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Research Article

Studies in the Measurements of Refractive Index of Substituted Thio-Carbamidonapthols In 100% & 90% Binary Mixtures of 70% Etoh-H_2O Mixture at 298.15 K

[1]S. R. Khan, [2]M. S. Lunge, [3]D. T. Tayade

[1]Department of Chemistry G. V. I. S. H., Amravati (M.S.) 444 604
[2]Department of Chemistry, Jagadamba Mahavidyalaya Achalpur, Dist: Amravati
[3]Department of Chemistry G. V. I. S. H., Amravati (M.S.) 444 604

A B S T R A C T

After synthesis of any chemical moiety; physico-chemical properties of that chemical moiety must be investigated. These are essential for predications of medicinal, agricultural, industrial, biochemical and biological applications theoretically and refractometric measurement is one of the best method for the determination of the same in the drug chemistry. Refractometric measurements of chemical moiety are one of the important study for understanding the pharmacokinetics study of synthesized or isolated chemical moiety. Considering all these things refractrometic measurements of 4-amino-1-naphthol [4-AN], 4-phenylthiocarbamido-1-naphthol [4-PTCN], 4-*p*-chlorophenylthiocarbamido-1-naphthol [4-*p*-CPTCN] and 4-*p*-tolylthiocarbamido-1-naphthol [4-*p*-TPTCN] have been carried out at 100% and 90%, binary mixtures of 70% ethanol-water mixtures in 0.002, 0.004, 0.006, 0.008 and 0.01M concentrations at 298.15K were successfully investigated and gave good resultss.

Key words: Refractive index, binary mixture, substituted thiocarbamidonapthols, 298.15K

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*Address for Correspondence:
S. R. Khan, Department of Chemistry G. V. I. S. H., Amravati (M.S.) 444 604

INTRODUCTION:

Refractive index is one of an important property of liquid and has been considered as one of the most important parameters used to be monitored pharmacokinetics and pharmacodynamics of the drug. A well-known device typically used for this purpose is the traditional Abbe's refractometer[1]. Refractometer is use to detect the refractive index[2]. Refractometry is also an important aspect in the field of pharmacology. Pharmacology is the study of the actions, mechanisms, uses and adverse effects of chemical moiety. A chemical moiety is any natural chemical moiety or synthetic chemical moiety that alters the physiological state of a living organism.Refractive index can be affected by nature of solvent, temperature, wavelength of light, pressure and concentration of solute in solution. Temperature influences the refractive index of a medium primarily because of the accompanying change in density, for many liquids, the temperature coefficient lies in the range of -4 to -6 $x10^{-4}deg^{-1}$. Water is an important exception, with a coefficient of about $-1x10^{-4}deg^{-1}$. The refractive index of a transparent medium gradually decreases with increasing wave length; this effect is referred to as normal dispersion. This means that the refractometer has got the ability to measure and analyze lipids, oil, paints, food, lacquered and chemical substances, alcohols and solvent elements[3]. Literature survey also reveals that much work have been reported to study the properties of liquid such as refractive index along with the density, ultrasonic velocity and viscosity of binary and ternary liquid mixtures[4-6]. Refractive index of ternary system i.e. isopropyl alcohol-cyclohexane-water system is reported[7]. Density, speed of sound, viscosity and refractive index of binary system of hydrazone (HCAIH and HMAIH) in DMF is reported[8]. Refractometric study of s-triazinothiocarbamides in 70% water-dioxane mixtures had been successfully investigated[9]. Refractometric study of ternary mixture of 2-aminothiazole in DMF-water at different temperatures is reported[10]. Abbe's instrument is widely used as one of the indispensable tools in petroleum, oil and fats pharmaceutical paint, food, chemical and sugar making industries as well as in the factories and research institutes concerned with geological survey. The material with significantly different physical properties that when combine to produce a material with characteristics from individual components are used for construction. Individual component remains same, separated and distinct within the finished structure. The new material may be preferred for many reasons common examples include materials which are stronger, lighter or less expensive. The material use in the construction of refractometer are prism, cylinder, biometric strip, scale lens, illuminating flap, reflector, lamp, mirror, rubber grip, sensor, calibration screw[11]. Refractive index and density of binary liquid mixtures of Eucalyptol with hydrocarbons at various temperatures is reported[12]. Studies on molecular interactions between the components of liquid mixtures are of the great importance[13]. Spectroscopic methods have been used for the study of molecular interactions of number of various types of solutions[14-16]. However, the refractive index measurement[17] for the study of molecular interactions in liquid mixtures are very limited. Binary mixtures of ethyl chloroacetate[18] with cyclohexanone, chlorobenzene, bromobenzene and benzene alcohol and of dimethyl ether of a glycol and ethanol have been studied refractometrically[19]. Molecular interactions of bromoalkanes and non-polar hydrocarbons have been carried out by refractometrically[20]. Molar refraction and polarizability constant of 2-amino-5-chloro benzoin sulphuric acid in different percentage of dioxane-water mixture is reported[21]. Refractive index in mixed solvents were successfully carried out[22,23]. Dielectric constant and refractive index of binary mixtures was successfully determined[24]. Molar refraction and polarizability constant of Al(III), Ce(III) and Fe(III) complexes with substituted isoxazolines, pyrazole and pyrazoline were determined by refractimetrically[25].

