International Journal of Chemical and Physical Sciences, ISSN:2319-6602
IJCPS Vol. 4 Special Issue – NCSC Jan-2015
www.ijcps.org

Variation of Acoustical Parameters of Herbal Extract Pomegranate Solutions at Frequency 4MHz

S. R. ASWALE, SUNANDA S. ASWALE AND V. N. GOWARDIPE

Lokmanya Tilak Mahavidyalaya, Wani. Dist. Yavatmal, M. S. 445304.
Corresponding author: sraswale@gmail.com;

Abstract

Herbal extracts are natural products which are derived from plants. Herbal extract of pomegranate is widely used in the skin care treatment. This includes herbal extracts, oil, protein and bioactive materials from plant and animal. Ultrasound assisted extraction process is the modern method used in allied industries. In the present study, our aim is to find the activity of present drug by ultrasonic velocity measurement in aqueous medium. Intermolecular interaction study plays an important role in development of molecular sciences. The ultrasonic velocity of liquid is fundamentally related to the binding forces between the atoms or molecules. Ultrasonic parameters provide valuable information about various inter and intramolecular interactions in solutions. The ultrasonic velocity (v), density (d) and viscosity (η) for the aqueous solution of herbal extract of pomegranate of different concentration at 4MHz have been measured at 298K, 303K and 308K. The data is used to evaluate the ultrasonic parameter such as adiabatic compressibility (β_S), intermolecular free length (L_f), acoustic impedance (Z), relative association (R_A), relative strength (r), relaxation time (τ) etc. These calculated values are interpreted to elucidate the molecular interactions in the liquid mixture.

Keywords: Herbal extract, Pomegranate, Ultrasonic velocity

Introduction:

Herbal extract is a concentrated ingredient of herb blended with water as a suiTable solvent to preserve the potency of its active ingredients. This method ensures that the extracts have a much higher shelf life while it is highly concentrated to a required guaranteed potency level. The significance of herbal extract in relation to synthetic drugs is that herbal drugs are absorbed by the body very quickly especially in older adults. Cosmetics is the science of alternation of beauty and has been practiced since last several decades. In India, herbs are widely used for the purpose of worship and sensual enjoyment. Also the herbals are used as whole or part for various ailment of the skin, hair and for overall appearance. [1-4]

Ultrasonic technique is the most important and universally accepted technique to study the physical and chemical properties of solution[5-8]. The measurement of ultrasonic velocity in liquid and liquid mixtures provides valuable information about the physico-chemical parameters and the nature of molecular interactions in them[9-10]. Ultrasonic velocity measurements have been widely used in the field of molecular interactions and structural aspects. Numbers of workers[11-14] have carried out ultrasonic studies of liquid in aqueous as well as non aqueous medium. The molecular interaction between pomegranates with water as a solvent at 298K, 303K and 308K have been investigated in the present paper, again this gives idea about solubility of pomegranate in solvents like water. By the measurement of ultrasonic velocity, density and viscosity of the solution at 298K ,303K and 308K at 4MHz frequencies, the acoustic properties like Adiabatic compressibility (β), Specific acoustic impedance (Z), Relative strength (r), Relative association (R_A), Intermolecular free length (L_f) and Relaxation time (τ) are determined.

Experimental

A] Materials All the chemicals used were of analytical Range. Double distilled water was used for the preparation of solutions. A special thermostatic water bath arrangement was made to maintain constant temperature. 1%, 0.5%, 0.25% solution of pomegranate extract was prepared by taking accurate weights on electronic digital balance. (Model CB/CA/CT-series, Contech, having accuracy ± 0.0001 g).

B] Methods Ultrasonic velocity and density measurements are necessary to determine the acoustic parameters of solutions. Ultrasonic velocity through 1%, 0.5%, 0.25% solution of pomegranate extract in water was measured with the Mittal type (Model,M-83,Mittal Enterprizes) multifrequency ultrasonic interferometer at different frequencies with an accuracy of ±2 m/s. All the readings were taken at 298K, 303K, and 308K viscosity of solution was measured by Ostwalds viscometer and density of solution was measured by Digital Densitometer (DMA-35,Anton paar)

Computations

By using Ultrasonic velocity, following acoustic parameters are calculated,

Adiabatic compressibility

$\beta_S = 1/v^2d$ Where v= Ultrasonic velocity, d =Density.

