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Diurnal Variation of the Essential Oil of Four Medicinal Plants Species in Central Region of Iran

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Abstract: The yield of the essential oil from the leaves of Eucalypt (*Eucalyptus nicholii*), Rosemary (*Rosmarinus officinalis* L.), White Cedar (*Thuja occidentalis* L.) and Lawson Cypress (*Chamaecyparis lawsoniana*) shows seasonal and diurnal variation. In order to, aerial shoots of those plants harvested in three times (6, 12 and 18) and then dried in shade condition as natural method. The essential oils obtained by hydrodistillation way. This research carried out with 5 replications in random completely design and amount of essential oils measured in any species base on dry mater and data analysis performed with LSD test. Amount of essential oils in both of Lawson Cypress and White Cedar species at 7 h were high in compared with other treatments in 1% level and non significant difference between 12 and 18 times in Lawson Cypress. The results indicated that maximum of essential oil in Eucalypt and Rosemary obtained in 12 and 18 times, respectively that have significant differences with other times in 1% level. According these results we conclude that for obtaining of more yields of essential oil and other volatile compounds, harvesting of matter plants must be accomplished at special time in one day.

Key words: Diurnal variation, essential oil, medicinal plants, yield

INTRODUCTION

The Rosemary (*Rosmarinus officinalis* L.), Eucalypt (*Eucalyptus nicholii*), White Cedar (*Thuja occidentalis* L.) and Lawson Cypress (*Chamaecyparis lawsoniana*) genus are trees and shrubs, indigenous to the Mediterranean area (Khare, 2007) that also used as ornamental plant in landscape design in tropical and subtropical regions at Iran country. They produce a number of compounds with pharmacological properties (Khare, 2007; Coppen, 2002).

The essential oil content and its composition are one of the most important quality criteria for mentioned plant species in all purposes. Because of those powerful pharmaceutical properties, anti-inflammatory, astringent, antiseptic, stomachic, carminative, circulatory disorders (Rosemary), antiseptic, antibiotic, antiviral, antifungal, antispasmodic, decongestant, antiasthmatic, expectorant, antirheumatic, diaphoretic, bronchitis, migraine, congestive headache, neuralgia and ague, inhalant or internal medicine (Eucalypt), insecticides, anthelmintic, diuretic (White Cedar) and Tincture-vasoconstrictor, antiseptic, sedative, antispasmodic and diuretic used for cough, cold, bronchitis, varicose veins, piles, menopausal cramps, leg-cramps (Lawson Cypress) such as α-pinene, 1, 8-cineole, camphor, verbenone, borneol, linalool, citronellal, citronellol and limonene the main components, content of the essential oils are considered as a quality criterion (Khare, 2007).

Numerous studies have been conducted on these species (Moudachirou *et al*., 1999; Silvestre *et al*., 1997; Zrira *et al*., 2004; Gachkara *et al*., 2007), particularly on their volatile compounds (Zaouali *et al*., 2005; Flamini *et al*., 2002) that it's shown in Fig. 1.

Although, synthesis of volatile compound in medicinal plants control by genetic processes, but those productions obviously influenced by environmental factors so that environmental factors cause changes in growth of medicinal plant, quantity and quality of them volatile compound (Alkaloids, Glycosides, Steroids,

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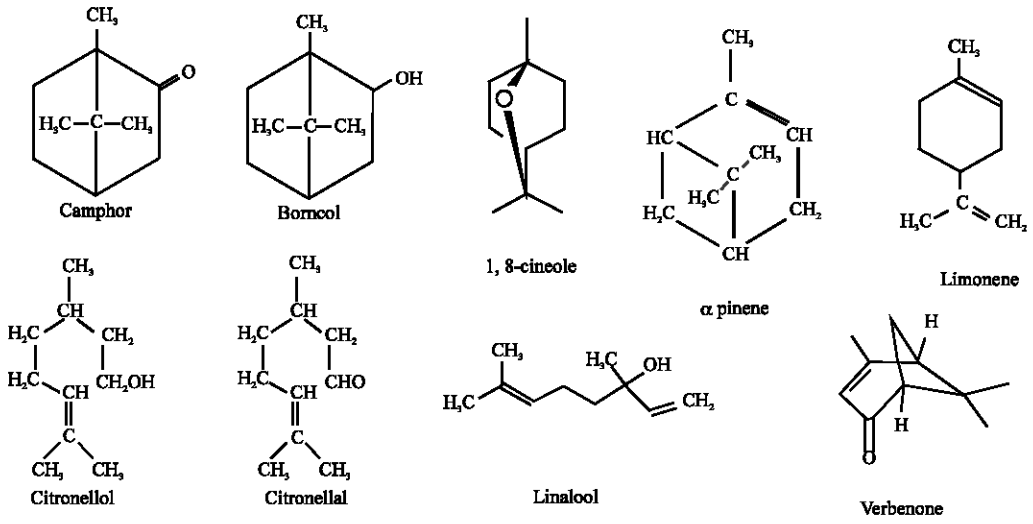

