

Thermodynamic function of valineacid in n-n dimethyl formamide mixtures from conductance measurement

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Abstract:

Some physical properties enthalpy (ΔH), entropy (ΔS), free energy (ΔG), capacities (ΔC_p) and P_{ka} values) for valine in dimethyl formamide over the temperature range 293.15-318.15K, were determined by direct conductance measurements. The acid dissociation at six temperature was examined at solvent composition x_2 involving 0.141 of dimethyl formamide. As results, calculated values have been used to determine the dissociation constant and the associated thermodynamic function for the valine in the solvent mixture over temperatures in the range 293.15-318.15 k. The P_{ka1} , and P_{ka2} were increased with increasing temperature.

Key words: valine, Dimethyl formamide, Thermodynamic function, conductance measurement

Introduction:

Amino acid play many important roles in the living system. The interactions between the solvent and the various constituent group of a protein, play a crucial role in the structure and function of proteins in aqueous solutions. Thermodynamic properties of amino acids in aqueous electrolyte solutions can provide valuable information regarding the confirmation stability of proteins in the solutions. The study of the behavior of the amino acids in aqueous solutions is a useful model for understanding the thermodynamic behavior of protein [1] [2]. In this paper, we study the dissociations constant and the associated thermodynamic properties of acid mean of investigation the change in the solute - Solvent interaction patterns that are attributed to the variation of the solvent composition [3]. Such investigation include valine and other amino acids in aqueous 1-Propyl-3-Methylimidazolium Bromide Ionic liquid so

solution of amino acids have also been reported as a function of temperature in the geochemical literature including densities, molar volumes, viscosities, molar heat capacities and refraction indices. amino acid dissociation constant have also been reported as a function of temperature [4] [5]. In this paper, results are given for dissociation of valine in dimethyl formamide mixture at various temperature from direct conductance measurements.

Materials and Methods:

Materials:

Reagents used in this work were dimethyl formamide (DMF) of purity >99% obtained from Fluka was passed through a freshly prepared activated molecular sieve without any further purification. The solvent containing 40% w/w (DMF) was prepared by mass ratio using doubly distilled deionized water and then used for preparation of valine in required concentration.

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Valine of purity 99% from (BDH), was used after re-crystallation from doubly distilled deionized water with a conductivity of approximately $0.7\mu\text{S}\cdot\text{cm}^{-1}$ was used for preparation of solution[6].

Apparatus and Procedure:-

The samples were prepared by filling glass volumetric flask with composition of amino acid and (DMF) and then closing them tightly. The mass of chemicals used to prepare the mixture was determined with an uncertainty 1×10^{-6} kg using Sertrious analytical balance AGTE2145. The uncertainty in molalities of prepared solutions is approximately $= 1 \times 10^{-4} \text{ mol}\cdot\text{kg}^{-1}$ viscosity were determined using a suspended level Ubbelohde viscometer. the flow times were recorded electronically within electronic timer of precision ± 0.015 and the temperature of both was controlled to be better than ± 0.018 . the viscometer was calibrated with doubly distilled deionized water . flow times were reproducible to 0.01S[7]. Densities were determined using a vibrating-tube dosimeter Anton Paer (DMF 60/602) digital dosimeter, thermos total to $+0.01 \text{ C}^{\circ}$ the overall precision of measurements was estimated to be better then $\pm 2 \times 10^{-6}$ g/ml . Tacussel electronic conduct meter , type CD810 , was used to measure the conductivity of the deionized water and of the valine. prepared solutions with an accuracy of $1 \pm 10^{-9} \text{ S}\cdot\text{cm}^{-1}$ The dielectric constant of the mixtures were determined using Radelkis precision

dielectrometer type OH-302 of maximum error on the dielectric constant scale of 2%. .densities of mixed solvents were measured with help of digital precision system DMA 60/602 (Anton Paer) the reproducibility of density measurement was $\pm 3 \times 10^{-5} \text{ g}\cdot\text{cm}^{-3}$ [8]. the density and the dielectric constant data of (DMF) at various temperatures have been used to estimate the appropriate values of the Debye-Huckel-Onsuger constant A and B using the relationships :-

