# Progress in Essential Oils

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## Mountain Savory Oil

Savory oil of commerce is known to be produced from both *Satureja hortensis* L. and *Satureja montana* L. This latter member of the Lamiaceae is a perennial taxon that can exist in numerous subspecies forms, although the one commonly used for oil production is *S. montana* L. subsp. *montana*, which can be found growing from Spain to southern Albania.

An oil of *S. montana* obtained from plants grown experimentally in the Pisa area from cuttings collected from plants growing in Val di Vara (Italy) was the subject of analysis by Angelini et al. (2003). They found that the main components of this oil were:

α-pinene (0.8%)
camphene (0.2%)
β-pinene (0.2%)
myrcene (1.9%)
α-terpinene (2.0%)
p-cymene (9.7%)
limonene (0.4%)
1,8-cineole (0.2%)
γ-terpinene (13.2%)
linalool (0.3%)
borneol (0.7%)
terpinen-4-ol (0.1%)
thymol (0.3%)
carvacrol (56.8%)
β-caryophyllene (3.6%)
germacrene D (0.4%)

Chizzola (2003) examined the compositions of the volatiles of four populations of *S. montana* from France. The populations were collected from Utelle (Alpes-Maritime at 830–850 m), Rougon (Alpes-de-Haute-Provence at 950 m), Mont Ventou (Vaucluse at 1080–1090 m) and Plateau de Gras (Ardéche at 210 m). The first three populations were found growing in the pre-Alps limestone region, while the fourth was growing west of the Rhone on a limestone plateau. The author obtained representative volatile concentrates by extracting 0.2–0.3 g of the leaves of single plants using 1.5–2.0 mL of methylene chloride in an ultrasonic bath for 30 min. After filtration, the extract was directly analyzed using GC/MS only. The variability of 11 selected components of 33–40 analyses of all populations, except for the one from Utelle, can be seen in **T-1**. The variability in the quantitative results is not unexpected, even though the plants harvested were all flowering, because the small sample taken from each plant was not sufficient to average out within plant variation that is known to occur within the Lamiaceae family. Finally, it was revealed that the population from Utelle was mixed between the carvacrol forms and the linalool forms so that data will not be reported.

*Satureja montana* plants that were collected in Dalmatia (Croatia) were dried and subjected to hydrodistillation by Radonic and Milos (2003). Analysis of this oil revealed that it was thymol-rich, the full composition of which was reported to be as follows:

α-thujene (1.0%)
α-pinene (1.0%)
α-terpinene (3.5%)
γ-terpinene (5.9%)
p-cymene (6.4%)
allo-ocimene (0.6%)
1-octen-3-ol (0.7%)
*trans*-sabinene hydrate (0.2%)
linalool (0.6%)
methyl thymol (5.1%)
methyl carvacrol (5.8%)
β-caryophyllene (2.3%)
borneol (3.9%)
α-humulene (0.3%)
α-elemene (0.3%)†
β-bisabolene (1.1%)
geranyl acetate (2.1%)
nerol (1.1%)
geraniol (5.0%)
thymol (45.2%)
carvacrol (5.3%)

†incorrect identification based on GC elution order

Trace amounts (>0.1%) of β-pinene, terpinolene, α-copaene, β-bourbonene, β-cubebene, zingiberene, γ-cadinene, δ-cadinene, α-muurolene, neral, geranial and 3-phenylpropanol were also characterized in this oil.

