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Evaluation of Volatile Oil and Its Chemical Constituents of Some Basil Varieties in Egypt

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Abstract

A pot experiment was carried out during two successive seasons to evaluate four basil varieties (*Ocimum basilicum* var. odoratus, *Ocimum basilicum* var. alba, *Ocimum basilicum* var. thyrsiflorum and *Ocimum basilicum* var. purpurascens) and their behavior in Egypt. Essential oil content and its composition of four basil varieties were studied.There were significant differences between the varieties under study in the volatile oil content. *Ocimum basilicum* var. thyrsiflorum was more produced essential oil content in the two cuts of both seasons. With behave of *Ocimum basilicum* var. alba and *Ocimum basilicum* var. purpurascens reciprocal behavior in both seasons. Whereas, *Ocimum basilicum* var. odoratus was less produced essential oil content in the two cuts of both seasons. The major constituents of four basil varieties essential oil were eugenol (38.36 to 57.79%) and linalool (27.30 to 39.74%). Als, it was found that both eugenol and linalool have a reverse behavior. When increasing eugenol concentration decreasing linalool compound and vice versa. *Ocimum basilicum* var. alba gave the highest and lowest percentages of eugenol and linalool, respectively followed by *Ocimum basilicum* var. purpurascens and *Ocimum basilicum* var. thyrsiflorum then *Ocimum basilicum* var. odoratus. The four basil varieties were eugenol and linalool chemotype.

Keywords

Basil, Variety, Essential Oil, Eugenol, Linalool, Chemotype

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1. Introduction

Nowadays, medicinal and aromatic plants occupy a prominent economic position because of the continuous and increasing demand for their products. Basil is one of the most important plants in this concern. The oil is extensively employed in several countries for flavoring of food stuffs, confectionery goods, and condiments and in toiletry products. It also finds a prominent place in the flavoring of foods, and in perfumes industry. Various uses are attributed to different parts of the plant in indigenous system of medicine and homoeopathy. It is also recognized as a febrifuge and ant malarial plant. A high degree of polymorphism in the genus *Ocimum* determines a large number of subspecies, different varieties and forms producing essential oils with varying chemical composition offering variable level of medicinal potential (Pandey et al., 2014).Essential oils extracted from *Ocimum* plants have been reported to possess interesting biological properties. These volatile oils have been applied in perfumery, to inhibit growth of microorganisms, in food preservation and in aromatherapy. The potential uses of *O. basilicum*, *O. Canum, O. gratissimum* and O. *sanctum* essential oils, particularly as antioxidant and antimicrobial agents have also been explored (Bozin et al., 2006; Matasyoh et al., 2007; Politeo et al., 2007; Hussain et al., 2008]. Recently, Mondal et al. reviewed the antimicrobial, adaptogenic, antidiabetic, hepato-protective, anti-inflammatory,

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anti-carcinogenic, radioprotective, immunomodulatory, neuro-protective, cardio-protectiveand mosquito repellent properties of *O. sanctum* (Mondal et al., 2009).

Basil is represented by the plant *Ocimum basilicum* L. belonging to the family Lamiaceae. *Ocimum basilicum* L. is the most important species being utilized as a source of essential oil. In view of the great diversity, the various species and varieties have been classified, in accordance with their chemical composition and geographical sources, into four major types as follows: European or sweet basil; Reunion basil; methyl cinnamate basil; and eugenol basil; it is distilled in Russia and some North African countries, including Egypt and Morocco, it is an oil richin eugenol (Husain et al., 1988).Basil essential oil could be classified into four chemotypes: linalool and methylchavicol type;methylchavicol type; methyl cinnamate type andeugenol type (Vernin, 1984). Hegnauer (1966) reported that, these were four distinct chemo types of *Ocimum basilicum*e; methylchavicol / linalool type; camphor type; methylcinnamate type and eugenol type. In India, Sobti and Pushpangadan (1982) reported that, in addition to methylchavical and linalool containing oils, they found the following (1) geraniol (40-50%) and eugenol(20-30%), (2) eugenol (20-40%), (3) camphor (10-15%), (4) methyl cinnamate (60-65%), (5) geranol (20-35%), linalool (30-35%) and eugenol (20-30%).

According to the chemical composition and geographical origin, Lawrence (1988 and 1989)and Lawrence et al.(1980) observed that the chemical composition and morphological characters of *Ocimum basilicum* varieties very variable and established four essential oil chemo-types, i.e. methylchavicol; linalool; methyleugenol and methylcinnamate and also numerous subtypes. According to the biosynthetic origins of major compounds, He classified them as chemo-types with single or double biosynthetic pathways. The system of chemo-type classification used was the one proposed by Grayer et al.(1996)which is based on the combination of major chemical components rather than the sole dominant compound, defining a major component as one with content close to 20%.In Egypt, Omer et al. (2008) found that , chemotypes of basil species/ varieties summarized as shown: linalool >geraniol (*O. basilicum* var. siam queen); linoloal> nerol>methylchavicol> geraniol>citral (*O. tenuiflorum*); methylchavical> linalool > eugenol>methyleugenal (*O. basilicum* var. genoveser); methylchavical> linalool (*O. basilicum* var redrubin); linalool >methylchavicol (*O.basilicum* var. purple ruffles); linalool>methylchavicol>eugenol (*O.basilicum*); linalool > methylchavicol >nerol >citral (*O.americanum*).

