Exploring the Synergy of Ionic Liquids and Inositol: A Chapter on Novel Applications and Molecular Interactions

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Graphical Abstract

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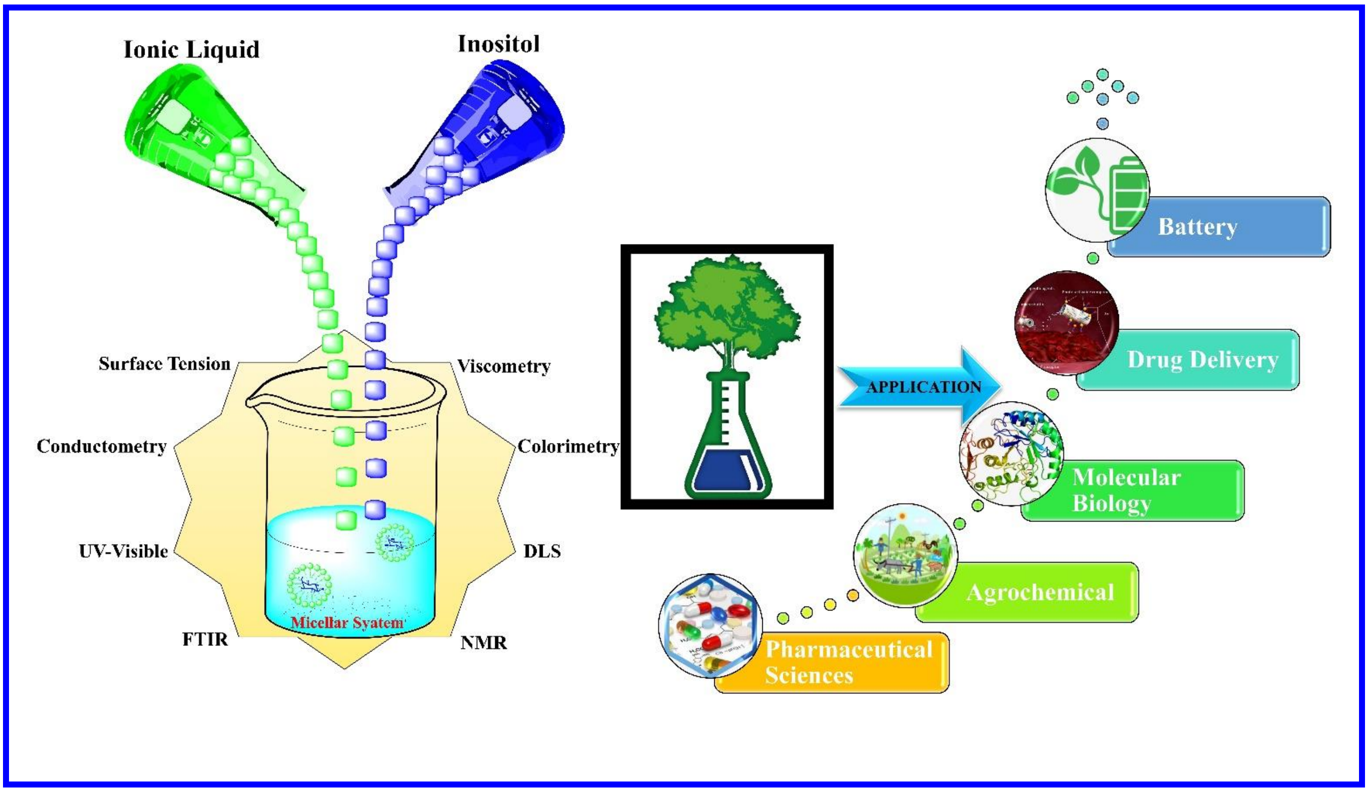

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Abstract

In this chapter, ionic liquids and inositol are discussed and an array of novel applications and molecular interactions are revealed. A variety of applications have emerged for ionic liquids, which are characterized by their unique physicochemical properties. Similarly, inositol, a polyol pivotal to biological systems, has been gaining attention for its health benefits. An overview of ionic liquids and inositol is provided in the first chapter, setting the stage for an understanding of their collaborative potential. This synergy then leads to innovative applications. Combined approaches to drug delivery, materials synthesis, and green solvents offer a wide range of potential opportunities. These applications are based on molecular interactions, which are central to this exploration. In order to gain an understanding of the driving forces behind the observed synergies, we need to dissect these mechanisms. Moreover, pharmaceuticals, energy, and environmental sustainability are discussed in light of their potential implications. The combination of inositol and ionic liquids presents a promising avenue for achieving sustainable solutions. This chapter underscores the transformative power of their collaboration, presenting a tapestry of opportunities for scientific advancement and technological innovation. As research progresses, this synergy holds the promise of reshaping conventional practices and driving progress towards a more sustainable and healthier future.

Keywords: Ionic Liquids, Inositol, Physicochemical, Collaboration, Sustainable, Application.

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1. **Introduction**

Ionic liquids have recently revolutionized research facilities and the chemical sector. They are a crucial target for the development of a wide variety of developing technologies, including medication delivery, catalysis, sensors, agriculture, nanoscience, pharmaceuticals, biopolymer processing, colloidal sciences, waste recycling, etc., in addition to their special solvent characteristics [1-2]. Ionic liquids (ILs), a new class of solvents, have distinct characteristics. These substances, which are included in green chemicals like solvents, are crucial in lowering the usage of potentially dangerous, poisonous, and ecologically damaging substances. As shown in **Fig. 1**, there are now three distinct generations of ILs that can be distinguished [3].

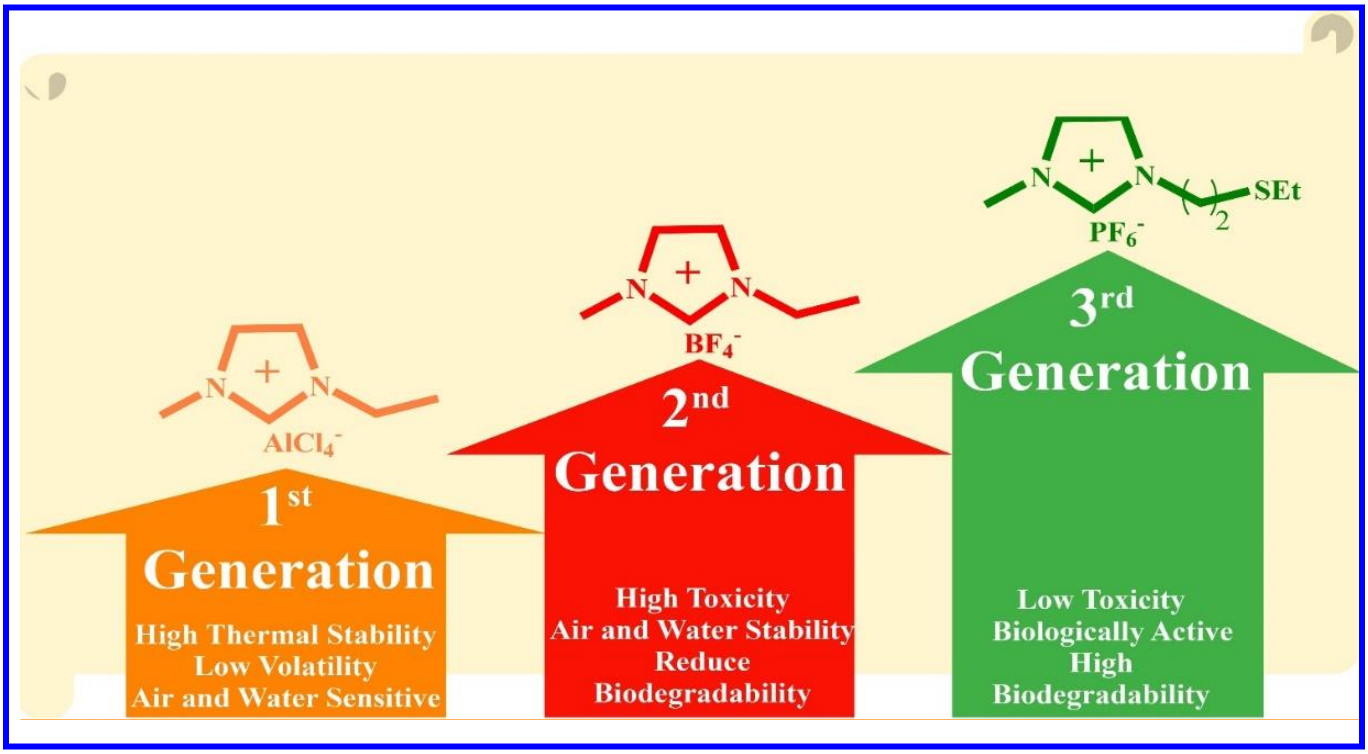

Fig. 1 Systematic representation of ionic liquid generations.

The ionic liquids (ILs) are salt-like green chemicals that are in a liquid state. The ionic liquids are just ionic = ions (cations+anions) and liquid = molten state. Whose melting point is below some of the erratic temperatures viz. 100°C also variously called molten salt, ionic fluids, fused salt, ionic melts, etc. ILs are dynamic green solvents it can be used in various fields. Many researchers have shown a special interest in ionic liquids in the last few years [4]. ILs are versatile properties such as low vapour pressure, low melting point, high thermal stability, good electric conductivity, easily recyclable and green solvents, task-specific solvents, etc. There are strong interactions with different molecules because ILs have high lattice energies that could have the ionic bond usually stronger than the Van der Waals bond. Developing a toxic-free, eco-friendly product is a significant challenge in our society it has promoted sustainable chemistry using green and non-toxic products to create fruitful products and protect nature [5].

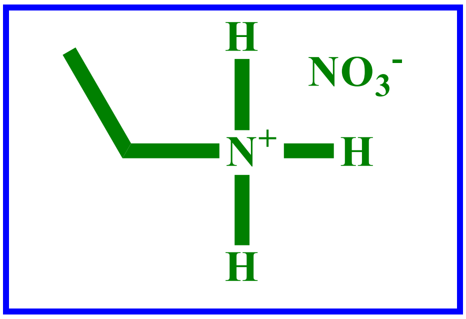

Fig. 2 Ethyl ammonium nitrates

2. History

The history of ionic liquids (ILs) (green solvents) dates to 1914 with the synthesis of the first ionic liquids "ethyl ammonium nitrates" (**Fig. 2**) at room temperature by German chemist **Paul Walden** (**Fig. 3**) appearing at a melting point of 12℃. In place of nitro-glycerine, these ionic liquids have been employed to make explosives. In 1934, ionic liquids were produced for the electrodeposition of aluminium in combinations of aluminium chloride and 1-methyl pyridinium bromide [6].

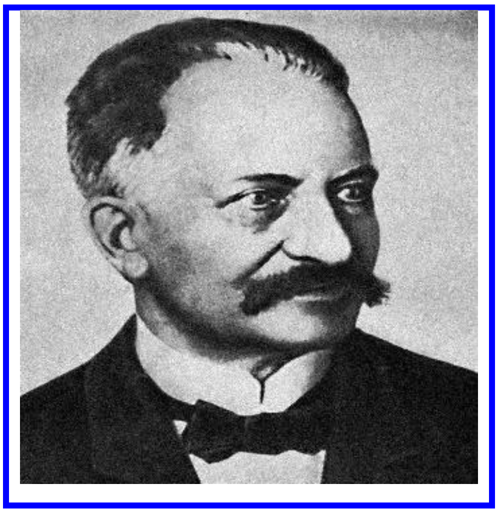

Fig. 3 Paul Walden-1914

3. Defination

"Ionic liquids are salts that are liquid at temperatures below 100°C, or even at room temperature, and include weakly coordinated ion pairs. A stable crystal lattice cannot form in the presence of one organic element and at least one ion with a delocalized charge [7]."

4. Structure of ionic liquids

The ILs structure consists of various types of cations and anions (**Fig. 4 and 5**). The positive charge such as cations are played a huge role in an organic compound and the negative charge i.e., anions are little amount of their formation of a structure that is an inorganic compound. The bonding with cations and anions is weak and these compounds have a molten state at arbitrary temperatures below 100˚C because ionic liquids have a salt-like structure, the salt structure has a strong crystalline structure, which melts at very high temperatures, but ionic liquids tend to melt between room temperatures below 100°C. Between these temperatures, they are called ionic liquids. Some ionic liquids are liquid at room temperature, they are called RTIL (room temperature ionic liquids) [8-9].

