CHAPTER 5

EMULSION LIQUID MEMBRANE EXTRACTION

This chapter presents the results of the batch extraction of the Facilitated extraction of the single component L-lysine solution. The acidity (pH) of the external phase was acidic pH. The cation carrier D2EHPA, the emulsifying agent Span 80, and n-dodecane were components in the organic membrane phase.

Experimental Materials and Methods for Extraction of L-lysine from Aqueous Solutions.

All chemicals used were previously described in chapter 4. The membrane phase was prepared by blending all necessary components in advance. The organic liquid membrane solution consisted of n-dodecane, D2EHPA, and Span 80. The experimental conditions of the emulsion liquid membrane system were as follows:

a) External Phase

The external or feed phase is 0.01 M L-lysine solution at a pH of 2, 3, 4, 5, and 6. The pH of the solution was adjusted with Sulfuric acid solution (H_2SO_4).

b) Membrane Phase

Each 100 ml of membrane phase consists of :

Solvent	:	n-Dodecane	85	ml
Carrier	:	D2EHPA	10	ml
Surfactant	:	Span 80	5	ml

c) Internal Phase

The solution for use as the internal phase for the extraction of L-lysine must have an acidic pH. In this study 1 N hydrochloric acid solution was used.

The experiments were carried out under the conditions shown in Table 5-1.

Table 5-1. Experimental Conditions.

Parameters	Conditions	Typical Conditions
Initial pH in external phase	pH 2, 3, 4, 5, and 6	pH 5.0
Initial concentration in external phase	1, 5, 10, 50, and 100 mM	1 mM
Surfactant concentration	1, 3, 5, 7, and 10 % (v/v)	5 %(v/v)
Carrier concentration (as D2EHPA dimer)	3, 5, 7, 10, and 15 % (v/v)	15 %(v/v)
Agitation Speed	240, 300, 360, 420, and 480 rpm	480 rpm
Internal HCl concentration.	0.5 N, 1.0 N, 2.0 N and 3.0 N	2.0 N

The emulsion was prepared by homogenizing 60 ml of internal phase and 60 ml of membrane phase with a high speed homogenizer(model T25, IKA Labortechnik) at 8000 rpm. The w/o emulsions (100 ml) thus prepared were poured and dispersed in a vessel containing a measured volume of external phase (200 ml) of L-lysine solution.

The vessel was 9 cm in diameter and equipped with a marine type impeller as shown in figure 5-1. The extraction time for each example was started from the time that emulsion was poured and stirred at the speed of 250 rpm. After each extraction, all solution was removed from the vessel. Then, the emulsion phase and external phases were separated after being allowed to settle. The volumes of each phase was measured and L-lysine concentrations in the external phase were measured by Ninhydrin method (Appendix C) using a Spectrophotometer (Spectronic 20D) at 570 nm. The pH of the external phase solutions were also measured by a pH meter (HANNA). The experimental data are shown in the Appendix B. The process diagram of emulsion liquid membrane is shown in figure 5-2.

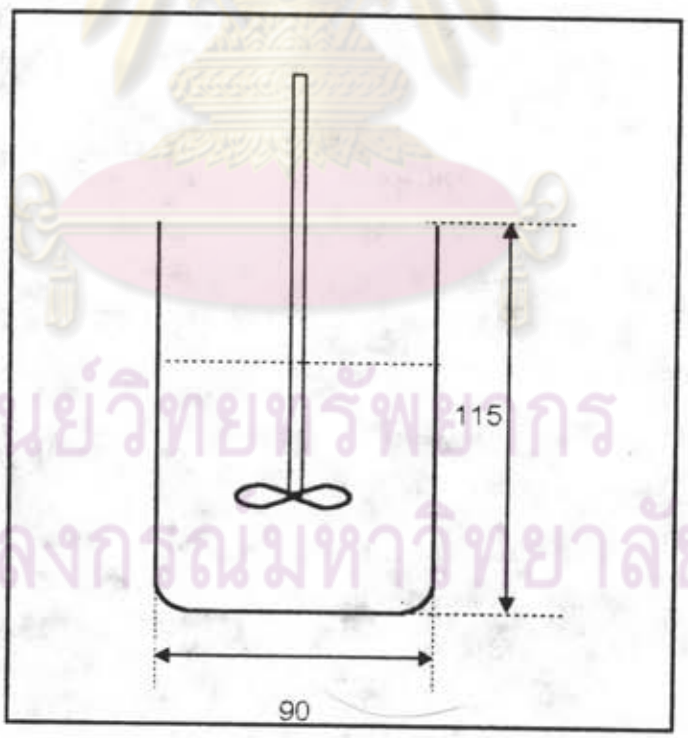

Figure 5-1. Schematic diagram of the vessel used for the batch extraction of L-lysine.(All dimensions are in mm)

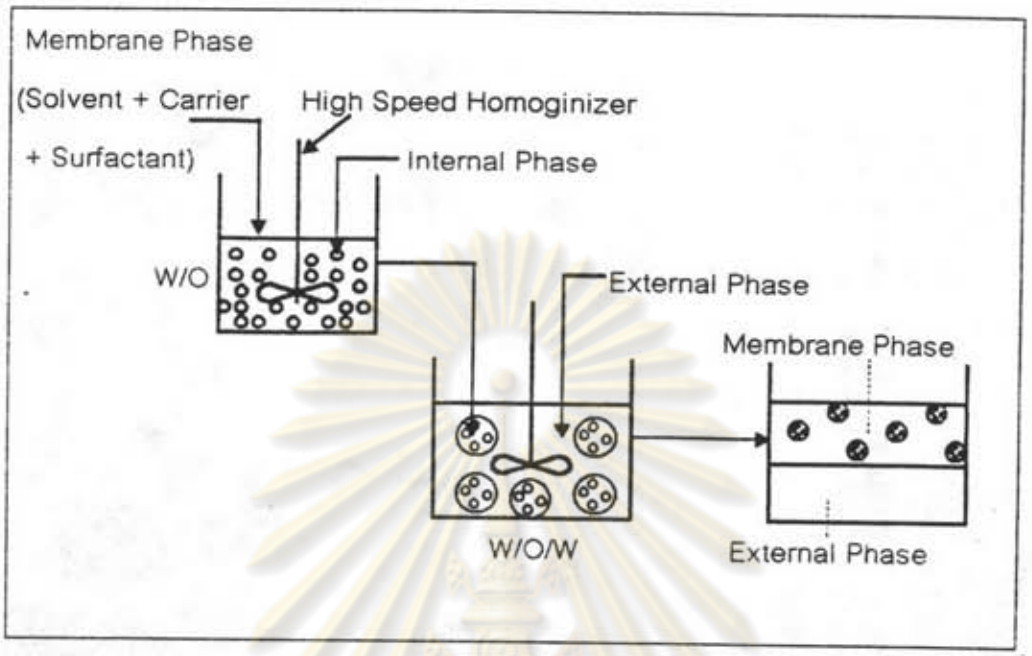

Figure 5-2. Process diagram of the Emulsion Liquid Membrane System.

Calculation of Swelling in the Internal Phase

The measurement of emulsion swelling can be done by measuring the volume of the emulsion phase and the external phase after each extraction experiment. The internal phase volume can be calculated by using a mass balance. The percentage of emulsion swelling can be then calculated using the following equations:

$$\%\text{Swelling} = \frac{(\text{Internal Phase Volume} - \text{Initial Internal Phase Volume}) \times 100}{\text{Initial Internal Phase Volume}}$$

$$\%\text{Swelling} = \frac{(\text{Internal Phase Volume} - 50) \times 100}{50}$$

Calculation of L-lysine Concentration in the Internal Phase

In the experiment, the concentration of L-lysine in the external phase was measured. On the other hand, the concentration of L-lysine in the internal phase was calculated using material balance based on the assumption that there was no accumulation in the internal phase is shown in the following example :

Initial concentration of L-lysine in the external phase or $[Lys]_0$ = 1 mM ,

From experimental results, the concentration of L-lysine in the external phase after 1 minute extraction = 0.63 mM ,

Therefore, the amount of L-lysine that penetrated into the internal phase = 1mM - 0.63 mM

= 0.37 mM

Since the volume of the external phase = 200 ml

From experimental results, the volume of the internal phase at 1 min=50 ml

Therefore, the concentration of L-lysine in the internal phase, $[A]_i$;

$$= \frac{0.37 \text{ mM} \times 200 \text{ ml}}{50 \text{ ml}} = 1.48 \text{ mM}$$

Results and Discussions

1. Effect of Initial pH in External Phase

As described in chapter 3, the ionic structure of L-lysine changes significantly with changes in pH. As long as a cation carrier is used, L-lysine must exist as a cation to be separable. In order to separate and concentrate more L-lysine into the internal phase, a large difference of H^+ between the internal and the external phases must be established. Since pH in the external phase is so important, experiments under various pH's in the external phase were carried out.

The results are shown in figure 5-3. There is a significant difference in the permeation rate between pH 2 and the others pH, from the figure shown at a pH of 2 just 5% of the L-lysine can permeate to the internal phase. This result occurs because the pH in the external phase is too low, the carrier will become protonated and thus unable to transport other ions. As pH was increased to 5.0, the permeation rate of L-lysine increased. At a pH of 5.0, 60% L-lysine can be extracted. The permeation rate L-lysine was decreased at a pH of 6.0 because at high pH in the external phase, the L-lysine will not be able to dissociate as a cation.

Figure 5-4 shows the concentration of L-lysine in the internal phase during extraction of L-lysine at various initial pH of external phase. It was found that, the process can maximum concentrated two folds concentration of L-lysine at a pH of 5.0.

Figure 5-5 shows the initial rate of various initial pH in external phase. This initial rate can be calculated using the extraction of L-lysine at the interval of time

that L-lysine in external phase suddenly decreased. It was found that, at pH 5.0 has the highest initial rate of 0.0906 mMolar/min.

In fact, as mentioned above, since Lys^+ is exchanged for H^+, the pH in the external phase was gradually decreased. Figure 5-6 shown the change of pH in the external phase during extraction. For example, starting with an initial pH of 5.0, the final pH became about 2.3.

From the results can be conclude that at the initial pH of external phase equal to 5.0 is the best condition for extraction of L-lysine for this process.

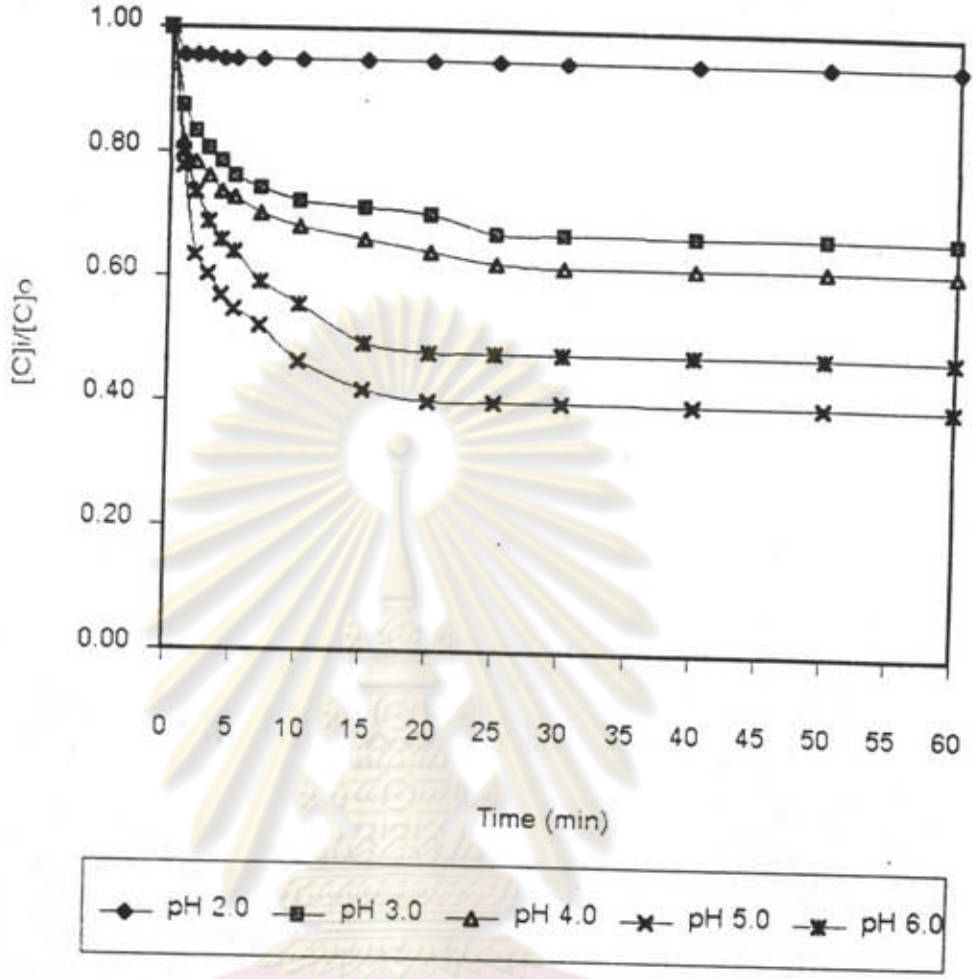

Figure 5-3 Effect of pH on extraction of 10 mM L-lysine by emulsion liquid membrane.

Experimental conditions :

External phase : 10 mMolar L-lysine at various pH (adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

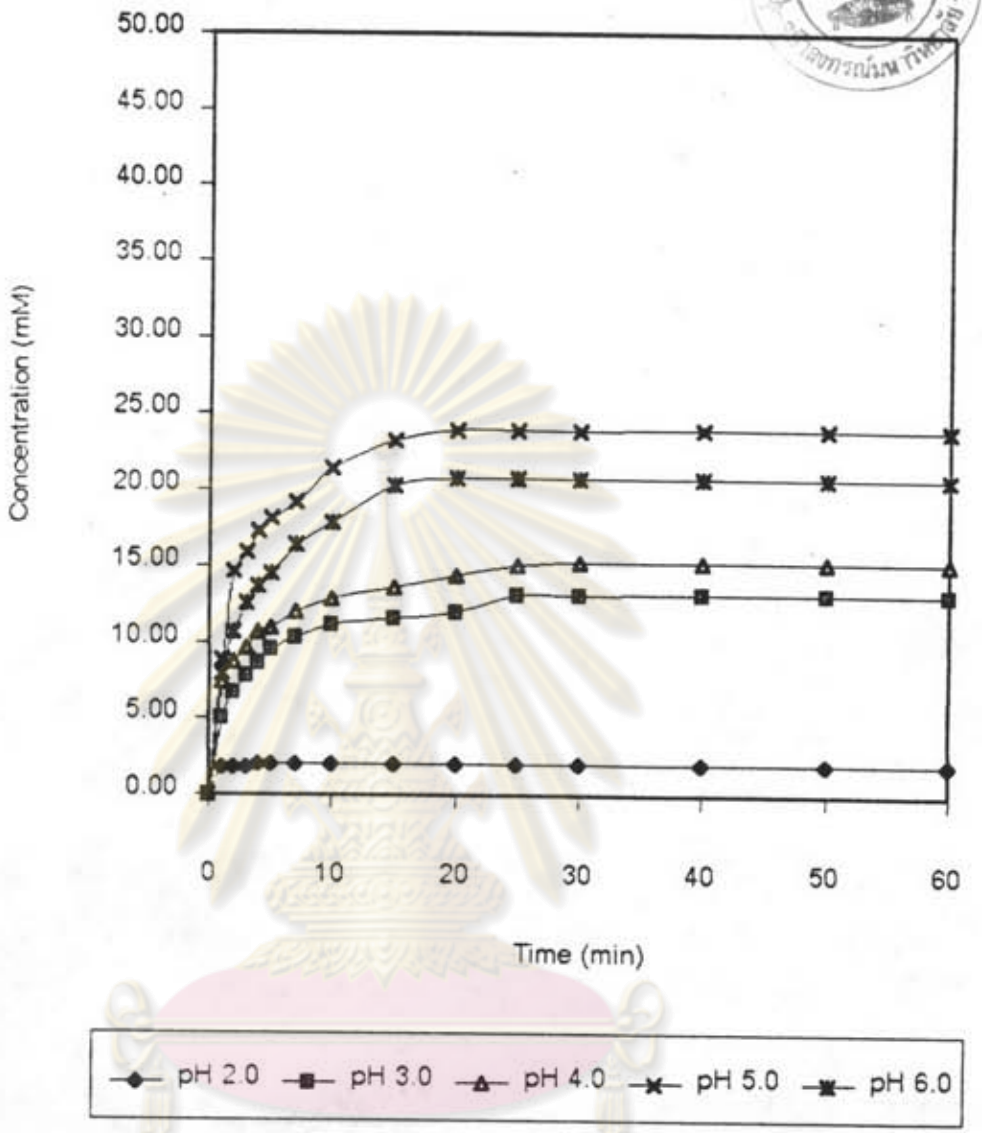

Figure 5-4. Concentration of L-lysine in the internal phase during extration of L-lysine at various initial pH.

