

# Essential oil composition of *Torilis arvensis* subsp. *neglecta* from Bingöl (Turkey)

## Abstract

Plants are a large source of new bioactive molecules with therapeutic potentials. Only a small percentage of living plants on earth have been phytochemically investigated. Many of the Apiaceae taxa have medicinal, aromatic or economical properties and can potentially be used in the industries such as cosmetics, foods, hygienic products, perfumery and they are used presumed to be connected to the terpenic constituents of the essential oils. *Torilis arvensis* subsp. *neglecta* belonging to the Apiaceae family and distributed in Asia, Europe and North Africa. *T. arvensis* subsp. *neglecta* has been used in folk medicine for the treatment of gastrointestinal illnesses in Iran and Pakistan. Some *Torilis* species from Turkey have antioxidant, antimicrobial and antibacterial effects. In addition, the plant is highly effective against some pathogens, thus confirming its use as disinfectant or antiseptic. In this study aerial parts essential oil of *T. arvensis* subsp. *neglecta* was analyzed by HS-SPME (Headspace Solid Phase Microextraction), as a result thirty four components were identified. Spathulenol (29.2%),  $\beta$ -farnesene (18.5%) and  $\beta$ -caryophyllene (10.2%) were detected the major constituents of the plant. With this study, chemotypes of studied sample was spathulenol,  $\beta$ -farnesene and  $\beta$ -caryophyllene. In addition studied plant sample was found to be rich in respect to essential oil. The results discussed natural product, renewable resources and chemotaxonomy.

**Keywords:** *Torilis*, essential oil, HS-SPME, Apiaceae

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## Introduction

*Torilis* Gaertn. is in the Umbelliferae family and this family has a cosmopolitan spreading, but most of Apiaceae taxa are confined to northern temperate areas, and high altitudes in the tropic regions.<sup>1</sup> Apiaceae has annual and perennial herbs, rarely shrubby, the leaves are generally alternate, hollow stems, usually exstipulate, the petioles are often large and sheathed at the base, the inflorescence is usually a compound umbel, and the flowers are generally hermaphrodite.<sup>2</sup> Apiaceae is a large family in terms of number of plants, composed of more than 3,700 species belonging to 434 genera all around the world.<sup>3</sup> In Turkey this family is represented by about 102 genus and 465 species from which 130 are endemic with a 30% endemism rate.<sup>4-6</sup> Plants of this family, generally known as carrot or parsley, are mostly aromatic and medicinally important and, are well known with regard to variability and rich profile of secondary metabolites, especially essential oils.<sup>7</sup> Apiaceae taxa are rich in respect to secondary metabolites and embodies numerous genera of high economic and medicinal value yielding flavonoids, coumarins, acetylenes, terpenes, essential oils and it is well known that occurrence of essential oils and oleoresins is a characteristic feature of this family.<sup>8</sup> Taxa of the parsley family are well known with regards to their economic importance, diversity of essential oils<sup>7</sup> and these plants have particular flavors, odor and are largely used in traditional medicine in many parts of the world.<sup>9</sup> Herbal and botanical products, such as essential oils and plant extracts, have been studied for their antimicrobial activities.<sup>10</sup> Essential oils are aromatic oily liquids obtained from different plant parts and have broad activities. Other than antibacterial and antiviral effects, most EOs investigated possess insecticidal, antifungal, acaricidal, cytotoxic and antioxidant properties.<sup>11</sup> Therefore, they are intensely investigated in the fields of pharmacology, pharmaceutical botany, medical and clinical microbiology, phytopathology and

food preservation. They are also widely used as food flavours and preservatives to prevent growth of food-borne bacteria and molds, and so extend the shelf life of processed foods.<sup>12</sup> Plants of the Apiaceae family possess a range of compounds with many biological activities. Some of the main properties are ability to induce apoptosis, antibacterial, hepatoprotective and vaso-relaxant activities, cyclooxygenase inhibitory effect and antitumor action.<sup>13</sup>

*Torilis* is a genus of potential use in medicine because of interesting anti-infectious and anticancer properties [14]. It is mainly spreading in the Mediterranean area but distributed also in South and Central Asia. Anatolia is thought to be the main diversity centre for the genus because 11 of these 13 species and also the only endemic species of the genus are found in Anatolia.<sup>15</sup> Indeed, members of this genus display intraspecific variations like heterocarpy and heterophylly as well as interspecific similarities, thus complicating their classification. There is often confusion between different samples of this genus in herbariums and so the aim of this study is to develop a method to find characters providing data of both taxonomical and pharmaceutical use. Most phytochemical studies on *Torilis* have focused on terpenoids<sup>16</sup> so data on flavonoids is limited.

In this study, essential oil composition of *Torilis arvensis* subsp. *neglecta* which was collected from Bingöl (Turkey) was undertaken for the first time.

## Materials and methods

### Plant material

*T. arvensis* subsp. *neglecta* was collected from Bingöl, vicinity of Sancak waist, stony areas, 1700-1750 m, on May 2018. The taxonomic description of the plant sample was made according to

volume 4 of Flora of Turkey.<sup>2</sup> Voucher specimen was deposited in the Bingöl University, Department of Park and Garden Plants.

