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Production of biostimulants from tuna cooking waters through membrane nanofiltration and enzymatic hydrolysis

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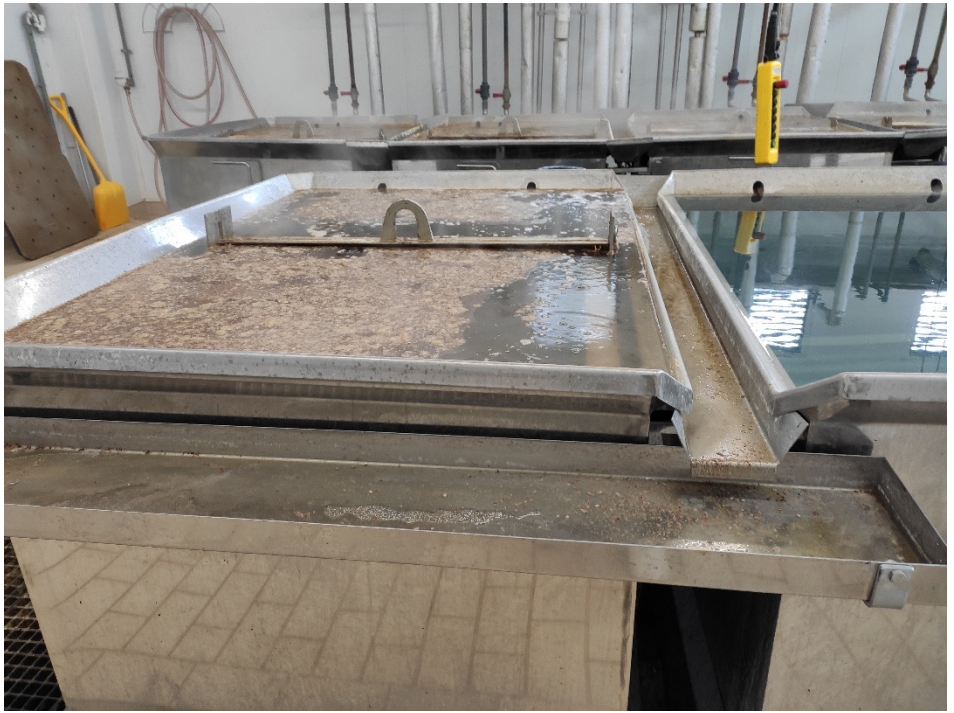
Spent tuna cooking brines

Tuna canning industry in Europe generates 300,000-500,000 tonnes of tuna cooking spent brines each year.

High salinity: 6 to 14 % (x 3 to x 5 times that of seawater).

They cause problems in wastewater treatment plants.

Protein content up to 5 % (highly variable).



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Plant biostimulants

Plant biostimulants improve the use of nutrients, and the plant resistance to stress, thus, the efficiency of the fertilizers and the quality and yield of cultivars.

They can contribute to the sustainability of the agricultural sector reducing the use of mineral fertilizers and pesticides.

Amino acids are used as plant biostimulants.

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Objectives

Concentration and desalting of the tuna cooking brine and further enzymatic hydrolysis to produce:

1. A free amino acid-based hydrolysate to be further used as an ingredient for the formulation of a new plant biostimulant.

