

CONSTITUENTS OF LEAF ESSENTIAL OIL OF *Mentha longifolia* FROM INDIA

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In India, *Mentha longifolia* (Lamiaceae) grows in Garhwal, Kumaon, Kashmir, and Punjab [1] and has two varieties, viz. *incana* with slender interrupted spikes and *royleana* with stout continuous spikes. The plant has carminative, antiseptic, antispasmodic, and stimulant activity [2]. Leaves upon hydrodistillation yield essential oil that has antimicrobial, antioxidant [3], and pesticidal activity [4], and find use as a substitute for peppermint in confectionary [5]. However, the biological activity of the oil depends upon the chemical constituents in the oil, which vary greatly with geographical regions. For example, essential oil rich in piperitenone oxide (from Lithuania and Jordan), carvone and *cis*-carveol (from Iran), pulegone (from Israel), and diosphenol (from Spain) have been reported [6-11]. However, details about the composition of the leaf essential oil of *M. longifolia* (from Sirmour) growing abundantly as a wild herb along riverbanks, canals, and water streams in Himachal Pradesh, India are lacking.

TABLE 1. Components of Leaf Essential Oil of *Mentha longifolia*

| Compound | Time, min | Kovats Index* | Percentage | Compound | Time, min | Kovats Index* | Percentage |
|---------------------------------|-----------|---------------|------------|---------------------------------------|-----------|---------------|------------|
| β -Myrcene | 4.16 | 1161 | 0.32 | α -Terpineol | 19.26 | 1695 | 1.51 |
| <i>psi</i> -Limonene | 4.30 | 1170 | 0.03 | <i>cis</i> -Piperitone oxide | 19.49 | 1703 | 7.04 |
| α -Terpinene | 4.47 | 1181 | 0.06 | <i>trans</i> -Piperitone oxide | 20.07 | 1724 | 24.06 |
| <i>dl</i> -Limonene | 4.83 | 1202 | 1.42 | <i>dl</i> -Carvone | 20.15 | 1726 | 0.09 |
| Eucalyptol | 5.02 | 1210 | 1.25 | <i>p</i> -Menthane-1,2,3-triol | 20.32 | 1733 | 0.62 |
| <i>cis</i> - β -Ocimene | 5.59 | 1234 | 0.20 | <i>cis</i> -Pinocarvyl acetate | 21.28 | 1748 | 0.12 |
| γ -Terpinene | 5.83 | 1244 | 0.08 | 2-Hydroxypiperitone | 22.31 | 1804 | 0.06 |
| <i>trans</i> - β -Ocimene | 6.00 | 1251 | 0.03 | Unidentified | 22.39 | 1822 | 0.11 |
| <i>p</i> -Cymene | 6.46 | 1270 | 0.20 | Isopiperitenone | 23.13 | 1831 | 0.41 |
| α -Terpinolene | 6.73 | 1281 | 0.04 | <i>p</i> -Cymen-8-ol | 23.65 | 1850 | 0.12 |
| 3-Octanol | 9.98 | 1395 | 0.36 | <i>p</i> -Mentha-1(7),8(10)-dien-9-ol | 24.65 | 1886 | 0.11 |
| <i>trans</i> -Sabinene hydrate | 12.11 | 1462 | 0.06 | 4-Hydroxypiperitone | 25.14 | 1904 | 0.34 |
| Dihydroedulan II | 12.76 | 1482 | 0.13 | Piperitenone | 25.34 | 1911 | 0.25 |
| α -Bourbonene | 13.53 | 1507 | 0.05 | <i>cis</i> -Jasmone | 25.99 | 1935 | 0.22 |
| Linalool | 14.84 | 1550 | 0.25 | Piperitenone oxide | 26.42 | 1951 | 54.23 |
| (-)- β -Caryophyllene | 15.90 | 1584 | 3.02 | Isocaryophyllene oxide | 26.66 | 1960 | 0.25 |
| Terpinen-4-ol | 16.32 | 1598 | 0.20 | Caryophyllene oxide | 26.88 | 1968 | 1.09 |
| Resorcinol | 17.03 | 1622 | 0.09 | Unidentified | 27.61 | 1979 | 0.20 |
| α -Humulene | 18.07 | 1656 | 0.11 | <i>trans</i> -Nerolidol | 28.78 | 2041 | 0.05 |
| <i>cis</i> - β -Farnesene | 18.34 | 1665 | 0.20 | <i>m</i> -Thymol | 32.39 | 2189 | 0.46 |
| Linalyl propanoate | 18.48 | 1670 | 0.12 | | | | |

*Based on *n*-alkane series (C₈-C₃₂).

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Upon hydrodistillation, leaves of *M. longifolia* yield a pale yellow colored oil (~ 0.51%, v/w). GC/MS analysis of the oil revealed the presence of 41 volatile constituents eluted between 4 and 33 min (Table 1). Among these, 39 were identified and accounted for 99.25% of the oil. In general, the oil was of monoterpenoid nature with 7 sesquiterpenes (~4.77%), 1 aliphatic ketone (0.22%), 1 hydrocarbon alcohol (0.36%) and 1 irregular terpenoid (0.13%). The oil was oxygenated (26 constituents) and rich in epoxy ketones with piperitenone oxide (54.23%), *trans*-piperitone oxide (24.06%) and *cis*-piperitone oxide (7.04%) as the main components, and these together constitute ~85.3% of the oil (Table 1).

Identification of piperitenone oxide as the major constituent in the oil is in sharp contrast to other report from Jammu, India where the oil had carvone as the major component [12]. Nevertheless, it was similar to reports from Lithuanian and Jordanian chemotypes that were rich in piperitenone oxide [8, 9]. However, it contrasted with oil rich in carvone [10] or *cis*-carveol [11] from Iran, and pulegone- rich oil from Israel [7].

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