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REVIEW ARTICLE

Viscometric properties of triglycine in different aqueous solutions of $NaNO_3$, KNO_3, $Mg(NO_3)_2{\cdot}6H_2O$ at T =(288.15-318.15)K

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Abstract:
Viscometric measurements for triglycine in water and in $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ at concentration range (0.25-2.0)$mol{\cdot}kg^{-1}$ have been done using Ubbelhode viscometer at four different constant temperatures (288.15,298.15, 308.15 and 318.15)K. Viscosity B thermodynamic parameter has been calculated using Jone-Dole equation from relative viscosity. The transfer Δ_t B factor has provided the net change in values of B before and after addition of different nitrates. The effect of temperature and the addition of different nitrates at four different temperatures have carefully studied and approach is being made to compare and contrast the difference in the behavior of these nitrates using viscometric approach. The increase of B-values with increasing $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ molality reveals that this electrolyte gains a progressively more structured environment. The salt-triglycine and salt-water interactions enhance the overall structure of the solvent resulting in the increased viscosity B-coefficient with increase in salt molality.

1. Introduction

Protein interaction with their solvent, ions and side chain of other protein molecules. These interactions are especially non-covalent in nature[1]. At infinite dilution, ion – ion interactions become absent and we got ion-solvent interactions[2-5]. Thermodynamic properties of amino acids in different electrolytes are very useful in evaluating the effect of electrolytes on biologically important systems[6-10]. Salt solutions have great effect on solubility, denaturation etc. of various protein model compounds[11]. Proteins can be easily denatured by heat, change in pH, and by chemical agents like urea and guanidinium chloride[12]. Sodium, potassium and magnesium ions are very important for different physiological functions of various organs[13]. Magnesium ion is used in the activation of ATP(adenosine triphosphate) and provide energy source to carry out different functions of the cell [13]. This paper provides a systematic study of the viscosity behavior of triglycine in water and in aqueous $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ solutions at T =(288.15, 298.15, 308.15 and 318.15)K. viscosity, relative viscosity, Jone-Dole Coeff.(B) and transfer parameters have been studied systematically.

2. Experimental

Triglycine (mass fraction purity > 0.990) were obtained from sigma chemical company, USA, dried and used without purification. The $NaNO_3$ (A.R., mass fraction purity > 0.995), KNO_3 (A.R., mass fraction purity > 0.995) and $Mg(NO_3)_2{\cdot}6H_2O$ (A.R., mass fraction purity > 0.995) were purchased from (A.R., S.D. Fine Chemicals Ltd., India) were kept in a vacuum desiccator till use.

Water with a specific conductance less than 1.4 $\cdot 10^{-6}$ $\Omega^{-1}{\cdot}cm^{-1}$ used to prepare by distilling deionised water over alakaline $KMnO_4$ and further degassed by boiling. Mettler balance of readability ± 0.01 mg was used for the mass measurements.

Viscosity measurements were carried out using Micro Ubbelhode Viscometer, which has flow time of not less tan 300s for water at T=298.15K , shown in Figure 1. Flow time calculations were done by automatic time measurement unit (SCHOTT AVS 350) with a resolution of 0.01s.