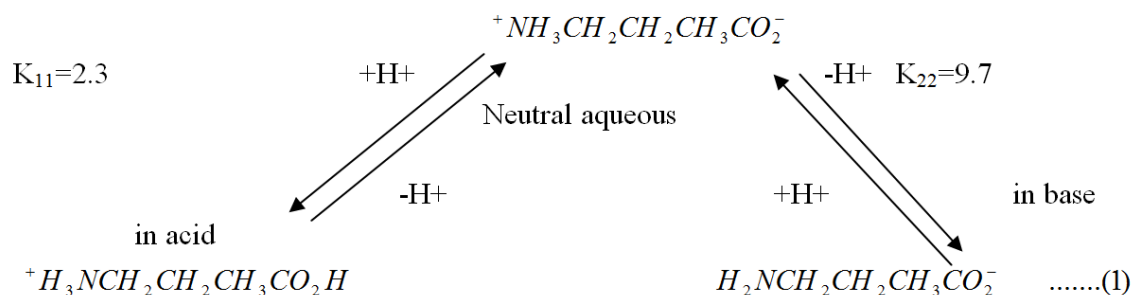
$$A = \frac{82.4}{\eta(DT)^{1/2}} \quad \text{and} \quad B = \frac{8.2 \times 10^5}{(DT)^{3/2}}$$

Where D, η and T represent respectively the dielectric constant, the viscosity and the temperatures , the resulting values of the constant A and B are presented in table (1) the solvent composition was expressed in terms of the mole fraction (x) of dimethyl formamide in the (DMF) +water mixture. The investigation covered on solvent compositions (x) which was 0.141 corresponding to 40% weight percentages of (DMF) in the mixture.

Results:

1-The degree of dissociation:

The acid dissociation of amino acids offer interesting examples of the relations between the function K_a and the true or 'thermodynamic' constant K_a of valine . In the dissociation of valine[9].



The microscopic constants are K_{11}, K_{22} and so we define the first acid dissociation constant K_1 , a macroscopic dissociation constant by

$$K_1 = \frac{(H^+)[(^+H_3NCH_2CH_2CH_3CO_2^-) + (H_2NCH_2CH_2CH_3CO_2H)]}{(^+H_3NCH_2CH_2CH_3CO_2H)} \quad \dots(2)$$

And second acid-dissociation constant is given by

$$K_2 = \frac{(H^+)(H_2NCH_2CH_2CH_3CO_2^-)}{[^+H_3NCH_2CH_2CH_3CO_2H + (H_2NCH_2CH_2CH_3CO_2^-)]} \quad \dots(3)$$

An amino acid is said to be isoelectric at the pH at which there are equal concentrations of the positively and negatively charged forms setting $(H_3N^+CH_2COO^-)$ and substituting from equations (2) and (3) yields

$$(H^+)_{isoelectric}^2 = K_1 K_2$$

Which may be written

$$pH_I = \frac{1}{2}(pK_1 + pK_2) \quad \dots(4)$$

The onsager equation for incompletely dissociated electrolytes, can be written as [9,10].

$$\Lambda = \alpha [\Lambda_o - (A + B\Lambda_o)(\alpha C)^{1/2}] \quad \dots(5)$$

Where A and B are onsager constants and Λ_o is the molar conductivity of the weak electrolyte at infinite dilution, Eqn.(5) may be written as:

$$\Lambda = \alpha \Lambda^- \quad \dots(6)$$

Where

$$\Lambda^- = \Lambda_o - (A + B\Lambda_o)(\alpha C)^{1/2} \quad \dots(7)$$

$$\Lambda^- = \Lambda_o - K(\Lambda_c / \Lambda^-)^{1/2} \quad \dots(8)$$

Λ^- is the molar conductivity of 1 mole of free ions, at the concentration C mole per liter, at the actual ionic concentration in the solution, where K, representing $A + B\Lambda_o$, is constant for a given solute in a particular solvent at a definite temperature. In order to estimate the value of α in Eqn.(6), an approximate value of Λ_o for amino acid, for a given solvent composition and temperature, was first made by extrapolating the experimental data of Λ^- against $(C)^{1/2}$. As a first approximation, Λ^- in the term. $(\Lambda_c / \Lambda^-)^{1/2}$ of Eqn.(8) was then taken as equal to Λ_o and hence a preliminary value of Λ could be derived from Eqn.(8), by utilizing the experimental value of Λ at the concentration (c). The result for Λ^- thereafter, inserted under the square root sign in Eqn.(8), thus obtaining a

