

Abstract:

This study focuses on the manufacture of cobalt oxide (Co_3O_4) and iron oxide (Fe_3O_4) nanoparticles using sol-gel techniques, the extraction of cellulose and nanocellulose from cow dung compost, and the creation of hybrid composites comprising nanocellulose and metal oxide. FTIR analysis of the extracted cellulose and nanocellulose revealed that the distinctive peaks were preserved, albeit with slight changes in the O-H and C-H vibrations brought on by nanosizing. Metal-oxygen stretching vibrations verified the presence of (Co_3O_4) and Fe_3O_4 nanoparticles, and FTIR showed their successful incorporation into nanocellulose matrices, demonstrating robust interfacial contacts. Thermal study demonstrated the two-step behavior of the composites, with metal oxides staying thermally stable and nanocellulose breaking down at about 300°C . According to solubility experiments, it was insoluble in acetone and water and just slightly soluble in methanol and DMSO/DMF. Metal oxide nanoparticles showed dose-dependent suppression of *Staphylococcus aureus* antimicrobial activity, but pure cellulose and nanocellulose were found to be ineffective. Because of their synergistic effects and better dispersion of nanoparticles, hybrid composites demonstrated increased antibacterial activity. According to these results, composites of nanocellulose and metal oxide show promise for use in antibacterial and biological applications.