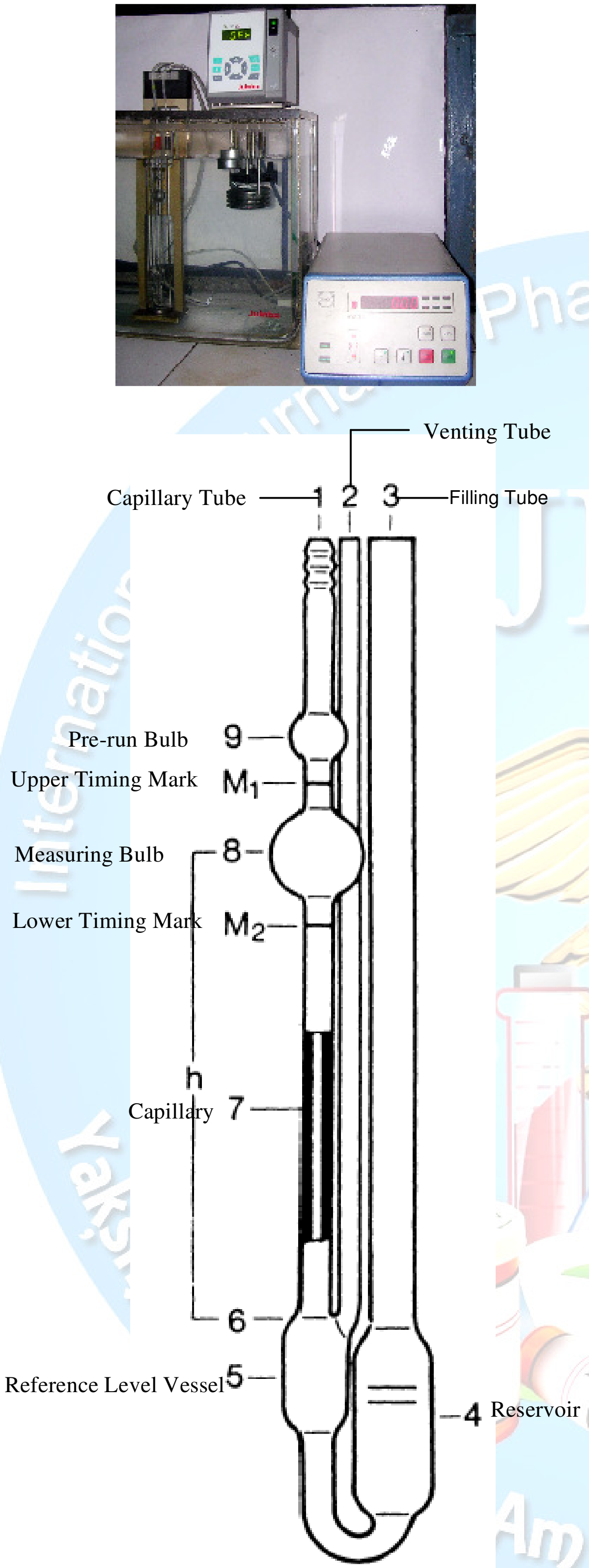

FIGURE 1. Shows automatic visocity unit (SCHOTT AVS 350) with constant temperature bath (MC 31A Julabo/Germany) & Ubbelohde type capillary viscometer from SCHOTT-GERATE.

2.1. Calibration of the viscometer

The viscometer was calibrated by using deionised, doubly distilled and degassed water. The flow time of water between reference marks M_1 and M_2 was noted with the help of AVS 350 at different temperatures. The flow times and literature values of viscosities were fitted to the equation:

$$\eta = d.\left(at - \frac{b}{t} \right) \qquad (1)$$

where *a* and *b* are constants of the viscometer, *d* is the density and *t* is the flow time for water.

2.2. Cleaning of viscometer

Before first use the viscometer was cleaned with 15% H_2O_2 and 15% HCl and then with labolene (A.R.) using the ultratranssonicator for 15 minutes. Thereafter the viscometer was rinsed with dry acetone and then dried thoroughly. It was kept under dust free environment before it was put to use for automatic measuring.

2.3. Filling of viscometer

About 15ml of the filtered fresh sample was transferred through the filling tube (3) into the reservoir (4) of the viscometer. Filling capacity is indicated by etched marks on reservoir (4)(shown in Fig. 1).

Viscosity describes a fluid's internal resistance to flow and may be thought of as a measure of fluid friction. This is true for only Newtonian or ideal solutions, whereas non-Newtonian fluids are not independent of shear rate [14][Jenkins *et al.*(1995)].
Relative viscosity may be defined by the relation, $\eta_r = \eta/\eta_o$, where η and η_o are viscosities of the solution and solvent respectively.

2.4. Development of Jones Dole equation:

Arrhenius (1887) gave the following relationship between the relative viscosity and concentration (c) for moderately dilute solutions:

$$\eta = A^c \qquad (2)$$

Where *A* is a constant for given salt and temperature. Various workers have showed negative curvature for the salt solutions instead of straight at lower concentrations and at low temperature. Rabinovich (1992)[15] have concluded that depolymerization of water molecules must be responsible for negative viscosity.

Inspired by the special behavior of salts [Jones and Dole (1929)] [16]concluded that there must be some effect which is of relatively greater importance and is responsible for curvature in η versus *c* plots, and this effect always tend to increase whether the overall effect of addition of salt is to increase or decrease the viscosity. The decrease in viscosity was attributed to interionic forces.

Earlier Debye and Huckel observed that the effect of interionic forces in opposing the motion of ions is proportional to the square root of the concentration in very dilute solutions. Thus they gave the equation:

$$\phi = \frac{1}{\eta} = 1 + A\sqrt{c} + Bc \qquad (3)$$

where ϕ is the fluidity and A and B are constants, where A has negative value for the strong electrolytes, which tend to stiffen the solution or decrease the fluidity and zero for the non-electrolytes. The B has positive value for the liquids with high fluidity and negative for those with low fluidity.

Later Jones and Talley (1933)[17] measured the viscosities of urea and sucrose solutions and further confirmed that the values of A for non-electrolytes like urea and sucrose is zero and the equation reduced to

$$\phi = 1 + B.c \qquad (4)$$

This equation was extended to represent the data of solutes in the form:

$$\eta_r = \frac{\eta}{\eta_o} = 1 + B.c \qquad (5)$$

where B is an empirical constant, η and η_o are the viscosities of the solution and solvent respectively. η_r is the relative viscosity and c is the molarity.