2. A regenerated brine that can be recycled and reused in the process, saving water.

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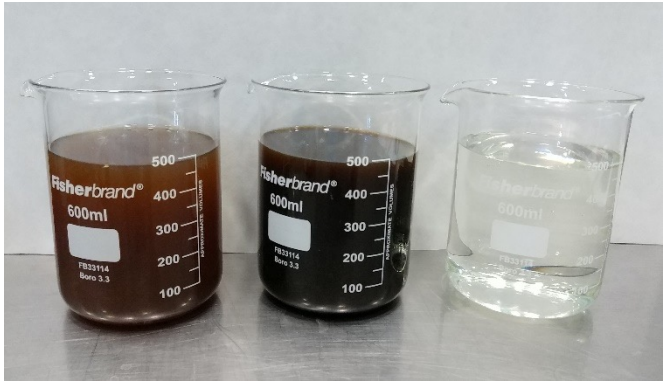
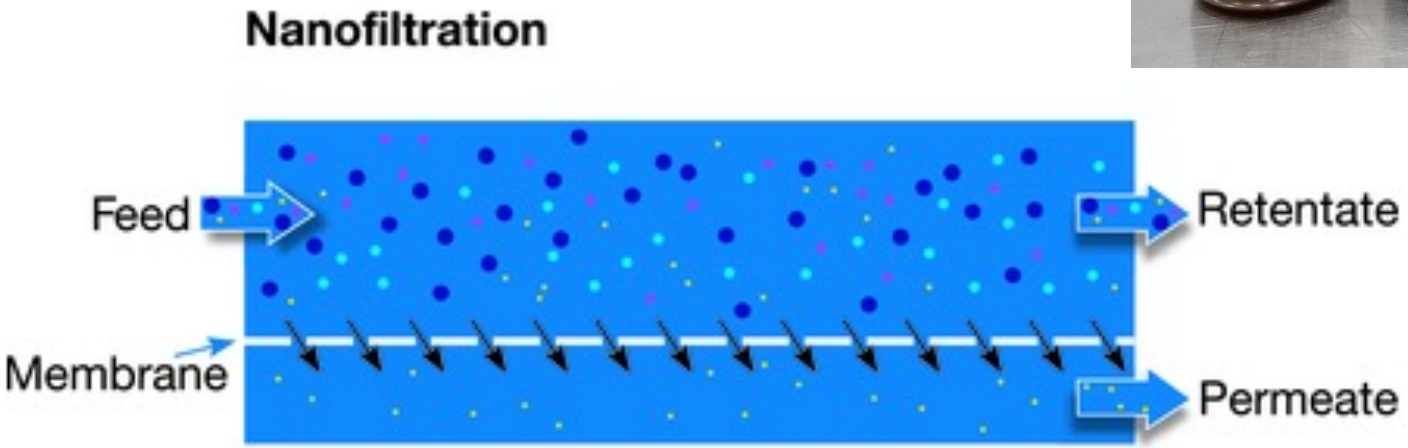
Recovery of water through membrane filtration

Salts pass through the membrane and protein is retained.

A protein concentrate and a clean brine are obtained.





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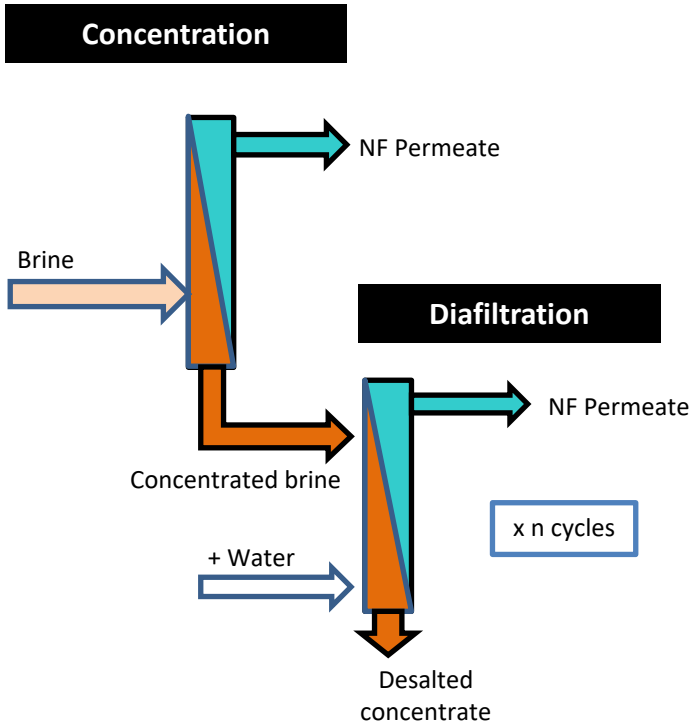
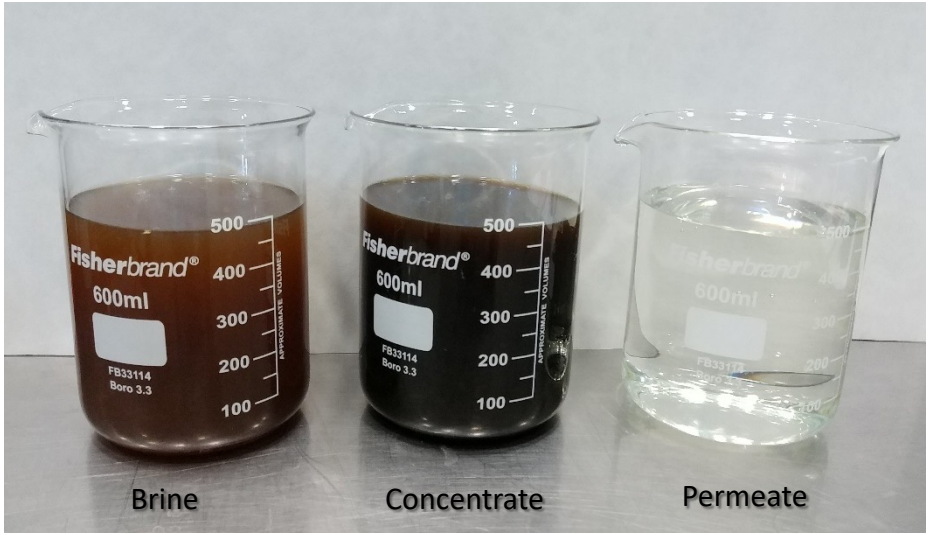
Desalting with nanofiltration



