

CHAPTER 4

CONCLUSION AND RECOMMENDATION

Amaranth, Ponceau 4R, and Erythrosine are red dyes, and they were used as food and drug additives before last two years. The use of Amaranth as food additive was terminated in many countries since 1976⁽¹³⁾ and in Thailand since 1978⁽¹⁴⁾ owing to the cause of cancer. The compound and complex formations of Amaranth, Ponceau 4R and Erythrosine with metal ions such as Hg(II), Cd(II), Fe(II), Fe(III) and Pb(II) were of interest in the present study.

The purities of Amaranth, Ponceau 4R, and Erythrosine as examined by paper chromatographic technique, ultraviolet-visible, infrared, and atomic absorption spectrophotometric techniques are sufficiently high for using in the study of compound and complex formations with metal ions. The buffer systems used in this study are McIlvaine buffer, phosphate buffer, acetate buffer, diethylamine, nitric acid and sulfuric acid. Amaranth and Ponceau 4R are very soluble in the aqueous solution and in these buffer systems but Erythrosine precipitates as its acidic form in the solution at pH 1-2 and is very soluble in the aqueous solution and every buffer system studied except acetate buffers at pH 4.4 and 6.0 it is soluble to some extent.

By visible and atomic absorption spectrophotometric studies, linear relationships between absorbances and concentrations were obtained in the ranges of concentrations of 4.00×10^{-6} - 6.00×10^{-5} M. Amaranth in aqueous solution, 1.00×10^{-5} - 1.00×10^{-4} M Ponceau 4R in aqueous solution, 1.00×10^{-6} - 1.40×10^{-5} M Erythrosine in aqueous solution, 1.00×10^{-6} - 8.00×10^{-6} M Erythrosine in the acetate buffer pH 4.4, 4.00×10^{-7} - 1.00×10^{-6} M Erythrosine in nitric acid at pH 3.3, 50.00-200.0 $\mu\text{g}/\text{cm}^3$ Hg(II) ion in nitric acid, and 2.00-20.00 $\mu\text{g}/\text{cm}^3$ Fe(III) ion both in nitric acid and in acetate buffer at pH 4.4.

The pK_a of Amaranth, Ponceau 4R, and Erythrosine were found to be 10.0, 11.0, and 4.2, respectively.

No reaction was found when Amaranth or Ponceau 4R was mixed with every metal ion studied in aqueous solution or in any buffer system since no physical change and no change in absorbances of the dye and the metal ion in the mixture solutions were observed.

Precipitate was formed when Erythrosine was mixed with Fe(II) Hg(II), Fe(III), or Pb(II) ion. However, Erythrosine did not react with Cd(II) ion. The molar ratio method was used for determining the compositions of the compounds and complexes formed in the mixture. The compound formed between Erythrosine and Hg(II) ion was found to have the molar ratio of 1 : 1 and its stability constant and solubility product in every electrolyte studies were found to be in the order of 10^9 (Hg(Eryth)) or 10^{19} ($\text{Hg}_2(\text{Eryth})_2$), and 10^{-10} (Hg(Eryth)) or 10^{-20} ($\text{Hg}_2(\text{Eryth})_2$), respectively (calculated from visible spectrophotometric data)

Erythrosine reacted with Fe(III) ion to form complexes of molar ratios of 1 : 1 and 2 : 1 (Erythrosine to Fe(III) ion) as well as to form precipitated compound of molar ratio of 3 : 2 (Erythrosine to Fe(III)ion). The stability constant and solubility product of this compound were 3.9×10^{23} and 2.6×10^{-24} (calculated from visible spectrophotometric data)

Erythrosine also reacted with Fe(II) ion but the compositions of the compound and complex formed could not be determined accurately with the conditions studied. The oxidation state of Fe(II) ion in the mixture solution should be controlled or at least the accurate concentration of Fe(II) existed in the solution should be known. Then the composition of the compound and complex formed can be evaluated. This should be interested in the further study.

In addition, compound and complex formations between Erythrosine and Pb(II) ion was found to have molar ratios of 1 : 1, 1 : 3, and 2 : 3 for Erythrosine to Pb(II) ion. It seemed that polynuclear complexes were formed in the mixture solutions of higher concentrations of Pb(II) ion. This could be worthwhile for the further study. The precipitated compound formed between Erythrosine and Pb(II) ion is very soluble in acetate buffer, and soluble in acetic acid, nitric acid and Erythrosine solution. Thus, the stability constant and solubility constant was found to be 7.5×10^8 and 1.3×10^{-9} .

The IR spectrophotometric study of the precipitated compounds of Hg(II) Erythrosinate, Fe(III)Erythrosinate and Pb(II)Erythrosinate seemed useless in the region of $650 - 4000\text{cm}^{-1}$ since the bonding of metal ion to Erythrosine could not be seen. Thus, the far-infrared spectrophotometric study and the structure elucidation of the compounds formed between Erythrosine and Hg(II), Fe(III), or Pb(II) would be suggested for the next study.