Original Research Article

Effect of solvent on acoustic parameters of extract of brayophyllum leaf

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Abstract

Experimental measurement of ultrasonic velocity, density and viscosity have been carried out on solution of Extract of Brayophyllum leaves with Water, Alcohol, Methyl Acetate and Ethyl Acetate at 303 K temperature and 2 MHz frequency. Extraction of leaves were done by Soxhlet extractor. For velocity measurement, Ultrasonic Interferometer (Model No. F-81, Mittal, New Delhi) working at fixed frequency 2 MHz was used. From the experimental data of density (ρ), ultrasonic velocity (U) and viscosity (η), various acoustical parameters such as adiabatic compressibility (βa), intermolecular free length (L_f), free volume (V_f) and relaxation time (τ) were calculated. Ultrasonic studies may throw more light on the molecular interaction to know the behavior of solute and solvent molecules in liquid mixtures and solutions. Changes in solvent and temperature affect compressibility of solution, which in turn affects molecular interactions in liquid mixtures and solutions. From the acoustic parameters effect of solvent on molecular intraction of extract of Brayophyllum Leaf can be directly predicted.

Key Words: Acoustical parameters, Molecular interactions, Brayophyllum Leaf, Alcohol, Methyl Acetate and Ethyl Acetate.

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INTRODUCTION

Liquid mixture containing componentsultrasonic investigation is of considerable importance in understanding intermolecular interaction between the component molecules as that finds application in several industrial and technological processes[1].The ultrasonic technique is a powerful and effective tool for investigation of molecular interaction in the solutions[2-5]. The medicinal plants are useful for healing as well as for curing of human diseases because of the presence of phytochemical constituents[6]. Phytochemicals are naturally occurring in the medicinal plants, leaves, vegetables and roots that have defense mechanism and protect from various diseases. Phytochemicals are primary and secondary compounds. Chlorophyll, proteins and common sugars are included in primary constituents and secondary compounds have terpenoid, alkaloids and phenolic compounds[7].Bryophyllum is widely distributed especially in philipines. Components of Brayophyllum leaves possess antibacterial, antitumorous, cancer preventive and insecticidal actions[8]. From the literature, the nature and degree of molecular interactions in different solutions depend upon the nature of solvent, the structure of solute molecule and extent of solutes taking place in the solution[9].Hydrogen bonding is one of the most important types of intermolecular interactions play an important role in various physicochemical, biological and industrial processes[10]. In the present study we were extracted Bryophyllum leaves using soxhelt extractor in the solvents water, alcohol, methyl acetate and ethyl acetate. The ultrasonic velocity, density and viscosity of each extract is measured. From experimental data acoustic parameters were calculated and effect of solvent on molecular interaction was predicted.

METHODS AND MATERIALS

The leaves of Brayophyllum leaves were collected. The powdered plant samples were extracted successively with water ethanol, ethyl acetate, and methyl alcohol using Soxhlet apparatus at 55-85 °C for 8-10 hour in order to extract the polar and non-polar compounds[11]. For each solvent extraction, the powdered pack material was air dried and then used. The ultrasonic velocity (U) in liquid mixtures which prepared by taking purified AR grade samples, have been measured using an ultrasonic interferometer (Mittal type, Model F-81) working at 2MHz frequency and at temperature 303K. The accuracy of sound velocity was ±0.1 ms-1. An electronically digital operated constant temperature water bath has been used to circulate water through the double walled measuring cell made up of steel containing the experimental solution at the desire temperature. The density of pure liquids and liquid mixtures was determined using pycknometer by relative measurement method with an accuracy of ±0.1Kgm-3.

RESULT AND DISCUSSION

Using the experimental data of ultrasonic velocity (U), density (ρ), viscosity (η), various acoustical parameters such as adiabatic compressibility (β_a), intermolecular free length (L_f), Acoustic impedance (Z) were calculated by the following equations (1-4).

$\beta_a = (U^2\rho)^{-1}$ ….. (1)

$L_f = K_T\beta a^{1/2}$ ….. (2)

$Z = U\rho$... … (3)

$\tau = 4/3\eta\beta_a$... … (4)

Experimental data for density, viscosity, and ultrasonic velocity frequency 2 MHz, for the different extract of Brayophyllum leaves and calculated acoustic parameters have been presented in Table 1. Ultrasonic velocity in the solutions depends on intermolecular free path length. It is shown that ultrasonic velocity decrease with changing the solvent. In water ultrasonic velocity is highest while it decreases in ethanol, ethyl acetate and methyl acetate gradually. It shows that the there is strong molecular interaction in the extract of Brayophyllum leaves in water solvent as compared to others. More is the ultrasonic velocity more is the cohesive forces in the molecules. This indicates that there is a significant interaction between phytochemicals of Brayophyllum leaves and the solvent. The decrease of adiabatic compressibility in extract of Brayophyllum leaves shows that there is formation of more hydrogen bonding in water solvent than the extract of ethyl alcohol, ethyl acetate and methyl acetate. The free length dependentson the adiabatic compressibility and inverse to that of velocity. Intermolecular free length is minimum in extract of Brayophyllum leaves in water shows strong molecular interaction in water solvent suggesting a structure promoting behavior when Brayophyllum leaves are extracted with the water solvent. Acoustic impedance is more in water extract shows more molecular interaction in water solvent while relaxation time varies irregularly shows specific interaction in the solution.

Table 1: The experimentally measured values of Velocity (U), Density (ρ), Viscosity (η) and the calculated values of Adiabatic compressibility (β_a), Intermolecular free length (L_f), Acoustic impedance (Z) and relaxation time at 303K and 2MHz frequency.

Extract	Density ρ (kg/m^3)	Ultrasonic velocity U (m/s)	Viscosity $\eta*10^{-3}$ (CP)	Adiabatic Compressibility β_a*10^{-10} (Pa^{-1})	Intermolecular free length L_f*10^{-10} (m)	Acoustic Impedance $Z*10^4$ (kg/m^2s)	Relaxation time $\tau*10^{-13}$ (Sec)
				T=303K			
Water Extract	1053.1	1715.5	0.9375	3.2252	0.0112	180.72	4.0317
Alcohol Extract	970.53	1453.50	0.9987	4.8781	0.0138	141.03	6.4957
Methyl Acetate Extract	991.80	1206.66	0.3443	6.9247	0.0164	119.67	3.0730
Ethyl Acetate Extract	932.32	1118	0.3997	8.5812	0.0183	104.23	4.5730

CONCLUSION

It is observed that ultrasonic velocity for extract of Brayophyllum leaves in water is high while adiabatic compressibility, intermolecular free length is minimum in the same extract which shows strong molecular interaction of the component of Brayophyllum leaves in water.

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