ejpmr, 2018,5(4), 80-86

SJIF Impact Factor 4.897

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

STUDY OF THE VOLATILE OIL IN LAURUS NOBILIS L. WIDE SPREAD IN SYRIA

Mohammad Said Chmit*[1] and Mhd. Isam Hasan Agha[2]

[1]Department of Pharmacognosy and Medicinal Plants, Faculty of Pharmacy, Damascus University, Damascus, Syria.
[2]Department of Pharmacognosy and Medicinal Plants, Faculty of Pharmacy, Syrian Private University (SPU) Damascus-Countryside, Syria.

***Corresponding Author: Mohammad Said Chmit**

Department of Pharmacognosy and Medicinal Plants, Faculty of Pharmacy, Damascus University, Damascus, Syria.

Article Received on 02/02/2018 **Article Revised on 23/02/2018** **Article Accepted on 15/03/2018**

ABSTRACT

The volatile oil was extracted from samples taken from three regions of Syria with different heights, by distillation Method. Gas Chromatography was used in order to determine the analytical different of the chemical components of these oils, and then a comparative study was done between the analytic results of extracted essential oil of the Syrian *Laurus* and other studies. The analytic chemical study of the volatile oils of *Laurus* nobilis L. showed the richness with 1.8 Cineol, α-Pinene, β-Pinene, α-Humulene and Sabinen, which are consistent with the reference studies.

KEYWORDS: *Laurus* nobilis, GC, Volatile oil, 1.8 Cineol.

INTRODUCTION

Laurus nobilis L. is an aromatic, evergreen (Vardapetyan et al. 2013) and perennial (Zeković et al. 2009), shrub or small tree (Nurba et al. 2005), usually growing up to height of from 3 to 15 m high (9 to 50 feet) at a slow rate (Moghtader et al. 2013). It belongs to Lauraceae family, which comprises numerous aromatic and medicinal plants (Hogg et al. 1974). The genus *Laurus* is consists of two species *Laurus* azorica and *Laurus* nobilis (Basak et al. 2013). *Laurus* nobilis is a very important medicinal plant and there is a comprehensive monograph about this plant in many Herbal Pharmacopoeia (Ghannadi et al. 2002), and it has a long history of folk use in the treatment of many ailments (Moghtader et al. 2013). Laurus Leaves appear in January (Moghtader et al. 2013), alternate, they are 5–12 cm long and 1.8–5 cm wide, oblong, leathery, on both surfaces, lateral veins 10–12 pairs, margin slightly undulate, apex acute or acuminate, with a darkgreen color (Peter et al. 2010). The leaves do not fall during winter (Basak et al. 2013), they have a strong pungent odor because they contain essential oil up to 3%. The leaves can be used either dried or fresh but the flavour is stronger in dried and grinded leaves, but the leaves which are stored longer than one year, or in bade situation, they will lose their flavour (Bown, 2001). Laurus leaves essential oil is used in the flavourings industry (Bauer et al. 1985), as food preservative, in the preparation of hair lotion due to its antidandruff activity and for the external treatment of psoriasis, and also, it has antibacterial properties (Dadalioglu et al. 2004; Seyed et al. 1991). There are many studies on the chemical composition of the essential oil obtained from *Laurus* grown in Mediterranean and Europe, showed that the geographical, genetic and environmental factors, are the key factors on the *Laurus* volatiles specifications in the yield and composition (Amin et al. 2007; Marzouki et al. 2009; Verdian-rizi., 2008). However, remains 1-8 cineole the predominant compound (Zeković et al. 2009). Beside 1-8 cineole, *Laurus* essential oil contains many components such as sabinene, linalool, alpha-terpinyl acetate, alpha-pinene and terpinen-4-ol (Table1).

