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Research Article

The Study of Molecular Interaction between Niacinamide (Vitamin B3) and Ascorbic Acid (Vitamin C) with Water at Different Temperatures

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Abstract

In this current work, the ultrasonic studies have been discussed for different systems such as: 1) Ascorbic Acid + H_2O and 2) Niacinamide + H_2O under different temperatures and concentrations. Both the systems have been described in three phases a) Higher order elastic constant b) Mechanical properties and c) Ultrasonic velocity and Density. These properties and constants are providing the information about the instinct properties of the liquid systems, such as information about interaction, kind of information about bonding stability, etc. Therefore, this kind of study is valuable and interesting in view from number of features in the field of pharmaceutical and industries.

Keywords: Ascorbic Acid; Niacinamide; Ultrasonic; Thermal Properties; Intermolecular Interactions

Introduction

Ultrasonic methods are widely used in the field of medical and other industrial areas.in this present work, ultrasonic velocity and density was calculated experimentally. With the help of we have calculated some this data, we have calculated some mechanical, thermal and elastic parameters at different temperatures and concentrations operated at 2Mz frequency. The determination of ultrasonic velocity is important to knowing the molecule properties and physio-chemical properties. Of liquids and liquid mixture of appreciable to conclude the inter-molecular interaction between solute and solvent mixture.

The skin is composed day-to-day to a very large numbers of environmental factors, including ultraviolet radiation or various types of pollution, that can negatively and harmful effect in skin and health. These influences are called as antioxidants as well as take a part in the harm of biological materials, proteins, deoxyribonucleic acid glycolipids. Oxidative agents damage a skin aging cause by UV radiation [1].

However, among the stresses vitamins plays important role and multiplicity task in an anatomy and is necessary for well skin and good fitness [2]. The application of nutrition opposed to aerobic agent's harm in similar conceptualisation is famous master plans. Ascorbic acid appreciates antioxidant properties. Ascorbic acid is known as vitamin c. Ascorbic. it is widely used in recently in cosmetic products for protect against the UV radiation. The use of Ascorbic Acid still challenges because it is simply recreated according to change in potential of hydrogen, susceptibility to sunbeam, aqueous, climatic oxygen, and temperatures [1].

Nowadays, various types of nutritional addition in the out of pills and fluid be accessible in the sell. Either of them vitamin B3 (Niacinamide) recently niacinamide produces solely synthetically. The niacinamide involved the regulations of DNA, synthesis, and transcription process [3]. So, the niacinamide is used in the skin aging problems in the form of tablets, cosmetic. It is also controlling the skin pigmentation [4].

Taken all together, Ascorbic acid and niacinamide individually show ant melanogenic effect. The results show of the treatments with the mixture of the compounds on decreasing the skin problems in our human body in the form of many factors [5]. The benefits of this review to survey the potentials as well as application of vitamins as a cosmetical ingredients to promote tendon production for skin problems [6].

Materials and Methods

Materials

Ascorbic acid (vitamin c) is a dissoluble vitamin. Its molecular weight is 176.12 g/mol. Its (CAS NO: 50:81:7) mass fraction purity is 99.0% while Niacinamide (vitamin B3) mass fraction purity is 99.5%. Its molecular weight is 122.12 g/mol. Its (CAS NO: 98:92:0). All the beakers, conical flask is clean with the pure water and acetone before its used.

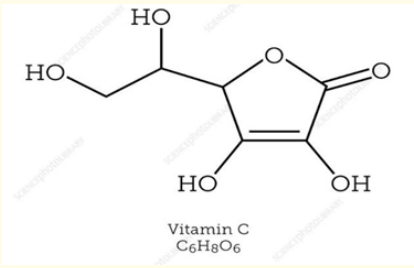

Figure 1: Ascorbic Acid.

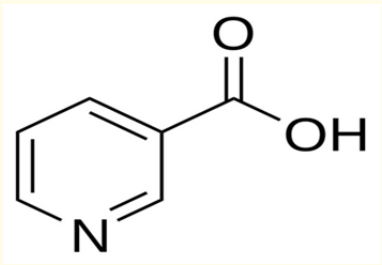

Figure 2: Niacinamide.

