Recovery of biomolecules from liquid side-streams from mussel processing

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Introduction

Along with an increasing consumption of convenience seafood products like fillets and ready meals, the amount of fish and shellfish side-streams and rest raw materials is increasing. Process waters from the seafood industry contain valuable nutrients, that could be used in food or aquaculture feed. But currently, these process waters are treated as liquid waste.

In many cases, the side-streams ended in the wastewaters, increasing the organic matter to the point that the company may fail to comply with the discharge limit values. This fact is especially relevant considering that in this sector this organic matter is mainly composed of useful proteins that can be used in food, feed or other valuable purposes.

So that, the aim of this study is to develop and optimise the process for the recovery of the protein fraction transforming the side-stream into a useful secondary raw material in a scheme of circular economy.

Material and methods

Within this framework, WASEABI project proposes a sustainable solution for reusing mussel cooking by-products through the application of an innovative ways of sorting, storing and transporting the side-streams to the success in valorisation for higher incoming quality and higher expected ingredient quality.

The process for protein obtention consists, firstly, in a sorting at origin with food grade quality management. Then for improving logistics an step of water content is needed, so a concentration process by using different technologies as filtration and vacuum techniques.

Mussel side-stream was collected directly from the Mussel cooking tank from Pescados Marcelino (Galicia, Spain), and preserved at -18ºC.

Concentrated by Nanofiltration (NF) membranes in order to obtain RO and NF concentrates with a final solid content around 15% as a previous step for every valorisation alternative. Filtration was carried out in a membrane filtration pilot plant (TIA, Bollène, France) with a pair of 2.5 m^2 surface (NF elements DK 2540 5K (molecular weight cut-off of 150-300 Dalton) and a prefilter 200 µm at 30-40ºC.

Vacuum concentration (VC): Vacuum rotatory evaporator (Buchi)

Analytical measurements for protein fraction characterisation: protein content, molecular weight protein fingerprint (HPLC), microbiological content, COD (Chemical oxygen demand), solids content (APHA, 1998)

Results and discussion

The valorisation processed selected in WASEABI project, considered the side-stream composition and quality parameters, both of them were used to identify their potential for a later application as fine chemicals, pharmaceuticals, cosmetics and human or animal nutrition. In that case, we evaluated the savoury compounds was the best option for mussel cooking stream.

It is very important to select a pre-concentration step for mussel cooking waters, without full dewatering because it facilitates de logistic and subsequent the valorisation of process water biomolecules in a centralized facility. Due to the heat sensitivity of the savoury proteins, thermal concentration processes were avoided. Therefore, different separation techniques had been tested: NF and RO membrane filtration and vacuum evaporation. In three cases we evaluated the collection of savoury biomolecules and different fraction ratio were found. The best protein recovery in the concentrated fraction was achieved by RO and VC but the resulting products showed a high saline concentration that can prevent its use as flavouring agent in food industry. While the subsequent effluent, in both cases resulted in a good quality water for reuse in other process.

On the other hand, NF yielded lower result in protein recovery, due to the permeation of small molecular weight proteins. However, the salt content was lower than the values obtained with the other technologies. The resulting permeate still had a organic load in the final effluent, but reduced enough to be discharged with the regulatory frame.

All techniques permitted to reduce de volume of the side-streams to allow the logistics needed for the further valorisation steps.

Conclusions

In conclusion, three technologies had been tested to concentrate the high value proteins from mussel cooking waters (steam cooking). In all cases, the high content on salt from the water contained in the mussels, was the limiting factor as well as the fact that the interesting biomolecules retention.

In addition, the reduction of pollution of wastewater has been monitored with each of the technologies tested that also contribute to reduce the environmental impact of the company.

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