



Development of bioink for 3D printing applications in tissue engineering

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Tissue engineering is the application of the combined knowledge in the fields of engineering and life science. It has been developed as an alternative treatment and has become a promising approach to recover a function of damaged tissues or organs of patients [1]. This strategy involves in the combination of three components including cells, bioactive factors, and scaffolds [2].

In field of tissue engineering, scaffolds play an important role in the development process of new tissue. This is because they act as a temporary support which allows human tissues/cells in the defective area to attach and regenerate new tissues for the recovery of their functionality [3]. However, a successful fabrication of scaffold with precisely controlled architecture still remains challenge [4].

Currently, 3-dimensional bio-printing (3DP) technology has attracted significant attentions for 3D scaffold fabrication because it can provide a simultaneous deposition of living cells and bioactive compounds along with biomaterial scaffolds at precise desired locations [5]. One of the requirements for a successful bio-printing is bioink, which has to be compatible with printing devices and able to retain high cell viability after printing process [6].

Hydrogels are hydrophilic and polymeric networks which are capable of retaining large amount of water and biological fluids [7]. Because their structures are very similar to that of ECM and they can provide a hydrated environment and mechanically supportive 3D environment for cell and tissue growth [8], they are an attractive class of material for bioprinting [9]. However, they have some unsatisfactory properties such as poor mechanical strength and lack of structural integrity [10].

In present work, we focus on the development of hydrogel bioink for 3D printing applications based on alginate which has a good biocompatibility and a capability to form hydrogel under mild conditions with the presence of divalent cations such as Ca^{2+} . Gelatin and methylcellulose will be incorporated into the material to improve the cell-material interaction and improve the shape fidelity of the printed structures respectively. Moreover, the physicochemical properties of the hydrogels will be evaluated.

Keywords:

Tissue engineering, 3D printing, bioink, hydrogel, biofabrication, bioprinting

Explain the impacts of your work especially to Thailand.

Thailand will become an aged society in 2025. Therefore, the technologies related to the elders' health will be very important in the future. Tissue engineering and 3D printing technology could play an important role in the production of the biological substitute to restore the function of tissues or organs damaged from diseases or accidents.

Moreover, research and development about the materials for tissue engineering applications may be the fundament to promote Thailand to become a medical hub according to the strategic master plan of Thai government.

Explain how your work fit with the ATPER conference theme

This research complies to the theme of Group 7: Medical Technologies

Currently, this research is carrying out at the institute of biomaterials, university of Erlangen-Nuremberg, Germany under the supervision of Prof. Aldo R. Boccaccini. This institute has a lot of collaborations with many international research institutes, companies, and universities. The institute is always open for the new collaborations. So, it is possible to set up the collaboration with research institutes in Thailand to facilitate the research about biomaterial for medical applications.