Experimental conditions :

External phase : 10 mMolar L-lysine at various pH (adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

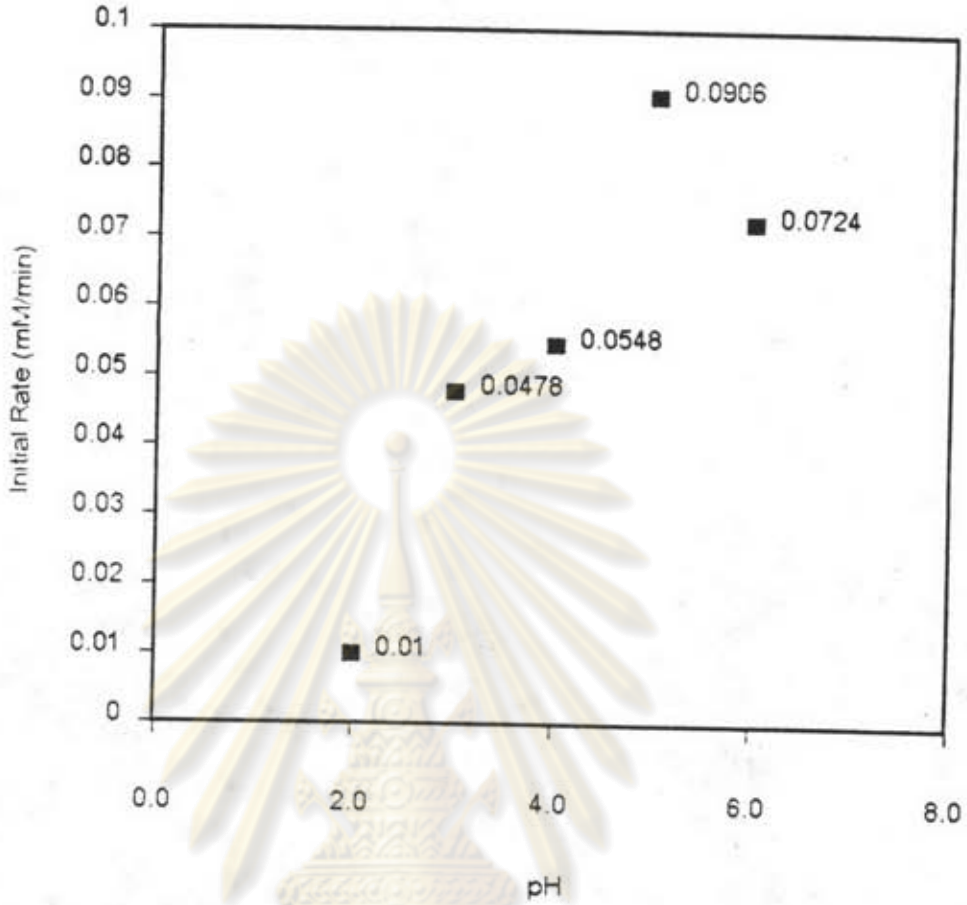

Figure 5-5. Initial rate of various initial pH in the external phase

(at first 4 minutes interval).

Experimental conditions :

External phase : 10 mMolar L-lysine at various pH (adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

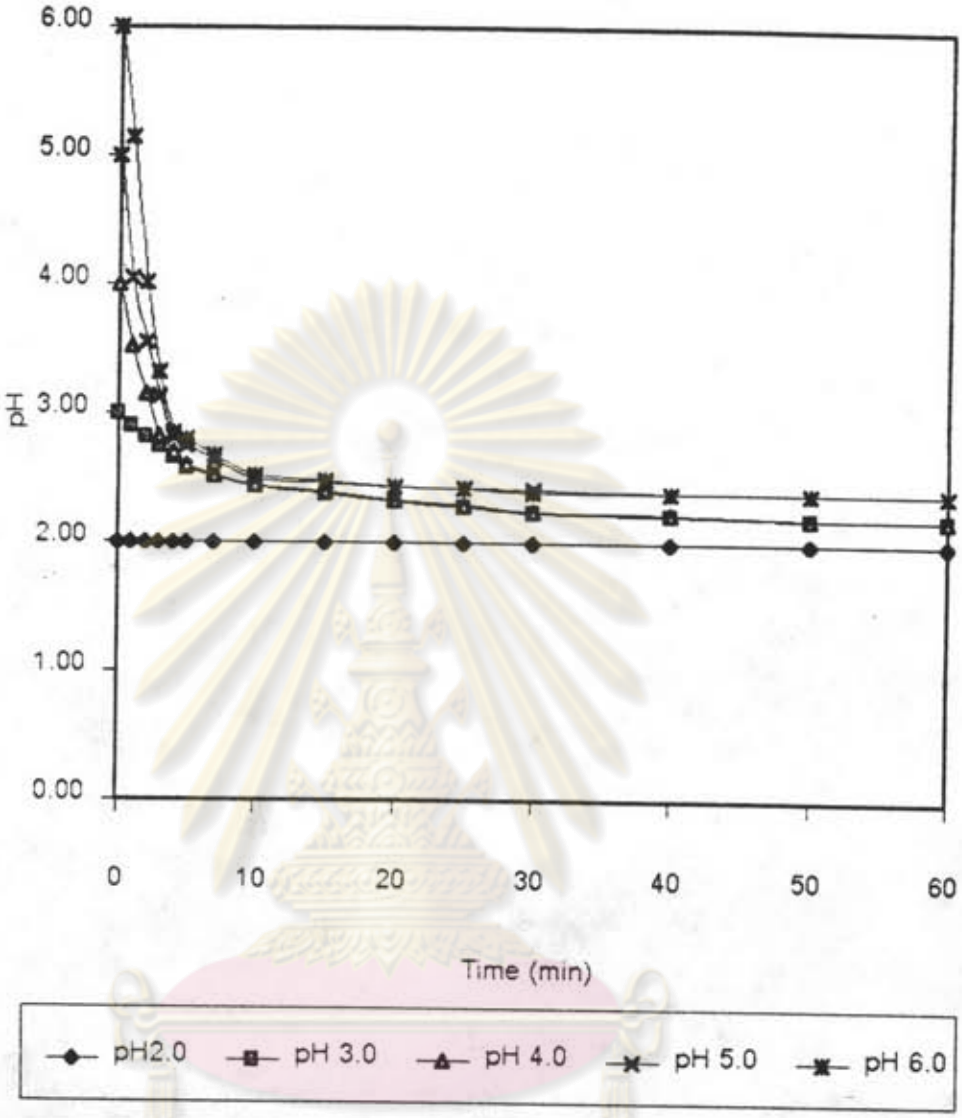

Figure 5-6. Change of pH in external phase during extraction of various initial pH of L-lysine.

Experimental conditions :

External phase : 10 mMolar L-lysine at various pH (adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

2. Effect of Initial Concentration of L-lysine in the External Phase

In this experiment, the extraction of L-lysine from various initial concentration of L-lysine in the external phase were carried out. (from 1 mM to 100 mM) and is shown in figure 5-7. The results showed that the extractions was no significantly difference from 40 minutes while lower initial concentration give more extractions at the first time intervals. This effects occurs due to the dissociation of L-lysine as cation in external phase that can be described in chapter 3. From figure 5-8, the range of pH in the external phase during the extraction of various L-lysine concentrations showed that, at higher L-lysine concentrations, the pH value after extraction was still high and have been effect of ($A^{\pm}$) and (A^{+}). From equation 3.5, dissociation constant(K_1) will increase by increasing the concentration of H^{+} and $A^{\pm}$ and decreasing of the A^{-} concentration.

Figure 5-8 shows the concentration of L-lysine in the internal phase during the extraction of L-lysine at variuos L-lysine in the external phase concentrations. It was found that, the process can concentrated two folds concentration of L-lysine at each concentrations.

Figure 5-9 shows the initial rate of the external phase concentration variable. As the initial concentration of L-lysine increased, the L-lysine transport rate decreased.

Figure 5-10 shows the change of pH in the external phase during extraction of various L-lysine concentration. It was not significantly difference between various L-lysine concentrations.

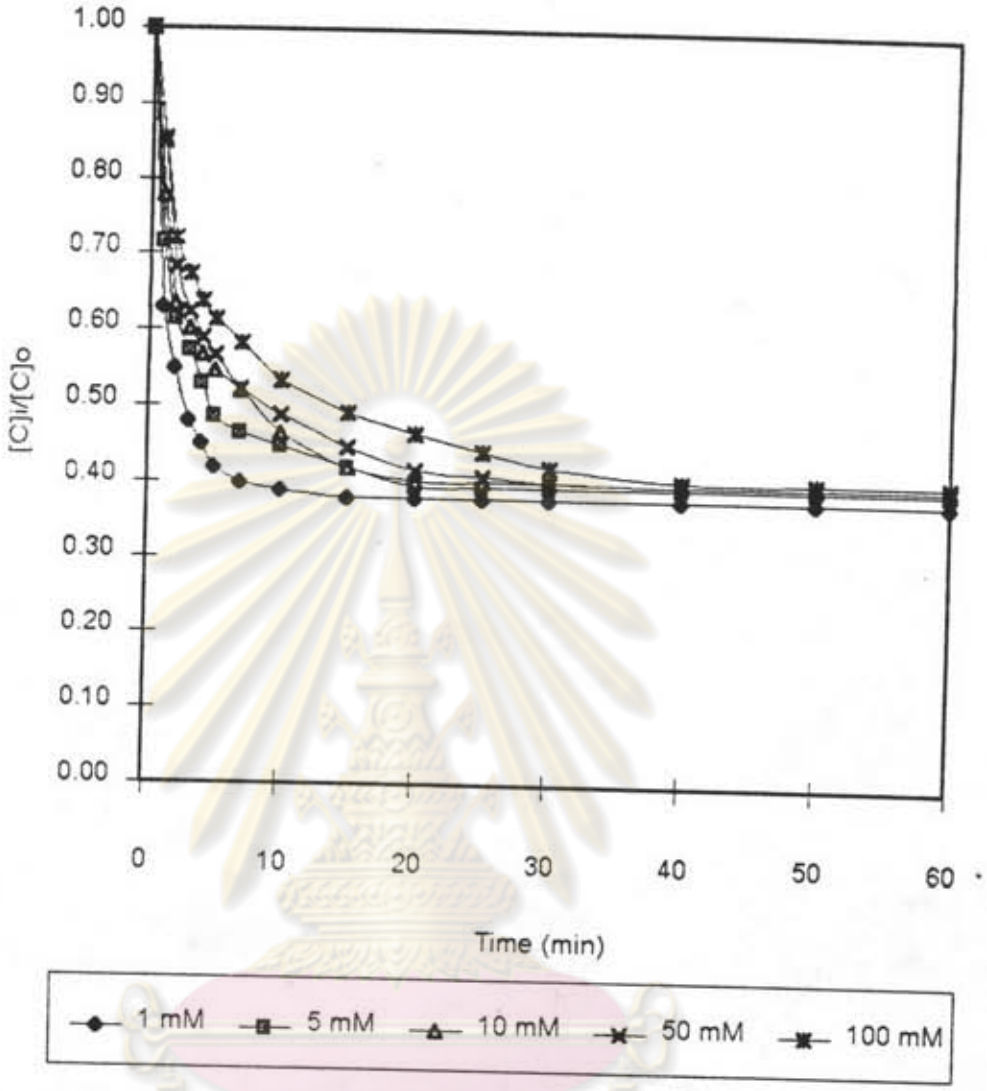

Figure 5-7. Extraction of various L-lysine concentration by emulsion liquid membrane.

Experimental conditions :

External phase : Various concentration of L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

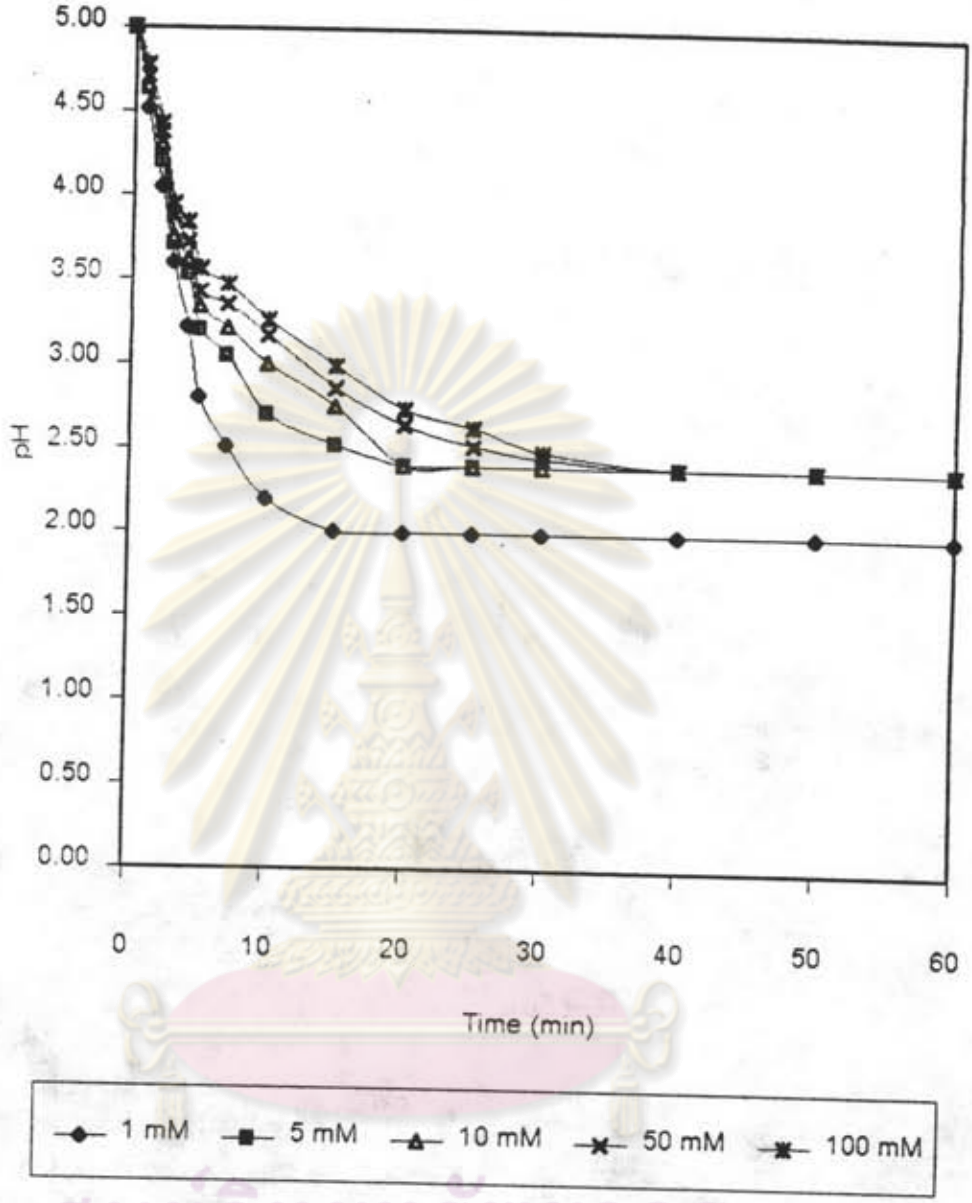

Figure 5-8. Change of pH in external phase during extraction of various L-lysine concentration.

