CHAPTER 5

Conclusions

In conclusion, the essential oils of six plants, comprising *E. stachyodes*, *E. communis*, *E. griffithii*, *E.* sp., *C. lansium*, and *C. harmandiana*, were extracted using steam distillation method. The highest yield of the essential oil content was obtained from *E.* sp., followed by *E. griffithii*, *E. communis*, *E. stachyodes*, *C. harmandiana*, and *C. lansium* at 1.21, 0.58, 0.44, 0.26, 0.10 and 0.01%w/w, respectively. The dried solid residues were re-extracted with hexane, acetone, and ethanol obtained residual crude extracts.

The chemical constituents of the essential oils were characterized by gas chromatography mass spectrometry (GC-MS) technique on the HP-5MS column. The results can be concluded that the major compounds of six essential oils were presented by monoterpene, oxygenated monoterpene, sesquiterpene, oxygenated sesquiterpene, acyl furan and fatty acids. The essential oil of *E. stachyodes* was dominated by monoterpene and oxygenated monoterpenes which the main compounds were *γ*-terpinene (24.39%), *α*-terpinene (6.57%), *p*-cymene (6.09%) and carvacrol (43.75%). The chemical constituents of *E. communis* oil consisted mainly of neral (35.53%) and geranial (45.43%), which were oxygenated monoterpene whereas *E. griffithii* oil was dominated by acyl furan such as elsholtzia ketone (83.87%) and *β*-dehydroelsholtzia ketone (6.12%). Moreover, the major components of *E.* sp. essential oil consisted mainly of acyl furan followed by oxygenated monoterpenes and sesquiterpene at 26.89, 17.30, and 38.53%, respectively. The major compounds were neral (9.98%), geranial (12.03%), (*E*)-caryophyllene (9.92%), *α*-humulene (1.66%), *α*-zingiberene (3.80%), and elsholtzia ketone (38.21%).

The chemical constituents of the essential oil of *C. lansium* were dominated by sesquiterpene and oxygenated sesquiterpenes. The essential oil consisted mainly of (*E*)-caryophyllene (18.66%), *α*-(*E*,*E*)-farnesene (8.73%), *β*-(*E*)-farnesene (5.56%), *α*-(*Z*)-santalol (24.81%), *trans*-sesquisabinene hydrate (10.63%), (*E*)-nerolidol (5.36%), and *α*-(*Z*)-*trans*-bergamotol (2.54%). Whereas the major compounds of *C. harmandiana* oil were fatty acids such as decanoic acid (15.74%), undecanoic acid (6.86%), and dodecanoic acid (35.65%), followed by monoterpene such as *β*-(*Z*)-ocimene (12.41%) and *β*-(*E*)-ocimene (13.56%).

The study of anti-acne inducing bacterial activity demonstrated that the essential oils of *E. stachyodes*, *E. communis*, *E. griffithii*, *E.* sp., and *C. lansium*, could inhibit the growth of *S. aureus* and *S. epidermidis*. In part of *Elsholtzia* species, the essential oil of *E. stachyodes* showed the highest efficacy against the growth of *S. aureus* at MIC 0.78 µl/ml and *S. epidermidis* at MIC 1.56 µl/ml, followed by *E. communis*, *E. sp*, and *E. griffithii* oils, respectively. The antibacterial activity of essential oil from *C. lansium* against *S. aureus* and *S. epidermidis* was detected by disc diffusion method with the low concentration at 125 and 62.50 µl/ml, respectively. In addition, the residual crude extracts presented weakly antibacterial activity in comparison with the essential oils. However, this study demonstrated that the essential oils of *Elsholtzia* and *Clausena* species presented anti-acne inducing bacterial activity. The essential oil of *E.stachyodes* and *E. communis* revealed the strong activity, which was visible by the low MIC value. Therefore, these essential oils are interesting to study more about their biological activities for applying as the natural acne-inducing bacterial inhibitor or the ingredient of product treatments for acne.

Recommendation for Future Work

The antibacterial activity of *C. harmandiana* essential oil should be studied. Moreover, the antibacterial activity against *P. acnes* as one of acne-inducing bacteria of these essential oils should be investigated.