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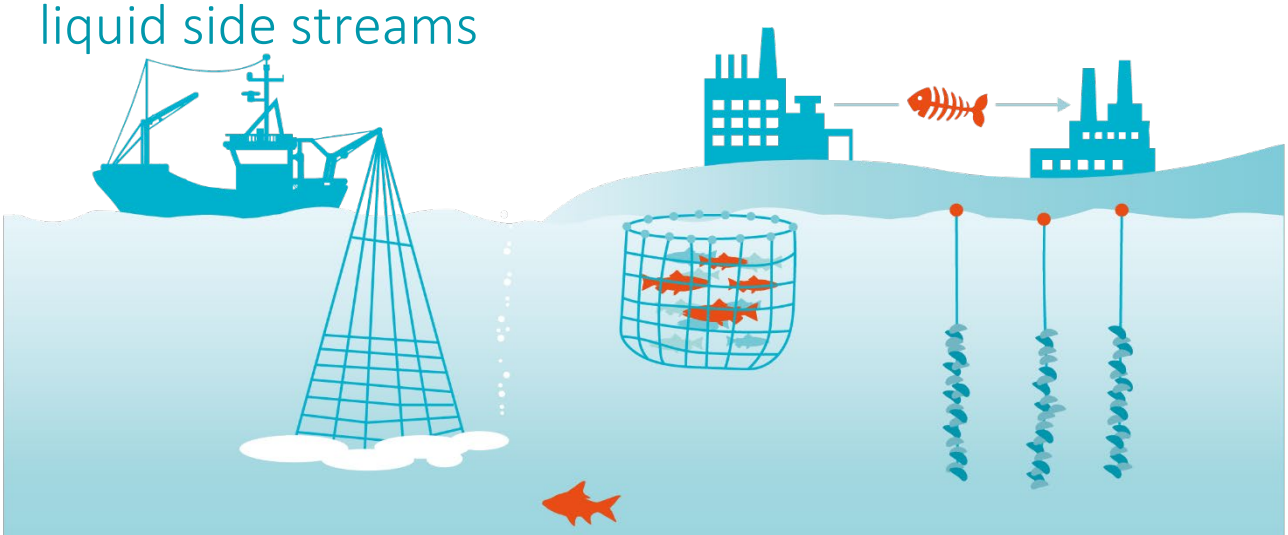
Optimal utilization of seafood side-streams through the design of new holistic process lines

D3.1 Report on the four most promising concentration strategies for biomolecules of liquid side streams



Deliverable type: Report
WP number and title: WP3 Developing and testing (bio)technological processes on lab scale
WP leader: AZTI
Task number and title: Task 3.1 concentration strategies to recover biomolecules from liquid side-streams
Lead beneficiary for the task: CTH
Dissemination level: Confidential
Due date: 31.12.2021
Actual submission date: 17.12.2021
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Contributing Partners: CTH, AZTI, SP and PM

BBI JU
Bio-based Industries Consortium
Horizon 2020 European Union Funding for Research & Innovation

Deliverable 3.1 on “Report on the four most promising concentration strategies for biomolecules of liquid side streams” is considered confidential, and as stated in the consortium agreement and in IPR management plan only executive summary, that contains non sensitive data, will be released within the project time span to protect any exploitable results.

1 Executive Summary

This document reports on the valorisation strategies of liquids side streams; herring brine generated at Sweden Pelagic (SP), mussel cooking water generated at Pescados Marcelino (PM), and cod brines generated at Jeka Fish (JF). The overall aim of task 3.1 was to provide recommendations, based on the technical feasibility evaluated at laboratory scale, for at least 4 promising strategies for recovery of potential ingredients from process waters that will be later scaled up in WP4 and whose environmental performance and economic assessment will be addressed in WP5. All the tested solutions were based on the use of side-streams managed in an improved manner, allowing to obtain food grade quality ingredients and to propose circular economy schemes based on best solutions.

Task 3.1 is divided into two subtasks, 3.1a which deals with the application of food grade flocculants in biomass recovery from liquid process waters using flocculation technique and 3.1b deals with recovery of a savoury ingredient from mussel cooking water.

In task 3.1a we have reported on the results obtained from flocculation techniques investigated with herring brine, mussel cooking water and cod brine. A selection of food grade flocculants comprising $CaCl_2$, silica-based flocculants and chitosan lactate have been used as the main driver for the recovery process. Flocculation occurred upon addition of flocculant to the sample and protein sedimentation is reported after centrifugation and measurement of residual protein in the upper phase. The flocculation tests were performed with silica-based flocculants, $CaCl_2$ and chitosan at native pH of each process water. Also, the effect of acidification on the protein sedimentation in different process waters were evaluated. Best results of flocculation treatments of herring brine were obtained with $CaCl_2$ and silica-based flocculants resulting in 73 % and 89 % sedimentation of protein, respectively. In mussel cooking water, flocculation with silica-based flocculants resulted in 40 % protein recovery, while for the cod brine samples treatments with chitosan lactate and silica-based flocculant both resulted in 46 % of sedimented protein.

In task 3.1b the main activity was the design, development, and optimization of the processes for the concentration and stabilisation of high value components, mainly proteins, from the mussel cooking water to use as ingredient for savoury purposes in food industry. For this purpose, membrane filtration and vacuum evaporation were selected as concentration techniques. The preferred membrane was nanofiltration because it allowed concentration of proteins and not salt (present in high amounts in this type of side stream and not desirable for food uses). The results showed that the vacuum technique concentrates the salt at high level, so the selected concentration technique was nanofiltration with a second step of diafiltration with the purpose of decreasing the salt content, achieving an overall protein recovery yield of 70 %. A second step was the stabilisation of the concentrates through the use of spray-dryer, in which the performance parameters was optimised.

In summary, task 3.1 has resulted in recommendations of 8 different valorisation processes for further evaluation and upscaling of the following depuration/recovery technologies in WP4:

- Flocculation treatment with $CaCl_2$ and silica-based flocculants for herring brine at SP
- Flocculation treatment with chitosan lactate and silica-based flocculant for two selected cod brines at Jeka Fish
- Flocculation with silica-based flocculants for mussel cooking water at PM
- Membrane concentration by nanofiltration with a second step of diafiltration of mussel cooking waters in the facilities of Pescados Marcelino.

The implementation of these technologies could lead to the recovery of 71 t/year of herring protein in Sweden, or 30 t/year of cod protein at Jeka Fish (Denmark) facilities or about 196 t/year of mussel protein in Galicia. Promoting the setup of new value chains based in circular economy schemes, and at the same time improving the environmental footprint of these industries by reducing up to 90 % the organic load of their wastewaters.

On the other hand, the environmental and economic performance of this value chain is being studied in WP5, where different impact indicators will be identified. Environmental categories such as carbon footprint, freshwater eutrophication or acidification will be analyzed, as well as economic indicators such as capital and operating expenditures and return on investment. These results will be part of WP4 and 5 tasks.