Specific acoustic impedance

$Z = v.d_s$ d_s = Density of solution

Intermolecular free length

$L_f = K . \sqrt{\beta_S}$ K = Jacobsons constant(631)

β_S = Adiabatic compressibility of solution β_o = Adiabatic compressibility of solvent.

Relative association

$R_A = d_o/d_s(v_o/v_s)^{1/3}$

Relaxation time

$\tau = 4/3\ \beta_S\ \eta$ Where η =Viscosity

Relative strength

$r = 1-(v\backslash v_\infty)^2$ v =velocity, $v_\infty = 1600ms^{-1}$

Results and Discussions

The experimentally determined values are listed in following Tables.

Table 1: Density, Viscosity and Velocity (at frequency 4MHz) of Pomegranate extract solution

Sr. No.	Conc. (%)	Temp. (K)	Density d_s $\times 10^3$	Velocity V (m/s)	Viscosity $\times 10^{-3}$ η (Kg m^{-1} s^{-2})
1	1	298	1.0012	2801.0	1.3855
		303	1.0001	3107.5	1.3129
		308	1.0004	3553.0	1.2154
2	0.5	298	0.9989	2716.0	0.8404
		303	0.9985	2923.5	0.7952
		308	0.9980	3252.5	0.7502
3	0.25	298	0.9984	2002.6	0.8400
		303	0.9982	2364.3	0.7716
		308	0.9977	2998.4	0.7121

Table 2 : Acoustic Parameters of Pomegranate extract solution in water at 4MHz.

Sr. No.	Conc (%)	Temp. (K)	Adiabatic compressibility $\beta\times10^{-5}$ (pa^{-1})	Specific acoustic impedance $Z\times10^5$ (Kgm^{-2} Sec^{-1})	Intermolecular free length(m) Lf $\times 10^{-8}$	Relative association R_A	Acoustic relaxation time $\tau\times10^{-7}$	Relative strength (r)
1	1	298	12.7613	28.0436	2.2214	0.9377	2.3574	-2.0647
		303	10.3650	31.1030	2.0158	0.9205	1.8144	-2.7721
		308	07.9247	35.5442	1.7813	0.8660	1.2842	-3.9312
2	0.5	298	13.5414	27.1301	2.2883	0.9495	1.5173	-1.8815
		303	11.6827	29.1912	2.1401	0.9417	1.2386	-2.3386
		308	09.4340	32.4600	1.9435	0.8940	0.9423	-3.1323
3	0.25	298	24.8952	19.9940	3.1027	1.0515	2.7882	-0.5666
		303	17.8572	23.6004	2.6458	1.0110	1.8371	-1.1836
		308	11.0974	29.9150	2.1079	0.9188	1.0536	-2.5119

The ultrasonic velocity of 1%, 05%, 0.25% pomegranate extract solution in water was measured at 298K, 303K and 308K at 4MHz frequency. From Table no.1, it is observed that at different concentrations ultrasonic velocity is increases with increase in temperature. From Table no. 2 and fig. 1, fig. 3, fig. 4, fig. 5 and fig. 6 it is observed that adiabatic compressibility (β), intermolecular free length (Lf), relaxation time (τ), relative strength (r) and relative association (R_A) decrease with increase in concentration and temperature. Whereas, from fig. 2 it is observed that specific acoustic impedance (Z) increases with the increase in concentration and temperature.

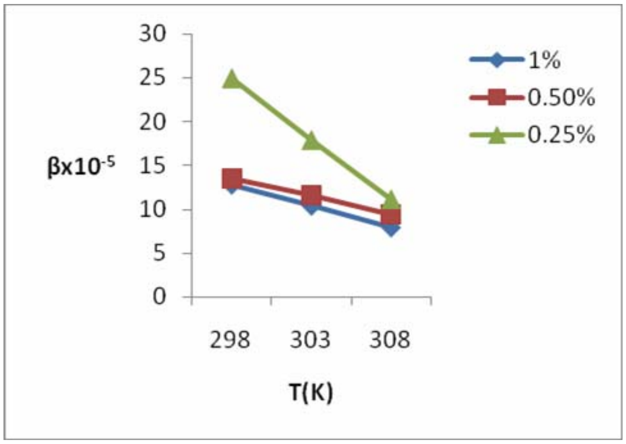

Fig.1 Variation of adiabatic compressibility with temperature at different concentration

