Evaluation of the Essential Oil Content of Cretan Dittany Cultivated in Northern Greece

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Abstract

Origanum dictamnus was cultivated at the Laboratory of Conservation and Evaluation of the Native and Floricultural Species (North Greece), far away from the island of Crete (South Greece) where it is growing wild. After one year of cultivation dittany barks/leaves and flowers were analyzed on the basis of their essential oils (yield and quality) for two subsequent years. The essential oils from different parts of the plants were obtained by hydrodistillation in a modified Clevenger-type apparatus, and their chemical analyses were performed by GC and GC-MS. The essential oil yield (1.05-3.14%) and content did not show a negative response to cultivation. Carvacrol was shown to be the main constituent in all samples (45.3-75.1%), with its percentages increasing at the second year of cultivation.

Keywords: Origanum dictamnus; Carvacrol; Essential oil; GC-MS; Cultivation

Introduction

Origanum dictamnus L. or 'Cretan dittany' is a white lanate subshrub, growing wild exclusively in the rocky slopes of mountainous Crete (Greece) [1,2]. It is well known since Aristotle's time for its curing abilities and it was widely used in Crete as a panacea for almost every illness [3-5]. It is characterized by the U.S.A. CFR (2009) as a safe spice for consumption and it is employed by the food industry as a natural additive, with flavouring, antioxidant or preservative role, thus holding great commercial value for the local Greek economy [6].

O. dictamnus is mainly commercialized for its essential oil. In most cases, carvacrol proved to be the major component, with p-cymene and γ-terpinene following in amounts [7-9]. Its content in carvacrol is considered very important since this aromatic monoterpene holds a significant commercial interest. It is a known antimicrobial, antiseptic and antioxidant agent with low acute toxicity and weak genotoxic potential. It is approved by both the FDA and the European Commission as an additive [10]. Finding a stably and abundant rich source of carvacrol would be very important for the food industry. Carvacrol is a common component of the oils from oregano, thyme, marjoram and summer savory [3].

Nowadays the world demand for dittany's essential oil and especially its main compound, carvacrol is increasing. Impetuous collection of dittany from several areas of the island making its systematic cultivation crucial [3]. Furthermore, cultivation and production of dittany have nowadays ceased and scientific data concerning dittany's cultivation are sparse and based mostly on the farmers' experience. It must be emphasized that its cultivation is restricted to Crete, especially in Heraklion estate. In fact earlier authors reported that cultivation far away from Crete would be unsuccessful and it's not recommended [4,11].

The overall objective of the present research was to examine whether the Cretan dittany could be cultivated in a location other than Crete (South Greece), specifically in the Balkan Botanic Garden of Kroussia (North Greece) and to determine the effects of cultivation on the essential oil yield and composition. The chemical composition of the essential oil of the cultivated plants was compared with the previously stated in the literature. Our focus was also centred on the carvacrol content of the plants since it has great industrial interest. The results could be very important because they could enforce the cultivation of this economically important plant in the continental Greece.

Materials and Methods

Plant material

Wild plants of O. dictamnus were collected at Emparos Mountain (alt. 430 m; island of Crete). The wild O. dictamnus was identified by Dr. Koureas D. (taxonomist) and a voucher specimen has been deposited in the Balkan Botanic Garden of Kroussia (Greece)-Laboratory of Conservation and Evaluation of the Native and Floricultural Species.

Propagation and conservation conditions: The plant has been asexually propagated by softwood tip cuttings of 3-5 cm, under mist. Cuttings were placed in propagation trays in a substrate of peat (Klaßmann, KTS 1) and perlite (1:3 v/v) and maintained at bottom heat benches in a polycarbonate greenhouse. Soil temperature was kept at 18-21°C, while air temperature was 15-25°C, depending on weather conditions, and relative humidity 90% [12].

Young plants produced, were transplanted in 2 l pots in a mixture of peat (Klaßmann, TS3) and perlite (2:1 v/v) and continue growing in the greenhouse. The temperature was different during the day and night and among the seasons (average temperatures day/night: winter 18/10°C, spring 25/10C, summer 32/20°C). The relevant humidity (RH) was kept at 55%. Drip irrigation system was applied for the plants and was dependant on the weather conditions (approximately 3 times/...
A list of cultivated O. dictamnus samples.

