BIBLIOGRAPHY

Akimoto , N. , Hanakuma , H. and Hozumi , K. Errors in Acid-Base Titration Using Gran's Method. Anal. Sci. 3 (1987) : 515-519.

Anfalt , T. and Jagner, D. The precision and accuracy of some current methods for potentiometric end point determination with reference to a computer calculated titration curve. Anal. Chim. Acta. 57 (1971) : 165-176.

Betti , M. , Papoff , P. and Meites , L. Factors affecting the precisions of analyses , by potentiometric titrimetry , of solutions containing two weak acids. Anal. Chim. Acta. 182 (1986) : 133-145.

Boiani , J. A. The Gran plot analysis of an acid mixtures. J. Chem. Ed. 63 (1986) : 724-726 .

Brown , R. D. Introduction to Instrumental Analysis. International Edition. McGraw Hill Book Company. New York , 1987.

Budavari , S. The Merck Index : An Encyclopedia of Chemicals , Drugs and Biologicals , 11th Edi. Merck & Co., Inc. USA , 1989.

Burden , S. L. and Euler , D. E. Titration Errors Inherent in Using Gran Plots. Anal. Chem. 47 (1975) : 793-797.

Buttler , J. N. Ionic Equilibrium : A mathematical approach. Addison - Wesley Publishing Company. USA , 1964.

Byrkit , D. R. Statistics Today : A comprehensive introduction. The Benjamin / Commings Publishing , 1987.

Castillo , C. A. , and Alonso , J. A. An alternative procedure for titration curves of a mixture of acids of different strengths. J. Chem. Ed. 66 (1989) : 341-342 .

Christian , G. D. Analytical Chemistry. 4th Edi. Johnson Willey & Sons . Canada , 1986.

Cohen , S. R. A simple graphical method for locating the end point of a pH or a potentiometric titration. Anal. Chem. 38 (1966) : 158.

Devore , J. and Peck , R. Introduction Statistics. West Publishing. USA , 1990.

Draper , R. N. and Smith , H. Applied Regression Analysis. John Wiley & Sons. New York , 1966.

Dunteman , G. H. Introduction to Linear Models. Beverly Hills : Sage Publications , 1984.

Florey , K. Analytical Profiles of Drug Substances. Vol. 13. Academic Press , Inc. Florida , 1984 : p. 523.

_____. Analytical Profiles of Drug Substances. Vol. 14. Academic Press , Inc. Florida , 1985 : 210-241.

_____. Analytical Profiles of Drug Substances. Vol. 17. Academic Press , Inc. Florida , 1987 : p. 535.

Gran , G. Determination of the equivalent point in potentiometric titrations : part 2. Analyst 77 (1952) : 661-670 .

_____. Equivalence volumes in potentiometric titrations. Anal. Chim. Acta. 206 (1988) : 111-123 .

Harned ,H. S. and Owen , B. B. The Physical Chemistry of Electrolytic Solutions. American Chemical Society Monograph Series No. 137 , 3th Edi. Reinhold Publishing Corporation. New York , 1957.

Ingman , F. and Still , E. Graphic method for the determination of titration end-points. Talanta 13 (1966) : 1431-1442 .

Jackson , J. V. , Moss , M. S. and Widdop , B. Clarke's Isolation and Identification of Drugs. Part 2 ; Monographs Analytical and Toxicological Data. The Pharmaceutical Press. London , 1986.

Jeffery , H. G. , Bassett , J. , Mendham , J. , and Denney , C. R. Vogel's Textbook of Quantitative Chemical Analysis. 5th ed. Great Britain : Bath press Ltd., 1989.

Johnson, R. and Bhattacharyya ,G. Statistics : Principles and Methods. John Wiley & Sons. New York , 1987.

Juthamas Sukbunthern g . Quantitative determination of weak acidic drugs by using Gran's method in mixed solvent. Master's Thesis. Chulalongkorn University , 1988 .

Kateman , G. , Smit , H. C. and Meites , L. Weighting in the Interpretation of Data for Potentiometric Acid-Base Titrations by Non-linear Regression. Anal. Chim. Acta. 152 (1983) : 61-72.

Litneau , C. , and Cormos , D. Contribution an probleme de la determination du point D'equivalence - 1. Talanta 7 (1960) : 18-24 .

Macca , C. and Bombi , G. G. Linearity Range of Gran Plots for the End-point in Potentiometric titrations. Analyst. 114 (1989) : 463-470.

McCallum , C. and Midgley , D. Linear titration plots for the potentiometric titration of mixtures of strong and weak acids. Anal. Chim. Acta. 78 (1975) : 171-181 .

Pecsok , R. L. , Shields , L. D. , Cairns , T. and McWilliam , I. G. Modern Methods of Chemical Analysis. 2 nd Edi. John Willey & Sons. Canada , 1976.

Recommendation of the Medicine Commission. British Pharmacopoeia. United Kingdom : The Majesty's Stationary Office , 1988.

Rossotti, F. J. C., and Rossotti, H. Potentiometric titrations using Gran plots. J. Chem. Ed. 42 (1965) : 375-378 .

Seksiri Arttamangkul. Quantitative determination of weak acidic drugs by Gran's method. Master's Thesis . Chulalongkorn University , 1986 .

Skoog , A. D. , West , M. , and Holler , J. F. Fundamentals of Analytical Chemistry. 6th ed. United State of America : Saunders College Publishing , 1992 .

Skoog , D. A. , West , D. M. and Holler , F. J. Analytical Chemistry : An Introduction. 5th Edi. Saunders College Publishing . Philadelphia , 1990.

Supawadee Chiewcharnwattana . The Interpretation of Data for Potentiometric Titration of Weak Acid Mixtures by Multiple Linear Regression Analysis. Master's Thesis. Chulalongkorn University , 1993.

Tubbs, C. F. Determination of potentiometric titration inflection point by the concentric arcs method. Anal. Chem. 26 (1954) : 1670-1671 .

APPENDICES

APPENDIX A

TABLES

Method	Range
A	maximum F value.
B	maximum pH of weaker acid.
C	sum of data points in G plot linearity range of both acids.
D	For Ve_A : maximum pH of acid A For Ve_B : maximum pH of acid B
E	Substitution of Ve_A or Ve_B obtained from Method D into multiple linear equation.

Table 1 : 5 Methods for choosing titration data ranges for data analysis.

Weak acids	Ka *	pKa *
Benzoic acid	8.71×10^{-5}	4.06
Potassium biphthalate	9.88×10^{-6}	5.01
p-Nitrophenol	9.75×10^{-8}	7.01
Vanillin	5.26×10^{-8}	7.28
Pralidoxime chloride	1.15×10^{-8}	7.94
Lidocaine hydrochloride	1.11×10^{-8}	7.95
Salicylamide	7.94×10^{-9}	8.10
Procaine hydrochloride	8.51×10^{-10}	9.07

Table 2 : The dissociation constant (Ka) and pKa of weak acidic compounds.

* *Ka and pKa values were obtained from the slope of G plots of each single weak acid titrations according to Eq. 9 and Eq. 21*

Weak acidic mixtures	ΔpKa	pKa_A, pKa_B
1. Neutral weak acid + Neutral weak acid		
p-Nitrophenol + Vanillin	0.27	7.01 , 7.28
Vanillin + Salicylamide	0.82	7.28 , 8.10
p-Nitrophenol + Salicylamide	1.09	7.01 , 8.10
2. Neutral weak acid + Ionized weak acid		
Salicylamide + Lidocaine HCl	0.15	8.10 , 7.95
Salicylamide + Pralidoxime chloride	0.16	8.10 , 7.94
Vanillin + Pralidoxime chloride	0.66	7.28 , 7.94
Vanillin + Lidocaine HCl	0.67	7.28 , 7.95
p-Nitrophenol + Pralidoxime chloride	0.93	7.01 , 7.94
p-Nitrophenol + Lidocaine HCl	0.94	7.01 , 7.95
Benzoic acid + Potassium biphthalate	0.95	4.06 , 5.01
Salicylamide + Procaine HCl	0.97	8.10 , 9.07
Vanillin + Procaine HCl	1.79	7.28 , 9.07
3. Ionized weak acid + Ionized weak acid		
Pralidoxime chloride + Lidocaine HCl	0.01	7.94 , 7.95
Lidocaine HCl + Procaine HCl	1.12	7.95 , 9.07
Pralidoxime chloride + Procaine HCl	1.13	7.94 , 9.07

Table 3 : The mixture of weak acids and their ΔpKa.

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
p-Nitrophenol	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.64	2.63	2.35	2.35	2.58	2.38	2.36
2	2.63	2.63	2.38	2.34	2.50	2.38	2.36
3	2.64	2.63	2.36	2.36	2.55	2.38	2.37
4	2.63	2.63	2.37	2.34	2.51	2.37	2.35
5	2.64	2.63	2.39	2.39	2.58	2.42	2.36
Mean	2.64	2.63	2.37*	2.36*	2.54*	2.37*	2.36*
S.D. x 10^2	0.548	0.000	1.58	2.07	3.78	1.95	0.707

Table 4 : The equivalence volume for p-nitrophenol (ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-vanillin mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Vanillin	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.63	2.63	2.86	2.86	2.62	2.86	2.83
2	2.64	2.63	2.87	2.87	2.71	2.87	2.84
3	2.64	2.64	2.86	2.86	2.65	2.86	2.84
4	2.64	2.63	2.83	2.87	2.69	2.87	2.82
5	2.64	2.64	2.82	2.82	2.62	2.82	2.83
Mean	2.64	2.63	2.85*	2.86*	2.66	2.86*	2.83*
S.D. x 10^2	0.447	0.548	2.17	2.07	4.09	2.07	0.837

Table 5 : The equivalence volume for vanillin (ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-vanillin mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Vanillin	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.54	2.54	2.55	2.55	2.53	2.55	2.53
2	2.54	2.53	2.54	2.54	2.52	2.54	2.52
3	2.54	2.53	2.50	2.51	2.49	2.51	2.52
4	2.54	2.53	2.49	2.49	2.50	2.50	2.52
5	2.54	2.54	2.51	2.51	2.51	2.52	2.53
Mean	2.54	2.53	2.52	2.52	2.51*	2.52	2.52
S.D. x 10^2	0.000	0.548	2.59	2.45	1.58	2.07	0.548

Table 6 : The equivalence volume for vanillin (ml) obtained from the titration of single acid solution and the solution of vanillin-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Salicylamide	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.53	2.54	2.52	2.52	2.55	2.52	2.54
2	2.54	2.53	2.53	2.52	2.55	2.52	2.53
3	2.54	2.54	2.56	2.55	2.58	2.55	2.54
4	2.53	2.54	2.56	2.56	2.55	2.56	2.54
5	2.54	2.54	2.55	2.55	2.57	2.55	2.55
Mean	2.54	2.54	2.54	2.54	2.56*	2.54	2.54
S.D. x 10^2	0.548	0.447	1.82	1.87	1.41	1.87	0.707

Table 7 : The equivalence volume for salicylamide (ml) obtained from the titration of single acid solution and the solution of vanillin-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
p-Nitrophenol	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.54	2.53	2.51	2.51	2.54	2.53	2.50
2	2.55	2.53	2.50	2.50	2.52	2.52	2.51
3	2.54	2.53	2.49	2.50	2.51	2.51	2.51
4	2.54	2.54	2.50	2.50	2.52	2.53	2.50
5	2.54	2.54	2.50	2.51	2.55	2.53	2.51
Mean	2.54	2.53	2.50*	2.50*	2.53	2.52	2.51*
S.D. x 10^2	0.447	0.548	0.707	0.548	1.64	0.894	0.548

Table 8 : The equivalence volume for p-nitrophenol (ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Salicylamide	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.56	2.53	2.54	2.54	2.48	2.54	2.52
2	2.55	2.54	2.55	2.54	2.52	2.54	2.53
3	2.55	2.54	2.56	2.55	2.53	2.55	2.54
4	2.55	2.53	2.53	2.53	2.52	2.53	2.52
5	2.55	2.53	2.56	2.55	2.49	2.55	2.54
Mean	2.55	2.53	2.55	2.54	2.51*	2.54	2.53
S.D. x 10^2	0.447	0.548	1.30	0.837	2.17	0.837	1.00

Table 9 : The equivalence volume for salicylamide (ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Lidocaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.54	2.54	1.49	1.73	0.66	1.60	1.96
2	2.55	2.54	1.73	2.13	3.37	2.00	1.92
3	2.55	2.54	1.84	2.17	4.02	2.14	1.92
4	2.55	2.54	1.75	1.95	3.78	1.96	1.93
5	2.54	2.54	1.36	1.66	3.29	1.63	1.94
Mean	2.55	2.54	1.63*	1.93*	3.02*	1.87*	1.93*
S.D. x 10^2	0.548	0.000	20.0	23.0	135	23.9	1.67

Table 10 : The equivalence volume for lidocaine HCl (ml) obtained from the titration of single acid solution and the solution of lidocaine HCl-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Salicylamide	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.56	2.54	3.53	3.28	4.42	3.28	3.15
2	2.56	2.54	3.27	2.87	1.56	2.87	3.13
3	2.56	2.54	3.16	2.83	0.87	2.83	3.13
4	2.56	2.53	3.26	3.06	1.11	3.06	3.14
5	2.55	2.54	3.63	3.33	1.62	3.33	3.14
Mean	2.56	2.54	3.37*	3.07*	1.92*	3.07*	3.14*
S.D. x 10^2	0.447	0.447	20.0	22.9	143	22.9	0.837

Table 11 : The equivalence volume for salicylamide HCl (ml) obtained from the titration of single acid solution and the solution of lidocaine HCl-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Pralidoxime Cl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.43	2.41	2.04	2.08	2.37	2.16	2.01
2	2.43	2.41	2.03	2.06	2.59	2.20	2.01
3	2.43	2.41	2.01	2.01	2.07	2.25	2.01
4	2.43	2.41	1.88	1.88	1.63	2.04	1.99
5	2.43	2.41	1.98	2.02	1.73	2.16	2.01
Mean	2.43	2.41	1.99*	2.01*	2.08	2.16*	2.01*
S.D. x 10^2	0.000	0.000	6.46	7.81	40.9	7.76	0.894

Table 12 : The equivalence volume for pralidoxime Cl (ml) obtained from the titration of single acid solution and the solution of pralidoxime Cl-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Salicylamide	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.43	2.42	2.74	2.70	2.40	2.70	2.62
2	2.43	2.41	2.75	2.72	2.17	2.72	2.63
3	2.43	2.42	2.78	2.78	2.73	2.78	2.64
4	2.42	2.41	2.89	2.89	3.16	2.89	2.62
5	2.42	2.41	2.81	2.77	3.09	2.77	2.64
Mean	2.43	2.41	2.79*	2.77*	2.71	2.77*	2.63*
S.D. x 10^2	0.548	0.548	6.02	7.40	42.9	7.40	1.00

Table 13 : The equivalence volume for salicylamide (ml) obtained from the titration of single acid solution and the solution of pralidoxime Cl-salicylamide mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Vanillin	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.69	2.69	2.63	2.64	2.74	2.64	2.62
2	2.69	2.69	2.60	2.61	2.76	2.62	2.61
3	2.68	2.69	2.57	2.60	2.67	2.60	2.62
4	2.70	2.69	2.57	2.61	2.75	2.62	2.62
5	2.69	2.68	2.61	2.62	2.72	2.63	2.63
Mean	2.69	2.69	2.60*	2.62*	2.73*	2.62*	2.62*
S.D. x 10^2	0.707	0.447	2.61	1.52	3.56	1.48	0.447

Table 14 : The equivalence volume for vanillin (ml) obtained from the titration of single acid solution and the solution of vanillin-pralidoxime Cl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Pralidoxime Cl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.68	2.66	2.67	2.66	2.52	2.66	2.68
2	2.68	2.66	2.70	2.68	2.48	2.68	2.67
3	2.68	2.66	2.74	2.71	2.60	2.71	2.68
4	2.69	2.67	2.74	2.69	2.50	2.69	2.68
5	2.69	2.67	2.69	2.68	2.54	2.68	2.68
Mean	2.68	2.66	2.71*	2.68*	2.53*	2.68*	2.68*
S.D. x 10^2	0.548	0.548	3.11	1.82	4.60	1.82	0.447

Table 15 : The equivalence volume for pralidoime Cl (ml) obtained from the titration of single acid solution and the solution of vanillin-pralidoxime Cl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Vanillin	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.85	2.84	2.81**	2.82**	2.83	2.85	2.86
2	2.85	2.84	2.87	2.88	2.85	2.87	2.88
3	2.86	2.84	2.88	2.89	2.91	2.92	2.88
4	2.85	2.84	2.88	2.90	2.88	2.88	2.89
5	2.85	2.84	2.87	2.89	2.86	2.84	2.90
Mean	2.85	2.84	2.88*	2.89*	2.87*	2.87*	2.88*
S.D. x 10^2	0.447	0.000	0.577	0.816	3.05	3.11	1.48

Table 16 : The equivalence volume for vanillin (ml) obtained from the titration of single acid solution and the solution of vanillin-lidocaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

*** : Data rejected by Q-test at 96% confidence interval.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Lidocaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.83	2.82	2.85	2.84	2.82	2.84	2.80
2	2.82	2.82	2.80	2.79	2.84	2.79	2.80
3	2.82	2.81	2.79	2.77	2.75	2.77	2.79
4	2.83	2.82	2.78	2.76	2.81	2.76	2.79
5	2.82	2.81	2.80	2.78	2.84	2.78	2.80
Mean	2.82	2.82	2.80	2.79*	2.81	2.79*	2.80*
S.D. x 10^2	0.548	0.548	2.70	3.11	3.70	3.11	0.548

Table 17 : The equivalence volume for lidocaine HCl(ml) obtained from the titration of single acid solution and the solution of vanillin-lidocaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
p-Nitrophenol	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.52	2.51	2.47	2.43	2.51	2.50	2.42
2	2.52	2.50	2.46	2.45	2.52	2.50	2.45
3	2.52	2.50	2.44	2.43	2.49	2.47	2.43
4	2.52	2.51	2.43	2.44	2.51	2.52	2.43
5	2.53	2.51	2.41	2.42	2.52	2.49	2.42
Mean	2.52	2.51	2.44*	2.43*	2.51	2.50	2.43*
S.D. x 10^2	0.447	0.548	2.39	1.14	1.22	1.82	1.22

Table 18 : The equivalence volume for p-nitrophenol(ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-pralidoxime Cl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Pralidoxime Cl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.52	2.53	2.47	2.52	2.43	2.52	2.48
2	2.52	2.52	2.52	2.52	2.43	2.52	2.49
3	2.53	2.51	2.52	2.53	2.45	2.53	2.48
4	2.53	2.52	2.54	2.53	2.44	2.53	2.49
5	2.53	2.52	2.54	2.53	2.40	2.53	2.48
Mean	2.53	2.52	2.52	2.53	2.43*	2.53	2.48*
S.D. x 10^2	0.548	0.707	2.86	0.548	1.87	0.548	0.548

Table 19 : The equivalence volume for pralidoxime Cl(ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-pralidoxime Cl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
p-Nitrophenol	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.35	2.35	2.33	2.33	2.34	2.35	2.33
2	2.35	2.34	2.33	2.33	2.33	2.32	2.33
3	2.34	2.34	2.31	2.31	2.32	2.33	2.32
4	2.35	2.35	2.32	2.32	2.34	2.33	2.33
5	2.35	2.34	2.33	2.33	2.36	2.36	2.33
Mean	2.35	2.34	2.32*	2.32*	2.34	2.34	2.33*
S.D. x 10^2	0.447	0.548	0.894	0.894	1.48	1.64	0.447

Table 20 : The equivalence volume for p-nitrophenol(ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-lidocaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Lidocaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.37	2.37	2.37	2.37	2.35	2.37	2.36
2	2.37	2.37	2.37	2.37	2.36	2.37	2.36
3	2.37	2.37	2.37	2.38	2.36	2.38	2.36
4	2.36	2.36	2.38	2.38	2.36	2.38	2.37
5	2.37	2.37	2.36	2.36	2.32	2.36	2.36
Mean	2.37	2.37	2.37	2.37	2.35*	2.37	2.36
S.D. x 10^2	0.447	0.447	0.707	0.837	1.73	0.837	0.447

