Solubility of Ethylenediaminetetraacetic
Acid in Some Aqueous Solutions

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In the course of study on the use of ethylenediaminetetraacetic acid as eluant for ion-exchange chromatography, it was found necessary to investigate its solubility behavior. No such data being available**, the authors measured the solubility of free acid, H_4Y, under various conditions.

The free acid was recrystallized thrice from an ammoniacal solution by adding dilute hydrochloric acid and then dried at 110°C for several hours. Chemical analysis by titration with standard zinc solution using Eriochrome Black T as indicator proved the sample was pure enough for this purpose. The free acid thus obtained was shaken with various media in a thermostat until equilibrium was attained. Then a portion of the saturated solution was taken by means of a pipette attached with cotton filter and the concentration of the free acid was determined by titration with 0.005 M standard zinc solution at pH 10 using the same indicator. All other chemicals were of guaranteed grade and were purified by distillation or recrystallization, if necessary.

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TABLE I

TEMPERATURE VARIATION OF THE SOLUBILITY
OF ETHYLENEDIAMINETETRAACETIC ACID IN
WATER

Temperature (°C)	Concentration of EDTA (H_4Y) (10^{-3}mol./l.)
2.7	0.566*
25.0	1.153
30.0	1.372
35.0	1.660
40.0	1.990
45.0	2.350
100	32.1

* Preliminary data of less accuracy.

Table I shows the temperature dependence of the solubility of ethylenediaminetetraacetic acid in water. Within the range of temperature between 25°C and 45°C the plot of the logarithm of solubility against the reciprocal of absolute temperature gave straight line and from its slope the heat of solution was found to be 6.76 kcal./mol. (endothermic) in the temperature range of our experiment.

TABLE II

SOLUBILITY OF ETHYLENEDIAMINETETRAACETIC
ACID IN POTASSIUM CHLORIDE SOLUTIONS AT 30°C

Concentration of potassium chloride (mol./l.)	Concentration of EDTA (H_4Y) (10^{-3}mol./l.)
0.00	1.372
0.01	1.509
0.04	1.636
0.09	1.781
0.16	1.901
0.20	1.990
0.50	2.330
1.00	2.650

The effect of the ionic strength on the solubility of the acid was determined in solutions of varying concentration of potassium chloride. The results are given in Table II. As is expected from the amphoteric nature of ethylenediaminetetraacetic acid, the solubility curve plotted against hydrochloric acid concentration passed through a minimum which is illustrated in Fig. 1.

The solubility of the acid in water-ethanol mixture was decreased with increasing of ethanol contents, as was shown in Fig. 2.
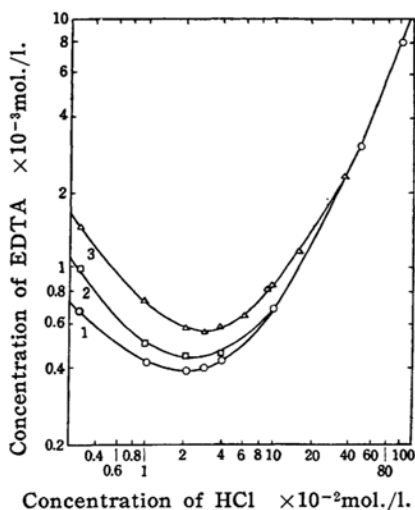

Concentration of HCl $\times 10^{-2}$mol./l.

Fig. 1. Relationship between the solubility of EDTA (H_4Y) and the molarity of HCl at 30°C.
1. The aqueous solution of HCl.
2. The aqueous solution of HCl–KCl. ($\mu = 0.10$)
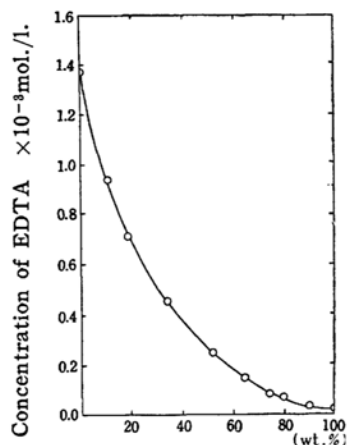3. The aqueous solution of HCl–KCl. ($\mu = 0.50$)

Concentration of ethanol

Fig. 2. Solubility of EDTA (H_4Y) in ethanol-water mixtures (at 30°C).

Details of the experiment will be reported elsewhere.

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