

## Investigation of Antimicrobial Activity of Dielectric Barrier Discharge Oxygen Plasma Combined with ZnO NPs-Treated Cotton Fabric Coated with Natural Green Tea Leaf Extracts

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**Abstract :** This research explores the antimicrobial effects of dielectric barrier discharge (DBD) oxygen plasma treatment combined with ZnO NPs on the cotton fabric, focusing on various treatment durations (5, 10, 15, 20, and 30 minutes) and discharge powers (15.5–17.35 watts) at flow rate 0.5 l/min. After treatment with oxygen plasma and ZnO NPs, the fabric was printed with green tea (*Camellia sinensis*) at five different concentrations. The study evaluated the treatment's effectiveness by analyzing surface wettability, specifically through wet-out time and hydrophilicity, as well as measuring contact angles. To investigate the chemical changes on the fabric's surface, attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy was employed to identify the functional groups formed as a result of the plasma treatment. This comprehensive approach aims to understand how DBD oxygen plasma treatment and ZnO nanoparticles change cotton fabric properties and enhance its antimicrobial potential, paving the way for innovative applications in textiles. In addition to the chemical analysis, the surface morphology of the O<sub>2</sub> plasma/ZnO NPs-treated cotton fabric was examined using scanning electron microscopy (SEM). FTIR analysis revealed an increase in polar functional groups (-COOH, -OH, and -C≡O) on the fabric's surface, contributing to enhanced hydrophilicity and functionality. The antimicrobial properties were evaluated using qualitative and quantitative methods, including agar plate assays and modified Hoenstein tests against *Staphylococcus aureus* and *Escherichia coli*. The results indicated a significant improvement in antimicrobial effectiveness for the cotton fabric treated with plasma and coated with natural extracts, maintaining this efficacy even after four washing cycles. This research demonstrates that utilizing oxygen DBD plasma/ZnO NPs treatment, combined with the absorption of tea and tulsi leaf extracts, presents a promising strategy for developing natural antimicrobial textiles. This approach is particularly relevant given the increasing medical and healthcare demands for effective antimicrobial materials. Overall, the method not only enhances the absorption of plant extracts but also significantly boosts antimicrobial efficacy, offering valuable insights for future textile applications.

**Keywords :** cotton, ZnO NPs, green tea leaf, antimicrobial activity, DBD oxygen plasma

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