Whole-cut cultured fish fillet production by cellular agriculture strategies

Bioengineering

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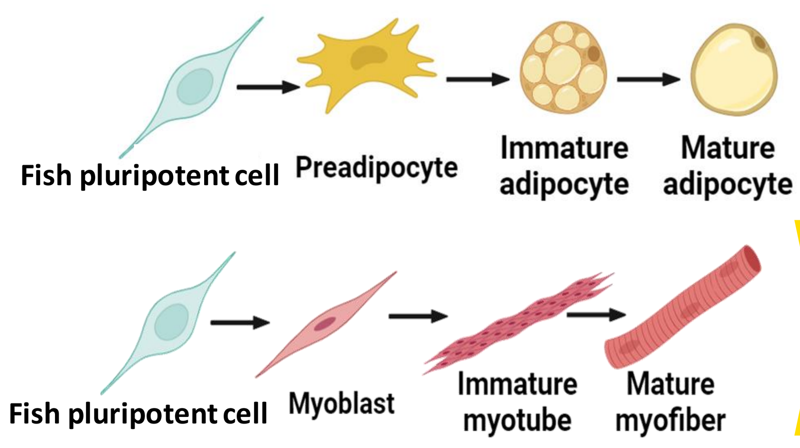
Motivation & Background

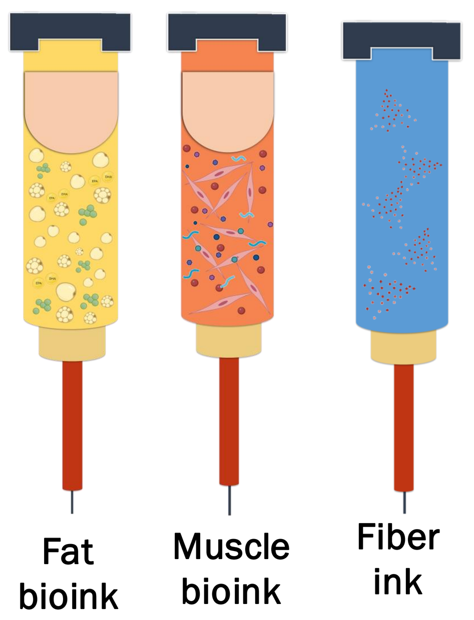
As the global population increases, the demand for animal products increases too. Production of meat is exhausting the use of fertile land and fresh water and contributes to greenhouse gas emissions. **Cellular agriculture** has the potential to revolutionise food production, by generating more sustainable animal proteins in bioreactors using cell sources rather than farming and sacrificing animals. This thesis aims to disrupt the traditional processes of obtaining fish products using cellular agriculture strategies based on cell culturing and scaffolding. These scaffolds support fish cell growth and contribute to the tissue's nutritional and sensory features. These tissues are engineered using **3D bioprinting and electrospinning**, allowing a precise deposition of different components to recreate in a high level of detail a fish fillet.

Methods

Fish cell culture

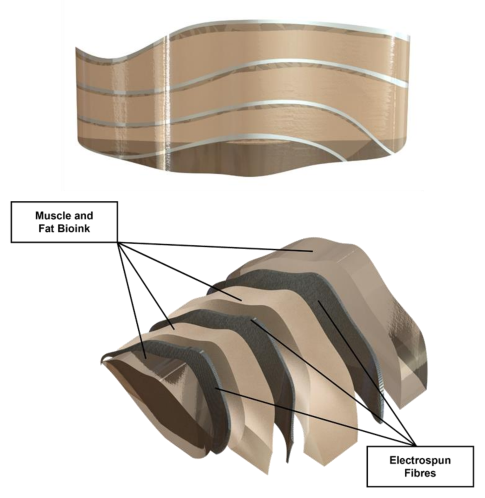


(Bio)ink development

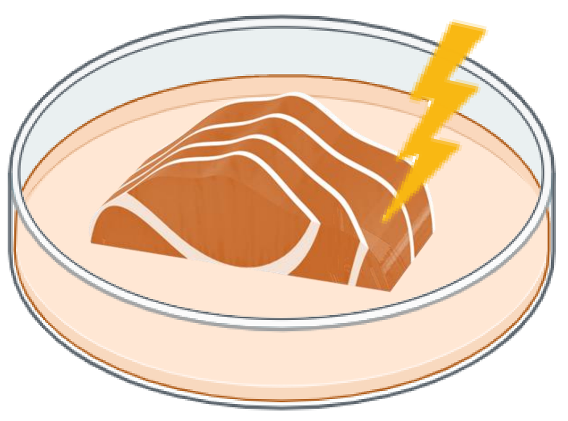


3D bioprinting & electrospinning

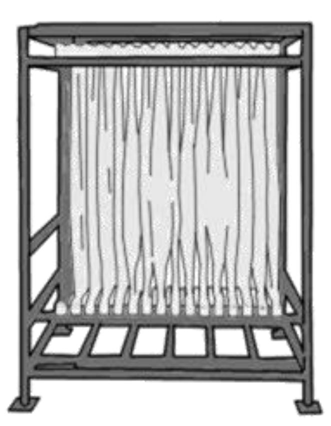
CAD fish fillet design



Fillet maturation with electrical stimulation

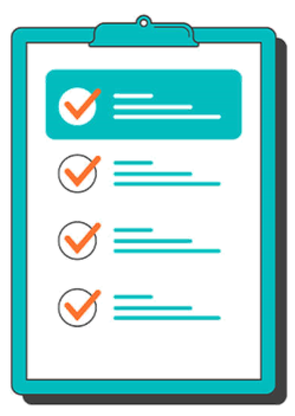


Novel plate&frame bioreactor



Nutritional and sensorial analysis

Consumer acceptance evaluation



Results

3D (bio)printed cultivated fish fillets with electrospun fibers incorporated. Different colors were achieved by tuning the bioink materials.

Atlantic mackerel (*Scomber scombrus*), "Mack" cells, under AC electrical stimulation during muscle maturation leads to enhanced cell alignment and potentially superior fish texture.

Electrospun edible and plant-based zein fibers incorporated into a 3D cultivated fish fillet, mimicking the fish myospetum.

Live/dead viability assay of 3D bioprinted seabass (*Dicentrarchus labrax)* embryonic-like cells after 7 days in culture.

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