

## CHAPTER 5

### CONCLUSIONS

From this research work the following conclusions can be drawn:

1. *S. alata* leaves were successively extracted under reflux conditions using the solution of 5 %v/v hydrochloric acid, 5 %w/v ferric chloride, and 15 %v/v water in methanol as the solvent. This could increase the anthraquinone content in the leaf extract up to 1.67 %w/w.

2. The anthraquinone high-yielding *S. alata* leaf extract was prepared using the extraction method as described above and subsequent fractionation by silica gel vacuum column chromatography using a mixture of hexane and ethyl acetate (9:1v/v) as eluent. This method was capable of improving anthraquinone content in the extract up to 16.70 %w/w.

3. The anthraquinone high-yielding *S. alata* leaf extract was obtained by our developing method. The extract yield was 0.73 %w/w based on the dried leaf powder. The content of the total anthraquinones, calculated as aloe-emodin and emodin was  $16.22 \pm 1.12$  %w/w quantified by HPLC.

4. Only two major anthraquinones, aloe-emodin and emodin were found in the anthraquinone high-yielding *S. alata* leaf extract.

5. The anthraquinone high-yielding *S. alata* leaf extract possessed antifungal activity against all tested dermatophytes with the MIC values between 15.62 - 250 µg/ml. The extract showed the highest antifungal activity against *T. rubrum* with the MIC value of 15.62 µg/ml. Although, the antifungal activity of the extract against *T. rubrum* was lower than that of aloe-emodin and emodin, the antifungal activities against *T. mentagrophytes* and *M. gypseum* were markedly higher than those of aloe-emodin and emodin. This may be due to the synergistic

effect of these two active compounds. These results confirm the potential of the anthraquinone high-yielding *S. alata* leaf extract as the antifungal agent against dermatophytes.

7. The standard specification of the anthraquinone high-yielding *S. alata* leaf extract was established as follow;

- Total anthraquinones is not less than 15 %w/w calculated as aloe-emodin and emodin.
- The moisture content (loss on drying) is not more than 0.6 %w/w
- No ash
- Microbial contamination: No contamination with aerobic bacteria, *E. coli*, and fungi.

8. The anthraquinone high-yielding *S. alata* leaf extract contains most likely moderate non-polar compounds therefore the suitable solvents for the leaf extract should be a moderate non-polar solvent such as DMSO, chloroform, and ethyl acetate.

9. The hydrophobic parameter ( $\log P_{ow}$  value) of the anthraquinones in the anthraquinone high-yielding *S. alata* leaf extract was  $2.59 \pm 0.24$ . It implies that the anthraquinones in the anthraquinone high-yielding *S. alata* leaf extract have good percutaneous absorption.

10. Stability evaluations of the anthraquinone high-yielding *S. alata* leaf extract in several conditions in the period of 4 months found that the extract possessed a satisfactory stability.

11. Weak acid and neutral condition are suitable conditions for development of herbal medicine from the extract.