**Algal protein-based 3D-printed fish-analogs as a new approach for sustainable seafood**

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**Abstract**

Rising global demand for animal-products exceeds human-population growth. This unsustainable trend causes harmful ecological effects. Overfishing causes extinction of aquatic animals and a dangerous biodiversity loss harming aquatic ecosystems. Hence, replacing animal-based food, particularly beef and fish, with sustainable alternatives is an urgent vital global mission. Analogs of animal-based products include plant-based, tissue-culture-based and fermentation-based products. Fish analogs have mainly been based on plant-protein, fungi, tissue-culture, but to our knowledge, fish analogs made of algae, particularly macroalgae, as the major component and protein-source have not been reported. 3D-food-printing is a fast-developing technology, enabling formation of complex three-dimensional structures with various heterogeneous topologies and tailorable compositions. Herein, we report the co-extraction of proteins and polysaccharides from the red marine-macroalgae Gracilaria cornea, and using the extract in injection-based 3D-printing to form prototypes of salmon-fillet. Two bioinks were used: a red bioink dyed with microalgal-astaxanthin, for the muscle tissue, and a white bioink dyed with CaCO3, for the ‘connective’ tissue. Algal proteins have excellent nutritional amino-acid composition, and the co-extraction with agar facilitates 3D-printing thanks to its pseudoplastic and gelling properties. This study highlights macroalgae as an exciting natural raw-material for fish analogs towards sustainable seafood production, thereby decreasing harm to ocean fisheries.

**Reference**

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