Characterisation and modelling of high value natural compounds released during the salting process of codfish (*Gadus morhua*)

V. Ferraro [1,2], I.B. Cruz [1,2], R. Jorge Ferreira [2], F.X. Malcata [1], P.M.L. Castro [1] and M.E. Pintado [1]

[1]**CBQF/Escola Superior de Biotecnologia,**
Universidade Católica Portuguesa,
Rua Dr. António Bernardino de Almeida,
4200-072 Porto, Portugal

[2]**WeDoTech – Companhia de Ideias e Tecnologias Lda.,**
CIDEB - Edif. da Escola Superior de Biotecnologia,
Universidade Católica Portuguesa,
Rua Dr. António Bernardino de Almeida, 4200-072 Porto, Portugal

Introduction

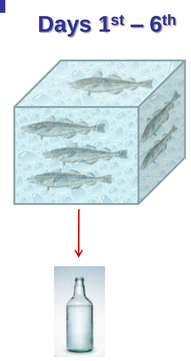
In Portugal, Atlantic codfish (*Gadus morhua*) is usually consumed dry-salted by mixing codfish fillets with food-grade marine salt followed by stacking in a tank for 6 days. Along the salting process, codfish not only incorporates salts but also releases water up to 22 % (w/w). This by-product is normally directly discharged, carrying a significant amount of important compounds (viz. free amino acids and proteins), which may allow for valorisation opportunities not yet explored.

Objective

This research focused on the identification of the compounds present in codfish salting wastewater together with the characterisation and modelling of the release of the main compounds identified.

Methodology

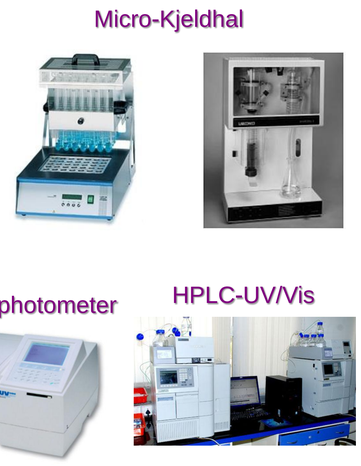
Codfish dry salting



Wastewater sampling

Materials

- Atlantic codfish was mixed with food-grade marine salt and stacked in a tank for 6 days.
- Throughout the salting process, a wastewater sample was collected each day during 6 days.
- Volume of wastewater released by codfish was measured each day at same time of sampling.



Wastewater analysis

Methods

- Water soluble nitrogen (WSN) and its fractions trichloroacetic acid-soluble nitrogen (TCASN) and phosphotungstic acid-soluble nitrogen (PTASN) were determined by the micro-Kjeldahl method.
- Free amino acids content were determined by HPLC-UV/Vis analysis.
- Myofibrillar was determined by a spectrophotometric method. Protein actin were quantified by HPLC-UV/Vis.

Results and Discussion

1. Proteins and peptides were released from codfish muscle promptly from the starting period of processing, whereas amino acids release took place gradually as a consequence of proteolysis (Figure 1); this is not the case for taurine, since it is naturally in its free form in muscle tissue.

