

## CHAPTER V

### CONCLUSIONS

#### 5.1 Conclusions

In this work, a novel electrode, G/PVP/PANI nanocomposite-modified SPCE for the simultaneous determination of five parabens, methyl paraben, ethyl paraben, propyl paraben, butyl paraben and isobutyl paraben coupled with HPLC was successfully developed. The advantages of SPCE were very inexpensive and easy to modify. To improve the sensitivity of detection, G/PVP/PANI nanocomposite material was modified onto the SPCE using an electrospraying technique under the optimized conditions. The physical characterization of the G/PVP/PANI nanocomposite-modified SPCE was verified by SEM and TEM analysis. The result exhibited a homogenous and well distribution of G/PVP/PANI nanocomposite on SPCE. The electrochemical behavior of ferri/ferrocyanide exhibited a well-defined peak shape and the response current obtained from modified electrode was distinctly higher than those of the unmodified, and its mass transfer was controlled by the diffusion process. The cyclic voltammogram of each paraben presented the irreversible reaction with anodic peak at about +1.0 V vs Ag/AgCl. The peak currents of the modified electrode were approximately between 3-8 times higher than that of the unmodified electrode. The optimal conditions for simultaneous determination of parabens were 0.05 M phosphate buffer solution (pH 6):acetonitrile (60:40, %v/v) at flow rate of 1.5 mL min<sup>-1</sup>, and injection volume of 50 µL. The chromatograms of paraben were achieved by amperometric detection with an applied constant potential of +1.2 V vs Ag/AgCl at room temperature (~25 °C). Interestingly, this proposed system can separate even butyl paraben and isobutyl paraben which are isomeric compounds. The calibration curves of five parabens were linear in similarly equal range of 0.1 and 30 µg mL<sup>-1</sup> with the correlation coefficient ( $R^2$ ) of higher than 0.99 (n=3). The limit of detection (LOD) and the limit of quantitation (LOQ) of five parabens were found to be in the range of 0.01 to 0.03 µg mL<sup>-1</sup> and 0.04 to 0.10 µg mL<sup>-1</sup>, respectively. Eventually, the proposed method was successfully applied for the simultaneous determination of five parabens in real samples, soft drink and cosmetic product, with



good agreement to the HPLC-UV method at a confidence level of 95%. Hence, this detection method can potentially be an alternative and very attractive detection method for simultaneous determination of parabens.

## 5.2 Suggestion for further work

In this proposed research, the G/PVP/PANI nanocomposite-modified SPCE was developed, and coupled with high performance liquid chromatography for simultaneous determination of five parabens in beverages and cosmetic products. In the future, the G/PVP/PANI nanocomposite-modified SPCE should be applied for the determination of parabens in various samples and other preservative compounds. In addition, the G/PVP/PANI nanocomposite-modified SPCE can be developed for biosensor application because numerous of amino groups ( $-NH_2$ ) of PANI can be readily functionalized with biomolecules. Moreover, because of excellent electrochemical properties of graphene, it can be used as the modifier of electrode to improve the sensitivity of detection