Final salt concentration must be < 3% d.m. basis for biostimulant use.

Salt may also affect enzyme activity.

Therefore, a diafiltration step is added.



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Enzymatic hydrolysis

Four commercial enzymes were tested: two endo and two exoproteases.

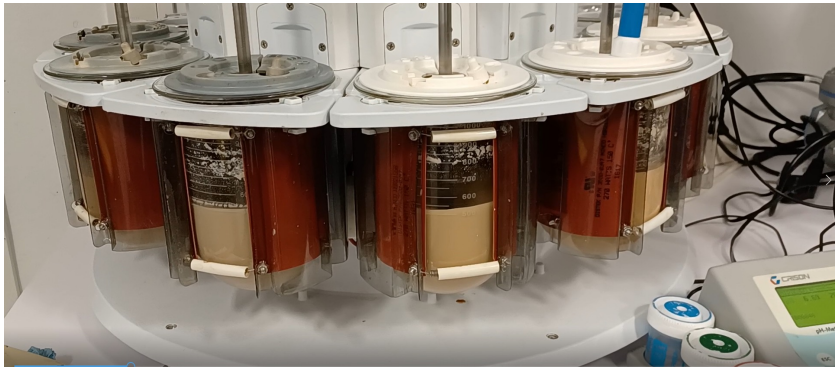
Exo and endoproteases were combined and used also alone as control.

All at the same dose and for 6 h hydrolysis time.

In 500 mL batches and duplicates.

<u>The objective: maximum yield of free amino acids (FAA).</u>

Expressed as % FAA/ % Protein in the hydrolysate.



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RESULTS

First trial

	Salt (%)
Initial	7.58
After 2 DFs	0.25

After hydrolysis, the maximum yield of FAAs was 12.79 %

Considered the low yield, a second trial was done by reducing more the salt content.

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Second DF trial

	Salt (%)	Protein (%)
Initial	8.31	3.52
After 3 DFs	0.012	15.86

Near 90 % of the brine was recovered in the first concentration by NF step.