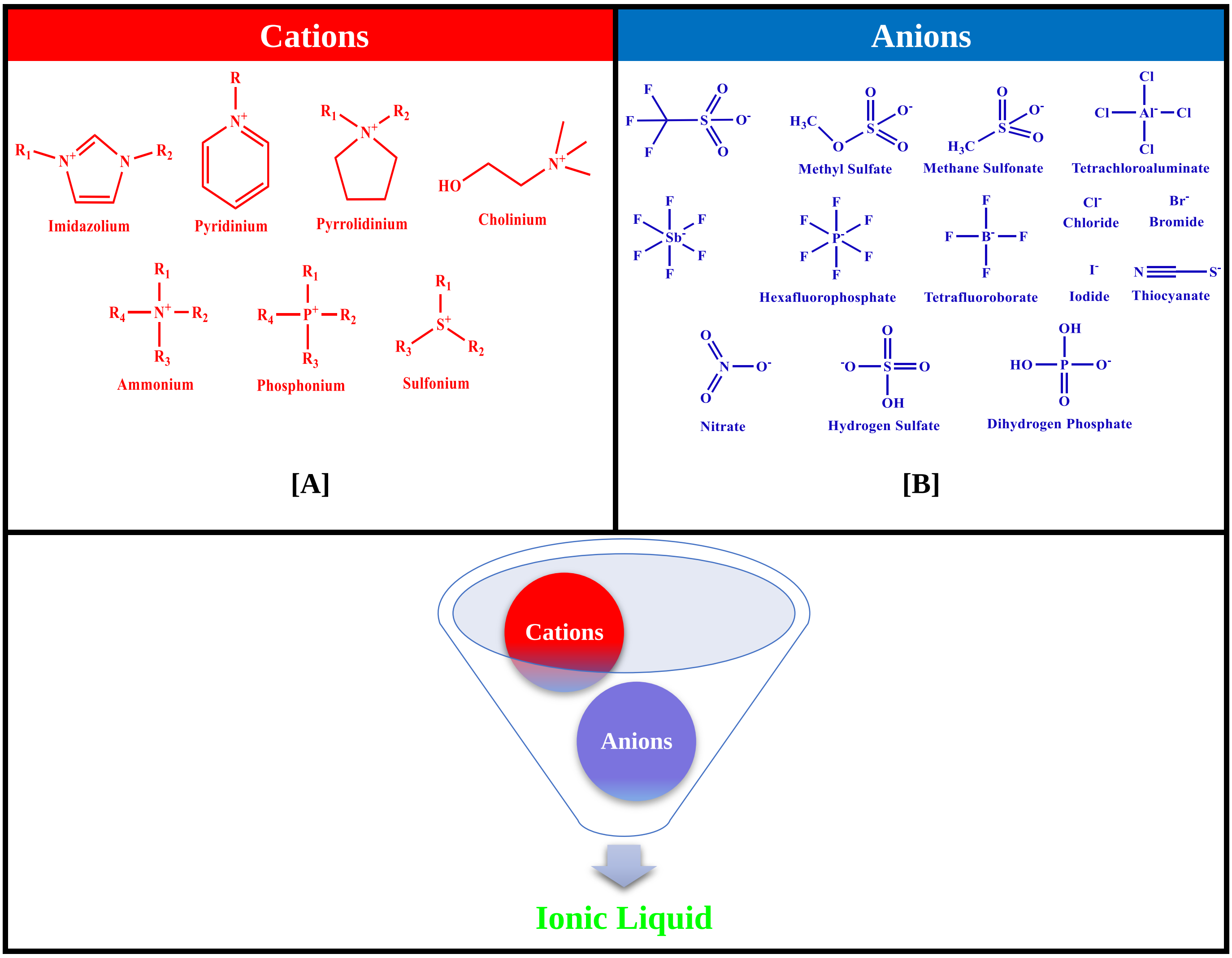

Fig. 4 Structure of different ionic liquids, [A] Cations, [B] Anions.

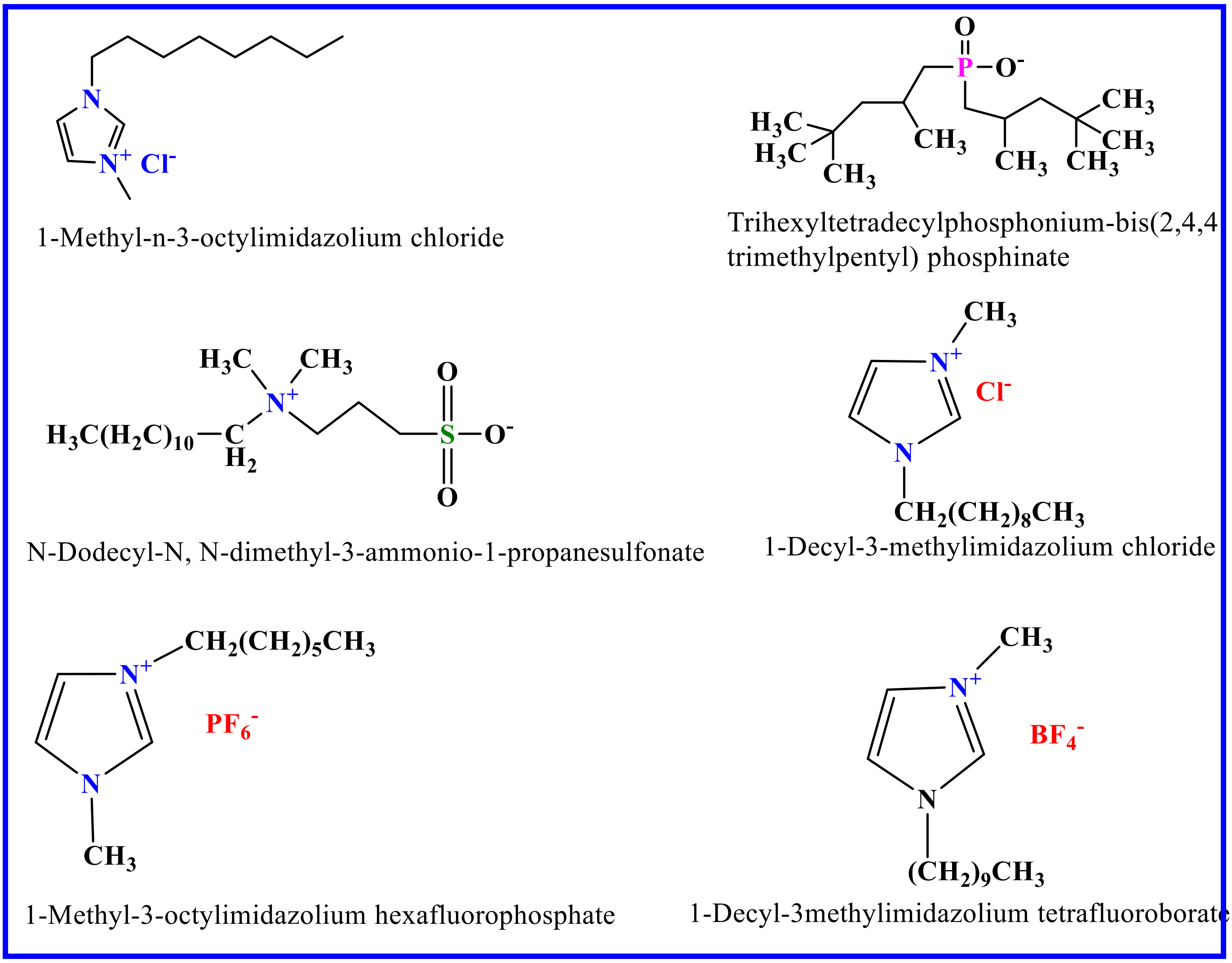

Fig. 5 Some molecular structures of ionic liquids.

5. Different generations of ionic liquids

ILs have drawn the great attention of scientists since the mid-1990s. Since then, they have garnered a lot of interest in several fields of scientific research. The Scopus database has had huge numbers of papers in the last few years, demonstrating the significance of ILs as a possible "green solvent." Recent years have seen widespread use of the second and third-generation ILs, which are more efficient and ecologically friendly than the first generation ILs [10-11]. The cations and anions of the second and third-generation ILs may be synthesized from cost-effective, ecologically favorable renewable resources. The notion of task-specific IL design for certain applications was inspired by the possibility of tailoring the unique cation and anion properties to enable the development of important new materials. As shown in **Fig. 6**, there are now three distinct generations of ILs that can be distinguished physical, chemical, and biological properties [12].

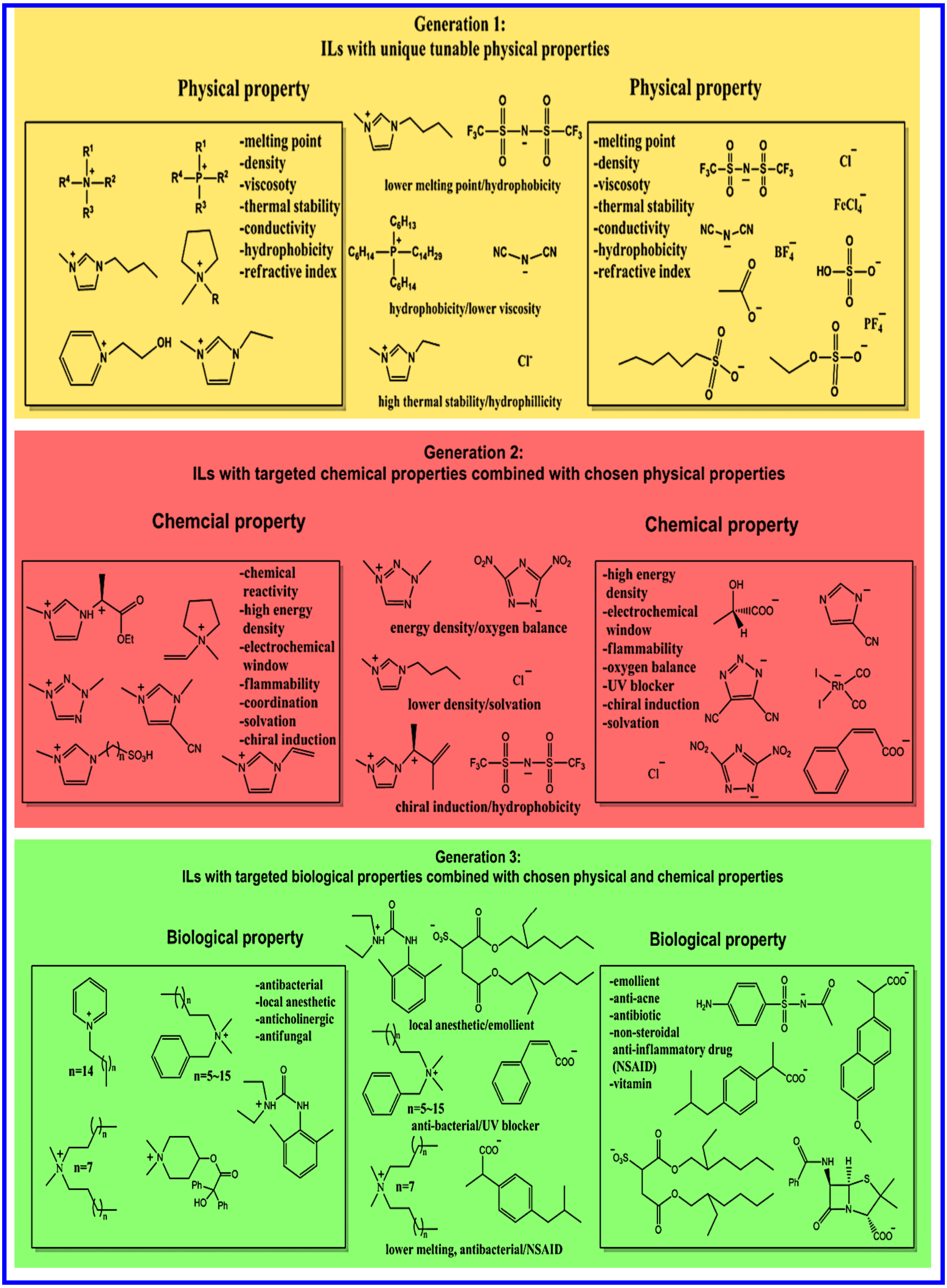

Fig. 6 Systematic representation of first, second and third generation ILs molecule with physical, chemical and biological property.

