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RESEARCH ARTICLE

ULTRASONIC CHARACTERIZATION ON GLUCOSE IN AQUEOUS VITAMIN C SOLUTION

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ABSTRACT

Glucose and Vitamin C both are important for human body as well as plants and all living creature. The value of velocity, density of glucose at different concentration 0.02-0.2 Min the solution aqueous vitamin C solution of 0.2M concentration at different temperature 283.15K-298.15K has been measured. By using the velocity and density other acoustical, thermodynamical and volumetric parameter also calculated like free length (Lf), Wada's constant(W), Rao's constant(R), internal pressure(π_i), Viscosity(η), apparent molar volume (V_ψ), adiabatic compressibility(β), acoustic impedance(Z), relative association(R_A) and Relaxation Strength(r). Variation in this all parameter with respect to change in molality and temperature exhibit the existence of intermolecular interaction. And this all parameter shows the solute-solvent interaction.

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INTRODUCTION

Carbohydrates are the most important source of energy in the living creature and it is mostly consumed by the humans. It performs an important role in humans to regulating of living throughout biologically based cycle (Sanjeevan, 2022). And carbohydrates are the building blocks in living creature. Its molecules are the saccharides and they play a major role not only for livings but also in chemical process. Mono and Di-Saccharides are called to improve the form of water so it is behaved as a steadying agent for enzymes and protein (Tanu Sharma, 2022). Glucose is the example of saccharides and it is the simplest form of carbohydrate. Glucose is a simplest form of sugar which has mol. formula $C_6H_{12}O_6$. The morpheme "-ose" is chemical classifier which indicates that the it belongs to a carbohydrates group. It has 6 carbon atoms and it is classified as a hexose, a sub group of monosaccharides. Glucose is made in plant during the photosynthesis process from water, carbon dioxide, in the presence of sunlight. Glucose is an omnipresent fuel in biology. It is boost up the energy level in the most organisms like bacteria, humans, etc. Glucose is the human body's key source of energy (Dikko, 2015). Glucose presents in the human blood and it gives energy to the cells for metabolism. In blood, Glucose contains intercellular fluid, interstitial fluids (ISF), tears, saliva and urine (Liu Tang, 2020). Glucose is the main resource of energy for the brain and other cells, hence it's obtainability effects psychological process.

When it is low, psychological process to required mental efforts like self-control, wrong decision making is harmed (Liu Tang, 2020). As much as carbohydrate/glucose/saccharides important for body likewise vitamins also essential for living organisms. Carbohydrates/Glucose gives energy to the cell like that vitamins mandatory to balance the normal cellular and metabolic function of humans and animals body and it is a wide group of organic compounds. Vitamins are natural constituent of food and well-balanced diet supplies of all the required vitamins (Saad Antalki, 2015). Vitamins are a well-known group of compounds that are essential for human health. Organic chemical compound is called vitamins. Vitamins are as so many like vitamin A, B, B2, B5, B6, B9, B12, C (ascorbic acid), D and E. Ascorbic acid is a vitamin C. It is a colorless and dissolvable vitamin. The structure of L-ascorbic acid was first discovered by scientist Norman Haworth and for that he got a noble price in 1937 (Dudhe, 2016). Ascorbic acid is essential to development of brain of unborn baby. It is also playing an important role in the health of adults like: boosting immunity power, repairs damage tissues etc. while its deficiency can cause major effect on the human brain progress, which cannot be remediable after birth and vitamin C supplementation (Dudhe, 2014). Other than this all information we can also find the other parameters by using ultrasonic technique. The investigation of molecular nature and physic-chemical behavior of various liquid and their mixtures can be assessed by using ultrasonic characterization (Samuel, 2015). Ultrasonic method generally involves measuring the ultrasonic velocity of pure solution or mixture at different temperature and concentration (Mustafa Vatondas, 2006).

Ultrasonic studies helps to characterizing acoustical, volumetric, elastic and thermodynamics behavior of various liquid mixtures. Ultrasonic waves propagates with frequency above 20kHz (Neha Sawhney, 2014). So, by investigating we can find other acoustical, thermodynamic and volumetric parameters like thermal conductivity, Enthalpy, Specific heat ratio, adiabatic compressibility, Viscosity, Surface tension etc. and byusing ultrasonic we can also find the inter molecular interaction between saccharides and vitamins at different temperature and concentration. So, presented work is focused to understand the interaction of glucose and vitamins at different concentration 0.02- 0.2 mol/kg and different temperature 283.15K to 298.15K.Glucose is one of the compound produced in plants after the disintegration of carbohydrates into mono and disaccharides. After the whole process of citric acid cycle and oxidative phosphorylation, the oxidation of glucose eventually form CO_2 and water, through which most energy release in the form of ATP(3). The interaction of glucose and vitamin C regulates bloodsugar level in human body.

MATERIAL AND METHOD

Materials: AR grade chemicals such as Glucose (CAS no.: 50-99-7) those have mol. formula $C_6H_{12}O_6$ with mol. weight 180.16 g/mol and Ascorbic acid known as vitamin C (CAS no.: 50-81-7) having molecular weight is 176.12 g/mol, were access from Himedia Laboratory Private Limited, Mumbai. All compounds were used without processing. The concentration (0.02-0.2 mol/kg) of ascorbic acid in 0.2M aq. glucose solution were different by weight. All the beakersand other equipment's was clean with double distilled water and acetone. All the equipment' sdried before use (Paritosh, 2021).