Methods

An Analog ultrasonic velocity interferometer was operated for calculating the ultrasonic frequency 2MHZ and 0.1% accuracy. This procedure is taking place at different temperatures (283.15k to 298.15k). The weight of substance was measured by using a digital weighing machine. The temperature is maintained constant by thermostat. The densities of the solutions were determined 10ml specified gravity bottle.

Defining relation

- Internal pressure (πi): $\pi i = \{T^*\alpha/kT\}$
- Isothermal compressibility (Kt2) = $17.1^*10^{-4}/(T^{\frac{4}{5}}U^2$
- Surface tension $(\sigma) = (6.3 * 10^{-4})\, dc^{\frac{3}{2}}$
- Bulk modulus (K) = C*2d
- Thermal conductivity (k) = $\{3.0^*(dN_Am)^{\frac{2}{3}}k_BC\}$

Result and Discussion

In the present work, we get the change in ultrasonic velocity and density in the system aqueous niacin and ascorbic acid at different temperature and concentrations (0.02-0.2 mol/kg) are plotted is shown in figure 1-9. The examiner report of ultrasonic velocity increase with rising in conc. of vitamin C and vitamin B3 in aqueous solution as shown in figure 3. There is a significant relation between the solute-solvent components of the aqueous vitamins [7]. The varying of density with conc. are shown in figure 4. Which indicates that the density of mixture of aqueous solution with vitamins rising with rise in concentration and drop with rising in temperatures [8]. The Internal pressure is increasing with increasing conc. as shown in Figure 5. this show that the dispersion forces among the solute and solvent in aqueous are become powerful show that there exists a strong intermolecular force [9]. Figure 6 shows the isothermal compressibility decreasing with increasing in concentration of vitamins in aqueous solution. The molecule is closely packed in the conservation shell as compared in non-appearance of ions [8].

Figure 7 indicates that the significant associative interaction in the solution of vitamins and aqueous. The increase variation of surface tension with different temperatures and concentration as shown in graph [9]. The bulk modulus is increases with increasing in temperatures and concentrations as shown in figure 8 which observed that the chemicals bond among the different elements in the compound increases [10]. The variation of thermal conductivity with concentrations and temperatures is shown in figure 8. it is observed that the thermal resistivity of aqueous is increase by

