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## Production Systems

# Quantitative changes in major components of lavender oil during the distillation process

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**Abstract.** In 2009 in IREMK lavender variety *Seuthopolis* was distilled under laboratory conditions and the variation of the basic oil components was traced during distillation. Gas chromatography analysis was performed of the individual oils and organoleptic assesment was made with the aim to use the oil in cosmetics and perfumery. It was established that linalylacetate increased for 15 minutes, then began to decline, hydrocarbons and 3-okatanon distilled in great quantity in the first 5 min and gradually reduced within one hour, terpineol-4 evenly distilled during the process as differences in the content of various fractions are not more than 10%. In relation to flavour the most suitable oils are separated within 30 min of the process.

**Keywords:** variety *Seuthopolis*, lavender oil, distillation, quality.

## Introduction

Essential oil production is typical for the Bulgarian agriculture sector which is constantly expanding. Recently lavender and production of lavender oil has aroused particular interest. Lavender oil is widely used in perfumery and cosmetics (Battaglia, 2005; Bown, 2002). In perfumery it is mainly used for top notes that create first impression to consumers. (Fortineau, 2004). Lavender oil is known in aromatherapy with its ability to improve mood and reduce anxiety and trouble (Lehrner et al., 2005). It is obtained by steam distillation of lavender blossom (in our country *L. Vera*, while in other countries *L. spica*, *L. delphinensis*, *L. fragrans*, etc.). The oil is transparent to pale yellow liquid with characteristic odor like lavender blossom. It mainly contains linalool and linalylacetate and in less quantity terpineol, myrcene, cineol, otcimen and others (Georgiev and Stoianova, 2006; Georgiev, 1995; Brief Chemical Encyclopedia, 1971).

Survey of the dynamics of lavender oil components during the distillation process has been carried out with lavender variety *Seuthopolis*. The variety was recognized by SVC in 1987. With regard to the development and flowering, *Seuthopolis* refers to the group of middle flowering varieties (Boiadzhieva et al., 1988). According to its creators, it is characterized by a rich content of essential oil, 2.5%, and high yield of essential oil - 133 kg/ha. The oil from that variety has very good quality: ester content - linalylacetate 56.92-58.97%, low terpinene-4-ol content 3.36% and good flavour (Raev et al., 1987).

Opinions about changing of the main components of lavender oil during the distillation process differ. About linalylacetate some authors noted that it was increased at the end of the process, while others point out initial increase for up to 15 minutes. For some varieties it is indicated that during the process of distillation the amount of hydrocarbon linalylacetate, linalool and  $\beta$ -otcimene reduces. It is noted that the undesirable components for the smell of lavender oil such as borneol and terpineol-4 increase (Balnova et al., 1988; Stoianova et al., 2009).

In this study the main attention was focused to the variety *Seuthopolis* which occupies a large area of lavender plantations in Bulgaria but up to now comprehensive investigation of qualitative and quantitative changes of composition of the oil during the distillation process has not been performed.

## Material and methods

The studies were conducted in an Accredited test laboratory in IREMK. For the purpose lavender clusters of the variety *Seuthopolis* were harvested from the land of IREMK - Kazanlak in the morning at about 9-10 a.m. The samples were taken every few days throughout the flowering period starting before flowering. The extent of flowering is determined as BDS 3666-75 using lavender clusters of 20%, 60% and 80% degree of flowering. The quality indices of the oils are determined by organoleptic, physico-chemical and gas chromatography analysis by BDS / ISO 3515:2002.

Essential oil is obtained by steam distilled in a copper tank within one hour at an average speed of distillation 10% and temperature of distillate 25-30 °C. To separate fractions of distillation it is interrupted at 5 min, 15 min, 30 min. and 1 hour. With this method lavender oils are obtained, 0-5 min 5-15 min, 30 min and 15 30 - 60 min.

The experiment was performed in three repetitions and statistically processed by statistical analysis program Biostat.

