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Quality and Safety

Gas-chromatography and organoleptic analysis of the essential oil of *Agastache foeniculum* (Pursh.) Kuntze

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Abstract. Through distillation in a Clevenger apparatus, IRAP has obtained essential oils of *Agastache foeniculum* leaves and blossoms. The gas-chromatography and organoleptic analysis have identified three types of oil: anethole, sweet menthol, and menthol. The anethole oil has the least number of components and contains around 90% of methylhavicol, its aroma being typically anethole with some additional spicy notes. The other two types of oils have similar structures of the main components, with emerging menthofuran, pulegon, and increasing limonene. The main differences of the sweet menthol and the menthol are in the ratio of their components. With the menthol the smell is sharper and fresh, with green, grassy notes, whereas with the sweet menthol it is warmer, and flavoured with additional notes.

Keywords: *Agastache foeniculum*, essential oil, analysis

Introduction

Agastache foeniculum is a perennial shrub-like plant of the Lamiaceae family, whose origins are in North America and Canada. It is cultivated for the production of essential oil, for flavouring, decorating and as a honey-bearing plant. The leaves are used for flavouring food, tea and low-alcohol drinks (Denys et al., 1991, Wilson et al., 1992). The Eastern medicine uses it widely in cases of stomachache, colds, fever, headaches, vomiting (Theson, 1987). The oil is used in cosmetics as an antibacterial agent, as well as in anti-dandruff preparations (Chang, 2006; Partl et al., 2002). It combines well with the menthol oil and can be used in toothpaste compositions instead of the anise oil (Toleva and Dimitrov, 1976). *Agastache* is a valuable aromatic and medicinal plant and a viable essential oil raw material. Polak and Hixon (1945) analysed the essential oil of *Agastache foeniculum* and discovered methylhavicol, limonene and pinen. Later (1980) Zamureenko (cited by Denys et al., 1991) reported the main components to be methylhavicol and eugenol. Nykanen et al. (1989) analysed the oil of Canadian specimens and identified 39 components, among which 74.6% methylhavicol, 8.5% limonene, 5.5% beta-caryophyllene and 3.3% germacrene. The other 35 ingredients were under 1% (Nykanen et al., 1989).

The studies of Mallavarapu et al. (2004) on the composition of the essential oil (based on gas-chromatography and mass spectrum analyses) of *Agastache foeniculum* growing in India established the presence of methylhavicol – 91.7%, and limonene - 3.6%. Omidbaigi and Sefidkon (2003) studied *Agastache foeniculum*, cultivated in Iran and found a yield of 1.8% essential oil drW; the research also identified 46 components, with methylhavicol being the main one - 87.5%, limonene - 2.4%, cineol - 2.0% and globulol - 1.4%. The quantity and composition of the essential oil vary depending on the time of sowing. Omidbaigi and Sefidkon (2004) determined that the best time for sowing *Agastache foeniculum* in the conditions in Iran is

the period before March 20th when the yield and the methylhavicol content (92%) are at their highest. After that period the agricultural indices of this plant fall abruptly due to the dry hot climate. For an optimum yield and high quality oil from *Agastache foeniculum* in Iran, Kaboudani and Omidbaigi (2008) recommend nitrogen fertilizing at the rate of 150 kg/ha.

Agastache foeniculum demonstrates a strong anti-oxidant activity. Nikolova and Dzhurmanski (2009) reports on activity towards DPPH radical IC₅₀, which is 57.8; the following flavonoids were isolated: apigenin, campherol, and their esters (Nikolova, 2009).

The short survey made here shows that *Agastache foeniculum* is a commercially viable essential oil raw material. Its introduction in Bulgaria began in the 1980s and specimens with enhanced agricultural indices were selected. *Agastache foeniculum* can successfully be grown as a two- or three-year plant in the soil and climate conditions of the Kazanlak Rose Valley. The accumulated essential oil in different parts of the plant shows that the build-up is the most intensive in the leaves, between 0.52-0.84% for the fresh raw material, and 0.23-0.56% for the racemes. The optimum picking time is the end of the blossoming period, and it should be noted that only the top well-leaved parts of the plant should be harvested. The fresh herb yield varies between 390 and 815g per plant, i.e. twice, and the average values for the studied population are 510 g (Dzhurmanski et al., 2010).

So far no gas-chromatography or organoleptic analysis have been carried out on specimens introduced in the Kazanlak region, which is a traditional source of essential oil crops.

Material and methods

The *Agastache foeniculum* used in the study was cultivated in the experimental field of IREMK Kazanlak. Stems and blossoms

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were used in the distillation. The essential oil was obtained by a two-hour hydrodistillation in a modified Clevenger apparatus (Georgiev and Stoyanova, 1997).