Fig. 1: Structures of the major compounds identified in the essential oil of plant species examined in this experiment

essential oils, Flavonoides, Phenols, Terpenoides, Tannins, Azotoides, Carbohydrates, Keton, Saponin, Biter matters, Mucilage, Salicilic acid, etc). The environmental factors as light (quality, intensity and duration), temperature, irrigation, elevation, soil and nutrition elements alone or in combination with to have main influence on secondary metabolite situation of plants. The temperature in day duration usually is variable from morning to night. The temperature has more effect on essential oil in medicinal plants.

There are no data concerning the diurnal variation of composition and yield of the essential oil in these species growing in Iran during specific hours of the day. Thus, this study reports the diurnal variation of the essential oil from shoots of a natural population of *Eucalyptus nicholii*, *Rosmarinus officinalis* L., *Thuja occidentalis* L. and *Chamaecyparis lawsoniana* collected at south of Tehran (Iran).

MATERIALS AND METHODS

Plant matter and extraction of essentials oils: Aerial parts of Eucalypt (leaves), Rosemary (shoots and flowers), Lawson cypress (leaves) and White cedar (leaves) plants harvested in the 2006 year at three times (6, 12 and 18 h) in one day in July from landscape plants of the Shahed University (35°32′N, 51°20′E, 1028 m), Tehran, Iran. Aerial parts of investigated plants were air dried at room temperature (<25°C) in shady place for 10-16 days dependent on plant species. The dried herb of all species was subjected to water distillation (hydro-distillation) for 3 h using an all glass Clevenger-type apparatus, to produce oil according to the method recommended by the European Pharmacopoeia.

The oil volume was measured directly in the extraction burette. Yield percentage was calculated as volume (mL) of essential oil per 1000 g of plant dry matter. The obtained oil were dried over anhydrous sodium sulphate and stored in sealed vial at low temperature.

Statistical analysis: The experiments were arranged as a completely randomized design with 5 replications of each treatment. The significance of differences ($p<0.05$, 0.01) between treatments was determined by tukey multiple range tests. All the statistical analysis was performed using SPSS/PC software version 13.

RESULTS AND DISCUSSION

Differences in the yield of the essential oils under the influence of the harvest time have been reported for several plants (Lopes *et al*., 1997; Duschatzky *et al*., 1999; Moudachirou *et al*., 1999; Schwob *et al*., 2004; Msaada *et al*., 2007; Argyropoulou *et al*., 2007; Hussain *et al*., 2008; Angelopoulou *et al*., 2002; Marcum and Hanson, 2006; Ebrahimi *et al*., 2008; Chericoni *et al*., 2004; Callan *et al*., 2007). Also, our results indicated that various hours of diurnal have much influence on amount of Rosemary, Eucalypt, Lawson cypress and White cedar essential oils.

In this study, the essential oil content of Rosemary, Eucalypt, Lawson cypress and White cedar varied from 31-42, 34-46, 20-24 and 19.3-24.5 mL kg^{-1} dry matter according to the time of day, respectively (Table 1).

In our study the maximum yield of Rosemary essential oils from leaves was obtained in 12 h treatment (42 mL kg^{-1} dry matter) so that was significant difference at 5% level in comparing with 6 and 18 h treatments

Table 1: The effect of harvest time in day duration on essential oil yield of Rosemary, Eucalypt, Lawson cypress and White cedar species in Iran

	Time			Average	
Genus	6	12	18	mL kg^{-1}	%
Rosmarinus officinalis L.	31b	42a	34b	35.66	3.56
Eucalyptus nicholii	34b	35b	46a	38.33	3.83
Chamaecyparis lowsoniana	24a	20.6b	20b	21.53	2.15
Thuja occidentalis L.	24.5a	20.6b	19.3b	21.46	2.14

Means followed by the same letter within each Row are not significantly different, as indicated by Tukey test

