Salvia species as potential essential oil sources in Hungary

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Abstract

In the course of the evaluation of the species belonging to the Section *Salvia* of the genus *Salvia* (Family Lamiaceae) the essential oil content and the composition of the species have been investigated with special respect to their neurotoxic α-, and β-thujone content. It could be established that from among the species *S. lavandulifolia* Vahl., *S. candelabru* Boiss., *S. tomentosa* Mill., *(S. grandiflora* Etlinger), *S. fruticosa* Mill., *S. ringens* Sibth. & Sm. only *S. tomentosa* had both beneficially high essential oil content and low or no thujone content. As it can be cultivated in the temperate climatic belt, in Hungary, *S. tomentosa* may be an alternative essential oil producing plant beside the *S. officinalis* L.

Introduction

Lamiaceae family is one of the richest plant families in medicinal and aromatic plants of the Hungarian flora. The vast majority of Lamiaceae species prefers warmer climate than that exists in Hungary. It also holds true of the great majority of the genus *Salvia*. Despite this fact, the Mediterranean official sage (*S. officinalis* L.) can be cultivated well in Hungary among others for its exploitable high essential oil content. From among the approximately more than one thousand species of the *Salvia* genus only a few meet Hegnauer's definition on high essential oil containing species (namely the species bearing more than 0.5 % essential oil). (HEGNAUER 1966). *S. officinalis* fulfils Hegnauer's definition and can be cultivated successfully in Hungary. *S. officinalis* has several virtues. It is traditionally regarded as a panacea. Official sage has antispasmodic, antioxidant, (food preservative) effects. It is used to treat gastrointestinal disturbances, excessive perspiration, proposed for inflammation of the mucous membranes of the mouth and throat, etc. The drug is broadly used in perfume industry, oral hygiene. (BRUNETON 1999)

The essential oil fraction obtained from *S. officinalis* by steam distillation contains a significant proportion of the biologically active ingredients of the plant. Among the essential oil components, however, some ingredients, predominantly α- and β-thujones (up to 60% of the oil) are of harmful effect to health, because of their neurotoxic properties (BRUNETON 1999). So, especially for oral usage thujone free or at least in thujone poor oils or oil containing plants, plant products would be preferable in many cases. Our purpose was to find a plant, having similar beneficial properties than the official sage has, but without high thujone content in its essential oil fraction. To achieve this end the following possibilities were given: 1). to evaluate other *Salvia* species including those native to Hungary, 2) to try to select thujone free plants from the official sage populations of various origin, 3) to screen the closely related species of *S. officinalis* for high essential oil content with low or no thujone content. In all cases the possibilities of domestication of the strange plants should be investigated, if we want to cultivate and exploit the plants in Hungary.

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As far as the *Salvia* species, out of the members of the section *Salvia,* concerned including the species native to Hungary, a lot of studies have been performed by our research group. The *Salvia* species, native to Hungary are more different from the official sage in their properties including the relatively low essential oil content, so that they can not replace *S. officinalis* (MÁTHÉ et al. 1992, 1993). Consequently, we have to concentrate to the species of *Salvia* section. *S. officinalis* has been cultivated and used, without any problems, e.g. in the gardens as ornamental plant for a long time in Hungary. The other members of the *Salvia* section, however, had not been investigated and used in Hungary before.

Materials and Methods

The plants that can not be found in the Hungarian flora were grown from seeds in our experimental field at Vácrátót. The species of Section *Salvia* we have are as follows: beside *S. officinalis* L., *S. lavandulifolia* Vahl., *S. candelabrum* Boiss., *S. tomentosa* Mill., (*S. grandiflora* Etlinger), *S. fruticosa* Mill., *S. ringens* Sibth & Sm. Their seeds were obtained via the seed exchange program of botanical gardens. These plant stands have been serving our researches for several years and from time to time they were renewed by re-sowing. The plants were sampled for various purposes. The variation of oil content was measured in different times, e.g. during the vegetation period, in successive years, plants of different origin were compared with each others. The essential oil was obtained by steam distillation according to as the procedure is described in the actual Hungarian Pharmacopaea. (PH.HG. VIII. 2004). The content of essential oil was calculated in ml / 1oo g (dry or fresh weight). The oil composition was determined by GC, GC/MS measurements. Details of our methods and procedures had been published earlier (DOBOS et al. 1997, MÁTHÉ et al. 1997).