Table 21 : The equivalence volume for lidocaine HCl(ml) obtained from the titration of single acid solution and the solution of p-nitrophenol-lidocaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Benzoic acid	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.43	2.40	2.77	2.75	2.85	2.81	2.75
2	2.41	2.40	2.77	2.74	2.86	2.81	2.73
3	2.42	2.40	2.76	2.73	2.83	2.80	2.73
4	2.43	2.44	2.75	2.74	2.84	2.81	2.73
5	2.42	2.41	2.76	2.74	2.83	2.81	2.73
Mean	2.42	2.41	2.76*	2.74*	2.84*	2.81*	2.73*
S.D. x 10^2	0.837	1.73	0.837	0.707	1.30	0.447	0.894

Table 22 : The equivalence volume for benzoic acid (ml) obtained from the titration of single acid solution and the solution of benzoic acid-potassium biphthalate mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Potassium biphthalate	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.43	2.43	2.33	2.35	2.24	2.35	2.32
2	2.44	2.43	2.31	2.34	2.22	2.34	2.30
3	2.44	2.43	2.32	2.35	2.24	2.35	2.30
4	2.44	2.43	2.34	2.34	2.24	2.34	2.31
5	2.44	2.43	2.33	2.34	2.25	2.34	2.30
Mean	2.44	2.43	2.33*	2.34*	2.24*	2.34*	2.31*
S.D. x 10^2	0.447	0.000	1.14	0.548	1.10	0.548	0.894

Table 23 : The equivalence volume for potassium biphthalate (ml) obtained from the titration of single acid solution and the solution of benzoic acid-potassium biphthalate mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Salicylamide	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.41	2.40	2.37	2.38	2.41	2.41	2.38
2	2.41	2.40	2.39	2.41	2.45	2.44	2.40
3	2.41	2.40	2.37	2.38	2.38	2.39	2.38
4	2.41	2.41	2.38	2.40	2.47	2.42	2.39
5	2.41	2.40	2.37	2.37	2.39	2.38	2.39
Mean	2.41	2.40	2.38*	2.39	2.42	2.41	2.39
S.D. x 10^2	0.000	0.483	1.00	1.45	3.87	2.39	8.370

Table 24 : The equivalence volume for salicylamide(ml) obtained from the titration of single acid solution and the solution of salicylamide-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Procaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.45	2.43	2.44	2.42	2.38	2.42	2.40
2	2.44	2.42	2.43	2.41	2.35	2.41	2.41
3	2.44	2.43	2.44	2.43	2.43	2.43	2.41
4	2.44	2.42	2.43	2.40	2.31	2.40	2.40
5	2.44	2.42	2.44	2.44	2.40	2.44	2.40
Mean	2.44	2.42	2.44*	2.42	2.37*	2.42	2.40*
S.D. x 10^2	0.447	0.548	0.548	1.58	4.62	1.58	0.548

Table 25 : The equivalence volume for procaine HCl(ml) obtained from the titration of single acid solution and the solution of salicylamide-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Vanillin	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.12	2.10	2.12	2.12	2.16	2.12	2.15
2	2.12	2.10	2.13	2.12	2.14	2.12	2.13
3	2.12	2.10	2.14	2.12	2.14	2.10	2.13
4	2.12	2.10	2.13	2.12	2.12	2.09	2.12
5	2.12	2.11	2.13	2.13	2.12	2.11	2.12
Mean	2.12	2.10	2.13*	2.12*	2.14*	2.11	2.13*
S.D. x 10^2	0.000	0.447	0.707	0.447	1.67	1.30	1.22

Table 26 : The equivalence volume for vanillin (ml) obtained from the titration of single acid solution and the solution of vanillin-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Procaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.15	2.13	2.14	2.14	2.09	2.14	2.15
2	2.15	2.13	2.12	2.14	2.11	2.14	2.14
3	2.14	2.13	2.12	2.13	2.11	2.13	2.14
4	2.15	2.13	2.13	2.14	2.15	2.14	2.14
5	2.14	2.13	2.14	2.14	2.16	2.14	2.15
Mean	2.15	2.13	2.13	2.14	2.12	2.14	2.14
S.D. x 10^2	0.548	0.000	1.00	0.447	2.97	0.447	0.548

Table 27 : The equivalence volume for procaine HCl(ml) obtained from the titration of single acid solution and the solution of vanillin-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Pralidoxime Cl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.54	2.55	-	-	-	-	-
2	2.55	2.55	-	-	-	-	-
3	2.55	2.54	-	-	-	-	-
4	2.55	2.55	-	-	-	-	-
5	2.55	2.55	-	-	-	-	-
Mean	2.55	2.55	-	-	-	-	-
S.D. x 10^3	0.447	0.447	-	-	-	-	-

Table 28 : The equivalence volume for pralidoxime Cl (ml) obtained from the titration of single acid solution and the solution of pralidoxime Cl-lidocaine HCl mixture.

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Lidocaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	G plot
1	2.55	2.56	5.02	5.02	5.05	5.02	5.08
2	2.55	2.56	5.02	5.02	5.01	5.02	5.07
3	2.55	2.55	5.02	5.02	5.01	5.02	5.07
4	2.56	2.56	5.02	5.03	5.08	5.03	5.10
5	2.56	2.56	4.99	4.99	5.02	4.99	5.07
Mean	2.55	2.56	5.01*	5.02*	5.03*	5.02*	5.08
S.D. x 10^2	0.548	0.447	1.34	1.52	3.05	1.20	1.30

Table 29 : The equivalence volume for lidocaine HCl (ml) obtained from the titration of single acid solution and the solution of pralidoxime Cl-lidocaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

(Remark : Method E was not studied since Ve_A could not be obtained for this pair of acid mixture.)

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Lidocaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.64	2.64	2.61	2.61	2.61	2.62	2.63
2	2.64	2.64	2.62	2.62	2.62	2.63	2.63
3	2.64	2.64	2.61	2.61	2.61	2.63	2.61
4	2.64	2.63	2.61	2.61	2.61	2.62	2.62
5	2.64	2.63	2.63	2.64	2.63	2.64	2.63
Mean	2.64	2.64	2.62*	2.62*	2.62*	2.63	2.62*
S.D. x 10^2	0.000	0.548	0.894	1.30	0.894	0.837	0.837

Table 30 : The equivalence volume for lidocaine HCl(ml) obtained from the titration of single acid solution and the solution of lidocaine HCl-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Procaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.53	2.52	2.54	2.54	2.55	2.54	2.53
2	2.52	2.53	2.54	2.54	2.55	2.54	2.54
3	2.53	2.53	2.52	2.52	2.53	2.52	2.51
4	2.52	2.53	2.53	2.53	2.54	2.53	2.52
5	2.52	2.53	2.51	2.51	2.52	2.51	2.52
Mean	2.52	2.53	2.53	2.53	2.54	2.53	2.52
S.D. x 10^2	0.548	0.447	1.30	1.30	1.30	1.30	1.14

Table 31 : The equivalence volume for procaine HCl(ml) obtained from the titration of single acid solution and the solution of lidocaine HCl-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Pralidoxime Cl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.51	2.47	2.44	2.45	2.49	2.49	2.46
2	2.50	2.48	2.46	2.46	2.48	2.49	2.46
3	2.51	2.50	2.46	2.47	2.47	2.47	2.46
4	2.52	2.48	2.45	2.45	2.51	2.49	2.46
5	2.51	2.49	2.47	2.48	2.50	2.50	2.47
Mean	2.51	2.48	2.46 *	2.46 *	2.49	2.49	2.46 *
S.D. x 10^2	0.707	1.14	1.14	1.30	1.58	1.10	0.447

Table 32 : The equivalence volume for pralidoxime Cl(ml) obtained from the titration of single acid solution and the solution of pralidoime Cl-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Sample	Equivalence volume (ml)						
	Single acid		Mixed acids				
Procaine HCl	Titration Curve	G plot	Method A	Method B	Method C	Method D	Method E
1	2.51	2.52	2.55	2.54	2.49	2.54	2.52
2	2.51	2.53	2.54	2.53	2.51	2.53	2.52
3	2.51	2.52	2.53	2.53	2.51	2.53	2.52
4	2.52	2.52	2.55	2.54	2.45	2.54	2.52
5	2.52	2.52	2.53	2.53	2.47	2.53	2.52
Mean	2.51	2.52	2.54 *	2.53	2.49 *	2.53	2.52
S.D. x 10^2	0.548	0.447	1.00	0.548	2.61	0.548	0.000

Table 33 : The equivalence volume for procaine HCl(ml) obtained from the titration of single acid solution and the solution of pralidoime Cl-procaine HCl mixture.

** : Statistical difference at 95% confidence interval between the equivalence volumes obtained from the multiple regression analysis of two-mixed weak acids titration and G plot of the single acid titration.*

Weak acidic mixtures	Δ pKa	Results				
		Method A	Method B	Method C	Method D	Method E
1. Neutral weak acid + Neutral weak acid						
p-Nitrophenol + Vanillin	0.27	x	x	x	x	x
Vanillin + Salicylamide	0.82	✓	✓	x	✓	✓
p-Nitrophenol + Salicylamide	1.09	x	x	x	✓	x
2. Neutral weak acid + Ionized weak acid						
Lidocaine HCl + Salicylamide	0.15	x	x	x	x	x
Pralidoxime Cl + Salicylamide	0.16	x	x	x	x	x
Vanillin + Pralidoxime Cl	0.66	x	x	x	x	x
Vanillin + Lidocaine HCl	0.67	x	x	x	x	x
p-Nitrophenol + Pralidoxime Cl	0.93	x	x	x	✓	x
p-Nitrophenol + Lidocaine HCl	0.94	x	x	x	✓	x
Benzoic acid + Potassium biphthalate	0.95	x	x	x	x	x
Salicylamide + Procaine HCl	0.97	x	✓	x	✓	x
Vanillin + Procaine HCl	1.79	x	x	x	✓	x
3. Ionized weak acid + Ionized weak acid						
Pralidoxime Cl + Lidocaine HCl	0.01	x	x	x	x	x
Lidocaine HCl + Procaine HCl	1.12	x	x	x	✓	x
Pralidoxime Cl + Procaine HCl	1.13	x	x	x	✓	x

Table 34 : The results from the titration of binary weak acid mixtures

✓ = *no statistical difference at 95% confidence interval between the equivalent volumes obtained from G plot of single acid titration and multiple regression analysis of the titration of acid mixtures*

x = *statistical difference at 95% confidence interval between the equivalent volumes obtained from G plot of single acid titration and multiple regression analysis of the titration of acid mixtures*

Weak acidic mixtures	ΔpKa	Slope
1. Neutral weak acid + Neutral weak acid		
p-Nitrophenol + Vanillin	0.27	0.36
Vanillin + Salicylamide	0.82	0.45
p-Nitrphenol + Salicylamide	1.09	0.51
2. Neutral weak acid + Ionized weak acid		
Salicylamide + Lidocaine HCl	0.15	0.37
Salicylamide + Pralidoxime chloride	0.16	0.40
Vanillin + Pralidoxime chloride	0.66	0.39
Vanillin + Lidocaine HCl	0.67	0.37
p-Nitrophenol + Pralidoxime chloride	0.93	0.48
p-Nitrophenol + Lidocaine HCl	0.94	0.52
Benzoic acid + Potassium biphthalate	0.95	0.48
Salicylamide + Procaine HCl	0.97	0.50
Vanillin + Procaine HCl	1.79	0.88
3. Ionized weak acid + Ionized weak acid		
Pralidoxime chloride + Lidocaine HCl	0.01	0.37
Lidocaine HCl + Procaine HCl	1.12	0.50
Pralidoxime chloride + Procaine HCl	1.13	0.52

Table 35 : The slope of buffer region from the titration curves of two-mixed weak acids solution.

Weak acidic mixture	ΔpKa	% numbers of data points used for analysis			
		Method A	Method B	Method C	Method D
Vanillin and salicylamide mixture	0.82	84	82	58	82
p-Nitrophenol and pralidoxime Cl mixture	0.93	72	74	48	74
p-Nitrophenol and lidocaine HCl mixture	0.94	78	78	47	78
Benzoic acid and potassium biphthalate mixture	0.95	73	77	52	77
Salicylamide and procaine HCl mixture	0.97	77	70	48	71
p-Nitrophenol and salicylamide mixture	1.09	76	74	48	74
Lidocaine HCl and procaine HCl mixture	1.12	76	76	49	76
Pralidoxime Cl and procaine HCl mixture	1.13	78	74	44	74
Vanillin and procaine HCl mixture	1.79	71	76	45	76

Table 36 : % number of data points of two-mixed weak acid titrations used for multiple linear regression analysis

(Remark : % numbers of data points used in Method E were the same as Method D)

Weak acidic mixtures	ΔpKa	Numbers of data points chosen by							
		Method A		Method B		Method C		Method D	
		VeA	VeB	VeA	VeB	VeA	VeB	VeA	VeB
1. Neutral weak acid + Neutral weak acid									
p-Nitrophenol + Vanillin	0.27	40	40	41	41	28	28	39	41
Vanillin + Salicylamide	0.82	42	42	41	41	29	29	39	41
p-Nitrophenol + Salicylamide	1.09	38	38	37	37	24	24	28	37
2. Neutral weak acid + Ionized weak acid									
Lidocaine HCl + Salicylamide	0.15	39	39	32	32	20	20	34	32
Pralidoxime Cl + Salicylamide	0.16	37	37	36	36	23	23	30	36
Vanillin + Pralidoxime Cl	0.66	40	40	37	37	27	27	35	37
Vanillin + Lidocaine HCl	0.67	46	46	42	42	28	28	27	42
p-Nitrophenol + Pralidoxime Cl	0.93	36	36	37	37	24	24	27	37
p-Nitrophenol + Lidocaine HCl	0.94	36	36	36	36	22	22	20	36
Benzoic acid + Potassium biphthalate	0.95	35	35	37	37	25	25	30	37
Salicylamide and Procaine HCl	0.97	37	37	34	34	23	23	26	34
Vanillin + Procaine HCl	1.79	30	30	32	32	19	19	12	32
3. Ionized weak acid + Ionized weak acid									
Pralidoxime Cl + Lidocaine HCl	0.01	38	38	36	36	23	23	36	36
Lidocaine HCl + Procaine HCl	1.12	39	39	39	39	25	25	27	39
Pralidoxime Cl + Procaine HCl	1.13	39	39	37	37	22	22	21	37

Table 37 : Number of data points of two-mixed weak acid titrations used for multiple linear regression analysis

(Remark : Numbers of data points chosen by Method E were as same as Method D)

APPENDIX B

FIGURES

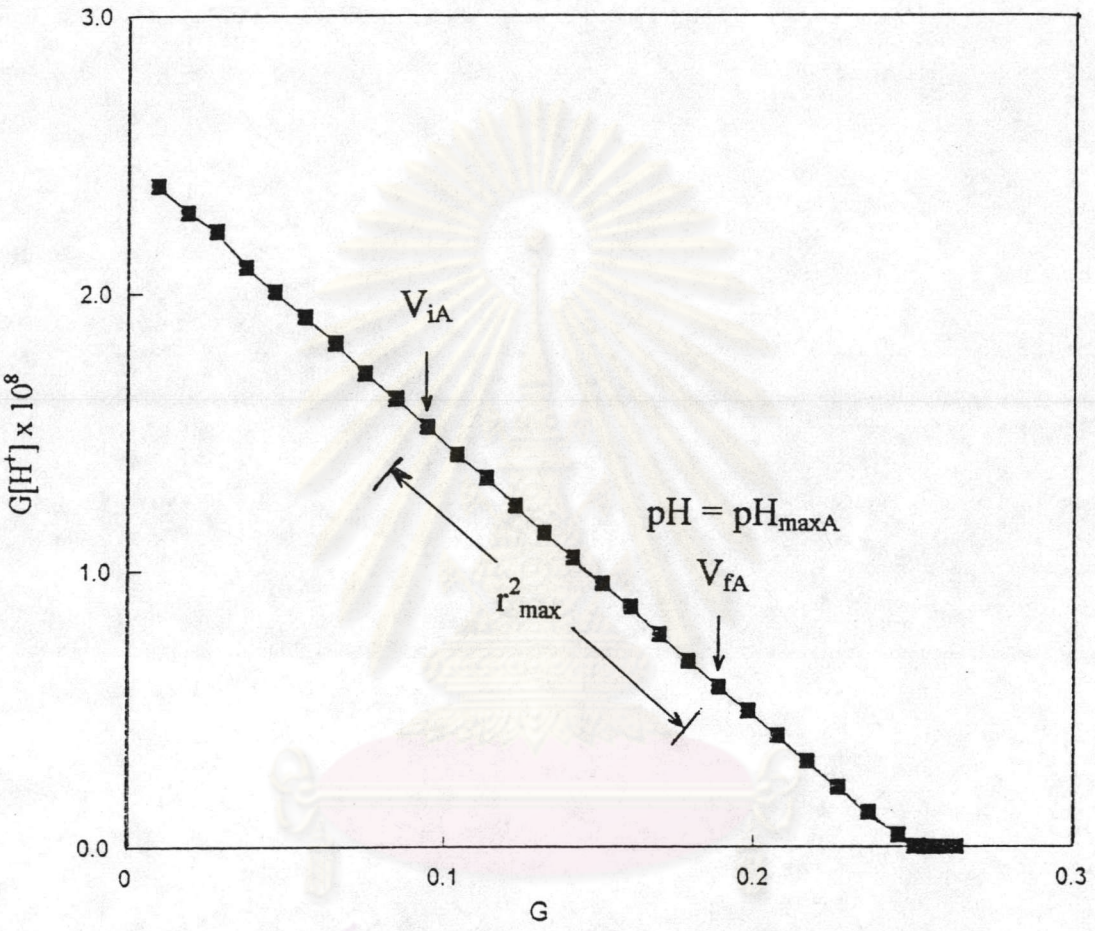

Fig. 1 : G plot linearity range of acid A (stronger acid).

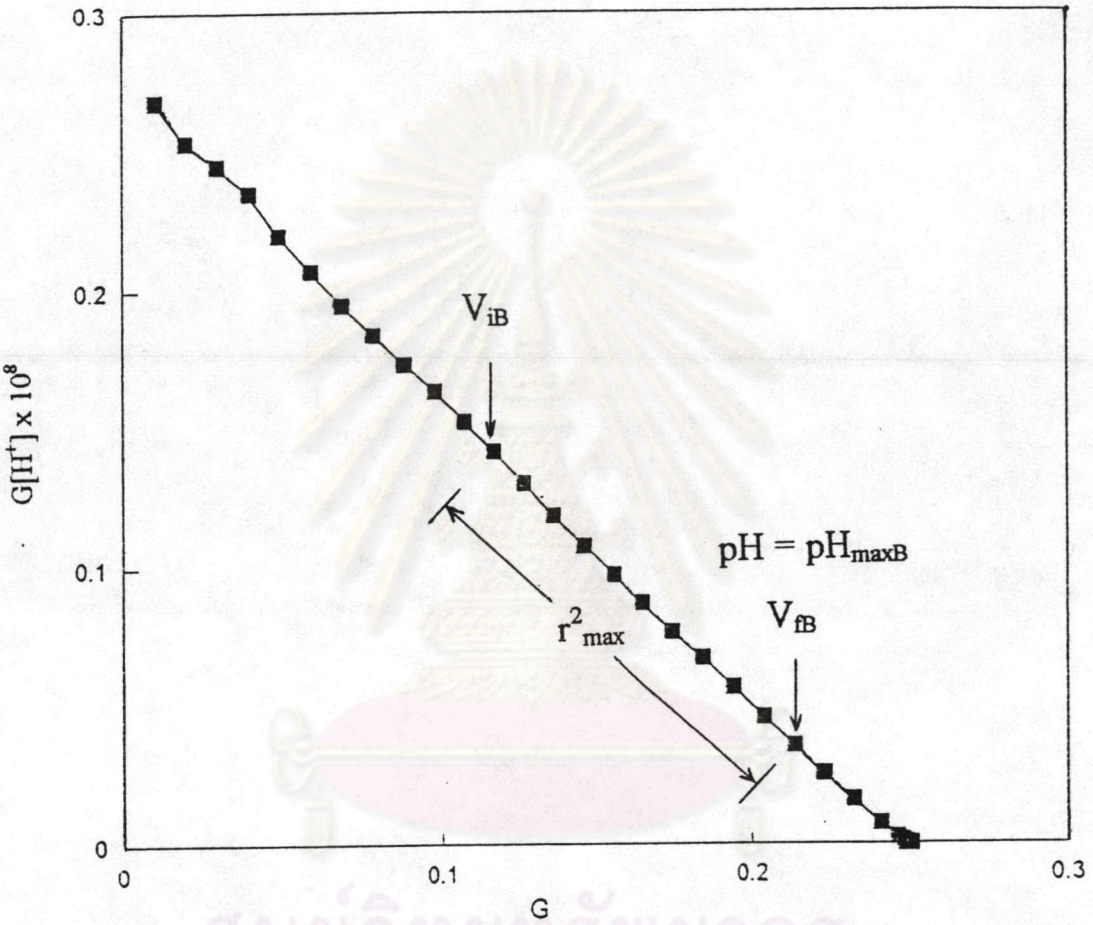

Fig. 2 : G plot linearity range of acid B (weaker acid).

