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SEAFOOD<sup>TOMORROW</sup> Final Event, 15.04.2021

# Paralytic Shellfish Poisoning (PSP) detoxification process for mussels, clams and scallops

Jorge Lago Alvarado ANFACO-CECOPESCA



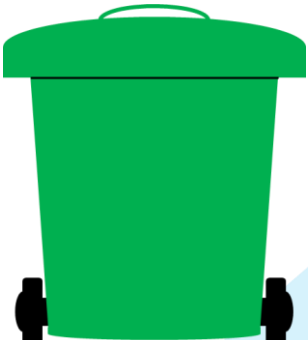
PSP Toxic shellfish



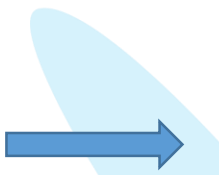
Analytical results over legal limit



Industrial processing



Destruction of a non edible product



Edible product for the market



***According to REGULATIONS (EC)Nº 853/2004 and 854/2004, in order to protect public health, harvesting areas are closed when toxin levels reach certain level in the mollusc flesh.***

***In the case of PSP, the limit level is 800 µg STX diHCl equiv./kg.***

***The closure of harvesting areas have important economic consequences along the mollusc value chain: producers, depuration plants, transforming factories and trading, as well as tourism.***

Table IV European annual losses per country for the mussel industry

Country	Average Loss \$
France	9,216,234
Spain	6,069,746
Netherlands	5,285,977
Italy	4,313,943
United Kingdom	2,700,281
Ireland	2,272,724
Germany	908,131
Greece	819,030
Norway	132,440
Croatia	104,454
Sweden	66,086
Denmark	56,989
Albania	47,639
Bulgaria	28,806
Montenegro	14,413
Portugal	12,930
Channel Islands	12,396
Slovenia	11,375
Russian Federation	9,216
Ukraine	6,961
Bosnia and Herzegovina	3,694
Iceland	1,988
Serbia and Montenegro	130
<b>TOTAL</b>	<b>32,065,171</b>



***European mussel production in 2016 was 480 000 tonnes (valued at €420 million, or \$465 million)***

***According the ASIMUTH project (CONTRACT SPA.2010.1.1-01) FP7 Collaborative Project, the annual loses for the mussel industry in Europe was 32,065,171 \$ (mean of 2000-2009; document released in November 2011).***

***Is not possible to separate loses due to the different toxins, since they can co-occur.***



***According to REGULATIONS (EC)Nº 853/2004 and 854/2004, in order to protect public health, harvesting areas are closed when toxin levels reach certain level in the mollusc flesh (800 µg STX diHCl equiv./kg for PSP)***

***European legislation makes an exception for this level, allowing harvesting and processing of the giant cockle *Acanthocardia tuberculatum* in production areas where the PSP level in the edible parts of these molluscs is higher than 800 µg STX diHCl equiv./kg but lower than 3000 µg STX diHCl equiv./kg. and establishes the conditions of harvesting, processing and control.***

**COMMISSION DECISION**

of 18 January 1996

**establishing the conditions for the harvesting and processing of certain bivalve molluscs coming from areas where the paralytic shellfish poison level exceeds the limit laid down by Council Directive 91/492/EEC**

(Text with EEA relevance)

(96/77/EC)

**Heat treatment applicable to bivalve molluscs *Acanthocardia tuberculatum* with the objective of reducing the PSP toxin to a level lower than 80 µg per 100 g**

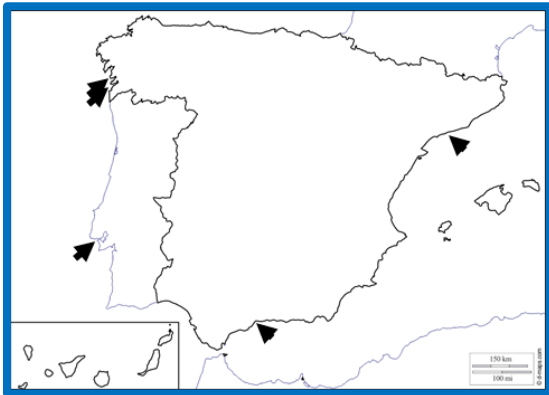
Molluscs have to undergo the following operations sequentially :

