REFRACTOMETRIC STUDY OF SUBSTITUTED FLAVONES AT 294K

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A B S T R A C T
Refractive index plays vital role in many areas of material science. It is one of the most important optical properties of a medium. Similarly, measurement of refractive index is widely used in analytical chemistry. Refractive index can be used as means of measuring the purity of a liquid compound by comparing it to literature values. Refractive index, molar refractivities and polarizability constant of substituted flavones have been studied in ethanol at 294K, at different concentrations. The values of molar refraction (R_m) and polarizability constant (α) are found to be decreased with decreasing concentrations of solute in solvent. This data reveals solute-solute interaction, solute-solvent interaction and relationship between refractive indices – temperature.
Keywords: Optical property, Refractive index, molar refractivities, molar refraction, polarizability constant

1. Introduction

Refractometry is a technique that measures how light is refracted when it passes through a given substance. The amount by which the light is refracted determines the refractive index. Refractive index of a liquid is very important property which gives idea about geometry and structures[1] of molecules. Refractive index can be used to identify an unknown liquid compound[2] , or it can be used as means of measuring the purity of a liquid compound by comparing it to literature values. The closer the refractive index is to the literature value the purer is the sample. The refractive index (n) of the medium is the ratio of the velocity of light in air to velocity of light in medium. The refractive index is the ratio of angle of incidence to angle of refraction. Measurement of refractive index shows very interesting applications[3] in the pharmaceutical, chemical, agriculture, food , oil and beverages industries. The basic principle of refractometric measurements is to study the interactions between solute and solvent even in case of blend of two solvents. Polar solute when dissolved in water shows strong interaction while non polar solute increases the structuredness of water[4] . The knowledge of refractive index property at different temperatures of liquid mixtures is an important step for their structure and characterization. Along with other thermodynamic data, refractive index values are also useful for practical purposes in engineering calculations. Refractive index is useful to assess purity of substances, to calculate the molecular electronic polarizability.

Many researchers have reported the refractive indices in mixed solvent, binary mixtures. Results of refractometric measurements directly gave information regarding solute-solvent, solvent-solvent interactions. Taking all these things into consideration the present investigation was carried out in various percentage compositions and at 294K for substituted flavones.

2. Experimental

2.1 Ligands

The ligands L_1, L_2, L_3, L_4, L_5 and L_6 were used for present ultrasonic measurements. Ethyl alcohol used in analysis was purified.

1) 6-methyl flavones (L_1)
2) 6-methyl-8-nitro- flavones (L_2)
3) 6-methyl-8-bromo flavones (L_3)
4) 6-chloro flavones (L_4)

5) 6-chloro-8-nitro flavones (L_5)
6) 6-chloro-8-bromo flavones (L_6)

2.2 Solvent

Distilled water :

Carbon dioxide free double distilled water used. Distilled water obtained in a steel container was again redistilled over alkaline potassium in glass-fit set up and was always used fresh of pH = 6.89± 0.01.

Ethyl Alcohol

Ethanol was purified by the method described by Vogel[5].

2.3 Thermostat

A special thermostatic arrangement was done for density and ultrasonic velocity measurement. Elite thermostatic water bath was used and temperature variation was maintained within ± 0.1°C.

2.4 Refractometric Technique

The branch of optical technology dealing with the methods and means of measuring the refractive index of solid, liquids and gaseous media in various regions of the optical radiation. If the refractive index n and its dispersion D are known, it is possible to determine other quantities dependent on n and D.

2.5 Types of Refractometer

1) Traditional Handheld Refractometer
2) Digital Handheld Refractometer
3) Inline process Refractometer
4) Abbe's Refractometer

The ligands of which physical parameters is to be explore are synthesized by using reported protocol[6] .In the present investigation, refractive indices of liquid mixture were measured with the help of Abbe's refractometer, specially designed to measure the refractive indices of the small squantities of the transparent liquid solution ranging from 1.300 to 1.700 rapidly by direct reading. The refractometric measurements of substituted flavones (L_1 to L_6) have been investigated at 0.01M concentration at 294K in different percentage composition.

The molar refractions were calculated for 75%, 80%, 85%, 90% and 95% ethanol-water mixture for all six ligands at temperature 294K.Then the resulted data was used to evaluate the polarizability constant(α).The intermolecular interactions were studied from molar refraction and polarizability constant.

