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Essential Oil Contents and Compositions of *Thymus sipyleus* Growing Wild in Central Turkey

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Essential oils from single *Thymus sipyleus* plants growing wild in Central Turkish Province of Tokat were analyzed for major constituents using gas chromatography. This area of Turkey is known for its richness of medicinal and aromatic plants. Twenty-five specimens collected from different areas of Tokat were subjected to essential oil content analyses. Essential oils were studied for eight major components (1,8-cineol, linalool, borneol, α-pinen, β-pinen, carvone, camphor, carvacrol). Essential oil contents varied from 0.08 to 0.82%. Eight components studied generally constitute more than 80% of the essential oils, 1,8-cineol being the predominant constituent followed by linalool and carvone. Some specimens contained about 10% of α-pinen and 15–20% camphor. β-pinen and carvacrol contents were 5–6% in essential oils of some specimens. Chemical compositions of our specimens were considerably different from specimens of the same species collected from western part of Turkey.

Key Words: *Thymus sipyleus*, Essential oil, Essential oil composition, 1,8-cineol, Linalool, Carvone.

INTRODUCTION

Thymus is a large genus with about 200 morphologically diverse species. Plants of different species that belong to Thymus genus are used as herbal tea, spice, medicine, food and in cosmetics. Essential oils of *Thymus* species consist of thymol, *p*-cymene, linalool, linalyl acetate, carvacrol, geraniol, myrene, borneol and carvone in different levels depending upon many factors including genotype and environment. Some of these components are used in different branches of industry.

Thymus genus also shows great inter- and intra-specific chemical variations. These variations are useful tools for taxonomical identifications[1]. However, sometimes the same species may have quite different chemotypes which have about hundred-fold differences from others for certain components. For example, within *Thymus herba barona* Lois species, linalool content changes from 0.5 to

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31.8%, terpinen-4-ol from 1.0 to 28.3%, *cis*-dihydrocarvone from 1.4 to 77.1%, carvone from 1.9 to 74.6%, thymol from 0.5 to 47.9%, geraniol from 0.5 to 60.6%, and carvacrol from 4.7 to 59.4%[2].

Generally, plants of the same species collected from different geographic areas show great variability for chemical composition. Salgueiro *et al.*[3] reported that major components of essential oil on *Thymus camphorates* specimens collected from north-west Portugal were borneol and 1,8-cineol while the major component of essential oil of specimens from south Portugal were linalool. Ecological conditions such as moisture[4], elevation, soil, light density, shadow effect, neighbouring vegetation and direction[5] also greatly affect the chemical composition.

Flora of Turkey has about 40 *Thymus species*[6]. *T. sipyleus* is naturally found in Turkey, mainly in central Anatolia and Aegean and Mediterranean coasts. *T. sipyleus* plants can be 10–20 cm long, erect stemmed, perennial woody sub shrubs[7].

There are only two reports about chemical composition of *T. sipyleus*. In a relatively old report by Tanker[8], *T. sipyleus* Boiss was reported to have two major components *i.e.*, citral (21%) and 1,8-cineol (13%). A recent and comprehensive study about five *T. sipyleus* Boiss *subsp. sipyleus var. sipyleus* specimens collected from middle and western part of Turkey showed that α-pinen content was 0.04–1.97, β-pinen 0.03–0.78, 1,8-cineol 0.17–7.22, camphor 1.42–5.45, linalool 0.12–21.77, carvacrol 0.05–2.25, neral 3.08–25.56, α-terpineol + isoborneol 1.47–25.46 and geranial 8.39–36.97%[9].

In the present work, we collected *Thymus sipyleus* Boiss specimens from different areas of Tokat province of Turkey. This area is especially rich for many aromatic plants including *Thymus* genus. Our aim was to determine the level of chemical variation for a number of components of *Thymus sipyleus* Boiss essential oil.

EXPERIMENTAL

Twenty-five different *Thymus sipyleus* Boiss subsp. *sipyleus* var. *sipyleus* specimens were collected from different areas of Tokat province of Turkey, with elevations ranging from 650 to 1650 m, in 1999 and analyzed for their chemical compositions. Aerial plant parts were taken from natural growing areas during anthesis period[3]. Stem, foliage and flower containing specimens were air dried until constant weight.

Essential Oil Contents

Essential oil contents of the specimens were volumetrically determined using a NeoClevenger apparatus in drug herbs. Essential oil contents were measured as mL/100 g herb[10] based on European Pharmacopoeia method[11].

Essential Oil Compositions

Gas chromatography was used for essential oil composition analyses. Working conditions were as follows: Column length 3 m (glass column), constant phase 3% OVI, support matter Gas Chrom Q, column temperature 110°C, detector and

injector temperature 250°C, flow rates of carrier gases: nitrogen 25 mL/min, hydrogen 1.5 kg/cm^2, dry weather 1.5 kg/cm^2, detector type FID, printer Beckman, integrator Spectra Physic, paper speed 0.5 cm/min, injection volume 0.5 μL, solvent used chloroform.