## Results

The information about the yields of essential oils depending on the continuation of distillation at various stages of flowering is given in Table 1. The best extraction of essential oil from the variety *Seuthopolis* was observed in 60% degree of maturity, as is retained higher than 80%. Although the data are from interrupted distillation, they also confirm the investigation of the quantity of essential oil and

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the degree of flowering. Under interruption of distillation it is found that the greatest amount oil is distilled during the first 5 minutes - about 40%, and gradually decreases until the end of the process. Between 5 and 15 minutes 30% go out, in 15-30 min distilling interval - about 18% and to the end rest 12% of oil. Viewed in another way, it appears that in the first 15 minutes 70 percent of the oil is distilled, but up to half an hour - about 88%. Therefore, at the beginning the process has to be conducted with extreme care in order to avoid any loss of exhaled steam of the still.

The changes in the quantities of individual components during the distillation process are followed by gas chromatography analysis of individual oils and are listed in Table 2. Hydrocarbons and 3-octanone distilled in large quantity in the first 5 min and gradually decreased within 1 hour. 1.8 cineole released within the first 5 min. and then up to 15 min. reduced to half its amount and remained such until the end of distillation. Linalylacetate distilled increasingly up to 15 minutes, and started to decrease up to 30 minutes by 6% and up to 1 hour by 12% more. Linalool and camphor also distilled decreasingly to the end of the process, linalool reduced by 40% and camphor by 60%. In the essential oil after 30-minute and one-hour

distillation linalylacetate is 50 to 70% more than linalool. Lavender oil distilled with a constant quantity up to 30 min and then decreased to the end by about 10%. Lavandulyacetate,  $\alpha$ -terpineol and  $\beta$ -cariofilene at the beginning of distillation are in small quantities, which increase to the end of the process. Terpineol-4 distilled evenly throughout the process as the differences in its content in the separate fractions are not more than 10%.

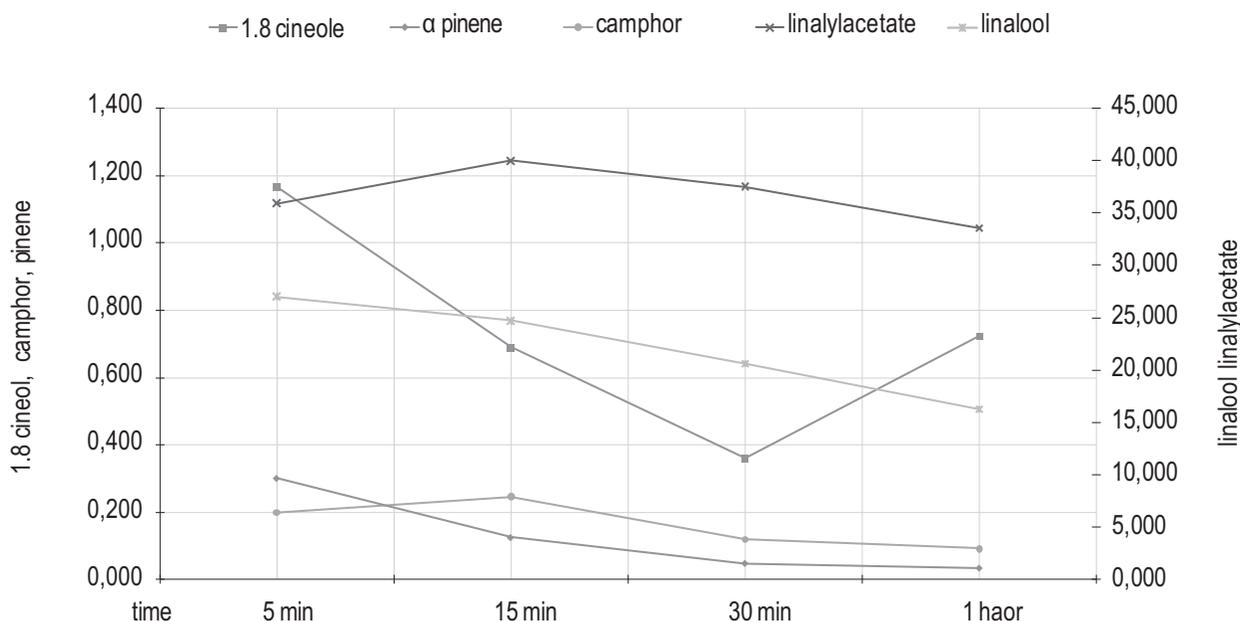
Changes of the amount of observed main compounds during distillation (Figure 1) were connected with the variations in the scent of the obtained essential oil. The 5 min oil is characterized with the highest content of hydrocarbons, 1.8 cineol and camphor and has a rich, fresh and flowery smell. From 5 to 15 min., although linalylacetate has increased, there is a sour, unpleasant partial flavor. Within 15-30 min. the scent is fresh, it looks like lavender with a slight touch of wood, as the quantity of linalylacetate reduced and its ratio to linalool is 1.8. Within 30 min. - 1 hour the scent lost the typical odor of lavender, rather it likes as if the moss and bark and it is defined as unpleasant, the amount of linalylacetate is the least and the ratio than linalool is above 2.