Skocibusic and Bezic (2004a) screened an oil of *S. montana* for its antimicrobial activity. The oil, which was produced by hydrodistillation from plants collected from the sub-Mediterranean region of Biokovo Mountain (Croatia), was analyzed by GC/MS only. The constituents characterized in this oil were as follows:

**T-1. Percentage composition of the volatiles in three populations of *Satureja montana***

| Compound | Rougon | Mont Ventou | Plateau de Gras |
|---|---|---|---|
| myrcene | 0.6–2.2 | 0.9–2.8 | 0.9–2.8 |
| α-terpinene | 0.4–2.3 | 0.8–2.6 | 0.8–2.9 |
| p-cymene | 0–34.4 | 7.0–25.1 | 0–20.8 |
| limonene | 0.2–5.9 | 0–4.6 | 0.1–4.4 |
| γ-terpinene | 3.2–20.5 | 4.7–24.0 | 4.9–22.5 |
| linalool | 0.5–2.5 | 0.4–4.0 | 0.5–4.2 |
| borneol | 0.1–3.2 | 0.3–3.2 | 0.4–2.4 |
| thymoquinone | 0.4–6.1 | 0.1–5.9 | 0.1–2.5 |
| methyl carvacrol | 0–4.1 | 0–9.5 | 0–0.3 |
| carvacrol | 31.6–65.0 | 32.4–67.8 | 31.7–.62.0 |
| β-bisabolene | 0.4–3.8 | 0.3–4.0 | 0.5–3.8 |

α-thujene (1.8%)
α-pinene (1.0%)
myrcene (0.8%)
α-terpinene (1.5%)
γ-terpinene (8.1%)
p-cymene (12.6%)
1-octen-3-ol (0.7%)
linalool (0.5%)
methyl thymol (2.3%)
methyl carvacrol (11.0%)
aromadendrene (<0.1%)
α-terpineol (0.5%)
borneol (4.8%)
β-cubebene (0.5%)
δ-cadinene (0.4%)
thymol acetate (0.2%)
caryophyllene oxide (0.4%)
spathulenol (0.3%)
thymol (3.9%)
carvacrol (45.7%)

Skocibusic and Bezic (2004b) collected *S. montana* from the littoral part of Brac Island (Croatia) during the months of June–October. Oils produced from the plants at three distinct ontogenetic states (pre-flowering, full flowering and post-flowering) in the range of 1.2–2.2% were analyzed by GC/MS only. The results of these analyses are reported in **T-2**.

Pre-flowering plants of *S. montana*, which were collected from Zabljak (Serbia) by Bezbradica et al. (2005), were hydrodistilled to yield an oil in 0.93% yield. Analysis of this oil by GC-FID and GC/MS revealed that it had the following main components:

α-thujene (1.0%)
α-pinene (1.5%)
camphene (1.4%)
1-octen-3-ol (1.0%)
myrcene (0.7%)
α-terpinene (1.4%)
p-cymene (28.8%)
limonene (0.9%)
1,8-cineole (0.4%)
(Z)-β-ocimene (0.1%)
γ-terpinene (1.7%)
terpinolene (1.2%)
linalool (0.4%)
borneol (3.8%)
terpinen-4-ol (1.7%)
p-cymen-8-ol (0.4%)
methyl thymol (0.1%)
cuminaldehyde (0.4%)
methyl carvacrol (0.7%)
thymol (33.4%)
carvacrol (4.2%)
β-caryophyllene (2.0%)
allo-aromadendrene (0.2%)
β-bisabolene (4.7%)
(Z)-α-bisabolene (0.3%)
2-methoxy-4-ethyl-6-methylphenol† (0.9%)
caryophyllene oxide (1.1%)

†doubtful correct identification

An oil produced in the laboratory in 1.4% yield from *S. montana* plants that were grown near Tehran was analyzed by Omidbaigi et al. (2007) using a combination of gas chromatographic techniques. The oil was found to possess the following composition:

α-thujene (1.1%)
α-pinene (0.5%)
β-pinene (0.9%)
myrcene (1.6%)
α-terpinene (2.8%)
p-cymene (4.7%)
limonene (0.5%)
1,8-cineole (0.5%)
γ-terpinene (16.3%)
terpinen-4-ol (0.9%)
thymol (1.6%)
carvacrol (65.8%)
β-caryophyllene (2.2%)
germacrene D (0.7%)

