 2001; Leizer et al., 2000; James et al., 2006). Inappropriate balance of essential fatty acids contributes to various kinds of malfunctioning, while a proper balance maintains and even improves health (James et al., 2006; Rosenfield, 2002). It has been scientifically proven that 2 to 3:1 ratio of LA: LNA suppressed inflammation of rheumatoid arthritis. Epidemiological studies also indicate that 1 to 2:1 ratio of LA: LNA has protective effects against the development of breast and colon cancer (Artemis and Leslie, 2003). The ratio of stearic and oleic acid is used as marker for the presence of malignant tissue particularly for prostate cancer (Wood et al., 1985). In tumours, the low stearic acid and high oleic acid cause a shift in the ratio of stearic to oleic acid, thus resulting in an increase in the metabolic rate of tumour membrane (rapid movement of nutrients) and this ratio is used to monitor the effectiveness of cancer therapy (Persad, 1990). In the present study, the percentage of linoleic acid was recorded higher among all the constituents and the ratio of LA and LNA comes in the range of 1.8:1 to 3.4:1, implying its potential in medicines. In all the accessions, content of oleic acid (11.97 to 21.08%) was higher than stearic acid (3.37 to 8.54%), thereby suggesting its medicinal significance. The variations in composition of fatty acids in seed oil of different rose accessions were also recorded. High content of seed oil present in domesticated wild roses and the presence of different polyunsaturated fatty acids as given in Table 1 can be used as chemo-taxonomical marker with cultivated rose species used for extraction of essential oil for perfumery purposes. There are possibilities of development of desirable hybrids having better seed setting and improvement in seed oil as well as effective fatty acid composition through hybridization between selected accessions of different groups. Results also indicated that accession no. 17 had better ratio of fatty acid composition in comparison to others and it can be utilized in hybridization with accession no. 11 and 14 from group A and 43A and 50 from group C. Furthermore, since the seed oil yield of accession nos. 28, 21 and 6 were recorded higher than other accessions, these can also be used for hybridization with other groups for improvement of seed oil quantity and quality. New hybrids of roses having better seed setting and producing hips of better oil quantity and quality can be utilized for seed production to cater the need of medicinal, food and cosmetic industries in the near future.

Conclusion

The present study indicated that rose seed oil from the fifteen different accessions belonging to 4 different species contained specific proportions of saturated and polyunsaturated fatty acid (PUFA) (essential fatty acids), which contribute to their medicinal importance. Some of the accessions were recorded with better quality of the oil (e.g. accession no. 17 with LA and LNA ratio of 3.4:1) and some with better oil yield (e.g. accession no. 21). These accessions can further be exploited for the development of new hybrid with improved seed oil quality and quantity through inter specific hybridization.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, IHBT, Palampur, H.P. India, for providing facilities. The financial assistance by Supra Institution Project SIP-0003 is also gratefully acknowledged. Mr. Praveen Kumar Verma is thankful to CSIR for granting Senior Research Fellowship. We are grateful to Mrs. Vijaylata Pathania for GC/MS analysis.

REFERENCES

Ercisli S (2007). Chemical composition of fruits in some rose (*Rosa* spp.) species. Food Chem. 104: 379-1384.

Kaul VK, Gujral RK, Singh B (1999). Volatile constituents of the essential oil of flowers of *Rosa brunonii* Lindl. Flav. Fragr. J., 14: 9-11.

Frederick C, Wagner A, Morvillo N (2002). Randomly amplified polymorphic and DNA (RAPD) analysis of the musk roses (*Rosa moschata*). Prac. Fla. State Hort. Soc., 115: 117-119.

Collett H (1984). Flora Simlensis. International book distributors, pp. 167-169.

Pal BP (1991). The rose in India. Publication and Information Division, ICAR: New Delhi, India, pp. 22-23.

Sabnis TS (1986). Flora of the Punjab and Associated Hill Regions. Scientific Publisher: Jodhpur, India, p. 43.