3. Results and discussion

It is well established that viscosity B-coefficient is a measure of solute-solvent interactions, and is directly dependent on the size, shape and charge of the solute molecules. Thus, the viscosity B-coefficient values reflect the net structural effects of the charged groups and the hydrophobic CH_2 groups on the solvent. The values of viscosity B-coefficients for triglycine studied in water and in aqueous $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ solutions at the four different temperatures are positive indicating that the ion-solvent interactions are strong.

Table 1. indicates the change in relative viscosities with respect to change in concentration as well as change in temperature of triglycine. Further perusal of **Table 2.** shows that the viscosity B-coefficient value of amino acids increases with increase in molality of aqueous $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ 3 which shows that the ion-solvent interactions further becomes stronger with the increase in concentration of $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ which results in the improvement of ionic solvation. The increase of B-values with increasing $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ molality reveals that this electrolyte gains a progressively more structured environment. The salt-triglycine and salt-water interactions enhance the overall structure of the solvent resulting in the increased viscosity B-coefficient with increase in salt molality.

Generally the concentration dependence of relative viscosity of dilute solutions of strong electrolytes is expressed by the following form of Jones-Dole equation [16] [Jones and Dole (1929)]:

$$\eta_r = 1 + Ac^{1/2} + Bc \qquad (6)$$

Where A is the ion-ion interaction parameter (which can be calculated from Debye Hückel theory) and B reflects the effect of ion-ion interactions. However in the present studies viscosity of various solutions of $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ determined within the concentration range of c = 0.25-2.0 mol.dm^{-3}, shows linear dependence upon concentration. As already discussed in earlier section, viscosity B-coefficients of the peptide (triglycine) possess linear concentration dependence.

The viscosity B-coefficient data in aqueous $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ solutions have been used to calculate corresponding transfer function, $\Delta_t B$:

$\Delta_t B$ [Water → aqueous $NaNO_3$/ KNO_3 / $Mg(NO_3)_2{\cdot}6H_2O$] = Viscosity B-coefficient [in aqueous $NaNO_3/KNO_3/Mg(NO_3)_2{\cdot}6H_2O$] – Viscosity B-coefficient (in water) (7)

The $\Delta_t B$ values of the triglycine as a function of molality of the cosolute $NaNO_3$/ KNO_3 / $Mg(NO_3)_2{\cdot}6H_2O$ and at various temperatures studied are illustrated in **Figs. 2-4**. The solutions may be attributed to the more structured medium in the presence of aqueous $NaNO_3/KNO_3/Mg(NO_3)_2{\cdot}6H_2O$ solutions.

4. Conclusion

The increase of B-values with increasing $NaNO_3$, KNO_3 and $Mg(NO_3)_2{\cdot}6H_2O$ molality reveals that this electrolyte gains a progressively more structured environment. The salt-triglycine and salt-water interactions enhance the overall structure of the solvent resulting in the increased viscosity B-coefficient with increase in salt molality.

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TABLE 1. Relative Viscosities, η_r, of Triglycine in Aqueous Sodium Nitrate, Potassium Nitrate and Magnesium Nitrate Hexahydrate Solutions as a Function of Concentration of Triglycine.

C /(mol · dm^{-3})	η_r	C /(mol · dm^{-3})	η_r	C /(mol · dm^{-3})	η_r
		T = 288.15 K			
		Triglycine in water (η_0 = 0.7194)			
0.02389	1.0121	0.05698	1.0259	0.08988	1.0435
0.03833	1.0174	0.07895	1.0358	0.10211	1.0464
		$NaNO_3$			
		Triglycine in 0.25 ms (η_0 = 0.8988)			
0.03943	1.0209	0.06789	1.0308	0.10211	1.0464
0.04593	1.0227	0.09899	1.0449	0.10458	1.0523
		Triglycine in 0.5 ms (η_0 = 0.9207)			
0.04598	1.0223	0.08988	1.0434	0.12898	1.0598
0.06894	1.032	0.10211	1.0489	0.13405	1.0645
		Triglycine in 0.75 ms (η_0 = 0.9907)			
0.03983	1.0123	0.06899	1.0348	0.10211	1.0523
0.04983	1.0289	0.08988	1.0488	0.11565	1.0598
		Triglycine in 1.0 ms (η_0 = 1.0324)			
0.04594	1.0239	0.06894	1.0359	0.09844	1.0513
0.05678	1.0296	0.08988	1.0468	0.10212	1.0558
		Triglycine in 1.5 ms (η_0 = 1.0419)			
0.04983	1.0289	0.07892	1.0449	0.10211	1.0558
0.05688	1.0323	0.08988	1.0489	0.14567	1.0823
		Triglycine in 2.0 ms (η_0 = 1.1398)			
0.03488	1.0199	0.05689	1.0398	0.08988	1.0519
0.04844	1.0283	0.06898	1.0423	0.10122	1.0621
		T = 298.15K			
		Triglycine in water(η_0 = 0.8904)			
0.02983	1.0139	0.07896	1.0372	0.10232	1.0479
0.04598	1.0218	0.09822	1.0452	0.11232	1.0543
		Triglycine in 0.25 ms (η_0 = 0.9011)			
0.02983	1.0144	0.07896	1.0381	0.10232	1.0493
0.04598	1.0222	0.09822	1.0473	0.11232	1.0556
		Triglycine in 0.5 ms (η_0 = 0.9343)			
0.03943	1.0194	0.05698	1.0281	0.09822	1.0484
0.04323	1.0213	0.08984	1.0443	0.12122	1.0601
		Triglycine in 0.75 ms (η_0 = 0.9989)			
0.04543	1.0229	0.08934	1.0449	0.11898	1.0596
0.06894	1.0349	0.10212	1.0511	0.14598	1.0789
		Triglycine in 1.0 ms (η_0 = 1.0425)			
0.03943	1.0209	0.04893	1.02542	0.07895	1.0409
0.04034	1.0212	0.05648	1.0293	0.10212	1.05299
		Triglycine in 1.5 ms (η_0 = 1.3644)			
0.04394	1.0282	0.06784	1.0356	0.09888	1.0518
0.05894	1.0309	0.08984	1.0471	0.11211	1.0589
		Triglycine in 2.0 ms (η_0 = 1.5877)			
0.04394	1.0278	0.06784	1.0318	0.09888	1.0484
0.05894	1.0282	0.08984	1.0423	0.11211	1.0745