This work aimed to evaluate essential oil content of different varieties of basil and to determine the chemo-type of these varieties cultivated in Egypt.

2. Materials and Methods

The present work was carried out under the naturalconditions of the greenhouse of the National Research Centre, Dokki, Giza, Egypt, during the two successive seasons of 1995 and 1996.Four varieties of *Ocimum basilicum* L. viz., *Ocimum basilicum* var. odoratus, *Ocimum basilicum* var.alba, *Ocimum basilicum* var. thyrsiflorum and *Ocimum basilicum* var. purpurascens were introduced from Suadi Arabia. These four varieties were identified botanically by Herbarium Royal Botanic Gardens, Kew, Richmond, Surry TW9 3EA, England. For cultivation, earthenware pots were used, and then each pot was filled with 7 kg of air dried soil. The seeds of basil varieties were sown in the nursery on March 6th throughout the two successive seasons of 1995and 1996. One and a half month after seed sowing, uniform seedlings were transplanted into pots. Each pot contained five plants.

Essential oil percentage of the fresh herb of each replicate at the first and second cuts after 60 and 120 days from transplanting, respectively, was determined according to the method described in the British Pharmacopoeia(2002) by using Clevenger apparatus and expressed as (ml100 g^{-1} fresh herb). The resulted essential oil of each treatment was collected and dehydrated over anhydroussodium sulphate and kept in refrigerator until GC analyses. The GC analysis of the oil samples was carried out in the second season using G cv Pye-Unicam gas chromatograph equipped with dual flame ionisation detectors at the CentralLaboratory of the Faculty of Agriculture, Cairo University. The chromatograph was fitted a coiled glass column (1.5 m x4 mm) packed with diatomite C (100-120 mesh) and coatedwith (10%) PEGA. The oven temperature was programmed at 4°C min-1, from 70 to 190°C, and was held at 190°C for 15min. Detector and injector temperatures were 250 and300°C, respectively. Gas flow rates for N2, H2 and air were30, 33 and 330 ml min-1, respectively. Main compounds ofthe essential oil were identified by matching their retention times with those of the authentic samples that were injected under the same conditions. The relative percentage of each compound was calculated from the peak area corresponding to each compound. Except for the constituents of the essential oils, the data of this experiment were statistically analyzed using LSD at the 5% level.

3. Results and Discussion

Data in Table 1 indicate that the oil % of *Ocimum basilicum* var. purpurascens was higher than in the other varieties, whereas *Ocimum basilicum* var. alba was lower in this respect in the two cuts during the twoseasons. In the meantime, oil percentage of *Ocimum basilicum* var.

purpurascens was significantly increased compared to that of *Ocimum basilicum* var.alba at the two cuts in both years. In addition, therewere significant differences between *Ocimum basilicum*var. alba and *Ocimum basilicum* var. odoratusor*Ocimum basilicum* var. thyrsiflorum in this regard inthe first cut during the two seasons. Generally, oil percentage values recorded for basil varieties were as follows: *Ocimum basilicum* var. purpurascens (0.2041-0.1966), *Ocimum basilicum* var. odoratus (0.1999-0.1812), *Ocimum basilicum* var. Thyrsiflorum (0.1728-0.1770) and *Ocimum basilicum* var. alba (0.1583-0.1666) in the second cut during the two seasons, respectively.

Table 2 show the data belonging to qualitative and quantitative constituents of essential oils distilled from the four basil varieties before flowering stage at both cuts during the season of 1996. According to analysis of essential oils, in both cuttings all identified compounds were detected in the oil of all varieties but at different percentages. The known compounds were grouped into three items ie major compounds (more than 10%), minor compounds (less than 10% and more than1%) and trace ones (less than 1%). In this respect, it is evident that linalool and eugenol exhibited as majors, 1, 8-cineol, methylchavicol, methyl eugenol and farnesol were representedas minors, and α- pinene, β-pinene, myrcene, ocimene, linalyl acetate and geraniol were considered as traces.