Table 1. Comparison between the chemical compositions of the components of volatile oil extracted from *Laurus* leaves that grow in some countries

Country Reference Materials	Tunisia	Algeria	Morocco	Turkey	Iran	France	Italy	Russia	Colombia	Croatia	Armenia	Georgia	Serbia
	Ben Jemâa et al. 2011	Ben Jemâa et al. 2011	Ben Jemâa et al. 2011	Kosar et al. 2005	Moghtader, 2013	Revelessence, 2013	Loizzo et al. 2007	Misharina et al. 2011	Quijano, 2007	Politeo et al. 2006	Vardapetyan et al. 2013	Vardapetyan et al. 2013	Politeo et al. 2007
α-Thujene	0.22	0.44	0.33	-----	0.38	0.62	0.44	-----	0.2	-----	19.18	12.23	-----
α-Pinene	2.52	4.58	4.31	4.7	5.25	5.66	5.72	5.8	2.9	1.9	7.44	6.41	2.1
Sabinene	0.41	0.25	0.42	8.1	8.7	8.67	6.17	9.5	1.5	1.2	-----	-----	5.7
Trans-sabinylacetate	-----	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----
β-Pinene	1.39	1.95	1.92	4.0	3.99	4.30	3.46	4.6	6.1	-----	6.90	5.55	-----
Camphene	7.21	8.91	-----	0.5	3.86	0.45	0.14	-----	0.1	-----	0.39	0.17	-----
Myrcene	0.30	0.87	0.80	0.6	1.86	1.01	0.45	-----	1.3	-----	0.74	0.32	-----
α-Phellandrene	-----	-----	-----	-----	0.73	0.39	0.12	-----	-----	-----	0.69	0.53	-----
α-Terpinene	0.11	0.28	0.32	0.3	2.12	0.63	0.68	-----	-----	0.3	-----	-----	0.3
ρ-Cymene	-----	-----	-----	-----	0.31	0.83	2.23	-----	-----	0.2	-----	-----	0.2
Limonene	-----	-----	-----	1.3	3.47	-----	1.10	-----	-----	0.9	3.21	1.17	0.9
β-Phallandrene	3.85	5.71	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.31	-----
1,8 Cineole	24.55	34.62	38.86	46.8	25.7	39.81	35.15	49.8	22.0	34.9	59.96	72.06	45.5
β-Ocimene	0.04	0.28	-----	-----	-----	0.21	0.08	-----	0.3	-----	1.35	0.92	0.2
γ-Terpinene	0.26	0.22	0.62	0.6	3.48	1.05	1.50	-----	0.6	0.8	0.14	0.10	0.7
Terpinolene	-----	0.15	0.20	0.2	0.22	0.31	0.49	-----	0.1	0.2	-----	-----	0.3
ρ-Cymenene	-----	-----	-----	0.6	-----	-----	-----	-----	-----	-----	-----	-----	-----
Linalool	17.67	12.57	9.45	2.1	1.65	6.00	7.08	4.4	16.4	13.5	-----	-----	8.5
Sabinol	-----	-----	-----	-----	2.45	-----	-----	-----	-----	-----	-----	-----	-----
Thujone	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
carveol	-----	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----
Carvone	-----	-----	-----	0.2	-----	-----	-----	-----	-----	-----	-----	-----	-----
Terpineol	1.29	0.90	5.83	4.6	3.79	2.63	2.42	2.3	4.9	0.3	-----	0.16	1.5
Borneol	-----	-----	-----	-----	2.37	0.16	-----	-----	-----	-----	-----	-----	-----
Terpinen-4-ol	-----	-----	-----	1.8	1.24	3.10	4.42	1.7	1.6	2.4	-----	-----	2.1
Camphor	2.66	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.1
Elemene	-----	-----	-----	-----	2.30	-----	-----	-----	-----	-----	-----	-----	-----
Elemicin	-----	-----	-----	-----	-----	0.08	-----	-----	0.9	-----	-----	-----	-----
Eugenol	2.18	-----	1.42	1.3	1.69	1.50	3.73	7.1	2.0	3.4	-----	-----	2.5
Methyl Eugenol	12.40	2.84	3.93	1.3	-----	5.71	2.52	-----	2.9	13.5	-----	-----	10.0
α-Ylangene	-----	-----	-----	-----	-----	-----	0.17	-----	-----	-----	-----	-----	-----
β-Bourbonnene	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

