

CHAPTER- X

CONCLUDING REMARKS

In chapter II subjects discussed in this thesis were introduced. Some thoughts on host-guest chemistry were discussed and how this type of study offer new opportunities, were brought forward.

Due to the major advantage of CDs to act as drug delivery vehicles, it is proposed to study CD complexation of various significant mol an important constituent of numerous pharmaceutical products, by using analytical techniques at different pH values. The proposed studies employ cyclodextrins as potential drug delivery vehicles because of their ability to alter the physical, chemical and biological activities of guest molecules through formation of inclusion complexes. The principal advantages of natural cyclodextrins as drug carriers are the following: (1) well-defined chemical structure, yielding many potential sites for chemical modification or conjugation (2) availability of cyclodextrins of different cavity size (3) low toxicity and low pharmacological activity (4) certain water solubility (5) protection of included/conjugated drugs from biodegradation.

The aim of the works embodied in this thesis was to explore the assortment of interfaces of some Ionic Liquids by physicochemical approach. Here, I have studied the molecular as well as ionic interaction on ionic liquids in some solvent systems. The molecular interactions occurring in the solution systems have been studied with the help of physicochemical, thermodynamic, transport and optical properties along with spectroscopic studies.

The study reported in this thesis explains the procedures and results as well as the studies of the molecular interactions of ionic liquids in different solvent systems and somewhere ionic liquid as solvent media with other as solute. The overall goal was to look into the structure, property and interaction of ionic liquids in different solvent

media. Therefore the systematic study of these properties has great importance in gaining a better knowledge about different interactions.

The volumetric, viscometric, interferometric, conductometric refractive index studies helped us to evaluate the extent of molecular interaction in a particular solution quantitatively whereas the spectroscopic measurements gave an insight into the type of molecular interaction occurring in any solution systems. Various types of interactions exist between the ions in solutions, and of these, ion-ion and ion-solvent interactions are of current interest in all branches of chemistry. These interactions help in better understanding the nature of solute and solvent, that is, whether the solute modifies or distorts the structure of the solvent.

The consequences of my research lead to some new scientific results in host-guest chemistry, which can be served as explanations of the change of the physical properties of the guest molecules. The investigations on the host-guest inclusion complex formation processes provides explanation about the driving force present in inclusion complex and also structural arrangement. The results of this study have provided data to new research and development tendency, to the theoretical and practical basis of the host-guest chemistry.

The surface tension, conductance and NMR study gives the clear indication of 1:1 host-guest inclusion complex formation of a series of surface active ionic liquids, benzyltrialkylammonium chloride $[(C_6H_5CH_2)N(C_nH_{2n+1})_3Cl]$; where $n=1,2,4$] with aq. β -cyclodextrin reveal in Chapter IV. The study also expose that benzyl, the hydrophobic group of ionic liquids encapsulated insight into the cavity of β -cyclodextrin and form the inclusion complex. This study also demonstrated that hydrophobic interactions and hydrogen bonding contribute to the inclusion of ionic liquids in CDs. It was found that addition of β -CD causes the shifting of micellization of the ionic liquids towards the higher concentration. This indicates the inclusion complex formation between the ionic liquids and β -CD.

Considering the showing the amantadine ion can bind nicely to three of the six available oxygen atoms in the 18C6 ring to form a stable complex (scheme 2) with 1:1 stoichiometry have been studied. The N-H...O hydrogen bridges between the ammonium functionalities and the oxygen acceptor heteroatoms of the crown ethers

play a significant role in packing the host-guest complexes. The stable complex formation is established by physicochemical methods surface tension measurements, conductivity and IR study and the density data also support the interaction between amantadine ion and 18C6 systems. The inclusion complex formation has been explained qualitatively as well as quantitatively so as to make it dependable in its field of application.

The Host-guest complex formation based on the macrocyclic molecules is a facile and reversible process, which provides the feasibilities to design stimuli-responsive supramolecular systems and these macrocyclic molecules are basically friendly to the biological environment and exhibit good biocompatibilities. Crown ether-based host-guest interactions, which show good selectivity, high efficiency, and reversibility, have been structurally characterized and the underlying supramolecular chemistry has been presented in this work. Supramolecular chemistry i.e host-guest complex formation through noncovalent interactions offer the basis for novel approaches in medicine and also helps in understanding the interactions present in living systems. It was also found that host-guest complexation with crown ethers resembles an established principle i.e the hydrogen bonding acceptance as well as the donation propensity of crown ethers. Amantadine is an antiviral agent that specifically inhibits influenza A virus replication at micromolar concentration. This drug is also very effective in the treatment of human Parkinson's disease. The host-guest complex is capable of protecting the drug molecule from chemical reactions and photochemical/thermal degradation in biological environment and the encapsulated drug can also be released sustainably from the cavity of macrocyclic molecule, achieving prolonged therapeutic effect.