5.1.Physical properties of all generations

Solvents frequently employ ionic liquids. All generations properties have been shown in the **Table 1**. These compounds' cations or anions can be altered to improve their special physical characteristics. With the development of these molecules, a number of ionic liquids with particular chemical applications have been created. On the cation of these compounds, there are a number of distinct functional groups that can interact and carry out particular chemical processes [13]. The chemical substance is frequently utilised as a complex ligand or as a lubricant. These substances, which are referred regarded as the second generation of ionic liquids, are also chemically and physically stable. Similar to our structure, classical ionic units have been shown to be physiologically active and hazardous in several medicinal molecules. Based on these medications, a third generation of ionic liquids has been created. These substances exhibit ionic liquid-like physical characteristics as well as very low toxicity. In other words, our ionic ions may be turned into medicines [14].

Table 1 Representation of three generation properties

First Generation ILs	Second Generation ILs	Third Generation ILs
➢ Mainly composed of Cations and Anions. ➢ Toxic. ➢ Non-Biodegradable. ➢ Not suitable for Biotransformations. ➢ Air and Water sensitive. ➢ Cations– Dialkylimidazolium and Alkyl pyridinium derivatives. ➢ Anions- Chloroaluminate and Metal Halides.	➢ Made up of Cations and Anions. ➢ Toxic. ➢ Lower Melting Point. ➢ Soluble in organic solvents. ➢ Viscus solvents. ➢ High Kinetic and Thermal Stability. ➢ Reduce Biodegradable. ➢ Air and Water stable. ➢ Cations– Dialkylimidazolium and Alkyl pyridinium derivatives. ➢ Anions- BF^{4-}, PF^{6-}, and $C_6H_5CO_2$.	➢ Also Made up of Cations and Anions. ➢ Lower Toxic. ➢ Lower cost. ➢ Highly purified. ➢ High-Biodegradable. ➢ Biological Active. ➢ High Viscosity. ➢ Green solvent. ➢ Function-specific ILs. ➢ More Hydrophilic and Hydrophobic nature. ➢ Cations– Choline. ➢ Anions- Sugars, $[(CF_3SO_2)_2N^-]$, amino or organic acids, alkyl sulfates, or alkyl phosphates.

6. Classification

Ionic liquids (ILs) are most frequently categorized into two: aprotic ionic liquids (APILs) and protic ionic liquids (PILs) [15].

6.1.Protic ionic liquids (PILs)

In 1888, Gabriel released the earliest PILs, ethanol ammonium nitrate (EOAN). PILs are frequently made by combining equimolar amounts of bases and acids, neutralising bases with acids, or both. A PILs is a salt in which protons are transferred from Bronsted acid to Bronsted base, but APILs don't undergo these proton transfers due to their ionic structure [16]. The melting point of PILs is often lower and they are more fluid and conductible than ordinary polymers. A polymer membrane fuel cell operates well under non-humid and high-temperature conditions thanks to the properties of PILs as proton-conducting electrolytes. As a result of aggregation or ion complex formation, complete proton transfer is prevented, thereby limiting the ionicity of PILs [17]. The PILs properties have shown in **Fig. 7 (A)**.

6.2. Aprotic ionic liquids (APILs)

Aprotic ionic liquids (APILs) containing large irregular organic cations have due to having low melting points because they cannot be efficiently packed with a monoatomic or polyatomic inorganic anion. APILs are made using a basic process and ion exchange. APILs are one of organic chemistry's most significant solvent classes for experimental assessment of chemical and physical properties such as melting point, density, viscosity, and conductivity [18]. The APILs properties have shown in **Fig. 7 (B)**.

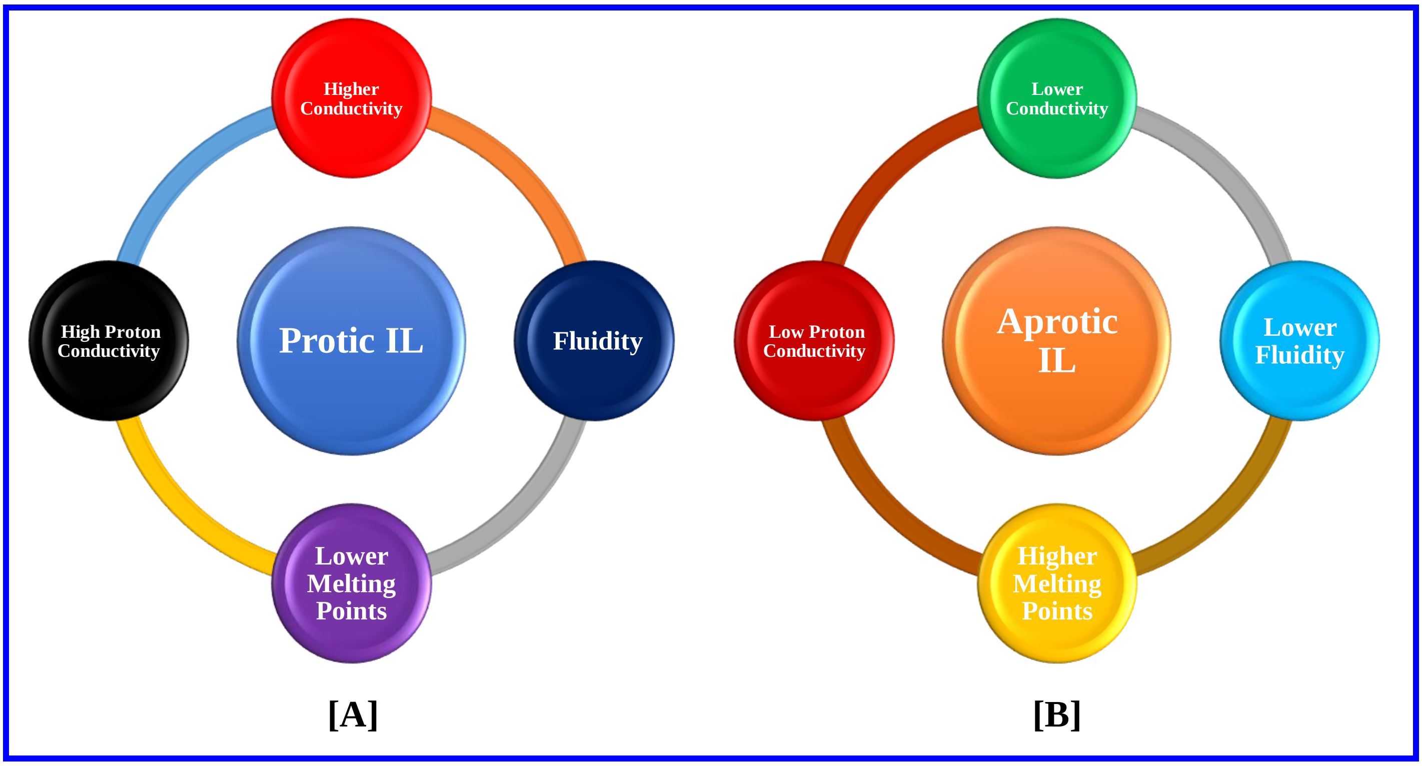

Fig. 7 [A] Protic ionic liquid (PILs) properties, [B] Aprotic ionic liquid (APILs) properties.

7. Properties of ionic liquids

The unusual physicochemical features of ILs, which may take on various forms depending on the known cations and anions they can combine with, have attracted scientific and industrial attention. They are also non-flammable and non-toxic, providing a safe working environment [19]. Furthermore, ionic liquids are highly tunable, allowing for the modification of their properties to suit specific applications. In summary, ionic liquids offer many advantages due to their low vapour pressure, tuneability, and non-toxicity **(Fig.8)**.

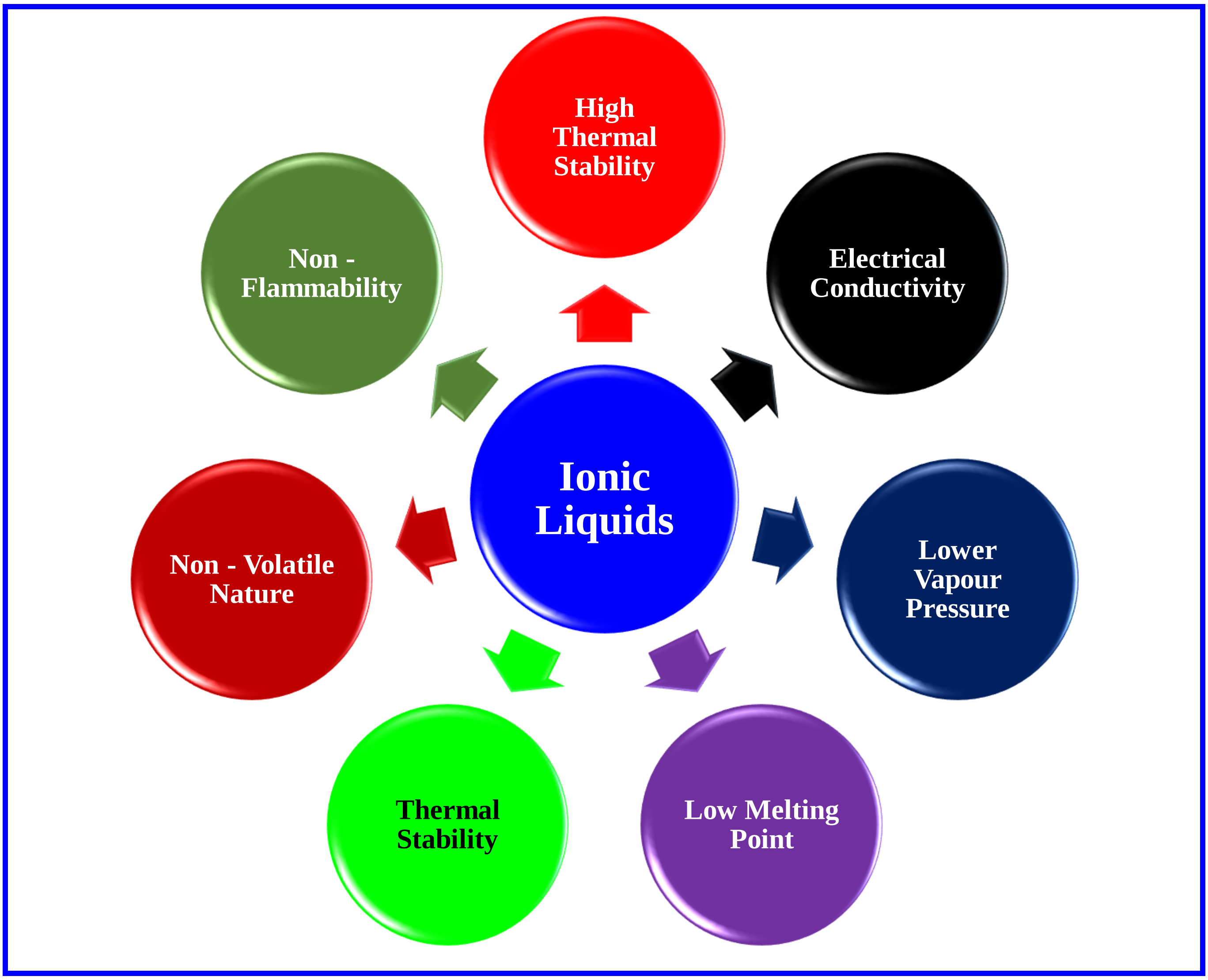

Fig. 8 Systematic representation properties of ionic liquids

8. Application of ionic liquids

ILs are now widely employed in many different fields of research and technology. ILs are most commonly used as green solvents in place of volatile solvents. Ionic liquids are used for a variety of additional things these days, some of which are briefly listed. main advantages of ionic liquids are that they are non-flammable, non-volatile, and thermally stable [20-22]. Additionally, their low vapour pressure makes them an attractive solvent for many reactions. Ionic liquids can be tailored to meet the specific requirements of a given application, making them a valuable tool in the modern chemical laboratory [23]. The versatile application of ILs have shown in **Fig. 9** and publication graph of ionic liquids in **Fig 10**.