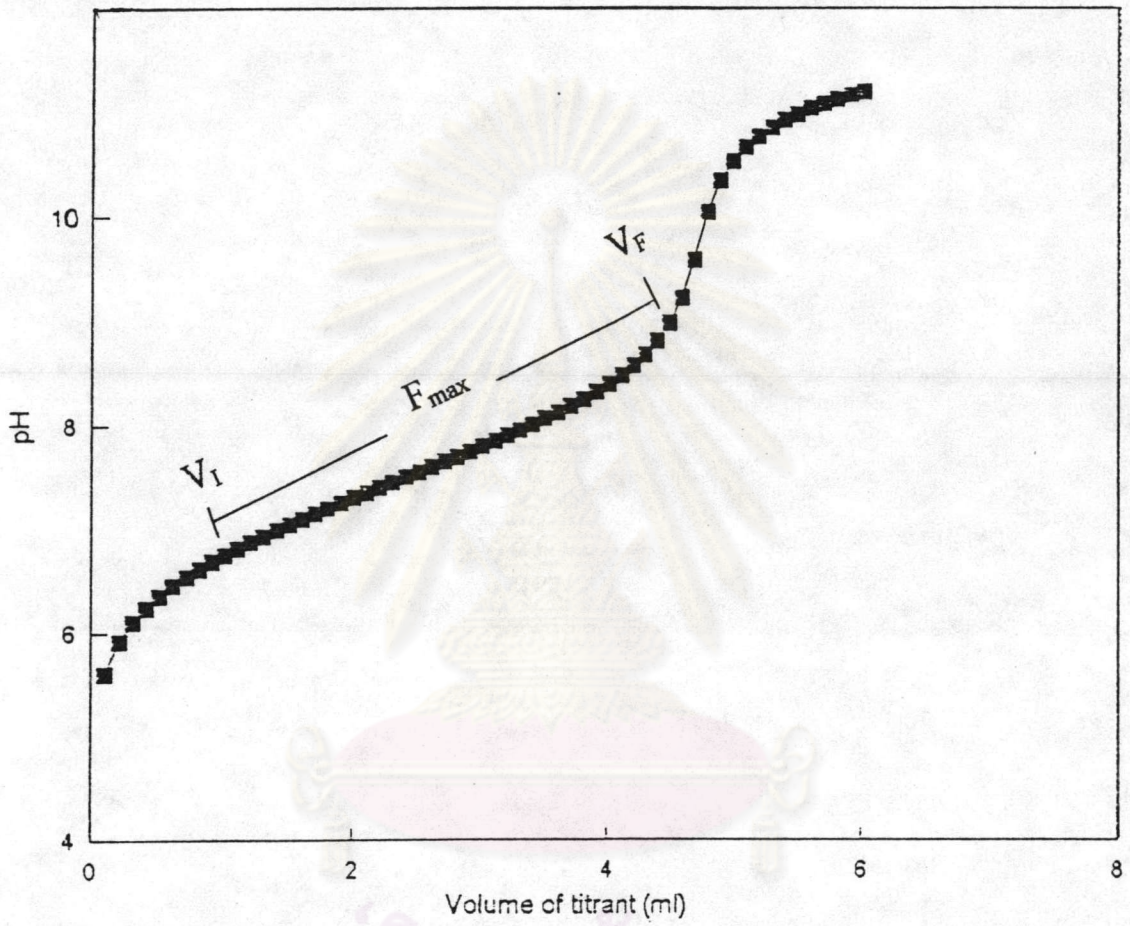

Fig. 3 : Titration data range chosen by Method A.

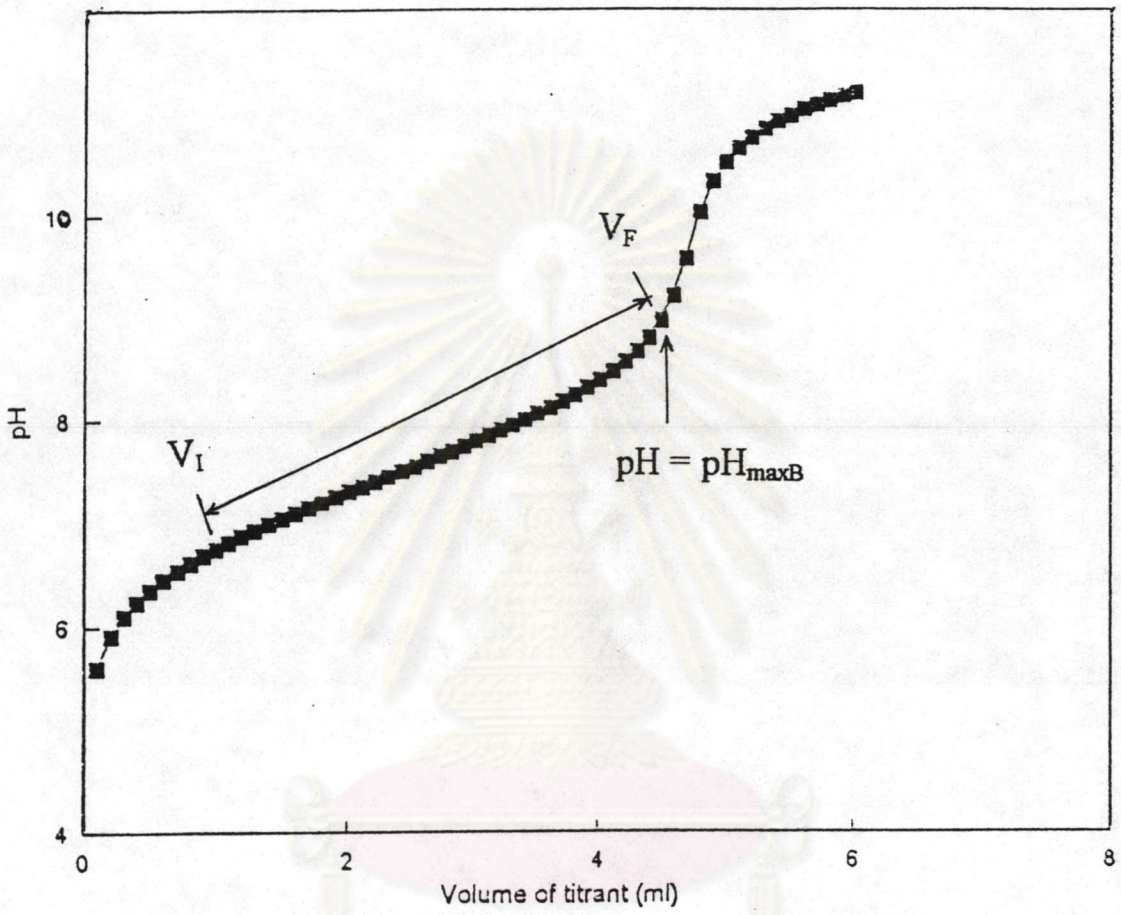

Fig. 4 : Titration data range chosen by Method B.

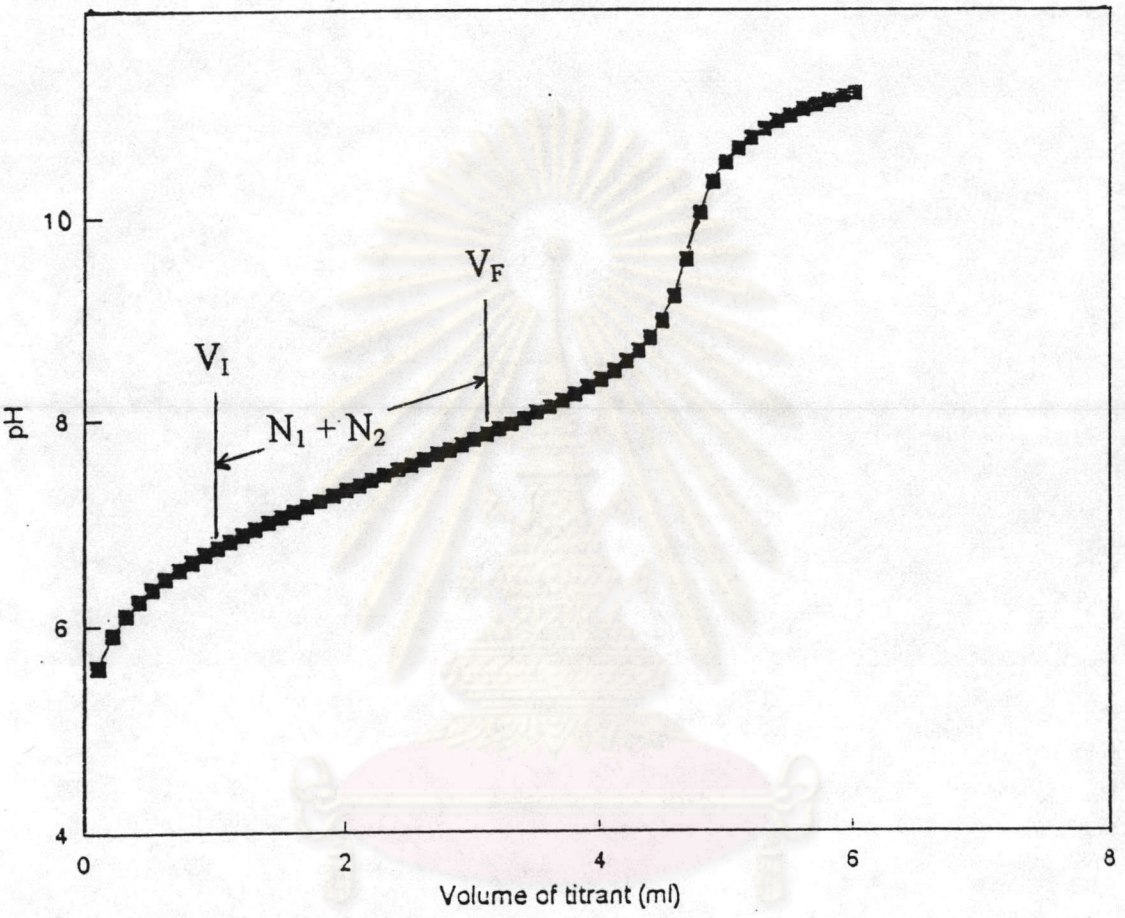

Fig. 5 : Titration data range chosen by Method C.

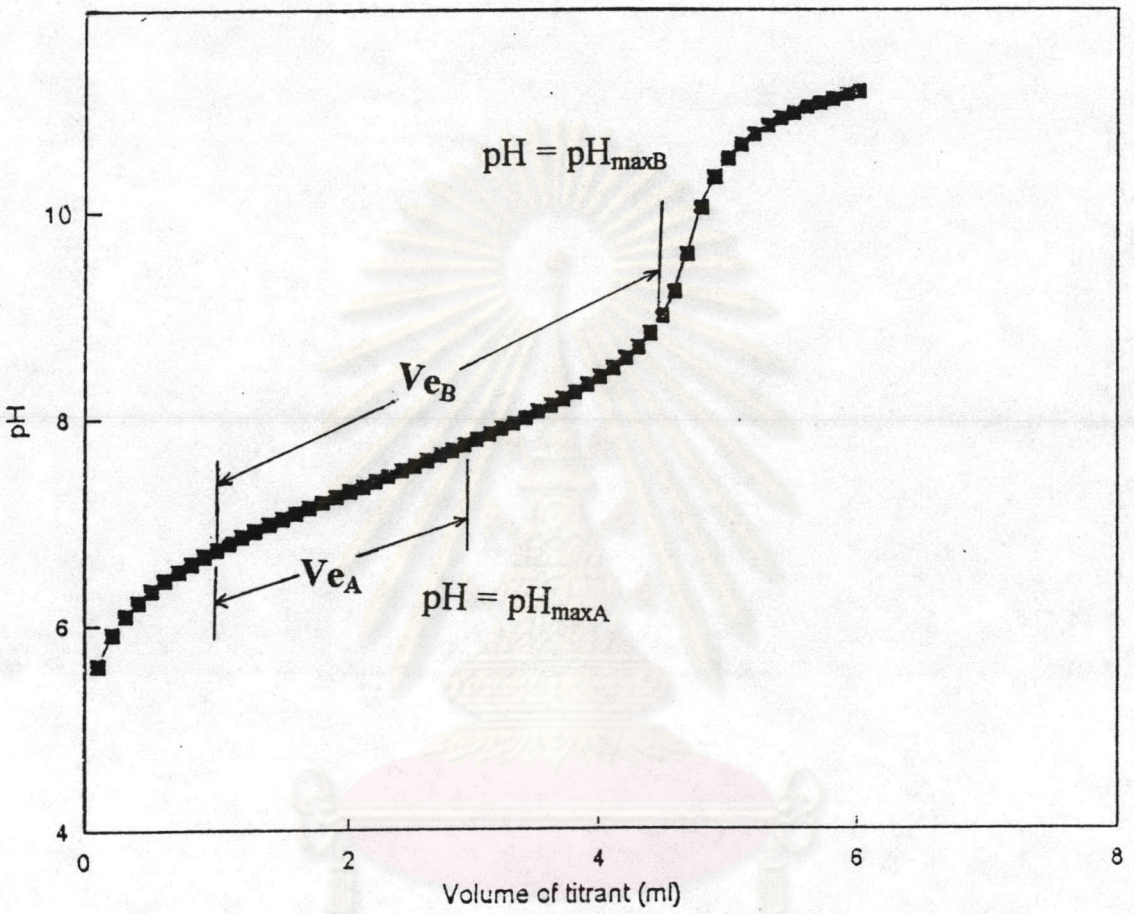

Fig. 6 : Titration data range chosen by Method D.

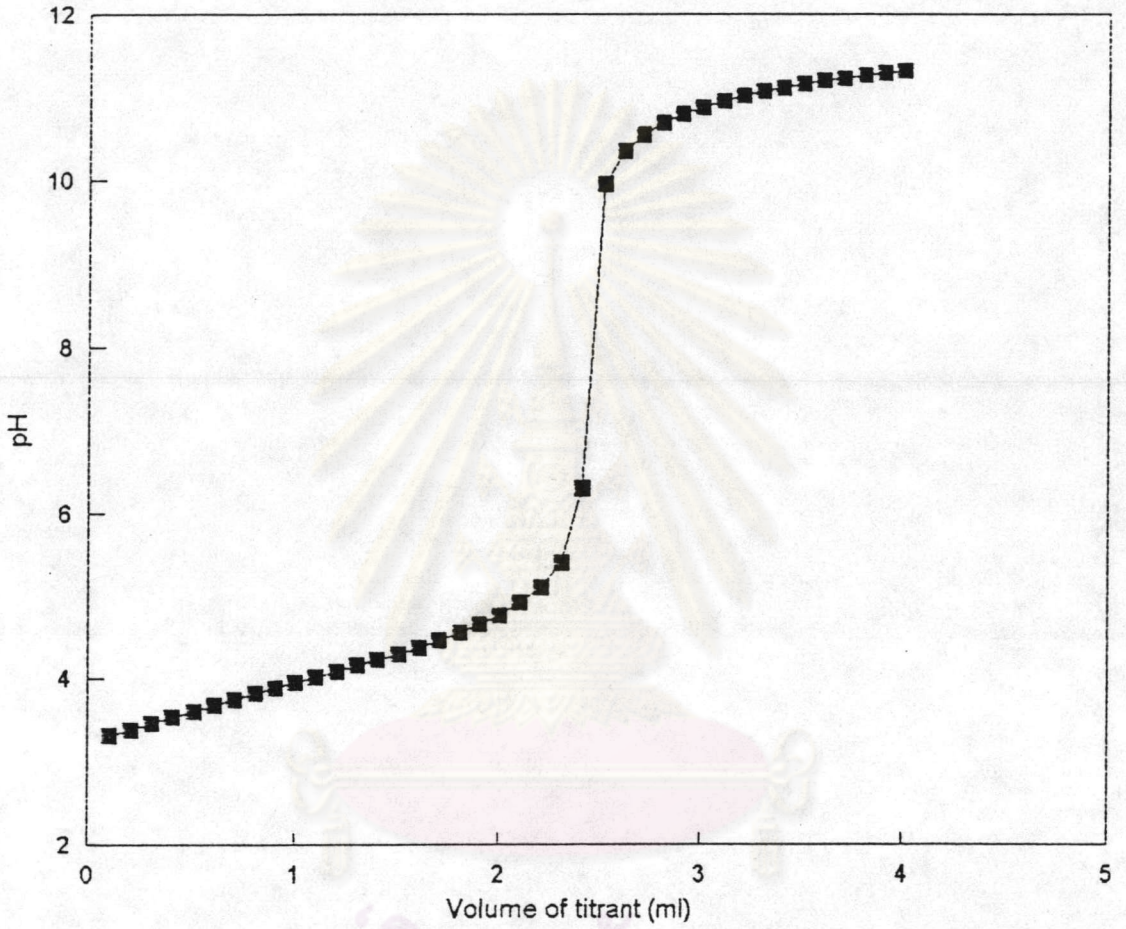

Fig. 7 : Titration curve of benzoic acid in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

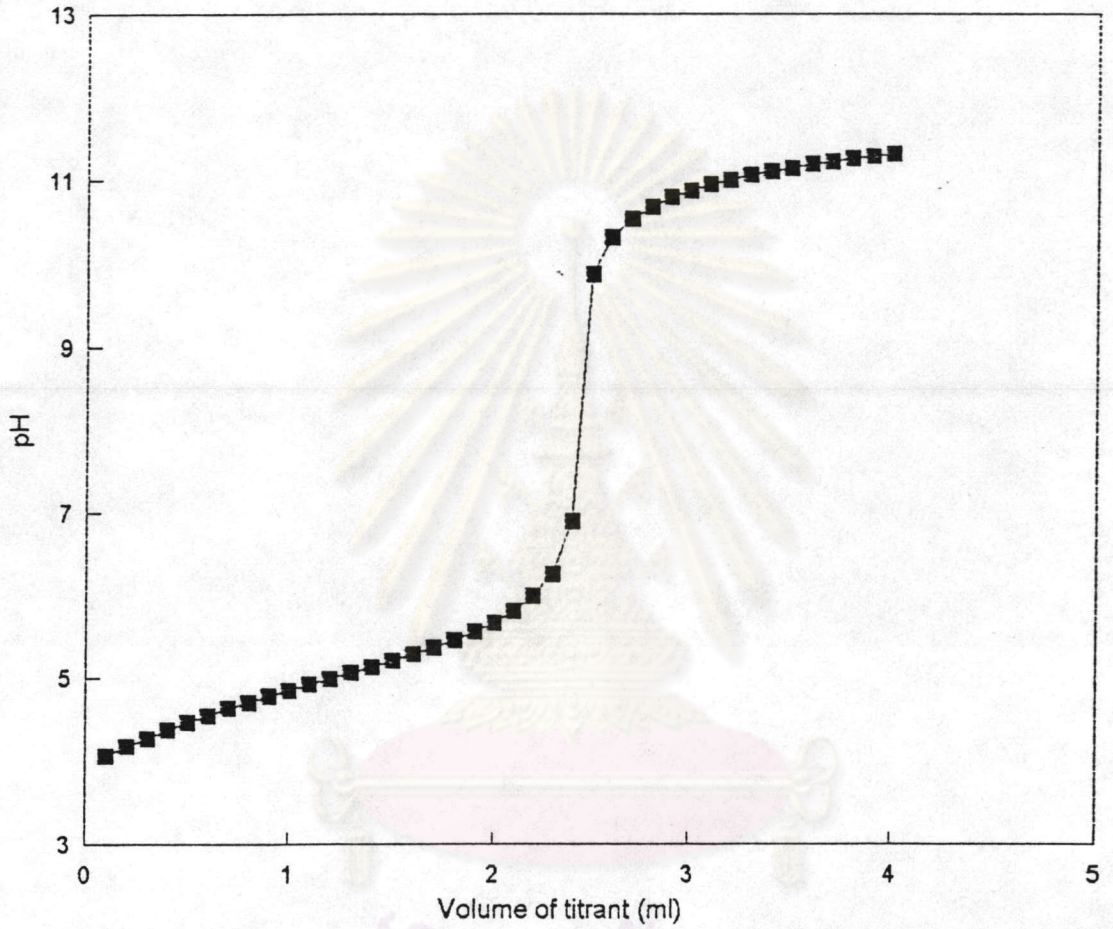

Fig. 8 : Titration curve of potassium biphthalate in 0.1 M potassium chloride solution with 0..1 N sodium hydroxide solution.