Cavar et al. (2008) collected *S. montana* from two different populations in Bosnia Herzogovina (Trebinje and Konjic). Oils produced from the air-dried plants whose maturity states were not described were hydrodistilled to produce oils (no yields given) that were analyzed by GC/MS only. The analytical results of this study are reported

**T-2. Comparative percentage composition of oils produced from three ontogenetic stages of *Satureja montana***

| Compound | Pre-flowering oil | Fall-flowering oil | Post-flowering oil |
|---|---|---|---|
| α-thujene | 1.4 | 1.3 | 1.3 |
| α-pinene | 0.6 | 1.4 | 2.2 |
| myrcene | 0.9 | 0.6 | - |
| α-terpinene | 1.7 | 0.9 | - |
| limonene | - | - | 1.1 |
| γ-terpinene | 5.8 | 4.9 | - |
| p-cymene | 3.8 | 15.2 | 25.6 |
| allo-ocimene* | 0.9 | - | - |
| 1-octen-3-ol | 0.4 | 1.0 | 1.4 |
| *trans*-sabinene hydrate | 0.3 | 0.2 | 1.2 |
| camphor | - | - | 0.7 |
| β-bourbonene | - | - | 0.3 |
| linalool | 0.5 | 0.6 | 0.9 |
| methyl thymol | 3.2 | 3.3 | 12.8 |
| methyl carvacrol | 4.6 | 6.4 | 5.4 |
| β-caryophyllene | 1.8 | 1.3 | 1.3 |
| aromadendrene | 0.2 | 0.3 | 0.5 |
| α-humulene | 0.2 | - | - |
| neral | - | 0.6 | - |
| α-terpineol | - | 0.3 | 0.6 |
| borneol | 3.2 | 6.5 | 11.5 |
| β-cubebene | 0.4 | - | 0.7 |
| geranial | - | 0.9 | - |
| β-bisabolene | 0.5 | - | 1.5 |
| geranyl acetate | - | 5.2 | - |
| δ-cadinene | 0.3 | - | 0.2 |
| nerol | - | 0.9 | 0.2 |
| geraniol | - | 10.2 | - |
| thymol acetate | 0.2 | - | - |
| caryophyllene oxide | - | 1.2 | 2.8 |
| spathulenol | - | 0.3 | 0.7 |
| thymol | 11.0 | 5.4 | 2.6 |
| carvacrol | 52.4 | 26.2 | 16.1 |

*correct isomer not identified

in **T-3**. The trace components (<0.5%) that were reported to be characterized in one or both oils were *cis*-p-mentha-2,8-dien-1-ol, piperitenone oxide, α-calacorene, 1-epi-cubenol, T-cadinol and 14-hydroxy-α-muurolene.

A carvacrol-rich commercial oil of *S. montana* of Slovenian origin was analyzed using GC-FID and GC/MS by Stoilova et al. (2008). The constituents characterized in this oil were as follows:

α-thujene (0.6%)
α-pinene (2.8%)
camphene (0.6%)
sabinene (0.1%)
1-octen-3-ol (1.1%)
β-pinene (0.2%)
myrcene (1.1%)
3-octanol (0.5%)
α-phellandrene (0.5%)
p-cymene (11.0%)
α-terpinene (1.3%)
limonene (1.3%)
1,8-cineole (1.0%)
(Z)-β-ocimene (2.1%)
(E)-β-ocimene (0.1%)
γ-terpinene (6.2%)
*trans*-sabinene hydrate (0.1%)
terpinolene (0.2%)
*cis*-sabinene hydrate (0.7%)
linalool (1.6%)
α-thujone (0.1%)
camphol (0.8%)
borneol (2.4%)
terpinen-4-ol (0.5%)
γ-terpineol[†] (0.2%)
α-terpineol (1.4%)
methyl carvacrol (0.6%)
neral (0.1%)
geraniol (0.1%)
carvone (0.5%)
piperitone (0.1%)
geranial (0.1%)
thymol (8.6%)
carvacrol (41.5%)
carvacrol acetate (0.1%)
geranyl acetate (0.1%)
β-bourbonene (0.1%)
β-caryophyllene (4.1%)
α-humulene (0.3%)
aromadendrene (0.2%)
germacrene D (0.1%)
bicyclogermacrene (0.1%)
β-bisabolene (1.0%)

[†]does not occur naturally

Trace amounts (<0.05%) of thuja-2,4(10)-diene, β-phellandrene, β-thujone, isoborneol and caryophyllene oxide were also characterized in this oil.