Conc.	Velocity		Density		Internal Pressure		Isothermal Compressibility	
	Vit B3	Vit C	Vit B3	Vit C	Vit B3	Vit C	Vit B3	Vit C
	283.15 k							
0.00	1447.42	1447.42	999.70	999.70	8.40E+13	8.40E+13	2.01E-15	2.01E-15
0.02	1460.28	1488.88	1020.04	1027.22	8.78E+13	9.17E+13	1.91E-15	1.81E-15
0.04	1461.32	1490.24	1022.08	1029.45	8.82E+13	9.22E+13	1.90E-15	1.80E-15
0.06	1463.41	1494.26	1023.52	1032.73	8.86E+13	9.31E+13	1.89E-15	1.78E-15
0.08	1465.52	1496.3	1024.22	1034.16	8.89E+13	9.34E+13	1.89E-15	1.77E-15
0.10	1466.54	1497.76	1026.77	1036.39	8.93E+13	9.39E+13	1.88E-15	1.76E-15
0.12	1467.56	1499.78	1027.58	1038.16	8.95E+13	9.43E+13	1.87E-15	1.75E-15
0.14	1468.60	1501.78	1028.65	1039.76	8.97E+13	9.47E+13	1.86E-15	1.75E-15
0.16	1472.92	1504.86	1030.93	1041.44	9.05E+13	9.53E+13	1.85E-15	1.73E-15
0.18	1473.94	1505.86	1031.20	1043.44	9.06E+13	9.57E+13	1.84E-15	1.73E-15
0.20	1474.98	1508.26	1032.21	1044.13	9.09E+13	9.60E+13	1.84E-15	1.72E-15
288.15 k								
0.00	1466.03	1466.03	999.10	999.103	8.72E+13	8.72E+13	1.96E-15	1.96E-15
0.02	1468.17	1489.24	1019.26	1025.75	8.99E+13	9.30E+13	1.89E-15	1.81E-15
0.04	1470.24	1491.46	1020.81	1026.99	9.03E+13	9.34E+13	1.88E-15	1.81E-15
0.06	1473.84	1492.02	1021.67	1028.94	9.08E+13	9.37E+13	1.87E-15	1.80E-15
0.08	1476.58	1494.58	1023.44	1030.16	9.14E+13	9.42E+13	1.86E-15	1.79E-15
0.10	1479.62	1496.5	1024.15	1031.76	9.18E+13	9.46E+13	1.85E-15	1.78E-15
0.12	1481.64	1498.96	1025.94	1033.72	9.22E+13	9.51E+13	1.84E-15	1.77E-15
0.14	1484.66	1502.34	1027.32	1034.12	9.27E+13	9.56E+13	1.82E-15	1.76E-15
0.16	1488.72	1505.41	1029.29	1035.11	9.34E+13	9.60E+13	1.81E-15	1.75E-15
0.18	1492.81	1506.44	1030.08	1037.24	9.40E+13	9.64E+13	1.79E-15	1.74E-15
0.20	1494.90	1509.86	1031.09	1038.89	9.43E+13	9.70E+13	1.79E-15	1.73E-15
293.15 k								
0	1481.49	1481.49	998.20	998.20	9.00E+13	9.00E+13	1.91E-15	1.91E-15
0.02	1483.21	1490.11	1017.86	1023.11	9.28E+13	9.42E+13	1.85E-15	1.82E-15
0.04	1487.32	1492.14	1018.78	1025.13	9.33E+13	9.47E+13	1.84E-15	1.81E-15
0.06	1491.4	1494.2	1020.86	1026.05	9.41E+13	9.50E+13	1.82E-15	1.80E-15
0.08	1494.44	1496.31	1021.56	1028.58	9.45E+13	9.56E+13	1.81E-15	1.79E-15
0.1	1497.51	1499.30	1023.98	1030.43	9.51E+13	9.62E+13	1.80E-15	1.78E-15
0.12	1499.17	1502.12	1025.88	1031.78	9.56E+13	9.67E+13	1.79E-15	1.76E-15
0.14	1500.38	1503.13	1027.81	1033.96	9.60E+13	9.71E+13	1.78E-15	1.76E-15
0.16	1506.49	1505.21	1028.12	1035.76	9.67E+13	9.76E+13	1.76E-15	1.75E-15
0.18	1508.11	1509.38	1029.97	1036.37	9.71E+13	9.81E+13	1.75E-15	1.73E-15
0.2	1511.16	1511.23	1031.19	1037.97	9.76E+13	9.85E+13	1.74E-15	1.73E-15
298.15 k								
0	1498.10	1498.10	997.00	997.00	9.31E+13	9.31E+13	1.87E-15	1.87E-15
0.02	1500.31	1499.87	1015.59	1021.99	9.58E+13	9.66E+13	1.81E-15	1.80E-15

0.04	1504.46	1504.15	1017.51	1023.92	9.65E+13	9.73E+13	1.80E-15	1.78E-15
0.06	1508.12	1506.18	1019.84	1024.89	9.72E+13	9.77E+13	1.78E-15	1.77E-15
0.08	1511.41	1508.24	1020.5	1026.64	9.77E+13	9.82E+13	1.77E-15	1.76E-15
0.1	1513.81	1512.38	1022.05	1028.05	9.82E+13	9.88E+13	1.76E-15	1.75E-15
0.12	1516.13	1513.4	1024.20	1029.70	9.87E+13	9.92E+13	1.75E+15	1.74E+15
0.14	1519.46	1518.61	1025.88	1031.77	9.93E+13	1.00E+14	1.73E-15	1.72E-15
0.16	1522.36	1520.28	1026.10	1032.17	9.97E+13	1.00E+14	1.73E-15	1.72E-15
0.18	1525.15	1522.34	1027.67	1034.89	1.00E+14	1.01E+14	1.72E-15	1.70E-15
0.2	1527.19	1526.91	1029.01	1035.67	1.01E+14	1.02E+14	1.71E-15	1.69E-15

Table 1: The value of velocity, density, internal pressure, isothermal compressibility of ascorbic acid and niacinamide with aqueous solution at different temperatures and concentrations.