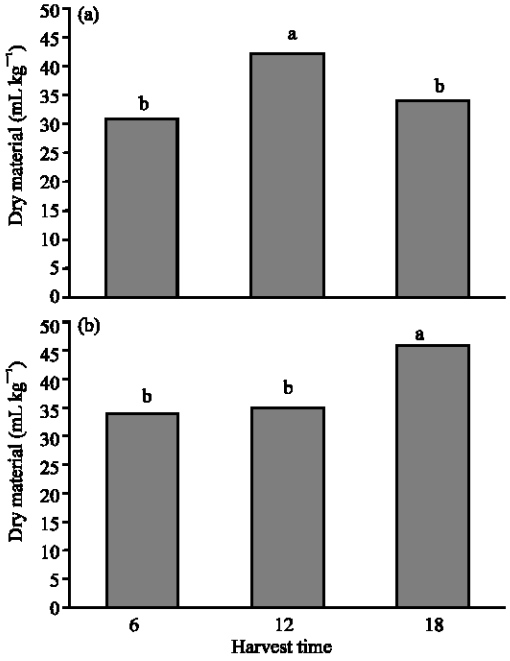

Fig. 2: The effect of harvest time in day duration (6, 12, 18) on essential oil yield of Rosemary (left) and Eucalypt (right) in Iran

(31 and 34 mL kg^{-1} dry matter, respectively). Also, there was no significant difference observed between 6 and 12 h treatment so that base on these results, optimum time for harvesting of Rosemary aerial parts is 12 h (Fig. 2).

Amount of essential oil obtained from leaves of Eucalypt at various times indicated that harvest at 18 h resulted in the greatest yield of essential oil (46 mL kg^{-1} dry matter). There were significant difference at 5% level with 6 and 12 treatments (34 and 35 mL kg^{-1} dry matter, respectively) that shown in Fig. 2.

Maximum quantity of essential oil in both of Lawson cypress and White cedar were obtained at 7 h treatment (24 and 24.5 mL kg^{-1} dry matter, respectively) and no significant differences were observed between 12 and 18 treatments. Thus, 7 h introduced as the best time for harvesting of Lawson cypress and White cedar for extraction of greatest part of essential oil (Fig. 3).

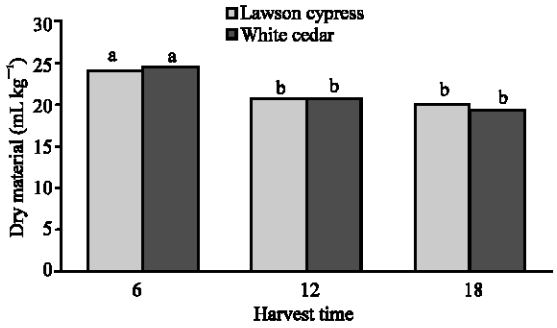

Fig. 3: The effect of harvest time in day duration (6, 12, 18) on essential oil yield of Lawson cypress and White cedar in Iran

CONCLUSON

Rosemary and Eucalypt are widely collected from nature and also cultivated especially in the southern regions of Iran. The harvest time of these species is very important for all kinds of usage.

It is known that genetic constitution and environmental conditions influence the yield and composition of volatile oil produced by medicinal plants. (Omidbaigi, 2007).

Volatile compounds in various plant species are different that this is resulted in variation yield of essential oils to environmental factors such as temperature and light, so that synthesis of these compound in various hours of diurnal will be vary.

As a conclusion of the present study, it could be stated that 12, 18, 7 and 7 harvests in Rosemary, Eucalypt, Lawson Cypress and White Cedar, respectively may result in higher values of essential oil content.

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REFERENCES

Angelopoulou, D., C. Demetzos and D. Perdetzoglou, 2002. Diurnal and seasonal variation of the essential oil labdanes and clerodanes from *Cistus monspeliensis* L. leaves. Biochem. Systemat. Ecol., 30 (3): 189-203. DOI: 10.1016/S0305-1978(01)00074-6.

Argyropoulou, C., D. Daferera, P.A. Tarantilis, C. Fasseas and M. Polissiou, 2007. Chemical composition of the essential oil from leaves of *Lippia citriodora* H.B.K. (*Verbenaceae*) at 2 developmental stages. Biochem. Systemat. Ecol., 35 (12): 831-837. DOI: 10.1016/j.bse.2007.07.001.

Callan, N.W., D.L. Johnson, M.P. Westcott and L.E. Welty, 2007. Herb and oil composition of dill (*Anethum graveolens* L.): Effects of crop maturity and plant density. Industrial Crops and Prod., 25 (3): 282-287. DOI: 10.1016/j.indcrop.2006.12.007.