The identification of the main ingredients of the essential oil is done by means of a gas chromatograph PYE UNICAM in the following working conditions: a capillary column Econo-Cap™ EC TM-1, 30 m long, inside diameter 0.32 mm. Temperature programming: from 60° to 220° with an increment of 6°C per minute. Injector temperature: 250°, and detector temperature: 250°, carrier gas – hydrogen, injected volume of 0.1 µl, and carrier gas speed – 1.3 ml/min. The accuracy of findings when determining the peaks is checked by means of standardized comparative materials for the Merck company (BDS-7609, 11024-1, 11.024-2). All variants were done in 5 replications and the data is processed statistically. The organoleptic analysis was performed as sampling of oils by dipping the smell tape (Toleva and Dimitrov, 1976). The studied indices were presented according to a profile method (Gacula and Gacula, 1997).

Results

The gas-chromatography and organoleptic evaluation have

identified 3 types of oil - anethole, sweet menthol, and menthol. The findings are given in Table 1. The anethole essential oil from leaves and racemes has the least number of ingredients and contains the most methylhavicol: 86.9% and 90.2%, respectively, followed by the limonene - 5.6% and 3.1%, which determines its aroma, typically anethole, with some spicy notes. The other two types of essential oils have similar structures of the main components, with a presence of menthofuran and pulegon. With the oil from leaves, menthofuran is dominating and the ratio menthofuran:methylhavicol in the menthol oil is 5:1, and in the sweet menthol oils - 1.6:1. The amount of pulegon is bigger in the leaves than in the blossoms, in the menthol oils it increases six-fold – from 1.4% to 8.5%, and in the sweet menthol – threefold – from 2% to 6.2%. Both types of limonene demonstrate a considerable increase of limonene, from 2 to 4 times, compared with the anethole type; with the menthol type it reaches 19.3%. The differences pointed out here are felt as nuances in the main menthol smell of the oils. With the menthol type the scent is sharper, fresh, with green, grassy notes, while in the sweet menthol one it is warmer, modified with some additional spicy notes.

The results of aroma evaluation of oils from leaves and racemes are given on Figures 1 and 2. We can observe that there are no considerable differences with the anethole type; the aroma is anethole, fresh, with grassy hues. In the case of menthol types,

Table 1. AR model series describing the normalized spectral characteristics of healthy and diseased kernels

№	Variants	komponents	ethanol	3-octanon	limonen	linalool	pulegon	menthofuran	methylhavicol	anehtol	thimol	methylvegenol	kariphilen	total
		number	%	%	%	%	%	%	%	%	%	%	%	%
1	Leaves sweet menthol	48	0.0	2.10	10.8	0.1	6.20	39.5	25.4	0.1	0.1	0.8	0.9	92.1
2	Leaves menthol	44	0.0	2.30	17.4	0.2	8.50	52.1	9.5	0.0	0.4	0.2	1.4	92.0
3	Leaves anethol	38	0.0	0.40	5.6	0.6	0.00	0.0	86.9	0.0	0.0	1.0	1.5	96.1
4	Cluster sweet menthol	55	0.0	1.00	8.2	0.1	2.20	14.5	62.9	0.7	0.2	0.0	1.1	91.5
5	Cluster menthol	46	0.1	1.00	19.3	0.1	1.40	10.2	58.0	0.1	0.2	0.1	1.1	91.4
6	Cluster anethol	32	0.0	0.30	3.1	0.3	0.00	0.0	90.2	0.0	0.0	0.9	0.4	95.2

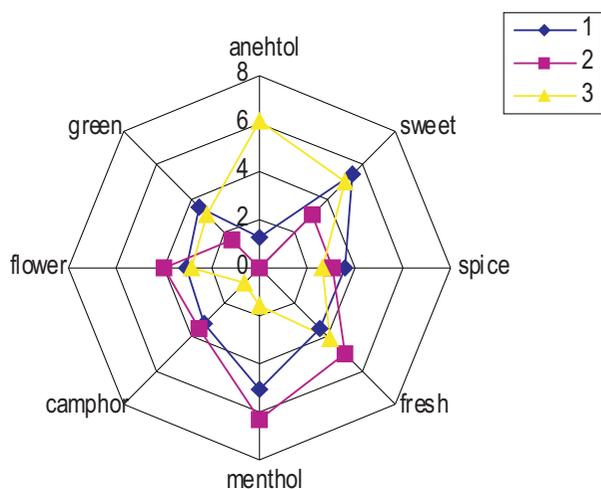


Figure 1. Smell profile leaves

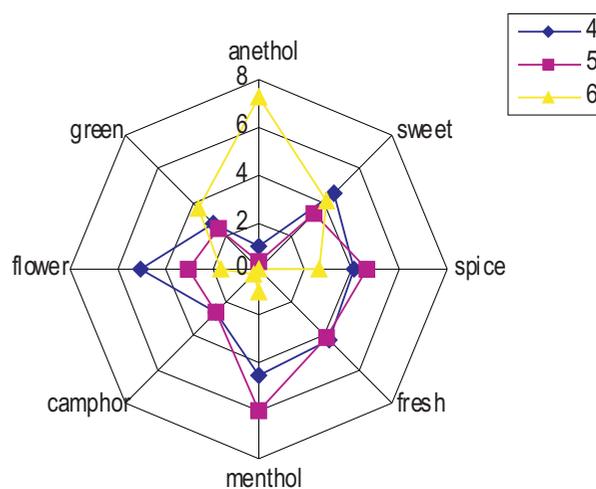


Figure 2. Smell profile cluster.

menthofuran and methylhavicol have opposite values in leaves and in racemes, which results in considerable differences in their aroma. The essential oil from leaves has a menthol, fresh aroma, with a camphor grassy hue, whereas with the oil from racemes the menthol aroma decreases, and additional anethole hues emerge. With the sweet menthol types the aroma of the leaves essential oil is menthol and spicy, while with the raceme type it is milder, with sweet cinnamon hues.