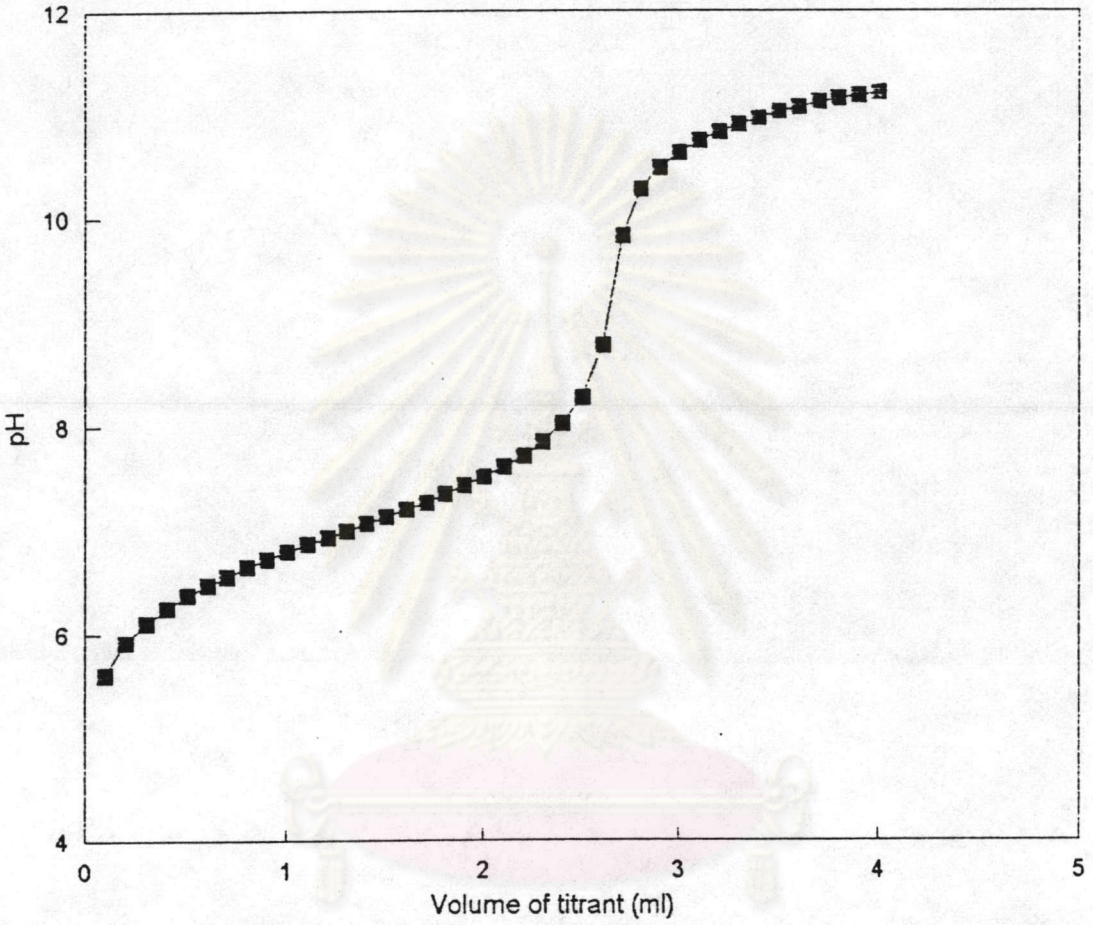

Fig. 9 : Titration curve of p-nitrophenol in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

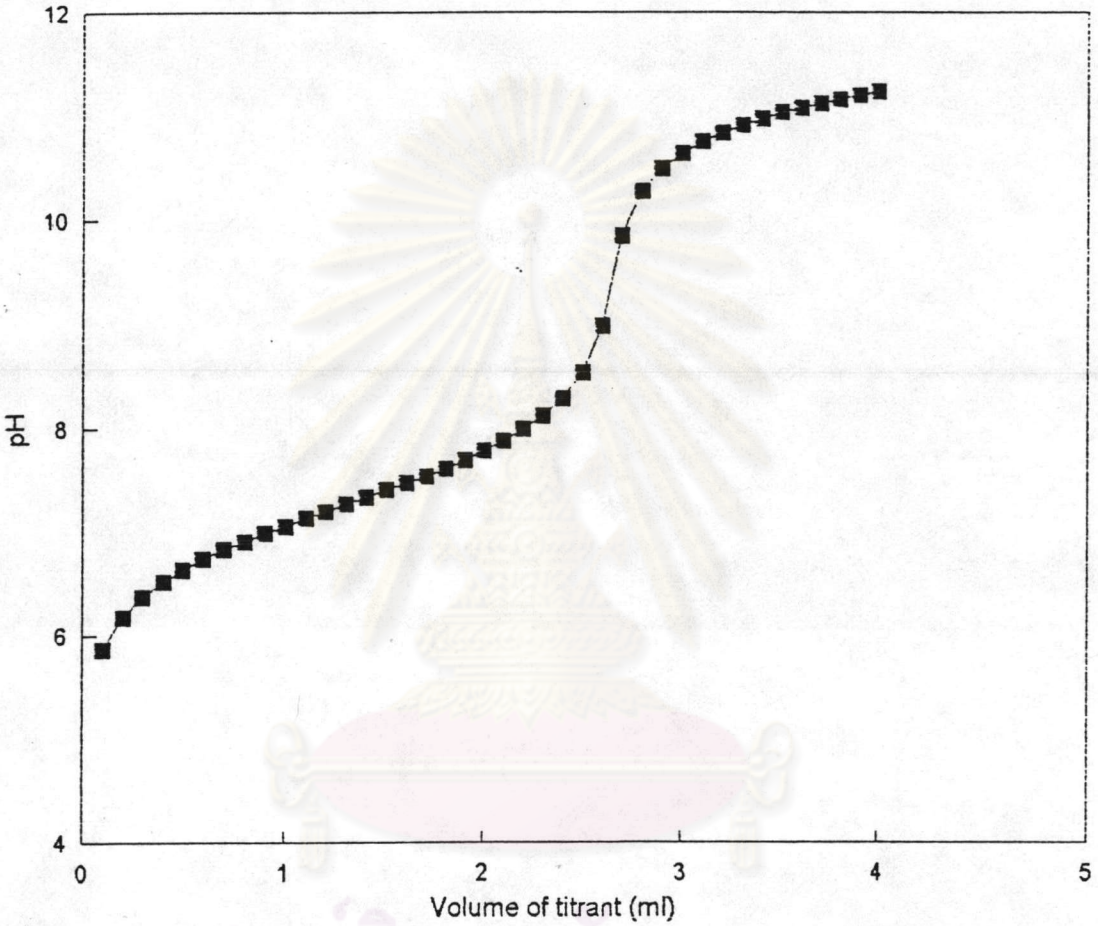

Fig. 10 : Titration curve of vanillin in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

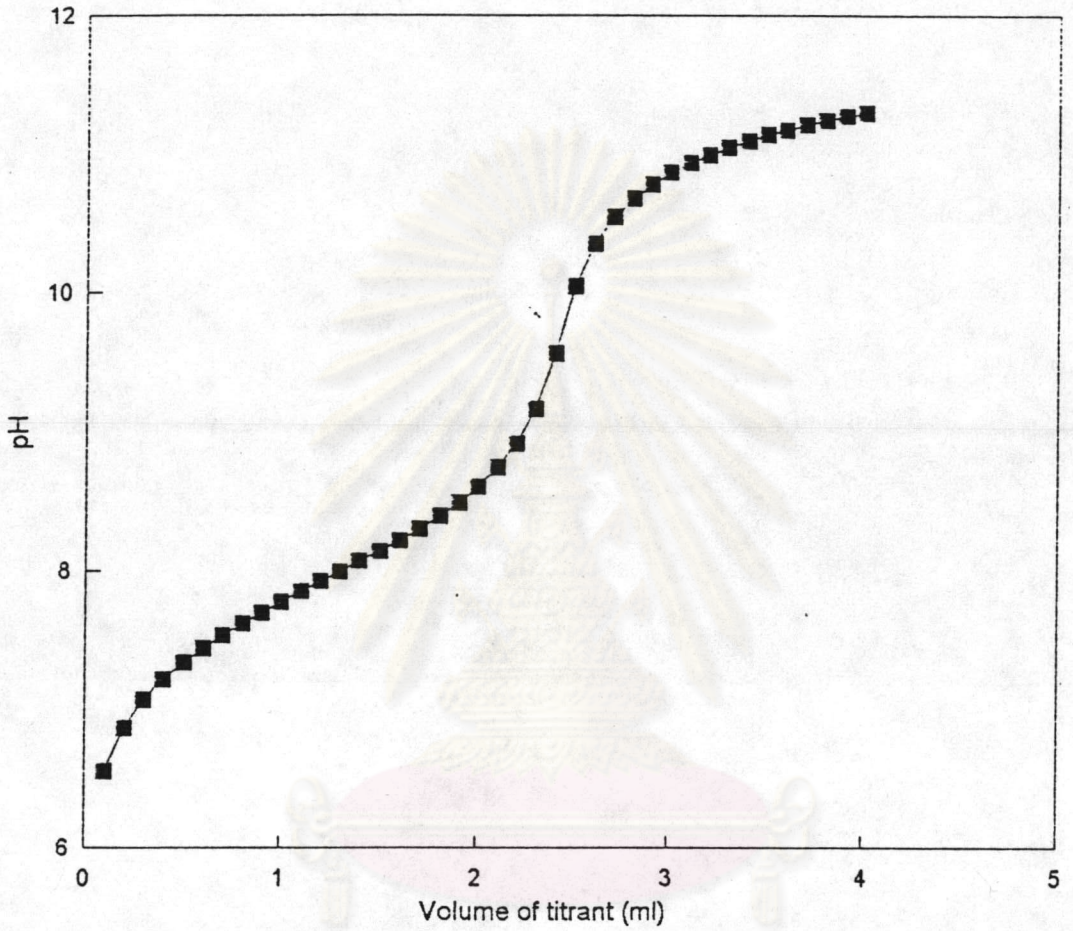

Fig. 11 : Titration curve of pralidoxime chloride in 0.1 M potassium chloride solution with 01 N sodium hydroxide solution.

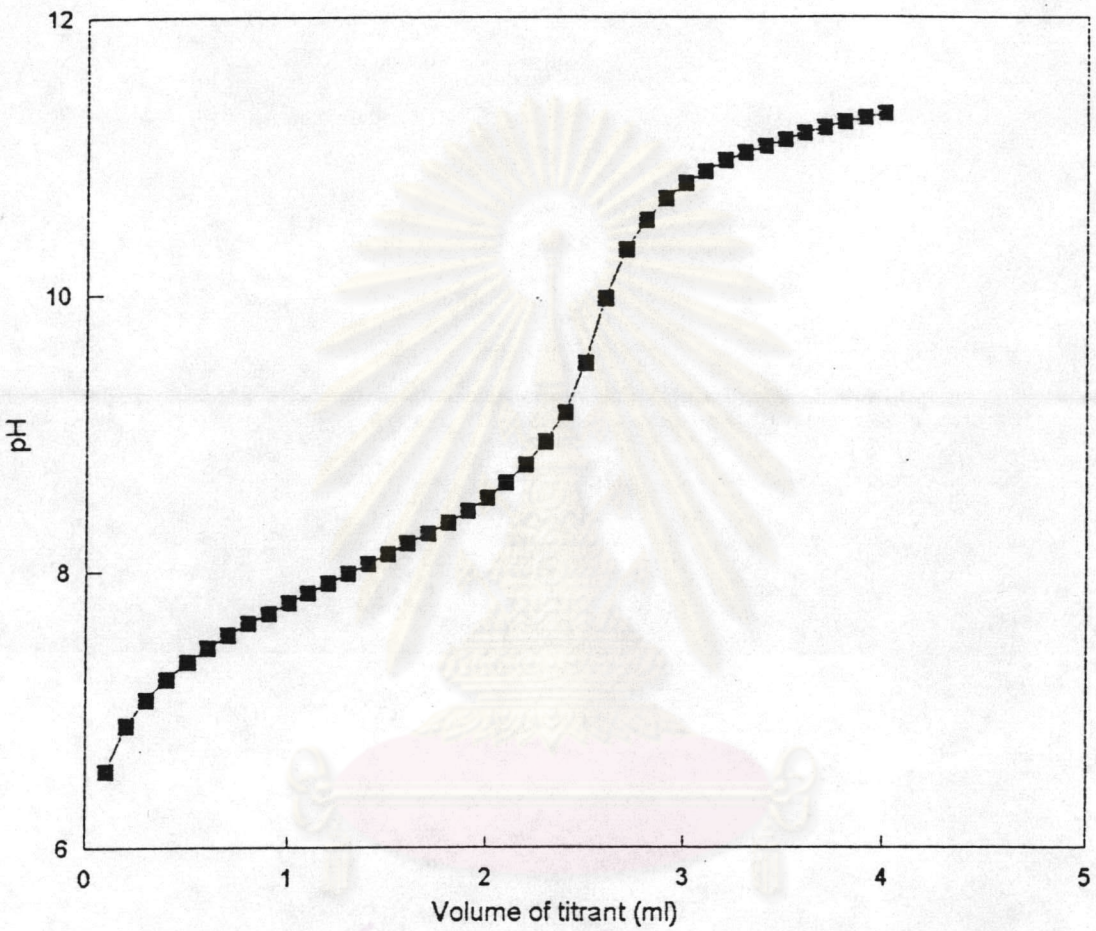

Fig. 12 : Titration curve of lidocaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

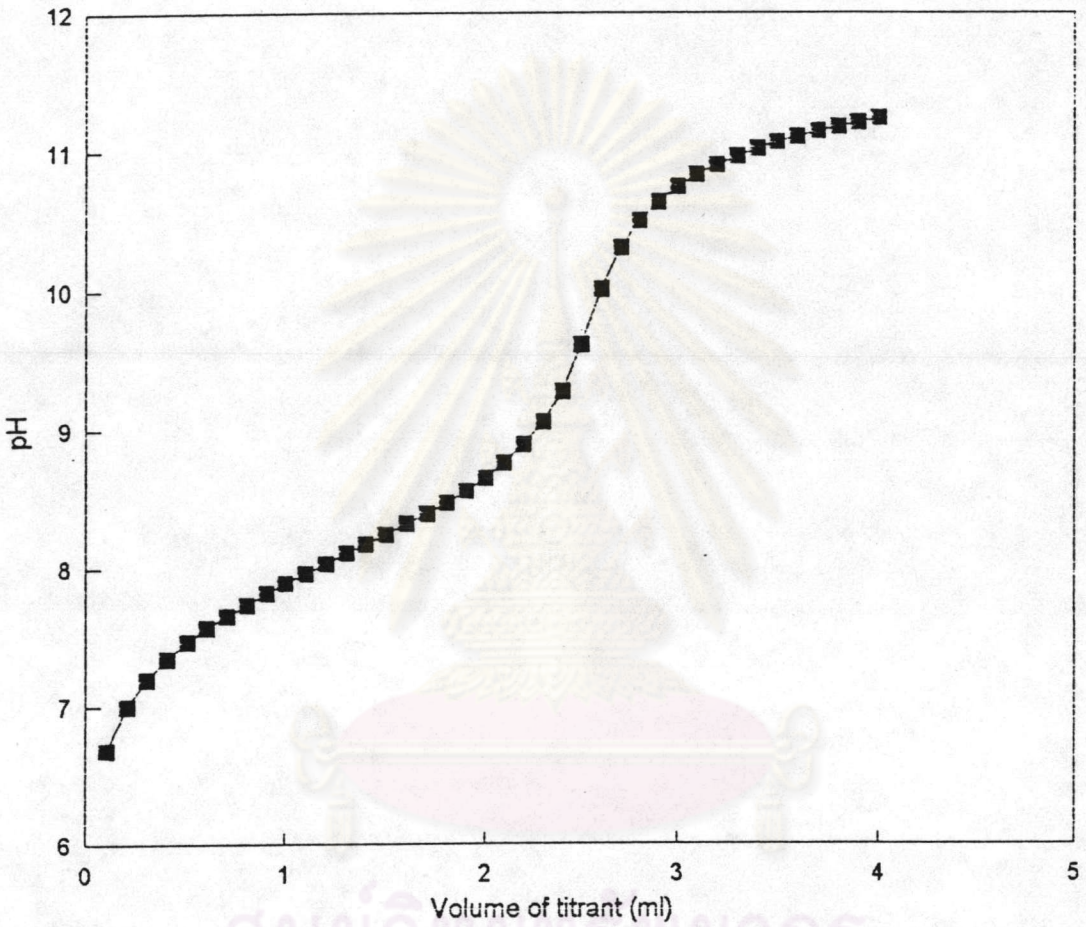

Fig.13 : Titration curve of salicylamide in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

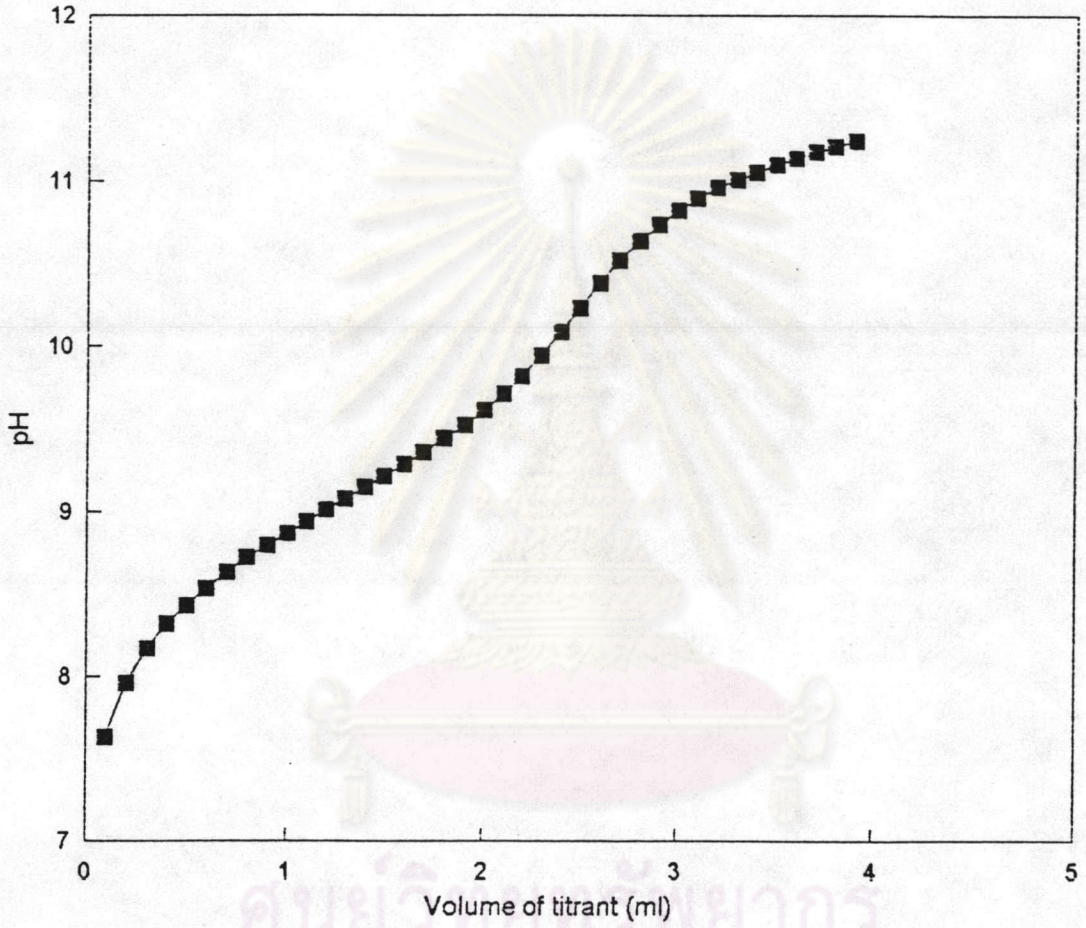

Fig.14 : Titration curve of procaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