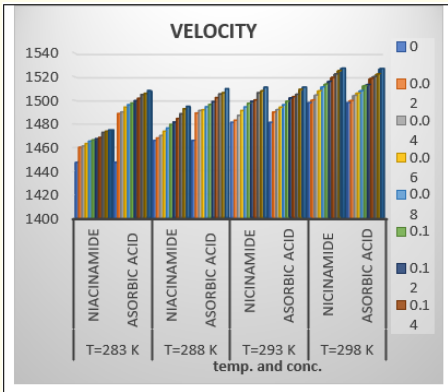

Figure 3: Varying of velocity with conc. and temp.

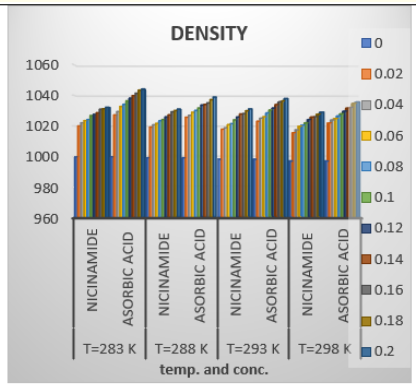

Figure 4: Varying of density with conc. and temp.

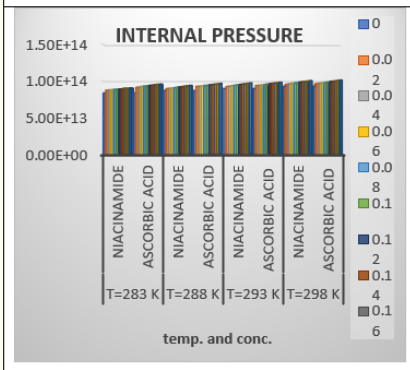

Figure 5: Varying of π_i with conc. and temp.

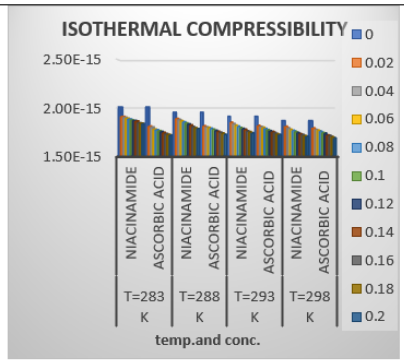

Figure 6: Varying of K_T with conc. and temp.

Conc.	Surface tension		Bulk modules		Thermal conductivity	
	Vit B3	Vit C	Vit B3	Vit C	Vit B3	Vit C
283.15 K						
0.0	34682.09	34682.09	4.77E-10	4.77E-10	0.621448	0.621448
0.02	35860.38	37178.83	4.60E-10	4.39E-10	0.177442	0.142395
0.04	35970.25	37310.64	4.58E-10	4.37E-10	0.177804	0.142732
0.06	36098.44	37581.1	4.56E-10	4.33E-10	0.178226	0.143421
0.08	36201.14	37710.27	4.55E-10	4.32E-10	0.178564	0.143749
0.1	36329.17	37846.69	4.53E-10	4.30E-10	0.178985	0.144096
0.12	36395.8	37988.23	4.52E-10	4.28E-10	0.179204	0.144455
0.14	36472.36	38122.91	4.51E-10	4.26E-10	0.179455	0.144796
0.16	36714.82	38302.04	4.47E-10	4.24E-10	0.180249	0.145249
0.18	36762.52	38413.59	4.46E-10	4.23E-10	0.180406	0.145531
0.20	36837.48	38531.07	4.45E-10	4.21E-10	0.180651	0.145827
288.15 K						
0.0	35331.82	35331.82	4.66E-10	4.66E-10	0.629185	0.629185
0.02	36123.73	37138.91	4.55E-10	4.40E-10	0.17831	0.142293
0.04	36255.28	37267.23	4.53E-10	4.38E-10	0.178742	0.142621
0.06	36419.17	37358.77	4.51E-10	4.37E-10	0.179281	0.142854
0.08	36583.84	37499.66	4.48E-10	4.35E-10	0.179821	0.143213
0.1	36722.55	37630.34	4.46E-10	4.33E-10	0.180275	0.143546
0.12	36861.84	37794.57	4.44E-10	4.31E-10	0.18073	0.143963
0.14	37024.44	37937.15	4.42E-10	4.28E-10	0.181261	0.144325
0.16	37247.89	38089.92	4.38E-10	4.26E-10	0.18199	0.144712
0.18	37430.2	38207.59	4.36E-10	4.25E-10	0.182583	0.14501
0.20	37545.61	38398.69	4.34E-10	4.22E-10	0.182958	0.145493
293.15 K						
0 .0	34682.09	34682.09	4.56E-10	k 4.56E-10	0.635439	0.635439