better value of Λ^- in here of α . Using such values of Λ^- and α in Eqn.(7), it was possible to derive the correct values of Λ_o from the plots of Λ^- values against the corresponding values of $(\alpha c)^{1/2}$. Table (3) gives the resulting value of X_2 at a given temperature. The exact values of Λ_o could be derived, as mentioned earlier, from Λ^- , $(\alpha c)^{1/2}$ for solvent mixtures and temperatures and data obtained are presented in table(3). The values of Λ_o table(3) are then plotted against the experimental temperature (T) as indicated in Figure (1). Figure (1) shows that Λ_o at $X_2=0.141$ followed the sequence $308>303>298>293$, implying an increase in Λ_o with increasing temperature. The change in Λ_o with change of temperature in the range 293–308 K is seen in Figure (1) to be almost linear suggesting a constant dependence of Λ_o values on temperature over the range referred to above. Thus, the increase of temperature invariably results in an increase of ion conductance. Since the conductance of an ion depends on its rate of movement, it seems reasonable to treat the conductance in a manner analogous to that employed for other processes taking at a definite rate which increases with temperature increasing, thus:

$$\Lambda_o = A e^{-E/RT} \quad \dots(9)$$

Where A is constant, which may be taken as being independent of temperature over relatively small range; E is the activation energy of the processes which determines the rate of movement of ions, R is the gas constant and T is the temperature in Kelvin, Eq.no.(9) may be written as :

$$d \ln \Lambda_o / dt = (1/\Lambda_o)(d \Lambda_o / dt) = E/RT^2$$

and

$$E = \alpha RT^2 \quad \dots (10)$$

Where $\alpha = (1/\Lambda_o)(d\Lambda_o/dt)$ is the temperature dependence of Λ_o . From the slopes of the lines in Figure (1) it was possible to evaluate the corresponding values of E, from Eqn.(10), that cover the temperature range 293-318K, the such values of Λ_o have then been combined with the appropriate values of $d\Lambda_o/dt$ to calculate the values of α and E. Table (4) gives the values α and E for Valine acid in Dimethyl form- amide at infinite dilutions.

2- The Dissociation Constant for the acid:

The relation between the function k_a and the true or "thermodynamic" constant K of Valine may be written as :

$$K = K_a f^+ f^- \quad \dots(11)$$

Where $K_a = \alpha^2 C / (1 - \alpha)$.

If the solution is sufficiently dilute for the Debye-Hukel law to be applicable, it follows, for Valine type electrolyte, that

$$\log f^+ = \log f^- = -A(\alpha C)^{1/2} \quad \dots(12)$$

The ionic strength, $1/2 \sum c_i z_i^2$, being equal to

$$1/2[(\alpha c x_1^2) + (\alpha c x_2^2)], \text{ i. e; to } \alpha c.$$

Eqn.(12) may be expressed as :

$$\log K = \log K_a - 2A(\alpha C)^{1/2} \quad \dots (13)$$

The plot $\log k_a$, obtained at various concentrations C, against $(\alpha C)^{1/2}$ should be thus derive a straight line of intercept $\log K$.

Combining equations (6) and (13), one may write :

$$\log K = \log \left[\frac{\Lambda_2 c}{\Lambda - (\Lambda - \Lambda^-)} \right] - 2A(\Lambda c / \Lambda^-)^{1/2} \quad \dots (14)$$

Since Δ^- for various concentration can be obtained from conductance data (table 2) and Onsager Eqn.(7), by method already described in the previous section, would be possible to derive the values of the dissociation function k_a for various acid concentration, and the k_{a2} is obtained from the Eq.(13):

$$K_{a2} = 4\alpha^2 C^2 / 1 - \alpha \quad \dots (15)$$

and, thereafter, calculate pI from Eqn.(4). Such results for the dissociation of Valine in Dimethyl formamide mixture at different temperature are given in (table 5)

The manner in which the pK values change with temperature as described in Figure (3). Suggests a relatively large dependence of pK on temperature;

The dissociation constants (k_1 and k_2) of valine derived in the present work (table 5) are substantially less than those reported [11,12]. for the acid in water and in a number of other solvents. This is likely to be due to greater basicity and lower dielectric constant of DMF mixture than water.

The dependence of pK values for valine dissociation in DMF mixture at a temperature could be expressed as:

$$pK = \frac{A_1}{T} - A_2 + A_3 T \quad \dots (16)$$

Where A_1, A_2 and A_3 are constants for a given solvent composition ($x=0.141$) over the temperature range 293-308K. Inserting the appropriate values of pK and temperature from table (5) in Eqn.(16), the values of the constant (A_1, A_2, A_3) could be calculated and the results are given in table (6).