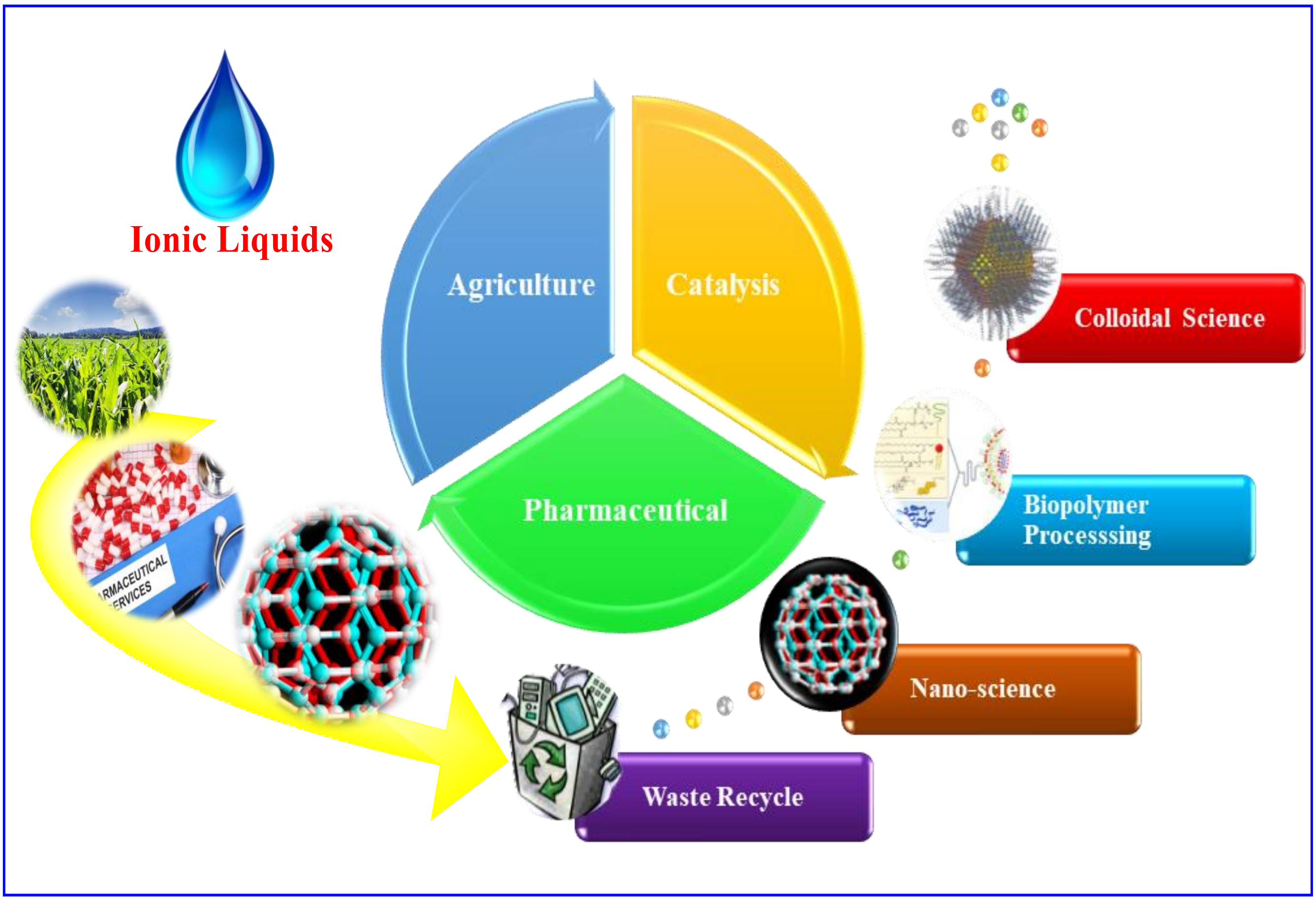

Fig. 9 Systematic representation application of ionic liquids.

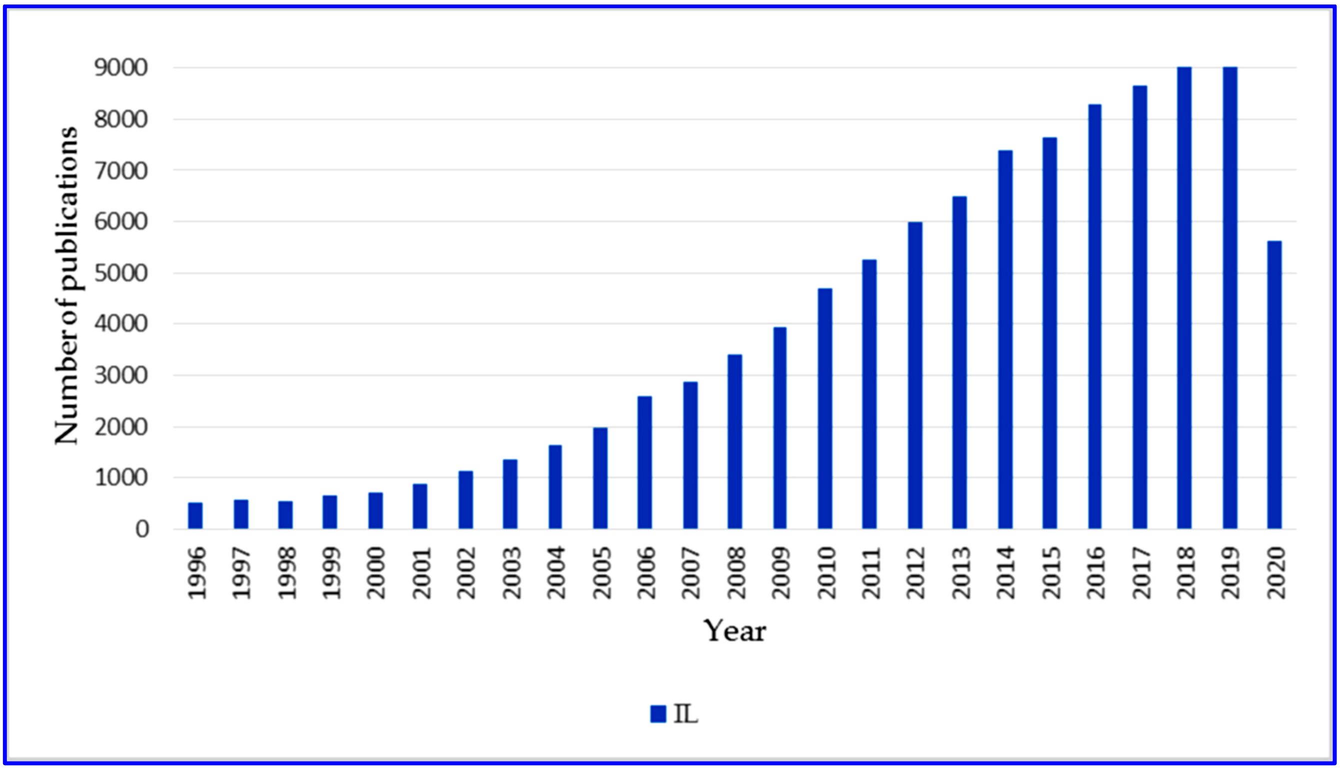

Fig. 10 Number of publications on ionic liquids in year between 1996 to 2020.

9. Micellar properties of ionic liquid

Ionic liquid (IL) micellar properties are a fascinating field of research because they combine ILs' distinctive characteristics with surfactant behaviour in solution. Salts made completely of ions and liquid at or close to room temperature are known as ionic liquids [24]. They have drawn a lot of interest due to their amazing solvent characteristics, non-volatility, and lack of flammability. Micelles, which are collections of surfactant molecules in a solvent, can be created when ILs and surfactants are mixed. Ionic liquids and surfactant chemistry cross in an interesting way thanks to the micellar characteristics of ionic liquids. For the purpose of better comprehending the underlying mechanics and creating new applications in a variety of sectors, researchers are still looking into these features [25]. Various key aspect of ionic liquids have shown given below in **Table 2**.

Table 2. Some key aspects of micellar properties

Micelle formation	In ILs, surfactant/inositol molecules can group together to form micelles, much like in conventional solvents. The ionic headgroups that make up the hydrophilic shell around these micelles' hydrophobic core are generated by the surfactant tails. The critical micelle concentration (CMC) and micelle size can be influenced by the special solvation characteristics of ILs.
Effect of ionic liquid structure	The creation of micelles can be considerably influenced by the ionic liquid's structure and makeup. The stability and production of micelles can be affected by the cation and anion composition of the IL because these interactions alter how the surfactant molecules interact with the IL ions.
Tuning micellar properties	By using certain surfactants/inositol and ILs with customized structures, researchers may adjust the micelle characteristics in ILs. This makes it possible to create micellar systems with the necessary characteristics for a variety of uses, including extraction, catalysis, and solubilization.
Enhanced solubilization	The solubility of hydrophobic substances in aqueous or polar solvents can be improved by the combination of ILs and surfactants/inositol. This characteristic can be helpful in fields where ILs are employed as substitute solvents, such as green chemistry.
Thermodynamic studies	Studies on the thermodynamics of micelle production in ILs can shed light on the energetics of the procedure. Due to ILs' special

	characteristics, the enthalpy and entropy changes connected with micelle production might vary from those in conventional solvents.

10. Impact of additives

The effect of additives on micellar formation in ionic liquids varies on the additive in question, its quantity, and the particular IL-surfactant/inositol system under investigation **(Fig. 11)**. To tailor micellar characteristics to a specific application's needs, scientists and engineers frequently conduct experiments with different additions [26-27]. The ability to modify micelles in ILs using additives has the potential to create new opportunities in a variety of fields, including chemical processing, medicines, and materials research.

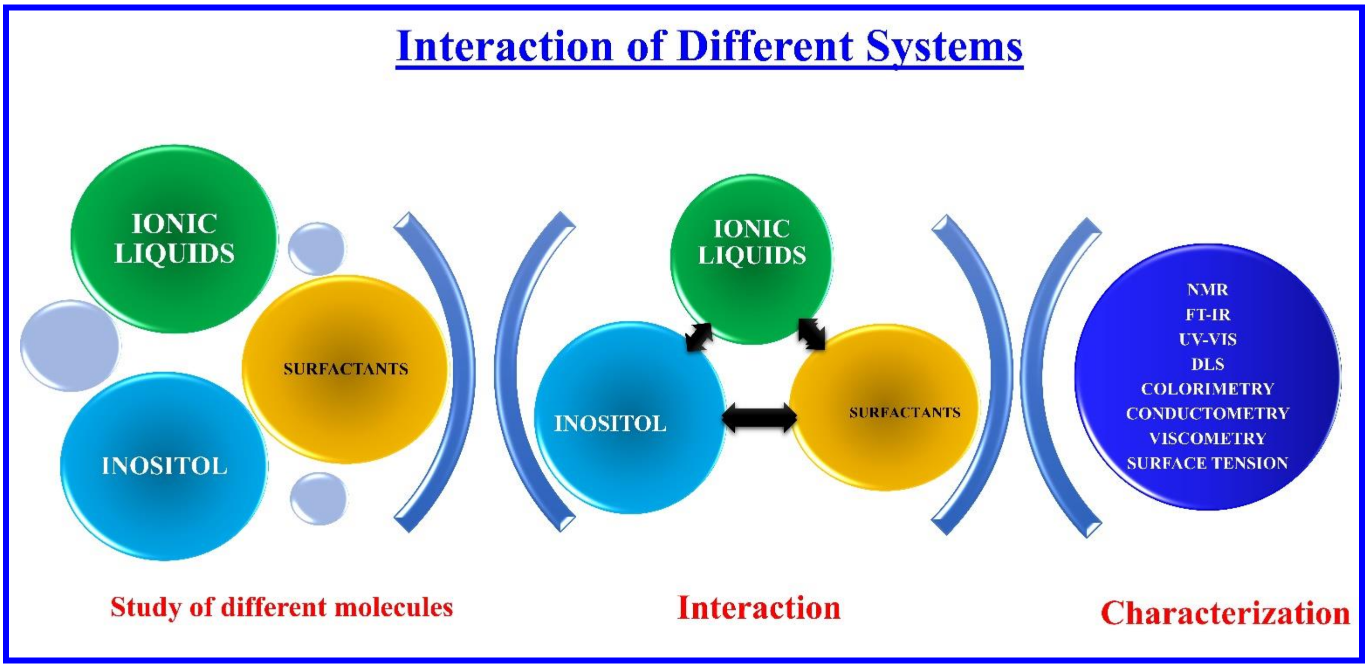

Fig. 11 Interaction with different additives of ionic liquids.

a) **Stability and Critical Micelle Concentration (CMC):**

Micelles in ILs can become less stable as a result of additives. The CMC, or concentration at which micelles first form, can be raised by some additions. Depending on their chemical makeup, other substances can improve the stability of micelles or potentially interfere with their creation [28].

b) **Tuning Micelle Size and Shape:**

Micelles in ILs can have their size and shape altered by additives. For instance, the inclusion of co-surfactants or co-solvents may cause the development of mixed micelles, in which several surfactant molecules are integrated into a single micelle. The micelles' dimensions and characteristics may change as a result.

c) **Solubilization:**

Specific substances can become more soluble in micellar solutions when certain additions are added. This is particularly significant in situations when the solubilization of target molecules is critical, such as medication administration or extraction procedures.

d) Ionic Strength:

The ionic strength of the IL solution may change after the addition of salts or other ionic species. By changing the electrostatic interactions between the surfactant molecules, this variation in ionic strength can have an impact on micelle formation [29].

e) pH and Temperature Sensitivity:

The micelles in ILs may become sensitive to pH or temperature due to certain additions. When the micelles break down or alter their characteristics in reaction to pH or temperature changes, this feature can be helpful in controlled release applications.

f) Viscosity and Rheology:

The viscosity and rheological behaviour of micellar solutions in ILs can be affected by additives. This can be significant in applications like improved oil recovery where it's crucial to manage the solution's flow characteristics.

g) Ionic Liquid Compatibility:

The compatibility of additions with the selected IL must be taken into account. It's possible that some additives won't mix with some ILs, causing phase separation or the development of unfavorable precipitates.

h) Application-Specific Properties:

The selection of additives can be customized for certain uses. For instance, additives can be utilized in catalysis to design micellar systems that are best suited for a certain chemical reaction [30].

i) Environmental Impact:

The selection of additives in the context of green chemistry can also affect how environmentally sustainable a process is. It may be preferable to use green additives that are less harmful or more easily biodegradable.

j) Characterization:

The characterization of micellar systems in ILs might become more challenging when additives are included. It may be necessary to use sophisticated methods like spectroscopy, scattering, and microscopy to fully comprehend the structure and behaviour of these intricate systems [31].