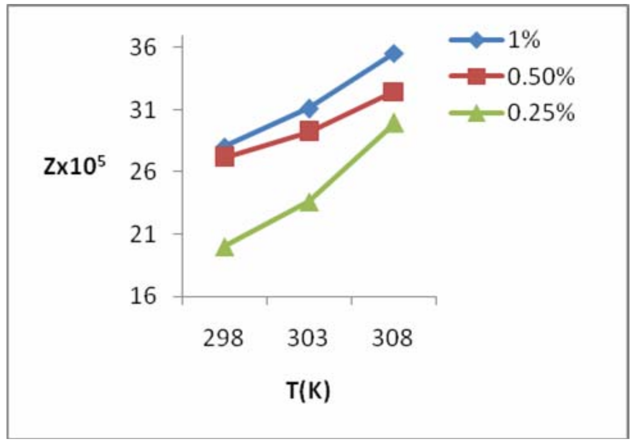

Fig.2 Variation of specific acoustic impedance with temperature at different concentration

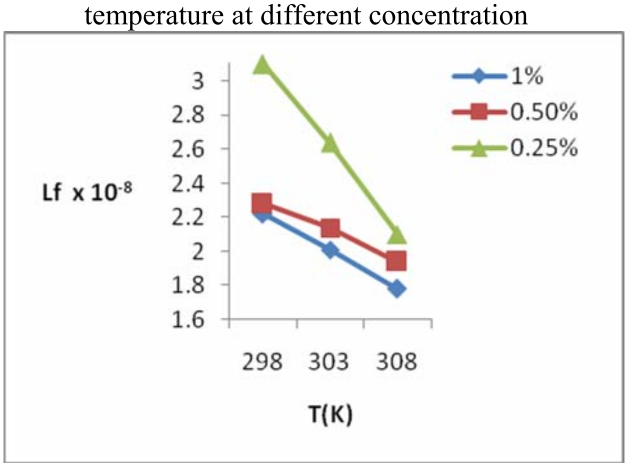

Fig.3 Variation of intermolecular free length with temperature at different concentration