1. Preliminary cleaning in fresh water for a minimum of two minutes at a temperature of 20 °C, plus or minus 2 °C.
2. Pre-cooking in fresh water for a minimum of three minutes at a temperature of 95 °C, plus or minus 5 °C.
3. The separation of flesh and shells.
4. Second cleaning in running fresh water for a minimum of 30 seconds at a temperature of 20 °C, plus or minus 2 °C.
5. Cooking in fresh water for a minimum of nine minutes at a temperature of 98 °C, plus or minus 3 °C.
6. Cooling in running cold fresh water for approximately 90 seconds.
7. The separation of the edible parts (foot) from the non-edible parts (gills, visceras and mantle) mechanically with water pressure.
8. Conditioning in containers closed hermetically in a non-acidified liquid medium.
9. Sterilization in autoclave at a minimum temperature of 116 °C for a time calculated according to the dimension of the containers used but which can not be lower than 51 minutes. **Also Pasteurization**



Not performed in  
mussels and clams →





Species	Location	Harvesting date	Present phytoplankton	Average result ( $\mu\text{g STX}$ diHCl equiv/kg) (n=2)
Mussel ( <i>Mytilus galloprovincialis</i> )	Ría of Vigo (Vigo A)	09/07/2018	<i>Alexandrium spp</i>	1072 $\pm$ 11
Mussel ( <i>M. galloprovincialis</i> )	Ría of Vigo (Redondela C)	23/07/2018	<i>Alexandrium spp</i>	1604 $\pm$ 330
Mussel ( <i>M. galloprovincialis</i> )	Ría of Vigo (Redondela C)	23/07/2018	<i>Alexandrium spp</i>	737 $\pm$ 134
Mussel ( <i>M. galloprovincialis</i> )	Andalucía (Benalmádena)	02/08/2018	<i>Gymnodinium catenatum</i>	812 $\pm$ 270
Mussel ( <i>M. galloprovincialis</i> )	Portinho da Costa (Lisbon)	22/10/2018	<i>Gymnodinium catenatum</i>	9001 $\pm$ 345
Mussel ( <i>M. galloprovincialis</i> )	Catalonia	05/03/2019	<i>Alexandrium minutum</i>	4205 $\pm$ 43
Mussel ( <i>M. galloprovincialis</i> )	Catalonia	05/03/2019	<i>Alexandrium minutum</i>	2317 $\pm$ 261
Mussel ( <i>M. galloprovincialis</i> ), frozen		05/03/2019		
Clam ( <i>R. philippinarum</i> )	Ría of Pontevedra	27/07/2018	<i>Alexandrium spp</i>	1041 $\pm$ 23
Clam ( <i>R. philippinarum</i> ), frozen	Ría of Pontevedra	27/07/2018	<i>Alexandrium spp</i>	903 $\pm$ 204
Scallop ( <i>Pecten maximus</i> )	Andalucía	22/08/2019	<i>Gymnodinium catenatum</i>	3232 $\pm$ 466
Scallop ( <i>P. maximus</i> ) eviscerated	Andalucía	22/08/2019	<i>Gymnodinium catenatum</i>	1976 $\pm$ 117
Scallop ( <i>P. maximus</i> )	Andalucía	22/08/2019	<i>Gymnodinium catenatum</i>	3171 $\pm$ 30
Scallop ( <i>P. maximus</i> ), eviscerated	Andalucía	22/08/2019	<i>Gymnodinium catenatum</i>	1779 $\pm$ 126