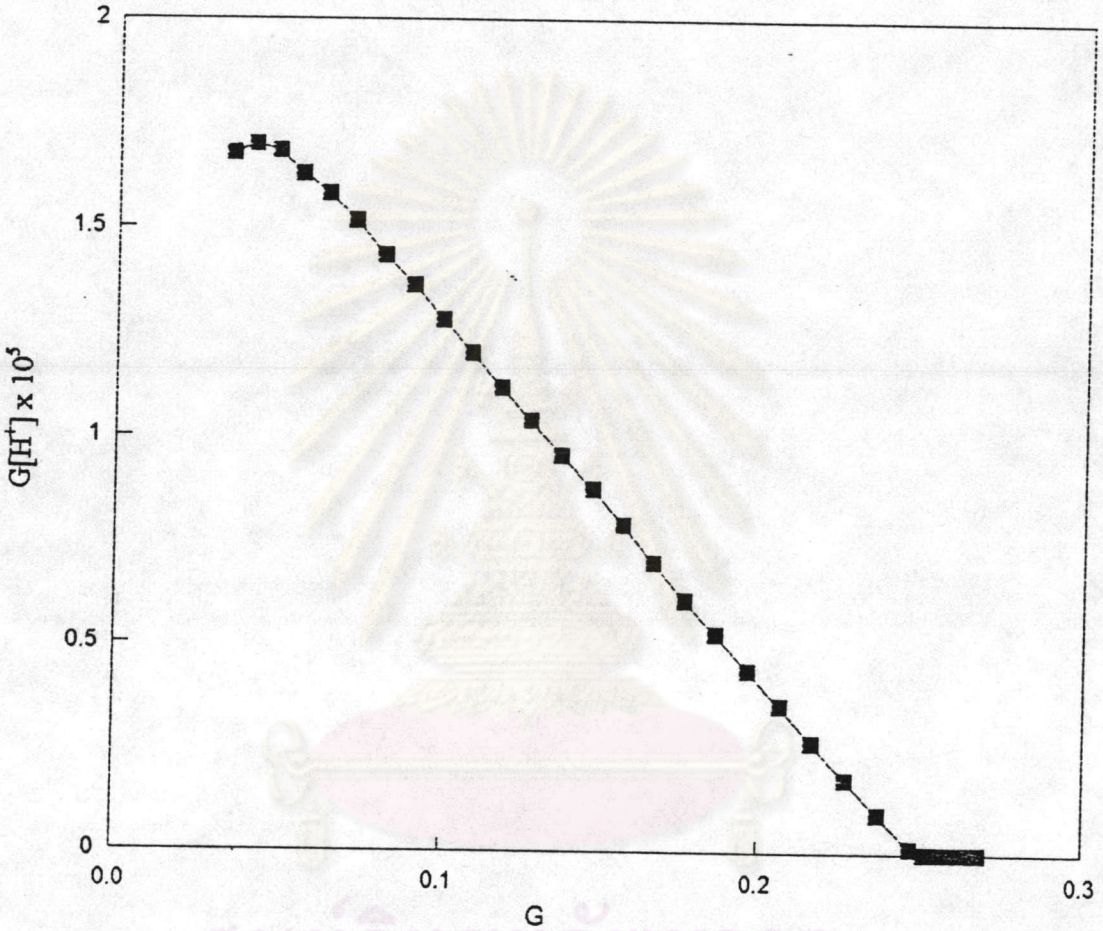

Fig. 15 : G plot for the titration of benzoic acid in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

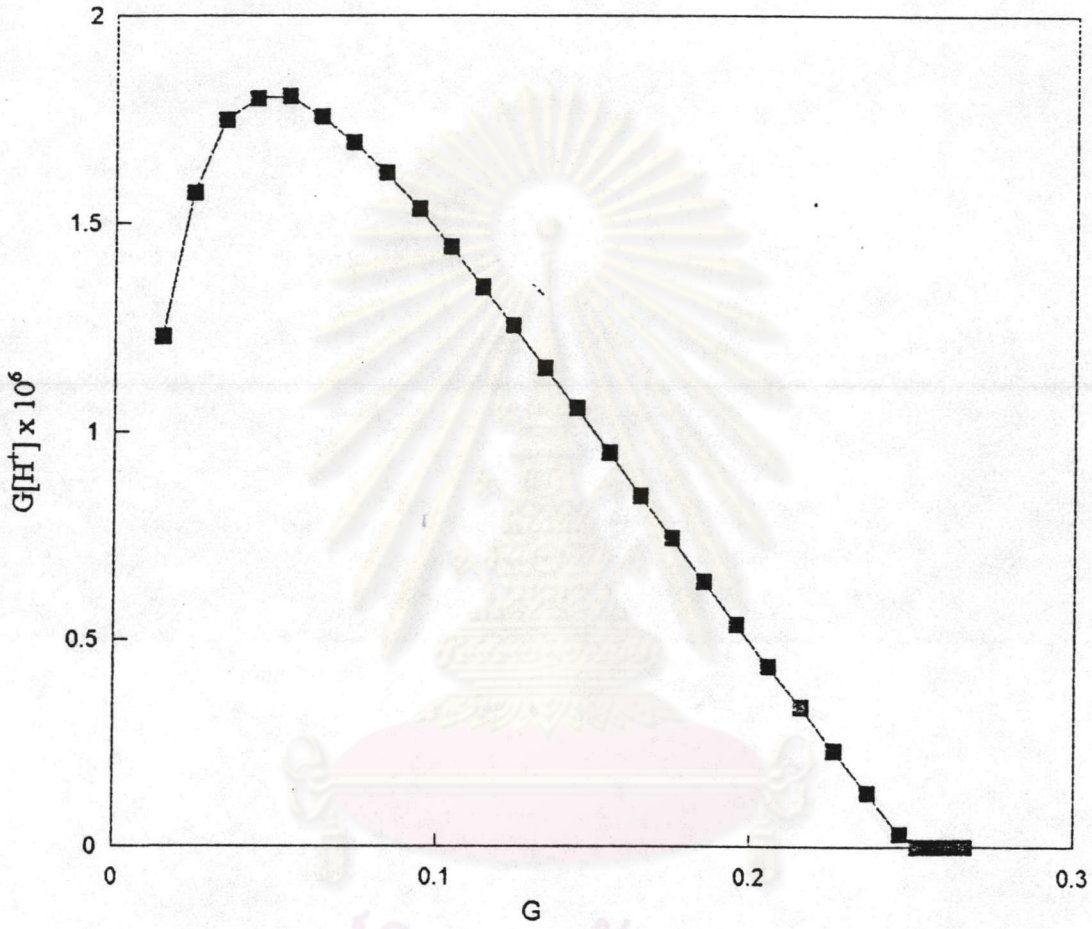

Fig. 16 : G plot for the titration of potassium biphthalate in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

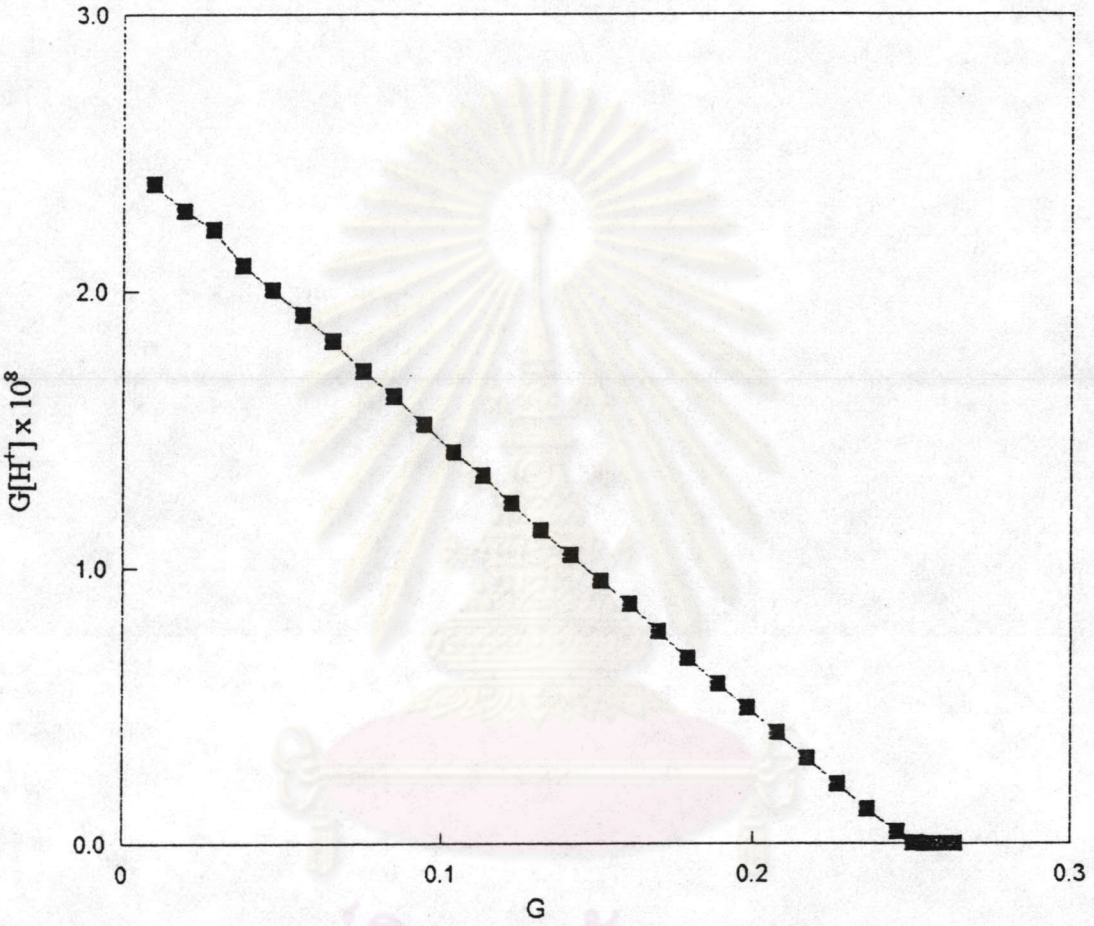

Fig. 17 : G plot for the titration of p-nitrophenol in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

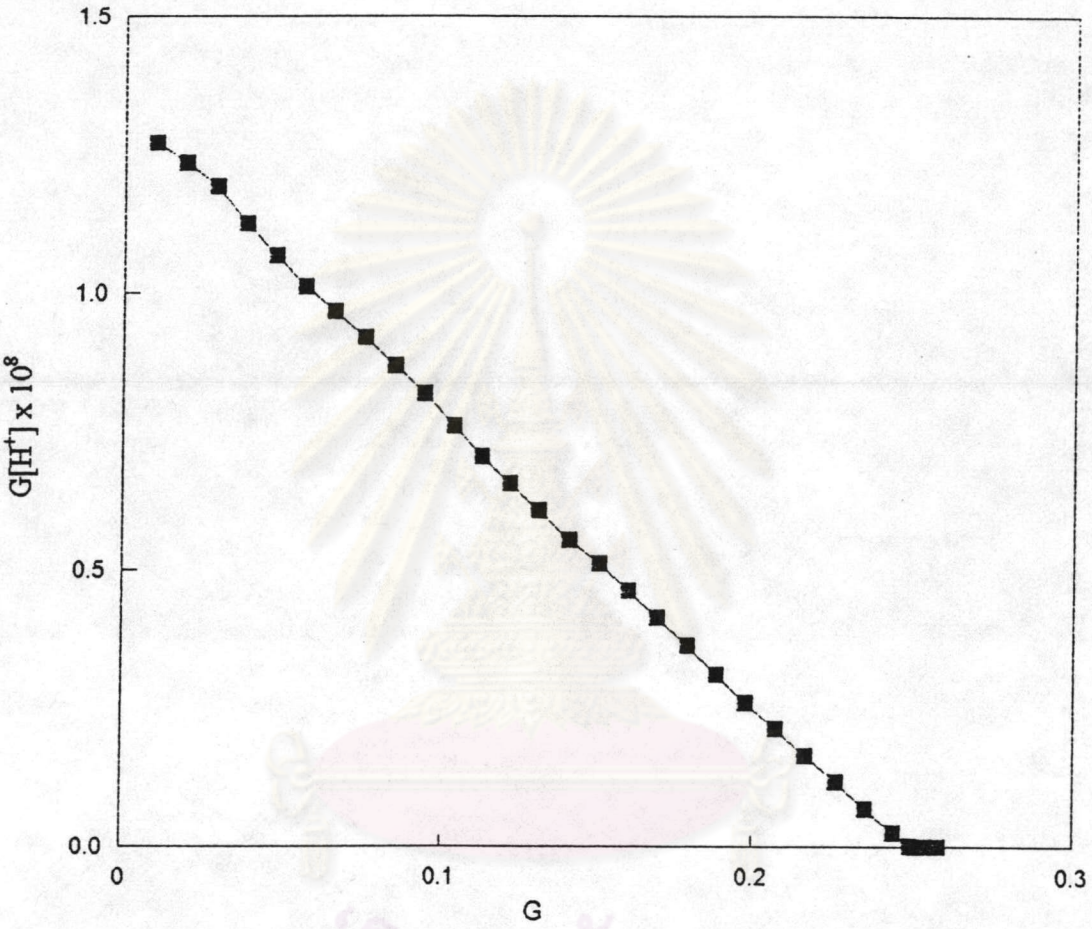

Fig. 18 : G plot for the titration of vanillin in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

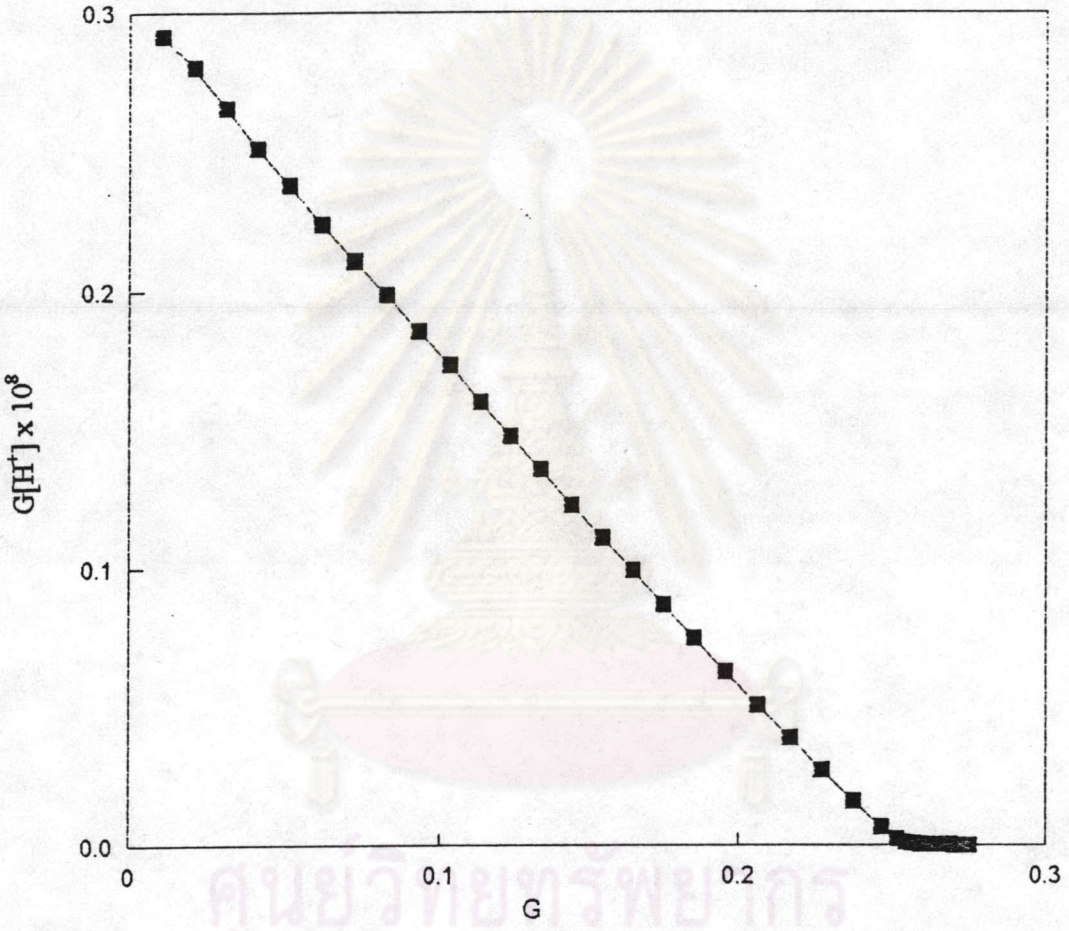

Fig. 19 : G plot for the titration of pralidoxime chloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

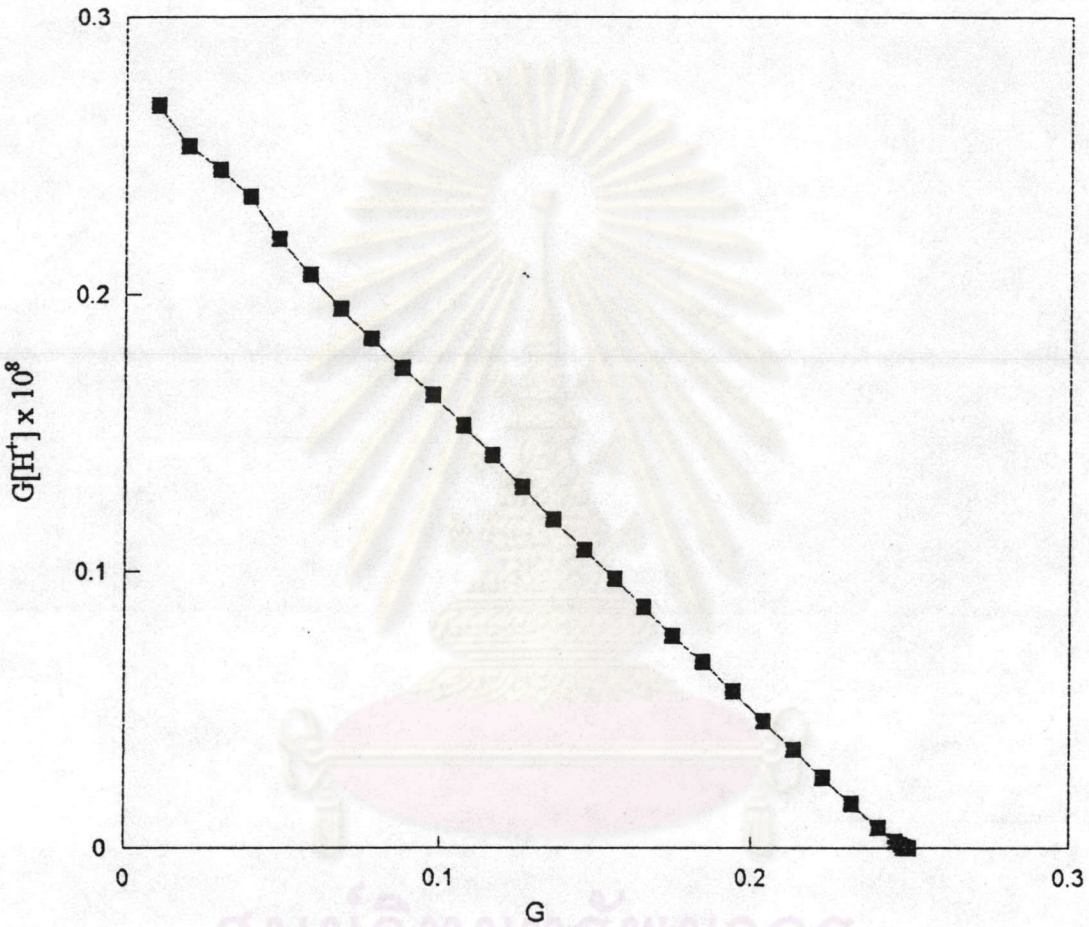

Fig. 20 : G plot for the titration of lidocaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

