CHAPTER 4

CONCLUSION

Fluorosis is a well-known problem in many countries. The main cause of fluorosis is a high fluoride content in drinking water. In our country, fluorosis amongst the people of Northern Thailand has been noted for many years. Therefore, the main purpose of this research is to compare the spectrophotometric methods for fluoride determination and to adopt the spectrophotometric methods in order to fabricate a simple fluoride test kit, which is based on a color comparison. There are several methods for spectrophotometric determination of fluoride, such as Eriochrome cyanine R, SPADNS, Alizarin red S and Alizarin fluorine blue methods. In Eriochrome cyanine R and SPADNS methods, the color of the solution produced became progressively lighter when the amount of fluoride increases. So, two methods cannot be adopted in fabricating a simple fluoride test kit based on color comparison. The other methods such as Alizarin red S and Alizarin fluorine blue methods, the color of the solution changes with the change of fluoride concentration. From this reason, these two methods can be hypothetically used for fabricating the fluoride color-test kit. In the previous work, the Alizarin fluorine blue method was modified by Rugrai for this purpose and was found that this method worked relatively well under the following optimal composition of the reagent: lanthanum mixed with Alizarin fluorine blue at equal concentration (0.002 M), 0.1 M of succinate buffer, pH 4.6 and acetone. This test kit can show the estimated level of fluoride in the range of 0-7 mg/l. The color of solution did change noticeably with the change of fluoride

concentrations, which can be divided into 5 categories. All these categories belong to the solution with different fluoride concentration levels. The first one with a concentration at 0 mg/l (light red), the second has at 1 mg/l (red), the third at 2 mg/l (purple), the fourth at 3-4 mg/l (violet blue) and the fifth at 5-6 mg/l (light violet blue). The color will only turn to be blue when the fluoride concentration level is higher than 7 mg/l. In the present work, the Alizarin red S method was attempted in order to replace the Alizarin fluorine blue and expected to work better on the color change with the change of fluoride concentration. However, when the factors in this method such as the concentrations of Alizarin red S, zirconyl nitrate dihydrate, hydrochloric and sulfuric acid were optimized. It was found that the Alizarin red S method was not suitable for fabricating the test kit because it was difficult to see the change of the color shade and the intensity of the color solution was very low. Therefore, the best spectrophotometric method for fabricating the fluoride test kit based on color comparison was concluded to be the Alizarin fluorine blue method.

The other spectrophotometric methods for determination of fluoride such as Eriochrome cyanine R and SPADNS methods were further studied to find out the optimal condition for fluoride determination. When the factors of Eriochrome cyanine R method such as the concentrations of Eriochrome cyanine R, zirconyl chloride octahydrate and the volume of hydrochloric acid were optimized. It was found that the optimum condition for fluoride determination was 3.4×10^{-3} mol/l of Eriochrome cyanine R, 8.0×10^{-4} mol/l of zirconyl chloride octahydrate and 700 ml of hydrochloric acid. Under this condition, the calibration curve for fluoride analysis was constructed which the fluoride concentration in the range of 0.00-1.20 mg/l with the slope, intercept and square of correlation coefficient of 0.404, 0.9316 and 0.9995,

respectively. The reproducibility of the method was 2.2% of its relative standard deviation (RSD) for 0.60 mg/l of fluoride and the limit of detection was 0.02 mg/l. The interfering ions such as Ca^{2+}, Cl^{-}, Mg^{2+}, NO_3^{-}, PO_4^{3-}, SO_4^{2-} and Cu^{2+} were also studied. It was found that Ca^{2+}, Cl^{-}, Mg^{2+} and Cu^{2+} did not influence fluoride determination while NO_3^{-}, PO_4^{3-} and SO_4^{2-} severely interfered.

In SPADNS method, the factors such as the concentrations of SPADNS, zirconyl chloride octahydrate and the volume of hydrochloric acid were studied. It can be concluded that the optimal condition for fluoride determination in this method was 1.3×10^{-2} mol/l of SPADNS, 8.3×10^{-4} mol/l of zirconyl chloride octahydrate and 600 ml of hydrochloric acid. The calibration curve for fluoride determination was constructed which was linear from fluoride concentration of 0.00-1.40 mg/l. From the calibration curve, the slope, intercept and square of correlation coefficient was 0.4261, 1.076 and 0.9992, respectively. The limit of detection in the method was 0.04 mg/l and the precision was 3.8% relative standard deviation (RSD) for 0.60 mg/l of fluoride. Liked Eriochrome cyanine R method, seven interfering ions (Ca^{2+}, Cl^{-}, Mg^{2+}, NO_3^{-}, PO_4^{3-}, SO_4^{2-} and Cu^{2+}) were also studied and the results found that three ions such as NO_3^{-}, PO_4^{3-} and SO_4^{2-} interfered fluoride determination while the others did not influence.

Eriochrome cyanine R and SPADNS methods were used to determine the concentration of fluoride in water samples. It was found that the results are agreeable to the ISE measurements. When compared linearity, limit of detection, sensitivity and precision in Eriochrome cyanine R and SPADNS methods, it can be concluded that Eriochrome cyanine R method is more suitable than SPADNS method for fluoride determination because it offered better limit of detection and precision.

The relevancy of the research work to Thailand

Due to the fact that fluorosis problem exists at high level in wide area especially in the northern part of Thailand. The main cause of fluorosis is high fluoride content in water. Therefore, determination and removal of fluoride from water are considerably important. This includes the introduction of the defluoridator to be used in removing fluoride from water before consuming, but this research need to tell whether the water to be consumed is safe or not. So, the present work was aimed to compare spectrophotometric methods, i.e. Eriochrome cyanine R, SPADNS and Alizarin red S methods for fabricating a simple fluoride test kit by using the color comparison. From this experiment, it was found that these methods cannot be used to fabricate a fluoride test kit based on color comparison. However, Eriochrome cyanine R and SPADNS methods are comparatively appropriate for fluoride determination in water spectrophotometrically as well as ISE method.