CHAPTER 4

CONCLUSION

4.1 Determination of fumaric acid by DPV and FI DPV methods

A DPV method was developed for the determination of fumaric acid. It involved electrochemically reductive reaction of fumaric acid on a HMDE in an electrolyte containing 0.1 M tetramethylammonium bromide and 0.01 M lithium chloride of pH 8. DPV potential waveform with potential amplitude of 100 mV, potential step of 10 mV, measuiring time of 20 ms, step time of 0.1 s, and pulse time of 60 ms was used. By scanning the potential from -900 to -1300 mV versus Ag/AgCl electrode, a well-defined votammogram with peak potential of about -1150 mV was obtained. Plotting of peak current versus fumaric acid concentration yielding a linear calibration graph in a concentration range of 1-10 mg/L fumaric acid ($y=20.7x - 185$, $r^2 = 0.9995$).

Simple, cost effective devices for FI system, i.e. gas pressure driven and gravity driven pumps, and a voltammetric flow through cell, have been developed. The devices were used for assembling of FI DPV system for determination of fumaric acid. A calibration graph in the range of 40-80 mg/L fumaric acid was observed. Fumaric acid at level lower than 40 mg/L could not be determined because the system has a high background current, which may arise from convective mass transfer in FI DPV system. Although the system could not be applied for fruit juice analysis, it may be suitable for analysis of samples containing high concentration of fumaric acid such as sarcandra grabra plant [20] and solution from fermentation tank.

4.2 Determination of ascorbic acid by FI amperometric with dialysis pretreatment method

The determination was based on the electrochemically oxidation of ascorbic acid at a glassy carbon working electrode, which was applied a constant potential at + 0.8 V versus Ag/AgCl reference electrode. The analyte in standard or sample solution was injected into donor stream of deionized water and separated from other ingredients by dialysis through a membrane to an acceptor stream containing 0.1 M phosphate buffer. The oxidation of the ascorbic acid occurred when ascorbic acid zone passed through the flow cell and the current change was recorded as a FI peak. The peak height corresponded to the concentration of ascorbic acid in the injected solution.

Condition of the method was optimized. Under the optimum condition, a linear calibration graph in range of 50-800 mg/L ascorbic acid was obtained ($y = 6x10^{-5}x - 0.0012$, $r^2 = 0.9990$). A sample throughput of 20 h^{-1} was achieved, with consumption of about 5 mL of reagent and 150 µL of sample per injection. The method was applied to the determination of ascorbic acid in fruit juice and pharmaceutical tablet samples. The results of the determination of ascorbic acid in fruit juice samples are significantly different from those obtained by the standard titrimetric method because of the interference of other ingredients in samples. However, the results of the determination of ascorbic acid in pharmaceutical samples are not significantly different from the labeled values at 99 % confidence level, and get along well with those obtained by voltammetric method.

THE RELEVANCE OF THE RESEARCH WORK TO THAILAND

Thai government policy proposes to develop Thailand to become a world's kitchen. An improvement of agriculture related enterprise is one of the main aims. One example is transformation of Thai's fruits into canned fruit juices which have more value added and can be preserved longer. An effective quality control is needed so that the appearances and nutrients of canned fruit juices will be accepted in the world market. Based on this aim, a simple, accurate and precise analytical technique was necessary. Voltammetric and flow injection amperometric methods were developed in this work for the determination of fumaric acid and ascorbic acid. The developed method was applied to fruit juice and pharmaceutical samples. In addition, the proposed methods are green technologies, using very small amounts of chemical reagents and producing minute waste.