Grosso et al. (2009) compared the compositions of hydrodistilled oils and

**T-3. Comparative percentage composition of the oils of two populations of *Satureja montana* from Bosnia Herzegovina**

| Compound | Population 1 oil | Population 2 oil |
|---|---|---|
| 1-octen-3-ol | - | 0.6 |
| 3-octanol | - | 0.1 |
| *cis*-sabinene hydrate | 0.1 | 3.7 |
| *trans*-linalool oxide[f] | t | 0.2 |
| *cis*-linalool oxide[f] | t | 0.2 |
| *trans*-sabinene hydrate | 0.2 | 2.5 |
| linalool | 0.1 | 1.1 |
| *cis*-p-menth-1-en-1-ol | 0.1 | 0.7 |
| 2-ethylhexanoic acid[‡] | 0.1 | - |
| *trans*-p-menth-2-en-1-ol | t | 0.5 |
| *trans*-verbenol | 0.2 | 0.2 |
| borneol | 2.9 | 4.8 |
| *cis*-linalool oxide[p] | 0.2 | - |
| *trans*-linalool oxide[p] | 0.2 | - |
| terpinen-4-ol | 0.8 | 10.3 |
| p-cymen-8-ol | 1.8 | 1.4 |
| α-terpineol | 1.9 | 1.5 |
| *cis*-piperitol | - | 0.2 |
| myrtenol | - | 0.1 |
| *trans*-piperitol | 0.1 | 0.4 |
| nerol | - | 2.0 |
| methyl thymol | - | 0.5 |
| *trans*-chrysanthenyl acetate[‡] | - | 0.1 |
| cuminaldehyde | t | 0.2 |
| neral | - | 0.5 |
| methyl carvacrol | - | 1.1 |
| thymoquinone | 2.8 | 0.1 |
| geraniol | 0.1 | 22.3 |
| geranial | - | 1.1 |
| 2-ethyl menthone[‡] | 0.2 | - |
| bornyl acetate | - | 0.1 |
| thymol | 31.7 | 3.8 |
| o-acetanisole[‡] | - | 0.4 |
| cuminyl alcohol | - | 0.2 |
| carvacrol | 23.3 | 10.6 |
| *cis*-piperityl acetate | - | 0.1 |
| α-terpinyl acetate | - | 0.1 |
| thymol acetate | 0.1 | - |
| eugenol | 0.1 | t |
| α-copaene | - | 0.1 |
| β-bourbonene | - | 0.4 |
| geranyl acetate | - | 0.1 |
| β-elemene | - | 0.1 |
| β-caryophyllene | - | 2.9 |
| β-copaene | - | 0.1 |
| aromadendrene | - | 0.1 |
| 4-t-butylcatechol[‡] | 1.1 | - |
| α-humulene | - | 0.1 |
| allo-aromadendrene | - | 0.1 |
| γ-muurolene | - | 0.1 |
| germacrene D | - | 1.9 |
| bicyclogermacrene | - | 1.0 |
| β-bisabolene | - | 0.7 |
| γ-cadinene | - | 0.1 |