RESULTS AND DISCUSSION

Data from essential oil contents and compositions of 25 *Thymus sipyleus* specimens collected from different areas of Tokat province with different elevations (Table-1) and from western parts of Turkey[9] reported elsewhere are given in Table-2. Compositions of our specimens are also illustrated in Graphic 1. Essential oil contents varied from 0.01 to 0.82%, which was very similar to 0.13–1.22% essential oil content reported for this species[9]. There was not a correlation between essential oil content and elevation.

TABLE-1
AREAS FROM WHICH SPECIMENS WERE COLLECTED AND THEIR ALTITUDES

Specimen No.	Area collected	Altitude
1.	Tokat-Artova 50 km	1000
2.	Tasliciftlik	650
3.	Tokat-Sivas 70 km	1450
4.	Artova-1	1050
5.	Zile-uckoy	800
6.	Artova-2	1050
7.	Zile Akcakeceli-1	900
8.	Artova-Agmusa-1	1100
9.	Tokat-uctepe	1150
10.	Camlibel	1100
11.	Tokat-Sivas 90 km	1650
12.	Camlibel gecidi-1	1650
13.	Camlibel gecidi-2	1650
14.	Almus-1	1000
15.	Uctepe yaylasi-1	1000
16.	Camlibel gecidi-3	1650
17.	Uctepe yaylasi-2	1100
18.	Camlibel-Ihsanbeyli	1500
19.	Camlibel gecidi-4	1650
20.	Zile-Akçakeçeli-2	900
21.	Almus-2	1000
22.	Artova-Agmusa-2	1100
23.	Tokat-Sivas 75 km	1450
24.	Uctepe yaylasi-3	1100
25.	Camlibel gecidi-5	1650

TABLE-2
ESSENTIAL OIL CONTENTS AND CHEMICAL COMPOSITIONS OF *THYMUS SIPYLEUS* SPECIMENS

Specimen No.	Essential oil (%)	1,8-Cineol	Linalool	Carvone	Borneol	α-Pinen	β-Pinen	Camphor	Carvacrol	Others
1.	0.40	73.8	2.9	0	2.2	0	0	0	0	21.1
2.	0.45	59.2	8.0	0	5.5	4.0	0	0	0	23.3
3.	0.82	58.8	0	0	9.3	10.1	0	0	0	21.8
4.	0.53	53.9	12.4	0	0	9.5	0	12.4	0	11.8
5.	0.35	53.3	6.2	0	5.4	8.9	0	14.9	0	11.3
6.	0.27	51.6	5.4	0	8.2	9.4	6.2	8.2	0	11.0
7.	0.59	51.4	7.5	0	4.0	11.4	5.2	16.0	4.4	0.1
8.	0.31	50.2	6.0	0	4.6	8.9	6.2	0	0	24.1
9.	0.39	49.7	6.6	0	4.9	11.4	6.6	0	0	20.8
10.	0.25	49.3	9.9	0	12.1	0	0	18.2	4.7	5.8
11.	0.41	45.1	7.3	0	0	12.7	6.2	22.4	6.2	0.1
12.	0.30	44.0	11.0	4.7	5.0	6.6	0	0	10.0	13.0
13.	0.30	43.6	20.4	0	0	8.2	6.0	9.2	0	12.6
14.	0.40	43.4	13.7	0	4.1	10.9	5.7	0	0	22.2
15.	0.38	42.1	0	0	3.9	7.6	0	0	0	46.4

Specimen No.	Essential oil (%)	1,8-Cineol	Linalool	Carvone	Borneol	α-Pinen	β-Pinen	Camphor	Carvacrol	Others
16.	0.25	37.8	7.2	0	21.1	0	6.2	10.5	0	17.2
17.	0.22	34.2	15.1	15.8	0	1.7	0	0	0	33.2
18.	0.24	37.3	35.0	0	3.3	5.6	4.2	9.2	0	5.4
19.	0.12	31.0	42.0	0	0	5.2	0	0	0	21.8
20.	0.50	22.6	45.1	15.1	0	0	0	0	0	17.2
21.	0.10	22.4	44.1	21.4	0	0	0	0	0	12.1
22.	0.01	19.9	21.4	42.3	16.3	0	0	0	0	0.1
23.	0.36	25.2	3.5	33.6	3.5	6.5	0	0	3.9	15.5
24.	0.08	29.6	14.9	31.2	3.9	0	0	7.4	0	13.0
25.	0.26	27.8	5.1	10.6	0	15.6	0	18.0	7.0	15.9
A*	0.30	1.54	21.77	N/A	N/A	0.04	0.03	2.23	0.05	74.34
B	1.22	1.83	0.12	N/A	N/A	0.37	0.13	1.56	0	95.99
C	0.22	7.22	0.73	N/A	N/A	1.26	0.78	5.45	0.31	84.25
D	0.13	3.65	3.80	N/A	N/A	0.46	0.19	1.42	2.25	88.23
E	0.90	0.17	1.86	N/A	N/A	1.97	0.49	3.77	0.15	91.59

*A, B, C, D, E are specimens collected from Western Turkey and reported by Baser *et al.*[9] (1995). N/A: data is not available for these constituents.

