CHAPTER 5
CONCLUSION

New ionic liquids, [TMA][EPPS] and [TMA][CAPS], were synthesized from tetramethylammonium hydroxide (TMA) as cation and biological buffers (EPPS or CAPS) as anion, respectively. Their molecular structures, thermal stabilities, melting points and water contents were investigated. The structures of the new ionic liquids were confirmed with NMR analysis and their molecular weights were estimated to be 325.47 g/mol for [TMA][EPPS] and 294.45 g/mol for [TMA][CAPS]. The TGA results shown that [TMA][EPPS] and [TMA][CAPS] were thermally stable up to about 200°C and 225°C, respectively. The melting points of [TMA][EPPS] and [TMA][CAPS] were determined by DSC analysis, which were about 80°C and 51°C, respectively. Moreover, both prepared ionic liquids exhibited a low water contents.

The density polynomial equation accurately correlated the experimental densities as temperature dependent. The thermal expansions were calculated from the density data by using the parameters of density polynomial equation and revealing that the values increased with the increasing of temperature. The apparent molar volumes were also calculated from the density data and the results shown that the calculated apparent molar volumes increased with the increasing of molality.

The solubility limits of [TMA][EPPS] and [TMA][CAPS] in water, methanol and ethanol at 298.15 K were determined from the results of the density measurements. The results reveal that the solubility limits in all solvents follow the order of anion [CAPS] > [EPPS]. Furthermore, the Gibbs free energies ($\Delta_{\text{mol}} G$) of these ionic liquids in water, methanol and ethanol were determined based on the solubility data. The new synthesized ionic liquids derived from biological buffers were found to be soluble in water and several organic solvents such as methanol and ethanol.

The experimental viscosities as a function of temperature were correlated with the Vogel-Fulcher-Tammann equation very well. The change of temperature
affected viscosity significantly. The increasing of temperature caused the values of the viscosities decreased exponentially.

The experimental conductivities were correlated in terms of molality by using the Casteel-Amis equation. As observed from many electrolytes systems. The conductivities were found to increase with the increasing of concentration at lower concentration range and reach to a maximum value, and then decrease at higher concentrations. The decrease of conductivities at higher concentrations may be due to an increase of viscosity. The conductivity of aqueous [TMA][CAPS] solution was also found to be higher than that of [TMA][EPPS].

The molar conductivities of the aqueous ionic solutions were calculated from the experimental conductivity values and could be well correlated by using the well-known Debye-Hückel-Onsager equation, in terms of concentration. In addition, the ionicity of these two new ionic liquids was analyzed using the Walden plot. Both [TMA][EPPS] and [TMA][CAPS] were categorized as good ionic liquids.