### HS-SPME Procedure

Dried aerial part powder of five grams plant samples were carried out by a head space solid phase microextraction method using a divinyl benzene/carboxen/polydimethylsiloxane fiber, with 50/30µm film thickness; before the analysis the fiber was conditioned in the injection port of the gas chromatography (GC) as indicated by the manufacturer. For each sample, 5g of plant samples, previously homogenized, were weighed into a 40ml vial; the vial was equipped with a “mininert” valve. The vial was kept at 35°C with continuous internal stirring and the sample was left to equilibrate for 30min; then, the solid fiber microextraction was exposed for 40min to the headspace while maintaining the sample at 35°C. After sampling, the solid microextraction fiber was introduced into the gas chromatography injector, and was left for 3 min to allow the analyzes thermal desorption. In order to optimize the technique, the effects of various parameters, such as sample volume, sample headspace volume, sample heating temperature and extraction time were studied on the extraction efficiency as previously reported by Verzera et al.<sup>17</sup> A Varian 3800 gas chromatograph directly interfaced with a Varian 2000 ion trap mass spectrometer was used with injector temperature, 260°C; injection mode, splitless; column, 60m, CP-Wax 52 CB 0.25mm i.d., 0.25mm film thickness. The oven temperature was programmed as follows: 45°C held for 5min, then increased to 80°C at a rate of 10°C/min, and to 240°C. at 2°C/min. The carrier gas was helium, used at a constant pressure of 10 psi; the transfer line temperature, 250°C; the ionisation mode, electron impact (EI); acquisition range, 40 to 200m/z; scan rate, 1 us<sup>-1</sup>. The compounds were identified using the NIST (National Institute of Standards and Technology) library and verified by the retention indices which were calculated as described by Van den Dool and Kratz.<sup>18</sup> The relative amounts were calculated on the basis of peak-area ratios. The identified constituents are listed in Table 1.

### Results and discussion

In this study, major compounds of *Torilis arvensis* subsp. *neglecta* were spathulenol (29.2%), β-farnesene (18.5%), and β-caryophyllene (10.2%) (Table 1); similarly, β-caryophyllene was detected as the main compound in different parts of *Torilis arvensis* stem (4.92%) and leaves (8.38%).<sup>19</sup> The leaf and stem essential oils of *Torilis arvensis* were analyzed and both oils are dominated by trans-β farnesene and contained significant amounts of β-cubebene, cis-β-farnesene, β-caryophyllene and nuciferyl acetate;<sup>19</sup> in our research β-farnesene (18.5%), β-caryophyllene (10.2%), β-cubebene (2.2%) were also detected high percentages (Table 1). It is noteworthy that, spathulenol was not detected in the essential oil of *Torilis arvensis*.<sup>19</sup> More than 25.000 different terpenoids are known; and terpenes play a board range of physiological and ecological roles including, plant primary metabolism, and protection against herbivores and pathogens, attractants for pollinators and as allelopathic agent; other economically important terpenes include carotenoid pigments, natural rubber and the essential oils.<sup>20</sup> The chemical composition of the essential oil of *Torilis arvensis* (Huds.) Link. was studied by GC/MS and twenty-two components have been identified, of which (E)-β-farnesene (27.7%) and ar-curcumene (19.5%) were the major ones.<sup>16</sup> In this research farnesene was detected major ones, but curcumene not detected (Table 1). In another study, spathulenol (15.7%) and trans-α bergamotene (10.4%) were the main components among the sixty constituents

characterized in the oil of aerial parts of *Torilis leptophylla* representing 91.3 % of the total components detected.<sup>21</sup> In our research spathulenol (29.2%) was detected major ones, but trans-α bergamotene not detected (Table 1). In herbal medicine, the mild sedative properties of hops is due to the presence of β-caryophyllene;<sup>22</sup> in vitro studies it was demonstrated the cytotoxic activity of the β-caryophyllene against breast cancer cells.<sup>23</sup> In our study β-caryophyllene was determined in high amount from *T. arvensis* subsp. *neglecta* (10.2%); so *T. arvensis* subsp. *neglecta* demonstrating their applicability for medicinal, cosmetic and pharmaceutical purposes with this results. In the present study, the chemical composition of these three important species of the family Apiaceae, commonly used in folk medicine and traditional food flavouring, were characterised by HS-SPME analyzes.

**Table 1** The identified constituents of *Torilis arvensis* subsp. *neglecta* (%)

Constituents	RRI*	%
α-pinene	1035	1.8
Camphene	1068	1.9
β-pinene	1120	1.7
Sabinene	1130	2.5
δ-3-carene	1145	1.2
Myrcene	1163	0.5
α-phellandrene	1180	1.2
β-phellandrene	1214	1.1
β-ocimene	1305	0.4
γ-Terpinene	1348	0.1
p-cymene	1360	0.1
Terpinolene	1370	0.4
α-copaene	1456	1.3
α-cubebene	1463	0.7
Linalool	1475	0.4
Bornyl acetate	1478	1.2
γ-elemene	1483	2.1
α-copaene	1490	0.3
β-cubebene	1540	2.2
δ-cadinene	1575	3.5
β-caryophyllene	1600	10.2
β-farnesene	1615	18.5
γ-Muurolene	1702	1.7
germacrene D	1715	1.8
δ-Cadinene	1760	1.2
β-Sesquiphellandrene	1775	0.4
Caryophyllene oxide	1989	1.2
Spathulenol	2120	29.2
α-bisabolol	2210	0.2
α-cadinol	2240	0.2
Pentadecanoic acid	2920	0.1
*RRI: Relative Retention Index	Total	88.3

## Conclusion

In conclusion, the present work is the first report on the composition of essential oils obtained from the aerial parts of *T. arvensis* subsp. *neglecta* from Bingöl (Turkey). Comparison of our *T. arvensis* subsp. *neglecta* results with the literature showed significant differences for the extracts which can be attributed to different analysis method, either due to climatic, factors or genetic differences of the plants. The biologic activity of *T. arvensis* subsp. *neglecta* may be related to its richness in secondary metabolites, especially essential oils. Spathulenol,  $\beta$ -farnesene and  $\beta$ -caryophyllene were found to be the chemotypes of studied sample.

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## Conflicts of interest

Author declares that there is none of the conflicts.

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