β-Elemene	0.08	0.31	0.16	-----	-----	0.16	-----	-----	0.3	-----	-----	-----	-----
β-Caryophyllene	0.27	0.74	0.05	-----	0.87	0.29	0.38	-----	9.0	2.1	-----	-----	-----
CaryophylleneOxide	-----	-----	-----	0.4	0.58	0.11	-----	-----	0.3	2.3	-----	-----	1.7
Elemene	-----	-----	-----	-----	-----	-----	0.10	-----	-----	-----	-----	-----	-----
α-Guaiene	0.10	0.8	-----	-----	-----	-----	0.22	-----	0.1	-----	-----	-----	-----
Selinene	-----	0.04	0.18	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----
α-Humulene	-----	-----	-----	-----	2.19	-----	-----	-----	-----	-----	-----	-----	0.2
Germacrene	-----	-----	0.1	-----	1.53	0.06	-----	-----	0.1	-----	-----	-----	-----
Bicyclo Germacrene	-----	-----	-----	-----	-----	-----	-----	-----	0.9	-----	-----	-----	-----
Cadinene	-----	-----	-----	-----	2.68	0.10	-----	-----	0.1	0.2	-----	-----	0.2
α-Cadinol	-----	-----	-----	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----
Bicyclogermacrene	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Linalyl acetate	0.69	0.41	-----	-----	-----	0.14	-----	-----	0.3	-----	-----	-----	-----
Bornyl acetate	-----	0.15	0.52	0.4	1.79	0.24	-----	-----	0.6	0.3	-----	-----	0.3
Cinnamyl acetate	-----	-----	0.06	-----	-----	0.04	-----	-----	2.2		-----	-----	-----
Terpinyl acetate	-----	-----	-----	7.9	0.24	11.79	4.43	9.6	11.1	12.2	-----	-----	9.1
Neryl acetate	-----	-----	0.13		-----	-----	-----	-----	0.2	0.3	-----	-----	-----
Spathulenol	-----	-----	-----	0.5	3.38	-----	0.31	-----	0.7	-----	-----	-----	-----
α-Bulnesene	-----	-----	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----
Viridiflorol	-----	-----	-----	0.1	-----	-----	-----	-----	0.2	-----	-----	-----	-----
Geranyl acetate	0.08	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----
α-Guaiene	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Cubebol	-----	-----	-----	-----	-----	0.06	-----	-----	-----	-----	-----	-----	-----
Elemol	-----	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----
Nerol	-----	-----	-----	-----	-----	0.22	-----	-----		-----	-----	-----	-----
Nerolidol	-----	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----
Δ^3-Carene	0.11	0.42	0.19	-----	-----	0.22	-----	-----	-----	0.4	-----	-----	0.4
α-Farnesene	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.6	-----	-----	0.6
β-Eudesmol	-----	-----	-----	-----		-----	-----	-----	0.6		-----	-----	-----

Laurus nobilis L. fruits are small and olive-like, fleshy, dark purple when mature, ovoid, thin, brittle, wrinkled pericarp, which when broken discloses the seed kernel, the seed-coats adhering to the inner surface of the pericarp. The fruits contain both fixed and volatile oils. The essential oil is existing up to 1% (Baytop, 2000), while *Laurus* fruits contain around 26% fixed oil (İlisulu, 1992), this oil is a green, granular, melting at 40°C, to a dark green aromatic fluid, and consisting of a semi-solid fat.

The need of the medicinal plants to use in treatment and food industries is increasing, due to increasing of population and to spread new types of diseases, also due to the resistance caused by pathogens such as bacteria which become stubborn against some types of antibiotics. The increasing demand for plants caused to wanton harvesting of plants, which led to decrease the enumeration of these plants and the spread of commercial cheat, and this led to a sharp decline in the population and natural spread, which led to the spread of fraud in the trade of these herbs, which called for the need to develop analytical methods to ensure the purity of these samples and free of fraud. The methods Chromatography techniques are the most important to determine the purity of the essential oil, which are extracted from *Laurus* leaves. Given the scarcity of the chemical studies on *Laurus* in Syria, which has not been reported to date. The aim of the current study was to determine the consistence the extracted *Laurus* volatile oils and to compare the results of these study with others.

