

## CHAPTER 4

### Conclusion

This work showed that flow injection amperometric (FI-Amp) sensor incorporating to a simple screen-printed carbon electrode modified with carbon nanotubes and the laccase immobilized column could be efficiency employed for sensitive and selective determination of hydroquinone. The reproducibility (n=9) and repeatability (n=11) of SPCE-CNTs were obtained at 4.4% and 0.89%RSD, respectively. Laccase was successfully immobilized on the activated silica gel using a cross-linking method by glutaraldehyde modification. The laccase column offered good efficiency and high selectivity for determination of hydroquinone. Hydroquinone was catalytically oxidized by the laccase enzyme to produce quinone, which was then detected amperometrically at the developed electrode. The biosensor retained around 80% of initial response after 30 days, indicating that there were strong covalent interaction between laccase and the activated silica gel. The proposed system gave a linear range of 1 to 50  $\mu\text{M}$  with detection limit of 0.86  $\mu\text{M}$ . Satisfactory recoveries in the range of 94.5–106.6% indicated that the proposed method is reliable for quantitative determination of hydroquinone. The system showed the performance of sensor in terms of good precision, high sensitivity, wide linear range, and low detection limit. Moreover, it provides many advantages such as cost effective, short analysis time, and

low chemical reagent and sample consumptions. The developed method was successfully demonstrated for determination of hydroquinone in real samples of water and waste water. Concentration lower than the control limit was found.

Because of the special catalytic property of laccase enzyme that can catalyze the oxidation of various phenolic compounds, the flow injection amperometric (FI-Amp) sensor can be developed to apply for determination of other phenolic compounds such as catechol in tea leave sample, methyldopa in pharmaceutical sample, dopamine in human urine sample and total phenolic compounds as antioxidant in wine or tea sample by using the new optimum condition for each case of application.



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