ROLE OF EMBEDDED VOIDS IN BIOPOLYMER GEL FILM WITH REFERENCE TO MECHANICAL DEFORMATION, AND DIFFUSION OF BIOACTIVE SPECIES

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ABSTRACT

Synergistic contributions of alginate, gelatin, and chitosan for better control over uptake and release of bioactive species, strength and compressibility, and the cell proliferation are addressed in this thesis. Alginate with blended gelatin, when crosslinked shows higher rigidity and tensile strength due to presence of two superposed polymer network. Chitosan, when applied as a layer over the crosslinked alginate film enables control of release and degradation rate, and provide a method for compartmentalized uptake and phased release of multiple bioactive species. Most importantly in this work, uniform macrovoids of 300 to 500 μm diameter are introduced before the formation of the composite gel structure using a fluidic method. The uniformity of bubbles has directed a self-alignment, creating uniform macroporosity across the gel structure over and above the intrinsic porosity of crosslinked matrix. The substantial increase in uptake capacity (% swelling) due to the presence of voids in alginate film was found to be in the range of 868% to 1416%. The strength of the gel films got reduced due to the absence of the gel material in the void space. For instance, when 500 μm voids were introduced in the Alg film, the ultimate tensile stress got reduced from 10.69 kPa to 5.12 kPa. The presence of voids in single or multiple layers “cushions” the compressive deformation by allowing the aqueous phase to exude from the gel, and reabsorbing upon decompression. During decompression phase of the repeated compression-decompression cycles, the entire expelled fluid got reabsorbed, as long as the amplitude did not exceed 30% deformation. The permeability of the gel matrix at different levels of deformation is evaluated here. Also, the advantages in cell penetration over the thickness of the gel structure, and cell proliferation inside the gel matrix due to the presence of voids are demonstrated.

***Keywords*:** Blended and layered biopolymers, macrovoids, fluidic device, uptake and release study, mechanical behaviour.