The results in Table 2 show that *Ocimum basilicum* var. purpurascens and *Ocimum basilicum* var. alba gave the highest content of eugenol, methyl eugenol and linalyl acetate, and that *Ocimum basilicum* var. purpurascens and *Ocimum basilicum* var. odoratus gave the same result of 1,8-cineol, α-pinene, β-pineneand ocimene in the first andsecond cuts, respectively. However, *Ocimum basilicum* var. thyrsiflorum followed by *Ocimum basilicum* var. Odoratus gave the highest content of linalool, methylchavicol andgeraniol. Also, *Ocimum basilicum* var. odoratus and *Ocimum basilicum* var. alba gave the same result of farnesol and myrcene. These results were recorded in the two cuts. According to major compounds, it was obviously clear that linalool was decreased and eugenol was increased at thesecond cut, comparing to that of the first cut ie *Ocimum basilicum* var. odoratus, *Ocimum basilicum* var. alba and *Ocimum basilicum* var. thyrsiflorum, whereas, linalool in *Ocimum basilicum* var. purpurascens was increased and eugenol was decreased. With regard to the minors, it was evident that methylchavicol and farnesol were increased in *Ocimum basilicum* var. alba, where as both compounds were decreased in *Ocimum basilicum* var. odoratus, *Ocimum basilicum* var. thyrsiflorum and *Ocimum basilicum* var. purpurascens at the second cut compared to that of the first cut. On the other hand, a - pinene and 1,8-cineol behaved at the same trend-both compounds were increased in *Ocimum basilicum* var. thyrsiflorum and *Ocimum basilicum* var. purpurascens, whereas, they were increased in *Ocimum basilicum* var. odoratus and *Ocimum basilicum* var. alba at the second cut comparing to that of the first cut. Also, methyl eugenol and ocimene were increased in *Ocimum basilicum* var. odoratus and *Ocimum basilicum* var. thyrsiflorum and decreased in *Ocimum basilicum* var. albaand *Ocimum basilicum* var. purpurascens at the second cut comparing to that of the first cut.

Basil essential oil could be classified into four chemotypes: linalool and methylchavicol type; methylchavicol type; methyl cinnamate type and eugenol type (Vernin et al., 1984). Hegnuaer (1966) reported that these were fourdistinct chemotypes of *Ocimum basilicum;* methylchavicol/ linalool; camphor; methyl cinnamate and eugenol types.Sobti and Pushpangadan (1982) reported that, in addition tomethylchavical and linalool containing oils, they found the following: (1) geraniol (40-50%) and eugenol (20-30%), (2)eugenol (20-40%), (3) camphor (10-15%), (4) methylcinnamate (60-65%), (5) geraniol (20-35%), linalool(30-35%) and eugenol (20-30%). According to the chemical composition and geographical origin, Lawrence (1988, 1989) and Lawrence et al. (1980) observed that the chemical composition and morphological characters of *Ocimum basilicum*varieties very variable and established four essential oilchemotypesie methylchavicol; linalool; methyl eugenol and methylcinnamate and also numerous subtypes. According tothe biosynthetic origins of major compounds, he classified them as chemo-types with single or double biosynthetic pathways.

Table 1. Effect of varieties on oil content (%) of basil at the two cuts during the two seasons

Variety	First season (1995)		Second season (1996)	
	1st cut	2nd cut	1st cut	2nd cut
Ocimum basilicum var. odoratus	0.2000	0.1833	0.2080	0.1333
Ocimum basilicum var. alba	0.1830	0.1583	0.1750	0.1583
Ocimum basilicum var. thyrsiflorum	0.2333	0.1750	0.2160	0.1500
Ocimum basilicum var. purpurascens	0.2000	0.1583	0.2000	0.1916
LSD at 5%.	0.0213	0.0204	0.0210	0.0158

Table 2. Effect of basil varieties on the constituents (%) of volatile oil at the two cuts in thesecond season

Compound	*O.basilicum* var. odoratus		*O.basilicum* var. alba		*O.basilicum* var. thyrsiflorum		*O.basilicum* var. purpurascens	
	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
α-pinene	0.34	0.31	0.15	0.12	0.12	0.29	0.15	0.36
β-pinene	0.43	0.24	0.23	0.33	0.13	0.20	0.30	0.55
Myrcene	0.38	0.48	0.05	0.37	0.27	0.34	0.12	0.16
1,8-cineol	5.43	4.99	4.14	2.46	0.27	4.23	4.72	7.33
Ocimene	0.12	0.16	0.13	0.09	0.06	0.12	0.27	0.11
Linalool	36.87	36.41	32.41	27.30	39.74	38.52	29.97	33.30
Linalyl acetate	-	0.25	0.31	-	0.25	0.49	0.11	0.51
Methylchavicol	8.73	6.94	1.10	1.47	12.39	1.91	1.31	1.06
Geraniol	0.25	0.19	0.08	0.21	0.31	-	-	0.15
Methyl eugenol	2.89	4.58	7.77	6.61	3.56	5.67	7.30	5.85
Eugenol	38.87	42.86	51.69	57.79	38.36	46.49	52.47	48.16
Farnesol	2.62	1.48	1.60	1.66	1.81	1.17	1.95	0.87

4. Conclusions

Ocimum basilicum var. purpurascens, followed by *Ocimum basilicum* var. thyrsiflorum, recorded higher values of oil production compared to those of the other ones of *Ocimum basilicum* var. alba then *Ocimum basilicum* var. odoratus.

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