The four essential oils obtained were yellow in colour, with characteristic and picking odour. The yields (v/w) of all essential oils obtained were comparable to the ones described in the literature [18,19]. It is noteworthy that the yields of the essential oils increased impressively after two years of cultivation.

The four samples presented generally the same chemical profile. The essential oils consisted of a complex mixture of different substances, with oxygenated monoterpenes as the dominating group.

After producing young plants from asexual propagation they were transferred in the nursery. Their essential oils compositions were determined for two subsequent years, after one year of cultivation (1st year of cultivation) and after two years of cultivation (2nd year of cultivation).

Barks/leaves and flowers of O. dictamnus were collected during the flowering stage at two subsequent years of cultivation. The different plant parts were distilled independently and the essential oils were analyzed by GC and GC-MS. A list of the collected and distilled samples of O. dictamnus is provided in Table 1. The identified volatile components are listed in Table 2, together with their retention indices and percentages.

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its cultivation was not recommended [4,11]. According to our results, profile and consequently the properties of dittany essential oil are only records of dittany cultivation were from the island of Crete, where value has given the impetus to its systematic cultivation. Until now the compound, carvacrol has many industrial uses. Thus, its commercial from 29.1% to 89.0% [19,24,25]. The only publication that refers to different conditions also revealed carvacrol as main compound ranging [23], 55.1% [7] and 42.9% [6]. Hydroponic cultivations in Crete under of Crete and the reported carvacrol percentages are 58.9% [20], 62.4% 51.7% [6]. Other papers refer to cultivated populations on the island and 46.3% from leaves [19]; 72.1% and 64.1% [21]; 64.1% [22] and 51.7% [6]. Other papers refer to cultivated populations on the island of Crete and the reported carvacrol percentages are 58.9% [20], 62.4% [23], 55.1% [7] and 42.9% [6]. Hydroponic cultivations in Crete under different conditions also revealed carvacrol as main compound ranging from 29.1% to 89.0% [19,24,25]. The only publication that refers to cultivation of dittany in a place other than Crete is from Figueredó, Cabassu, Chalchat, and Pasquier [26]. The authors cultivated it in France and they determined that its carvacrol content was 70.0%. In contrast, in one case of cultivated O. dictamnus, thymol (78.0%) was the dominant constituent of its essential oil, while carvacrol was totally absent [22]. Also, the examination of other samples revealed high percentages of p-cymene (26.0-48.2%) and thymoquinone (13.0-22.9%), while carvacrol was present in significant smaller quantities (2.9-6.3%) [9].

Conclusion

The medicinal uses of dittany oil are well known. Especially its main compound, carvacrol has many industrial uses. Thus, its commercial value has given the impetus to its systematic cultivation. Until now the only records of dittany cultivation were from the island of Crete, where it is also growing wild. Previous authors mention that the chemical profile and consequently the properties of dittany essential oil are affected in cultivated populations growing out of the island of Crete and its cultivation was not recommended [4,11]. According to our results, the chemical content of O. dictamnus was not affected negatively by the cultivation. In contrast it resembled the ones mentioned in the literature. Carvacrol was in all samples the main compound. In fact after the second year of cultivation its percentage increased to 75.1% (bark/lvs) and 60.9% (fl), while in previous studies on cultivated dittany essential oil was found 42.9% [6], 62.44% [23], 64.1% [18] and 72.1% [21]. This feature was accompanied by the decrease of the percentages of its precursor molecules, p-cymene and γ-terpinene. Perhaps, the plants were well adapted to the new climate conditions.

To the best of our knowledge this is the first time that O. dictamnus is cultivated in Northern Greece. The present study reveals undoubtedly that under concrete conditions the cultivation of the plant is feasible without negative affect on its essential oil composition. On the contrary, carvacrol content increased the second year of cultivation. The here in results could create the background for cultivation of the plant in large scale and consequently the augmentation of its industrial use.

References

17. Van den Dool H, Kratz PD (1963) A generalization of the retention index system

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<th>ord1</th>
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<th>ord3</th>
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<td>0.5</td>
<td>3.8</td>
</tr>
</tbody>
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Table 3: Percentages of grouped components of the essential oils.


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