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Abstract

Biopolymer-based hydrogels for 3D bioprinting †

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Abstract: Three-dimensional (3D) bioprinting is an emerging technology that could be used in the generation of 3D cellular structures for tissue engineering applications. The interest in this technology is due to its capacity to enable the fabrication of precise 3D constructs composed of biomaterials laden with living cells, biomolecules and nutrients. The process involving the deposition of cell-laden biomaterials or bioinks on a substrate is referred to as bioprinting. This bioprinting process can be used in the fabrication of living tissues and functional organs suitable for transplantation into the human body. Notably, the viability of utilising a bioink for bioprinting is dependent on its functionality, mechanical properties, printability and biocompatibility. The bioink must also be able to provide cells with a stable environment for attachment, proliferation and differentiation. To promote the sufficiency of bioinks in 3D bioprinting, several researchers have investigated pathways to enhance ink properties to meet bioprinting requirements, with several synthetic and natural hydrogels developed. These hydrogels are matrices made up of a network of hydrophilic polymers that absorb biological fluids. They can be created from a large number of water-soluble biopolymers including proteins and polysaccharides. The 3D structure of these hydrogels is due to the presence of structural crosslinks that are maintained the environmental fluid. The elasticity of these structures and the presence of a large amount of water enable the hydrogel to adequately mimic biological tissues. Recognising the importance of hydrogels in 3D bioprinting and its potential wide range of tissue engineering applications, the current study therefore investigated major physicochemical parameters that may affect the printability and biocompatibility of biopolymer-based hydrogels. Approaches employed in maintaining structural integrity of the hydrogel, via the application of crosslinking methods were comprehensively discussed with explorations of the status of the formulation and use of biopolymer-based hydrogels for 3D bioprinting, also presented.

Keywords: 3D bioprinting; hydrogels; biopolymers; bioinks.

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