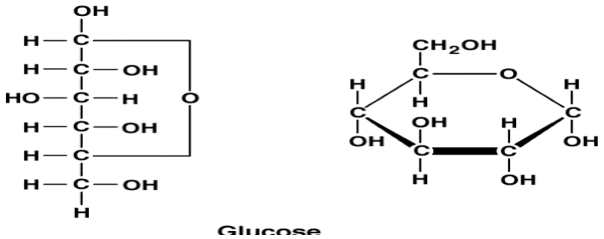

Fig 1(a). Structure of Glucose

Method

Table 1. Apparatus/Instruments used to complete the experimental work Company Mumbai

Sr. No.	Apparatus	Description	Supplier	Precision
1	Analog Velocity	Operates at 2MHz	Mittal Enterprises	
	interferometer	Frequency	Pvt. Ltd., New	0.0001m/s
		(Model F-81)	Delhi	
2	Specific Gravity Density Bottle	Density of mixture analyzed perfectly	Kings group Mumbai,	$\pm 2*10^{-2}$ kg/m^3
			Maharashtra	
3	Digital Electronic	Contech CA-34	WensarCompany	±0.0001gm
	Balance			
4	Thermostatic Water	Regulating	Lab-Hosp	±1K
	Bath	temperature of Water	instrumental	temperature

Table 3. Used Abbreviations

kHz	Kilo Hertz
ATP	Adenosine Triphosphate
CAS	Chemical Abstract Service
M	Molal Concentration in mol./kg
MHz	Mega Hertz

Defining Relation: Ultrasonic Velocity was deliberate by using pulse Echo overlap technique in 2MHz. The interferometer was stuffed with the test solution and the temperature of the interferometer was maintain with the help of thermostat which circulate the water around the cell ofinterferometer (Dudhe, 2014).

From experimental value we can calculate the velocity, density of given solution but also, we can find the other volumetric, acoustical and thermodynamical parameterby using following standard formulas:

- Adiabatic compressibility $(\beta) = \frac{1}{U^2\rho}$
- Acoustic Impedance$(Z) = U\rho$
- Relative Association $(R_A) = \{(\rho/\rho_0)(U_0/U)^{1/3}\}$
- Internal Pressure$(\pi_i) = \{\frac{T*\alpha}{K_T}\}$, Where α is the Thermal Expansion Coefficient and K_T is the Isothermal Compressibility
- Free Length $(L_f) = K(\beta)^{1/2}$, Where K is the Jacobian temperature dependent constant.
- Wada's constant$(W) = V_m\beta^{-1/7}$
- Rao's constant$(R) = V_mU^{1/3}$
- Viscosity$(\eta) = (Meff \times \rho^2)\text{^}1/3 \times U^3/K^* Ug^2$
- Apparent molar volume$(V_\psi) = \{\frac{M}{\rho} - [\frac{1000(\rho-\rho_0)}{m\rho\rho_0}]\}$
- Relaxation Strength(r) = $\{1-(\frac{U}{U_\infty})^2\}$, Where U_∞ = 1600 m/s

RESULT AND DISCUSSION

The knowing of molecular interaction between a solute and solvent and the packing efficiency of solute within the structure of solvents have been studied in aqueous and mixed aq. solutions (Vickramjeet Singh, 2015). When the glucose is dissolved in water, the volume of solution is almost equal to the sum of volume of crystal sugar and water (Shakeel Ahmad, 2004).

Ultrasonic velocity: The ultrasonic velocity of the water was measured at various temperatures (283.15K, 288.15K, 293.15k and 298.15K) and the calculated value given in *Table 2*. And after equatingthe calculated value and literature value it observed that the result is almost equal to the literature data. The ultrasonic velocity of Glucose at different concentration 0.02-0.2 M in thesolution aqueous vitamin C solution of 0.2M concentration at different temperature 283.15K- 298.15K were measured and given in Table-4.

It is examining that temperature and concentration affect the ultrasonic wave in existing system (Glucose + Water + Vitamin C). The observed data shows that the ultrasonic velocity ofthe solution is rising with increase in molarity and temperature shown in Fig. 2. So, by increasing carbohydrates concentration in the aqueous vitamin C solution the ultrasonic velocity increases (Shakeel Ahmad, 2004). It is observed that molecularassociation is accountable for this alteration. This alliance is due to the Hydrogen bonding between solute and solvent molecules (Neha Sawhney, 2014).

Free Length: Free length is a thermodynamical parameter because it is depending on the temperature i.e., Jacobian temperature dependent constant. The free length of the glucose and aqueous vitamin C solution at different concentration (0.02-0.2M) at different temperature (283.15-298.15K) is decrease with respect to increase in molarity and temperature that *Fig. 4*shows, because concentration of solute indicate that the intermolecular interaction between solute and solvent suggest the arrangement after adding the solute and increase in temperature shows that the spacing in the structure [14].

Density: The density of water was measured at various temperatures 283.15K, 288.15K, 293.15K and 298.15K and calculated value given in Table 2. And after comparing the calculated value and literature value it observed that the result is almost equal to the density ofwater at literature data. Density of glucose at different concentration 0.02-0.2M in the solution aqueous vitamin C solution at 0.2M of concentration. The observed data shows that density ofthe solution is rising with increase in concentration of Glucose in the solution of aq. vitamin C at different temperature but the density is fall off with increases in temperature for same molarity depicted in *Fig. 3*. The relationship between concentration and density for this particular is a linear one (Dikko, 2015).

Internal Pressure: Internal pressure is useful to understand the intermolecular interaction and structure ofthe solution. *Fig. 5* shows that the, internal pressure of the glucose at different temperature (283.15-298.15 K) at different concentration (0.02-0.2M) is increase with increase in temperature and molarity.