3. Results and Discussion

The refractometric study of L_1 to L_6 ligands at 294K and with different percentage composition to find the molar refraction (Rm) and polarizability constant (α). With the help of following equations Rm and α :

$$R_m = \frac{(n^2-1)}{(n^2+2)} \times \frac{M}{d} = 4/3\ \pi N\ \alpha$$

These refractometric parameters used to study the intermolecular interactions[7].

The present work deals with the interaction of L_1 to L_6 in different % composition like 75,80,85,90 and 95% of ethanol+water at 294K.

3.1 **Molar refraction (Rm)**

X-Axis %Ethanol,Y-Axis Rm

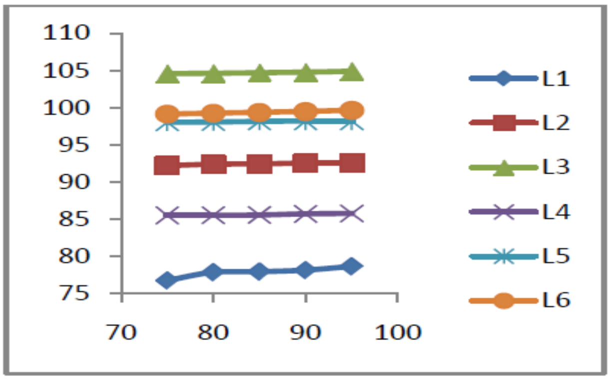

Fig.1

3.2 Polarizability constant (α)

X-Axis %Ethanol ,Y-Axis α

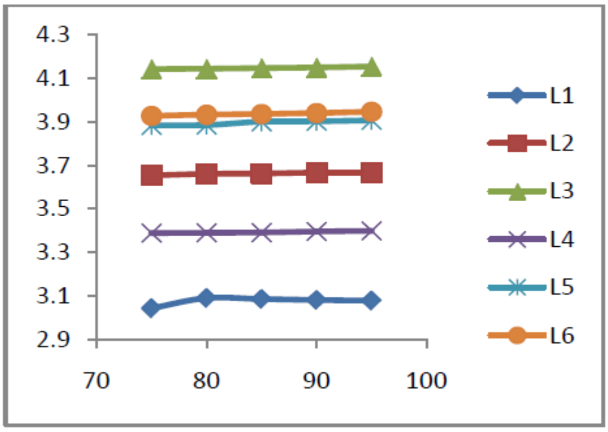

Fig.2

The above graphs show, concentration is directly proportional to molar refraction and polarizability constant[8].The value of molar refraction goes on decreasing with the decrease in amount of water in percent mixture. The molar refraction is greater in polar protic solvent than polar aprotic solvent[9].

The temperature of solution is inversely proportional to the density and refractive index for all ligand at all concentration[10]. Due to the temperature increase, randomness of solute molecule in solution also increases shows weak the molecular interactions.

Molar refraction showed linear relationship with concentration. Ligands showed following trend at 294K:

$L_3>L_6>L_5>L_2>L_4>L_1$

From this it is observed that refractive index and density increases with the increase in percentage composition of organic solvent. Those solvent having more value of dipole moment shows greater refractive index and density, also there is same trend for ligands. Ligand having more dipole moment shows greater value of refractive index and less value of density. The bulky substituents $–NO_2$,-Br on the molecule is not only factor in trend of refractive index but the reactivity and stability as well as electron donating nature, presence of hetero atom in ligands, and compactness in the molecule will directly hampered results and trend in the refractive index[11].

From above graphs it showed that polarizability constant directly proportional to concentration of ligands. Substituted flavones from L_1 to L_6 showed following trend as:

$L_3>L_6>L_5>L_2>L_4>L_1$

L_3 ligand showed highest value of polarizability constant where as L_1 ligand showed lowest value. Ligand having more dipole moment shows greater value of refractive index and less value of density[12]. The bulky substituents like –NO_2, -Br,-Cl electron donating and electron withdrawing group nature affects the polarizability constant value[13].

4. Conclusion

In the present work these refractometric parameters were studied for synthesized ligands, which are used as solutes.

The refractometric parameters studied in the present work are in pure solvents and interactions are interpreted. The further study of these parameters with different percentage composition of solvent at 294K temperature in all the mixtures may be carried out which will confirm or correct our interpretation.

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