		T = 308.15K			
		Triglycine in water (ϕ_0 = 0.7194)			
0.02389	1.0121	0.05698	1.0259	0.08988	1.0435
0.03833	1.0174	0.07895	1.0358	0.10211	1.0464
		Triglycine in 0.25 m_s (ϕ_0 = 0.8988)			
0.03943	1.0209	0.06789	1.0308	0.10211	1.0464
0.04593	1.0227	0.09899	1.0449	0.10458	1.0523
		Triglycine in 0.5 m_s (ϕ_0 = 0.9207)			
0.04598	1.0223	0.08988	1.0434	0.12898	1.0598
0.06894	1.032	0.10211	1.0489	0.13405	1.0645
		Triglycine in 0.75 m_s (ϕ_0 = 0.9907)			
0.03983	1.0123	0.06899	1.0348	0.10211	1.0523
0.04983	1.0289	0.08988	1.0488	0.11565	1.0598
		Triglycine in 1.0 m_s (ϕ_0 = 1.0324)			
0.04594	1.0239	0.06894	1.0359	0.09844	1.0513
0.05678	1.0296	0.08988	1.0468	0.10212	1.0558
		Triglycine in 1.5 m_s (ϕ_0 = 1.0419)			
0.04983	1.0289	0.07892	1.0449	0.10211	1.0558
0.05688	1.0323	0.08988	1.0489	0.14567	1.0823
		Triglycine in 2.0 m_s (ϕ_0 = 1.1398)			
0.03488	1.0199	0.05689	1.0398	0.08988	1.0519
0.04844	1.0283	0.06898	1.0423	0.10122	1.0621
		T =318.15K			
		Triglycine in Water (ϕ_0 = 0.5963)			
0.04898	1.0099	0.08988	1.0182	0.12898	1.0262
0.07892	1.0172	0.10211	1.0207	0.13434	1.0273
		Triglycine in 0.25 m_s (ϕ_0 = 0.8744)			
0.04898	1.0104	0.07887	1.0177	0.10232	1.0248
0.0548	1.0128	0.09982	1.0234	0.13488	1.0278
		Triglycine in 0.5 m_s (ϕ_0 = 0.8975)			
0.04898	1.0136	0.07887	1.0219	0.10232	1.0284
0.0548	1.0148	0.09982	1.0277	0.13488	1.0375
		Triglycine in 0.75 m_s (ϕ_0 = 0.9598)			
0.03892	1.0114	0.06588	1.0189	0.10211	1.03
0.04883	1.0144	0.08988	1.0264	0.12787	1.0376
		Triglycine in 1.0 m_s (ϕ_0 = 0.9928)			
0.04984	1.0171	0.05787	1.0198	0.08988	1.0308
0.05232	1.0189	0.06894	1.0236	0.10221	1.0351
		Triglycine in 1.5 m_s (ϕ_0 = 1.0082)			
0.03983	1.0138	0.06787	1.0247	0.10211	1.0388
0.04588	1.0159	0.08994	1.0327	0.12898	1.0469
		Triglycine in 2.0 m_s (ϕ_0 = 1.0236)			
0.02389	1.0117	0.05698	1.021	0.08988	1.0318
0.03833	1.0164	0.07895	1.0267	0.10211	1.0398