**Table 1.** Yield of essential oil in %.

Degree of flowering	Yield of essential oil in %				Total
	up to 5 min	5 – 15 min	15 –30 min	30 – 60 min	
20 %	1.08	0.66	0.26	0.175	2.175
60 %	0.97	0.95	0.5	0.29	2.71
80 %	1.06	0.805	0.43	0.26	2.555

**Table 2.** Quantity composition of lavender oil in 5 min, 15 min, 30 min and 60 min.

	20% degree of blossaming				60% degree of blossaming				80% degree of blossaming			
	5 m	15	30	60	5	15	30	60	5	15	30	60
$\alpha$ - pinene	0.374	0.270	0.202	0.202	0.401	0.161	0.093	0.087	0.302	0.126	0.049	0.035
camphene	0.421	0.313	0.250	0.227	0.413	0.167	0.107	0.097	0.340	0.129	0.056	0.047
3 octanone	2.635	1.950	1.602	0.927	3.932	2.358	1.038	0.461	6.123	2.83	1.371	0.641
mircen	1.356	1.191	1.195	1.302	1.150	0.603	0.743	1.006	1.036	0.662	0.354	0.938
1.8 cineol	4.903	4.214	3.759	3.188	2.682	1.067	1.455	1.559	1.165	0.690	0.360	0.724
cis $\beta$ ocimene	3.633	2.535	1.444	2.088	2.829	*	1.153	1.33	*	*	*	1.267
trans $\beta$ ocimene	3.330	2.270	1.190	2.221	3.322	*	1.516	1.984	*	*	*	2.015
linalool	28.763	25.085	25.823	21.43	27.00	24.705	20.628	16.262	26.685	23.271	18.728	16.052
camphor	0.136	0.38	0.101	0.143	0.199	0.246	0.120	0.093	0.210	0.177	0.120	0.057
lavandilool	0.433	0.451	0.545	0.419	0.402	0.465	0.325	0.227	0.352	0.340	0.339	0.185
terpineol - 4	0.759	0.623	0.580	0.267	0.364	0.350	0.283	0.296	0.374	0.343	0.454	0.326
$\alpha$ terpineol	0.621	0.753	1.110	1.383	0.630	1.137	0.672	1.399	1.057	1.142	1.242	1.314
linalylacetate	31.601	31.324	30.368	30.543	35.898	39.969	37.502	33.555	37.455	39.975	39.753	35.719
lavandulyacetate	3.680	4.080	4.603	5.464	3.879	4.955	5.452	6.117	3.709	4.769	5.425	5.865
$\beta$ cariofilen	4.432	7.234	7.478	9.513	4.017	3.372	9.072	11.103	0.884	3.120	1.476	10.896



**Figure 1.** The quantity changed at same components of lavender oil at the time of distillation

## Conclusion

During the distillation process the greatest amount of oil is released within the first 15 minutes. The quantity of linalylacetate increased up to 30 min. The oils separated up to 5 min. and between 15 and 30 min. have the best smelled performance and might be find private used.

