

ESSENTIAL OIL COMPOSITION AND ANTIMICROBIAL ACTIVITY OF *Citrus reticulata*

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The chemical composition of the essential oil obtained from the peel of Ponkan (*Citrus reticulata* Blanco) was analyzed by GC/MS. Table 1 shows the composition of the essential oil. Compounds were listed in order of their elution from a HP-5MS column. Twenty-six compounds were identified, representing 99.46% of the oil. As revealed by Table 1, the dominant components of Ponkan oil were monoterpene hydrocarbons (limonene 75.75%, 3-carene 10.12%, β -myrcene 5.12%, α -pinene 1.79%, β -pinene 1.20%, terpinolene 0.80%, sabinene 0.68, and other minor constituents, which represented 95.96% of the total oil. Trace amounts of 1-chlorooctane were also observed.

The antimicrobial activity of the essential oil measured by the disc diffusion method is given in Table 2. The essential oil showed marked antibacterial and antifungal activities, as evidenced by their zones of inhibition. Among the tested microbiology, the oil was very active against *Bacillus subtilis*, with an average inhibition zone of 36.38 mm. Although *Aspergillus flavus* was more resistant to the oil, as compared with *Escherichia coli* and *Staphylococcus aureus*, it could also be easily inhibited by the oil. In fact, the citrus oils have been proven to be inhibitory against a wide range of food spoiling microbes, dependent upon their concentration, method of testing, and active constituents present [1–3].

Our findings indicated that the essential oil isolated from Ponkan has antimicrobial activity and can be used to control microorganisms since this has been used in folk medicine for decades. It will be worthwhile to investigate the individual components in antibacterial and antifungal assays.

TABLE 1. Chemical Composition of Ponkan Essential Oil

| Compounds | Rt, min | Content, % | Compounds | Rt, min | Content, % |
|------------------------------|---------|------------|--------------------------------------------------|---------|------------|
| α -Phellandrene | 5.029 | 0.40 | 2-Heptanol | 8.95 | 0.04 |
| α -Pinene | 5.154 | 1.79 | 4-Terpineol | 9.152 | 0.29 |
| Sabinene | 5.792 | 0.68 | α -Terpineol | 9.351 | 0.14 |
| β -Pinene | 5.861 | 1.20 | Decanal | 9.508 | 0.57 |
| β -Myrcene | 6.047 | 5.12 | Citronellol | 9.849 | 0.21 |
| Limonene | 6.779 | 75.75 | 2-Methoxy-4-methyl-1-(1-methylethyl)- benzene | 9.982 | 0.15 |
| β -Ocimene | 7.011 | 0.10 | (+)-Carvone | 10.192 | 0.11 |
| 3-Carene | 7.25 | 10.12 | 1-Chlorooctane | 10.921 | 0.07 |
| Terpinolene | 7.694 | 0.80 | 1-Heptanol | 11.05 | 0.04 |
| Linalool | 7.834 | 0.56 | 3,7-Dimethyl-6-octen-1-ol acetate | 11.701 | 0.09 |
| Nonanal | 7.9 | 0.06 | Linalyl acetate | 11.874 | 0.17 |
| 4-Acetyl-1-methylcyclohexene | 8.392 | 0.04 | Dodecanal | 12.506 | 0.15 |
| Limonene oxide | 8.435 | 0.59 | Total | | 99.46 |
| Citronellal | 8.692 | 0.22 | | | |

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TABLE 2. Antimicrobial Activity of Ponkan Essential Oil

| Tested microorganism | Inhibition zone, mm | Tested microorganism | Inhibition zone, mm |
|---------------------------|---------------------|------------------------------|---------------------|
| <i>Aspergillus flavus</i> | 20.25±2.88 | <i>Staphylococcus aureus</i> | 22.94±3.20 |
| <i>Bacillus subtilis</i> | 36.38±3.90 | <i>Escherichia coli</i> | 26.58±3.71 |

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