		KNO_3			
		T =288.15 K			
		Triglycine in 0.25 ms (◎$_0$ = 1.1628)			
0.02983	1.0169	0.05688	1.0291	0.09899	1.0507
0.03893	1.0199	0.08977	1.046	0.11211	1.0574
		Triglycine in 0.5 ms (◎$_0$ = 1.2688)			
0.03244	1.0172	0.04583	1.0239	0.08988	1.0469
0.03899	1.0203	0.06782	1.0354	0.11232	1.0586
		Triglycine in 0.75 ms (◎$_0$ = 1.4317)			
0.02822	1.0169	0.05644	1.0299	0.08933	1.0474
0.03433	1.0182	0.07895	1.0419	0.11211	1.0595
		Triglycine in 1.0 ms (◎$_0$ = 1.6074)			
0.02992	1.0189	0.05787	1.0312	0.09899	1.0534
0.03433	1.0185	0.08976	1.0484	0.11211	1.0604
		Triglycine in 1.5 ms (◎$_0$ = 1.7796)			
0.03245	1.0192	0.05894	1.0327	0.08988	1.0499
0.04544	1.0252	0.07964	1.0442	0.11211	1.0622
		Triglycine in 2.0 ms (◎$_0$ = 2.0482)			
0.04599	1.0293	0.06788	1.0398	0.10211	1.0599
0.05894	1.0346	0.08966	1.0526	0.12322	1.0723
		T = 298.15 K			
		Triglycine in 0.25 ms (◎$_0$ =0.9507)			
0.03433	1.0189	0.06788	1.032	0.10211	1.0482
0.04954	1.0234	0.08977	1.0424	0.12322	1.0582
		Triglycine in 0.5 ms (◎$_0$ =1.0207)			
0.04322	1.0234	0.06522	1.0319	0.08922	1.0436
0.05898	1.0288	0.07239	1.0354	0.10211	1.0499
		Triglycine in 0.75 ms (◎$_0$ =1.1304)			
0.03982	1.0203	0.04893	1.0245	0.08933	1.0447
0.04039	1.0202	0.05499	1.0275	0.11211	1.0589
		Triglycine in 1.0 ms (◎$_0$ =1.2734)			
0.04589	1.0238	0.06234	1.0323	0.08988	1.0466
0.05833	1.0302	0.07899	1.0409	0.11211	1.0593
		Triglycine in 1.5 ms (◎$_0$ =1.4964)			
0.05499	1.0326	0.08988	1.0469	0.10232	1.0534
0.06784	1.0354	0.09822	1.0513	0.12892	1.0698
		Triglycine in 2.0 ms (◎$_0$ =1.7588)			
0.06788	1.0361	0.08923	1.0475	0.10211	1.0543
0.07833	1.0417	0.09811	1.0522	0.12388	1.0689
		T = 308.15 K			
		Triglycine in 0.25 ms (◎$_0$ =0.7788)			
0.04238	1.0204	0.05988	1.0289	0.08922	1.043
0.04588	1.0221	0.06788	1.0327	0.11211	1.0557
		Triglycine in 0.5 ms (◎$_0$ =0.8974)			
0.04889	1.0241	0.08922	1.044	0.10232	1.0504
0.05238	1.0258	0.09821	1.0484	0.13244	1.0662
		Triglycine in 0.75 ms (◎$_0$ =0.9582)			
0.05422	1.0272	0.06788	1.034	0.10211	1.0512
0.05892	1.0295	0.08922	1.0447	0.12112	1.0623
		Triglycine in1.0 ms (◎$_0$ =1.1088)			
0.05783	1.0323	0.07682	1.0395	0.09212	1.0473
0.06232	1.032	0.08922	1.0459	0.11211	1.0576