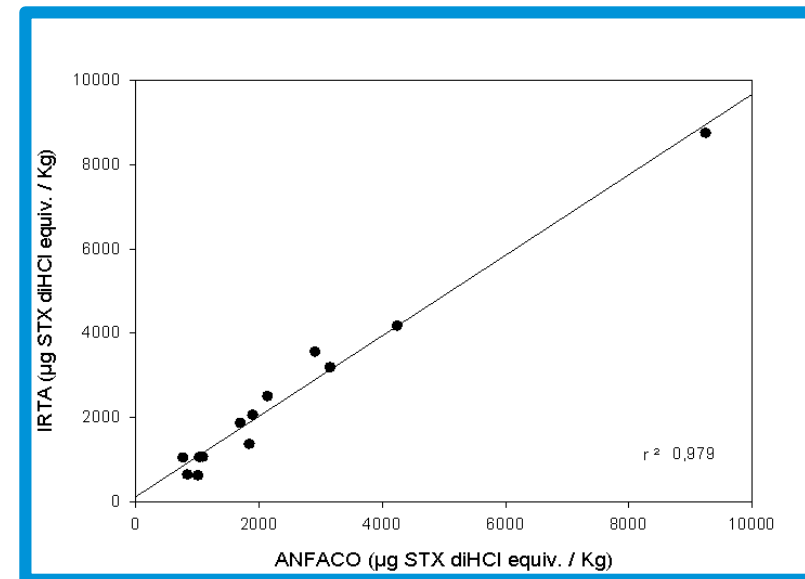
# Implementation of the procedure

*The EU protocol was applied to: mussels, clams and scallops*

*Raw material vs traditional canning or pasteurisation*

*Analyses by HPLC in two laboratories*