An extensive study was done on the ion-solvation behavioural aspect of the IL 1-butyl-3-methylimidazolium chloride in industrially-important non-aqueous polar solvents acetonitrile (CH_3CN), dichloromethane (CH_2Cl_2) and tetrahydrofuran ($\text{C}_4\text{H}_8\text{O}$) with the help of conductometric, FTIR, density and viscosity measurements has reveals in chapter VI. From the conductometric measurements it becomes clear that the IL exists as ion-pairs in acetonitrile and as triple ions in tetrahydrofuran, dichloromethane solvents. The tendency of the ion-pair and triple-ion formation of $[\text{bmim}][\text{Cl}]$ depends on the dielectric constant of the medium. The present study revealed that this type of

experimental study is being accompanied for a better understanding of the interionic interactions of ionic liquids. The evaluated values of thermodynamic functions of association suggest the spontaneity of the association process

The formation of three complexes of sulfa drug with several crown ethers in ACN have been investigated with the help of above mentioned spectroscopic and physicochemical studies. ^1H NMR data confirms the complex formation and the Job plot suggests the formation of complexes with 1:1 stoichiometry. The interaction of sulfa drug with crown ethers in the solution have been interpreted by density, viscosity, refractive index measurements. These measurements provide valuable information on ion-solvent and ion-ion interactions of the complexes in solutions. The association/formation constants are found highest for complex 2, then complex 1 and then complex 3 which indicates that SA form most stable complex with DC18C6 compared to other complexes. The probable structures of the three complexes of sulfa drug with crown ethers have been proposed by the above mentioned studies.

In this chapter VII we have found that the studied complexes are mainly stabilised by hydrogen bonds, and π -stacking play only a secondary role in case of complex 3 i.e complex of benzene substituted crown ether. The 1:1 complexation of the sulfa drug by different crown ethers proceeds spontaneously ($\Delta G^\circ < 0$). The roles of guest SA has been established in directing the formation of supramolecular architectures between crown ether and $-\text{NH}_2$ group of $-\text{SO}_2\text{NH}_2$ in SA by host-guest hydrogen-bonding interactions. Here the present work helps to understand the vital role of $-\text{NH}_2$ group in the design and construction of supramolecular host-guest materials. These results are also significant for other host-guest systems. However, with the knowledge acquired from the solution chemistry of SA-Crown complexes, we believe that the scope and future prospect of this type of studies with other supramolecules are also a promising preposition.

In chapter VIII the entire study reveals the fact of formation Host-Guest inclusion complex with 1:1 stoichiometry. The density and viscosity study confirms the formation of inclusion complexes between the drug and β -CD molecule. The single break point at the concentration near to 5mM of CD obtained from the surface tension study and Conductometric study indicates the formation of the inclusion complexes with 1:1

stoichiometry. From the UV-VIS spectroscopic data binding constant was calculated using Job's plot, which clearly explains that the drug molecule MP forms more effective inclusion complex. Taking all the parameters and results in account the plausible mechanism of the inclusion was depicted.

The conductometric titration data support the different types of interactions responsible for complex formation of crown ethers with IL molecule and are consistent with the IR and NMR spectra. The stability of complexes between planar, five-membered imidazolium cations and crown ethers were established by the different types of non-covalent interactions. We have found that the studied complexes are mainly stabilised by hydrogen bonds, and π -stacking or cation- π interactions play only a secondary role in case of complex 2. Larger formation constant value for complex 1 compared to complex 2 determined by conductivity study indicates that imidazolium cation form stable complex with 18C6 compared to DB18C6 in ACN solution. The 1:1 complexation of the imidazolium based IL by different crown ethers is driven by favourable changes in enthalpy ($\Delta H^0 < 0$) and proceeds spontaneously ($\Delta G^0 < 0$). This study also helps to get important information about the other host-guest system with crown ethers have been discussed in chapter IX.

The broad studies of the different physicochemical, thermodynamic, transport and spectral properties of the ionic liquids in different solvents will be of sufficient in understanding the nature of the ion-solvent interactions and the role of solvents in different chemical processes. Here in this research work I have also tried to explore the formation of Host-Guest inclusion complexes between ionic liquids and cyclodextrins and the formed inclusion complexes have been confirmed by Conductance, Surface tension, UV-Visible and NMR spectroscopy. Such type of ionic liquids are very important in pharmaceutical industry, cosmetic and hygiene industries, food industries, paint industries and it also increases in speed of diagnostic test reaction. So, it may be concluded that our research work has adequate significance in the different branches of Sciences and demands a far reaching effect for the augmentation of the advanced research.