MATERIALS AND METHODS

Plant samples

The samples of *Laurus* leaves were collected from three deferent areas in Syria, the first one sample was from the city Kesab, which is located at 800 m above the sea level with the Coordinates (35°55′30″N 35°59′19″E), the second one from the city Slinfah, which is located at 1130 m above the sea level with the Coordinates (35°36′1″N 36°10′43″E), and the last one from Mount Nabi Yunis area, which is located at 1562 m above the sea level with the Coordinates (35°38′29″N 36°13′0.9″E).

The Samples were air-dried at room temperature in the shade (final moisture content about 10.0%). Before using them, the dried samples were grinded. At the end of the milling process, the particle sizes were in the range of 0.8–0.9 mm.

Volatile oil extraction

The volatile oils of *Laurus* leaves were obtained by the process of hydro distillation in the Clevenger apparatus. (100g) of grounded *Laurus* dried leaves, were placed in a flask (2.5L) and hydro distilled for 2.5h. The oil samples were dried using anhydrous Sodium Sulfate and stored at 4°C in the darkness.

Volatile oil analysis

50 microns of the volatile oil sample was taken and extended to 250 microns by hexane, it mixed then 1 micron from it was injected in Gas chromatography (GC) for analysis. Gas chromatography (GC) analysis was carried out on a Shimadzu GC 2010 with FID detector and a DB23 capillary column (60 m×0.25 mm; film thickness 0.25 µm). The carrier gas was helium with a flow rate of 0.72 ml/min., the oven temperature for first 4 min. was kept at 60 °C and then increased at a rate of 4 °C/min. until reached to the temperature of 250 °C and keep on for 5 mints, injector and detector temperature were set at 250°C.

Standards of each comparative compound of volatile oil are also used to determine the amount of each component in the injected volatile oil in the GC under the same used parameters.

RESULTS AND DISCUSSION

Volatile oil extraction

As seen in the (Table 2), *Laurus nobilis*, which is grow in the Mount Nabi Yunis gives the high rate of leaves volatile oil, while *Laurus* which is grow in the city Kesab gave the double amount of volatile oil compared with *Laurus* which is grow in the city Slinfah:

Table 2: The Volatile Oil amount of *Laurus* nobilis leaves.

Region	Kesab	Slinfah	Mount Nabi Yunis
Coordinates	35°55′30″N 35°59′19″E	35°36′1″N 36°10′43″E	35°38′29″N 36°13′0.9″E
Height above sea level	880 m	1130 m	1562 m
V.O amount mL/100g	1.45	0.79	2.1

Volatile oil analysis

As seen in (Table 3), 18 different compounds were determined. Although there was no marked difference in the composition of leaves volatile oils:

Table 3: The essential oil composition of *Laurus* leaves.

Region		**Kesab**	**Slinfah**	**Mount Nabi Yunis**
Coordinates		**35°55′30″N 35°59′19″E**	**35°36′1″N 36°10′43″E**	**35°38′29″N 36°13′0.9″E**
Height above sea level		**800 m**	**1130 m**	**1562 m**
Compound	Structure	Concentration %		
α-Pinene		3.386	2.618	3.850
Camphene		0.091	0.054	0.274
β-pinene		3.179	2.656	3.246
Sabinen		8.897	7.089	3.560
Myrcene		0.419	0.380	-----
α-Phellandrene		0.069	0.083	0.076
Limonen		1.934	1.485	0.883
γ-terpinene		0.670	0.643	0.809
Trans β ocymene		0.713	0.632	----
1.8 Cineol		58.660	62.059	73.702
P-Cymene		0.610	0.902	2.236
Linalool		0.971	0.323	0.356
Terpinen-4-Ol		2.965	3.841	2.581
β-Caryophllen		0.657	0.493	1.177
α-Terpineol		3.499	2.868	1.118
α-humulene		10.906	10.097	3.369