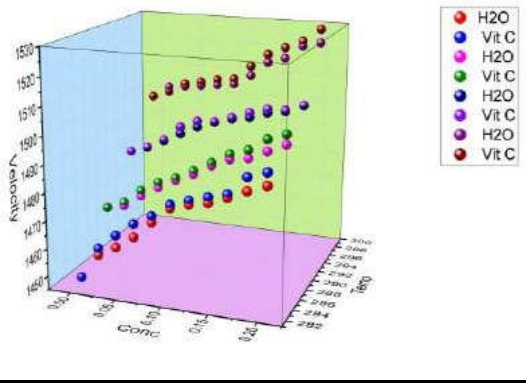

Fig. 2. Ultrasonic velocity at different temperature and concentration

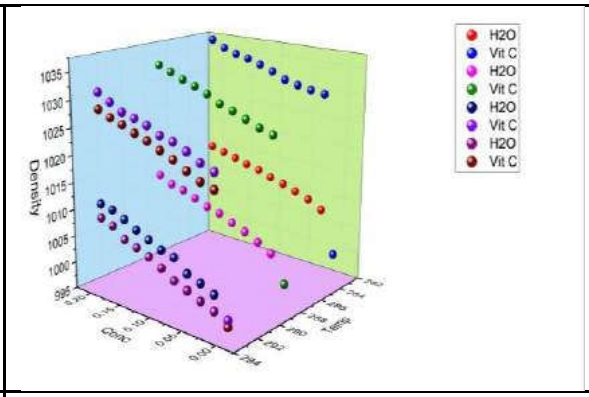

Fig. 3. Density at different temperature and Concentration

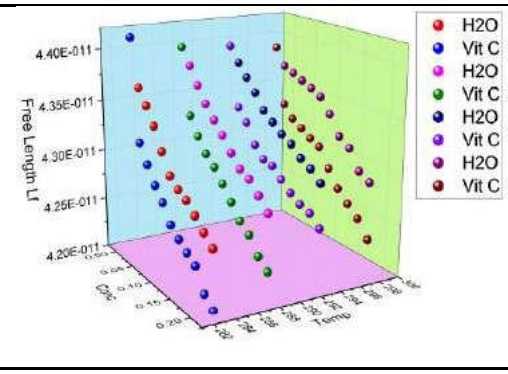

Fig. 4. Free length at different temperature and concentration

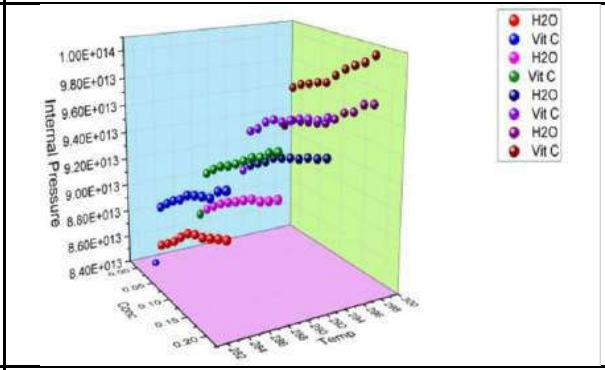

Fig. 5. Internal pressure at different temperature and concentration

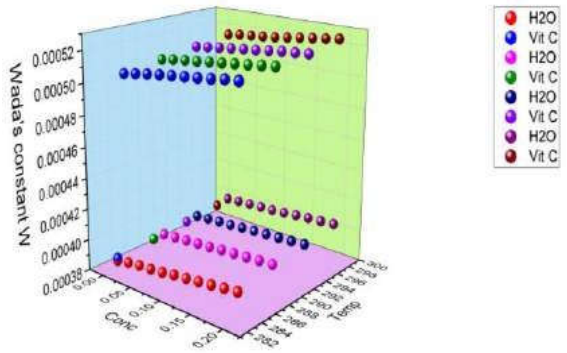

Fig. 6. Wada's Constant at different temperature and concentration

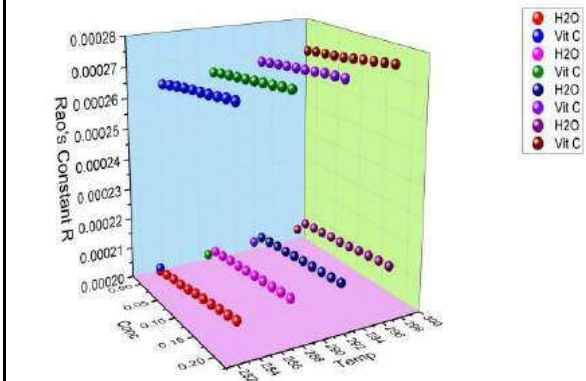

Fig. 7. Rao's constant at different temperature and concentration

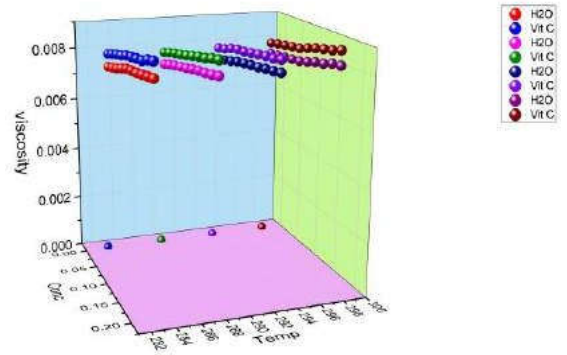

Fig. 8. Viscosity at different temperature and concentration

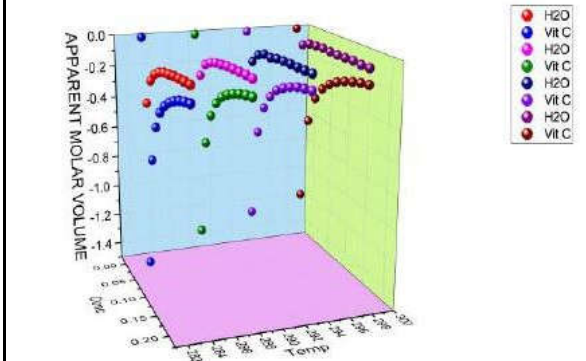

Fig. 9. Apparent Molal Volume at different temperature and concentration

This indicate that the binding force between solute and solvent is become stronger and it shows that there is strong intermolecular interaction (Anita Kunwar and Pritee Mhatre, 2014).