Expenmental conditions :

External phase : Various concentration of L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

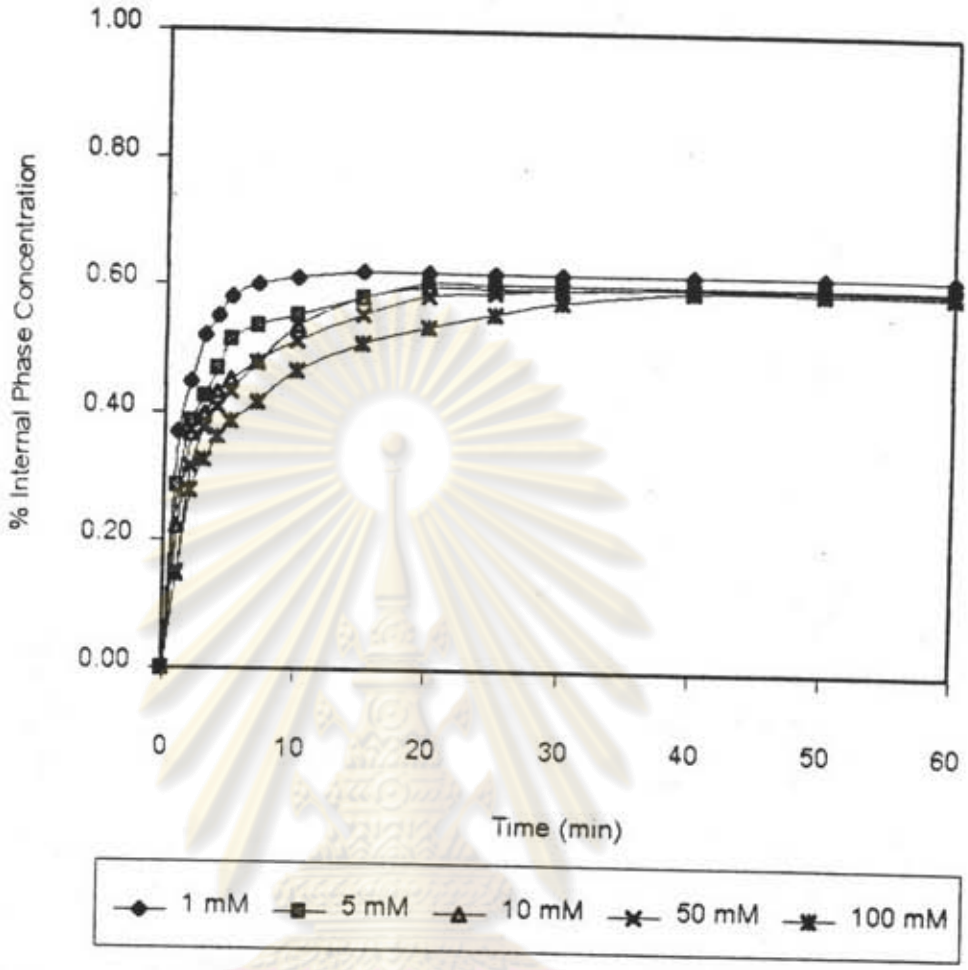

Figure 5-9. Concentration of L-lysine in the internal phase during extration at various L-lysine in the external phase

Experimental conditions :

External phase : Various concentration of L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

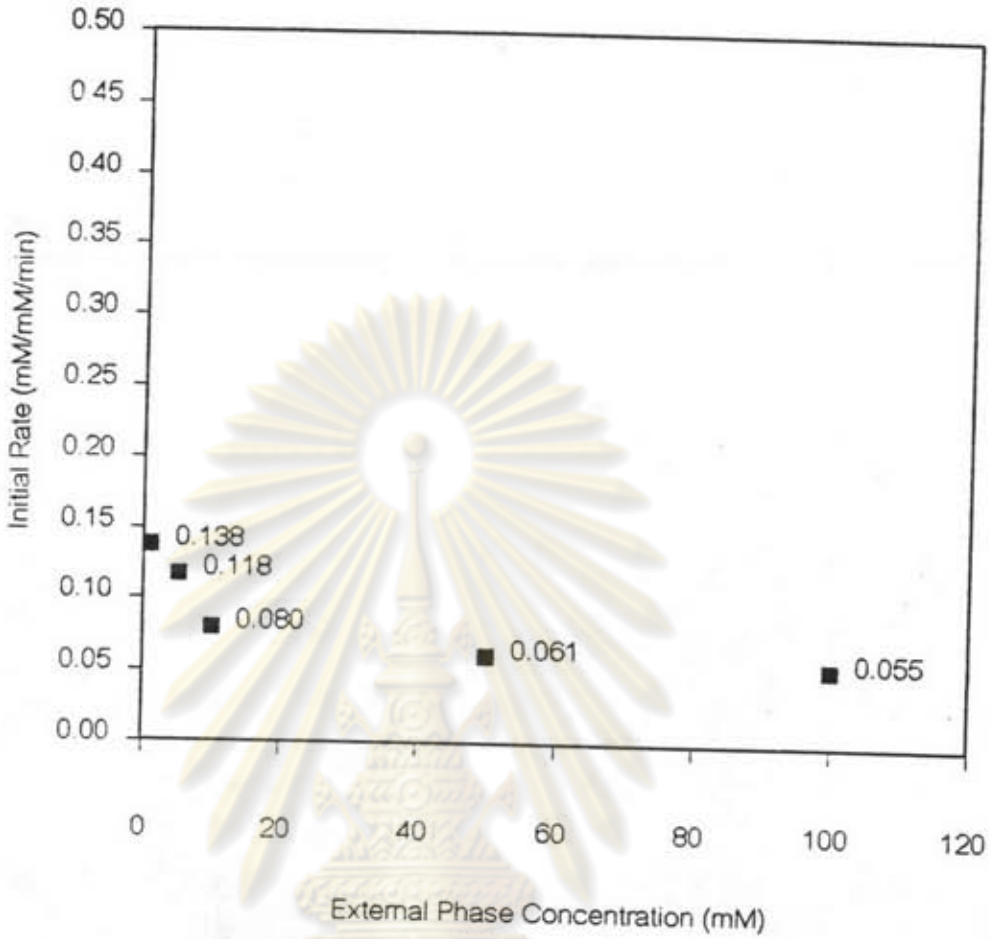

Figure 5-10. Initial rate of external phase concentration variable (at first 4 minutes interval).

Experimental conditions :

External phase : Various concentration of L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

3. Effect of Surfactant Concentration

Figure 5-11 shows the effect of the surfactant (Span 80) concentration on the L-lysine transport. As the Span 80 concentration was decreased from 10%(v/v) to 5% (v/v), the L-lysine transport rate increased. When it was further decreased from 5% (v/v) to 1%(v/v), however, the L-lysine transport rate decreased. This behavior can be explained. When the Span 80 concentration was increased from 5%(v/v) to 10% (v/v), the viscosity in the oil phase increased and the mass transfer resistance increased (diffusivity of carrier/Lys^+ complex decreased). On the other hand, when the Span80 concentration was extremely low, the emulsion became unstable. Consequently, though the amount of L-lysine transported through the membrane actually increased, the amount of L-lysine leakage due to the breakage of emulsion also increased and the resulting net amount of L-lysine transported did not increase. In this particular system, a Span80 concentration of 5%(v/v) seems optimal.

Figure 5-12 shows the concentration of L-lysine in the internal phase during the extraction of L-lysine at various surfactant concentrations. It was found that, at the 5% of Span 80, the extraction process can be maximum concentrated two folds concentration of L-lysine.

Figure 5-13 shows the initial rate at various surfactant concentrations. The highest initial rate was 0.1327 mMolar/min when used 5% Span 80.

Figure 5-14 shows the change of pH in the external phase during extraction of various surfactant concentrations. It was found that, the pH change during extraction decreased in the same way of the decreased of the L-lysine concentration in the external phase.

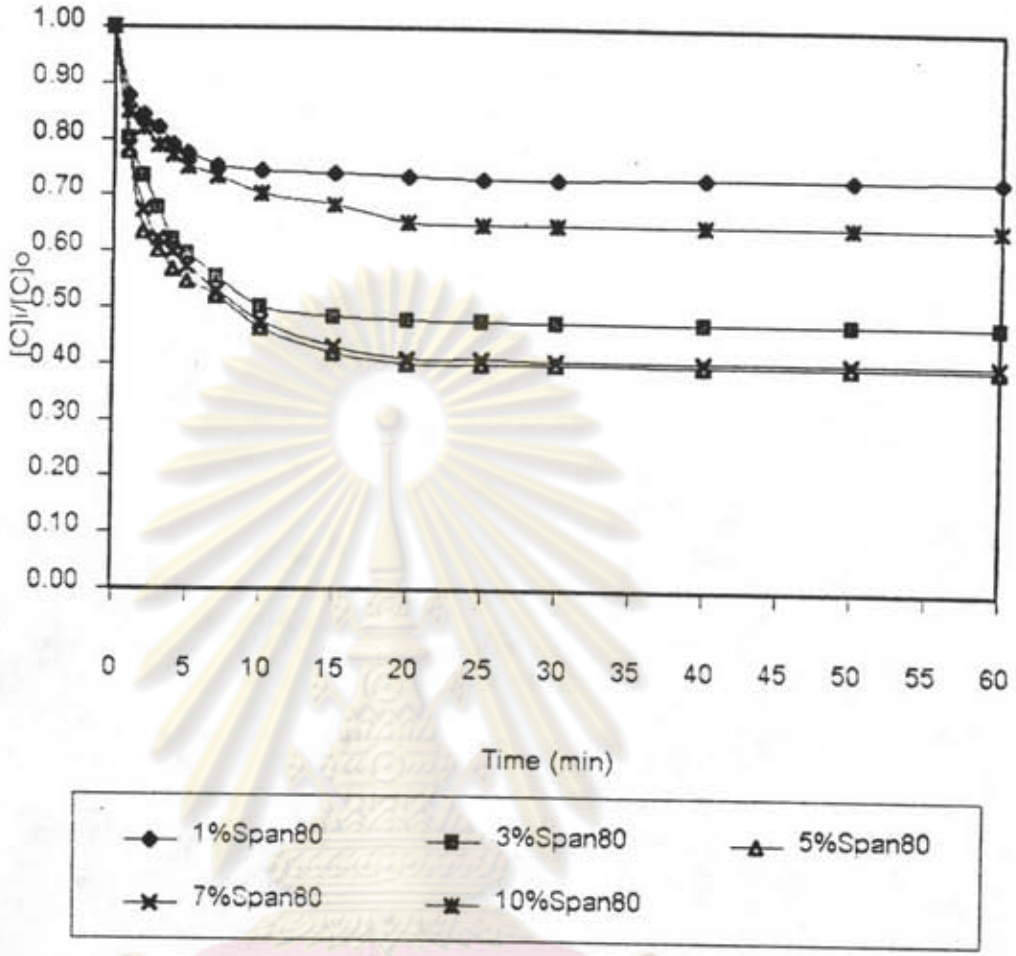

Figure 5-11 Effect of surfactant concentration on extraction of 10 mM L-lysine by emulsion liquid membrane.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : Span80 at various concentration, 10%D2EHPA and Dodecane(%of dodecane due to % of Span80)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

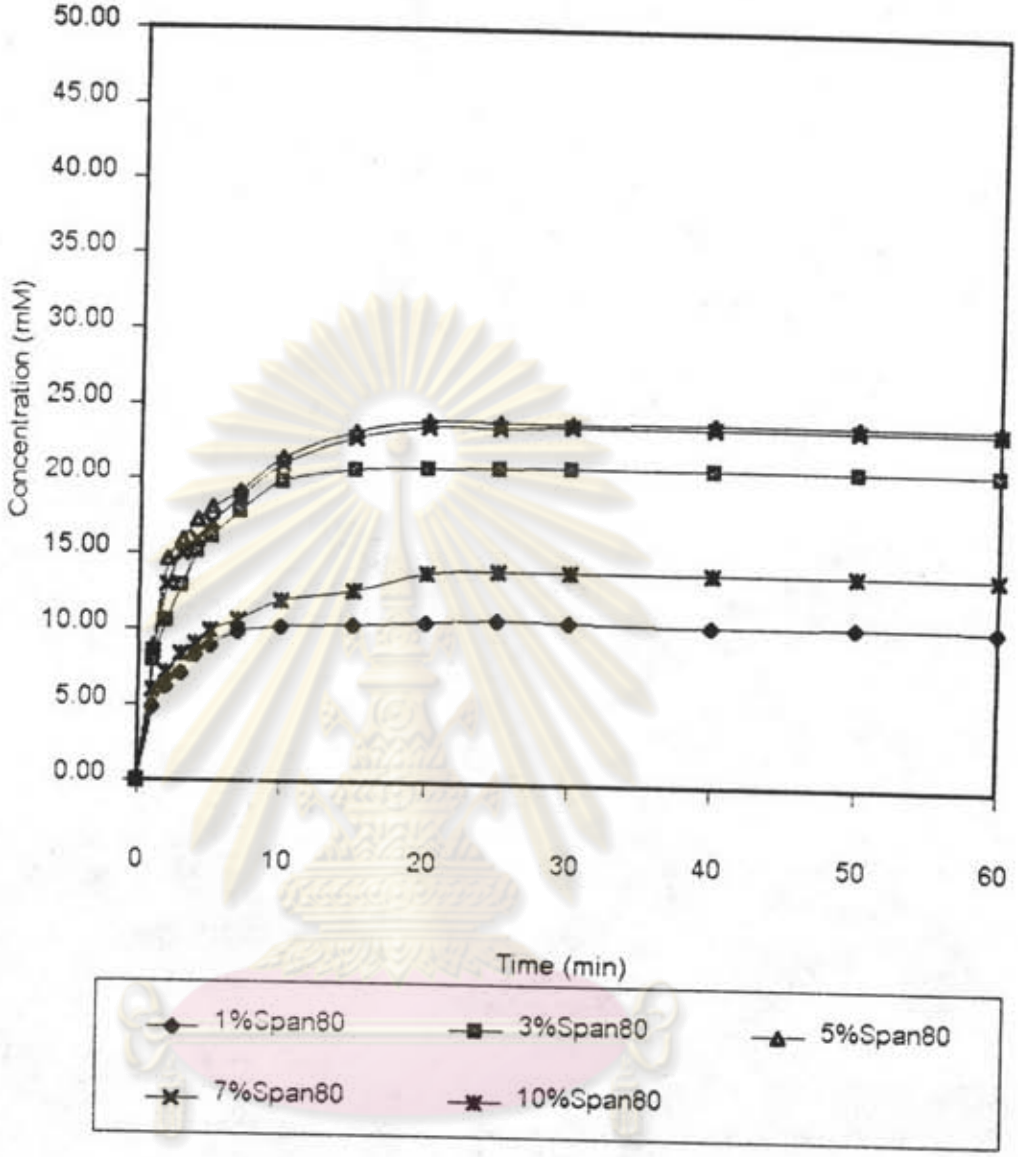

Figure 5-12 Concentration of L-lysine in the internal phase during extraction of L-lysine at various surfactant concentration.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : Span80 at various concentration, 10%D2EHPA and Dodecane(%of dodecane due to % of Span80)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

