ULTRASONIC STUDIES OF ANTIPROTOZOAL DRUG IN PROTIC AND APROTIC SOLVENTS AT 308.15 K

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Abstract — Ultrasonic velocities and density of various concentrations (0.01 to 0.10 M) of anti protozoal drug “Diloxanide Furoate” in methanol, dimethyl formamide and 1,4-dioxan have been measured at 308.15 K by using single crystal variable path ultrasonic interferometer operating at 2 MHz and pycnometer respectively. Using these experimental data, some acoustical parameters have been evaluated and they are interpreted in terms of solute-solute and solute-solvent interactions in these solutions.

Keywords — Anti protozoal drug, Ultrasonic studies, Diloxanide furoate.

I. INTRODUCTION

Diloxanide furoate is a luminal amebicide drug used in the treatment of amebiasis (Fernandes et al., 2009). It is a dichloroacetamide derivative that principally acts in the bowel lumen and is used in the treatment of intestinal amoebic infections (Reynolds, 2005). In addition to its anti protozoal and anti amoebic effect (Abbas et al., 2011), the drug contains an ester group which has wide usage in flavoring, perfumery, artificial essences, cosmetics, etc. (Abdelaleem and Abdelwahab, 2012).

These properties prompted us to study the molecular interaction of Diloxanide furoate in some protic and aprotic solvents. Ultrasonic velocity measurements in solutions furnish knowledge about ion-ion and ion solvent interactions.

In the last few years, our investigation groups have carried out various studies on acoustical properties of organic compounds in different solvents (Baluja and Parsania, 1995; Baluja and Oza 2003; Baluja and Shah, 2004, Baluja et al., 2005; Baluja et al., 2009) as well as on some drugs (Govdani et al., 2010; Govdani et al., 2012).

In continuation of these investigations, the present paper reports acoustical properties of the anti protozoal drug “Diloxanide Furoate” in different solvents.

II. EXPERIMENTAL

The solvents methanol, DMF and 1,4-dioxan used in the present work were of AR grade and purified according to the standard procedure (Riddick, 1986). The purity of solvents was checked by GC-MS and was found to be more than 99.97%.

The densities of pure solvents and their solutions were measured by using a single capillary pycnometer, made of borosilicate glass having a bulb capacity of 10 ml. The ultrasonic velocity of pure solvents and their solutions were measured by using a single crystal variable path ultrasonic interferometer operating at 2 MHz. The accuracy of density and velocity are ± 0.0001 g/cm³ and ± 0.1% cm/sec respectively. All the measurements were carried out at 308.15 K. The uncertainty of temperature is ± 0.1 K and of concentration is 0.0001 moles /dm³.

III. THEORY

From the experimental data of density (ρ) and ultrasonic velocity (U) of pure solvent and solutions, various acoustical parameters were calculated using following standard equations (Baluja and Oza, 2003).

Isentropic compressibility (κS):

$$\kappa_S = \frac{1}{(U \rho)^2}$$

(1)

Intermolecular length (Lf):

$$L_f = K_f \kappa_S^{\frac{3}{2}}$$

(2)

where Kf is Jacobson constant (= 6.0816 x 10⁴).

Rao’s molar sound function (Rn):

$$R_n = \frac{M}{(M/p)U^{1/3}}$$

(3)

where M is the molecular weight of solution.

Van der Waal’s Constant (b):

$$b = \frac{(M/p)(1-RT/MU^2)}{(\sqrt{1+MU^2/3RT})-1}$$

(4)

where R is gas constant and T is absolute temperature.

Molar Compressibility (W):

$$W = \frac{M}{(M/p)K_S^{1/3}}$$

(5)

Solvent number (Sn):

$$S_n = \frac{M_1/M_2[1-\kappa_S/\kappa_{11}][100-\times/X]}$$

(6)

where X is the number of grams of solute in 100 g of the solution. M1 and M2 are the molecular weights and κS1 and κS are isentropic compressibility of solvent and solute respectively.

IV. RESULTS AND DISCUSSION

Table 1 shows the experimental data of density and ultrasonic velocity (U) of solutions of the anti protozoal drug at 308.15 K in different solvents; methanol, DMF and 1,4-dioxane. It is observed that in all the three selected solvents, density as well as ultrasonic velocity increase with concentration.

Further, intermolecular free length (Lf) and isentropic compressibility (κS) values are also reported in Table 1. Both Lf and κS decrease with the increase in concentration for all the solutions.

The increase of U and decrease of κS and Lf suggest aggregation of solvent molecules around solute molecules indicating thereby the presence of solute-solvent interactions.

Figure 1 shows the variation of some acoustical properties like molar sound function (Rn), molar compressibility (W), intermolecular length (Lf), and isentropic compressibility (κS) with concentration.