**T-3. Comparative percentage composition of the oils of two populations of *Satureja montana* from Bosnia Herzegovina (Cont.)**

| Compound | Population 1 oil | Population 2 oil |
|---|---|---|
| butylated hydroxytoluene‡ | 0.1 | 0.1 |
| δ-cadinene | t | 0.2 |
| dihydroactinodiolide‡ | 0.4 | 0.1 |
| α-cadinene | - | 0.1 |
| salviadienol* | - | 0.1 |
| (E)-nerolidol | 0.3 | - |
| spathulenol | 3.0 | 3.1 |
| caryophyllene oxide | 7.7 | 5.2 |
| viridiflorol | 0.3 | - |
| salvial-4(14)-en-1-one | t | 0.2 |
| humulene epoxide II | 0.3 | 0.3 |
| guaia-6(10),14-dien-4β-ol | - | 0.1 |
| torilenol | 0.2 | 0.3 |
| caryophylla-3(15),7(14)-dien-6α-ol | 0.5 | 0.1 |
| caryophylla-3(15),7(14)-dien-6β-ol | 2.2 | 0.4 |
| isospathulenol | t | 0.2 |
| 3-isothujopsanone† | 0.2 | 0.2 |
| β-eudesmol | 0.2 | - |
| α-cadinol | 0.5 | - |
| 14-hydroxy-β-caryophyllene | 2.6 | 0.4 |
| 14-hydroxy-9-epi-β-caryophyllene | 4.1 | 0.8 |
| khusinol† | 0.5 | 0.4 |
| 6α-hydroxygermacra-1(10),4-diene† | - | 0.1 |
| eudesma-4(15),7-dien-1β-ol | t | 0.1 |
| oplopanone | 0.1 | - |
| benzyl benzoate | 0.2 | - |
| hexadecanoic acid | 1.0 | - |
| heneicosane | t | 0.1 |
| docosane | t | 0.2 |
| tricosane | 0.1 | 0.6 |
| tetracosane | 0.3 | 1.2 |
| pentacosane | 0.3 | 1.6 |
| hexacosane | 0.3 | 2.4 |

†doubtful correct identification
‡incorrect identification
*correct isomer not determined
ffuranoid form
ppyranoid form
t=trace (<0.05%)

supercritical fluid $CO_2$ extracts of *S. montana* (performed under different pressures) collected at their full flowering stage from a medicinal garden at Ejea (Spain). The results of the analyses performed using GC-FID and GC/MS can be seen summarized in **T-4**. The yield of oil from the dried plant material, which was reduced to different particle sizes (0.4, 0.6 and 0.8 mm), was 1.1–1.6%; the smaller the particle size, the higher the oil yield. The yield of volatiles found in the supercritical fluid extracts ranged from 0.9–1.8%, the highest being found with dried plant material with a mean particle size of 0.6 mm at 40°C and 100 bar pressure, and a 1.1 kg/hr flow rate of $CO_2$.

Silva et al. (2009) also compared the compositions of a hydrodistilled oil and a supercritical fluid extract of *S. montana*; however, these results were previously published by Grosso et al. (2009).

*Satureja montana* plants collected at the commencement of flowering near the village of Pijavicino (Peljesac Peninsula, Croatia) were dried at ambient temperatures, and a 10 g sample was hydrodistilled for 2 hr. The oil, which was analyzed by Vidic et al. (2009) using GC/MS only, was determined to possess the following composition:

1-octen-3-ol (1.4%)
3-octanol (0.2%)
α-terpinene (0.1%)
p-cymene (0.3%)
1,8-cineole (0.1%)
γ-terpinene (0.1%)
*cis*-sabinene hydrate (0.3%)
*trans*-sabinene hydrate (0.1%)
linalool (0.3%)
*cis*-p-menth-2-en-1-ol (0.1%)
*trans*-p-menth-1-en-1-ol (0.1%)
camphor (0.1%)
borneol (5.3%)
terpinen-4-ol (1.0%)
p-cymen-8-ol (0.2%)
α-terpineol (0.3%)
*cis*-dihydrocarvone (0.1%)
*trans*-dihydrocarvone (0.1%)
methyl thymol (0.3%)
methyl carvacrol (0.5%)
thymoquinone (0.6%)
thymol (20.1%)
carvacrol (59.1%)
thymol acetate (0.2%)
carvacrol acetate (0.3%)
β-caryophyllene (1.8%)
α-gurjunene (0.1%)
aromadendrene (0.4%)
α-humulene (0.1%)
allo-aromadendrene (0.1%)
γ-muurolene (0.1%)
viridiflorene (0.2%)
β-bisabolene (2.0%)
δ-cadinene (0.1%)
thymohydroquinone (0.2%)
spathulenol (0.6%)
caryophyllene oxide (1.9%)
globulol (0.1%)
cubeban-11-ol (0.1%)
rosifoliol (0.1%)
humulene epoxide II (0.1%)
14-hydroxy-9-epi-β-caryophyllene (0.2%)
epi-α-bisabolol (0.1%)