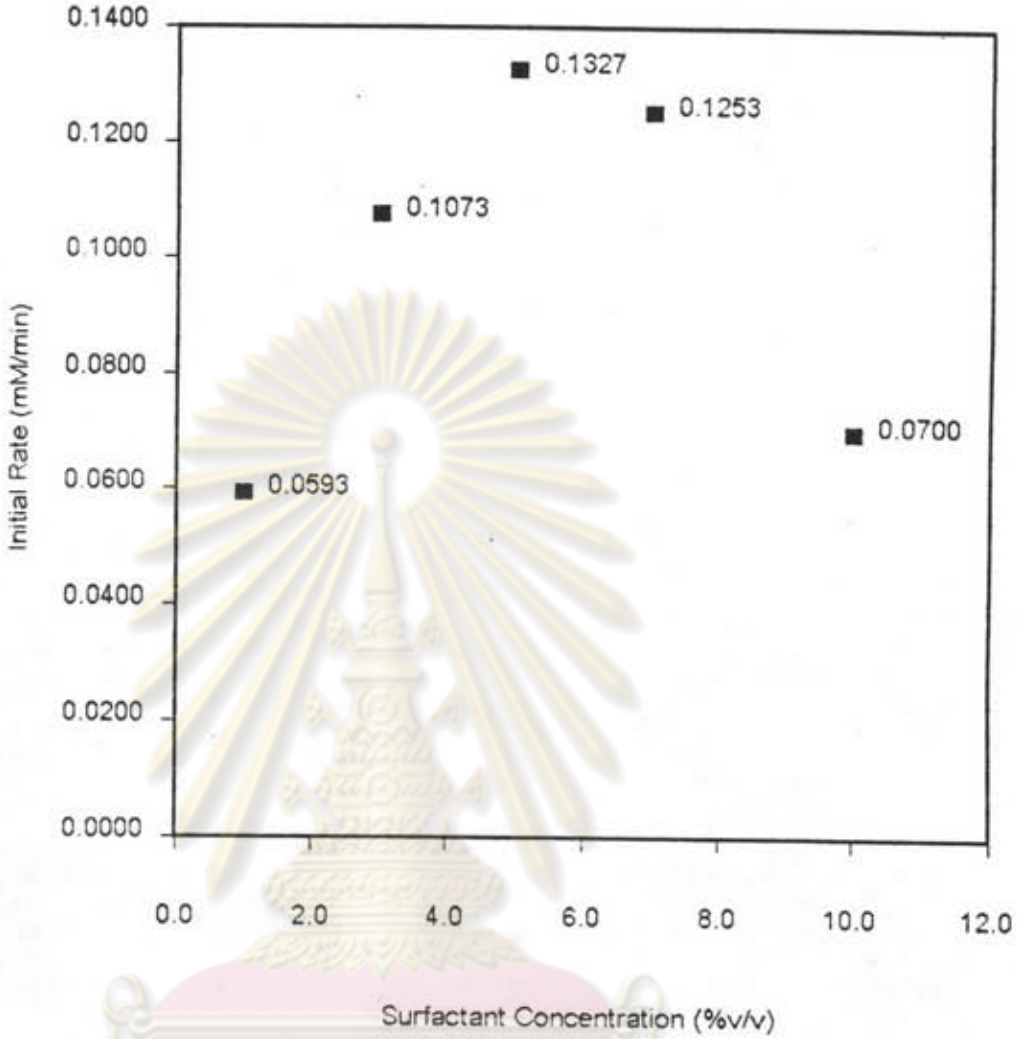

Figure 5-13. Initial rate on extraction of 10 mM L-lysine by emulsion liquid membrane at various surfactant concentrations (at first 4 minutes interval)..

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : Span80 at various concentration, 10%D2EHPA and Dodecane(%of dodecane due to % of Span80)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

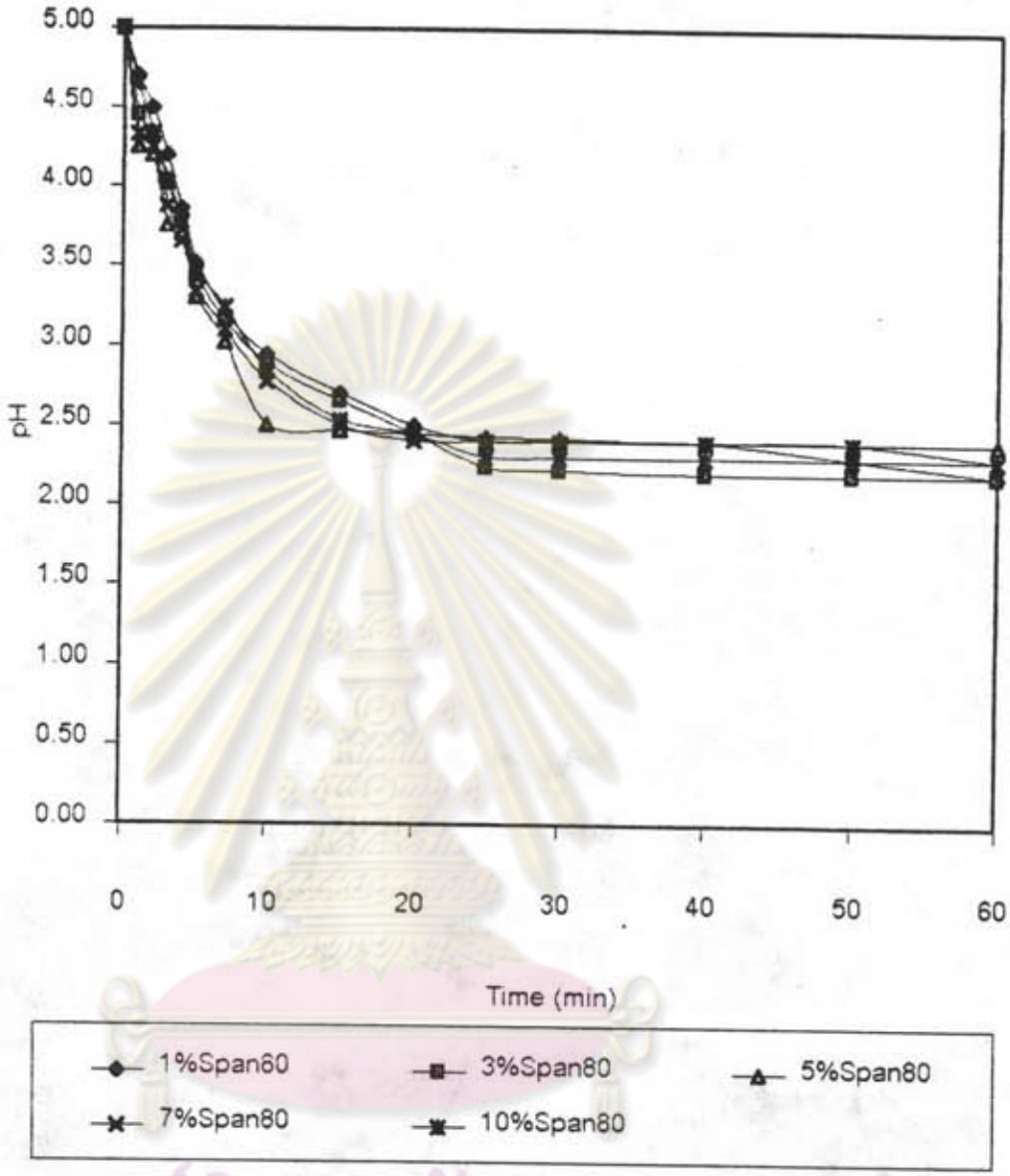

Figure 5-14. Change of pH in external phase during extraction of various surfactant concentrations.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : Span80 at various concentration, 10%D2EHPA and Dodecane(%of dodecane due to % of Span80)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

4. Effect of Carrier Concentration

The effect of the carrier concentration on L-lysine transport rate is shown in Figure 5-15. As the carrier concentration was increased, the L-lysine transport rate increased. As the carrier concentration exceeded 10%(v/v), additional significant increases in carrier concentration did not yield significant increases in the final external L-lysine concentration. They did, however, result in significant enhancement in initial flux rates. This demonstrates that changing the carrier concentration does not change the final equilibrium condition of the system, but it does affect how fast equilibrium is reached. Since the carrier is the most expensive agent among the components of the membranes, its concentration must be chosen conservatively. Therefore, the 10%(v/v) carrier concentration seems to be optimal for this system.

Figure 5-16 shows the concentration of L-lysine in the internal phase during the extraction of L-lysine at various carrier concentration. At the 15% of D2EHPA give the highest concentrated in the internal phase which approximately two folds concentration by initial concentration of L-lysine in the external phase.

Figure 5-17 shows the initial rate at various carrier concentrations. The maximum initial rate occurs when use 15% of D2EHPA but at 10% of D2EHPA was not significantly lower than 15% of D2EHPA.

Figure 5-18 shows the change of pH in the external phase during the extraction of L-lysine at various carier concentrations. It was found that, the change of pH was not significantly difference at various carrier concentrations.

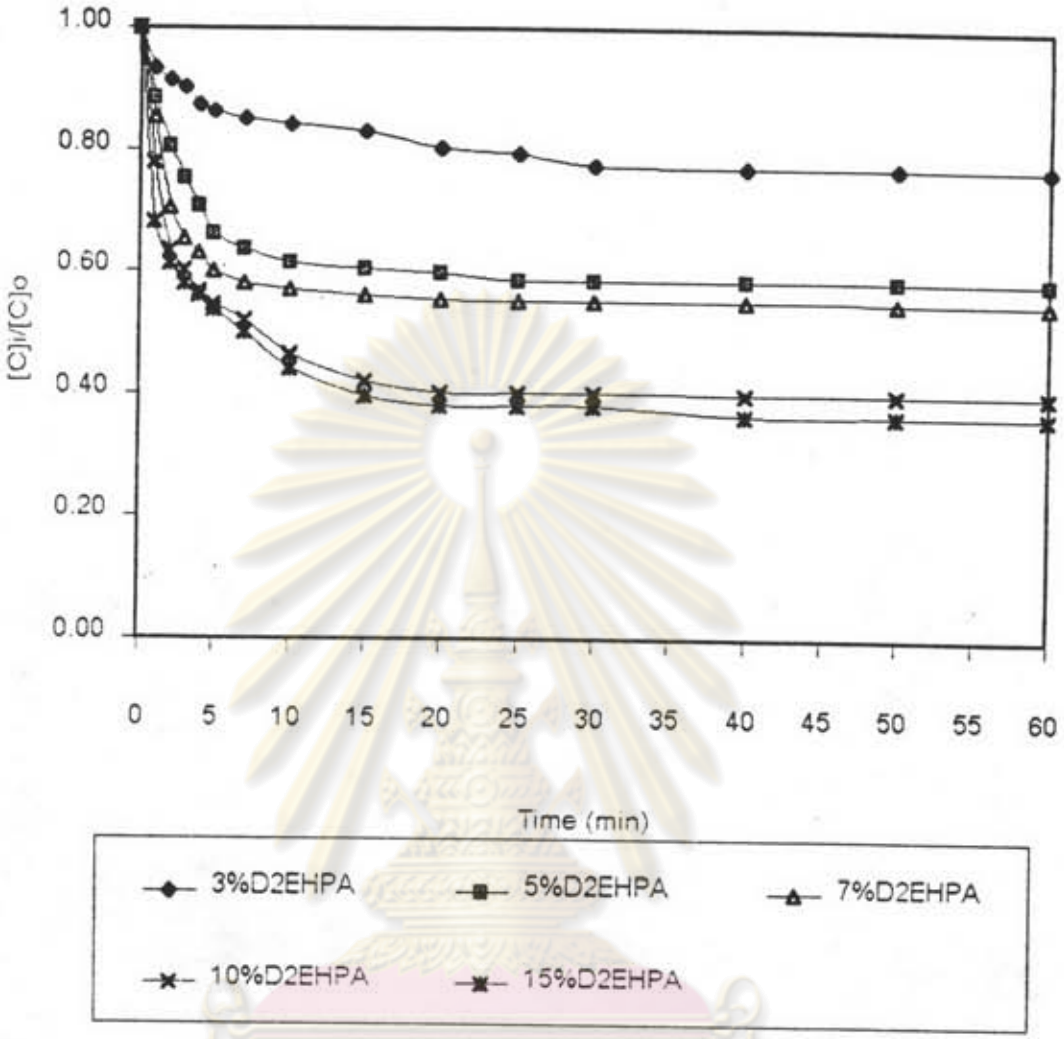

Figure 5-15. Effect of carrier concentration on extraction of 10 mMolar L-lysine by emulsion liquid membrane.
(condition of extraction see appendix B, part IV)

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0 (adjust by H_2SO_4)

Membrane phase : 5% Span80, D2EHPA at various concentration and Dodecane (depends on D2EHPA concentration)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

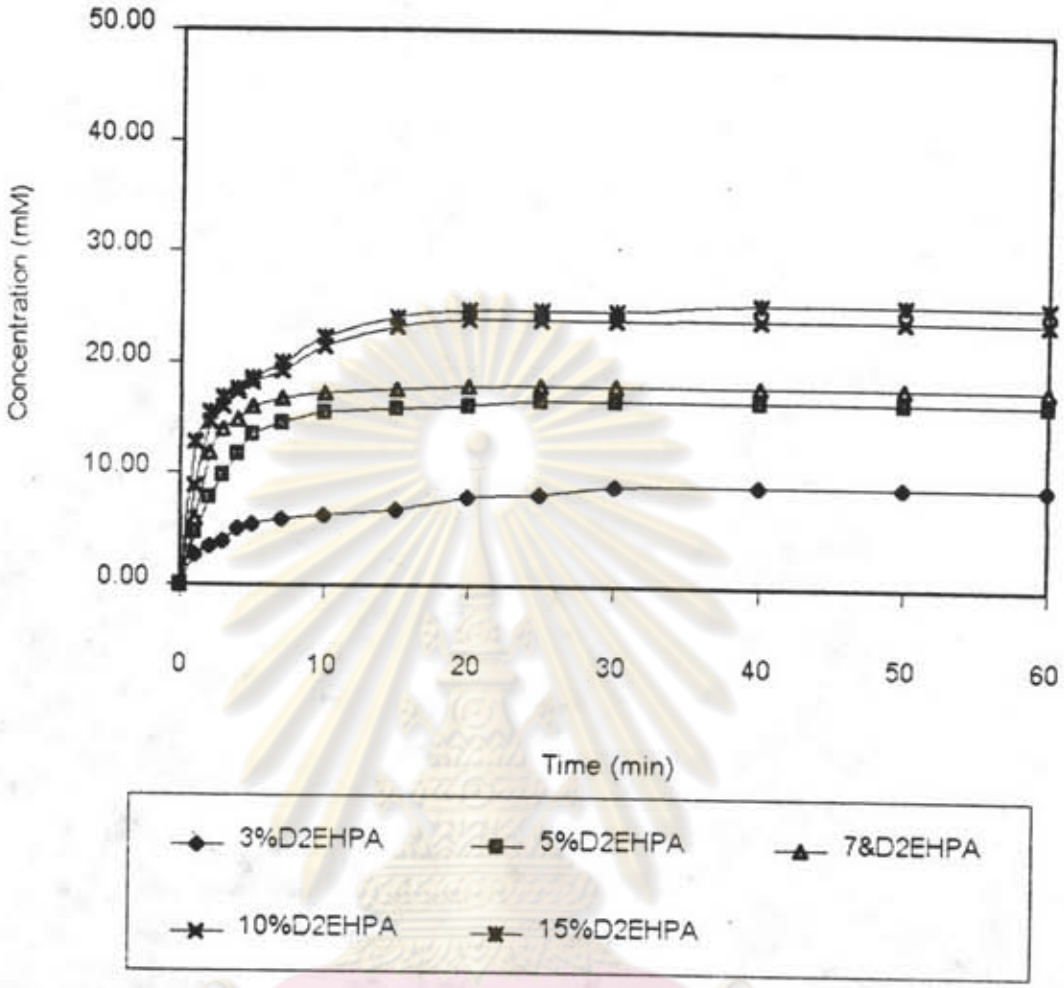

Figure 5-16. Concentration of L-lysine in the internal phase during extraction of L-lysine at various carrier concentration.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0 (adjust by H_2SO_4)

