CHAPTER-X

10. Summary and conclusions

Synthesis of novel cellulose composites using eco-friendly materials, this research was split-up into six chapters. All six chapters were clearly discussed and the antibacterial applications were studied. The following conclusions were drawn from this research work

1. Synthesis of cellulose/PVP/ZnO composite fabric for improved dyeability and antibacterial activity. From this chapter, poly-N-vinyl-2-pyrrolidone and cellulose linkage is established by FTIR and SEM–EDX analysis. The coated PVP and ZnO nanoparticles visibly evident on cotton fiber surfaces. The PVP modified cotton fabrics have 83-86% of dye uptake, color strength and fastness properties for the three dichlorotriazine reactive dyes. In antibacterial test, PVP and PVP/ZnO composite fabrics have very good antibacterial activity for time period of 120 min.

2. Synthesis of PVP/cellulose composite cotton fabric and its improved antibacterial activity with Ocimum tenuiflorum and Nyctanthes arbor-tristis extracts. The C-N stretching at 1437 cm\(^{-1}\) confirmed for cellulose/PVP composite fabric from FTIR studies. The SEM images clearly indicated the surface changes of cotton fabric on modification and EDX study also evidenced the nitrogen element present in modified fabric. Cellulose/PVP with tulasi extract treated fabric exhibited 80-85% of antibacterial activity. The tulasi extract treated fabrics showed higher antibacterial activity than parijataka treated fabrics.
3. Synthesis of cellulose/PVP composite membrane using [BMIM]⁺BF₄⁻ and [BMIM]⁺PF₆⁻ Ionic liquids. In this work, cellulose/PVP composite membranes showed relatively good miscibility among the cellulose and the ionic liquids. The appropriate ratio between cellulose and PVP levels can enhance the strength of membranes. The XRD studies exhibited the cellulose chains are miscible with the ionic liquids to disrupt the crystalline structure of the polymers. The cellulose/PVP membrane obtained from [BMIM]⁺BF₄⁻ ionic liquid showed smooth morphology with a non-fibrous structure. Thermal study TG/DTA proposed that the strong intra- and inter-molecular hydrogen bonds of cellulose were partially broken by ionic liquids and showing relatively high thermal stability.

4. Synthesis of cellulose/sulfated β-cyclodextrin/ZnO composite fabric and its antibacterial activity. The cellulose/sb-cd composite cotton fabric has successfully synthesized and the nanoparticles were coated on this fabric by pad-dry-cure method. The sb-cd crosslinking properties were studied by FTIR and SEM studies. UV–vis and DLS studies proved the average particle size of the nanoparticles. The coated nanoparticles are clearly shown in the SEM images. The EDX spectrum also confirms the S and Zn elements are present in the treated composites. The sb-cd with ZnO nanoparticles coated fabrics performed strong antimicrobial activity against both S. aureus and E. coli. From this study we have concluded that sb-cd crosslinked ZnO nanoparticles coated fabric act as best antibacterial agent.

6. Synthesis of cellulose / sb-cd composite membrane using [BMIM]$^+$ BF$_4^-$ and [BMIM]$^+$PF$_6^-$ Ionic liquids. The cellulose/sb-cd membranes were characterized for strength, molecular interaction, crystallinity, morphology and thermal stabilities. The appropriate ratio between cellulose and sulfated β-cyclodextrin levels can enhance the strength of membranes. The XRD studies exhibited the cellulose chains are miscible with the Ionic liquids and to disrupt the crystalline structure of the polymers. The cellulose/sb-cd membrane obtained from [BMIM]$^+$BF$_4^-$ Ionic liquid showed smooth morphology with a non-fibrous structure. The thermal study TG/DTA proposed that the cellulose/sb-cd membranes showing high thermal stability.

From this entire works, the antibacterial activity exhibited good reduction against *Escherichia coli* and *Staphylococcus aureus*. These types of synthesised fabrics and membranes recommended for wound cloths, surgical cloths, sports wears and kid’s wears.