CONCLUSION AND DISCUSSION

In this study, the essential oils of leaves of *Laurus* nobilis L. collected from three deferent areas in Syria, were obtained by hydro distillation and analyzed by gas chromatography with flame ionization detection (GC-FID) to determine their chemical composition and identification of their chemo types. The yield of essential oil extracted from the leaves varied from 0.79% (Slinfah) to 2.1% (Mount Nabi Yunis). These differences could be attributed to the geographical characteristics of the ecological zone of the samples, as the leaves of *Laurus* nobilis L., which is grew in the mountains, gave the highest rate of volatile oil than other areas. The comparison of the samples did not reveal any big difference in their qualitative composition, but the collection of the samples from different areas in Syria allowed observing the change of the volatile oil quantities. Eighteen components were identified, and the volatile compounds in the leaves of *Laurus* mainly consisted of 1.8 Cineole (58.66%-73.70%), followed by α-humulene (3.37%-10.91%), Sabinen (3.56%-8.89%), α-Pinene (2.62%-3.850%), and β-pinene (2.66%-3.25%). In the present study, the chemical composition of the essential oils is comparable to that of previous reports with some variation in the constituents (Table 1).

This could be due to different chemo types or may result of different environmental conditions. Previous studies reported that geographical origin, seasonal and maturity variation, genetic variation, vegetation stages, part of plant utilized and postharvest drying and storage may influence the essential oil composition (Marotti et al. 1994; Hussain et al. 2008; Anwar et al. 2009). Moreover, there are many reports showing the variation in chemical composition of the essential oil with respect to geographical regions (Uribe et al. 1992; Souto et al. 1997; Celiktas et al. 2006; Van Vuuren et al. 2007). Uribe et al. 1992 also reported that the essential oil composition varied significantly depending on the locations where the plants grew. Furthermore, climatic factors such as heat and drought were also related to the essential oil profiles (Milos et al. 2001). In addition to, Vokou et al. 1993 pointed out that altitude seems to be another important environmental factor influencing the essential oil content and chemical composition (Ben Jemâa et al. 2012). For example, 1.8 Cineol is increased from 58.660% (Kesab), to 62.059% (Slinfah), to 73.702% (Mont Nabi Yunis), this mean that the percentage of 1.8 Cineol is increasde as increased the height of the area, where the samples gatherd (also P-Cymene, γ-terpinene, β-Caryophllen and others).

But other volatile compounds such as Sabinen is decreased from 8.897% (Kesab), to 7.089% (Slinfah) to 3.560% (Mount Nabi Yunis), this result has the meaning that the percentage of Sabinen is decreased as increased the height of the area (also α-humulene and Limonen, Myrcene and others.). These results ensure the direct effect of the heights on some essential oil components. It can be related to humidity in winter and sunlight in summer. This study leads to the result that the sample of *Laurus* nobilis L. which is grow in the mountains (Mount Nabi Yunis) showed equilibrium in its essential oil, more than the samples of other regions.