Trace amounts (<0.1%) of *trans*-piperitol, isobornyl formate, *cis*-piperitenone oxide, bornyl acetate, β-bourbonene, β-cubebene, γ-amorphene, α-muurolene, γ-cadinene, *trans*-cycloisolongifol-5-ol (doubtful correct identification), α-cadinene, α-calacorene, caryophylla-4(12),8(13)-dien-5α-ol, caryophylla-4(12),8(13)-dien-5β-ol and T-muurolol were also reported as constituents of this oil.

A lab-distilled oil of *Satureja montana*, which was produced from dried leaves grown in Evora (Portugal), was screened

for its nematicidal activity by Barbosa et al. (2010). Analysis of this oil by GC-FID and GC/MS revealed that it possessed the following composition:

α-thujene (2.3%)
α-pinene (1.5%)
camphene (0.1%)
1-octen-3-ol (0.3%)
β-pinene (0.5%)
myrcene (2.5%)
α-phellandrene (0.4%)
δ-3-carene (0.1%)
α-terpinene (4.1%)
p-cymene (7.1%)
β-phellandrene (0.2%)
limonene (0.4%)
γ-terpinene (39.8%)
*trans*-sabinene hydrate (0.6%)
*cis*-sabinene hydrate (0.1%)
borneol (0.1%)
terpinen-4-ol (0.4%)
methyl carvacrol (0.2%)
carvacrol (38.8%)
β-caryophyllene (0.5%)

Trace amounts (<0.05%) of 3-octanol, (E)-β-ocimene, terpinolene, *cis*-dihydrocarvone, α-terpineol, thymol and β-bisabolene were also found in this oil.

Grosso et al. (2010) screened the oil and supercritical fluid $CO_2$ extract for their anticholinesterase and antimicrobial activities. They reported the same compositional data, as was reported by Grosso et al. (2009) and Silva (2009).

Finally, a summary of the published data on the composition of savory oil (Lawrence, 1979, 1981, 1988, 1992, 1996, 2003) reveals that *S. montana* oil possesses six chemotypic forms. A comparison of the major components found in these six chemotypic oils is shown in **T-5**.

**T-4. Comparative percentage composition of the oil and the volatiles of supercritical fluid $CO_2$ extracts of *Satureja montana* produced under different pressures**