Discussion

Firstly the essential oils of the official sage (*S. officinalis*) samples were analysed. In the most cases more than 30 components were separated and the majority of them could be identified by GC and GC MS methods. From among the several studies **Table 1**. illustrates how the ratios of some of the main components can vary, if samples of various origin were analysed. On the bases of this table and also that of other investigations it has become clear that α- and β-thujone occur in all samples in smaller or larger proportions. We have not found *S. officinalis* essential oil, free of thujones. Our data are in harmony with the results of other researchers (BRUNETON 1999, DOBOS et al. 1997, LAWRENCE 1992, MÁTHÉ et al. 1992, MÁTHÉ et al. 1993, NÉMETH et al. 2007).

	In Spring		In Autumn	
	Intervals	Means (X)	Intervals	Means (X)
1,8-cineol	3,8 – 10,1	6,8	3,6 – 12,1	7,6
α-tujone	15,8 – 38,7	27,3	21,4 – 47,0	34,2
β-tujone	1,3 – 6,1	3,6	1,9 – 17,2	9,4
Camphor	1,7 – 7,3	4,5	11,2 – 23,5	16,8
β-cariophyllene	2,7 – 14,7	8,6	1,8 – 6,7	4,2
α-humulene	4,6 – 14,1	9,3	2,2 – 6,5	4,3
guajol	6,7 – 19,9	13,3	3,5 – 6,4	5,0

***Table 1**. The variation of some main essential oil ingredients of **Salvia officinalis** samples (n=9). Remarks: Proportion of components in the percentage of the total oil fraction obtained by steam distillation*

Table 2. demonstrates the variation of the content of essential oil of *S. officinalis*. Table 2. shows that the highest content of oil is in the generative phase of the plants, when the yield (1-1.5 %) fits that of the requirements of Ph.Hg. VIII. As it can be estimated the oil composition varies even in the vegetation period. On the bases of our experiments too *S. officinalis* can be cultivated well in Hungary it may provide high essential oil content but in all case with thujones in it.

	Leaf	Generative Organs
April	0,88	
May	0,62	
June	0,81	
July	1,04	1,59
August	1,31	0,70
September	1,03	0,63
October	0,85	
November	0,83	

Table 2*. Variation of the essential oil content (ml/100 g dry wt.) of* ***Salvia officinalis*** *during the vegetation period* (MÁTHÉ at al. 1993)

As we have already pointed out, these species were introduced in successive years from seeds. They are perennial so the plants could be investigated several times in the past. (MÁTHÉ et al. 1993, 1997, MÁTHÉ és CSEDŐ 2007)1. **Table 3.** informs us about the average essential oil content of 7 *Salvia* species. It is obvious that *S. lavandulifolia* has the highest oil content. (Of course the cultivation and the conditions of harvest, processes of the species were similar, making the comparison possible!) *S. lavandulifolia* had no thujone content as it can be seen (**Figure 1**), as it could have been expected on the bases of scientific literature (BRUNETON 1999). This perennial plant fulfils our expectations (high oil content and without thujone) but in winter period at severe cold the plants died out. This West Mediterranean plant can not accept the continental climatic conditions predominantly the severe winters. As far as the other species concerned the oil content was more or less similar to that of *S. officinalis* with the exception of *S. ringens*. This plant contains essential oil only in traces. If the other species concerned out of *S. lavandulifola,* all of them had thujone content. This holds true of *S. triloba* (*S. fruticosa*) which ought to have had cineole content as main ingredient of the oil (Bruneton 1999) but, instead of cineole, thujone and camphore were found as the chief ingredients of the essential oil. *S. tomentosa* samples however had low, in many cases, only in traces, thujone content. This plant keeps well in the winter period and has relatively high oil content like in its native Bulgarian habitats (GENOVA et al. 1998) and, what is more, it seems to provide as much phytomass as *S. officinalis*.

S. lavandulifolia Vahl.	0,89
S. officinalis L.	0,25
S. tomentosa Mill.	0,39
S. candelabrum Boiss.	0,25
S. fruticosa Mill.	0,46
S. ringens Sibth.	traces

Table 3. *Essential oil content of some species of the section Salvia (ml / 100 g fresh wt.)* (MÁTHÉ et al. 2007)