REFERENCES

1. Amin G, Salehi Sourmaghi MH, Jaafari S. Hadjagaee R, Yazdinezhad A. Influence of phonological stages and methods of distillation on Iranian cultivated bay laurel volatile oil. Pakistan J Biol Sci., 2007; 10: 2895-2899.
2. Anwar, F., Ali, M., Hussain, A.I., Shahid, M., Antioxidant and antimicrobial activities of essential oils and extracts of fennel (Foeniculum vulgare Mill.) seeds from Pakistan. Flavour and Fragrance Journal, 2009; 24: 170e176.
3. Basak Serap Sahin and Ferda Candan, Effect of *Laurus* nobilis L. Essential Oil and its Main Components on α-glucosidase and Reactive Oxygen Species Scavenging Activity, Iranian Journal of Pharmaceutical Research, 2013; 12(2): 367-379.
4. Bauer, K. and D. Garbe: Common fragrance and flavor materials, preparation, properties and uses. VCH. Weinheim, Germany, 1985.
5. Baytop T. Theraphy with Medicinal Plants in Turkey (Past and Present), Nobel Tıp Press, İstanbul, 2000; 13-31.
6. Ben Jemâa Jouda M., Nisrine Tersim, and Mohamed Larbi Khouja, Composition and Repellent Efficacy of Essential Oil from *Laurus* nobilis against Adults of the Cigarette Beetle Lasioderma serricorne (Coleoptera: Anobiidae) Tunisian Journal of Plant Protection, 2011; 6(1).
7. Ben Jemâa Jouda M., Nesrine Tersim, Karima Taleb Toudert, Mohamed Larbi Khouja., Insecticidal activities of essential oils from leaves of *Laurus* nobilis L. from Tunisia, Algeria and Morocco, and comparative chemical composition., Journal of Stored Products Research, 2012; 48, 97e104.
8. Bown D., Encyclopaedia of Herbs and their Uses, 2001; 448.
9. Celiktas, O.Y., Kocabas, E.E.H., Bedir, E., Sukan, F.V., Ozek, T., Baser, K.H.C., Antimicrobial activities of methanol extracts and essential oils of Rosmarinus officinalis, depending on location and seasonal variations. Food Chemistry, 2006; 100: 553e559.
10. Dadalioglu I, Evrendilek GA. Chemical Compositions and antibacterial effects of essential oils of Turkish Oregano (Origanum minutiflorum), Bay (*Laurus* nobilis), Spanish Lavender (Lavandula stoechas L.), and Fennel (Foeniculum vulgare) on Common Food borne Pathogens. J Agric Food Chem., 2004; 52(26): 8255-8260.
11. Ghannadi A. Lauri Folium. In: "Iranian Herbal Pharmacopoeia". Tehran: Publications of Iranian Ministry of Health, 2002.
12. Hogg, J.W., S.J. Terhune and B.M. Lawrenc: Dehydro-1.8-cineole: A new monoterpene oxide in *Laurus* noblis oil. Phytochem, 1974; 13: 868-869.
13. Hussain, A.I., Anwar, F., Sherazi, S.T.H., Przybylski, R., Chemical composition antioxidant and antimicrobial activities of basil (Ocimum basilicum) essential oils depends on seasonal variations. Food Chemistry, 2008; 108, 986e995.
14. İlisulu K "İlaç Ev Baharat Bitkileri", Ankara University, 1992.
15. Kosar. Muberra, Zeynep Tunalier, Temel Özek, Mine Kürkcüoglu, and K. Hüsnü Can Baser., A Simple Method to Obtain Essential Oils from Salvia triloba L. and *Laurus* nobilis L. by Using Microwave-assisted Hydrodistillation., Z. Naturforsch, 2005; 60c: 501D504.
16. Loizzo. Monica Rosa, Rosa tundis, Federica menichini, Antoine Mikael Saab, Giancarlo Antonio statti and Francesco Menichini., Cytotoxic Activity of Essential Oils from Labiatae and Lauraceae Families Against In Vitro Human Tumor Models., Anticancer Research, 2007; 27: 3293-3300.
17. Marotti, M., Piccaglia, R., Giovanelli, E., Effects of variety and ontogenic stage on the essential oil composition and biological activity of fennel (Foeniculum vulgare Mill.). Journal of Essential Oil Research, 1994; 6: 57e62.
18. Marzouki H, Elaissi A, Khaldi A, Bouzid S, Falconieri D, Marongiu B, Piras A, Porcedda S. Seasonal and geographical variation of *Laurus* nobilis L. essential oil from Tunisia. Open Nat Prod J., 2009; 2: 86-91.
19. Milos, M., Radonic, A., Bezic, N., Dunkic, V., Localities and seasonal variations in the chemical composition of essential oils of Satureja montana L. And S. cuneifolia Ten. Flavour and Fragrance Journal, 2001; 16: 157e160.
20. Misharina Tamara, Margarita Terenina and Natalia Krikunova., Inhibition of 2-hexenal autooxidation by essential oils from clove bud, Laurel, cardamom, nutmeg and mace., Chemistry & Chemical Technology, 2011; 5: 2.
21. Moghtader. M and A. Farahmand. Evaluation of the antibacterial effects of essential oil from the leaves of *Laurus* nobilis L. in Kerman Province. Journal of Microbiology and Antimicrobials, February 2013; 5(2): 13-17.
22. Available online http://www.academicjournals.org/JMA DOI:10.5897/JMA2012.0233 ISSN 2141-2308 ©2013 Academic Journals.
23. Nurba Macid. [Nourbakhsh], Yeliz Bal. Recovery of fixed and volatile oils from *Laurus* nobilis L. Fruit and Leaves by solvent extraction method. Eski. ehir Osmangazi Universitesi Müh. Mim. Fak. Dergisi C. XVIII, S.2, 2005, Eng. & Arch. Fac. Eski. ehir Osmangazi University, 2005; XVIII: 2.
24. Peter H. Raven, yue gui., Flora of China, *Laurus* nobilis, ISBN 7030043391, 9787030043399., 2010.
25. Politeo Olivera, Mila Jukic, and Mladen Milos., Chemical Composition and Antioxidant Activity of Free Volatile Aglycones from Laurel (*Laurus* nobilis L.) Compared to Its Essential Oil., Croatica Chemica ACTA CCACAA, 2007; 80(1): 121-126.