*Pre-column HPLC-FLD: AOAC official method 2005.06*



Cleaning



Cooking



Conditioning



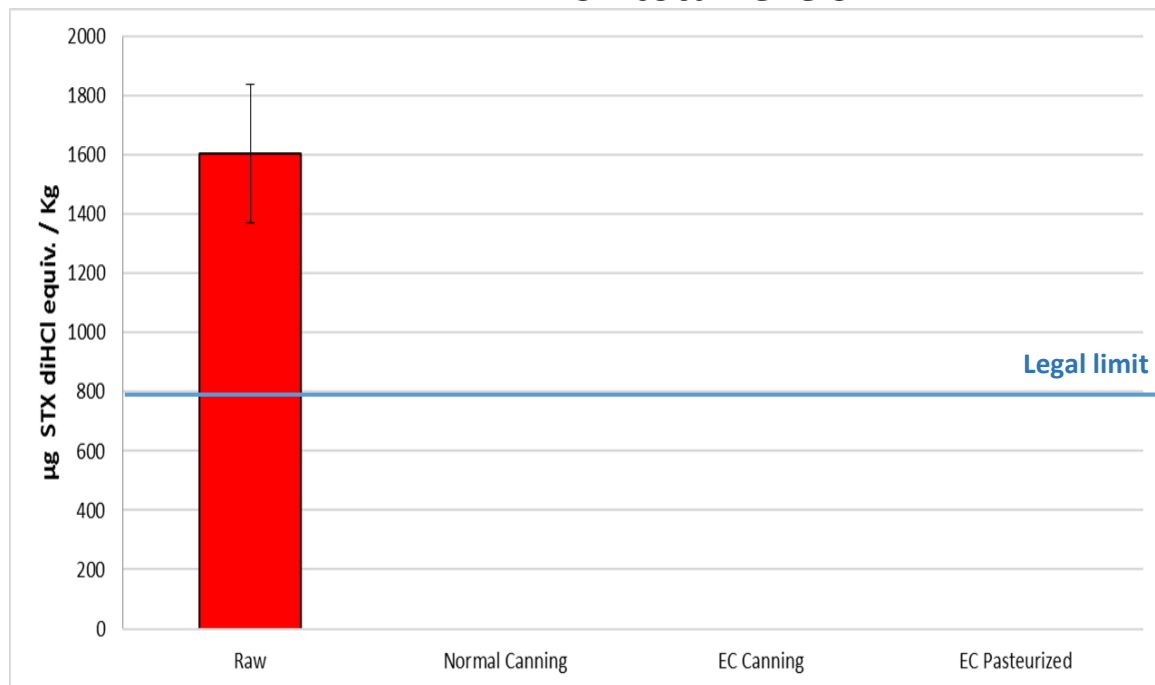
Sterilization/pasteurization



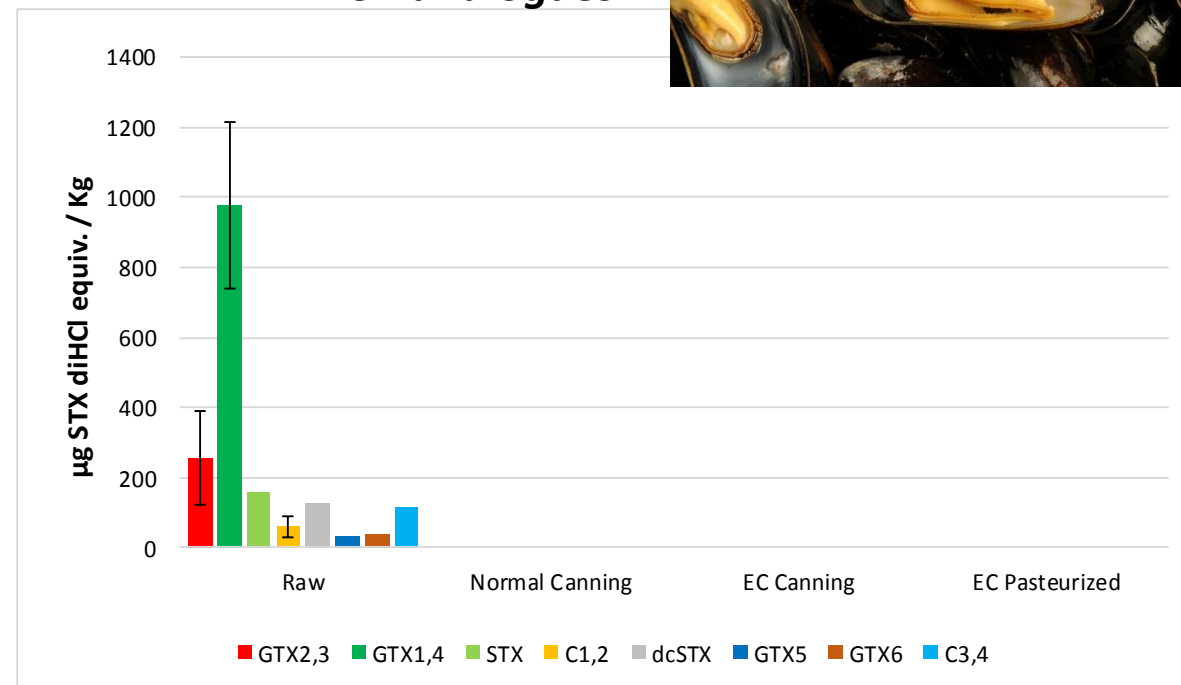
# Average of PSP toxins

Naturally contaminated mussels: Redondela