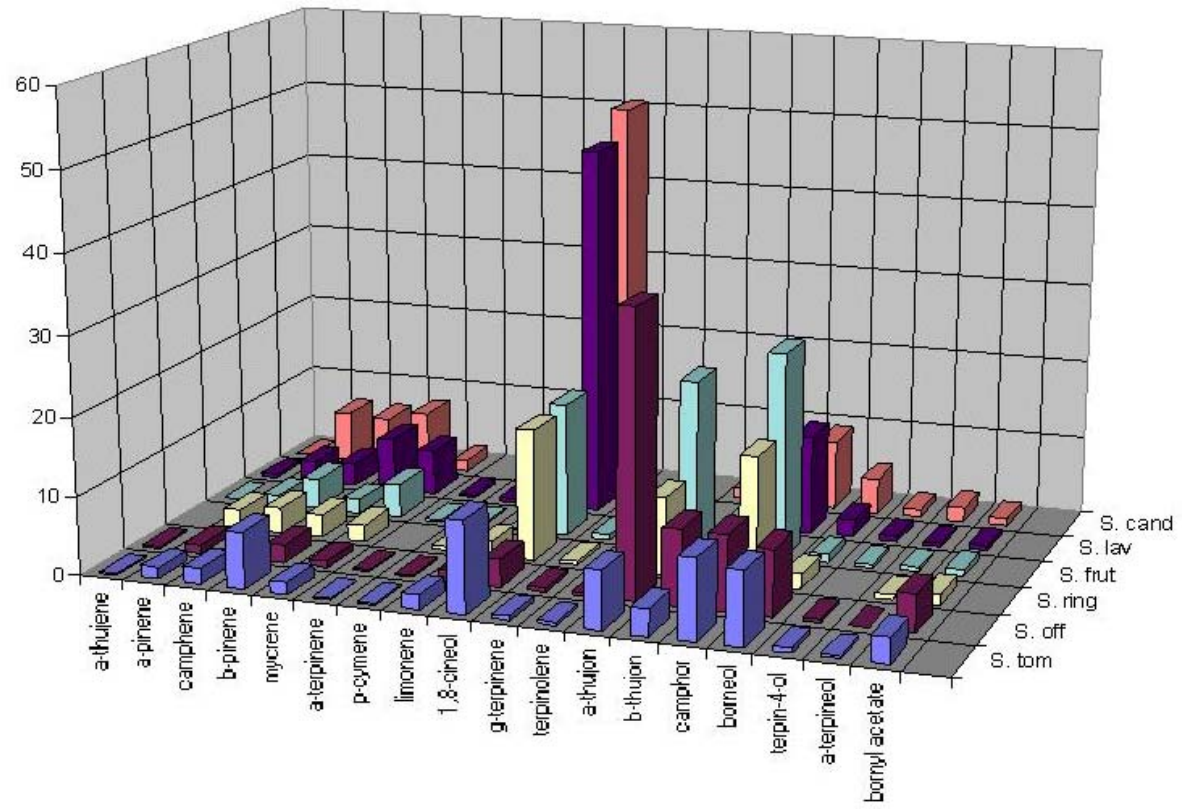

Figure 1. *Proportion in percentages of monoterpenes in the essential oils of the species of section Salvia*

Figure1, a column diagram, illustrates the proportions of individual components of the essential oils of some species of the Section *Salvia*. It shows that significant differences are among the species, but significant similarities can also be observed. In all, *S. tomentosa* can be proposed as alternative 'sage drug', beside *S. officinalis.* We have studied beside essential oils other types of biologically active ingredients (rosmarinic, caffeic, ursolic, oleanoilic acids, flavonoids, etc.) of these species. They do not differ significantly from those of *S. officinalis* (JANICSÁK et al. 1999, 2006, 2007, 2010, MÁTHÉ 2002, 2007, MÁTHÉ et al. 2002, 2007, NIKOLOVA et al. 2006). This holds also true of their biological effects, among them, their antioxidant capacities (JANICSÁK et al. 2010, HOHMANN et al. 1999, HÁZNAGY-RADNAI et al. 2006, ZUPKO et al. 2001).

Summary

Salvia species native to Hungary do not belong to the essential oil containing species. The most frequently used *S. officinalis* originated from the Balkan Peninsula, has high essential oil content but its high neurotoxic thujone content limits the internal application of its products. It has turned out that high thujone (α-, β-thujone) content can not be reduced by selection of the sage samples of various origin. Thujone content will be in all cases high at least under Hungarian climatic conditions. From among the closely related species *S. lavandulifola* proved to be the best plant both regarding its high essential oil production and with the lack of thujones in its oil. It has no thujone content but the perennial plant can not outlive the severe winter period. From among the other *Salvia* species, *S. tomentosa* Mill. has rather high essential oil production with no or very small amount of thujone in it. It seems to be well

cultivated in Hungary. We can grow its populations in our experimental field for several years without any difficulties. Consequently, *S. tomentosa* is worthy of further studies for a large scale production as an alternative or complementary species of *S. officinalis*.

Acknowledgements

The authors express their thanks to the late Imre Máthé member of the HAS and the late Dr Vilmos V. Miklóssy for the establishment of the plant collections, for the identification of the species. We thank for the financial support to the National Scientific Research Grant (OTKA) (Project number: OTKA 43148)

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