Triglycine in1.5 ms (ϕ_0 =1.2388)					
0.06454	1.0334	0.08923	1.0467	0.12133	1.0634
0.07833	1.041	0.10211	1.0534	0.12589	1.0658
Triglycine in 2.0 ms (ϕ_0 =1.5744)					
0.06765	1.0365	0.09822	1.0529	0.12393	1.0668
0.08933	1.0481	0.10211	1.055	0.13454	1.071
T = 318.15 K					
Triglycine in 0.25 ms (ϕ_0 =0.6594)					
0.05232	1.0115	0.06239	1.0137	0.08992	1.0197
0.05994	1.0131	0.07822	1.0171	0.10212	1.0224
Triglycine in 0.5 ms (ϕ_0 =0.7743)					
0.06459	1.0157	0.08922	1.0217	0.10211	1.0248
0.07822	1.019	0.09821	1.0239	0.12898	1.0321
Triglycine in 0.75 ms (ϕ_0 =0.8394)					
0.06984	1.0192	0.09212	1.0238	0.11212	1.0289
0.08933	1.023	0.10212	1.0263	0.13455	1.0347
Triglycine in 1.0 ms (ϕ_0 =0.9894)					
0.04589	1.0119	0.05833	1.0153	0.08922	1.0234
0.05232	1.0137	0.06988	1.0183	0.10211	1.0267
Triglycine in 1.5 ms (ϕ_0 =1.1043)					
0.05422	1.0158	0.07822	1.0217	0.09813	1.0272
0.05983	1.0166	0.08921	1.0247	0.11023	1.0305
Triglycine in 2.0 ms (ϕ_0 =1.2208)					
0.04983	1.0158	0.0782	1.0249	0.10211	1.0325
0.05238	1.0167	0.08988	1.0286	0.13289	1.0454
$Mg(NO_3)_2 \cdot 6H_2O$					
T = 288.15 K					
Triglycine in 0.25 ms (ϕ_0 = 2.0564)					
0.03434	1.0198	0.05998	1.0314	0.08912	1.0466
0.04893	1.0256	0.07212	1.0377	0.11211	1.0592
Triglycine in 0.5 ms (ϕ_0 = 2.3618)					
0.03678	1.0209	0.04238	1.0228	0.08988	1.0483
0.03988	1.0214	0.05189	1.0279	0.10211	1.0549
Triglycine in 0.75 ms (ϕ_0 = 2.5886)					
0.04893	1.0289	0.07821	1.0429	0.09821	1.0539
0.05882	1.0323	0.08911	1.0489	0.12211	1.067
Triglycine in 1.0 ms (ϕ_0 = 2.7005)					
0.05678	1.0321	0.08918	1.0504	0.10211	1.0577
0.07811	1.0441	0.09821	1.0555	0.11898	1.0689
Triglycine in 1.5 ms (ϕ_0 = 3.0188)					
0.06898	1.0438	0.09821	1.0562	0.12891	1.0737
0.08922	1.051	0.10211	1.0584	0.13723	1.0785
Triglycine in 2.0 ms (ϕ_0 = 3.2788)					
0.06232	1.0378	0.08988	1.0522	0.12781	1.0743
0.07389	1.0429	0.10212	1.0593	0.13112	1.0762
T = 298.15 K					
Triglycine in 0.25 ms (ϕ_0 = 1.2608)					
0.03982	1.0209	0.05982	1.0292	0.09212	1.0449
0.04822	1.0235	0.08988	1.0439	0.11211	1.0547
Triglycine in 0.5 ms (ϕ_0 = 1.4714)					
0.04239	1.0213	0.05892	1.0296	0.10212	1.0513
0.04533	1.0228	0.08922	1.0448	0.13422	1.0689

Triglycine in 0.75 ms (η_0 = 1.5988)					
0.03289	1.0189	0.06788	1.0354	0.11328	1.0591
0.04782	1.025	0.08988	1.0469	0.11898	1.0621
Triglycine in 1.0 ms (η_0 = 1.7014)					
0.04323	1.0245	0.06898	1.0375	0.10212	1.0554
0.04893	1.0266	0.09821	1.0533	0.12891	1.0699
Triglycine in 1.5 ms (η_0 = 1.9896)					
0.05893	1.0356	0.08922	1.0506	0.10212	1.0579
0.06882	1.039	0.09821	1.0557	0.13489	1.0765
Triglycine in 2.0 ms (η_0 = 2.2815)					
0.06232	1.0378	0.08988	1.0524	0.10223	1.0596
0.07892	1.046	0.09822	1.0573	0.11778	1.0692
T = 308.15 K					
Triglycine in 0.25 ms (η_0 = 1.2489)					
0.03984	1.0188	0.06782	1.032	0.09821	1.0463
0.04588	1.0216	0.08921	1.0421	0.11212	1.0548
Triglycine in 0.5 ms (η_0 = 1.4386)					
0.04238	1.0258	0.06722	1.0329	0.08982	1.0439
0.05893	1.0288	0.07899	1.0386	0.11211	1.0569
Triglycine in 0.75 ms (η_0 = 1.5604)					
0.05488	1.0292	0.07892	1.0404	0.09823	1.0503
0.06922	1.0354	0.08921	1.0457	0.10212	1.0545
Triglycine in 1.0 ms (η_0 = 1.6678)					
0.06733	1.0378	0.08988	1.0483	0.12834	1.069
0.07823	1.0421	0.10212	1.0549	0.13102	1.0705
Triglycine in 1.5 ms (η_0 = 1.7839)					
0.03982	1.0238	0.06772	1.0374	0.09821	1.0542
0.04882	1.0269	0.08922	1.0492	0.11211	1.0619
Triglycine in 2.0 ms (η_0 = 1.9804)					
0.04898	1.0285	0.07823	1.044	0.10212	1.0575
0.06723	1.0378	0.08988	1.0506	0.12898	1.0726
T = 318.15 K					
Triglycine in 0.25ms (η_0 = 1.1688)					
0.04232	1.0093	0.07823	1.0173	0.09821	1.0217
0.05898	1.013	0.08922	1.0197	0.11212	1.0258
Triglycine in 0.5ms (η_0 = 1.2897)					
0.04893	1.0118	0.06723	1.0157	0.08922	1.0209
0.05348	1.0125	0.07232	1.0169	0.10121	1.0237
Triglycine in 0.75ms (η_0 = 1.3706)					
0.05488	1.0134	0.08982	1.022	0.10212	1.0278
0.06898	1.0169	0.09212	1.0226	0.12122	1.0297
Triglycine in 1.0 ms (η_0 = 1.4806)					
0.05988	1.0168	0.07398	1.0191	0.09821	1.0253
0.06722	1.0173	0.08988	1.0232	0.10212	1.0263
Triglycine in 1.5 ms (η_0 = 1.6014)					
0.04388	1.0119	0.07822	1.0212	0.10212	1.0277
0.05892	1.016	0.08992	1.0244	0.12892	1.0359
Triglycine in 2.0 ms (η_0 = 1.7388)					
0.04892	1.0142	0.06788	1.0192	0.09211	1.0261
0.05239	1.0148	0.08932	1.0253	0.11212	1.0317