ISSN-0011-1643
26. Politeo. Olivera, Mila Jukic, and Mladen Milos., Chemical Composition and Antioxidant Activity of Essential Oils of Twelve Spice Plants., Croatica Chemica ACTA CCACAA, 2006; 79(4): 545-552. ISSN-0011-1643 CCA-3123
27. Quijano Clara Elizabeth, Jorge A. Pino., Characterization of the leaf essential oil from laurel (*Laurus* nobilis L.) grown in Colombia Revista CENIC. Ciencias Químicas, 2007; 38(3): 371374.
28. Centro Nacional de Investigaciones Científicas Cuba, Seyed M., Riaz M., and Chaudhary F. M., The antibacterial activity of the essential oil of the Pakistani Acotus calmus, Callistemon lanceolatus and *Laurus* nobilis. Pak. J. Sci. Ind. Res., 1991; 34: 456-458.
29. Souto-Bachiller, F.A., De-Jesus-Echevarria, M., Cardenas-Gonzalez, O.E., AcunaRodriguez, M.F., Melendez, P.A., Romero-Ramsey, L., Terpenoid composition of Lippia dulcis. Phytochemistry, 1997; 44: 1077e1086.
30. Uribe-Hernandez, C.J., Hurtado-Ramos, J.B., Olmedo-Arcega, E.R., Martinez- Sosa, M.A., The essential oil of Lippia graveolens H.B.K. from Jalisco, Mexico. Journal of Essential Oil Research, 1992; 4: 647e649.
31. Van Vuuren, S.F., Viljoen, A.M., Ozek, T., Demirici, B., Baser, K.H.C., Seasonal and geographical variation of Heteropyxis natalensis essential oil and the effect thereof on the antimicrobial activity. South African Journal of Botany, 2007; 73: 441e448.
32. Vardapetyan. H, Tiratsuyan. S, Hovhannisyan. A, Rukhkyan. M, Hovhannisyan. D., Phytochemical Composition and Biological Activity of *Laurus* nobilis L. Leaves Collected from Two Regions of South Caucasus. Journal of Experimental Biology and Agricultural Sciences, May-2013; 1(2).
33. Vardapetyan. H, Tiratsuyan. S, Hovhannisyan. A, Rukhkyan. M, Hovhannisyan. D., Phytochemical Composition and Biological Activity of *Laurus* nobilis L. Leaves Collected from two Regions of South Caucasus. Journal of Experimental Biology and Agricultural Sciences, May–2013; 1(2).
34. Verdian-rizi Mohammadreza and Abbas Hadjiakhoondi. Essential Oil Composition of *Laurus* nobilis L. of Different Growth Stages Growing in Iran. Z. Naturforsch, 2008; 63c: 785-788. received April-2008, 19/June 16.
35. Vokou, D., Kokkini, S., Bessiere, J.M., Geographic variation of Greek oregano (Origanum vulgare ssp. hirtum) essential oils. Biochemical Systematic and Ecology, 1993; 21: 287e295.
36. Zeković. Zoran P, Žika D. Lepojević1, Ibrahim O. Mujić. Laurel Extracts Obtained by Steam Distillation, Supercritical Fluid and Solvent Extraction. Journal of Natural Products, 2009; 2104-109.