11. Physicochemical properties

A lot of research has been done on the physicochemical aspects of amphiphilic molecules because of their distinctive traits **(Table 2)**. These molecules have both hydrophilic and hydrophobic components, which enables them to interact with both water and other molecules [32]. Applications in tissue engineering, nanotechnology, medication delivery, and other fields can all benefit from these qualities. The ability of amphiphilic molecules to form micelles, which are crucial for many biological activities, allows them to self-assemble structures. In addition, they may create a monolayer at the air-water interface by adsorbing, which is helpful for the creation of surfactants. Last but not least, amphiphilic molecules can function as emulsifiers to stabilise emulsions and improve the solubility of hydrophobic substances. Overall, due to their distinct physicochemical characteristics, amphiphilic compounds are a significant tool in many fields [33].

Table 2. Comparison the various physicochemical properties of ionic liquids with surfactants and organic solvents.

Property	Organic Solvents	Ionic Liquids	Surfactants
Number of solvents	>1,000	>1,000,000	>100000
Applicability	Single function	Multifunction	Multifunction
Catalytic ability	Rare	Common and tunable	Some and tunable
Chirality	Rare	Common and tunable	Common and tunable
Vapour pressure	Obeys the Clausius-Clapeyron Equation	Negligible under normal conditions	Negligible under normal conditions
Flammability	Usually, flammable	Usually, non-flammable	Non-flammable
Solvation	Weakly solvating	Strongly solvating	Strongly solvating as 'micelle'
Tunability	Limited range of solvents available	Unlimited range means 'designer solvents'	Broad range of tunability
Polarity Conventional	Polarity concepts apply	Polarity concept questionable	Polarity concepts apply
Cost	Normally inexpensive	2 to 100 times the cost of organic solvents	2 to 10 times the cost of organic solvents
Recyclability	Green imperative	Economic imperative	Economic imperative
Viscosity/cP	0.2-100	22-40,000	200-250
Density/g cm-3	0.6-1.7	0.8-3.3	1.02-2.04
Refractive index	1.3-1.6	1.5-2.2	1.0-1.8

11.1. Interfacial properties

Interfacial properties of ionic liquids are essential for understanding their behavior at the interfaces with other materials and phases. These properties are crucial for various applications, including electrochemistry, catalysis, and separations [34]. The interfacial properties of ionic liquids are highly versatile and can be tailored to suit specific applications. Their ability to interact with different interfaces, modify surface properties, and form stable interfaces with various materials makes them valuable in a wide range of scientific and industrial contexts [35]. Researchers continue to explore and exploit these properties for innovative solutions in various fields have shown in **Table 3** and **Fig. 12**.

Table 3 Some interfacial properties of ionic liquids.

Wettability	Adsorption	Electrode-IL interfaces

Ionic liquids frequently display unusual wetting behaviour on solid surfaces as a result of their low volatility and adjustable surface tension. Their capacity to moisten surfaces is beneficial in processes like coating and lubrication.	Ionic liquids are capable of adhering to solid surfaces and changing the interfacial characteristics of such surfaces. Utilizing this adsorption, materials' tribology and corrosion protection performance may be improved by altering the surface chemical.	The electrode-IL interface is essential for the functionality of components like batteries and supercapacitors in electrochemical applications. At these interfaces, ionic liquids offer a reliable and highly adjustable electrolyte, improving device performance and security.
Gas-IL interfaces	**Liquid-liquid interfaces**	**Biological interfaces**
Ionic liquids have the ability to create gas-IL interfaces, which is useful for the processes of gas adsorption and separation. In order to create cleaner and more effective gas separation systems, these interfaces may be made to selectively collect particular gases.	Ionic liquids can create solid liquid-liquid surfaces when in contact with other immiscible liquids, such as oils or organic solvents. In the emulsification and extraction processes, these interactions are crucial.	It has been investigated how ionic liquids interact with biological surfaces including cell membranes and proteins. Developing IL-based medication delivery devices and bioanalytical applications requires a thorough understanding of these interactions.
Nanostructure formation	**Rheological behavior**	**Interfacial tension**
Ionic liquids have the ability to self-assemble at interfaces, creating organized nanostructures. These structures may be modified for a variety of uses, such as creating templates for nanomaterials.	Ionic liquids function differently in lubricating and coating applications depending on their interfacial rheological characteristics, such as surface shear viscosity.	The efficiency of ionic liquids in procedures like liquid-liquid extraction and emulsification may be impacted by the fact that they may have lower interfacial tensions than conventional solvents.

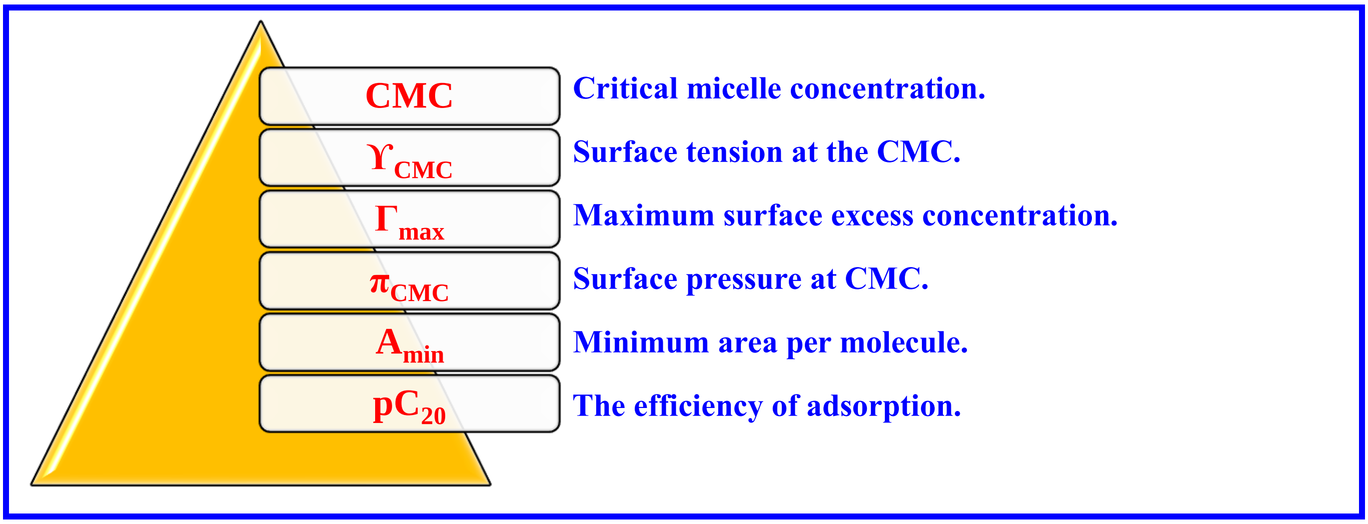

Fig. 12 Different interfacial parameters.

11.2. Thermodynamic properties

Thermodynamic properties of ionic liquids are essential for understanding their behavior in various processes and applications, including chemical reactions, separations, and energy storage. The thermodynamic properties of ionic liquids are fundamental for their design and utilization across a wide range of applications. Researchers and engineers use these properties to tailor ionic liquid formulations to meet the specific requirements of various processes, contributing to the development of innovative technologies in chemistry, materials science, and engineering [36].

Table 3 Some thermodynamic properties of ionic liquids

Heat capacity	Enthalpy and entropy of mixing	Phase equilibria
Ionic liquids typically have relatively high heat capacities compared to traditional organic solvents. This property allows them to absorb and release heat efficiently, making them useful in thermal energy storage applications.	The enthalpy (ΔH) and entropy (ΔS) of mixing of ionic liquids with other substances, such as solutes or solvents, play a critical role in determining the thermodynamics of processes like dissolution and extraction. These properties can be tuned by selecting specific ionic liquid compositions.	Understanding the phase behavior of ionic liquids, including liquid-liquid and vapor-liquid equilibria, is vital for designing separation processes and ensuring the stability of reactions. Thermodynamic modeling is often used to predict and optimize phase equilibria involving ionic liquids.
Vapor pressure	**Solubility**	**Thermal conductivity**
While ionic liquids are generally non-volatile, their vapor	The solubility of different compounds in ionic liquids is	Ionic liquids often have lower thermal conductivities compared

pressures can be important in certain applications, such as vacuum systems or gas-phase reactions. Ionic liquids with extremely low vapor pressures are preferred in these cases to minimize material loss.	essential for designing efficient extraction, catalysis, and reaction processes. Thermodynamic data on solubility help in predicting the behavior of ionic liquid-based systems.	to traditional solvents. This property can be advantageous in applications where thermal insulation or controlled heat transfer is needed.
Freezing and melting behavior	**Electrochemical properties**	**Solvation thermodynamics**
Ionic liquids exhibit a wide range of freezing and melting points, which can be tailored by choosing specific ions. Some ionic liquids remain liquid at extremely low temperatures, making them suitable for cryogenic applications.	In electrochemical applications like batteries and supercapacitors, the thermodynamics of ion transport and redox reactions in ionic liquids are critical for device performance. Ionic liquids are chosen for their wide electrochemical stability window.	The thermodynamics of solvation processes in ionic liquids impact their ability to dissolve various compounds. Understanding solvation thermodynamics is crucial for optimizing ionic liquid-based processes.

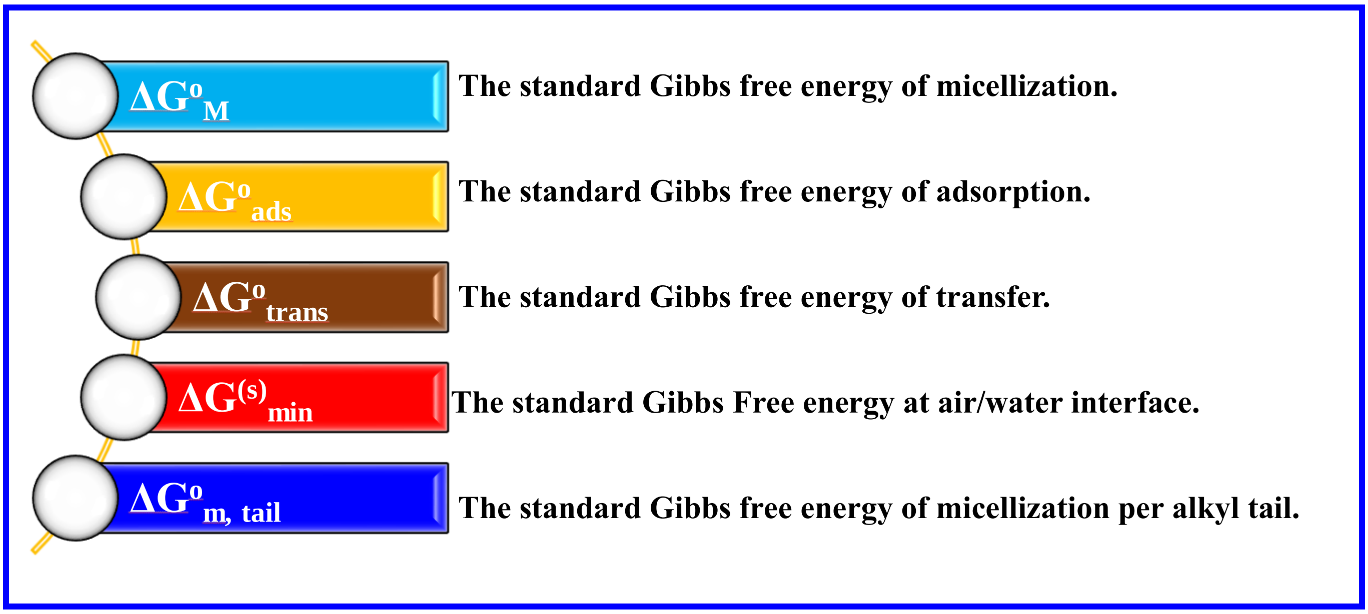

Fig. 13 Different thermodynamic parameters.