TABLE 2: Viscosity *B*-coefficients of the studied amino acids in water and in aqueous $NaNO_3$/ KNO_3 / $Mg(NO_3)_2 \cdot 6H_2O$ solutions at T= (288.15, 298.15, 308.15 and 318.15)K.

	B-coefficients						
^am_s	0	0.25	0.5	0.75	1	1.5	2
			NaNO3				
			T = 288.15 K				
Triglycine	0.478 ± 0.004	0.492 ± 0.004	0.508 ± 0.004	0.527 ± 0.004	0.534 ± 0.004	0.545 ± 0.005	0.556 ± 0.008
			T = 298.15 K				
Triglycine	0.471 ± 0.004	0.485 ± 0.004	0.494 ± 0.004	0.515 ± 0.004	0.519 ± 0.004	0.53 ±0.002	0.543 ± 0.007
			T = 308.15 K				
Triglycine	0.463 ±0.004	0.471 ±0.004	0.474 ±0.004	0.515 ±0.004	0.527 ± 0.002	0.559 ± 0.012	0.609 ±0.051
			T = 318.15 K				
Triglycine	0.204±0.004	0.223 ±0.004	0.277 ±0.004	0.293 ±0.004	0.344 ± 0.006	0.366 ± 0.002	0.37 ± 0.005
			KNO_3				
			T = 288.15 K				
Triglycine	0.478 ± 0.04	0.513 ± 0.03	0.522 ± 0.01	0.532 ± 0.03	0.541 ± 0.03	0.556 ± 0.04	0.589 ± 0.01
			T = 298.15 K				
Triglycine	0.471 ± 0.04	0.474 ± 0.03	0.491 ± 0.03	0.511 ±0.07	0.521 ±0.02	0.532 ±0.04	0.538 ±0.08
			T = 308.15 K				
Triglycine	0.463 ±0.02	0.487 ±0.03	0.495 ± 0.03	0.505 ±0.07	0.517 ±0.02	0.522 ±0.04	0.535 ±0.02
			T = 318.15 K				
Triglycine	0.204 ±0.03	0.219 ± 0.03	0.244 ± 0.03	0.259 ±0.07	0.261 ±0.02	0.278 ±0.04	0.326 ±0.02
			$Mg(NO_3)_2 \cdot 6H_2O$				
			T = 288.15 K				
Triglycine	0.478 ±0.03	0.536 ±0.06	0.539 ±0.05	0.551 ±0.02	0.568 ±0.07	0.576 ±0.01	0.582 ±0.05
			T = 298.15 K				
Triglycine	0.471 ±0.03	0.489 ±0.02	0.506 ±0.07	0.523 ±0.01	0.543 ±0.08	0.569 ±0.03	0.586 ±0.02
			T = 308.15 K				
Triglycine	0.463 ±0.02	0.488 ±0.02	0.501 ±0.06	0.518 ±0.05	0.539 ±0.04	0.553 ±0.07	0.563 ±0.05
			T = 318.15 K				
Triglycine	0.204 ±0.07	0.223 ±0.06	0.234 ±0.06	0.25 ±0.06	0.259 ±0.07	0.273 ±0.06	0.283 ±0.07