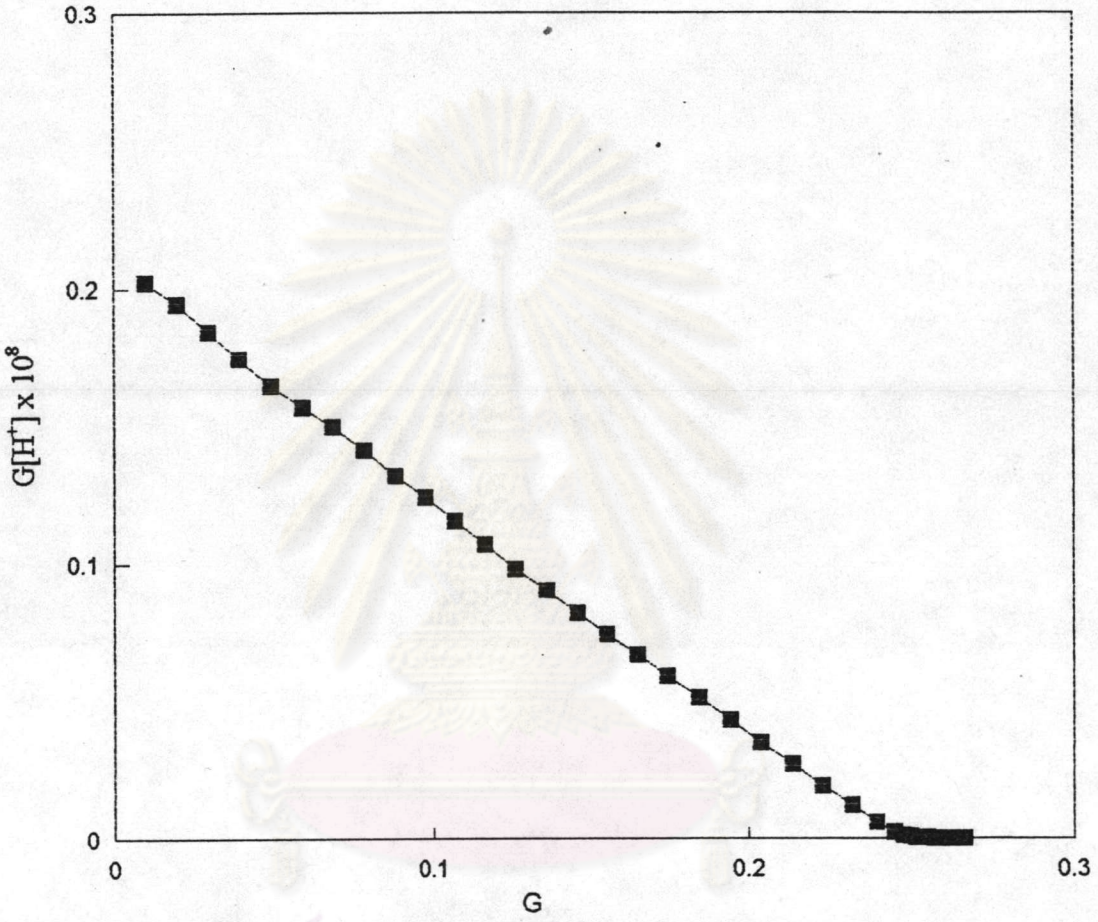

Fig. 21 : G plot for the titration of salicylamide in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

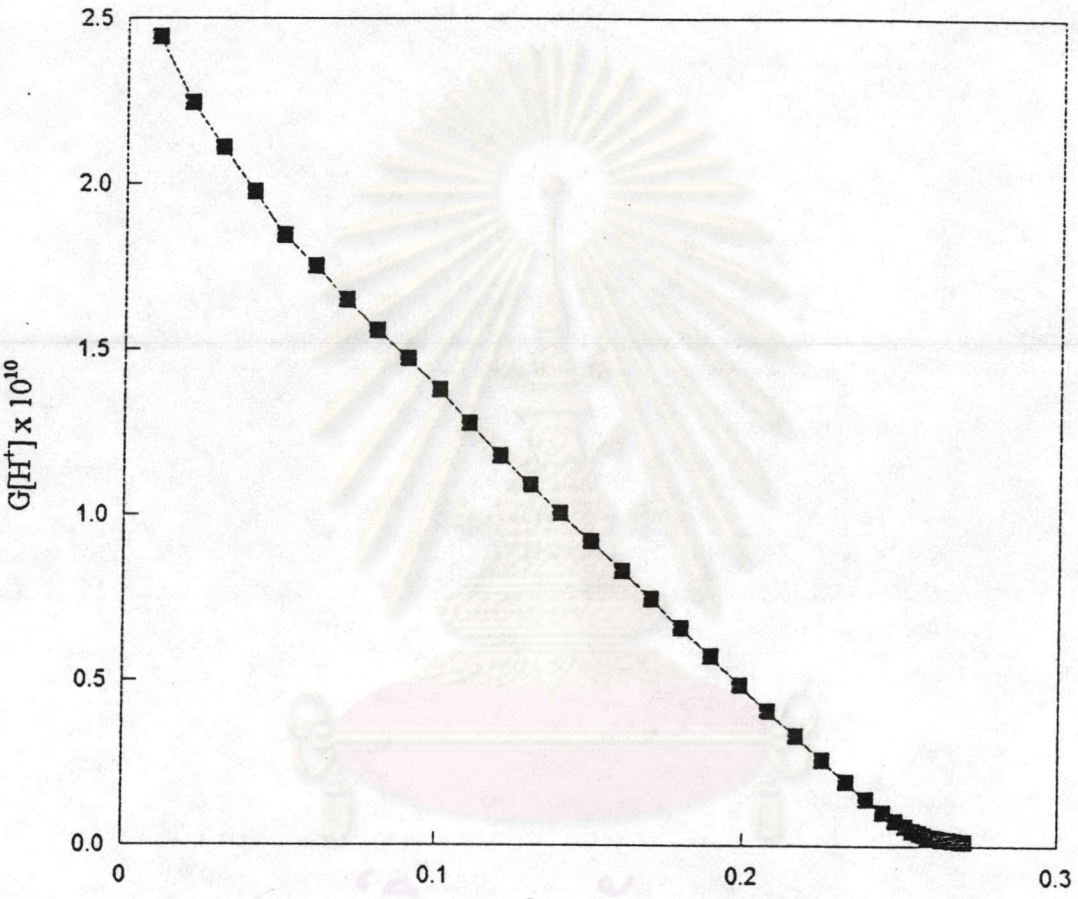

Fig. 22 : G plot for the titration of procaine hydrochloride in 0.1 M potassium chloride solution with 0..1 N sodium hydroxide solution.

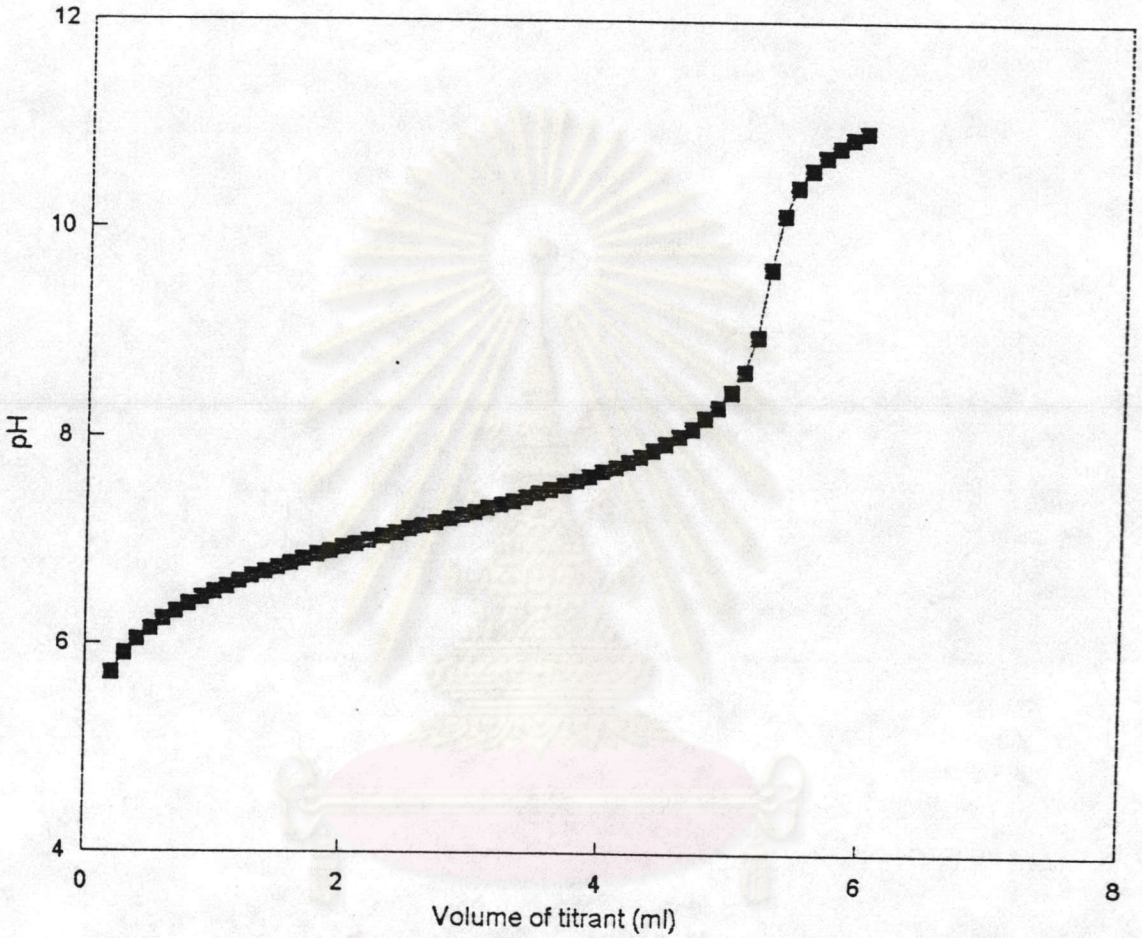

Fig. 23 : Titration curve of the mixture of p-nitrophenol and vanillin in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

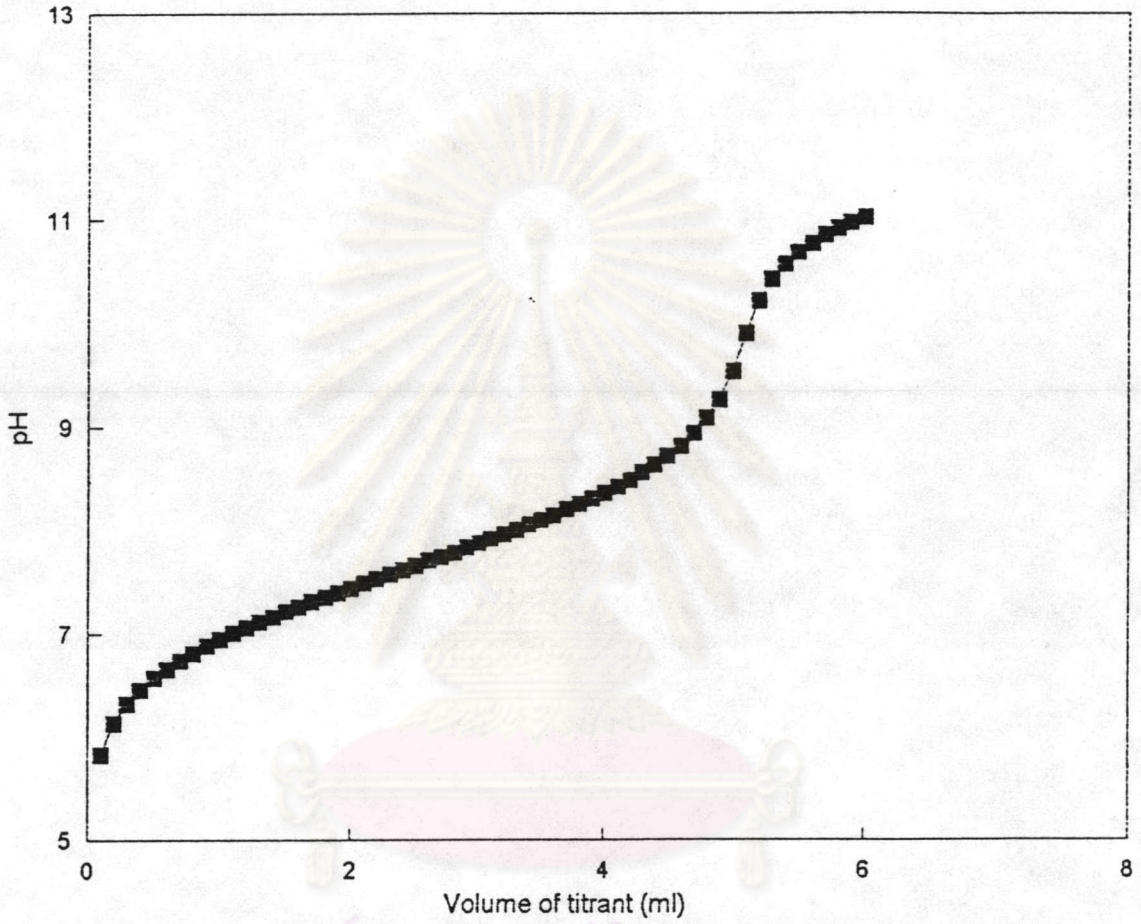

Fig. 24 : Titration curve of the mixture of vanillin and salicylamide in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

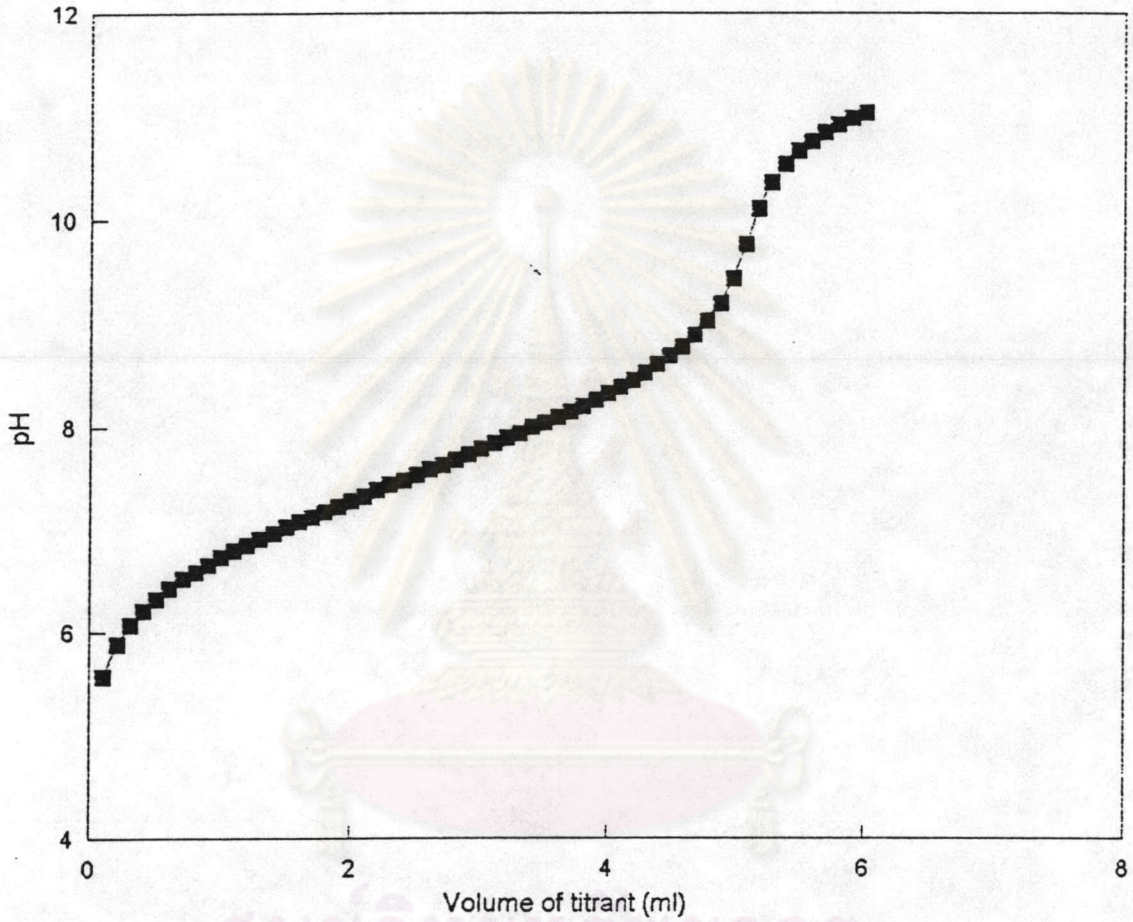

Fig. 25 : Titration curve of the mixture of p-nitrophenol and salicylamide in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

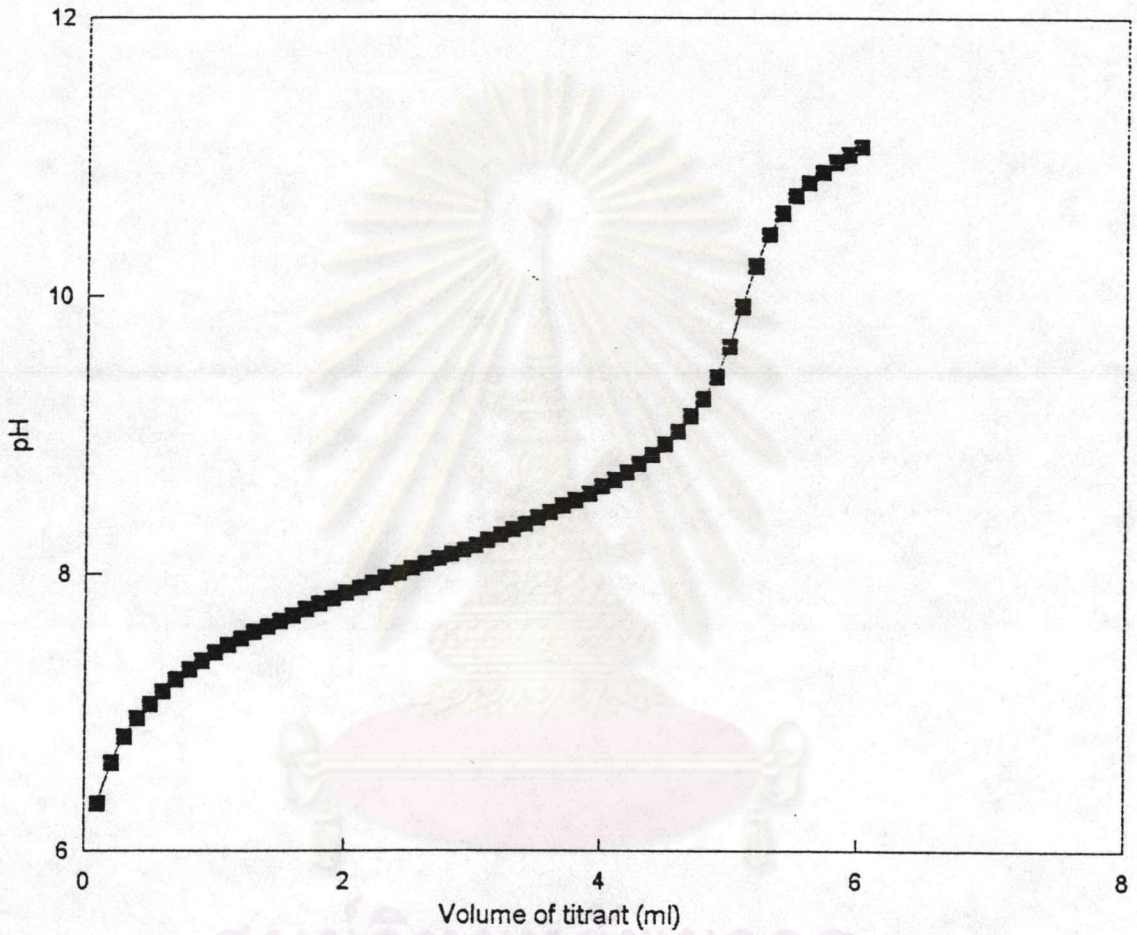

Fig. 26 : Titration curve of the mixture of salicylamide and lidocaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