12. Introduction

Sugar alcohols are chemical molecules that are often produced from sugars and have one -OH (hydroxyl group) linked to each carbon atom. They are sometimes referred to as polyhydric alcohols, polyalcohols, glycitols, or alditols [37-38]. They (sugar alcohols) are white, water-soluble solids that can either be found in nature or made artificially by hydrogenating sugars. They are categorized as polyols as a result of their many -OH groups. Sugar alcohols are frequently employed as thickeners and sweeteners in the food sector. In order to make up for their lack of sweetness, sugar alcohols are frequently utilized in commercial food items in place of sucrose (table sugar), generally in combination with highly concentrated artificial sweeteners. The sugar alcohols sorbitol and xylitol are widely used in processed foods [39].

13. General characteristics of sugar alcohols

The oral bacteria in the mouth do not biochemically metabolize sugar alcohols, so they do not contribute to tooth decay. In addition to being non-caramelized, they cannot be browned or caramelized. There is little difference in the food energy of sugar alcohols as a group compared to sucrose. Several high-intensity sweeteners have unpleasant aftertastes that can be hidden by sugar alcohols, which have a taste similar to sucrose [40]. When highly concentrated, sugar alcohols, like sugar-free chewing gum and hard candy, also produce a noticeable cooling sensation in the mouth. A crystalline phase may be formed when mannitol, lactitol, maltitol, erythritol, or xylitol are heated. An endothermic reaction (heat-absorbing) occurs as the sugar alcohols dissolve under the intense heat of the solution, leading to a cooling sensation [41].

14. History

Carbocyclic sugar-based alcohols are chemical compounds such as ‘inositol’ that contain a hydroxyl group (-OH) on each carbon atom. Inositol is a natural product with many biological aspects in the human body. It was first isolated by **Prof. J. J. Von Scherer** in 1850 and called “inosite” because of its sugar-like taste **(Fig. 14)**. After a long time in 1887, Maquenne was a fully purified compound to be a cyclohexanehexol and found its inert chemical behaviour like glucose. Inositol has different nine isomers the *myo*-inositol is larger and more abundant in nature. They are classified as cyclitol or polyols because they contain multiple – OH groups [42].

Fig. 14 J. J. Von Scherer-1850

15. Common sugar alcohols

Although sugar alcohols can be produced by both monosaccharides and disaccharides, only sugar alcohols obtained from disaccharides (such as lactitol and maltitol) can undergo complete hydrogenation because only one aldehyde group can be available for reduction [43]. Different types of common sugar alcohol have shown in **Fig. 15**.

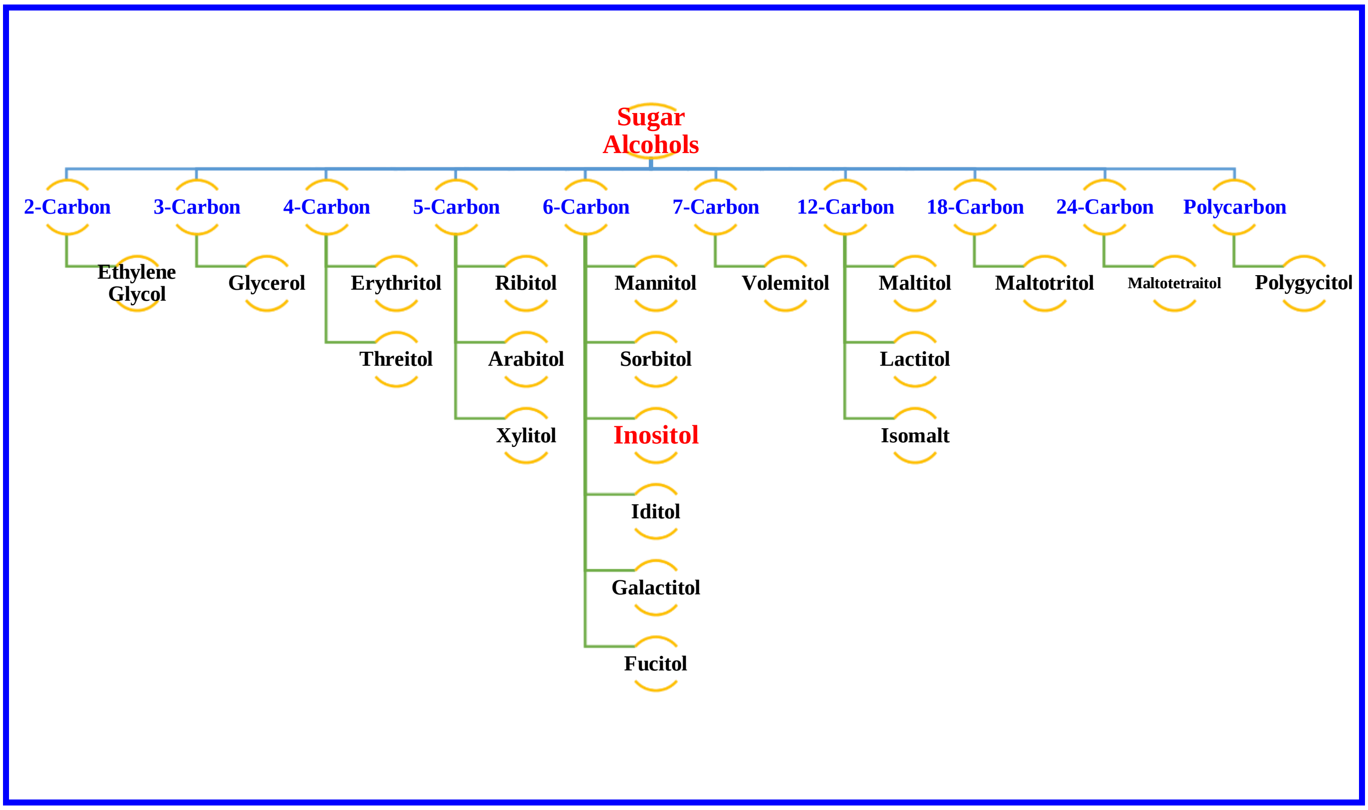

Fig. 15 Systematic representation of common sugar alcohol

16. Inositol molecules

Inositol belongs to the group of carbohydrates. It is a natural product that has a stereoisomer C_6 ring structure its simply carbocyclic sugar also called cyclitols or polyols. It is a naturally occurring eco-friendly component that's easily recyclable. Inositol molecules have a hydrophilic polar head part like surfactants [44]. The inositol family consists of nine members with numerous critical biological functions, thus the importance of generating and applying synthetic compounds to elucidate their function **(Fig. 16)**. An inexpensive and easily accessible compound, myo-inositol is the most common inositol. Nature contains a large amount of myo-inositol. Numbering purposes assign the lone axial group the 2-position, which is then referred to as nomenclature. A naming system is required to differentiate stereoisomers when substituting certain positions on the myo-inositol backbone (C-1/C-3 and C-4/C-6). D- and L-forms were used to denote the assigned positions [45]. It has many advantages, for example, cosmetics, pharmaceuticals, biochemistry, nutritional food components, etc.

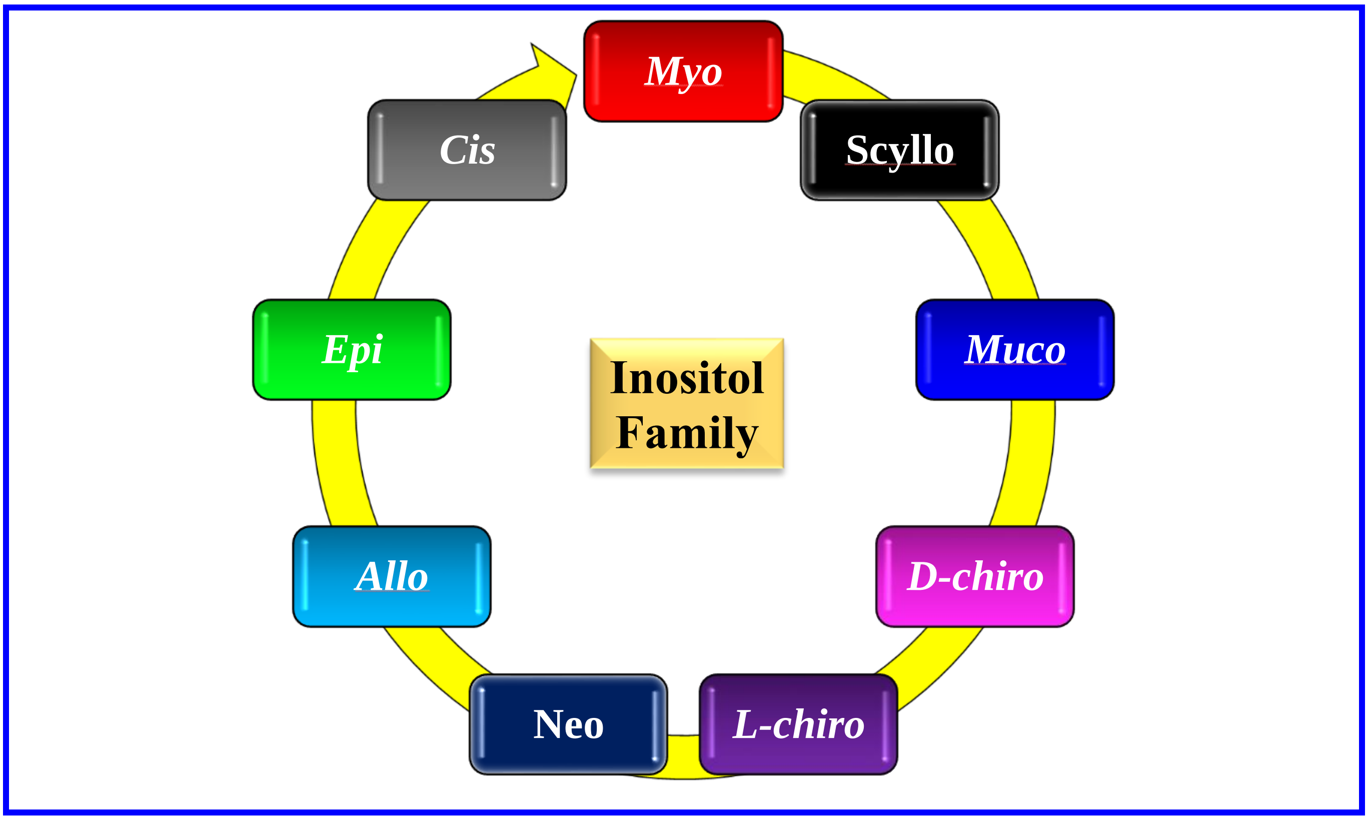

Fig. 16 Structure of inositol family

17. Structure of Inositol Isomer Family

Inositol has nine stereo-isomer i.e., the naturally occurring stereoisomers are *myo*-, *scyllo*-, *muco*-, D-*chiro*-, L-*chiro*-, and *neo*-inositol *myo*-Inositol and other possible isomers are *allo*-, *epi*-, and *cis*-inositol [46]. It is the most common isomer "*myo-inositol"* because these isomers are most abundant in nature **(Fig. 17)**.