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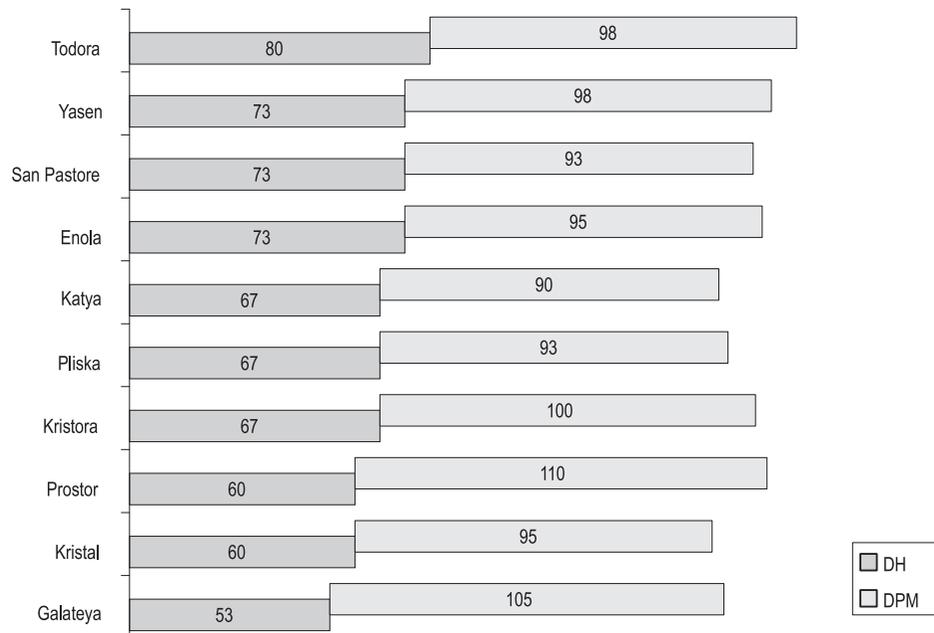
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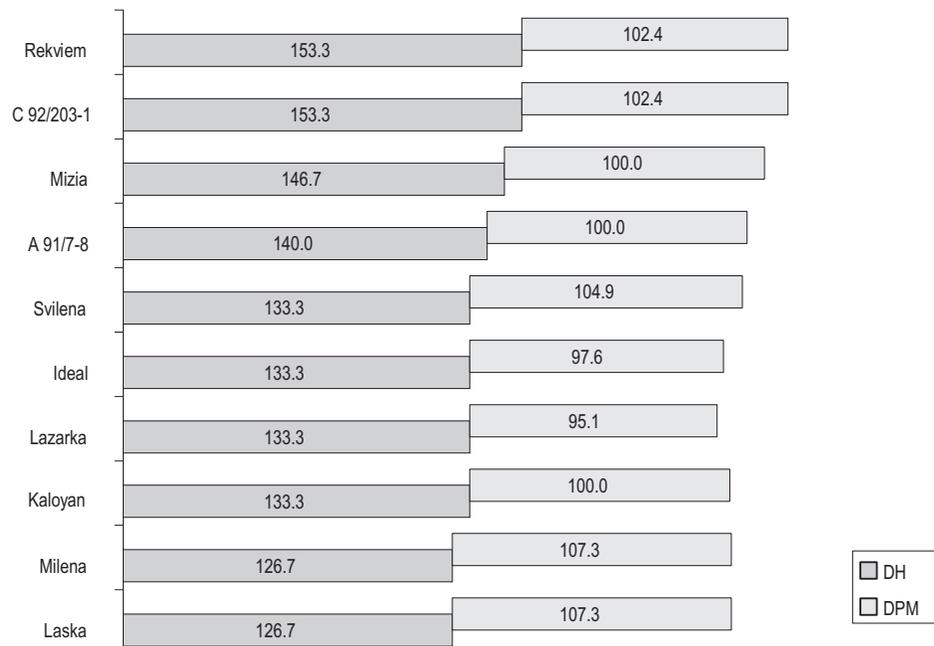
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On:  
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Figure 4 is:



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**Figure 4.** Duration of the period to heading and maturity in the group of late varieties expressed as relative value from the standard

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