Membrane phase : 5% Span80, D2EHPA at various concentration and Dodecane (depends on D2EHPA concentration)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

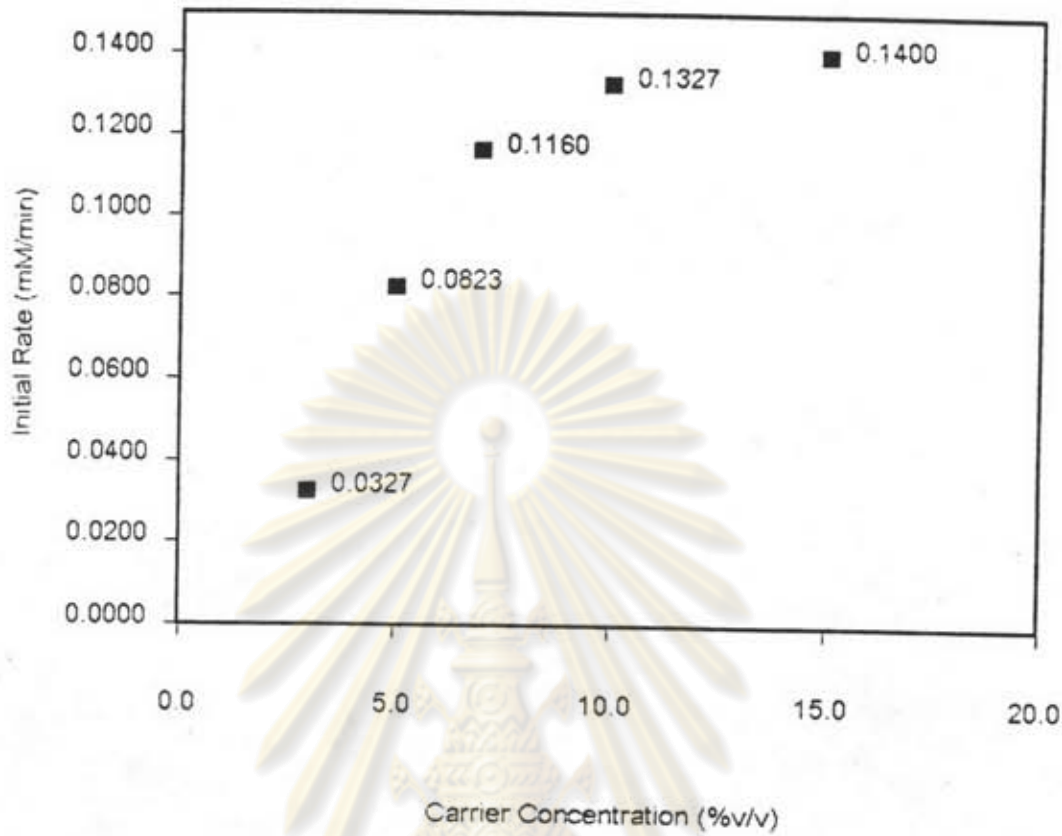

Figure 5-17. Initial rate on extraction of 10 mM L-lysine by emulsion liquid membrane at various carrier concentrations (at first 4 minutes interval).

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0 (adjust by H_2SO_4)

Membrane phase : 5% Span80, D2EHPA at various concentration and Dodecane (depends on D2EHPA concentration)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

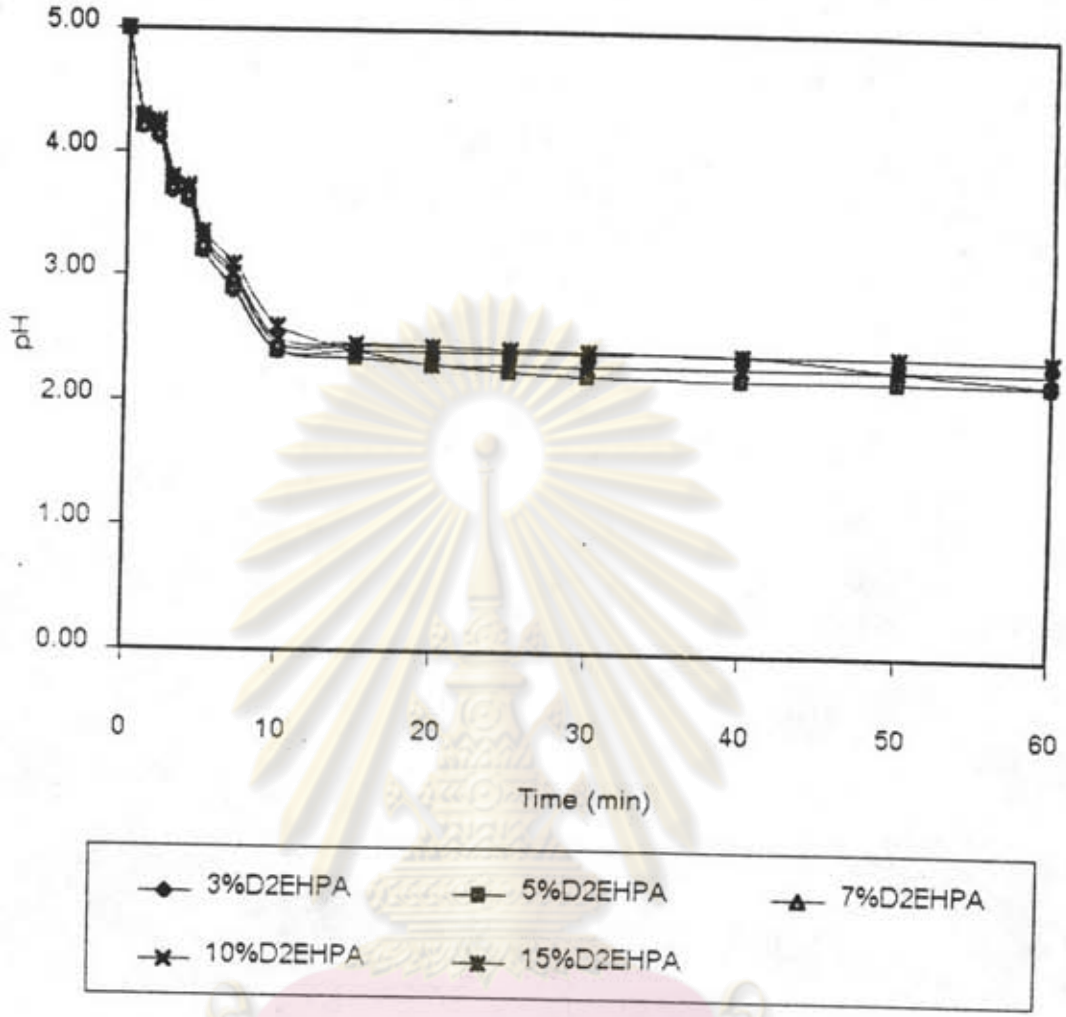

Figure 5-18. Change of pH in external phase during extraction of 10 mM L-lysine at various carrier concentrations .

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0 (adjust by H_2SO_4)

Membrane phase : 5% Span80, D2EHPA at various concentration and Dodecane (depends on D2EHPA concentration)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

5. Effect of Agitation Speed

The effect of the agitation speed on the L-lysine transport rate is shown in Figure 5-19. There a almost no difference in the L-lysine transport rate for agitation over 360 rpm. As the agitation speed increased the mass transfer coefficient of the external phase fiim and the surface area of the emulsion globules increased. On the other hand, the breakage of the membrane also seemed to have increased due to the increase in shear. The increase of the breakage seems to offset that of the mass transfer coefficient and the surface area. In this particular system, since the external L-lysine concentration was high and the diffusivity of the carrier/Lys complex was relatively low, the effect of increases in the mass transfer coefficient in the external phase appears to have been small.

Figure 5-20 shows the concentration of L-lysine in the internal phase during the extraction of L-lysine at various agitation speeds. When the agitation speed was increased, the L-lysine concentration in the internal phase increased. At over 360 rpm, the process can concentrated two folds concentration by initial concentration of L-lysine in the external phase.

Figure 5-21 shows the initial rate at various agitation speeds. It was found that, there was almost no difference of the initial rate over 360 rpm when compared with under 360 rpm.

Figure 5-22 shows the change of pH in the external phase during the various agitation speed. It was found that, there was no significant difference in the pH of the external phase while the agitation speed has been changed.

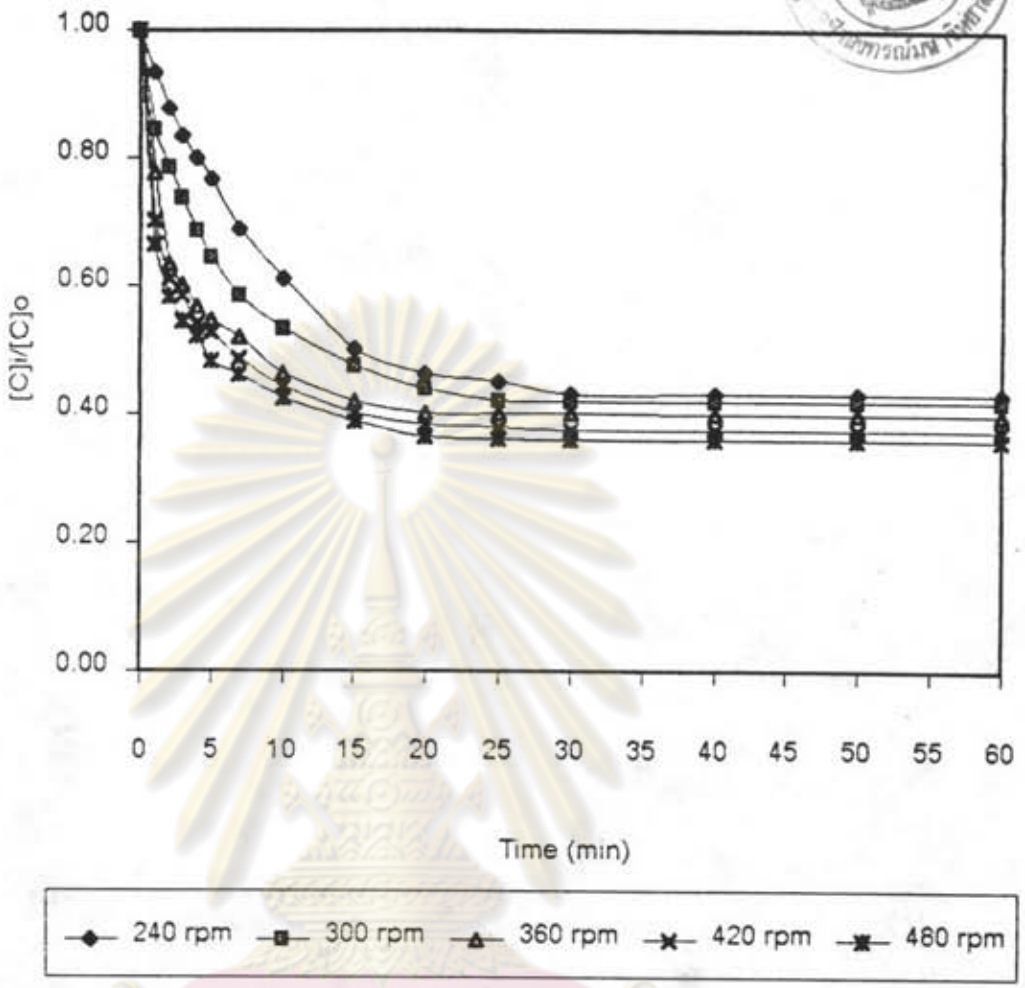

Figure 5-19. Effect of agitation speed on extraction of

10 mMolar L-lysine by emulsion liquid membrane.

(condition of extraction see appendix B, part V)

Expenmental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : vary 240 to 480 rpm

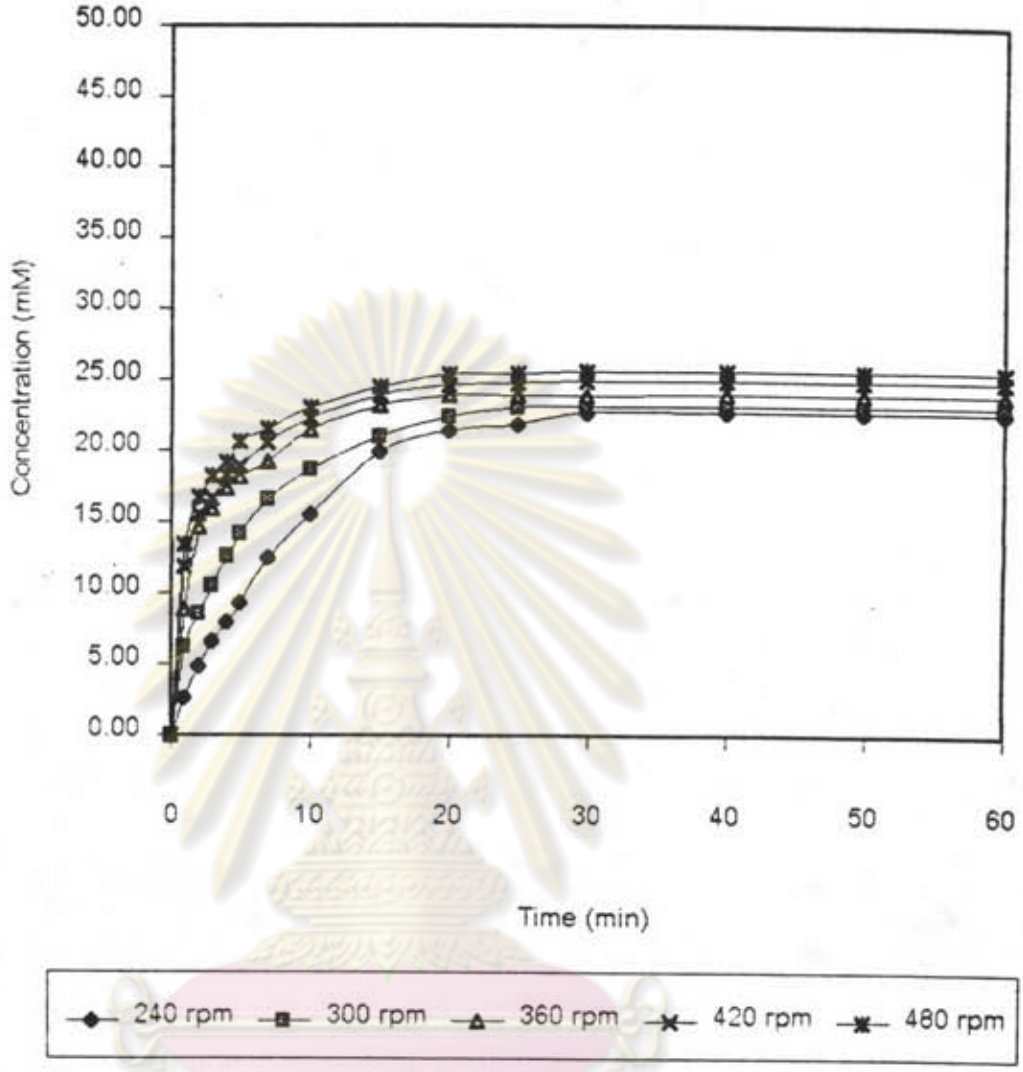

Figure 5-20. Concentration of L-lysine in the internal phase during extration of L-lysine at various agitation speed.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : vary 240 to 480 rpm