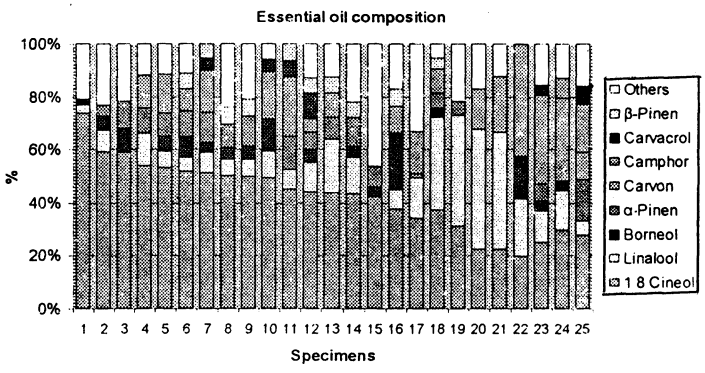

Fig. 1. Essential oil compositions of 25 *T. sipyleus* specimens collected from central Turkey.

Essential oils from specimens were studied for major components such as 1,8-cineol, linalool, carvone, borneol, α and β-pinens, camphor and carvacrol. These eight components generally constituted more than 80% of essential oils. In some specimens (Nos. **7** and **11**) these eight components were making up 99.9% of essential oils whereas in two specimens (Nos. **15** and **18**) 46.4 and 33.2% of the essential oils were constituted by other components.

1,8-Cineol was the dominant component in all of the specimens collected. It was the major component in 19 of the 25 (76%) *Thymus sipyleus* specimens. In general, specimens from northern slopes with higher leaf ratios tended to have higher 1,8-cineol contents. Percentage of 1,8-cineol in specimens varied from 19.9 to 73.8. In specimen No. **1**, almost three-quarters of essential oil was 1,8-cineol. Studying five *Thymus sipyleus* specimens collected from Middle and West Anatolia, Baser *et al.*[9] found 0.17–7.22% 1,8-cineol in this species. Tanker[8] on the other hand reported 13% 1,8-cineol in this species. This kind of variation in chemical compositions is quite common within this genus[12].

Twenty-three out of twenty-five specimens (92%) consisted linalool in their essential oils. Only Nos. **3** and **15** did not have linalool. Four specimens had considerably high amounts of linalool. These were Nos. **20, 21, 19** and **17** with linalool percentages of 45.1, 44.1, 42.0 and 35.0 respectively. Specimens of which major component was linalool were usually located in south slopes with higher light densities. In their five specimens, Baser *et al.*[9] found 0.12–21.77% linalool in *T. sipyleus* essential oil which clearly shows high chemical composition variation within this species.

Eight of the 25 specimens contained carvone, a component with antifungal and sprout inhibiting properties[13], in their essential oils. Carvone-rich specimens generally were found at high altitude range areas. Carvone percentages varied from 4.7–42.3%. The highest percentages were in specimens Nos. **22, 23** and **24** as 42.3, 33.6 and 31.2, respectively. Carvone was the major component of essential oil in these specimens.

Seventeen of the 25 specimens contained borneol with percentages from 2.2 to 21.1. Specimens Nos. **16** and **22** had considerably higher percentages than

others (21.1 and 16.3, respectively). Eighteen specimens contained 1.7–15.6% α-pinen. Specimen No. **25** was remarkably rich for this component. Eleven specimens contained camphor in their essential oils. Specimens Nos. **11, 10** and **25** with camphor percentages of 22.4, 18.2 and 18.0 respectively, were especially rich for this component. Six specimens had carvacrol ranging from 3.9–10.0%. Specimen No. **12** had relatively higher carvacrol content (10.0%) than others. Ten specimens contained similar amounts (4.2–6.6%) of β-pinen. Highest level of these components in our specimens are a few times more than the highest values reported by Baser *et al.*[9] for this species. Some of our materials could be useful for studies with these components.

Variations in essential oil contents may partly result from differences in soil, light density, shadow effect, neighburing vegetation, direction and genotype. Salgueiro *et al.*[3] reported that essential oil contents of *Thymus* genus may be different according to species as well as to locations. Our results clearly show that Tokat flora hosts a rich variation for chemical composition within *T. sipyleus*. Further research in the region could yield some other chemotypes in which some other rare components are predominant. These materials would be very useful for advanced studies with these components.

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