Wada's Constant: Wada's Constant also called as molar compressibility.

Fig. 6 indicate that the Wada's constant increase with arising in temperature of 283.15-298.15K and also increase with respect to increase in molality of mixture. The increasing trend shows that the availability of more components and closely packing of medium and there is an increasing the interaction (Nithiyanantham, 2010).

Table 4. The value of velocity, density and Specific heat at different concentration of glucose + 0.2M aqueous solution of vit C at different temperatures (282.15K-298.15K)

Conc.	Velocity(m/s)		Density (Kg/m^3)		Free Length(m)	
	H_2O	Vitamin C	H_2O	Vitamin C	H_2O	Vitamin C
	283.15 K					
0	1447.4	1447.4	999.7	999.7	4.41237E-11	4.41237E-11
0.02	1456.6	1459.3	1007.736	1029.794	4.36707E-11	4.31294E-11
0.04	1460.2	1464.6	1009.1179	1030.112	4.3532E-11	4.29566E-11
0.06	1464.8	1469.6	1010.0545	1030.630	4.33747E-11	4.27991E-11
0.08	1471.6	1473.2	1010.878	1031.241	4.31741E-11	4.26813E-11
0.1	1476.9	1478.1	1011.5554	1032.397	4.29884E-11	4.25177E-11
0.12	1479.0	1480.4	1012.4389	1033.327	4.29075E-11	4.24332E-11
0.14	1480.3	1482.3	1012.9835	1034.097	4.2858E-11	4.23624E-11
0.16	1482.9	1484.1	1013.6875	1034.628	4.27683E-11	4.23002E-11
0.18	1485.9	1490.6	1014.3517	1035.451	4.26691E-11	4.20971E-11
0.2	1488.5	1493.2	1014.9694	1036.747	4.25822E-11	4.2005E-11
	288.15 K					
0	1466.0	1466.2	999.103	999.103	4.398E-11	4.398E-11
0.02	1467.6	1468.8	1004.0106	1025.456	4.38249E-11	4.33291E-11
0.04	1472.2	1474.3	1005.3395	1026.160	4.36657E-11	4.31618E-11
0.06	1476.8	1477.8	1006.5368	1027.206	4.35214E-11	4.3028E-11
0.08	1479.4	1480.2	1007.4775	1028.173	4.34011E-11	4.29389E-11
0.1	1482.3	1483.6	1008.5235	1028.989	4.32937E-11	4.28229E-11
0.12	1486.2	1487.2	1009.1221	1030.291	4.31673E-11	4.26928E-11
0.14	1489.2	1491.2	1010.076	1031.298	4.306E-11	4.25632E-11
0.16	1490.2	1493.2	1010.9904	1032.074	4.30117E-11	4.24845E-11
0.18	1493.4	1497.6	1011.5101	1033.087	4.29085E-11	4.23378E-11
0.2	1496.3	1500.0	1012.6943	1034.002	4.2798E-11	4.22525E-11
	293.15 K					
0	1481.4	1481.4	998.2000	998.2	4.39E-11	4.39423E-11
0.02	1483.6	1483.8	1001.794	1022.713	4.38012E-11	4.33451E-11
0.04	1486.8	1487.2	1002.878	1023.572	4.36833E-11	4.32278E-11
0.06	1490.2	1492.8	1003.717	1024.887	4.35654E-11	4.3038E-11
0.08	1493.4	1495.6	1005.798	1025.951	4.34265E-11	4.29352E-11
0.1	1495.8	1496.9	1006.307	1026.460	4.33464E-11	4.2913E-11
0.12	1497.6	1498.2	1007.391	1027.649	4.3271E-11	4.28252E-11
0.14	1498.8	1500.6	1008.368	1028.361	4.32154E-11	4.27418E-11
0.16	1501.0	1502.4	1009.617	1028.951	4.31242E-11	4.26785E-11
0.18	1502.2	1502.6	1010.661	1030.226	4.30687E-11	4.26464E-11
0.2	1504.9	1505.4	1011.104	1031.535	4.29808E-11	4.25514E-11
	298.15 K					
0	1498.1	1498.1	997	997	4.38788E-11	4.38788E-11
0.02	1502.4	1500.6	998.8176	1019.743	4.37134E-11	4.33145E-11
0.04	1503.2	1504.2	999.6707	1020.412	4.36715E-11	4.31967E-11
0.06	1504.3	1505.4	1000.707	1021.607	4.36257E-11	4.3137E-11
0.08	1504.8	1506.8	1001.593	1022.893	4.35832E-11	4.30698E-11
0.1	1505.6	1507.6	1003.010	1023.897	4.35293E-11	4.30258E-11
0.12	1509.4	1513.1	1004.277	1024.966	4.33923E-11	4.28499E-11
0.14	1515.2	1518.6	1005.143	1025.760	4.32133E-11	4.26922E-11
0.16	1517.3	1521.4	1005.891	1026.738	4.31402E-11	4.25877E-11
0.18	1522.0	1523.8	1007.663	1027.466	4.29607E-11	4.24944E-11
0.2	1523.6	1528.6	1008.463	1028.451	4.28985E-11	4.23407E-11

Table 5. The value of Internal pressure, Wada's constant and Rao's constant at different concentration of glucose + 0.2M aq. solution of vit C at various temperatures (282.15K