In pharmaceutical, chemical, petrochemical, automotive and aviation industries and metal processing and building technology, the characterization tests in research and development in drug, identity test, and purity control and concentration determination of raw materials, semi-finished products and end products can be easily carried out by refractometric measurements. In food industry quality and purity control of raw materials and end products can be easily determined by refractometric measurements. Quality control of raw materials and auxiliary materials monitoring of the production of semi-finished products and end products can be judge by refractometric measurements. In beverage industry the routine analysis with high sample throughput the quality and purity control of raw materials and end products, determination of the sugar concentration in juices and alcohol-free beverages, determination of the alcohol or extract content in beer, spices, wine or spirits, quality control of dairy products and sewage water check can be done by refractometric measurements. Considering all these things refractrometic measurements of 4-amino-1-naphthol [4-AN], 4-phenylthiocarbamido-1-naphthol [4-PTCN], 4-*p*-chlorophenylthiocarbamido-1-naphthol [4-*p*-CPTCN] and 4-*p*-tolylthiocarbamido-1-naphthol [4-*p*-TPTCN] have been carried out at 100% and 90%, binary mixtures of 70% ethanol-water mixtures in 0.002, 0.004, 0.006, 0.008 and 0.01M concentrations at 298.15K were successfully investigated and gave good results.

Experimental

In present research work refractive index is measured by using refractometer AtagoDR-A-1 Japan. At first the refractometer was calibrated with distilled water (1.3333 at 303.15 k), din refractive index of each pure solvent is measured was measured by using refractometer at different temperatures all the measurements were perform at the wavelength of sodium D-line. The accuracy of the average refractometer was within ± 0.0002 unit. The temperature of prism box was maintained by circulating water around the prism jacket by controlled thermostatic water bath MSW–274 of Macro scientific work private limited Delhi. Specific refraction (*r*) is calculated by Lorenz and Lorenz equation as,

$$= \frac{n^2-1}{n^2+2} \times \frac{1}{p}$$

where, *r* is specific refraction; *n* is a refractive index of liquid mixtures and *p* is the density of liquid mixtures.

Solvents

Ethanol

Extra pure (E. Merck) ethanol was further purified by the prescribed procedure and used for preparation of drug solutions.

Distilled water

Distilled water redistilled by using alkaline potassium permanganate in a glass fit setup and was always used a fresh through work. CO_2 free double distilled water was used (pH = 6.89±0.01).

Chemical moieties i.e. organic compounds

4-Amino-1-naphthol [4-AN], 4-phenylthiocarbamido-1-naphthol [4-PTCN], 4-*p*-chlorophenylthiocarbamido-1-naphthol [*p*-CPTCN] and 4-*p*-tolylthiocarbamido-1-naphthol [*p*-TPTCN] were synthesized in the laboratory.

Instrument

Abbe's Refractometer - 2WAJ-T was used throughout the research work for determining the refractive index. Attachment: 1 x Refractometer, 1 x screwdriver, 1 Digital thermometer and user's manual. The Abbe-2WAJ-T Refractometer is a simple device to with a high resolution. It is able to perform multiple functions. It is a tabletop instrument to quickly and accurately determine the refractive index nD (between 1.300 and 1.700), Average colour dispersion NF-NC of transparent and semitransparent liquid or solid, as well as the sugar content in liquids, dispersions, emulsions and other translucent substances, with this refractometer we are able to determine the refractive index with a temperature range from 0 ... to + 70ºC by using the thermometer included in the delivery. The temperature can be controlled by means of an external thermostat with incorporated water tube adapters in the upper and lower prisms. It also allows you to determine the sugar content with a range of 0 ... 95% (1,333 ... 1,531) accurately.