3- Thermodynamic of the acid Dissociation: The standard thermodynamic function for valine dissociation in DMF mixture may be calculated from equation [13]:

$$\Delta G^o = (R \ln 10) (A_1 - A_2 T + A_3 T^2) \dots (17)$$

$$\Delta H^o = (R \ln 10) (A_1 - A_3 T^2) \dots (18)$$

$$\Delta S^o = (R \ln 10) (A_2 - 2A_3 T) \dots (19)$$

$$\Delta C_{p}^o = (R \ln 10) (-2A_3 T) \dots (20)$$

Table (7) summarizes the values of the standard thermodynamic functions which have been derived by Eq.(17-20) for the dissociation of the valine in DMF mixture at four temperatures. From the following information could be obtained:

The value of ΔG^o is negative values for pK is refer to spontaneous reaction and high positive values of ΔG for pK_a , at all temperature reflect the non spontaneous reaction.

The values of ΔH is high positive values at all temperature is reflect the large endothermic for pK_1 and negative value for pK_2 is reflect Exothermic step. The values of ΔS^o were generally positive which did not change significantly with the variation of temperature. ΔC_p^o values were negative for solvents with $x_2=0.141$, ΔC_p^o reflects, the effect of temperature on H^o so that one can write

$$C_p^o = dH^o / dT \dots (21)$$

It is shown in table(7) that the negative sign of ΔC_p^o , is due to decreasing tendency of ΔH^o with the increase temperature. Thus the relatively more endothermic behavior lead to the greater increase in ΔS^o .

The two sorts of interactions have to be considered; the first a maximum interaction between the two components of the solvent mixture and the second is the expected strong solute – solvent interaction due to the polarity and possibility of hydrogen bonds formation.

The values of ΔS for pK_a decrease because the decomposition of

valine is very order the reactant at path second stage pka_2 .

Moreover, the high positive ΔH values at this stage indicates that the

undissociated acid molecules are highly stable so that the release of these molecules and subsequent dissociation stage should highly be endothermic.

Table(1):Dielectric constant(D), viscosity, and the Onsager constants (A and B) for dimethyl formamide at six temperatures.

| X | T/K | Dialectic | Viscosity | Values A | Values B |
|--------|-----|-----------|-----------|----------|-----------|
| 0.1410 | 293 | 63.01 | 2.338248 | 1.418005 | 0.3268874 |
| | 298 | 59.22 | 2.039288 | 1.264859 | 0.3497220 |
| | 303 | 60.32 | 1.810804 | 1.103171 | 0.3318375 |
| | 308 | 54.39 | 1.561893 | 0.994360 | 0.3781892 |
| | 313 | 62.056 | 1.408857 | 0.832971 | 0.3029156 |
| | 318 | 55.62 | 1.355498 | 0.839841 | 0.3485994 |

Table(2): Values of Λ ($S \text{ mol}^{-1} \text{cm}^2$), Λ' ($S \text{ mol}^{-1} \cdot \text{cm}^2$), α and ka ($\text{mol} \cdot \text{L}^{-1}$) for versus concentrations ($\text{mol} \cdot \text{L}^{-1}$) of valine in dimethyl formamide + water mixture at different temperature (293-318)k at $x_2=0.1410$