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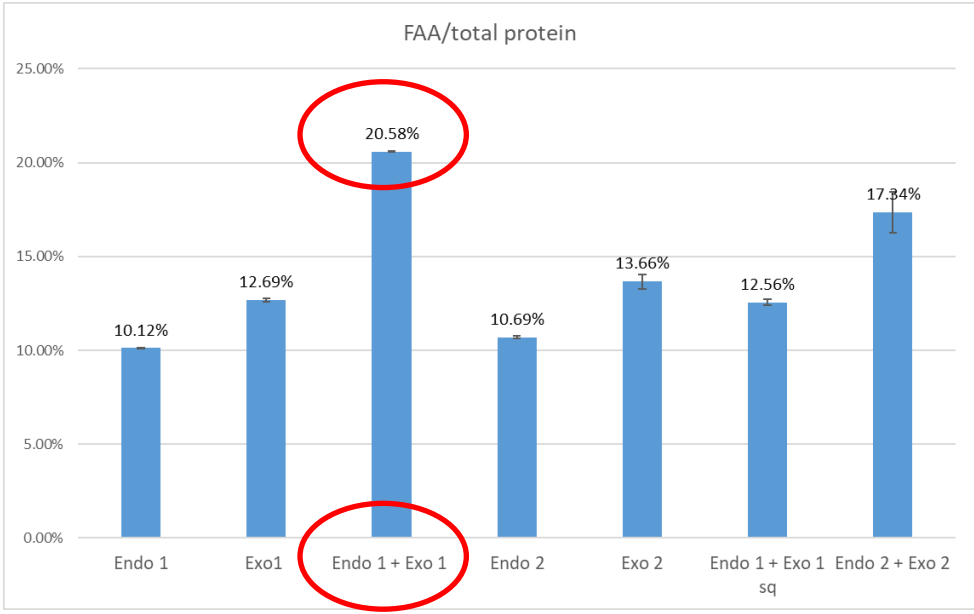
Enzymatic hydrolysis of second DF trial

The maximum FAA yield obtained increased to 20.58 %

All the combinations gave higher FAA yields than in the first trial.

The final product had 92 % protein and 17 % FAA d.m. basis.



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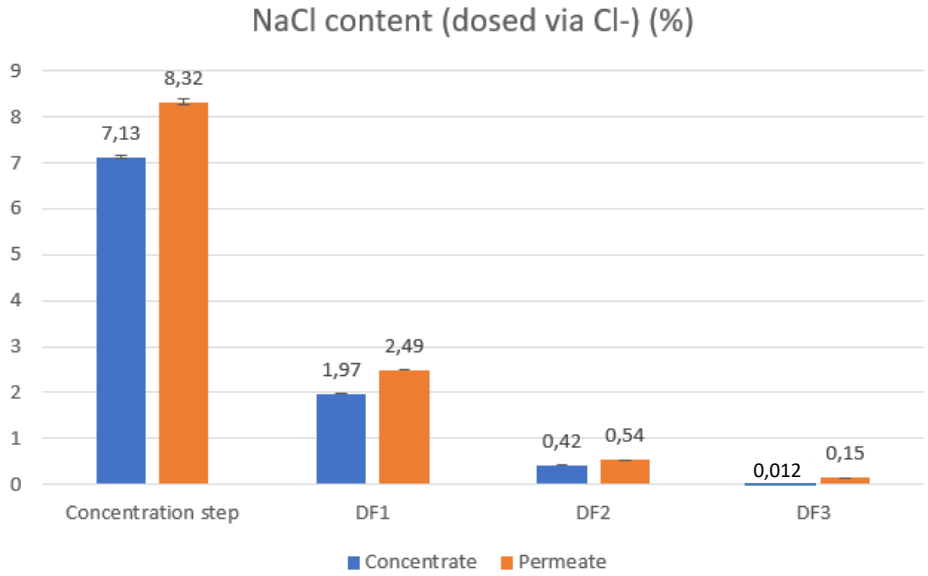
Observations

The chloride content measured in the permeates was systematically higher than in the concentrates of the correspondent DF cycle (see graph).



Meanwhile, sodium content in the final concentrate, measured by atomic absorption spectrometry, was higher than in the permeate: 0.32 % vs 0.07 % respectively.

Accordingly, the ash content of the final concentrate was higher than expected: 1.14 ± 0.15%

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Observations

The sodium seems to be retained in the concentrate while the chloride passes preferably with the permeate.

This could be due to the negative charge of the proteins of the retentate.

This affects the ionic strength of the final concentrate and perhaps the hydrolysis efficacy.

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CONCLUSIONS

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1. The process allows to recover the nano-filtered brine to be reused in the cooking process.
2. A protein hydrolysate with FAAs was obtained from tuna cooking brines that could be used as biostimulant.
3. Further research is needed to see if the FAA yield can be improved.

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