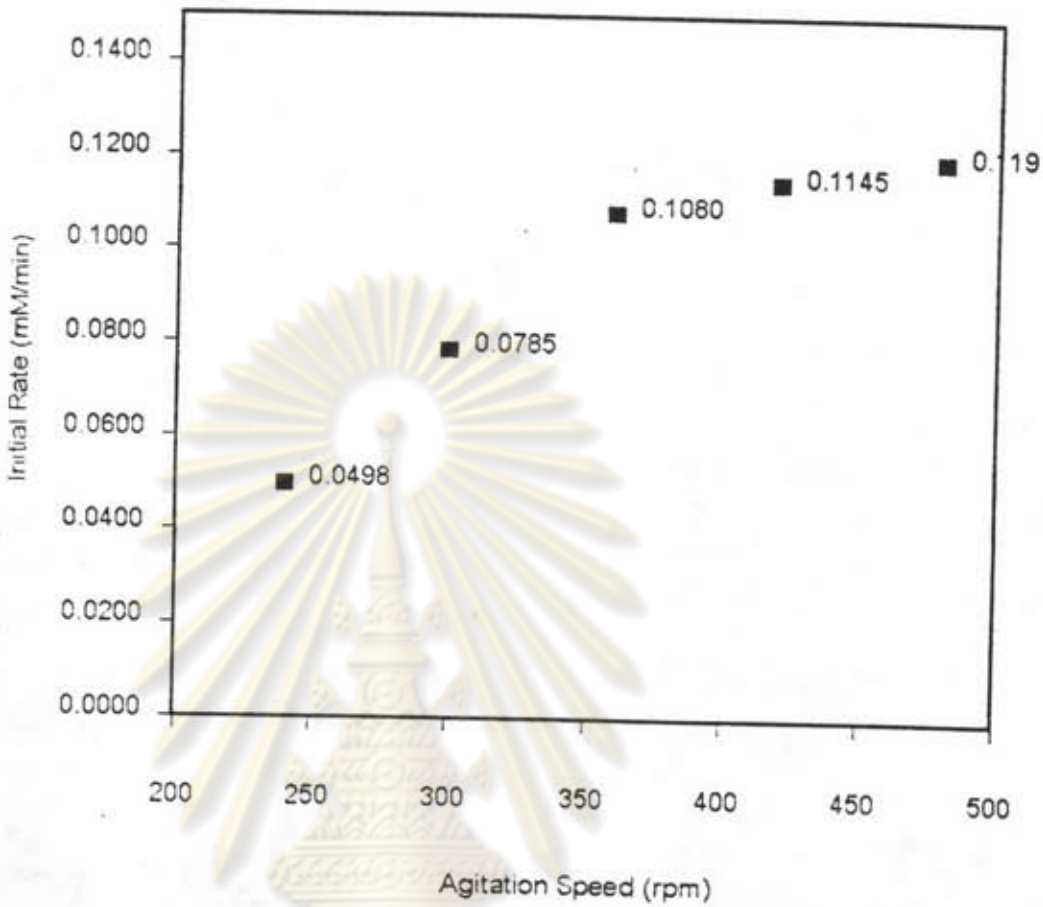

Figure 5-21. Initial rate on extraction of 10 mM L-lysine by emulsion liquid membrane at various agitation speed (at first 4 minutes interval).

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : vary 240 to 480 rpm

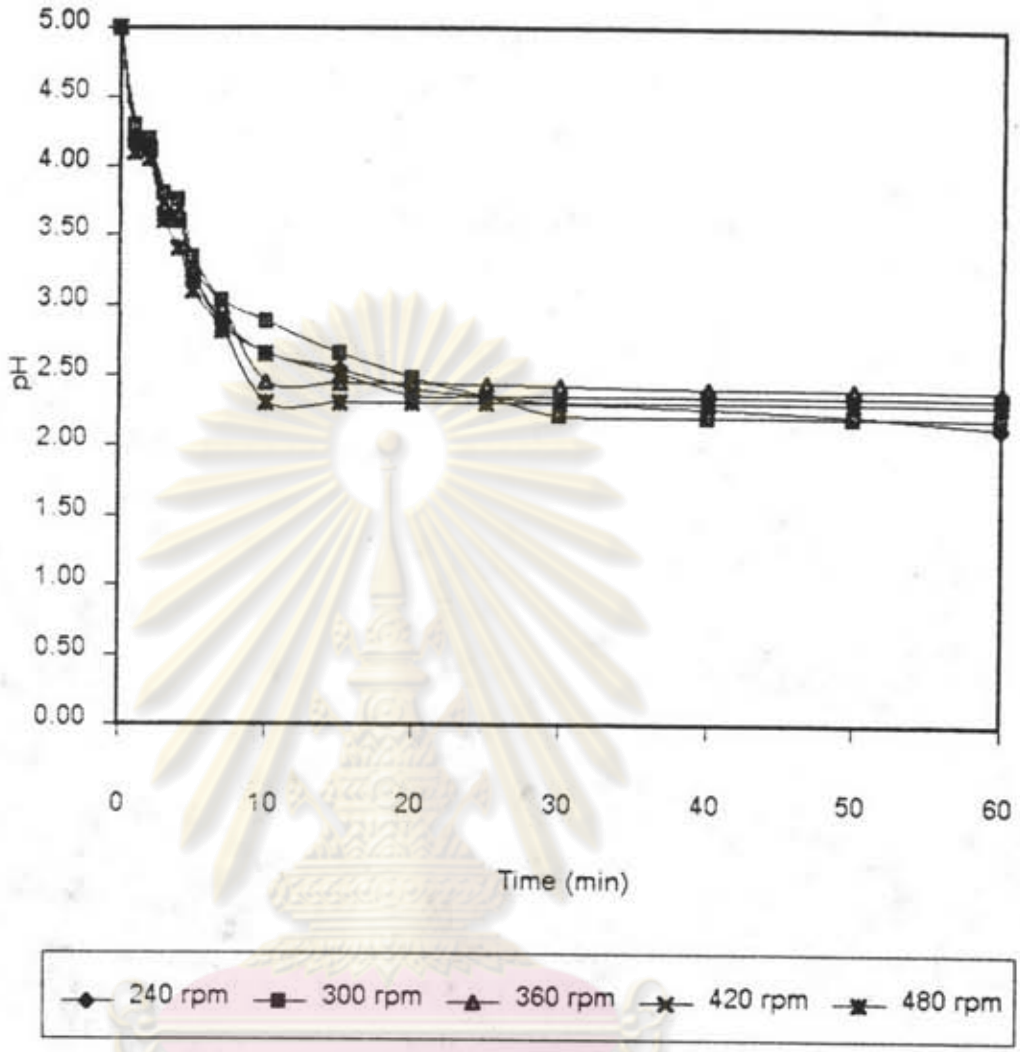

Figure 5-22 Change of pH in external phase during extraction of 10 mM L-lysine at various agitation speed.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : vary 240 to 480 rpm

6. Effect of the Initial Hydrochloric Acid Concentration in the Internal Phase

As mentioned above, the difference in hydrogen concentration between the external and the internal phases is the driving force in this emulsion liquid membrane process. The L-lysine transported for various HCl concentrations in the internal phase is shown in figure 5-23. As HCl concentration was increased, the L-lysine transport rate increased. There was, however, almost no difference between the results for 1N and 2N internal acid concentrations. As HCl concentration was increased to 3N, the agitation cannot occurs because the membrane was subjected to high swelling so that the membrane had a high viscosity and there was high mass transfer resistance. As HCl concentration was increased, the difference of osmotic pressure between the internal phase and the external phase increased providing a significant driving force for water transported across the membrane. The water was transported to the internal phase via a hydrated surfactant.

Figure 5-24 shows the concentration of L-lysine in the internal phase during the extraction of L-lysine at various internal HCl concentrations. There was almost no difference over 1N HCl which the process can be concentrated about two folds concentration of L-lysine in the internal phase by the initial concentration of L-lysine in the external phase.

Figure 5-25 shows the initial rate at various internal HCl concentrations. The maximum initial rate occurs when used 2N HCl.

Figure 5-26 shows the change of pH in the external phase during the extraction of L-lysine at various internal HCl concentrations. The change of pH in the external phase was significantly decreased in the 1N and 2N HCl at the first 10 minute but after that there was almost no difference in 0.5 N, 1.0 N and 2.0 N HCl.

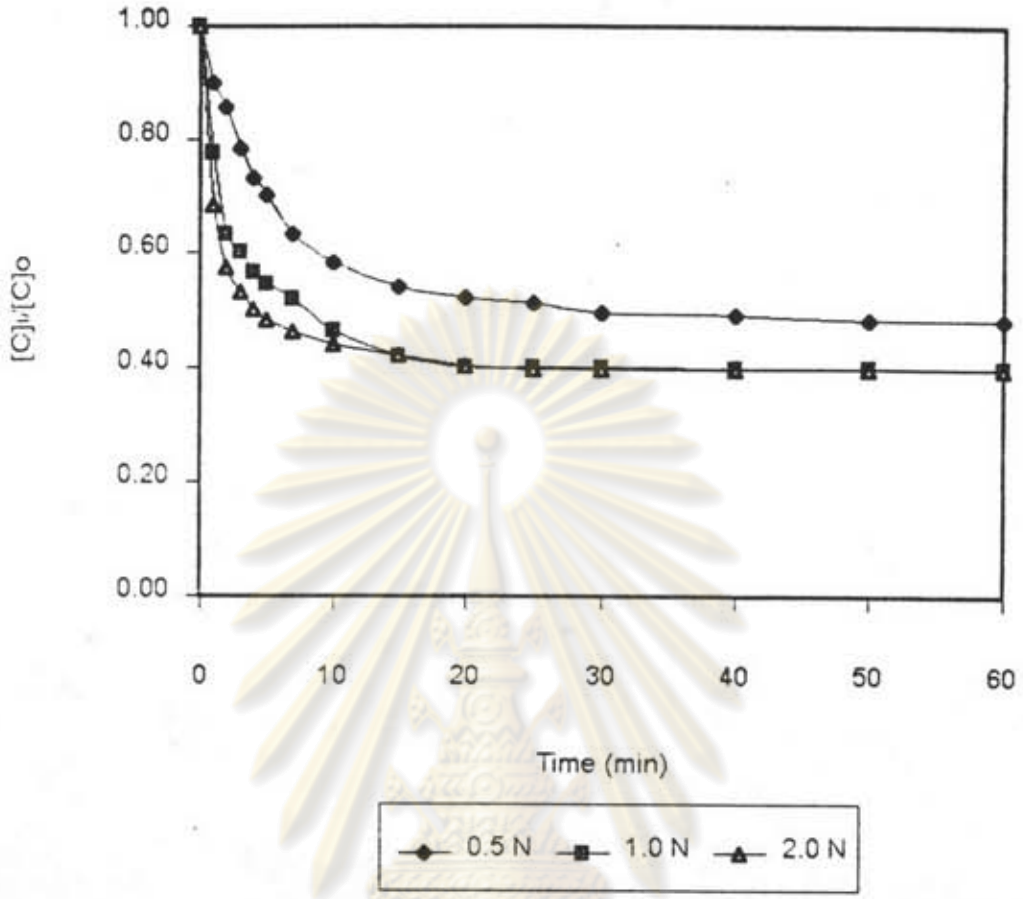

Figure 5-23. Effect of internal HCl concentration on extraction of 10 mMolar L-lysine by emulsion liquid membrane.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5%Span80 , 10%D2EHPA and 85% Dodecane

Internal phase : 0.5 N, 1.0 N and 2.0 N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

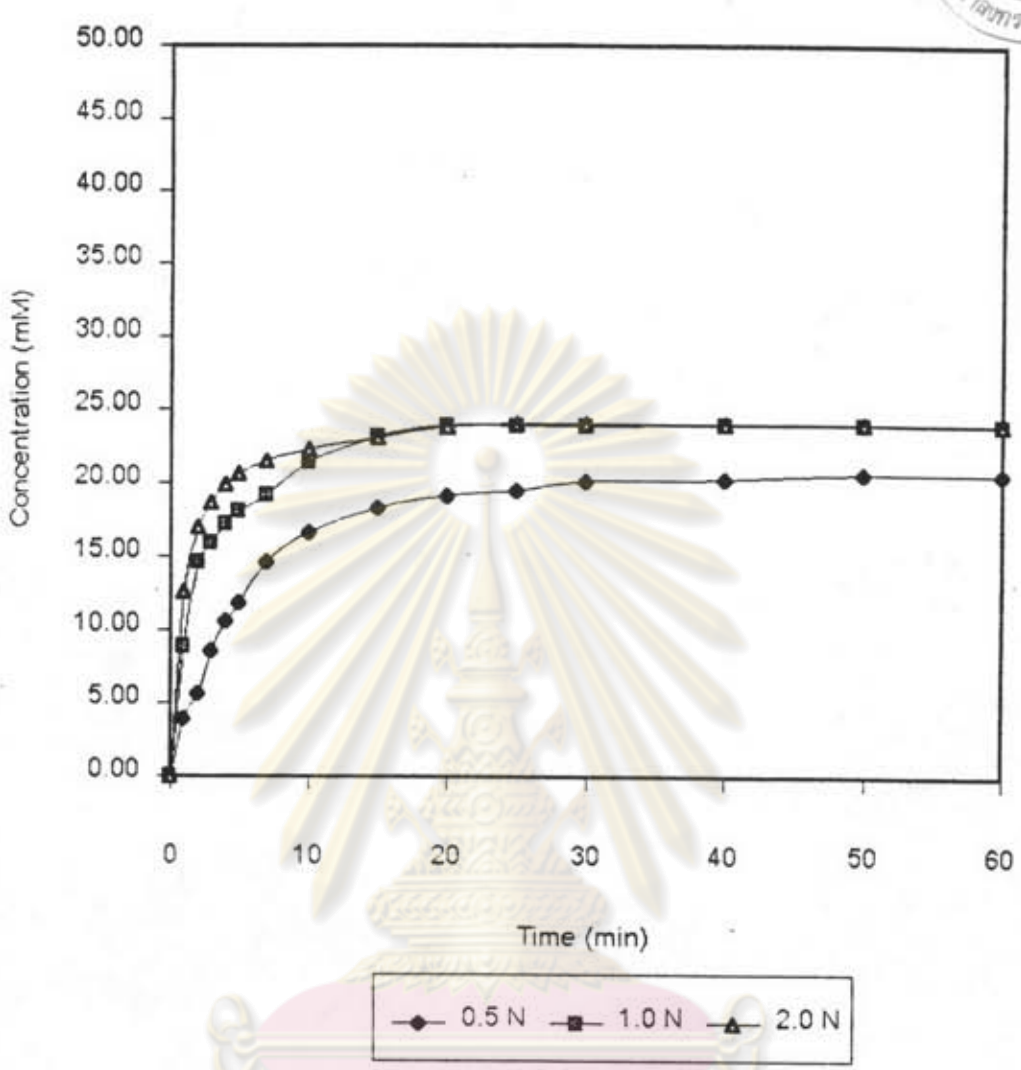

Figure 5-24. Concentration of L-lysine in the internal phase during extration of L-lysine at various internal HCl concentration.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5%Span80 , 10%D2EHPA and 85% Dodecane

Internal phase : 0.5 N, 1.0 N and 2.0 N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