Conc.	Internal Pressure (Nm^{-2})		Wada's Constant (m^3mole^{-1})(ms^{-1})$^{-1/7}$		Rao's Constant (m^3mole^{-1})(ms^{-1})$^{1/3}$	
	H_2O	Vitamin C	H_2O	Vitamin C	H_2O	Vitamin C
	283.15 K					
0	8.40197E+13	8.40197E+13	0.000384941	0.000384941	0.000202936	0.000202936
0.02	8.59228E+13	8.88549E+13	0.000386794	0.000507133	0.000203735	0.000266316
0.04	8.64666E+13	8.94961E+13	0.000388033	0.000508691	0.000204374	0.000267172
0.06	8.70596E+13	9.00977E+13	0.000388678	0.000510103	0.000204715	0.000267938
0.08	8.78074E+13	9.05624E+13	0.000389875	0.000511335	0.000205363	0.000268594
0.1	8.85044E+13	9.12286E+13	0.000391339	0.000512456	0.000206153	0.000269182
0.12	8.88388E+13	9.15915E+13	0.000392451	0.000513417	0.000206728	0.000269671
0.14	8.90442E+13	9.18965E+13	0.000393612	0.000514409	0.000207332	0.000270185
0.16	8.94051E+13	9.21589E+13	0.000394815	0.000515489	0.000207963	0.000270744
0.18	8.98009E+13	9.29785E+13	0.000396059	0.000516913	0.000208618	0.000271518
0.2	9.01517E+13	9.33985E+13	0.000397288	0.000517722	0.000209265	0.000271914
	288.15 K					

Continue ….

0	8.71922E+13	8.71922E+13	0.000388394	0.000388394	0.000204892	0.000204892
0.02	8.79663E+13	9.07684E+13	0.000394643	0.000509946	0.000208054	0.000268041
0.04	8.85918E+13	9.14192E+13	0.000395403	0.000511338	0.000208445	0.000268771
0.06	8.91637E+13	9.19679E+13	0.000396177	0.000512371	0.000208844	0.000269328
0.08	8.96422E+13	9.23492E+13	0.000396991	0.000513329	0.000209268	0.000269817
0.1	9.00821E+13	9.28272E+13	0.000397729	0.000514455	0.000209646	0.000270407
0.12	9.05734E+13	9.33868E+13	0.000398694	0.000515387	0.000210163	0.000270879
0.14	9.10153E+13	9.39346E+13	0.000399469	0.000516466	0.000210563	0.000271441
0.16	9.12392E+13	9.42777E+13	0.000400103	0.000517484	0.000210877	0.000271966
0.18	9.16496E+13	9.49007E+13	0.000401038	0.000518628	0.000211376	0.000272564
0.2	9.21219E+13	9.52819E+13	0.000401733	0.000519591	0.000211725	0.000273067
293.15 K						
0	9.00614E+13	9.00616E+13	0.000389862	0.000389862	0.000205796	0.000205796
0.02	9.07458E+13	9.34645E+13	0.000396616	0.000512603	0.000209268	0.000269671
0.04	9.12283E+13	9.39508E+13	0.000397369	0.000513714	0.000209654	0.000270253
0.06	9.17023E+13	9.47429E+13	0.000398219	0.000514845	0.000210101	0.000270846
0.08	9.23198E+13	9.51939E+13	0.000398632	0.000515805	0.000210278	0.000271335
0.1	9.26438E+13	9.53054E+13	0.000399513	0.000516767	0.000210743	0.000271826
0.12	9.29806E+13	9.57077E+13	0.000400154	0.000517611	0.000211061	0.000272244
0.14	9.32391E+13	9.60715E+13	0.000400784	0.000518677	0.000211372	0.000272797
0.16	9.36472E+13	9.63504E+13	0.000401399	0.000519741	0.000211674	0.000273351
0.18	9.39113E+13	9.65421E+13	0.000402001	0.000520346	0.000211968	0.000273622
0.2	9.42697E+13	9.69863E+13	0.000402927	0.000521152	0.000212462	0.000274017
298.15 K						
0	9.30671E+13	9.30671E+13	0.000391509	0.000391509	0.000206811	0.000206811
0.02	9.37766E+13	9.63696E+13	0.000399063	0.000515538	0.000210775	0.000271473
0.04	9.39776E+13	9.68646E+13	0.000399713	0.000516753	0.000211098	0.000272119
0.06	9.42034E+13	9.71607E+13	0.000400298	0.000517503	0.000211381	0.000272478
0.08	9.44093E+13	9.74925E+13	0.000400934	0.000518235	0.000211695	0.000272824
0.1	9.46867E+13	9.77188E+13	0.000401387	0.000519028	0.000211897	0.000273209
0.12	9.52755E+13	9.84777E+13	0.000402118	0.000520232	0.000212275	0.000273852
0.14	9.60121E+13	9.91566E+13	0.000403122	0.000521522	0.000212812	0.000274544
0.16	9.63355E+13	9.96342E+13	0.000403892	0.000522535	0.000213209	0.000275066
0.18	9.71337E+13	1.00056E+14	0.000404537	0.000523635	0.000213529	0.000275641
0.2	9.74222E+13	1.00745E+14	0.000405256	0.000524819	0.000213895	0.000276268

Table 6. The value of viscosity, apparent molal volume and adiabatic compressibility at different concentration in glucose + 0.2 M aqu. solution of vit C at different temperatures (282.15K-298.15K)