Dhyani D, Karthigeyan S, Ahuja PS (2004). An efficient round cut method (RCM) for emasculation of rose flowers. Acta Horticulture, 690: 125-130.

Mahmood N, Piacente S, Pizza C, Burke A, Khan AI, Hay AJ (1996). The anti-HIV activity and mechanisms of action of pure compounds isolated from *Rosa damascena*. Biochem. Biophys. Res. Comm., 229: 73-79.

Brinkworth RI, Stoermer MJ, Fairlie DP (1992). Flavones are inhibitors of HIV-1 protease. Biochem. Biophys. Res. Comm., 188: 631-637.

Basim E, Basim H (2003). Antibacterial activity of *Rosa damascena* essential oil. Fitoterapia. 74: 394-396.

Babu KGD, Singh B, Joshi VP, Singh V (2002). Essential oil composition of Damask Rose (*Rosa damascena* Mill.) distilled under different pressure and temperature. Flav. Fragr. J., 17: 136-140.

Karawya MS, Hashim FM, Hifnawy MS (1974). Oils of jasmine, rose and cassie of Egyptian origin. Bull. Fac. Phar. Univ. Cairo, 13: 183-192.

Baser KHC (1992). Turkish rose oil. Perfume Flav., 17: 45-52.

Kovats E (1987). Composition of essential oil. Part 7. Bulgarian oil of rose (*Rosa damascena* Mill.). J. Chromatogr., 406: 185-222.

Ozsan M (2002). Nutritional composition of Rose (*Rosa canina* L.) seed and oils. J. Med. Food, 5: 137-140.

Szentmihalyi K, Vinkler P, Lakatos B, Illes V, Then M (2002). Rose hip (*Rosa canina* L.) oil obtained from waste hip seeds by different extraction methods. Bioresour. Tech., 82: 195-201.

Ercisli S, Orhan E, Esitken A (2007). Fatty acid composition of Rosa species seeds in Turkey. Chem. Nat. Comp., 43: 605-606.

Lagerstedt SA, Hinrichs DR, Batt SM, Magera MJ, Rinaldo P, McConnell JP (2001). Quantitative determination of plasma C8-C26 total fatty acids the biochemical diagnosis of nutritional and metabolic disorder. Mol. Gent. Metab., 73: 38-45.

Leizer C, Ribnicky D, Poulev A, Dushenkov S, Raskin I (2000). The Composition of hemp seed oil and its potential as an important source of nutrition. J. Nutr. Funct. Med. Foods, 2: 35-53.

James HO, Keefe Jr, Hussam A, Sastre A, David MS, William SH (2006). Effect of omega-3 fatty acids on resting heart rate, heart rate recovery after exercise, and heart rate variability in men with healed myocardial infections and depressed ejection fractions. Am. J. Cardiol., 97: 1127-1130.

Rosenfield JM (2002). Application of analytical derivatizations to the quantitative and qualitative determination of fatty acids. Anal. Chim. Acta, 465: 93-100.

Artemis P, Leslie G (2003). Omega–6/Omega–3 essential fatty acid ratio: The Scientific Evidence. The Center for Genetics, Nutrition and Health, Washington, D.C. USA.

Wood CB, Habib NA, Thompson A, Bradpiece H, Smadja C, Hershman M, Barker W, Apostolov K (1985). Increase of oleic acid in erythrocytes associated with malignancies. Br. Med. J., 291: 163.

Persad AR (1990). Erythrocyte stearic to oleic acid ratio in prostatic carcinoma. Br. J. Urol., 65: 268-270.

Christie WW (1990). Preparation of methyl esters- Part 1. Lipid Technol., 2: 48-49.

Wiley (2000). Registry of mass spectral data. 7th edn. Adams RP (1995). Identification of essential oils by ion trap mass spectroscopy; Press: San Diego, New York.

McLaffety FW (1989). Registry of mass spectral data 5th edn. John Wiley and Sons: New York.

Jennings W, Shibamoto T (1988). Qualitative analysis of flavor and fragrance volatiles by glass capillary Gas Chromatography; Academic Press: New York.