June 4, 2025

#EU GREEN WEEK

THE WATER-ENERGY-FOOD NEXUS:
BUILDING RESILIENCE TO GLOBAL CHALLENGES

Partner Event

Sustainable use of fish by-products

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Introduction

30-70% of farmed fish biomass is by-product. Enzymatic hydrolysis with proteases is used to refine by-products to peptides and amino acids, called fish protein hydrolysates (FPH). Flavors and smells still limits use of these ingredients for human consumption. This challenge may be overcome by further enzymatic treatment (oxygenates; Goris et al, 2023).

This study focuses on a life cycle assessment of enzymatically processed food-grade FPH made from Norwegian salmon by-products. Climate change, acidification, and eutrophication (freshwater and marine) impacts were considered in the study. The results were compared to alternative protein sources.

Methodology

A cradle-to-gate LCA was conducted based on lab scale data of fish by-product hydrolyzation employing the EF3.1 methodologies and the SULCA-tool. The functional unit of the study was 1 kg protein (Figure 1).

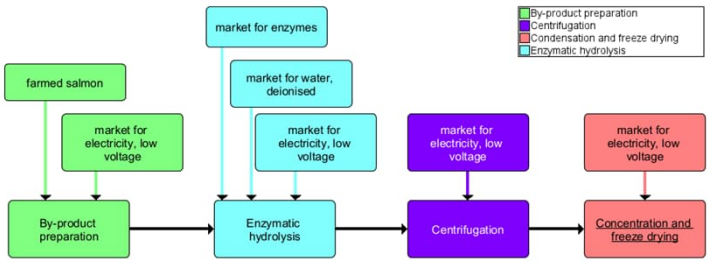

Figure 1. Study system boundaries. Flowchart of the FPH production

Results

Most environmental impacts of FPH were primarily related to the electricity consumption in the processing. The results are presented in Table 1.

Table 1. Comparison of life cycle assessment results of FPH to selected benchmark products.

Impact category	Unit	Total	By-product preparation	Enzymatic hydrolysis	Centrifugation	Condensation and freeze drying
acidification	mol H+ eq	0.27	0.001	0.05	0.02	0.19
climate change	kg CO_2e	24.52	0.09	4.52	2.05	17.86
eutrophication: freshwater	kg P eq	0.02	0.0002	0.0039	0.0019	0.0165
eutrophication: marine	kg N eq	0.04	0.0056	0.0089	0.0023	0.0198

Compared to benchmark protein isolates, FPH's climate impact was lower than that of whey protein concentrate but higher than soy and faba bean protein isolates (Table 2).

Table 2. Comparison of life cycle assessment results of FPH to selected benchmark products.

Impact category	Unit	FPH	Whey protein concentrate	Soy protein isolate	Faba bean protein isolate
acidification	mol H^+ eq	0.27	650-694		0.0174-0.0187
climate change	kg CO_2e	24.52	38-41	20.2	2.7-3.0
eutrophication: freshwater	kg P eq	0.02	3.3-3.6	0.01	0.000103-0.000113
eutrophication: marine	kg N eq	0.04	214-229		0.0109-0.0145

Discussion and conclusions

- FPH holds promise as a sustainable protein source
- Challenges may relate to scaling up operational capacity and the fragmented nature of the SME dominated industry
- The sustainability of industrial production should be verified with data from scaled up processes

Goris M, Cea-Rama I, Puntervoll P, Ree R, Almendral D, Sanz-Aparicio J, Ferrer M, Bjerga GEK. 2023. Increased Thermostability of an Engineered Flavin-Containing Monooxygenase to Remediate Trimethylamine in Fish Protein Hydrolysates. Appl Environ Microbiol 89:e00390-23. https://doi.org/10.1128/aem.00390-23

Part of this publication is based upon work from the COST Action <CA20138: Network on water-energy-food nexus for a low-carbon economy in Europe and beyond – NEXUSNET>, supported by COST (European Cooperation in Science and Technology)

OXIPRO has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000607

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