Conc.	Viscosity ($Kgm^{-1}s^{-1}$)		Apparent Molal Volume ((m^3mole^{-1}))		Adiabatic Compressibility (m^2N^{-1})	
	H_2O	Vitamin C	H_2O	Vitamin C	H_2O	Vitamin C
	283.15 K					
0	5.36994E-05	5.36994E-05	0	0	4.77466E-10	4.77466E-10
0.02	0.007502068	0.00798734	-0.3986565	-1.4614297	4.67706E-10	4.56183E-10
0.04	0.007603065	0.008105055	-0.2332117	-0.7381336	4.64742E-10	4.52536E-10
0.06	0.007711511	0.008217928	-0.1707301	-0.5001643	4.61388E-10	4.49224E-10
0.08	0.007844309	0.008310315	-0.1380848	-0.3822657	4.57131E-10	4.46755E-10
0.1	0.007970228	0.008436256	-0.1170569	-0.3166321	4.53207E-10	4.43336E-10
0.12	0.008041294	0.008514448	-0.1047069	-0.2710951	4.51502E-10	4.41575E-10
0.14	0.008092007	0.008583476	-0.0935164	-0.2374922	4.50461E-10	4.40103E-10
0.16	0.008167542	0.008645525	-0.0860897	-0.2108877	4.48577E-10	4.38811E-10
0.18	0.008248925	0.008798656	-0.0800932	-0.1917422	4.46499E-10	4.34608E-10
0.2	0.008323564	0.008888873	-0.0750662	-0.1785522	4.44682E-10	4.32709E-10
	288.15 K					
0	5.46355E-05	5.46355E-05	0	0	4.65696E-10	4.65696E-10
0.02	0.007451971	0.007903178	-0.2444399	-1.2859471	4.62416E-10	4.52014E-10
0.04	0.007562263	0.008019752	-0.1550446	-0.6596091	4.59062E-10	4.48528E-10
0.06	0.007665349	0.008122466	-0.1230237	-0.4562223	4.56034E-10	4.45752E-10
0.08	0.007754876	0.008200282	-0.1038189	-0.3535674	4.53517E-10	4.43908E-10
0.1	0.007839504	0.008293054	-0.0933142	-0.2905292	4.51276E-10	4.41513E-10
0.12	0.007931529	0.008399964	-0.0826336	-0.2523176	4.48644E-10	4.38835E-10
0.14	0.008017396	0.008505267	-0.0774881	-0.2230136	4.46416E-10	4.36175E-10
0.16	0.008070641	0.008578917	-0.0733765	-0.1996734	4.45414E-10	4.34563E-10
0.18	0.008151685	0.008697343	-0.0680272	-0.1827472	4.43279E-10	4.31567E-10
0.2	0.008244164	0.008778283	-0.0669871	-0.1687352	4.40999E-10	4.29829E-10
	293.15 K					
0	5.51824E-05	5.51824E-05	0	0	4.56438E-10	4.56438E-10
0.02	0.007507944	0.007936543	-0.1795468	-1.2004581	4.53511E-10	4.44115E-10
0.04	0.007595373	0.008027025	-0.1166476	-0.6206556	4.51073E-10	4.41715E-10
0.06	0.007681745	0.008164023	-0.0916003	-0.4346024	4.48642E-10	4.37845E-10
0.08	0.007791738	0.008251073	-0.0944262	-0.3385545	4.45785E-10	4.35755E-10
0.1	0.007856972	0.008286927	-0.0805322	-0.2756455	4.44142E-10	4.35306E-10

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0.12	0.007925494	0.008367717	-0.0759889	-0.2390673	4.42599E-10	4.33526E-10
0.14	0.007982674	0.008442257	-0.0719835	-0.2097574	4.41462E-10	4.31838E-10
0.16	0.008062686	0.008504086	-0.0706306	-0.1869503	4.39601E-10	4.30562E-10
0.18	0.008121432	0.008554304	-0.0684472	-0.1728424	4.38469E-10	4.29913E-10
0.2	0.008193336	0.008643318	-0.0637509	-0.1616964	4.36682E-10	4.27999E-10
298.15 K						
0	5.58177E-05	5.58177E-05	0	0	4.46913E-10	4.46913E-10
0.02	0.007591429	0.007994178	-0.0910811	-1.1183369	4.43557E-10	4.35491E-10
0.04	0.007637905	0.008083966	-0.0668104	-0.5751606	4.42773E-10	4.33125E-10
0.06	0.007688366	0.008146747	-0.0617539	-0.4024763	4.41771E-10	4.31929E-10
0.08	0.007735971	0.008215153	-0.0573176	-0.3171972	4.40911E-10	4.30585E-10
0.1	0.007794809	0.008268062	-0.0599274	-0.2633083	4.39825E-10	4.29706E-10
0.12	0.007897847	0.008399029	-0.0603866	-0.2278882	4.37057E-10	4.26199E-10
0.14	0.008022079	0.008518818	-0.0578638	-0.2007021	4.33458E-10	4.23068E-10
0.16	0.008087599	0.008610086	-0.0552336	-0.1813946	4.31994E-10	4.21000E-10
0.18	0.008224211	0.008693088	-0.0587872	-0.1650557	4.28406E-10	4.19157E-10
0.2	0.008285707	0.008817132	-0.0568294	-0.1531902	4.27167E-10	4.16138E-10

Table 7. The value of Acoustic Impedance, Relative Association and Relaxation strength at different concentration in glucose + 0.2 M aq. solution of vit C at different temperatures (282.15K-298.15K)