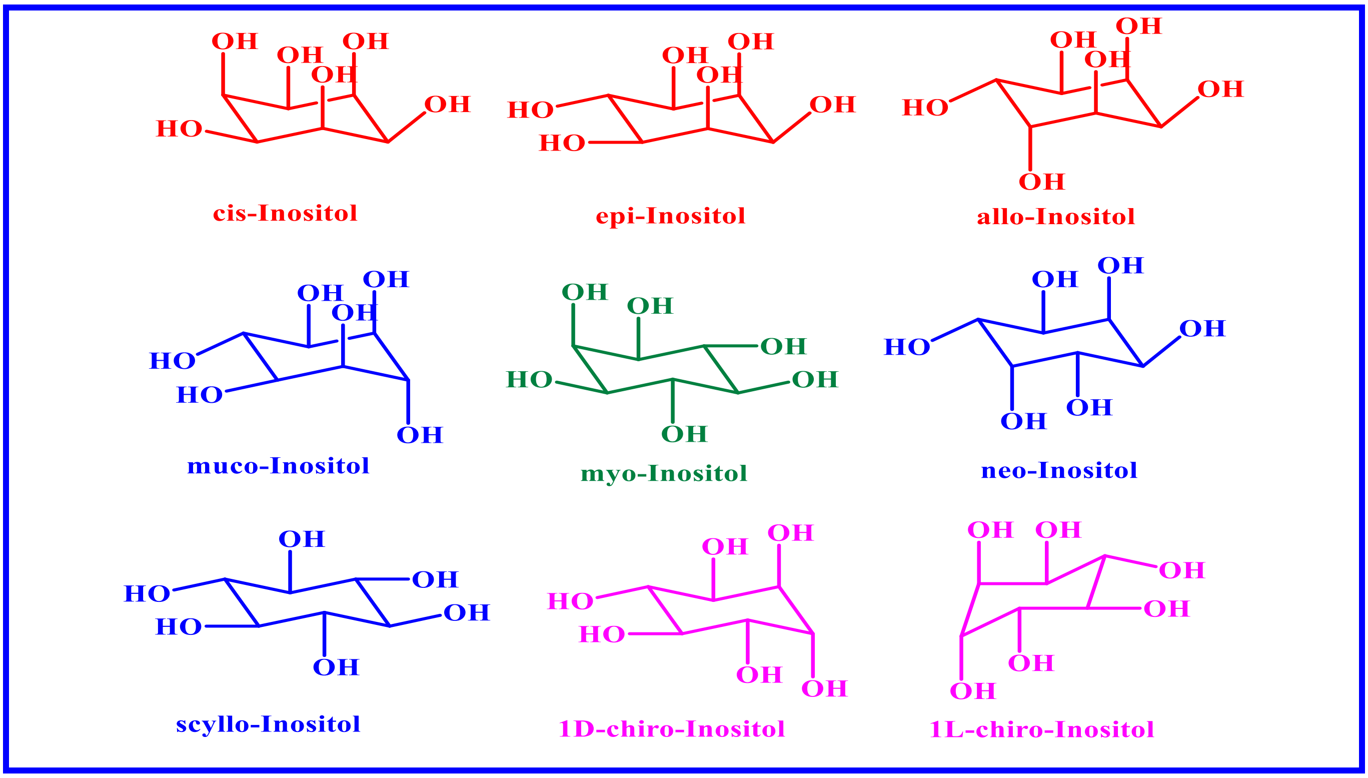

Fig. 17 Structure of inositol isomers

18. Properties of inositol

Inositol is a carbohydrate that is frequently referred to as a sugar alcohol and has a number of crucial functions in the human body. It comes in a variety of shapes, the most prevalent and medically relevant of which being myo-inositol. Inositol is a versatile substance that is essential to many bodily physiological functions. While it may be obtained from dietary sources, supplements are also utilised for its possible health advantages, particularly in relation to mental health and metabolic diseases. To make sure supplements are suitable for your unique requirements, it's crucial to utilise them under the direction of a healthcare professional [47]. Different properties of inositol have shown in **Fig. 18**.

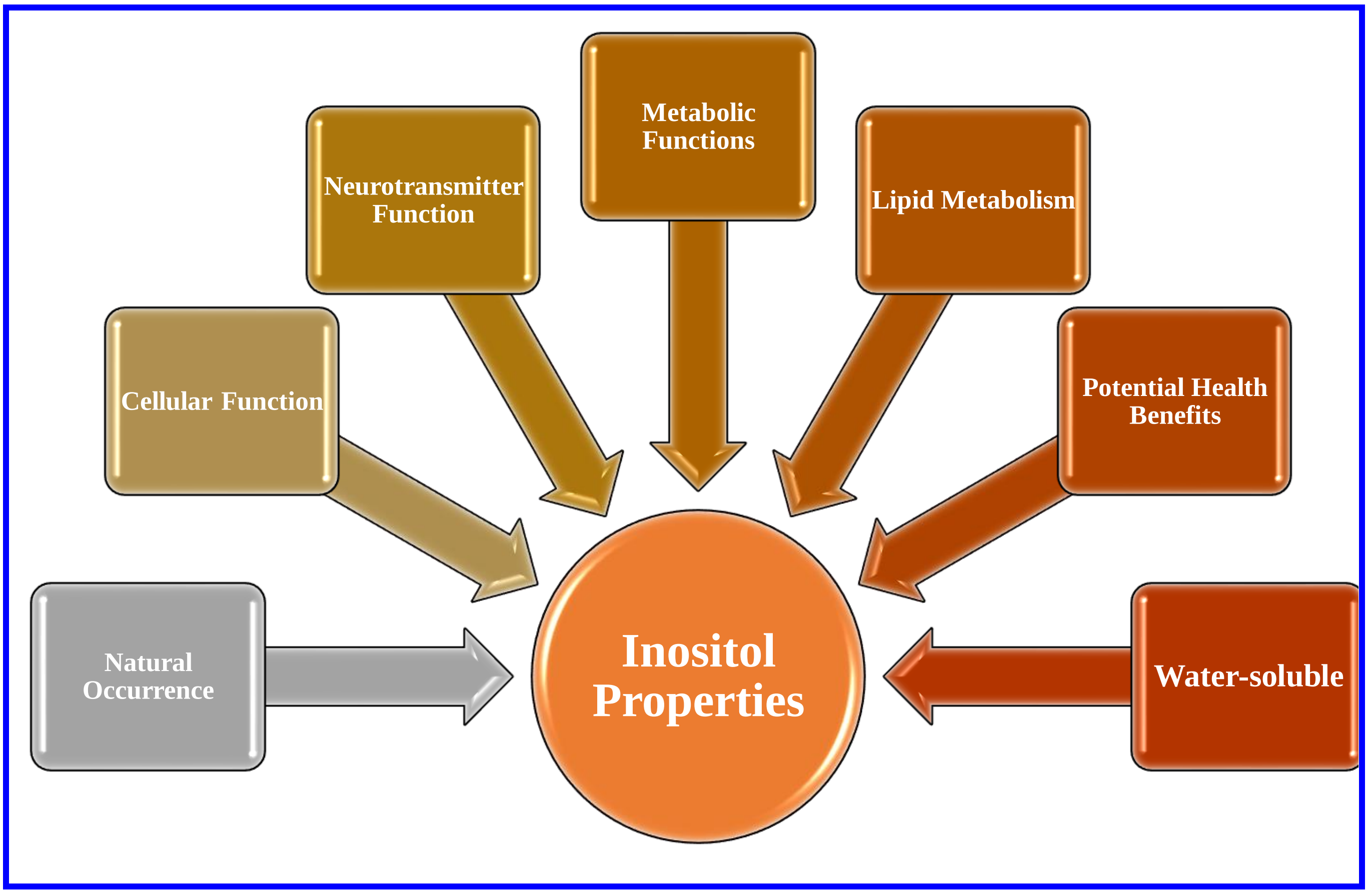

Fig. 18 Some important properties of inositol.

19. Application of inositol

Inositol, especially myo-inositol, has several uses in a variety of industries, including biotechnology, nutrition, and medicine [48]. It's crucial to remember that even while inositol has numerous potential uses, research into how beneficial it is in many of these areas is currently underway **(Fig. 19)**. To identify the proper dosage and to make sure that inositol is safe and suited for your particular requirements, it is advised to speak with a healthcare expert if you are thinking about using it for a particular health condition [49-50].

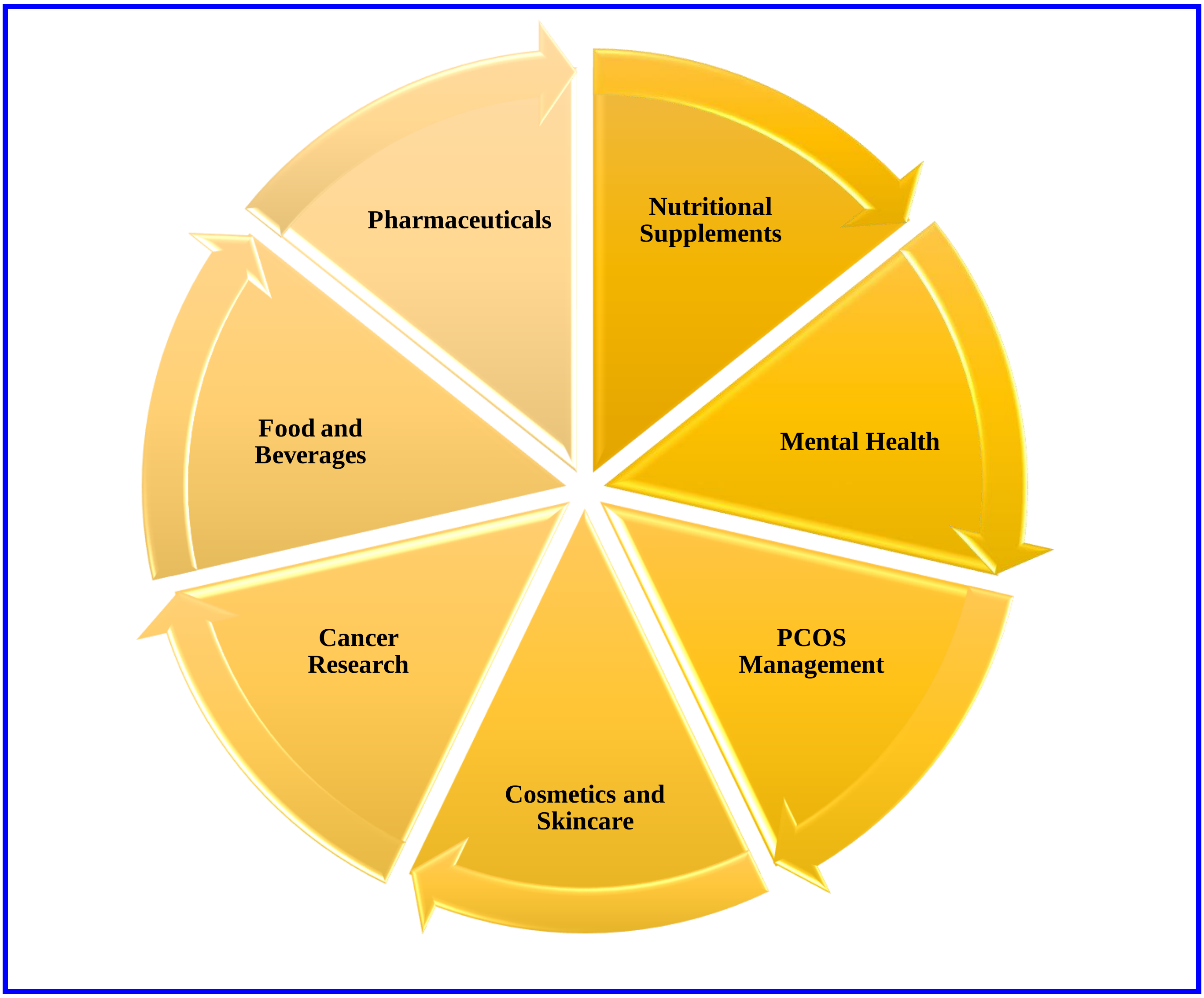

Fig. 19 Application of inositol.

20. The focus of this review

Since that ILs and inositol are cutting-edge, scientific solvents that can be specifically tailored to match an application, there is a growing desire in modern life for chemicals that are eco-friendly and sustainable. Several notable chemists have thoroughly examined this developing subject [51]. Moreover, the utilisation of ILs and inositol as solvents for chemical synthesis has recently undergone serious examination and revision. Without a question, this field of study has dominated green chemistry over the previous two decades. To enhance the physical properties of these amphiphilic molecules such as ionic liquids and inositol by interacting with different types of natural products such as glucose, inositol, proteins etc. and to create effective systems [52].