In the oil produced from dried racemes the methylhavicol decreased by 24%; the minor ingredient methyleugenol increased 4 times – the aroma of the essential oil remains menthol, fresh, but duller, and it loses the velvet gentle note of the fresh raceme oil. After the running-to-seeds phase in the blossoms there is a considerable quantity of essential oil, but the change in its aroma is undesirable because of the emerging odour of glues, synthetic chemistry and rubber.

Conclusion

The specimens of *Agastache foeniculum* introduced into Kazanlak field give 3 types of essential oils: with a different number of components, composition, and aroma. The anethol type contains the least components with methylhavicol as a main content. The aroma is typical anethole, with spice hues. The menthol and sweet menthol essential oils contain new components menthofuran and pulegon, limonene is increased, the smell is substantially different from anethol in the result. With the menthol the smell is sharper and fresh, with green, grassy notes, whereas with the sweet menthol it is warmer, and flavoured with additional notes.

References

- BDS 11024.** – 1 Essential oils. General guidelines for chromatographic profiles. Chromatographic profiles preparation for their presentation in standards, (Bg).
- BDS 11024.** – 2 Essential oils. General guidelines for chromatographic profiles. Application of chromatographic profiles of essential oil samples, (Bg).
- BDS 7609.** Essential oils. Gas chromatography analysis with capillary columns. General method, (Bg).
- Chang W Y,** 2006. The evaluation of anti-Pityrosporum ovale and anti-inflammatory activity of essential oil. Graduate of Cosmetics Science.
- Denys J, Simon J and Widrechner M,** 1991. Characterization of essential oil of *Agastache* species, *Journal of Agricultural and Food Chemistry*, 1946-1949.
- Dzhurmanski A, Zhekova G and Nikolova M,** 2010. Features of the growth and development of *Agastache foeniculum* Kuntze in the conditions of Kazanlak field, Scientific conference Science and society, Kardzhali, (Bg).
- Gacula E and Gacula M,** 1997. Descriptive sensory analysis in practice. Associates Scottsdale ISBN 0-91 7678-37-0, Arizona 700.
- Georgiev E and Stoyanova A,** 1997. Guidelines for laboratory practice on the essential oil technology in synthetic aromatic substances, University of food technology, Plovdiv, 53-58, (Bg).
- Kabaudani M and Omidbaigi R,** 2008. Effect of different levels of N-fertilizer on the growth, development, essential oil content and composition of *Agastache foeniculum*. Abstracts of the World congress on medicinal and aromatic plants, Capetown, November, 2008.
- Mallavarapu G, Kulkarni R, Baskaran K and Ramesh S,** 2004. The essential oil composition of anise hyssop grown in India. *Flavour and Fragrance Journal*, 19, 4, 351-353.
- Nikolova M and Dzhurmanski A,** 2009. Evaluation of free radical scavenging capacity of extracts from cultivated plants, (Bg).
- Nykanen I, Holm Y and Hiltunen R,** 1989. Composition of the Essential oil of *Agastache foeniculum*. *Planta Medica*, 55, 314-315.
- Omidbaigi R and Sefidkon F,** 2003. Essential oil composition of *Agastache foeniculum* cultivated in Iran. *Journal of Essential Oil Research*, 15, 1, 52-53.
- Omidbaigi R and Sefidkon F,** 2004. Effect of sowing time on the essential oil content and composition of *Agastache foeniculum*. *Journal of Essential Oil-bearing Plants*, 7(2), 190-194.
- Partl A, Blažević N, Stilinović B and Brkić D,** 2002. *Agastache foeniculum* (Pursh) O. Ktze. Essential oil composition and its antibacterial activity. 33rd International Symposium on Essential Oils, Lisabon, Portugal, 4-07.09. 2002.
- Shlyapnikov V, Shlyapnikova A, Radchenko N, Fedorovich A, Zemtsova G, Serkova A and Arinstein A,** 1975. New natural products for the perfumery and cosmetic, and pharmaceutical industry and sources for their development. Second national conference, Problems of the cosmetics and perfumery production, Varna 21-23.05.1975, 412-416, (Bg).
- Theson C,** 1987. Medicinal plants, M. Medicine, 78-80.
- Toleva P and Dimitrov D,** 1976. Perfumery manual. University of food technology, Plovdiv, 8-10, (Bg).
- Wilson L, Senechal N and Widrechner M,** 1992. Headspace analysis of the volatile oil of *Agastache*. *Journal of Agricultural and Food Chemistry*, 1362-1366.

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Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows, IXth International Conference on Production Diseases in Farm Animals, Sept.11 – 14, Berlin, Germany, p. 302 (Abstr.).

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