Chericoni, S., G. Flamini, E. Campeol, P.L. Cioni and I. Morelli, 2004. GC-MS analyses of the essential oil from the aerial parts of *Artemisia verlotiorum*: variability during the year. Biochem. Systemat. Ecol., 32 (4): 423-429. DOI: 10.1016/j.bse.2003.10.002.

Coppen, J.J.W., 2002. Eucalyptus: The Genus *Eucalyptus*. Taylor and Francis Inc, USA.

Duschatzky, C., P. Bailac, A. Carrasull, N. Firpo and M. Ponzi, 1999. Essential oil of Lippia aff. Juneliana grown in San Luis, Argentina. Effect of harvesting period on the essential oil composition. J. Essential Oil Res., 11 (4): 104-106.

Ebrahimi, S.N., J. Hadian, M.H. Mirjalili, A. Sonboli and M. Yousefzadi, 2008. Essential oil composition and antibacterial activity of Thymus caramanicus at different phonological stages. Food Chem., 110 (2): 927-931. DOI: 10.1016/j.foodchem.2008.02.083.

European Pharmacopoeia, 2005. Council of Europe. 5th Edn. Strasbourg, 2: 2667-2668.

Flamini, G., P.L. Cioni, I. Morelli, M. Macchia and L. Ceccarini, 2002. Main agronomic-productive characteristics of 2 ecotypes of *Rosmarinus officinalis* L. and chemical composition of their essential oils. J. Agric. Food Chem., 50 (12): 3512-3517.

Gachkara, L., D. Yadegaria, M.B. Rezaeib, M. Taghizadehc, A.Sh. Alipoor and I. Rasooli, 2007. Chemical and biological characteristics of Cuminum cyminum and Rosmarinus officinalis essential oils. Food Chem., 102 (3): 898-904.

Hussain, A.I., F. Anwar, S.T.H. Sherazi and R. Przybylski, 2008. Chemical composition, antioxidant and antimicrobial activities of basil (*Ocimum basilicum*) essential oils depends on seasonal variations. Food Chem., 108 (3): 986-995.

Khare, C.P., 2007. Indian Medicinal Plants. Springer Science + Business Media, LLC.

Lopes, P.N., J.M. Kato, A.H.E. Andrade, S.G.J. Maia and M. Yoshida, 1997. Circadian and seasonal variation in the essential oil from *Virola surinamensis* leaves. Phytochemistry, 46 (4): 689-693.

Marcum, D.B. and B.R. Hanson, 2006. Effect of irrigation and harvest timing on peppermint oil yield in California. Agric. Water Manage., 82 (1): 118-128.

Moudachirou, M., J.D. Gbenou, J.C. Chalchat, J.L. Chabard and C. Lartigue, 1999. Chemical composition of essential oil of eucalyptus from Beunin: *Eucalyptus citriodora* and *E. camaldulensis*. Influence of location, harvest time, storage of plants and time of steam distillation. J. Essential Oil Res., 11 (2): 109-118.

Msaada, K., K. Hosni, M.B. Taarit, T. Chahed, M.E. Kchouk and B. Marzouk, 2007. Changes on essential oil composition of coriander (*Coriandrum sativum* L.) fruits during 3 stages of maturity. Food Chem., 102 (2): 1131-1134.

Omidbaigi, R., 2007. Production and processing of medicinal plants. Behnashr pub. Mashhad, Iran. 1: 346.

Schwob, I., J.M. Bessiere, V. Masotti and J. Viano, 2004. Changes in essential oil composition in Saint John's wort (*Hypericum perforatum* L.) aerial parts during its phenological cycle. Biochem. Systemat. Ecol., 32 (2): 735-745.

Silvestre, A.J.D., J.A.S. Cavleiro, B. Delmond, C. Filliatre and G. Bourgeois, 1997. Analysis of the variation of the essential oil composition of *Eucalyptus globulus* Labill. from Portugal using multivariate statistical analysis. Industrial Crops and Prod., 6 (1): 27-33.

Zaouali, Y., C. Messaoud, A. Ben Salah and M. Boussaid, 2005. Oil composition variability among populations in relationship with their ecological areas in Tunisian *Rosmarinus officinalis* L. Flavour fragrance. J., 20 (5): 512-520.

Zrira, S., J.M. Bessiere, C. Menut, A. Elamrani and B. Benjilali, 2004. Chemical composition of the essential oil of nine Eucalyptus species growing in Morocco. Flavour Fragrance J., 19 (2): 172-175.