



Progress in Essential Oils

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Tejpat Oil

Although tejpat oil is normally produced in India from the leaves of *Cinnamomum tamala* Nees et Eberm, Baruah et al, (2004) examined the composition of an oil obtained in the laboratory from the hydrodistillation of mature fruit of *C. tamala*. They found that the composition of this oil was:

- 1,8-cineole (1.1%)
- camphol (0.7%)
- terpinen-4-ol (1.3%)
- α -terpineol (2.3%)
- eugenol (73.6%)
- methyl cinnamate (0.8%)
- β -caryophyllene (2.8%)
- isoeugenol* (0.5%)
- ethyl cinnamate (0.9%)
- eugenyl acetate (6.1%)
- α -humulene (0.7%)
- α -farnesene* (5.1%)
- caryophyllene oxide (1.7%)

*correct isomer not identified.

Trace amounts of linalool, borneol, cinnamaldehyde and methyl eugenol were also found in this oil.

Botanically authenticated *C. tamala* leaves that were purchased at a local market in Delhi were subjected to hydrodistillation and analysis by Mir et al. (2004). The oil was found to be unusual as it was devoid of eugenol. Its composition was determined to be as follows:

- α -pinene (3.1%)
- camphene (1.8%)
- sabinene (2.3%)
- β -pinene (0.7%)
- myrcene (4.6%)
- p-cymene (0.2%)
- (Z)- β -ocimene (17.9%)
- trans-sabinene hydrate (29.8%)
- trans-pinocarveol (0.2%)
- trans-verbenol (0.5%)
- citronellal (0.8%)
- terpinen-4-ol (0.9%)
- α -terpineol (1.2%)

- neral (0.3%)
- carvone (0.5%)
- 2,6-dimethyl-2 (3),7-octadiene[†] (0.8%)
- α -copaene (0.4%)
- β -caryophyllene (0.3%)
- α -guaiene (1.2%)
- aromadendrene (1.1%)
- α -humulene (0.2%)
- germacrene D (0.8%)
- β -selinene (1.9%)
- eremophilene (0.1%)
- β -bisabolene (0.5%)
- germacrene A (11.3%)
- γ -cadinene (1.6%)
- δ -cadinene (0.9%)
- ledol (1.2%)
- spathulenol (1.1%)
- epi-globulol (1.9%)
- caryophyllene oxide (1.9%)
- globulol (0.7%)
- viridifloriol (0.2%)
- T-muurolol (0.3%)
- hexadecanoic acid (1.2%)

[†]incorrect identification based on GC elution order

It should be noted that as the authors used an initial temperature program of 100°C and the β -elemene content is lower than would be expected because of the Cope rearrangement of germacrene A, consequently the quantitation of both these sesquiterpene hydrocarbons is probably incorrect.

Baruah and Nath (2004) summarized the composition of oils from *C. tamala*. They did show that a study by Upadhyaya et al. (1994) on a Nepalese oil revealed that the main components of this oil were:

- α -pinene (9.7%)
- β -pinene (4.5%)
- p-cymene (6.4%)
- limonene (2.6%)
- linalool (54.7%)

The oil also contained cinnamaldehyde (1.2%) while eugenol was not detected.

Baruah et al. (2005) used a combination of GC and GC/MS to examine the

composition of oils produced from tejpat leaves collected in Assam (India). They found that the oil contained the following constituents:

- α -pinene (0.4%)
- camphene (0.2%)
- β -pinene (0.4%)
- myrcene (0.2%)
- α -phellandrene (4.8%)
- 1,8-cineole (0.6%)
- p-cymene (4.2%)
- linalool (24.5%)
- linalyl acetate (1.4%)
- eugenol (56.6%)
- β -caryophyllene (3.9%)
- isoeugenol* (0.5%)
- eugenyl acetate (0.8%)
- eugenyl cinnamate (1.2%)

*correct isomer not identified.

A trace of methyl (E)-cinnamate was also found in this oil.

An oil produced from the leaves of *C. tamala* grown in Manipur that were purchased in a local market in Imphal was the subject of analysis by Rana and Blazquez (2005). The composition of the oil was found to be as follows:

- (Z)-3-hexenol (0.2%)
- 2-hexenol* (0.1%)
- α -thujene (0.2%)
- α -pinene (0.5%)
- β -pinene (0.1%)
- myrcene (0.1%)
- α -phellandrene (4.1%)
- δ -3-carene (0.1%)
- p-cymene (1.4%)
- limonene (0.8%)
- 1,8-cineole (0.5%)
- (E)- β -ocimene (0.1%)
- terpinolene (0.3%)
- terpinen-4-ol (0.1%)
- α -terpineol (0.2%)
- eugenol (81.7%)
- β -caryophyllene (0.1%)
- germacrene D (0.1%)
- bicyclogermacrene (0.6%)