Method

The 0.01M solution of drugs [4-AN], [4-PTCN], [4-*p*-CPTCN] and [4-*p*-TPTCN] were prepared in 100% ethanol-water binary mixture of 70% ethanol-water mixture. Same solution was prepared for 90% ethanol-water binary mixture binary mixture of 70% ethanol-water mixture, similarly 0.008M, 0.006M 0.004M and 0.002M solutions of the same drugs were prepared for 100% and 90% binary mixture of 70% ethanol-water mixture in 100 ml volumetric flask. Then in 50 ml Borosil glass beaker first drug solution was taken and it was kept inside the thermostat for 15-20 minutes to attain the thermal equilibrium 298.15 K, after achieving the thermal equilibrium, the refractive index of each solution was measured. The results obtained are given in **Table No.1** and **Table No.2**

Table 1: Refractive index (*n*D) and Specific refractivity (*r*) of 4-AN, 4-PTCN, 4-*p*-CPTCN and 4-*p*-TPTCN at T=298.15 K 100% Ethanol-water mixture of 70% ethanol-water mixture

Drug →	**4-AN**		**4-PTCN**	
Conc ↓	***n*D**	$r \times 10^{-4}$	***n*D**	$r \times 10^{-4}$
0.000	1.3425	2.4515	1.3582	2.5256
0.002	1.3427	2.4631	1.357	2.4918
0.004	1.3426	2.4444	1.3568	2.4906
0.006	1.3429	2.4376	1.3786	2.4969
0.008	1.3430	2.4343	1.3579	2.4989
0.01	1.3431	2.4316	1.358	2.5014
Drug →	**4-*p*-CPTCN**		**4-*p*-TPTCN**	
Conc ↓	***n*D**	$r \times 10^{-4}$	***n*D**	$r \times 10^{-4}$
0.000	1.3679	2.5492	1.3949	2.2096
0.002	1.3700	2.6155	1.395	2.3207
0.004	1.3702	2.6104	1.3952	2.3215
0.006	1.3697	2.5959	1.3954	2.3214
0.008	1.3702	2.5895	1.3957	2.3219
0.01	1.3695	2.7906	1.3959	2.3200

Table 2: Refractive index (*n*D) and Specific refractivity (*r*) of 4-AN, 4-PTCN, 4-*p*-CPTCN and 4-*p*-TPTCN at T=298.15 K 90% Ethanol-water mixture of 70% ethanol-water mixture

Drug →	**4-AN**		**4-PTCN**	
Conc ↓	***n*D**	$r \times 10^{-4}$	***n*D**	$r \times 10^{-4}$
0.000	1.3411	2.4618	1.3567	2.529
0.002	1.3405	2.4683	1.3563	2.4973
0.004	1.3409	2.4672	1.3562	2.4990
0.006	1.3407	2.4658	1.3467	2.5108
0.008	1.3408	2.4607	1.3568	2.5091
0.01	1.3410	2.4568	1.3569	2.5057
Drug →	**4-*p*-CPTCN**		**4-*p*-TPTCN**	
Conc ↓	***n*D**	$r \times 10^{-4}$	***n*D**	$r \times 10^{-4}$
0.000	1.3662	2.5560	1.3930	2.3195
0.002	1.3697	2.6227	1.3931	2.3182
0.004	1.3690	2.6089	1.3932	2.3181
0.006	1.3684	2.5937	1.3939	2.3208
0.008	1.3679	2.584	1.391	2.3202
0.01	1.3678	2.5798	1.3943	2.3202

Results and Discussion

It is observed from **Table No.1 to Table No.2** refractive index and specific reactivity decreases when temperature increases. This is due to when temperature increases solutions becomes less dense and less viscous which causes light to travel faster in the medium and this is responsible for decreasing refractive index. It means that refractive index is inversely proportional to temperature. It is also observed that when the concentration of solute increases means numbers of molecules (solute) in the solution increases which increases more chances of hitting the molecules into the solution; which slow down the light as it goes through absorption and reemission causing increase in the index of refraction, from this it is clear that refractive index of any medium depends on temperature, wave length of light and optical density. When the temperature increases then refractive index decreases and vice versa. Refractive index is also depending on wave length of light; i.e. refractive index is directly proportional to wave length of light. Refractive index of solution increases when optical density increases; in this case when optical density increases mean the extent to which a light beam is deflected. It observed that, with increasing the percentage of solvent the molar refractivity (true molar volume) decreases. This may be attributed to the fact that the dipole in the organic compounds lies perpendicular to the longer axis of the molecules and with increase in the percentage of solvent causing decrease in the dielectric constant of the medium. Considerable dipole association (intermolecular attraction) takes place which would be accompanied by decrease in refractivity because of mutual compensation of the dipoles.

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