Conc.	Acoustic Impedance (Kg-m^{-2}s^{-1})		Relative association		Relaxation Strength	
	H_2O	Vit C	H_2O	Vit C	H_2O	Vit C
	283.15 K					
0	1446992.77	1446992.77	1	1	0.18162307	0.18162307
0.02	1467868.25	1502469.44	1.008642058	1.027372155	0.17121735	0.16848398
0.04	1473554.32	1508743.97	1.009185253	1.026369075	0.16706997	0.16204284
0.06	1479582.37	1514676.56	1.009060236	1.025714762	0.16179795	0.15628886
0.08	1487062.19	1519307.62	1.008460784	1.025481565	0.15468065	0.15212736
0.1	1493986.40	1526009.01	1.007800139	1.025508479	0.14793254	0.14654506
0.12	1497457.87	1529737.43	1.008193649	1.025905422	0.14546153	0.14391243
0.14	1499589.37	1532863.40	1.008438557	1.026226826	0.14394829	0.14169039
0.16	1503258.01	1535513.29	1.008551339	1.026338818	0.14094907	0.13960461
0.18	1507245.47	1543538.17	1.008541601	1.025653513	0.13751631	0.13198169
0.2	1510781.95	1547884.90	1.008572373	1.026393031	0.13451865	0.12925440
288.15 K0						
0	1464716.96	1464716.96	1	1	0.16044928	0.16044928
0.02	1473509.04	1506200.90	1.004548745	1.025729789	0.15862606	0.15726452
0.04	1479859.74	1512560.57	1.004880372	1.025227749	0.15360000	0.15129843
0.06	1485648.31	1518036.58	1.005167471	1.025385456	0.14899375	0.14688222
0.08	1490462.21	1521902.56	1.005335545	1.025802773	0.14506860	0.14414373
0.1	1494934.38	1526629.10	1.005722593	1.025827143	0.14171355	0.14018425
0.12	1499757.26	1532250.11	1.005438518	1.026300909	0.13719123	0.13602975
0.14	1504205.17	1537665.91	1.005712696	1.026430038	0.13370443	0.13160898
0.16	1506577.89	1541093.79	1.006397924	1.026697844	0.13254060	0.12904443
0.18	1510589.18	1547193.61	1.006195556	1.026689159	0.12881110	0.12385719
0.2	1515375.49	1551003.30	1.006704371	1.027058694	0.12533081	0.12109375
293.15 K						
0	1478829.307	1478829.30	1	1	0.14264437	0.14264434
0.02	1486262.32	1517502.88	1.003126331	1.024027529	0.14020743	0.13997560
0.04	1491079.159	1522257.61	1.003490408	1.024106012	0.13649443	0.13602975
0.06	1495739.52	1529952.50	1.003565722	1.024137755	0.13254060	0.12951100
0.08	1502079.745	1534413.21	1.004923421	1.024560598	0.12878777	0.12624243
0.1	1505234.609	1535584.75	1.004898244	1.024977339	0.12600873	0.12577514
0.12	1508668.911	1539624.93	1.005577224	1.025662491	0.12390430	0.12320185
0.14	1511343.307	1543171.87	1.006284562	1.025833722	0.12249943	0.12039048
0.16	1515476.703	1545896.58	1.007029452	1.026003714	0.11987457	0.11827968
0.18	1518216.156	1548018.63	1.007811231	1.027229781	0.11851373	0.11804423
0.2	1521651.606	1552460.17	1.007640412	1.027987255	0.11529515	0.11522460
298.15 K						
0	1493606.69	1493606.69	1	1	0.12331773	0.12331773
0.02	1500623.56	1530227.09	1.000866615	1.022243846	0.11827954	0.11739048
0.04	1502704.99	1534904.93	1.001543724	1.022098088	0.11733975	0.11616498
0.06	1505064.08	1537927.32	1.002404672	1.023022389	0.11642091	0.11475423
0.08	1507197.59	1541295.44	1.003114149	1.023992936	0.11545975	0.11310693
0.1	1510132.91	1543627.26	1.004355756	1.024816583	0.11451901	0.11216493
0.12	1515855.83	1550774.76	1.004779234	1.024665299	0.11004360	0.10579335
0.14	1522792.14	1557104.89	1.004405258	1.024331938	0.10342773	0.09987343
0.16	1525937.25	1561669.25	1.004710886	1.024633731	0.10105898	0.09631210
0.18	1533663.23	1565653.91	1.005377151	1.024732116	0.09512343	0.09298185
0.2	1552460.17	1572090.31	1.005823501	1.024639046	0.09321993	0.08725860