0.02	36629.78	37075.90	4.56E-10	4.56E-10	0.635439	0.635439
0.04	36815.42	37224.93	4.47E-10	4.42E-10	0.179971	0.142132
0.06	37042.48	37335.81	4.44E-10	4.41E-10	0.180579	0.142513
0.08	37181.42	37507.14	4.40E-10	4.39E-10	0.181320	0.142796
0.10	37384.33	37687.21	4.38E-10	4.37E-10	0.181773	0.143232
0.12	37515.99	37843.25	4.35E-10	4.34E-10	0.182434	0.143690
0.14	37632.16	37961.46	4.34E-10	4.32E-10	0.182862	0.144087
0.16	37873.39	38106.36	4.32E-10	4.31E-10	0.18324	0.144387
0.18	38002.72	38287.35	4.29E-10	4.29E-10	0.184022	0.144754
0.20	38163.51	38416.99	4.27E-10	4.26E-10	0.18444	0.145212
298.15 K						
0.0	36420.62	36420.62	4.47E-10	4.47E-10	0.642000	0.642000
0.02	37181.81	37399.69	4.37E-10	4.35E-10	0.182508	0.143547
0.04	37406.88	37630.93	4.34E-10	4.32E-10	0.183231	0.143832
0.06	37629.55	37742.9	4.31E-10	4.30E-10	0.183717	0.144193
0.08	37779.33	37884.97	4.29E-10	4.28E-10	0.184187	0.144720
0.10	37924.49	38093.12	4.27E-10	4.25E-10	0.184728	0.144973
0.12	38091.67	38192.87	4.25E-10	4.24E-10	0.185337	0.145667
0.14	38280.14	38467.66	4.22E-10	4.20E-10	0.185717	0.145865
0.16	38398.06	38545.81	4.21E-10	4.19E-10	0.186248	0.146319
0.18	38562.65	38726.19	4.18E-10	4.17E-10	0.186659	0.146832
0.20	38690.32	38929.87	4.17E-10	4.14E-10	0.181775	0.142959

Table 2: The value of surface tension, bulk modulus, thermal conductivity with aqueous solution at different concentrations and temperatures.

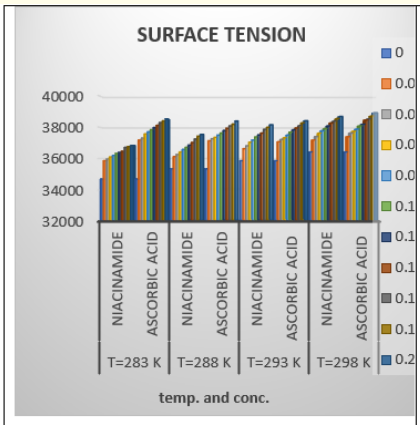

Figure 7: Variation of surface tension with conc. and temp.

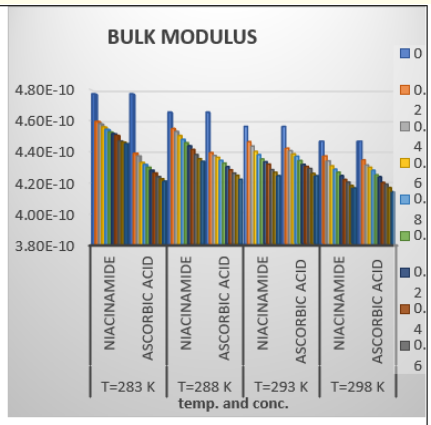

Figure 8: Variation of bulk modulus with conc. and temp.

