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Impact of Sterilization and Bioactivity of Plasma-activated Hybrid Hydrogels

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Hybrid hydrogels have been developed to address and mitigate the issues of both natural and synthetic polymers. Traditional synthetic hydrogels exhibit network defects such as phase-separated regions, chain ends, and entanglements and significant heterogeneity which greatly affect their mechanical properties and alter the bioactivity and diffusion rates of the active molecules [1]. The definition of hybrid hydrogel is still up for debate. They can be defined as either a complex that is made up of hundreds of physically or chemically cross-linked nanogels or it refers to combined systems of different polymers and/or nanoparticles. It can also be constituted by functionally, chemically, and morphologically distinct building blocks that are formed from at least two different classes of molecules, which can include biologically active polymers like peptides, polysaccharides and/or proteins, or micro/nanostructures that are interconnected via chemical or physical means. The hybridization of hydrogels can occur at microscopic or molecular level depending on the nature and size of the building blocks [2].

This study explored the feasibility of integrating plasma treatment in developing hybrid hydrogels. Specifically, the study employed plasma treatment where the blend of synthetic and natural polymers is exposed to an atmospheric pressure plasma discharge. The impact of sterilization on the structural integrity of plasma-activated hydrogels was observed. The enthalpy of the hybrid hydrogels, whether plasma-treated or not, increased after sterilization. The increase in the enthalpy values is attributed to the decrease in the onset temperature of the samples where this change in the onset temperature was attributed to the additional water inside the hydrogel structure after sterilization

The bioactivity of the hydrogel samples was first examined through its surface where its surface composition and the porosity were observed. A decrease in the %porosity was observed when the samples were sterilized. The %porosity of the samples before sterilization was in the range of $33.46 \pm 10.13\%$ to $67.93 \pm 14.61\%$. The %porosity range decreased to $7.65 \pm 5.93\%$ - $39.19 \pm 11.30\%$. The %porosity of the plasma-treated hydrogels did not change drastically compared to the pristine samples after sterilization. This is probably due to increased chemical species attributed to the crosslinking sites.

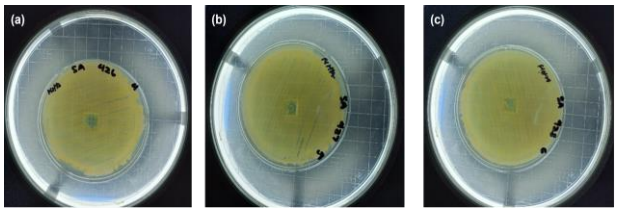

Figure 1. Antibacterial activity of plasma-activated hydrogels

Zone of inhibition test was conducted to the plasma-activated hydrogels to inspect their possible antibacterial activities. The assay, shown in Figure 1, used *Staphylococcus aureus (S. aureus)* as the test microorganism. The microbial suspension was spread all over the surface of the agar plate. Results showed that the area where hydrogels were placed are clear. This showed no visual sign of contamination. The inhibition of microbial suspension to infiltrate the hydrogel network may be caused by the additional ionic bridges created by plasma treatment.

References

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