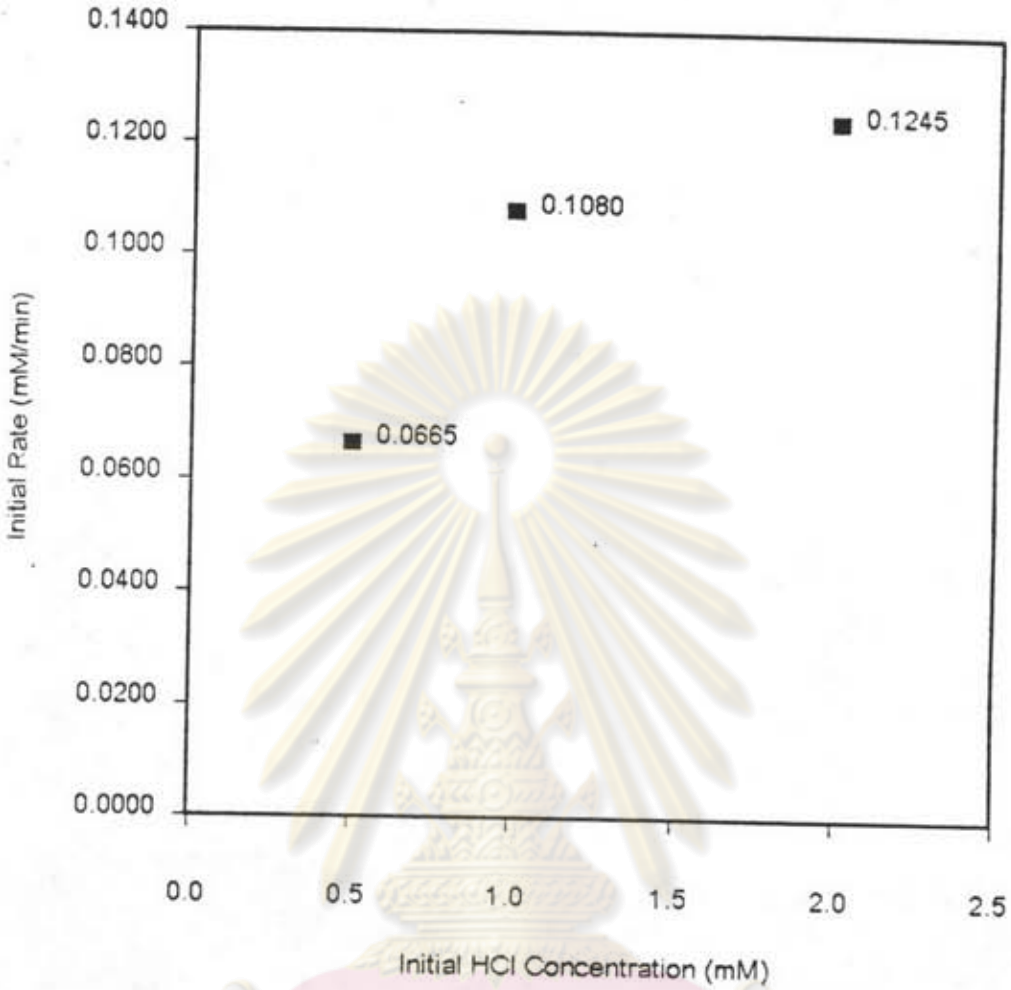

Figure 5-25. Initial rate on extraction of 10 mM L-lysine by emulsion liquid membrane at various internal HCl concentration (at first 4 minutes interval).

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5%Span80 , 10%D2EHPA and 85% Dodecane

Internal phase : 0.5 N, 1.0 N and 2.0 N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

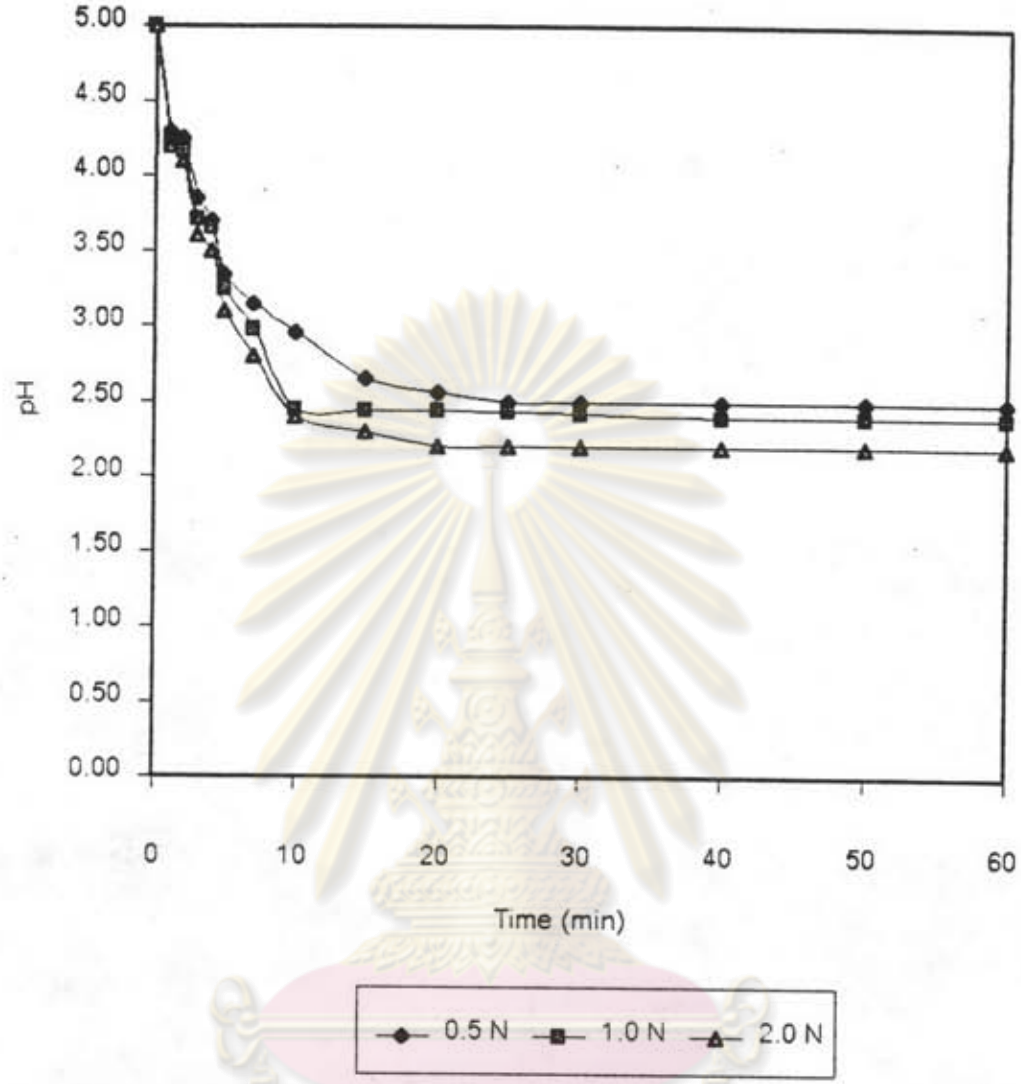

Figure 5-26. Change of pH in external phase during extraction of 10 mM L-lysine at various internal HCl concentration.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5%Span80 , 10%D2EHPA and 85% Dodecane

Internal phase : 0.5 N, 1.0 N and 2.0 N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

7. Effect of %Swelling on the Extraction of 10 mMolar L-lysine by Emulsion Liquid Membrane.

The effect of pH on swelling is shown in figure 5-27. The swelling started at about 4 to 5 minute after the extraction, as pH was increased from 2 to 4 ,the swelling increased. At the pH 2.0, the swelling effect was 70% swelling at 60 minutes. Which considered by the extraction rate, as the swelling was increased, the extraction rate was decreased.

From figure 5-28 shows the effect of L-lysine concentration on % swelling in the emulsion liquid membrane. At the end of the extraction time, the swelling of emulsion was 25% to 30% swelling which no significantly difference in any L-lysine concentrations.

From figure 5-29 shows the effect of the surfactant concentration on % swelling in the emulsion liquid membrane. At the end of the extraction time, the swelling of emulsion was 15% to 35% swelling, there was the small difference because, when increased the surfactant concentration, the oil phase viscocity and the mass transfer resistance became higher.

From figure 5-30 shows the effect of the carrier concentration on % swelling in the emulsion liquid membrane. At the end of the extraction time, the swelling of emulsion was 20% to 40% swelling. This results can be explained, the increased of the carrier concentration makes the molecules of water following into the internal phase so that the volume of internal phase will be increased.

From figure 5-31 shows the effect of agitation speeed on % swelling in the emulsion liquid membrane. At the end of the extraction time, the swelling of the

From figure 5-31 shows the effect of agitation speeed on % swelling in the emulsion liquid membrane. At the end of the extraction time, the swelling of the emulsion was 25% to 35% swelling. As the agitation speed increased the swelling of membrane phase decreased. Itoh et.al (1989) explained the breakage of the membrane, they was found that the membrane breakage also seems to have increased due to the increase in shear and the membrane breakage increased as the increased of the agitation speed. At low agitation speed, there was no breakage of membrane phase make the swelling effect was large while at high agitation speed, membrane can be breakage by the increasing of shear make the swelling effect was small because the water will be back transport into the external phase.

From figure 5-32 shows the effect of the internal HCl concentration on % swelling in the emulsion liquid membrane. At the end of the extraction time, the swelling of emulsion at 0.5 N and 1.0 N HCl was 20% and 25%, consequently, which no significantly difference in this concentration but the swelling at 2.0 N was 80% which significantly difference while compared with the lower concentration. This effect occurs because the pH in the internal was increased while increased the internal HCl concentration, the decreased of pH in the internal phase makes the system has higher driving force so that while the Lys molecule was transfered from the external phase to the internal phase the molecule of water can be transfered too by this higher driving force.

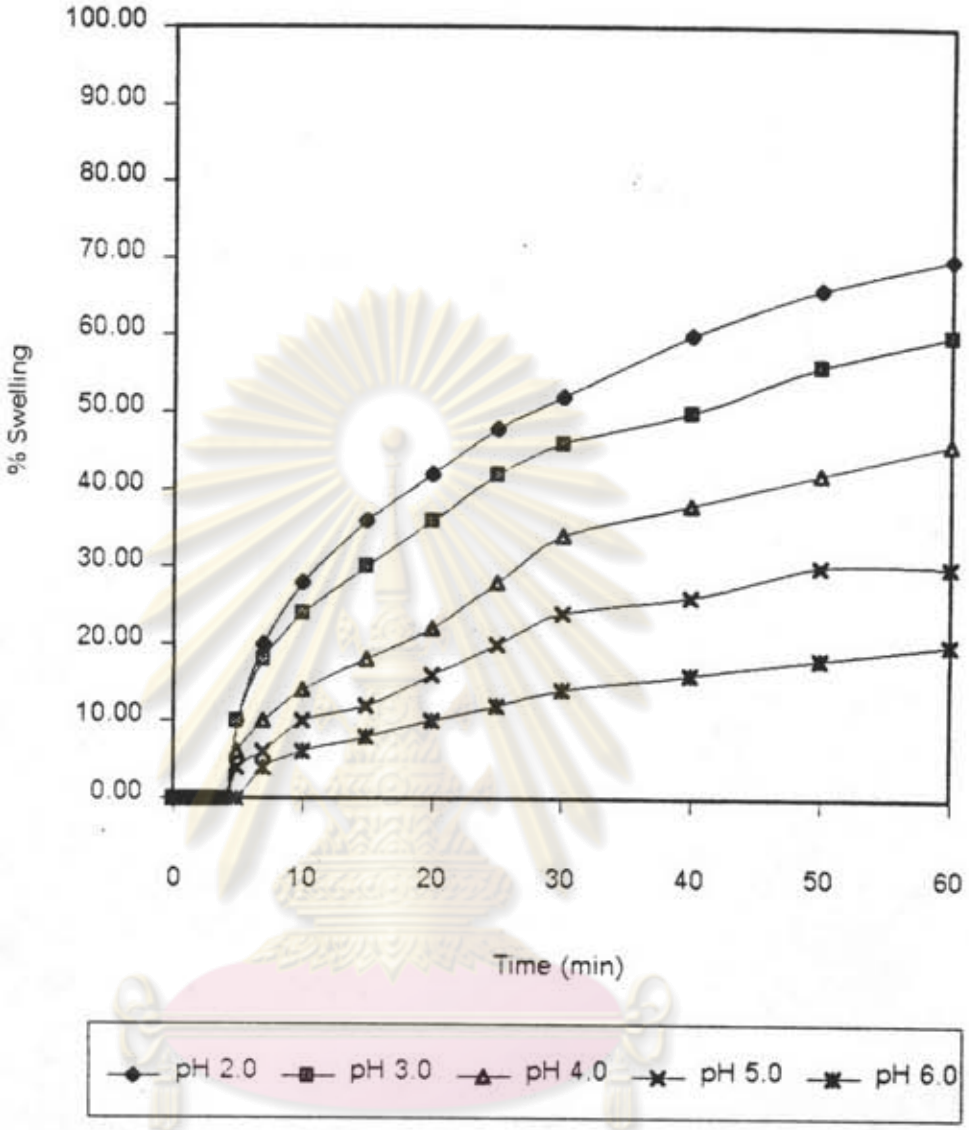

Figure 5-27. Effect of initial pH of L-lysine on %swelling in emulsion liquid membrane extraction.

Experimental conditions :

External phase : 10 mMolar L-lysine at various pH (adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

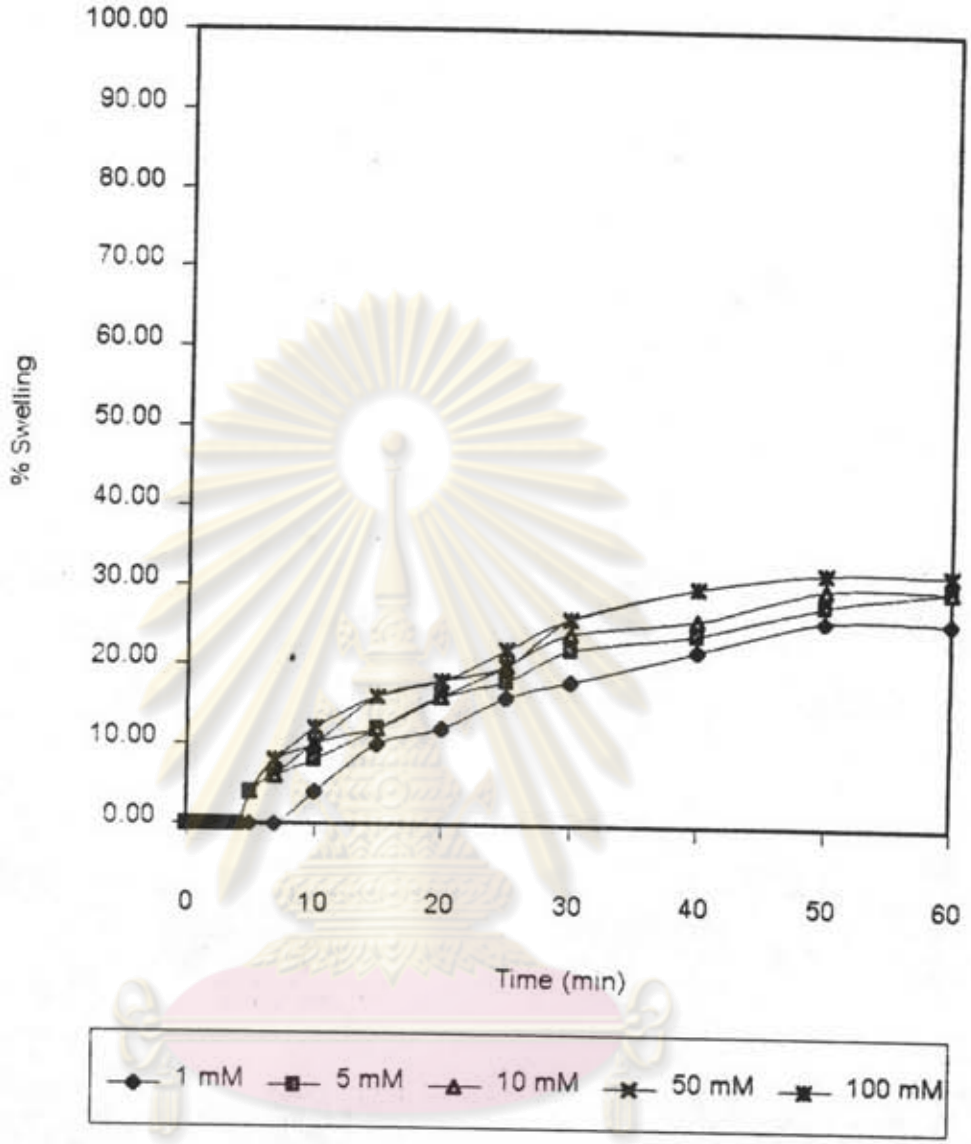

Figure 5-28. Effect of L-lysine concentration on %swelling in emulsion liquid membrane extraction.