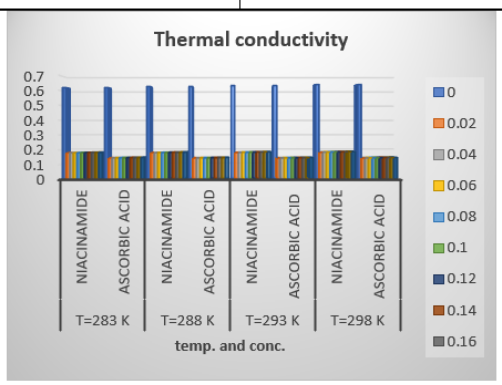

Figure 9: Varying of thermal conductivity with conc. and temp.

increased within temperatures as compared to concentrations. It is seeing that the thermal conductivity rather rising with rise in temperatures and concentrations. The energy is flow when the molecule is closed to each other. this means that in the given system intermolecular interaction take place [11,12].

Conclusion

The uniqueness is in the fact that mixture of ascorbic acid and niacinamide with aqueous has a characterized feature, which is observed in all the properties discussed in our study. Our aim is to be established that the various elastic, Mechanical and Thermal parameters support the experimental finding as solution Ascorbic Acid + H_2O has compared to Niacinamide + H_2O. This kind of interactions helps to our skin diseases in human body in the form of medicinal, pharmaceutical and cosmetic in view to make more effective drugs related to applications.

Bibliography

1. Leonardo Deleuo Di Filippo., *et al*. "*In vitro* skin co-delivery and antibacterial properties of chitosan-based microparticles contain ascorbic acid and niacinamide". *Life* 12 (2022): 104.

2. Hee-Jae Suh and So Hee Kim. "Simultaneously determination of water-soluble vitamins in dietary supplements by highly performance liquid chromatography". *The Korean Journal of Food and Nutrition* 24 (2011): 414.

3. Johannes Wohl Rab Daniela Kreeft. "Niacinamide mechanisms of actions and is topical used in dermatology". *Skin Pharmacology and Physiology* 27 (2014): 311-315.

4. Yong Choo Boo. "Mechanism basis and clinical evidence for the applications of niacinamide to control the skin aging and pigmentation". *Antioxidants* 10 (2021): 1315.

5. Hyun Jun Park., *et al*. "The combination of vitamin c and niacinamide and PDRN mitigates melanogenesis by modulating nicotinamide trashy dragonise". *Molecules* 27 (2022): 4923.

6. Hyong Moon Kim and Kyung-A Byun. "A mixture of topicals forms polydeoxyribonnudotide vitamin c and niacinamide attenuated skin pigmentation and increased in skin elasticity by modulating nuclear factors". *Molecules* 27 (2022): 1276.

7. VG Dubhe. "Thermo-acoustical study of aqueous ascorbic acid at different temperatures". *Journal of Emerging Technologies and Innovative Research* 6 (2019): 2349.

8. Paritosh L Mishra., *et al*. "A volumetric and acoustical study to explore interaction between saline salts an fertilizer in viewed to control salinity of soil". *Journal of Scientific Research* 65 (2021): 72-78.

9. Samiksha C Patrange., *et al*. "Volumetric an ultrasonic investigation of acetamide in aqueous sodium chloride". *Journal of Applied Research* 8 (2022): 389-392.

10. Jongbeom Kim., *et al*. "Absolute measurement and relative measurement of ultrasonic non-linear parameters". *Research in Non-Destructive Evaluation* 25 (2017): 211-225.

11. Zhi young Gu and Johan F Brennecke. "Volume expansivities an isothermal compressibility of imidazolium and pyridinium -based iconic liquids". *Journal of Chemical and Engineering Data* 47 (2002): 339-345.

12. A A Mistery., *et al*. "Acoustical studies on ternary mixture of toluene in cyclohexane and nitrobenzene at 308k using ultrasonic technique". *Journal of Chemical and Pharmaceuticals Research* 4.1 (2012): 170-174.