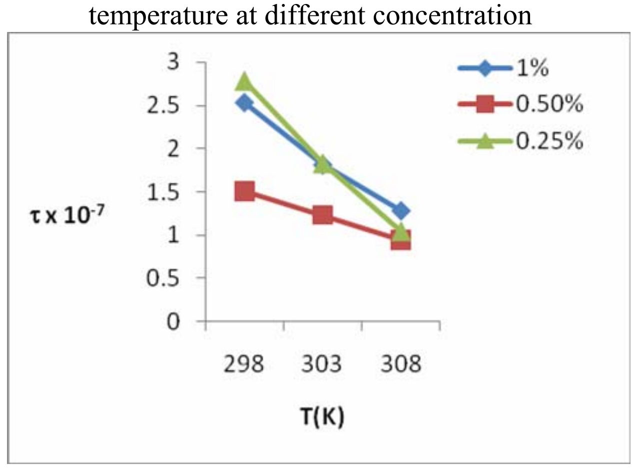

Fig.4 Variation of relaxation time with temperature at different concentration

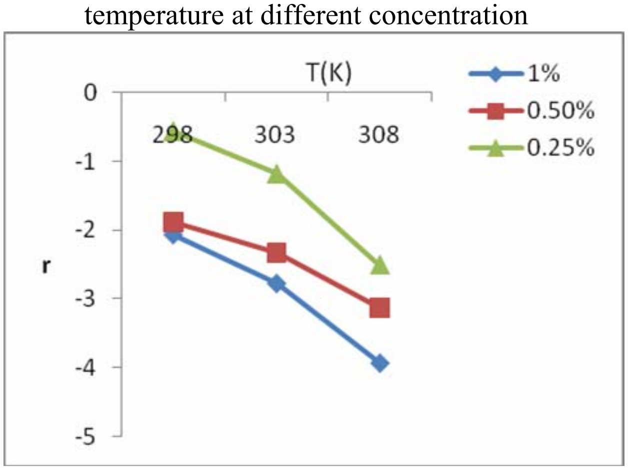

Fig.5 Variation of relative strength with temperature at different concentration

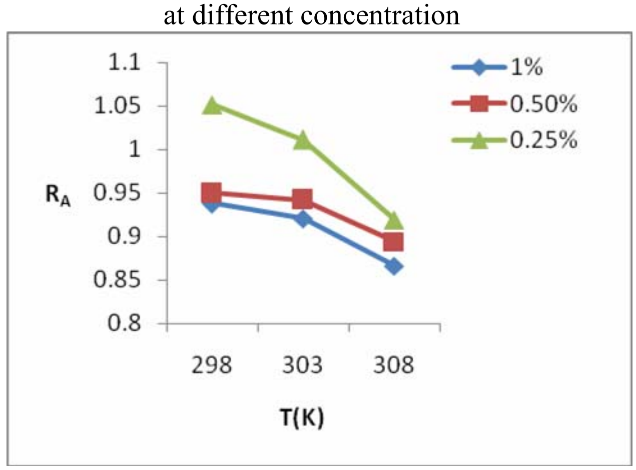

Fig.6 Variation of relative association with temperature at different concentration

From these observations it can be predicted that water molecules associate strongly through hydrogen bonding with the pomegranate molecules. Therefore bonds between solute-solvent strengthen the intermolecular forces resulting in the decrease of adiabatic compressibility with the increase of concentration.

Increase in the acoustic impedance is an indication of strong interaction between pomegranate extract and solvent. From the above it is observed that molecular association between pomegranate extract-solvent molecules may arise from intermolecular hydrogen bonding which strongly supports the molecular association occurring in these systems.

Conclusion

i) Ultrasonic velocity increases with increase in temperature and with increasing concentration.
ii) Adiabatic compressibility decreases with increase in temperature and with increase in concentration.
iii) Acoustic impedance increases with increase in temperature and concentration.
iv) Relaxation time decreases with increase in temperature and with increasing concentration.
v) Relative association decreases with increase in temperature and concentration.
vi) Relative strength decreases with increase in temperature and concentration.

The variation in the acoustical parameters with temperature and concentration for pomegranate extract in water suggests that there are strong solute-solvent interactions at higher concentration.

References

[1]. Z. D. Draelo; 2003A Cosmetics Dermatol, 2003, 16 (9), 46-49.
[2]. D. A. Glaser; Facial Plast Surg,Clin N AM, 2004, 12, 363-372
[3]. Z. D. Draelos; 2003B, Cosmetics Dermatol, 2003,16 (10), 41-42
[4]. The British Herbal medicine, Association, 1996 A. Ceres; Thorsons Publishers, London, 1984.
[5]. Subhraraj Panda, Achyuta Prasad Mahapatra, J. Chem. Pharma. Res. 2014, 6(10): 818-825 ISSN: 0975-7384 CODEN (USA): JCPRC5.
[6]. G. R. Bedare, V. D. Bhandarkkar and B. M. Suryavanshi, Ind. J. Res. Pure & Appl. Phys. ISSN 2278-134x 27 June 2013.
[7]. S. P. Dange, O. P. Chimankar, Int. Global Res. Analysis Vol. 2, (7) Jul 2013, ISSN 2277-8106.
[8]. H. Houkhani and Z. Rostami; J. Chem. Eng. Data, 52, 921, (2007).
[9]. Sridevi G.; Ind. J. Res. Chem. & Environ. ISSN 2248-9649 Vol.3, Jul 2013 70-80.
[10]. Munendra Kumar Gagwar, Ashish Kumar Saxena & Pawan Srivastava; Archives Phys. Res. 2013, 4(1): 29-34 ISSN: 0976-0970 CODEN (USA) :APRRC7.
[11]. S. S. Aswale, S. R. Aswale and A. B. Dhote, Golden Research Thoughts [ISSN NO: 2231-5063], Vol.1, issue IV/Oct 2011, 1-4.

[12]. S. S. Aswale, R. S. Hajare and S. R. Aswale, Proceeding of National Conference on Recent Researches in Chemistry, A Journey Towards Social Upliftment, [ISBN-978-81-905776-12-1], 14,15 Feb 2012, pp 24.

[13]. Sunanda S. Aswale, Shashikant R. Aswale, Bhavana Ramteke, Int. J. Chem. Environ. & Pharma. Res., [ISSN (online):0976-0083], Vol. 3 No. 1, 58-63, Jan.-Apr. 2012.

[14]. Aparna B. Dhote, Sunanda S. Aswale and Shashikant R. Aswale, Adv. Appl. Sci. Res., ISSN: 0976-8610, CODEN (USA): AASRFC, 3(4):2299-2302, 2012.