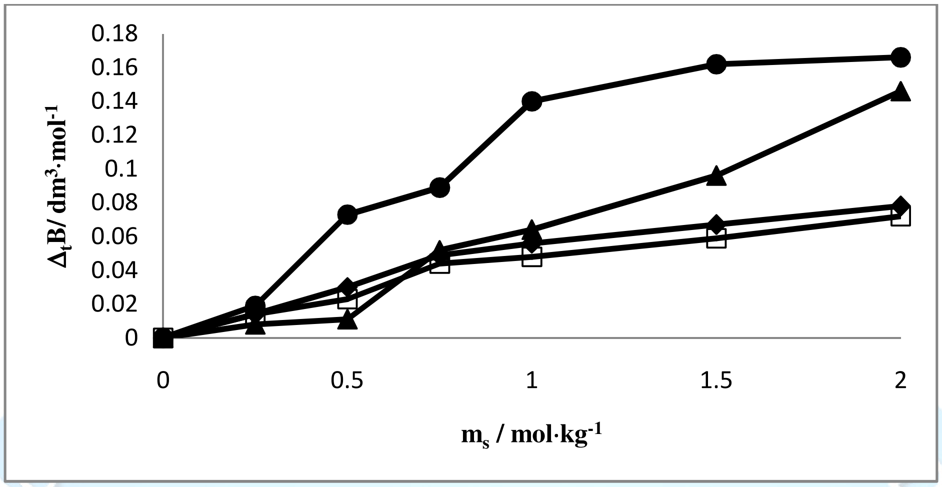

FIGURE 2. Viscosity B-coefficient of transfer $\Delta_t B$ of Triglycine vs concentration of aqueous sodium nitrate, m_s at T = ♦, 208.15 K; , 298.15 K; ▲, 308.15 K ; •, 318.15 K.

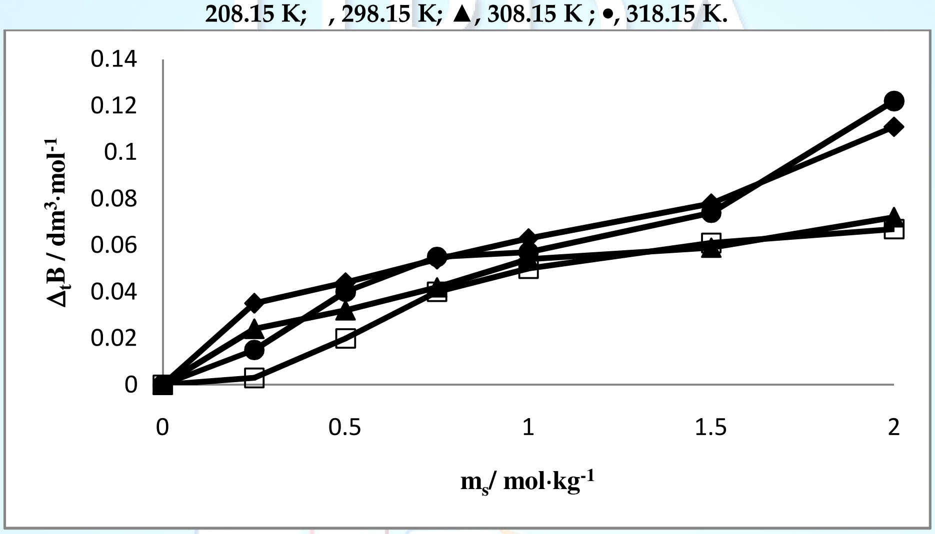

FIGURE 3. Viscosity B-coefficient of transfer $\Delta_t B$ of Triglycine vs concentration of aqueous potassium nitrate, m_s at T = ♦, 208.15 K; , 298.15 K; ▲, 308.15 K ; •, 318.15 K.

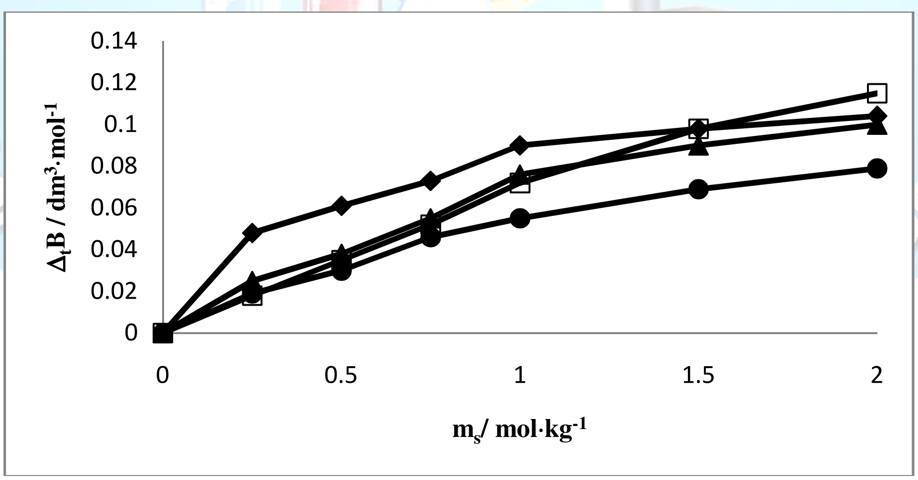

FIGURE 4. Viscosity B-coefficient of transfer $\Delta_t B$ of triglycine vs concentration of aqueous magnesium nitrate hexahydrate m_s at T = ♦, 208.15 K; , 298.15 K; ▲, 308.15 K ; •, 318.15 K.

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