| T/K | Conc. $\text{mol} \cdot \text{L}^{-1}$ | $\Lambda S \text{ mol}^{-1} \text{cm}^2$ | $\Lambda' S \text{ mol}^{-1} \text{cm}^2$ | A | $Ka_1 \text{mol} \cdot \text{L}^{-1}$ | $Ka_2 \text{mol} \cdot \text{L}^{-1}$ | pPI |
|-----|--|--|---|-------------|---------------------------------------|---------------------------------------|-------------|
| 293 | 0.0183687 | 12.02 | 20.14184 | 0.596767723 | 0.016223098 | 0.00071134 | 0.008467219 |
| | 0.032785 | 8.601 | 20.01396 | 0.429750034 | 0.010617977 | 0.000598402 | 0.010917177 |
| | 0.0551302 | 5.754 | 19.95733 | 0.288315112 | 0.00643927 | 0.000409405 | 0.006643973 |
| | 0.08912 | 3.303 | 19.99606 | 0.165182541 | 0.002912809 | 0.000171519 | 0.002998568 |
| | 0.191326 | 1.5444 | 19.99429 | 0.077242053 | 0.001237069 | 7.3127605 | 0.001273632 |
| 298 | 0.0183687 | 11.198 | 18.85645 | 0.593855153 | 0.015949921 | 0.000695949 | 0.008322935 |
| | 0.032785 | 8.049 | 18.74356 | 0.429427494 | 0.010596051 | 0.000596718 | 0.01089441 |
| | 0.0551302 | 5.318 | 18.67903 | 0.284704291 | 0.006247294 | 0.000392225 | 0.006443407 |
| | 0.08912 | 3.067 | 18.71463 | 0.163882481 | 0.002862681 | 0.00016724 | 0.002946301 |
| | 0.191326 | 1.739 | 18.60999 | 0.093444435 | 0.001842835 | 0.000131787 | 0.001908729 |
| 303 | 0.0183687 | 11.269 | 19.20559 | 0.586756252 | 0.015303388 | 0.000659757 | 0.007981572 |
| | 0.032785 | 8.357 | 19.08497 | 0.437883843 | 0.011183222 | 0.000642186 | 0.011504316 |
| | 0.0551302 | 5.378 | 19.03644 | 0.282510806 | 0.006132596 | 0.000382058 | 0.006323624 |
| | 0.08912 | 3.171 | 19.05937 | 0.166374859 | 0.002959237 | 0.00017551 | 0.003046992 |
| | 0.191326 | 1.797 | 18.95996 | 0.094778681 | 0.001898631 | 0.000137716 | 0.001967489 |
| 308 | 0.0183687 | 13.23 | 21.79473 | 0.607027479 | 0.017223957 | 0.00076821 | 0.008996083 |
| | 0.032785 | 8.949 | 21.69511 | 0.412489266 | 0.009494775 | 0.000513609 | 0.00975158 |
| | 0.0551302 | 5.751 | 21.63724 | 0.265791755 | 0.005304608 | 0.000310917 | 0.005460067 |
| | 0.08912 | 3.682 | 21.61589 | 0.170337654 | 0.003116701 | 0.000189252 | 0.003211327 |
| | 0.191326 | 1.954 | 21.53393 | 0.09074052 | 0.001732562 | 0.000120316 | 0.00179272 |
| 313 | 0.0183687 | 14.645 | 22.14921 | 0.661197397 | 0.023702489 | 0.001151499 | 0.012426994 |
| | 0.032785 | 9.846 | 22.06828 | 0.446160734 | 0.011783495 | 0.000689447 | 0.012128219 |
| | 0.0551302 | 6.847 | 21.97954 | 0.311516984 | 0.007770694 | 0.000533815 | 0.008037601 |
| | 0.08912 | 6.468 | 21.73129 | 0.297635345 | 0.011240394 | 0.001192618 | 0.011836703 |
| | 0.191326 | 2.283 | 21.90009 | 0.104246147 | 0.002321161 | 0.000185182 | 0.002413752 |
| 318 | 0.0183687 | 17.007 | 27.45968 | 0.619344435 | 0.018510183 | 0.000842328 | 0.009676256 |
| | 0.032785 | 11.16 | 27.36626 | 0.407801431 | 0.009206728 | 0.000492367 | 0.009452912 |
| | 0.0551302 | 7.676 | 27.25641 | 0.281621828 | 0.00608652 | 0.000377994 | 0.006275517 |
| | 0.08912 | 4.892 | 27.23475 | 0.179623459 | 0.003505 | 0.000224433 | 0.003617217 |
| | 0.191326 | 2.648 | 27.12756 | 0.097612907 | 0.002020206 | 0.000150917 | 0.002095664 |

Table (3): Values of the molar conductivity dimethyl formamide at infinite dilution ($\Lambda_0/S \text{ mol}^{-1} \text{ cm}^2$) at $x_2=0.141$ and different temperature (293-318)K

| Values of Λ_0 | | | | | | |
|-----------------------|----------|-----------|-----------|-----------|-----------|-----------|
| X_2 | 293 K | 298 K | 303 K | 308 K | 313 K | 318 K |
| 0.14 | 22.04101 | 20.740218 | 20.978493 | 24.046443 | 24.106415 | 30.009986 |
| 1 | 1 | 8 | 5 | 5 | 6 | 9 |