| Compound | Oil | SFE 90 bar | SFE 100 bar |
|---|---|---|---|
| α-thujene | 0.4–0.6 | 0.1–0.3 | 0.2–0.3 |
| α-pinene | 0.4–0.7 | 0–0.3 | 0.2 |
| camphene | 0–t | 0–0.1 | 0–t |
| sabinene | 0.1–0.2 | 0–0.1 | t–0.1 |
| 1-octen-3-ol | 0.1–0.2 | t–0.2 | 0.1 |
| β-pinene | 0.5–0.8 | 0.4–0.6 | 0.7–1.2 |
| myrcene | 0.7–1.1 | 0.3–0.6 | 0.4–0.8 |
| α-phellandrene | 0.2 | 0.1–0.2 | 0.1–0.3 |
| δ-3-carene | t–0.1 | 0–t | t |
| α-terpinene | 1.2–1.8 | 0.7–1.4 | 1.0–1.9 |
| p-cymene | 6.9–12.8 | 6.0–10.9 | 8.9–17.8 |
| 1,8-cineole | 0.3–0.5 | 0.2–0.4 | 0.3–0.6 |
| β-phellandrene | 0.3–0.5 | 0.2–0.4 | 0.3–0.6 |
| limonene | 0.2–0.4 | 0.1–0.3 | 0.3 |
| (Z)-β-ocimene | 0–0.1 | 0–0.1 | - |
| γ-terpinene | 6.4–9.4 | 2.3–5.5 | 3.1–6.0 |
| *trans*-sabinene hydrate | 0.4–0.5 | 0.3–0.7 | 0.3–0.6 |
| terpinolene | 0.2 | 0.1–0.2 | 0.1–0.3 |
| *cis*-sabinene hydrate | 0.1 | 0–0.2 | 0.1 |
| linalool | 0.6–0.8 | 0.5–1.1 | 0.9–1.0 |
| borneol | 0.7–0.8 | 0.7–0.9 | 0.6–0.8 |
| terpinen-4-ol | 0.6–0.7 | 0.4 | 0.4–0.6 |
| α-terpineol | 0.2 | 0.1–0.2 | 0.2–0.3 |
| carvone | 0–0.1 | 0.1–0.3 | 0.1–0.3 |
| thymoquinone | 0.2 | 1.6–3.1 | 2.5–2.9 |
| methyl carvacrol | 0.1 | - | 0–t |
| thymol | 8.6–11.0 | 6.0–10.9 | 9.1–11.3 |
| carvacrol | 52.2–62.0 | 52.7–64.5 | 41.7–52.8 |
| β-bourbonene | t–0.1 | t–0.1 | 0.1 |
| β-caryophyllene | 1.3–1.5 | 1.4–1.5 | 1.3–2.1 |
| *trans*-α-bergamotene | 0.1–0.2 | t–0.3 | t–0.5 |
| γ-muurolene | 0.1 | 0–0.2 | 0.1 |
| germacrene D | 0.2–0.3 | 0–0.3 | 0.3–0.5 |
| β-bisabolene | 2.0–2.7 | 2.5–3.0 | 2.2–3.5 |
| δ-cadinene | 0.2 | 0–0.2 | 0.2–0.3 |
| thymohydroquinone | 0.3–0.4 | 0.3–0.5 | 0.4–0.6 |
| caryophyllene oxide | 0.2–0.3 | 0.1–0.2 | 0.1–0.2 |
| α-bisabolol | 0–t | 0–t | 0–t |

t=trace (<0.05%)

**T-5. Percentage composition of the oils of six chemical forms of *Satureja montana***

| Compound | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| α-pinene | 0.4–1.4 | t–1.1 | 1.7–1.8 | 0.1 | 0.4 | 0.2 |
| myrcene | t–0.2 | t–1.2 | t–0.2 | 0.1 | 0.5–1.9 | 4.9 |
| γ-terpinene | 3.5–10.3 | 1.8–15.1 | 8.1–11.6 | 1.3 | 1.9–6.4 | 1.0 |
| p-cymene | 2.5–13.0 | 2.2–14.6 | 4.6–8.9 | 0.9 | 3.7–12.5 | 0.6 |
| linalool | 0.3–0.6 | 0.1–0.6 | 0.2–0.4 | 72.2 | 27.8–29.9 | 0.6 |
| terpinen-4-ol | 0.1–1.2 | 3.1–4.1 | 0.1–0.6 | 8.5 | 6.8–11.5 | 14.9 |
| α-terpineol | 0.3–3.1 | 2.4–4.4 | 0.2–0.7 | 1.9 | 11.5–27.7 | 18.0 |
| thymol | 53.5–65.7 | 1.0–8.0 | 22.3–42.6 | 0.6 | 2.2–9.0 | 14.5 |
| carvacrol | t–6.8 | 46.5–75.0 | 17.6–31.0 | t | 0–4.2 | 3.7 |

t=trace amount (<0.05%)


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