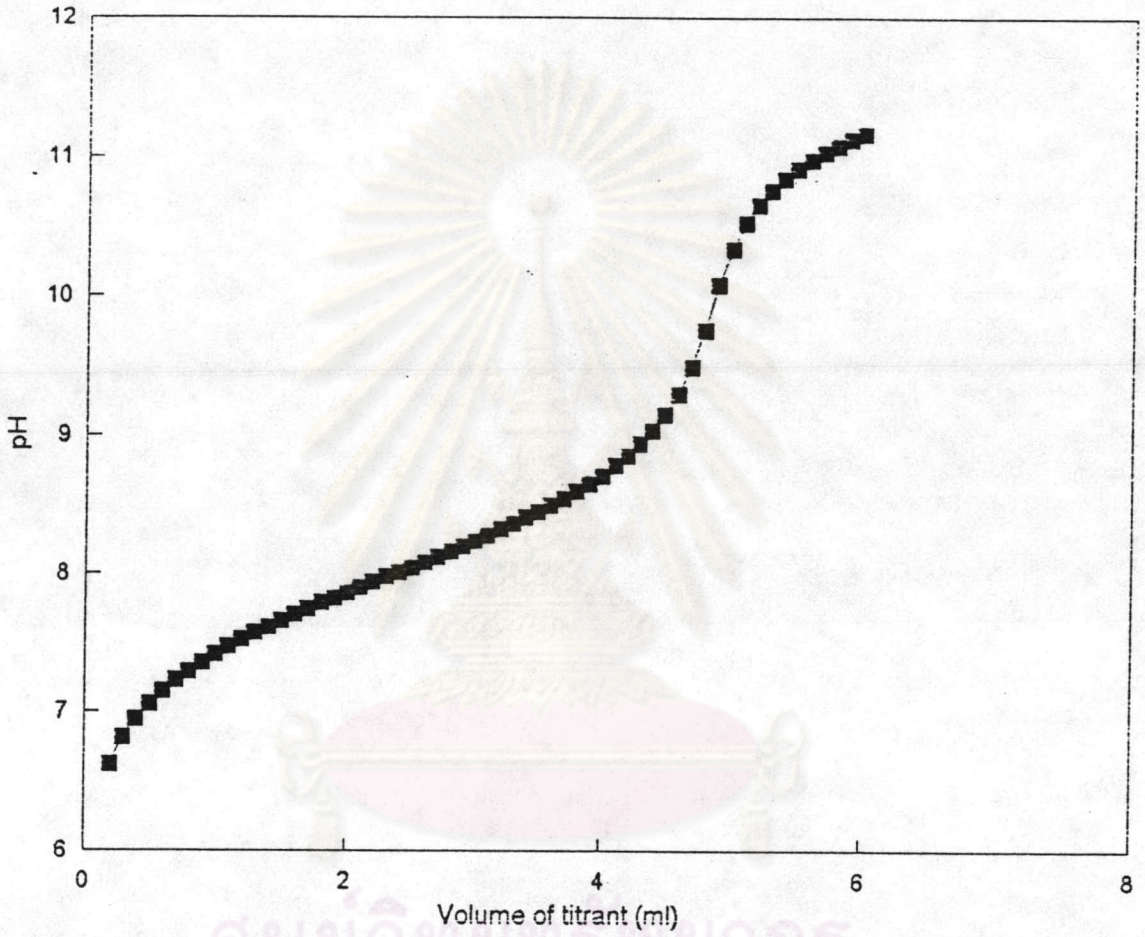

Fig. 27 : Titration curve of the mixture of salicylamide and pralidoxime chloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

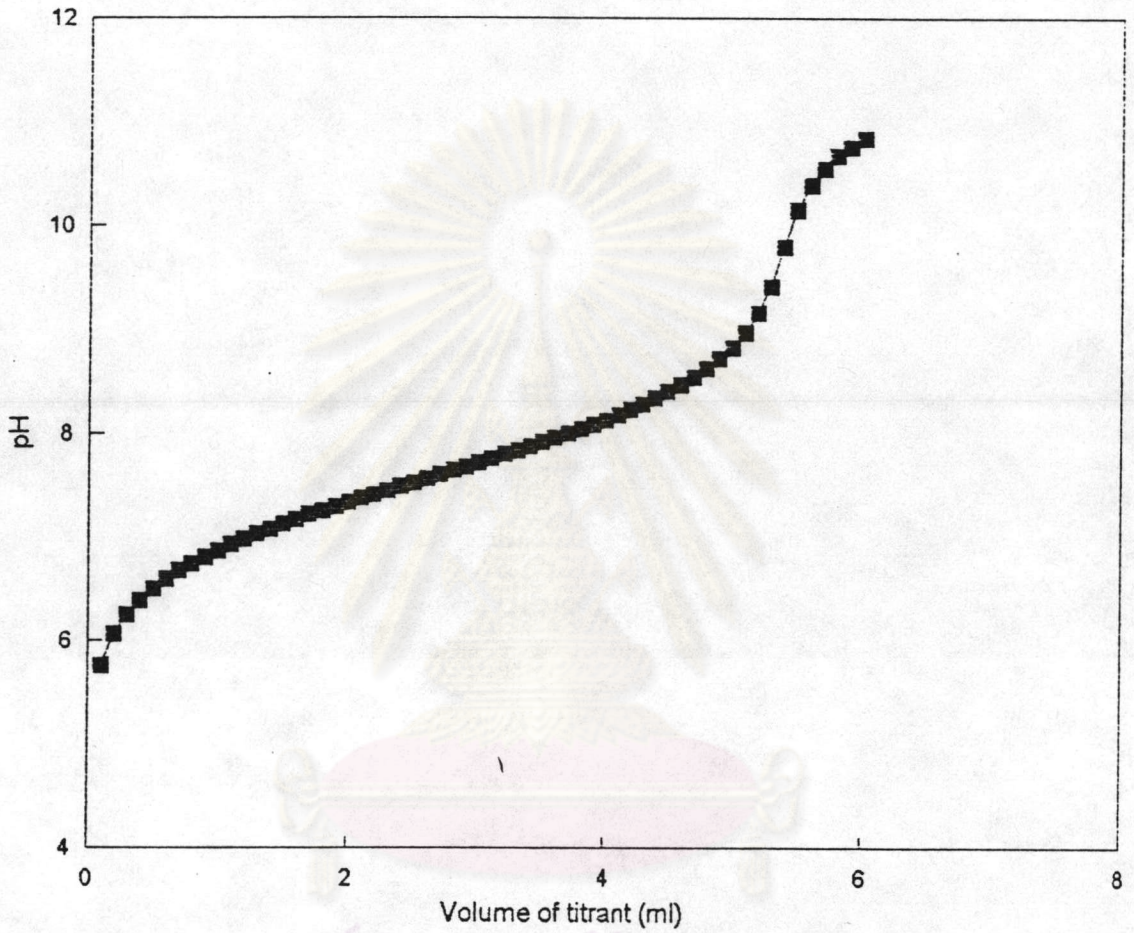

Fig. 28 : Titration curve of the mixture of vanillin and pralidoxime chloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

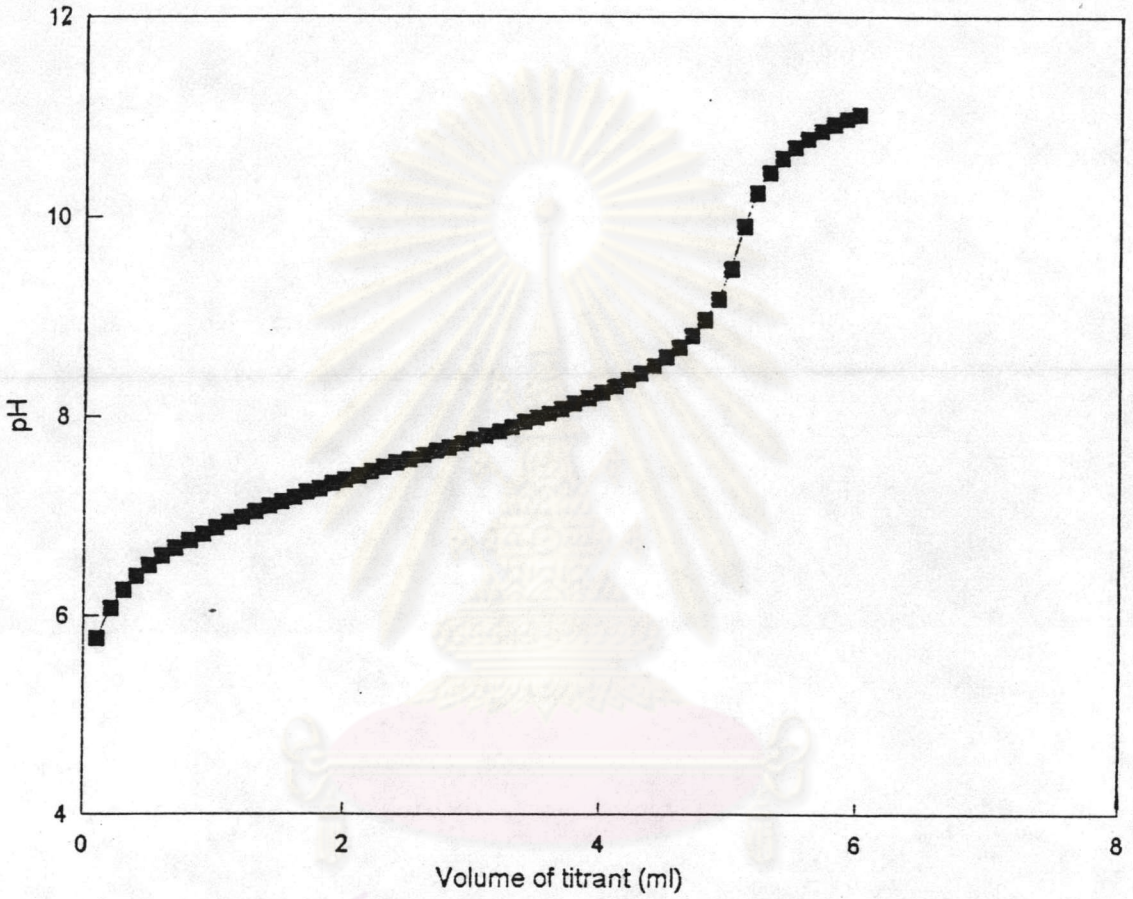

Fig. 29 : Titration curve of the mixture of vanillin and lidocaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

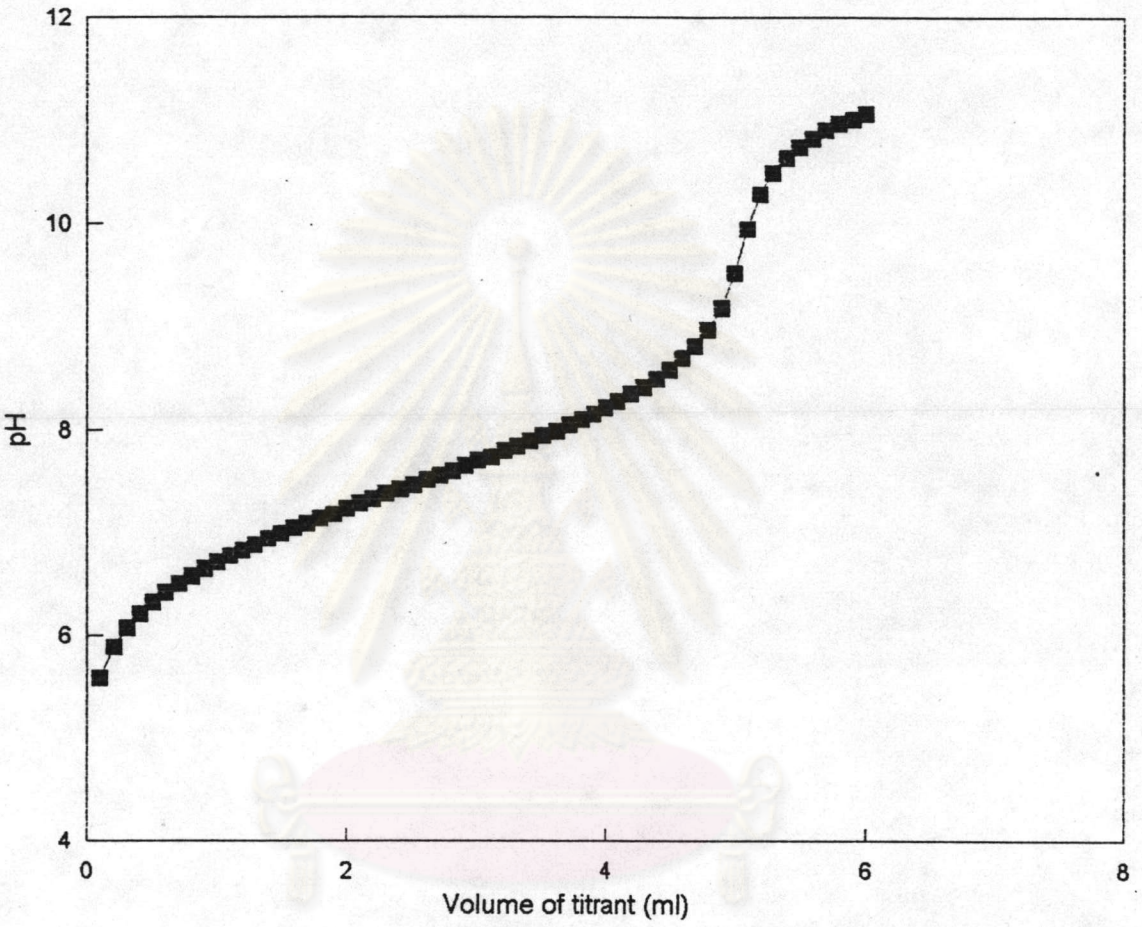

Fig. 30 : Titration curve of the mixture of p-nitrophenol and pralidoxime chloride in 0.1M potassium chloride solution with 0.1 N sodium hydroxide solution.

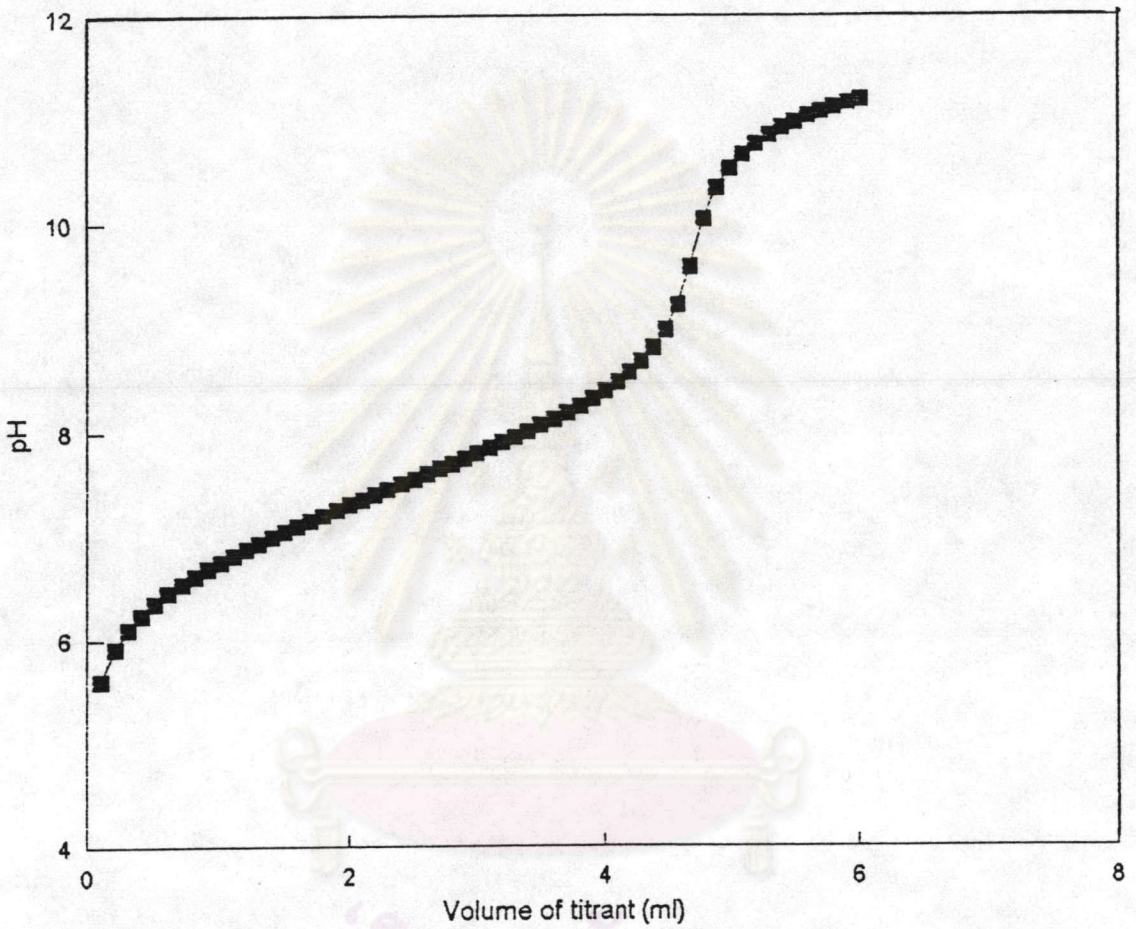

Fig. 31 : Titration curve of the mixture of p-nitrophenol and lidocaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

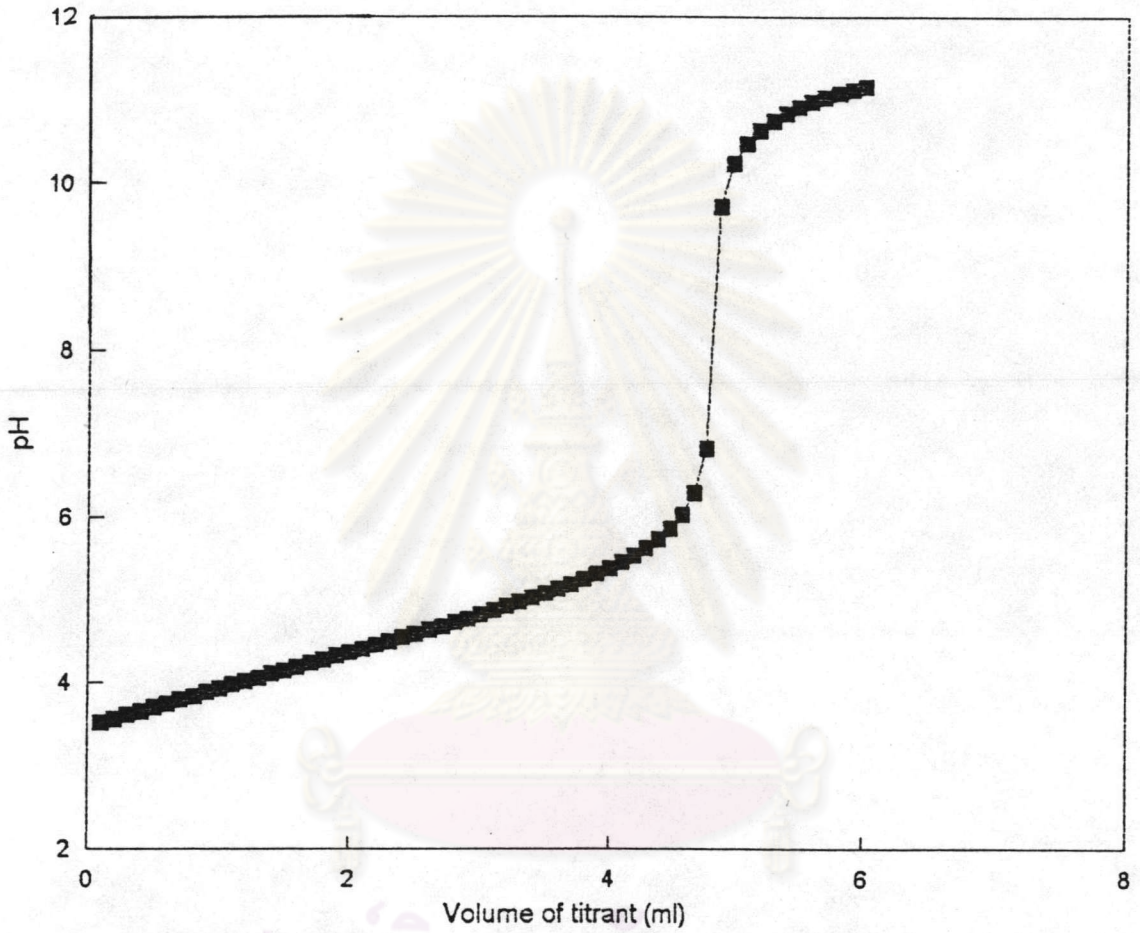

Fig. 32 : Titration curve of the mixture of benzoic acid and potassium biphthalate in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

