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3D Bioprinted Cell-Cultured Meat Scaffolds Based on Starch/Gelatin

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Abstract

The development of cell-cultured meat offers a sustainable alternative to conventional aquaculture [1], yet suitable scaffolds for fish myoblast culture remain underexplored. In this study, we aim to fabricate 3D-printed scaffolds using starch and gelatin as base materials and systematically investigate the effects of transglutaminase (TGase) crosslinking and glycerol plasticization on scaffold performance for large yellow croaker (*Larimichthys crocea*) myoblast-based cultured meat. Starch and gelatin, which are low-cost, biocompatible, and widely used in tissue engineering [2], will be mixed at a 2:1 weight ratio, and different concentrations of TGase and glycerol will be incorporated to prepare bio-inks. Scaffolds will be printed via an extrusion-based 3D printer (20G nozzle, 4–6 bar, 8 mm/s) into grid structures, and their printability, rheological properties, swelling ratio, degradation rate, compressive modulus, and microstructure (SEM) will be characterized. We expect that TGase crosslinking will enhance the mechanical strength and resistance to degradation of the starch/gelatin network [3], thereby improving scaffold stability, while glycerol will act as a plasticizer to increase extrusion continuity and scaffold flexibility, although excessive glycerol may compromise shape fidelity [4]. The combined effect of TGase and glycerol is anticipated to produce scaffolds with optimized pore size, swelling behavior, and mechanical properties that support large yellow croaker myoblast adhesion, proliferation, and myotube formation, as will be assessed by CCK-8, live/dead staining, and MyHC immunofluorescence. This study will provide a rational formulation strategy for starch/gelatin-based 3D scaffolds tailored to fish cell-based cultured meat, highlighting the synergistic roles of TGase and glycerol in tuning scaffold performance.

References

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