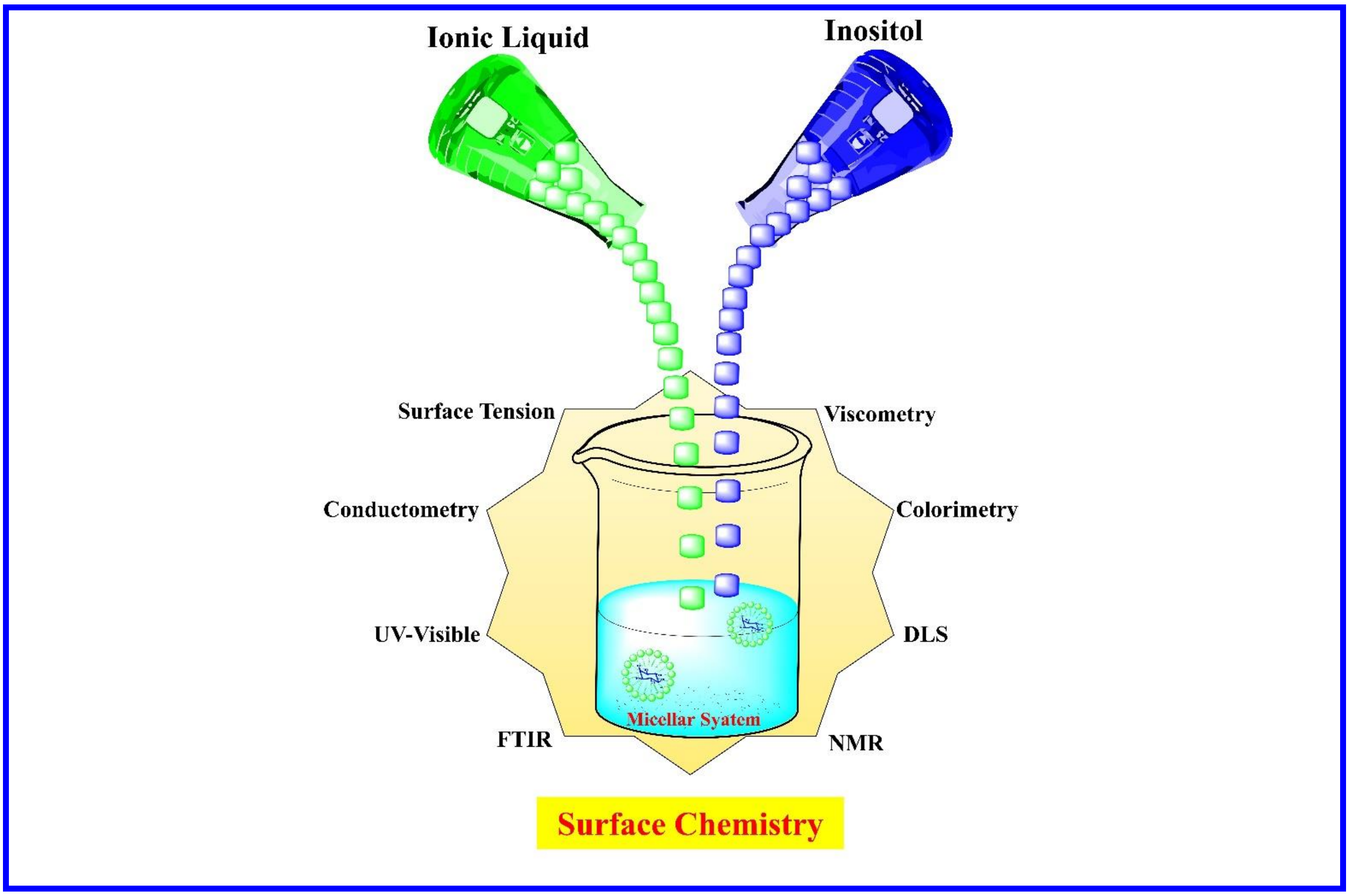

Fig. 20 Systematic representation of mixing of ionic liquid and inositol.

21. Synthesis of sugar-based amphiphilic molecule

Here, we will discuss the effects of sugar-based carbohydrate molecules on amphiphilic molecules, focusing on structural and synthetic aspects, and basic information about their physicochemical properties and applications, or referring to literature related to them [53]. The synthetic process does not involve characterization and fabrication issues with amphiphilic carbohydrates, polymers, and materials. Ionic liquids are the key components of the chapter chemical action. Firstly, these connections are of great importance in terms of chemical sensitivity and their potential applications [54].

22. Future Aspects

Ionic liquids (ILs) have drawn a lot of interest because of their special qualities and adaptability in a variety of applications. Myo-inositol and D-chiro-inositol are two isomers of inositol, a naturally occurring sugar alcohol. Ionic liquids and inositol both show promise in a variety of sectors, and future study and innovation are likely to find additional uses and advantages for both of these substances [55-56]. These potential uses for inositol and ionic liquid are listed below in **Fig. 21**.

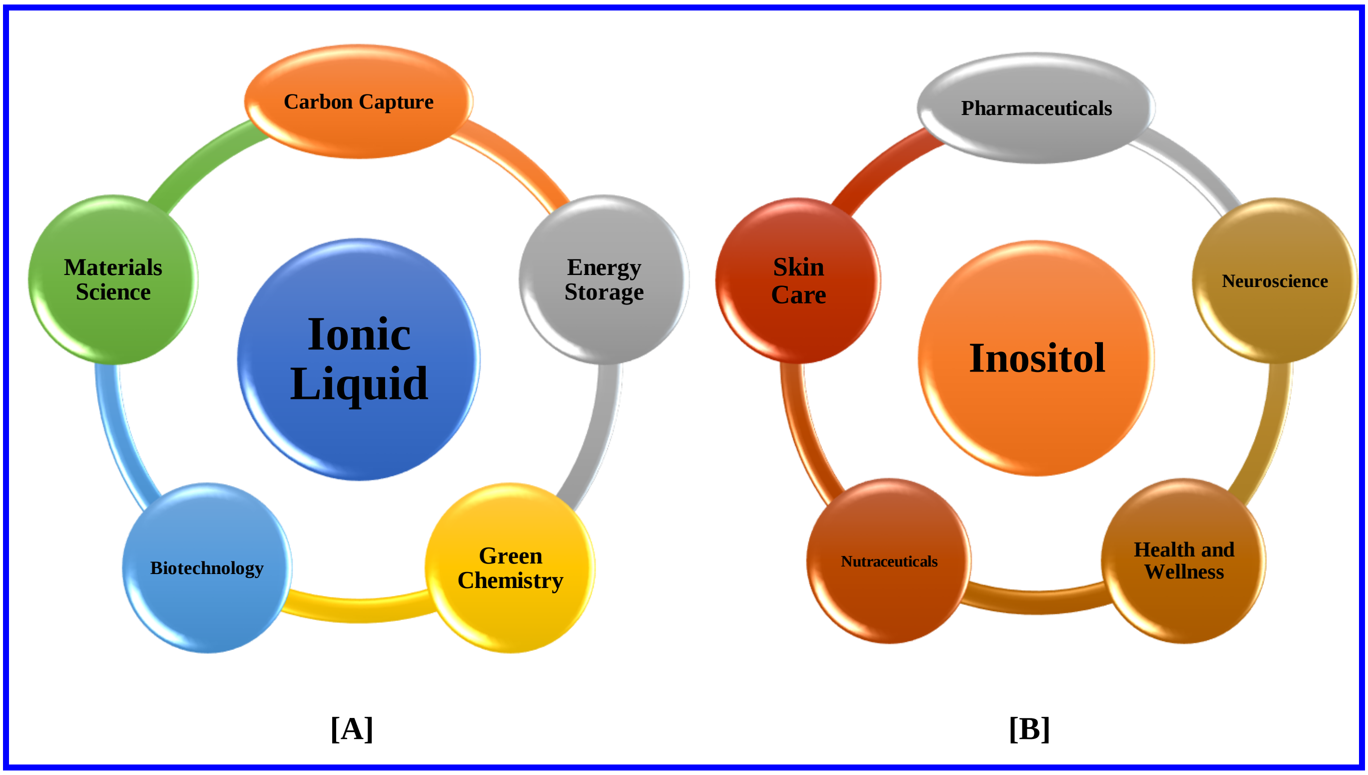

Fig. 21 Some future scope [A] Ionic liquid, [B] Inositol.

23. Challenges

Ionic liquids and inositol must overcome these difficulties in order to fully realise their promise in a variety of applications and cures. To do this, it will take continuing research, innovation, and cooperation among scientists, engineers, healthcare providers, and regulatory organisations [57-58]. All challenges have shown in **Fig. 22**.

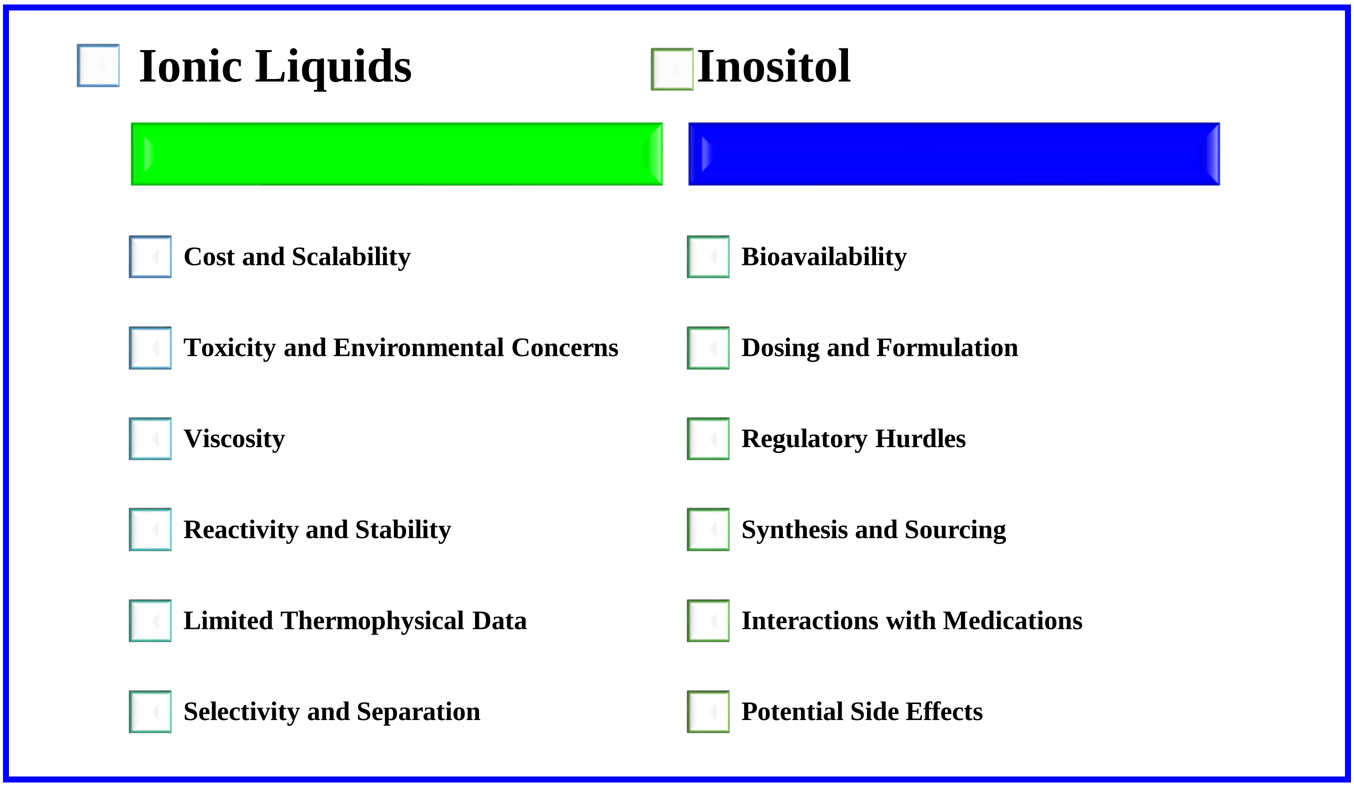

Fig. 22 Systematic representation of challenges of ionic liquid and inositol.

24. Conclusion

In conclusion, the synergistic interaction between ionic liquids and inositol exhibits an amazing union of two different chemical entities, opening up a viable path for innovative applications in a variety of sectors. Ionic liquids and inositol have a fascinating relationship that offers enormous promise in a variety of fields, such as green chemistry, medicines, and materials research. Inositol, a naturally occurring sugar alcohol, provides biocompatibility and usefulness while ionic liquids, recognised for their distinct characteristics, give a flexible solvent platform. Together, they produce a synergistic relationship that improves the functioning of both parts as a whole. By increasing solubility, catalytic activity, and stability, this synergy paves the way for the development of more eco-friendly and productive processes. Novel applications of this synergy, including medication delivery methods, enhanced materials synthesis, and green solvent systems for chemical processes, are among its most fascinating features. We can anticipate even more creative solutions that will favourably influence several industries and contribute to a sustainable and technologically advanced future as research continues to untangle the complexities of this interplay.

Authors contribution

The manuscript was written through the contributions of both authors. All authors have approved the final version of the manuscript.

Notes

All authors declare no competing financial interest.

Conflicts of interest

There are no conflicts to declare.

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