Table (4): The temperature coefficients (α) and the energies of activations (E) at infinite dilution as a function of the $x_2 = 0.141$

| X_2 | $d\Lambda_0 / dt$ | $\Lambda_0 / S \text{ mol}^{-1} \text{ cm}^2$ | Slope | $E_{(kj,mole)}$ | A |
|--------|-------------------|---|-----------|-----------------|------------------------|
| 0.1410 | -0.2451 | 0.568721963 | -0.005288 | 0.10125374 | 1.304×10^{-7} |

Table (5): Values of pk for the dissociation of valine in dimethyl formamide + water mixture at six temperatures at $x_2 = 0.141$

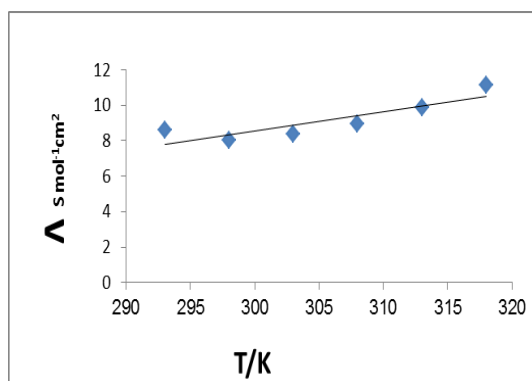
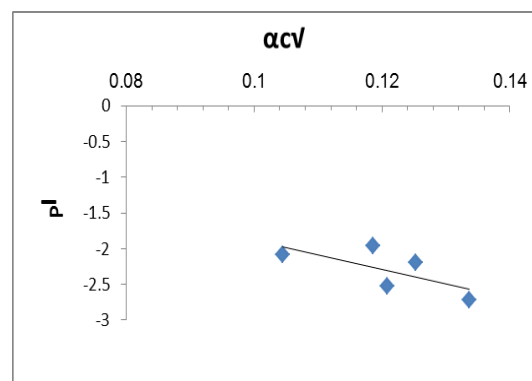
| T/K | $\sqrt{\alpha c}$ | Pka_1 | Pka_2 | pPI |
|-----|-------------------|-------------|------------|------------|
| 293 | 0.104698841 | 5.36489692 | 2.34300818 | 1.73576896 |
| | 0.118698588 | | | |
| | 0.12607486 | | | |
| | 0.121330409 | | | |
| | 0.121566496 | | | |
| 298 | 0.104443033 | 5.03714706 | 2.04243847 | 2.46144833 |
| | 0.118654037 | | | |
| | 0.125282898 | | | |
| | 0.120852003 | | | |
| | 0.133709947 | | | |
| 303 | 0.103816904 | 4.58962148 | 1.59375805 | 2.06472791 |
| | 0.119816617 | | | |
| | 0.124799348 | | | |
| | 0.121767514 | | | |
| | 0.134661152 | | | |
| 308 | 0.105595008 | 7.17103372 | 4.17627391 | 4.42734958 |
| | 0.116290415 | | | |
| | 0.121050207 | | | |
| | 0.123209138 | | | |
| | 0.131761226 | | | |
| 313 | 0.110205883 | 0.181801638 | 2.6973395 | 1.0620594 |
| | 0.120943705 | | | |
| | 0.13 1049585 | | | |
| | 0.162865779 | | | |
| | 0.141226762 | | | |
| 318 | 0.106660921 | 5.5778053 | 2.60359368 | 3.35330991 |
| | 0.115627721 | | | |
| | 0.124602840 | | | |
| | 0.126522894 | | | |
| | 0.136659749 | | | |

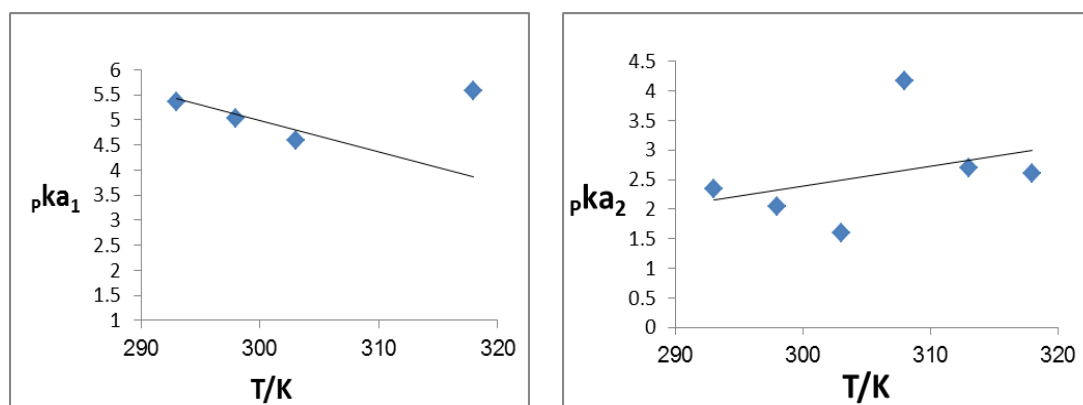
Table (6): Values of temperature dependence constants A_1 , A_2 and A_3 at $x_2=0.141$ of DMF+water.

