IMPACT OF CHOLINE CHLORIDE/ETHYLENE GLYCOL DEEP EUTECTIC SOLVENT ON TAMARIND SEED POLYSACCHARIDE-BASED POLYMER ELECTROLYTE

NURUL FARAH ATIEQAH BINTI SUDDIN

BACHELOR OF SCIENCE (Hons.) APPLIED CHEMISTRY
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA

FEBRUARY 2024

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NURUL FARAH ATIEQAH BINTI SUDDIN

Final Year Project Report Submitted in
Partial Fulfilment of The Requirements For The
Degree of Bachelor of Science (Hons.)
Applied Chemistry
in The Faculty Of Applied Sciences
University Teknologi MARA

FEBRUARY 2024

The Final Year Project Reported entitled **"Impact of Choline Chloride/Ethylene Glycol Deep Eutectic Solvent on Tamarind Seed Polysaccharide-based Polymer Electrolyte"** was submitted by Nurul Farah Atieqah Binti Suddin in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Applied Chemistry, in Faculty of Applied Sciences, and was approved by

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Dr. Nabilah Akemal Muhd Zailani
Supervisor
B. Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

____

Dr. Khuzaimah binti Nazir
Co-Supervisor
B. Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

____

Dr. Siti Nurlia Ali
Project Coordinator
B. Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

____

Dr. Nur Nasulhah Kasim
Head of Programme
B. Sc. (Hons.) Applied Chemistry
Faculty of Applied Sciences
Universiti Teknologi MARA
02600 Arau
Perlis

Date: _______________

ABSTRACT

IMPACT OF CHOLINE CHLORIDE/ETHYLENE GLYCOL DEEP EUTECTIC SOLVENT ON TAMARIN SEED POLYSACCHARIDE-BASED POLYMER ELECTROLYTE

Natural polymer electrolytes (PE) consisting of polysaccharides is widely studied to overcome the leakage issues in commonly used liquid electrolytes (LE). However, the presence of hydroxyl group in polysaccharides will produce brittle electrolyte films leading to poor ionic conductivity. Harmful plasticizers such as phthalic acid esters and dioctyl phthalate (DOP) were proven to improve the brittleness issues of polysaccharide films. Deep eutectic solvent (DES) is known to be an alternative to conventional plasticizer due to its low toxicity, low volatility, and high thermal stability. In this study, using the solution casting technique, choline chloride/ethylene glycol DES were incorporated into tamarind seed polysaccharide (TSP) matrix to obtain flexible and free-standing electrolyte films. Lithium triflate was added to provide additional conducting species to the system. The flexibility of the system was confirmed using Universal Tensile Machine (UTM). As the optimal quantity of DES is essential in producing highly conducting PE, the effect of different amount of DES on the structural, electrical, and morphological properties of TSP-based polymer electrolyte films were analyzed using Fourier Transform Infrared Spectroscopy (FTIR), Electrochemical Impedance Spectroscopy (EIS), Optical Microscopy (OM), respectively. Adding DES at various weight percentages (0.2, 0.3, 0.4, 0.5, and 0.6 wt%) produced solid, flexible, and self-supporting TSP-polymer electrolyte films. This is supported by increased tensile strain, reduced modulus, and tensile stress, indicating enhancement in the flexibility of the films. EIS analyses show that adding up to 0.4wt% DES significantly improves ionic conductivity in polysaccharides (1.19×10^{-4} S cm^{-1} from 1.33×10^{-5} S cm^{-1} in TSPL). This improvement is due to the successful prevention of hydrogen bonding, reducing TSP matrix crystallinity, and promoting a more amorphous phase, as proven by FTIR analysis, highlighting the successful interaction of TSP-DES. The presence of Cl^- ions as confirmed by TSP-DES interaction also contributes to the conductivity enhancement. Optical microscopy confirms these findings by showing a smoother surface, indicating structural changes associated with the higher conductivity. However, above 0.4wt% DES reduces conductivity and limits Li^+ ion mobility due to surface aggregation and the presence of neutral ions as shown in the OM analysis. In conclusion, the ionic conductivity of the TSPL 0.4 meets the requirements of devices, making it potentially suitable for application lithium-ion batteries.

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