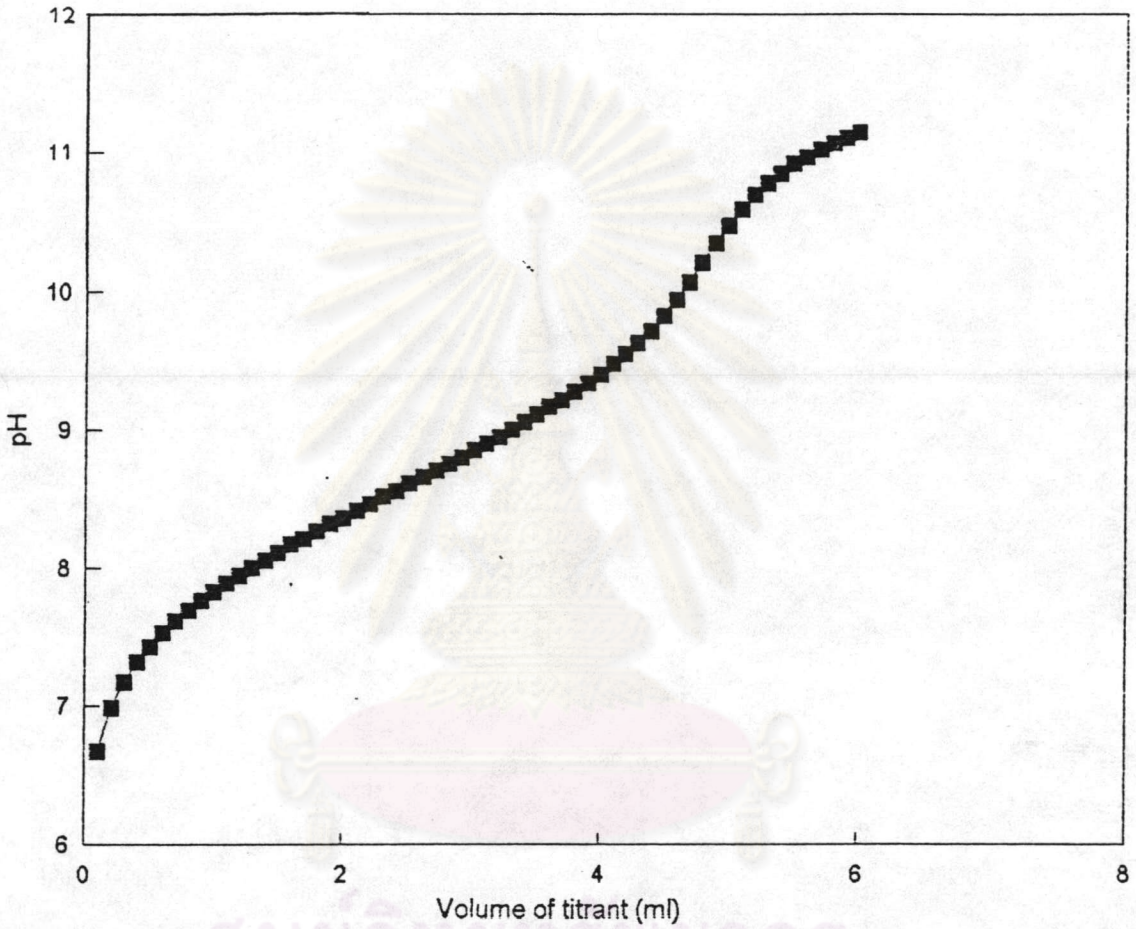

Fig. 33 : Titration curve of the mixture of salicylamide and procaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

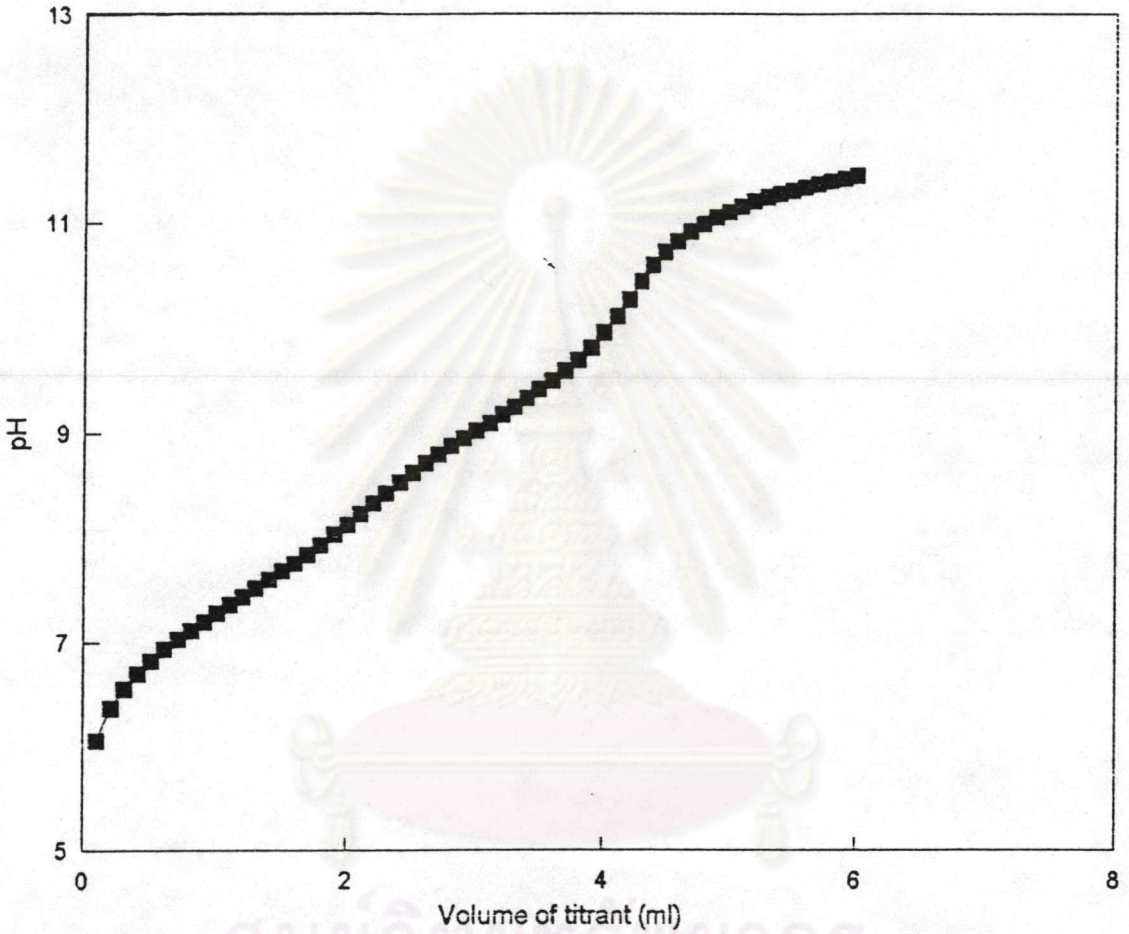

Fig. 34 : Titration curve of the mixture of vanillin and procaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

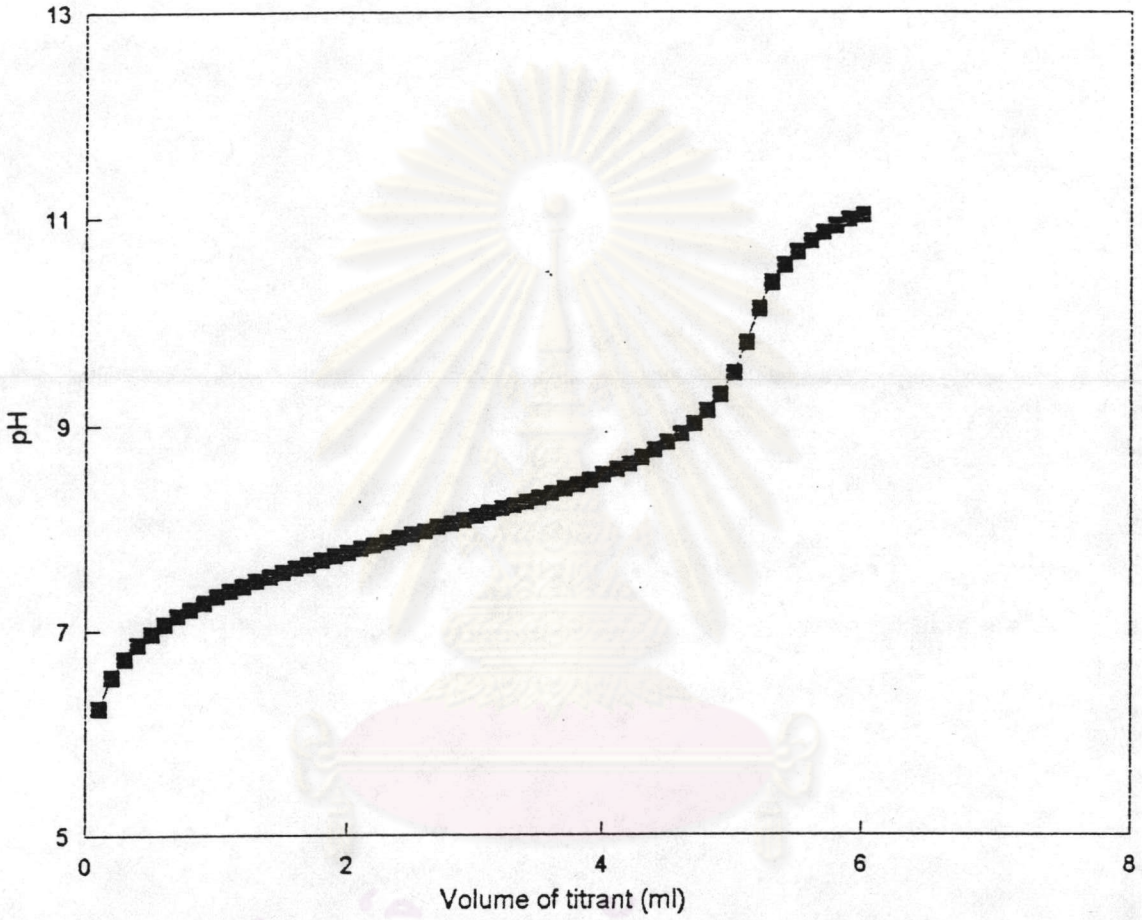

Fig. 35 : Titration curve of the mixture of pralidoxime chloride and lidocaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

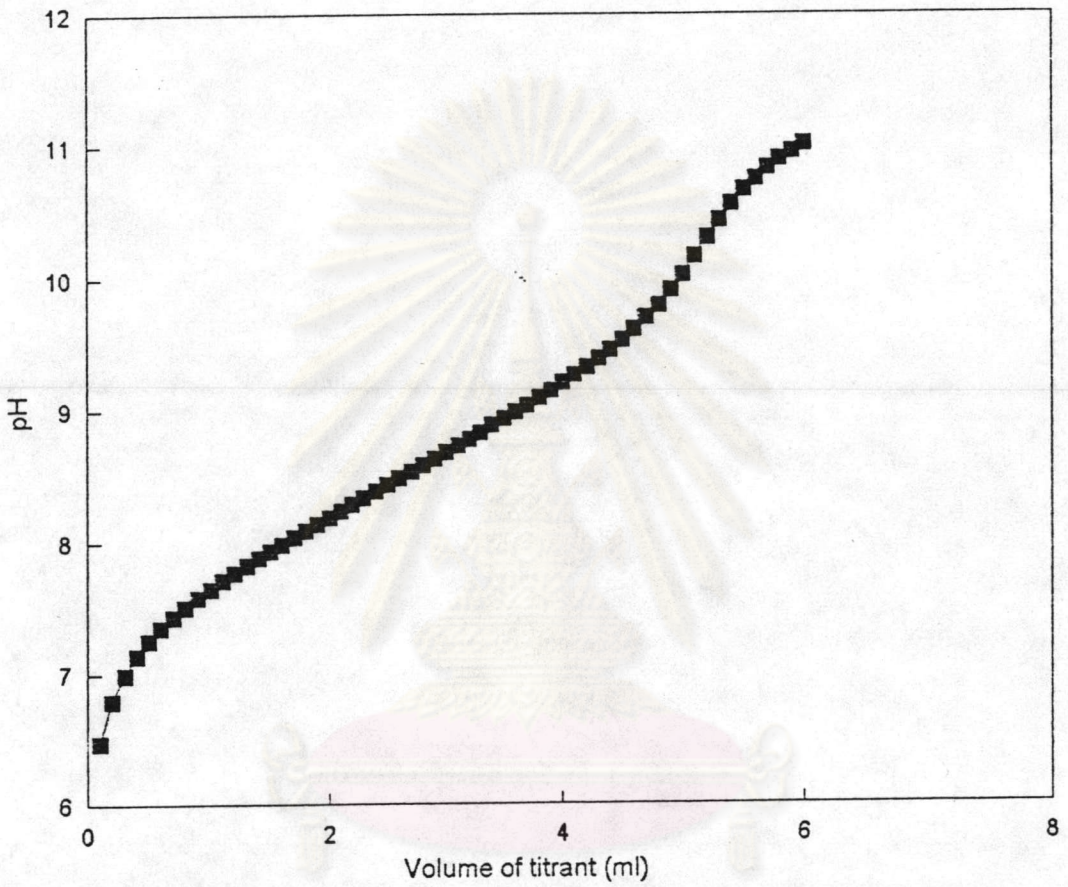

Fig. 36 : Titration curve of the mixture of lidocaine hydrochloride and procaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

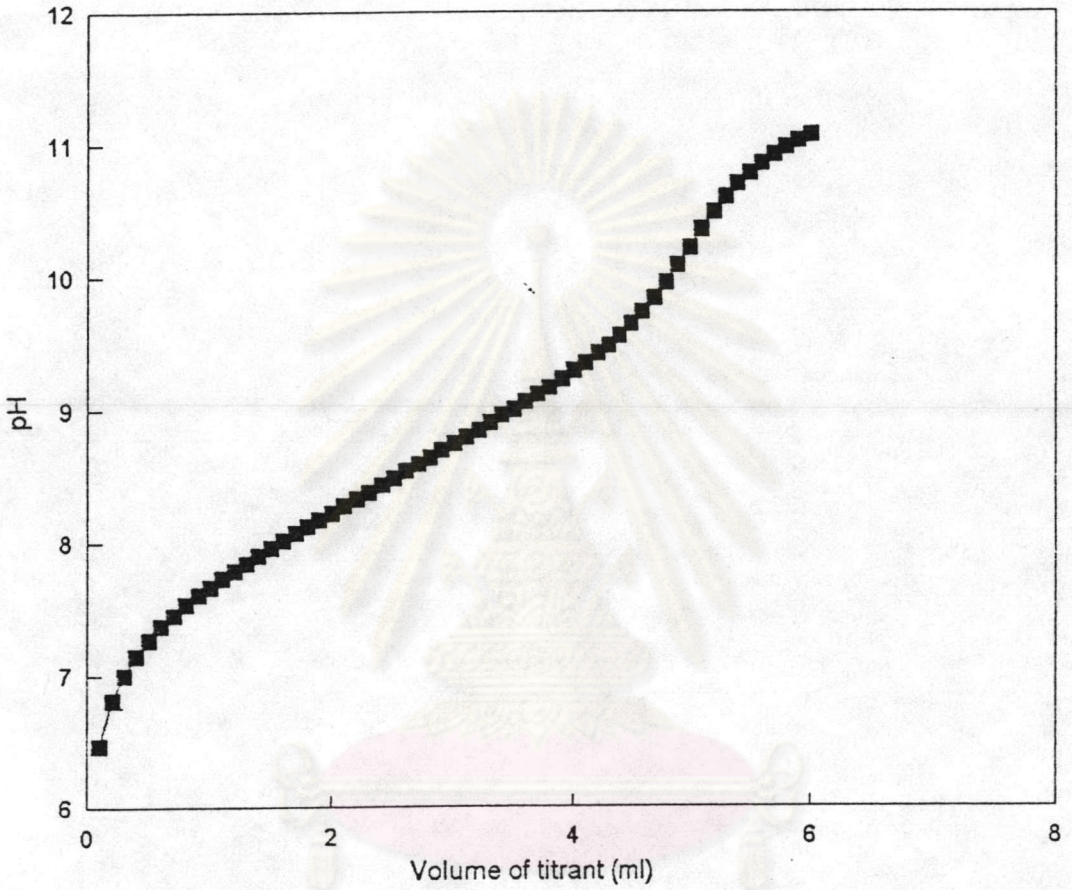

Fig. 37 : Titration curve of the mixture of pralidoxime chloride and procaine hydrochloride in 0.1 M potassium chloride solution with 0.1 N sodium hydroxide solution.

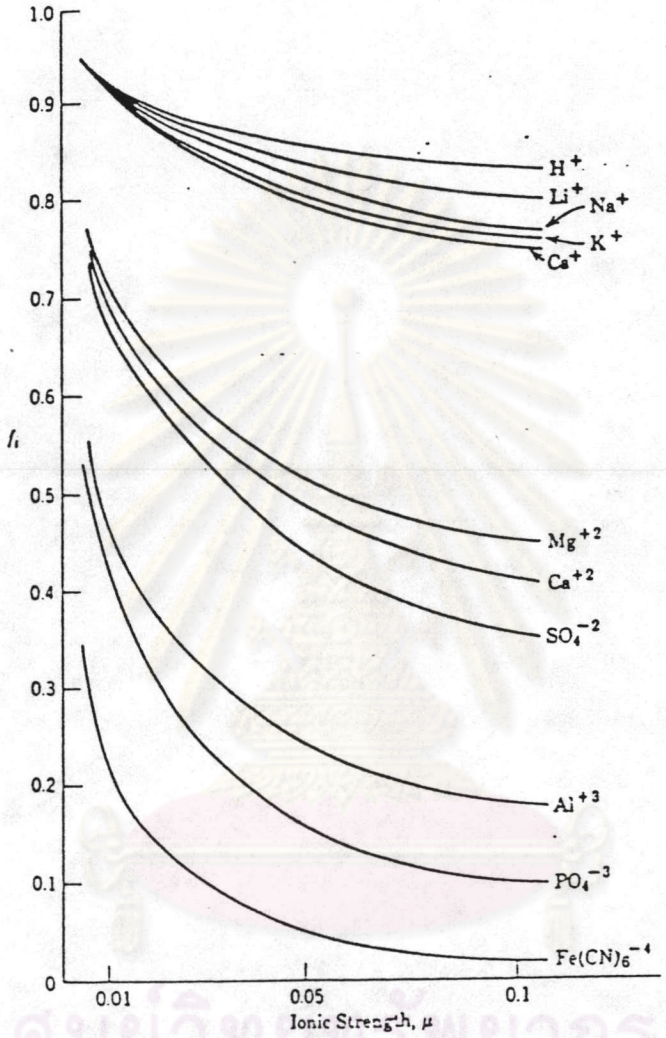

Fig. 38 : Single ion activity coefficients as a function of ionic strength of the solution. (Pecsok et al., 1976)

VITA

Miss Arunya Prachasitthisak was born on August 16, 1966 , in Pitsanulok ,Thailand. She graduated with a Bachelor degree of Pharmacy from Faculty of Pharmacy, Chiang Mai University , Chiang Mai in 1989. She worked as a pharmacist at Rong Kwang Hospital , Phrae province between 1989-1991.