| Values of P | A_1 | A_2 | A_3 |
|-------------|--------------------|-------|--------|
| pka_1 | 4.27×10^4 | 256 | 0.3955 |
| pka_2 | 3.99×10^4 | 241.9 | 0.3692 |
| pPI | 4.58×10^4 | 302.7 | 0.4923 |

Table (7): Values of pK for the dissociation and the standard thermodynamics functions for the Valine in DMF+water mixture at six temperature.

| Values of P | T/ K | ΔG° / kJ / | ΔH° / kJ / | ΔS° / J / mol | ΔCp° / kJ/K mol |
|-------------|------|-------------------------|-------------------------|----------------------------|------------------------------|
| pka_1 | 293 | -31.1 | -167 | -464.0024166 | 4.436959693 |
| | 298 | -29.0 | -145 | -388.2863808 | 4.512675728 |
| | 303 | -2.72 | -122 | -312.5703451 | 4.588391764 |
| | 308 | -25.9 | -98.8 | -236.8543094 | 4.6641078 |
| | 313 | -24.9 | -75.3 | -161.1382737 | 4.739823835 |
| | 318 | -48.8 | -51.4 | -85.42223801 | 4.815539871 |
| pka_2 | 293 | -14.1 | -157 | -489.16018 | 4.141910287 |
| | 298 | -11.9 | -137 | -418.434956 | 4.21259135 |
| | 303 | -99.6 | -115 | -347.753893 | 4.283272413 |
| | 308 | -84.0 | -93.7 | -277.07283 | 4.353953476 |
| | 313 | -71.9 | -71.8 | -206.391767 | 4.424634539 |
| | 318 | -29.5 | -49.5 | -135.710704 | 4.495315602 |
| pPI | 293 | -11.6 | 68.1 | 272.0838035 | -5.522921 |
| | 298 | -12.8 | 40.2 | 177.8360048 | -5.6171688 |
| | 303 | -13.4 | 11.9 | 83.5882061 | -5.7114166 |
| | 308 | -13.6 | -16.9 | -10.65959259 | -5.8056644 |
| | 313 | -13.3 | -46.1 | -104.9073913 | -5.8999122 |
| | 318 | 116.4 | -75.9 | -199.15519 | -5.99416 |

**Fig (1) Molar conductivity ($S \text{ mol}^{-1} \text{ cm}^2$) of valine in DMF + water mixture as a function of temperature T****Fig.(2) $\log pI$ versus $\alpha\sqrt{c}$, (C) expressed in moles per Liter**



Fig(3) pK_{a1} , pK_{a2} and pH value of valine as a function of temperature T

Conclusion:

The done work showed that the dissociation constant (k_1 and k_2) of valine derived in present work are substantially less than those reported for the acid in water and a number of other solvents. The two sorts of interaction have to be considered; the first maximum interaction between the two components of the solvent mixture and the second is the expected strong solute-solvent interaction due to the polarity and possibility of hydrogen bonds formation.

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الدوال الحرارية لحمض الفالين في مزيج الداى مثيل فورمامايد من قياسات التوصيلية

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الخلاصة :

تم تعيين بعض الخواص الفيزيائية مثل الانتالبي (ΔH)، والانتروبي (ΔS)، والطاقة الحرة (ΔG)، والسعة الحرة (Δcp_0)، وثابت التفكك للحامض الفالين pka في مذيب من داى مثيل فورمامايد في مدى من درجات الحرارة K (293.15-318.15) عن طريق قياسات التوصيلية مباشرة وعند كسر مولي للمذيب هو 0.141 من داى مثيل فورمامايد. ومن خلال النتائج لوحظ إن قيم ثابت التفكك لحمض الفالين تزداد بزيادة درجة الحرارة.