Expenmental conditions :

External phase : Various concentration of L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

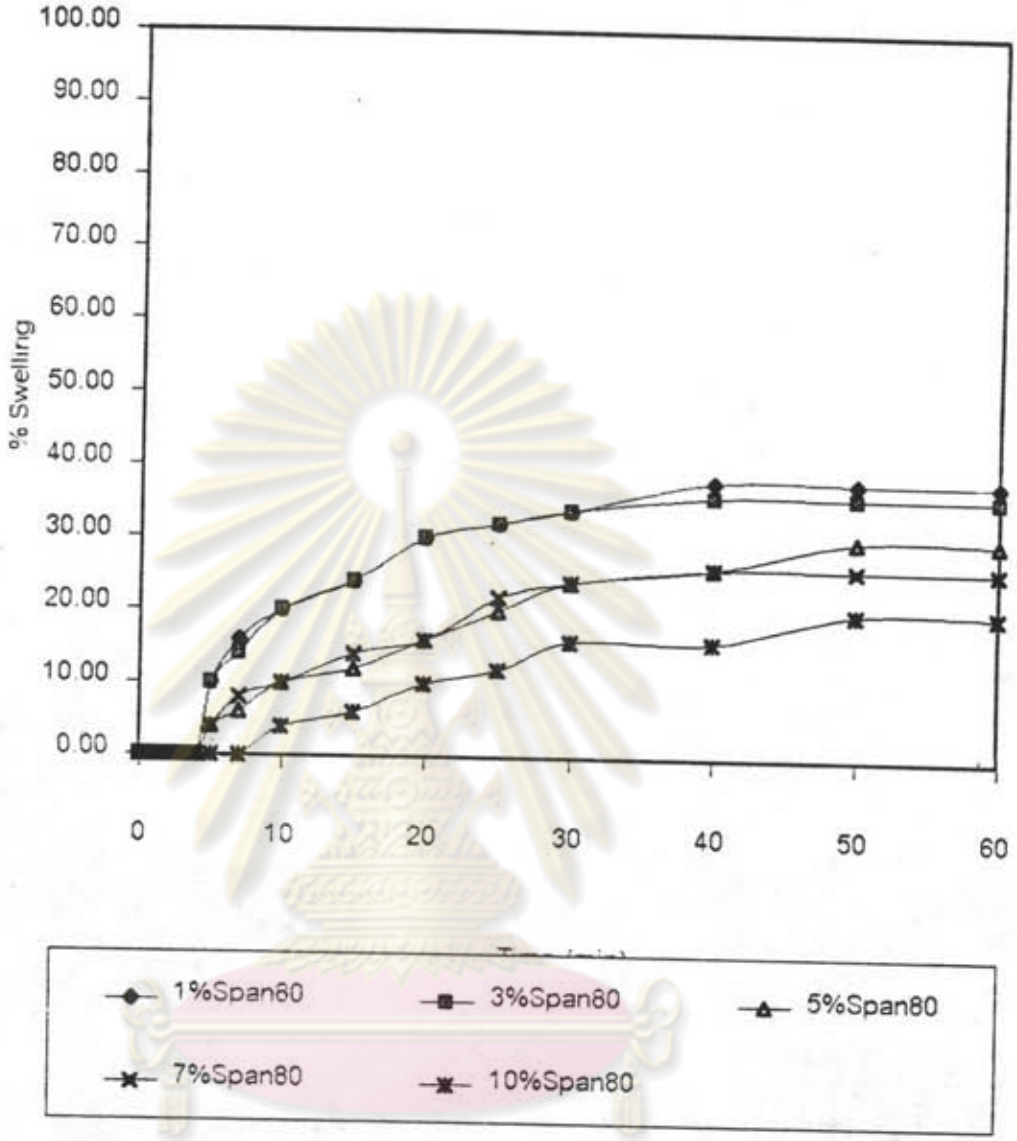

Figure 5-29. Effect of surfactant concentration on %swelling in emulsion liquid membrane extraction.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : Span80 at various concentration, 10%D2EHPA and Dodecane(%of dodecane due to % of Span80)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

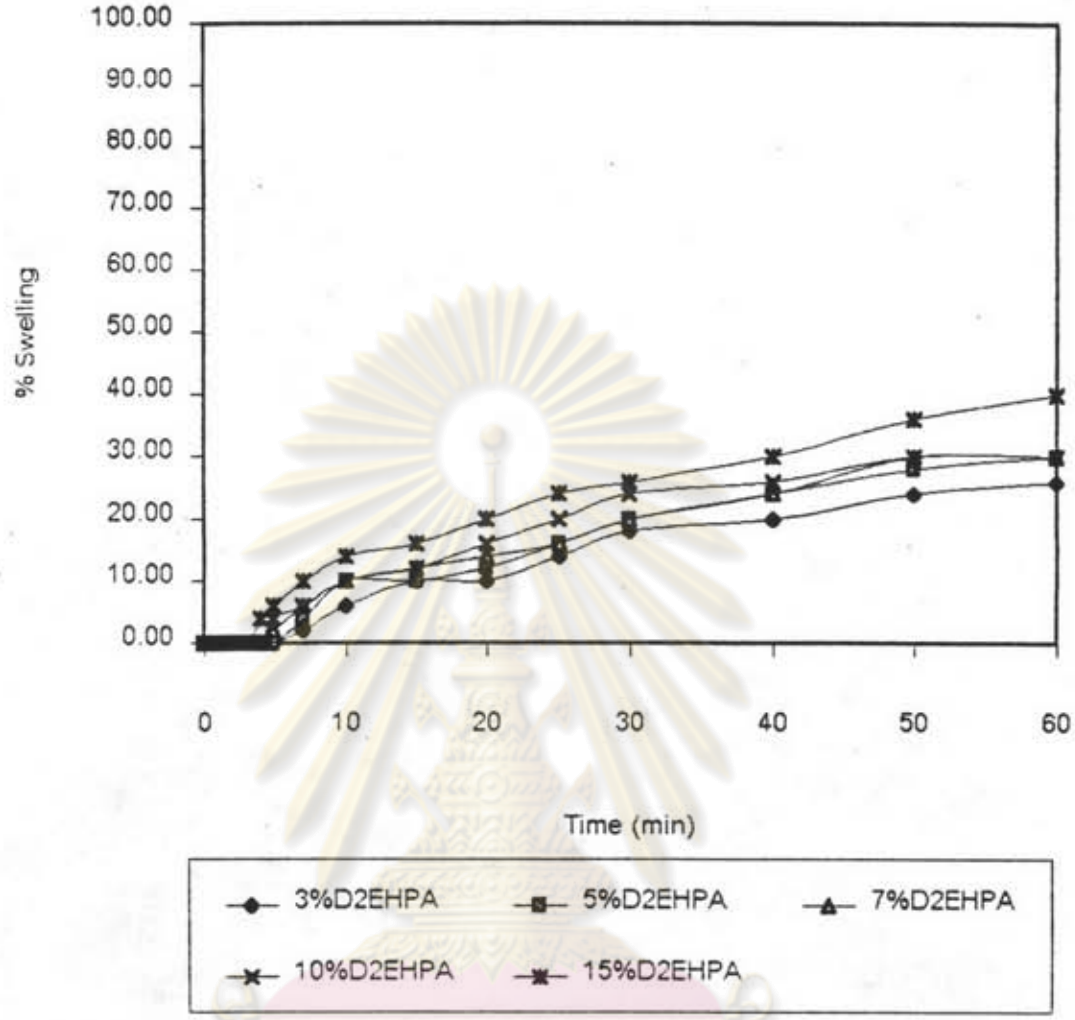

Figure 5-30. Effect of carrier concentration on %swelling in extraction of 10 mM L-lysine by emulsion liquid membrane.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0 (adjust by H_2SO_4)

Membrane phase : 5% Span80, D2EHPA at various concentration and Dodecane (depends on D2EHPA concentration)

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm

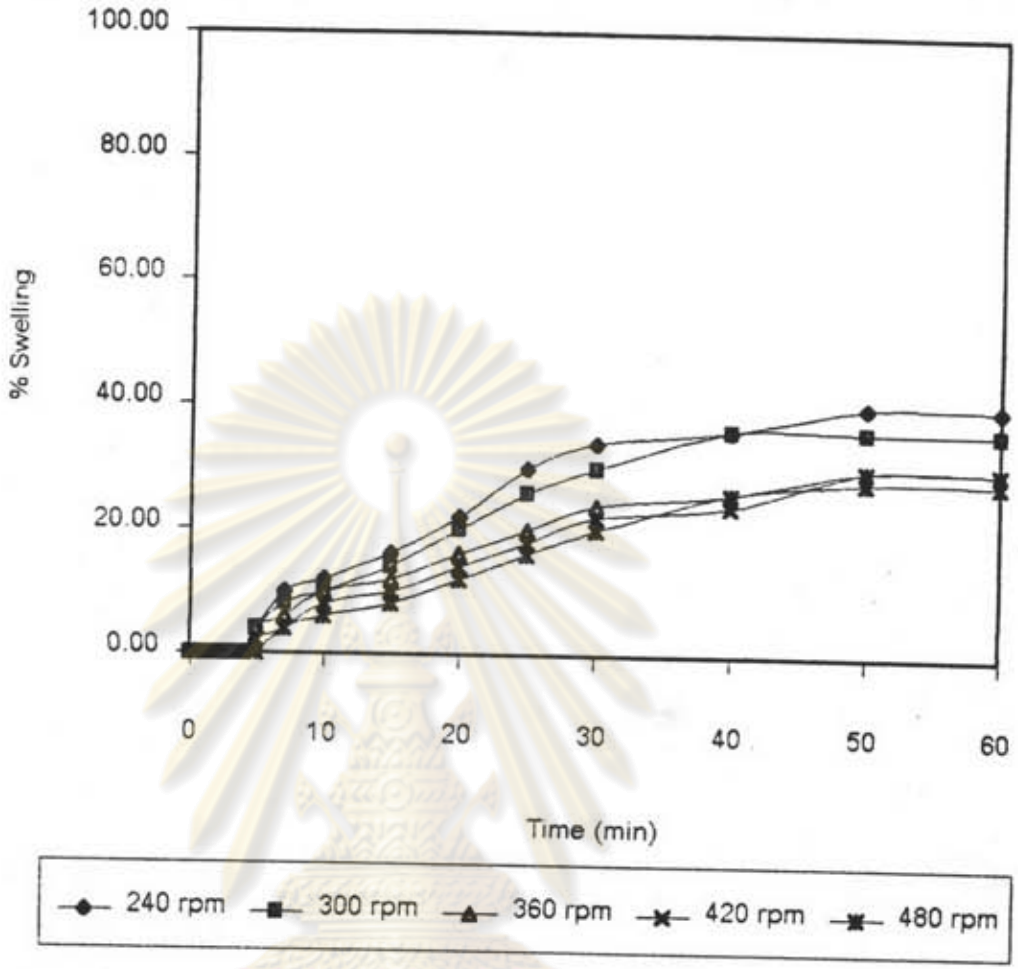

Figure 5-31. Effect of agitation speed on %swelling in extraction of 10 mM L-lysine by emulsion liquid membrane.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5% Span80, 10%D2EHPA and 85%Dodecane

Internal phase : 1N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : vary 240 to 480 rpm

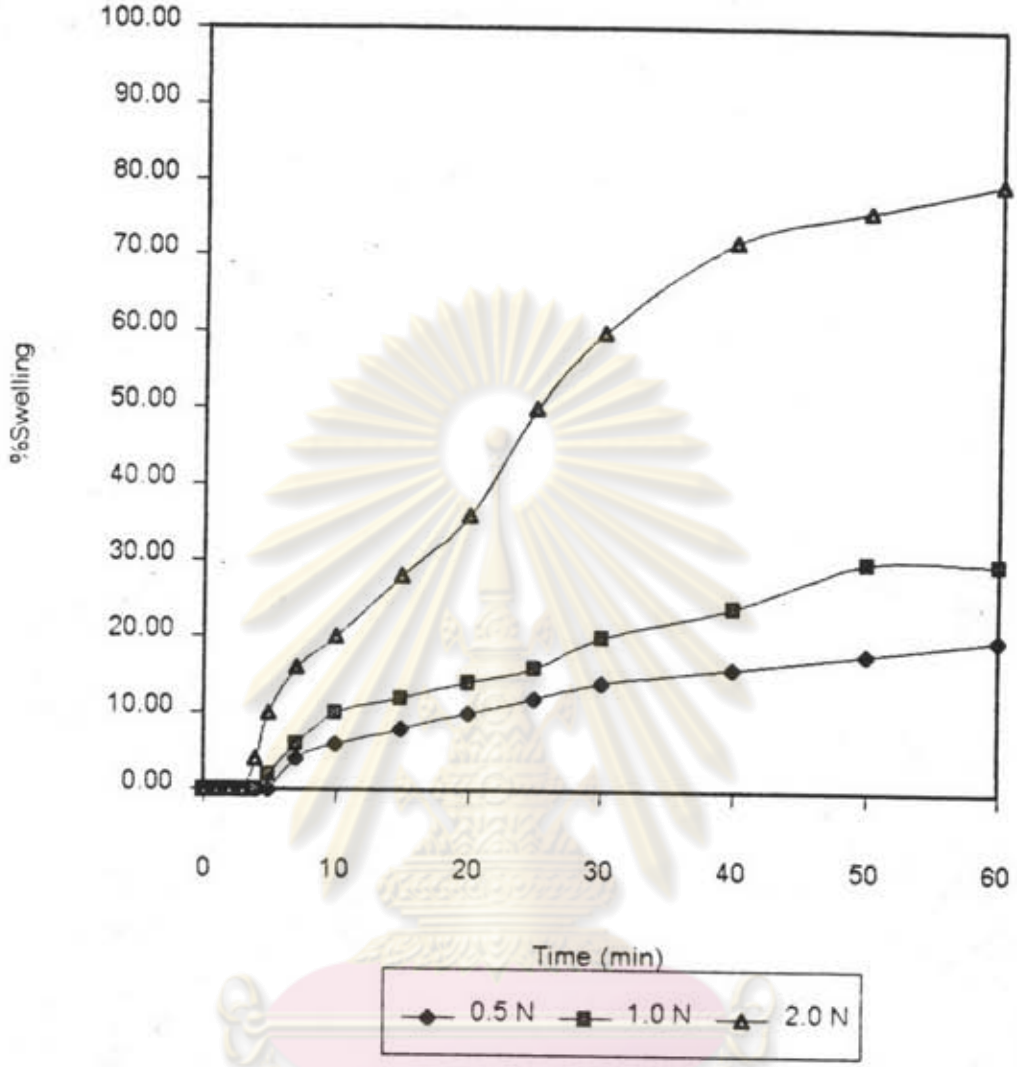

Figure 5-32. Effect of internal HCl concentration on %swelling in extraction of 10 mM L-lysine by emulsion liquid membrane.

Experimental conditions :

External phase : 10 mMolar L-lysine at pH 5.0(adjust by H_2SO_4)

Membrane phase : 5%Span80 , 10%D2EHPA and 85% Dodecane

Internal phase : 0.5 N, 1.0 N and 2.0 N HCl Solution

Membrane preparation : at homoginizing speed = 8000 rpm 10 minute

Agitation speed : 360 rpm