δ -cadinene (0.1%)
 isoeugenyl acetate* (0.2%)
 spathulenol (0.5%)
 viridiflorol (0.2%)
 cubenol (0.2%)
 isospathulenol (0.1%)
 T-cadinol (0.1%)
 α -cadinol (0.1%)
 dodecyl acrylate† (0.1%)

*correct isomer not identified

†incorrect identification based on GC elution order

Trace amounts (<0.1%) of 1-hexenol, α -fenchene, camphene, sabinene, ethyl hexanoate, α -terpinene, (Z)- β -ocimene, γ -terpinene, *cis*-sabinene hydrate, linalool, *cis*-p-menth-2-en-1-ol, *trans*-p-menth-2-en-1-ol, borneol, p-cymen-8-ol, *cis*-piperitol, thymol, aromadendrene, α -humulene, β -selinene, 4-allyl-2,6-dimethoxyphenol and α -muurolol were also found in this oil.

Baruah et al. (2007) analyzed an oil of the leaves of *C. tamala* collected from a single tree in Baghchung, Jorhat (Assam, India). This oil was found to possess the following composition:

benzaldehyde (1.1%)
 α -pinene (2.3%)
 camphene (0.3%)
 β -pinene (0.4%)
 myrcene (0.5%)
 α -phellandrene (14.9%)
 p-cymene (2.5%)
 1,8-cineole (1.3%)
 β -phellandrene (0.3%)
 γ -terpinene (0.3%)
 linalool (1.1%)
 borneol (0.1%)
 α -terpineol (0.5%)
 hydrocinnamaldehyde (0.1%)
 (E)-cinnamaldehyde (0.2%)
 eugenol (70.6%)
 β -caryophyllene (0.3%)
 isoeugenol* (0.2%)
 methyl isoeugenol* (0.3%)
 eugenyl acetate (1.2%)
 caryophyllene oxide (0.9%)

*correct isomer not identified

In addition, methyl cinnamate and terpinolene were found as trace (<0.1%) components of this oil. The main components of tejpat oil were determined by Sultana et al. (2008) to be as follows:

α -thujene (0.1%)
 α -pinene (0.2%)
 linalool (0.3%)
 isoeugenol* (31.3%)
 eugenol (74.4%)

β -elemene (1.1%)
 ethyl cinnamate (0.7%)
 β -caryophyllene (0.2%)
 eugenyl acetate (1.2%)
 caryophyllene oxide (0.3%)
 spathulenol (0.4%)

*correct isomer not identified

Joshi et al. (2008) analyzed leaf oils from *C. tamala* produced from trees growing in different areas in Uttarakhand (India). Their analyses revealed that there were significant quantitative differences found in the oils. A summary of these difference are shown in **T-1**. As can be seen, the oils ranged in cinnamaldehyde and linalool. One oil contained camphor while only one commercial oil contained

eugenol which supports the existence of chemotypical forms of *C. tamala*.

Oils of *C. tamala* collected from seven locations in Manipur (N.E. India) were analyzed by Rana et al. (2009). The oils were found to range in composition as follows:

(Z)-3-hexenol (0–0.1%)
 α -thujene (t–1.1%)
 α -pinene (0.1–2.5%)
 α -fenchene (0–0.1%)
 camphene (0–0.1%)
 sabinene (0–1.0%)
 β -pinene (0–0.5%)
 myrcene (0.1–0.7%)
 α -phellandrene (1.0–25.4%)
 δ -3-carene (t–1.0%)
 α -terpinene (t–0.3%)

T-1. Comparative percentage composition of leaf oils of *Cinnamomum tamala* of Uttarakhand origin

Compound	1	2	3	4
α -thujene	0-0.6	t-0.2	t-0.1	-
α -pinene	0-0.6	0.1-0.5	1.2-1.3	0.3
camphene	0-1.0	t-0.1	0-0.8	t
benzaldehyde	0-1.8	0.4-0.7	0.6-0.8	0.3
sabinene	0-1.4	0-0.3	0.6-1.1	-
β -pinene	0-1.3	0.2	0.9-1.1	0.1
myrcene	0-0.4	0-0.1	0.3-0.5	-
α -phellandrene	0-1.8	t	t	0.1
α -terpinene	0-0.3	t-0.6	0.1-0.6	0.4
p-cymene	0.1-5.1	0.2-1.0	1.0-3.0	1.3
limonene	0.1-1.3	0.3-0.5	0.1-3.6	0.9
1,8-cineole	0-0.4	0.8-0.9	t-0.2	0.3
terpinolene	0-0.2	t-0.3	0.2-0.3	t
linalool	3.4-13.9	27.9-30.7	15.9-17.5	23.3
camphor	0-2.9	-	23.6-25.4	-
borneol	0.1-0.4	0.5-1.5	0.2-0.4	0.4
terpinen-4-ol	0.1-0.4	0.1-0.5	0.2	0.1
methyl chavicol	0-0.6	0.1-0.2	0-0.3	0.2
(Z)-cinnamaldehyde	0.1-0.6	0-0.4	0.1-0.3	0.2
(E)-cinnamaldehyde	57.6-79.9	44.0-50.9	36.1-38.2	23.2
bornyl acetate	0-0.9	0-0.8	0.4	0.3
eugenol	0-0.1	0-t	-	39.7
α -copaene	0-0.2	t-0.2	t-0.2	-
methyl (E)-cinnamate	0-9.6	-	t-0.3	0.1
β -cubebene	0-0.2	0.3-0.6	0-0.2	-
β -caryophyllene	t-1.3	0.6-6.9	0.5-0.6	2.7
(E)-cinnamyl acetate	0-11.4	1.1-5.9	6.8-7.0	1.1
γ -cadinene	0-0.4	t-0.3	t-0.2	0.2
spathulenol	0-0.3	0-0.2	0.1-0.2	-
caryophyllene oxide	0.1-0.5	t-1.7	0.2-0.3	1.8
10-epi- γ -eudemol	0-0.6	0.1-0.6	t-0.3	0.2