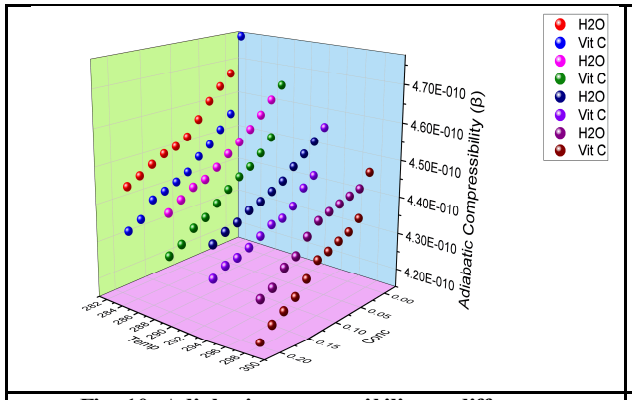

Fig. 10. Adiabatic compressibility at different temperature and concentration

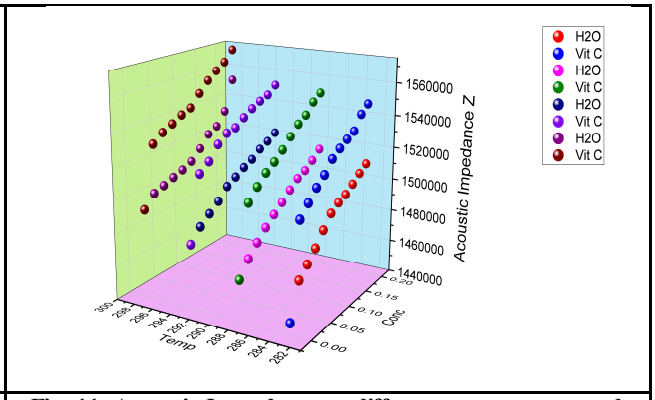

Fig. 11. Acoustic Impedance at different temperature and concentration

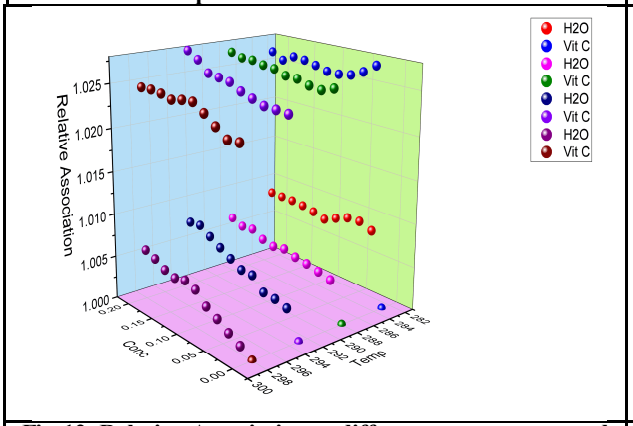

Fig 12: Relative Association at different temperature and concentration

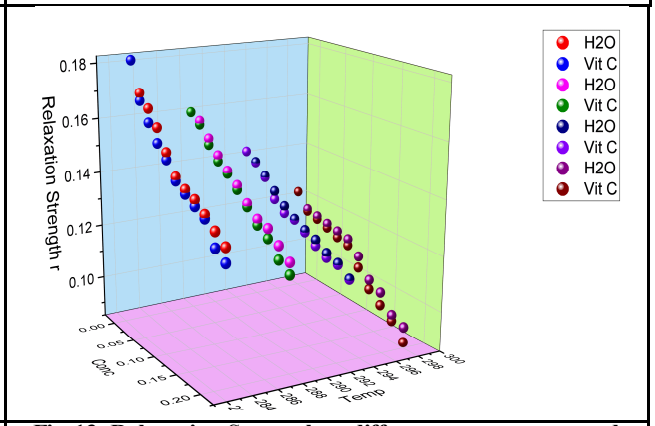

Fig 13: Relaxation Strength at different temperature and concentration

Rao's Constant: Fig. 7 shows that the solution of Glucose and Vitamin C at 0.2 M of different concentration (0.02-0.2M) and different temperature (283.15-298.15 M) is increasing with rising in temperature and concentration because the atoms are closely packed (Manisha Lamba, 2023). And Rao' constant also called as sound molar velocity.

Viscosity: Viscosity is the important parameter which shows the strong bond between two components. The viscosity of the Glucose and aqueous Vitamin C solution at different temperature 283.15-298.15 K and concentration 0.02-0.2 molality is increasing with increase in temperature and concentration. This happen because strong interaction between molecules of solute and solvent because of that cohesive force is increase (Dudhe, 2019).

Apparent Molal Volume: Solute and solvent interaction confirm with the positive result of Apparent Molal Volume parameter. The solution of Glucose and Vitamin C at different concentration (0.02-0.2M) and at various temperatures (283.15 K-298.15 K) shown in *Fig. 9* is increase with respect to increase in temperature and concentration (Jamal Akhter Siddique, 2015).

Adiabatic Compressibility: Compressibility is a very microscopic observable parameter. It can be used to identifythe solvation property of solute in aqueous solution. Fig. 10 shows that at different concentration and temperature of the solution of Glucose and aqueous Vitamin C is decrease with increase in temperature and concentration. The decrease in value of compressibility and rising in value of velocity shows that the interaction between solute and solvent due to which structural arrangements of other molecules is affected (Hariharankrishnan, 2015).

Acoustic Impedance: Fig. 11 shows that the projection of acoustic impedance in aqueous Glucose + Vitamin C solution at different temperature and concentration. The trends increase with rise in molarity and concentration because the value of density increases so that the value of impedance increases linearly (Naoyuki Akashi, 2000).

Relative Association: Graphical trends of Fig. 12 exhibits Relative association of the solution of Glucose in aqueous Vitamin C at temperature of 283.15-298.15K and concentration of 0.02-0.2M is increasing with increase in molality and temperature. The increasing value shows that the both solute-solute and solute-solvent interaction happen in mixture (Nithiyananthan, 2010).

Relaxation Strength: According to trend, the Relaxation strength in Glucose aqueous Vitamin C solution at different temperature and concentration is decreasing with increase in temperature and concentration and fig 13 shows the result. It is directly proportional to the adiabatic compressibility. When we increase the concentration of solute in solvent then the value decreases and it shows solute-solvent interaction in the solution. It happens due to the complex solvent formation around the solute (Giratkar, 2017).

CONCLUSION

We find the ultrasonic velocity and density of the glucose at different concentration 0.02-0.2M in the 0.2M aqueous Vitamin C solution at different temperature ranging from 283.15K-298.15K. Related to velocity and density we calculate the other volumetric, acoustical and thermodynamic parameter like free length, internal pressure, Wada's constant, Rao's constant, viscosity, apparent molal volume, adiabatic compressibility, acoustic impedance, relative association.

The parameters Velocity, Density, Internal Pressure, Wada's Constant, Rao's Constant, Viscosity, Apparent Molal Volume, Acoustic Impedance, Relative Association are increases with increase in concentration while Free Length, Adiabatic Compressibility, Relaxation Strength are decreases with increases in concentration. This behavior of the systemconcludes that there is a strong bond between them. We further conclude that, this solution control and regulate the blood sugar level in human body. And also maintain the growth of brain in human babies.

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