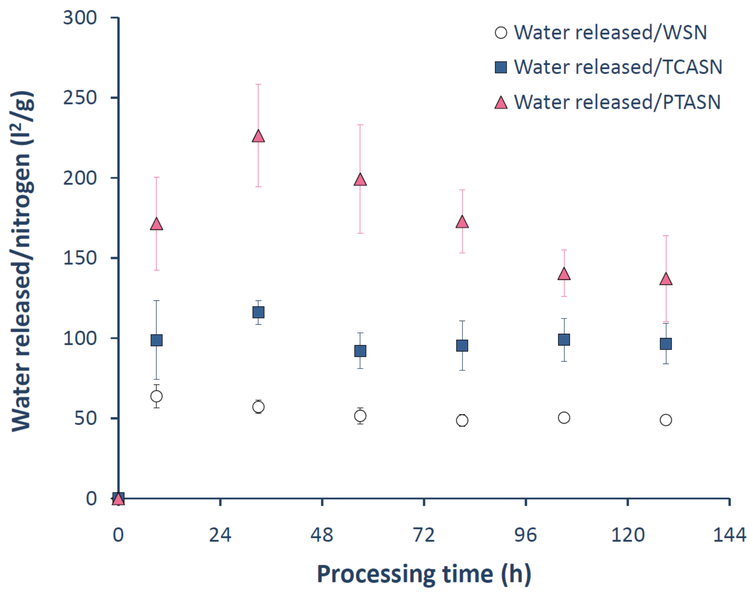


Figure 1. Nitrogen evolution trends along codfish salting process

2. By the end of the process, the WSN concentration was found to be 3.1 g/l, which is equivalent to 18.1 g/l of total protein, assuming a nitrogen-to-protein Kjeldahl conversion factor of 5.8.
3. Muscle protein concentration was found to increase with time, from ca. 3 to ca. 3.7 g/l, while the ratio of muscle protein to actin was constant and actin represented ca. 2.2% of the muscle protein released each day.
4. Major amino acids released in wastewater were: aspartic and glutamic acids, creatine, glycine, taurine and tryptophan (Figure 2). Other amino acids have been found, but in minor amounts (<0.05 g/l). The release of major amino acids was fitted to a theoretical model – monomolecular equilibrium kinetic – using the STATISTICA software (Figure 1 and Table 2).
   The equation of the model is:

$$r = \frac{dC}{dt} = k \cdot (C_\infty - C) \qquad C(t=0) = 0$$

$$C = C_\infty \cdot (1 - e^{-k \cdot t})$$

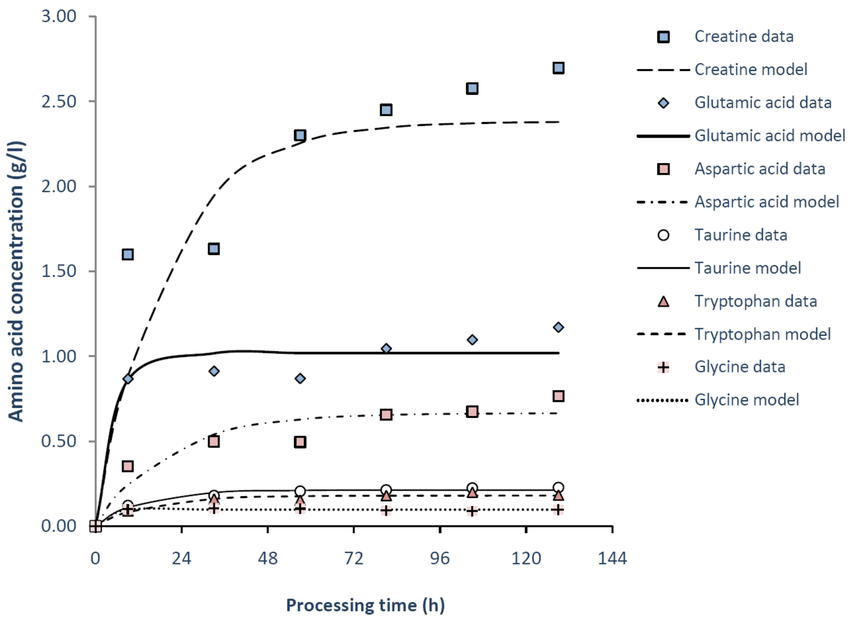


Figure 2. Concentration of major released amino acids

Table 1. Statistic and kinetic parameters for amino acids release modelling

Amino acid	Parameter			
	%SEM [a]	Adjusted R^2 [b]	C_∞ (g/l)	k (h^{-1})
Aspartic acid	14.74	0.87	0.665	0.050
Glutamic acid	10.52	0.92	1.019	0.205
Creatine	14.11	0.84	2.382	0.051
Glycine	5.52	0.98	0.098	0.540
Taurine	5.84	0.98	0.212	0.081
Tryptophan	7.89	0.96	0.180	0.067

[a] **%SEM: percent standard error of mean. Values for %SEM below 15 % indicate goodness of fit.**

[b] **Adjusted R^2: adjusted coefficient of determination. Values for adjusted R^2 close to 1 indicate goodness of fit.**

Conclusions

The work carried out so far suggests that codfish salting wastewater has a sufficiently high nutritional value and non-toxic levels to justify its upgrade: ca. 800 g of free amino acids and 570 g of muscle proteins have been found in 155 l of wastewater, in each tank. Their high biological and physiological value gives place to a new area that can be explored through the extraction of such components, which may be further incorporated into functional food, food supplements and in drugs formulations.

References

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Acknowledgments

V. Ferraro thanks Marie Curie Actions for the Grant ref. FP6 InSolEx RTN;

WeDoTech, Lda. thanks *PASCOAL & FILHOS, SA.* Portugal, for support and samples;

I.B. Cruz thanks the Ministry of Science and Higher Education (Foundation for Science and Technology – grant ref. SFRH/BPD / 20653 / 2004.