t = trace (<0.1%)

1 = oils from Pithoragarh, Ranikhet, Jeolikote, Hedakhan and a commercial oil from Nainital

2 = oils from Almora and a commercial oil from Ramnagar

3 = oils from Bageshwar and Tanakpur

4 = a commercial oil from Tanakpur

p-cymene (t-1.1%)
 o-cymene (0-4.1%)
 limonene (0.1-1.5%)
 1,8-cineole (0.2-2.7%)
 (Z)- β -ocimene (0-0.3%)
 (E)- β -ocimene (0.1-1.6%)
 γ -terpinene (t-0.3%)
 terpinolene (0.1-2.8%)
 linalool (0.1-0.4%)
cis-p-menth-2-en-1-ol (0-0.2%)
trans-p-menth-2-en-1-ol (0-0.1%)
 borneol (0-0.6%)
 terpinen-4-ol (t-0.4%)
 p-cymen-8-ol (0-0.2%)
 verbenone (0-0.2%)
 bornyl acetate (0-0.2%)
 thymol (0-0.2%)
 eugenol (35.1-94.3%)
 α -copaene (0-0.2%)
 geranyl acetate (0-0.1%)
 β -elemene (t-0.2%)
 tetradecane (0-0.1%)
 α -gurjunene (0-0.1%)
 β -caryophyllene (0.2-1.6%)
 aromadendrene (t-0.4%)
 α -humulene (t-0.2%)
 allo-aromadendrene (t-0.5%)
 γ -muurolene (t-0.2%)
 germacrene D (t-0.6%)
 β -selinene (0-0.1%)
trans-muurola-4(14),5-diene (0-0.1%)
 α -selinene (0-0.1%)
 bicyclogermacrene (0.4-12.8%)
 γ -cadinene (t-0.7%)
 δ -cadinene (0.1-1.8%)
 eugenyl acetate (0-13.8%)
 cadina-1(2),4-diene (0-0.1%)
 α -cadinene (0-0.1%)
 germacrene B (0-0.1%)
 germacrene D-4-ol (0-1.4%)
 spathulenol (0.3-2.5%)
 caryophyllene oxide (0-1.9%)
 viridiflorol (0-0.5%)
 guaial (0-0.7%)
 humulene epoxide II (0-0.1%)
 1,10-di-epi-cubenol (0-0.1%)
 1-epi-cubenol (0-0.2%)
 isospathulenol (0-0.1%)
 T-cadinol (0-1.2%)

T-muurolol (0-2.0%)
 α -cadinol (0-3.2%)
 dodecyl acetate (0-0.2%)
 selin-11-en-4 α -ol (0-0.4%)

Trace amounts (<0.1%) of 2-hexenal, hexanol, 2-hexenol, (Z)-3-hexenyl acetate, 3,4-dimethylbenzaldehyde, chavicol, α -cubebene, β -cubebene, β -gurjunene, γ -elemene, *trans*-cadina-1(6),4-diene, α -muurolene, and 4-allyl-2,6-dimethylphenol were found in one or more of the tejpatt oils analyzed.

Baruah (2010) reviewed the published studies on the composition of tejpatt oil. In addition to the compositions cited in Lawrence (1981, 1983, 2002) and in this article the composition of an oil from Mahur (Maharashtra, India) determined by Nath et al. (1994) (cited in Baruah, 2010) was reposted to be as follows:

benzaldehyde (1.4%)
 α -pinene (10.5%)
 camphene (3.1%)
 β -pinene (10.4%)
 myrcene (0.1%)
 limonene (3.2%)
 linalool (60.7%)
 benzyl acetate (0.1%)
 α -terpineol (0.2%)
 geraniol (2.2%)
 linalyl acetate (0.3%)
 cinnamaldehyde (0.2%)
 eugenol (0.9%)

This report appears to suggest the existence of another chemotype of *C. tamala* leaf oil.

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