*PSP total levels*



*PSP analogues*

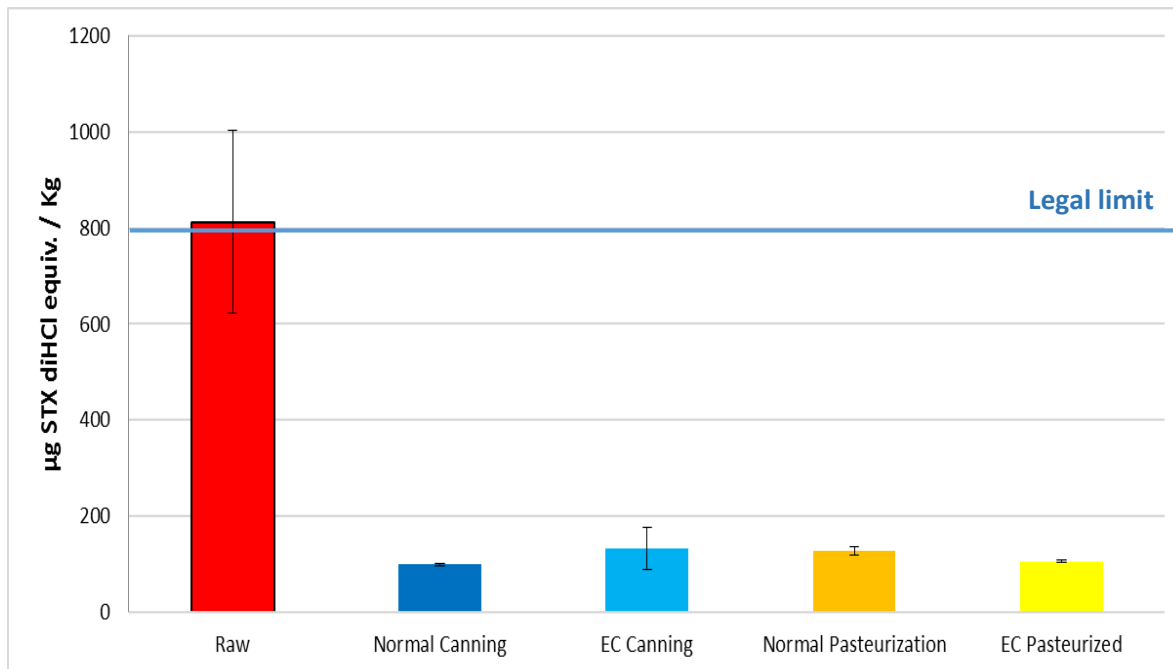


# Average of PSP toxins

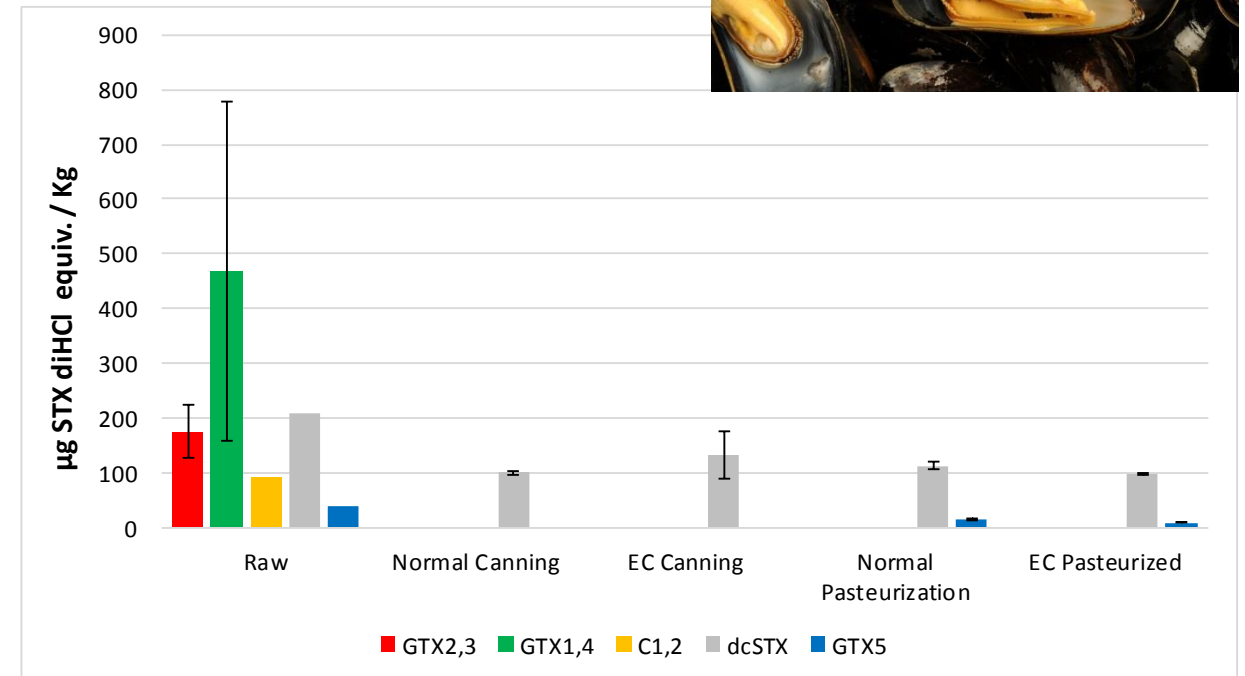
Naturally contaminated mussels: Andalucia



*PSP total levels*



*PSP analogues*

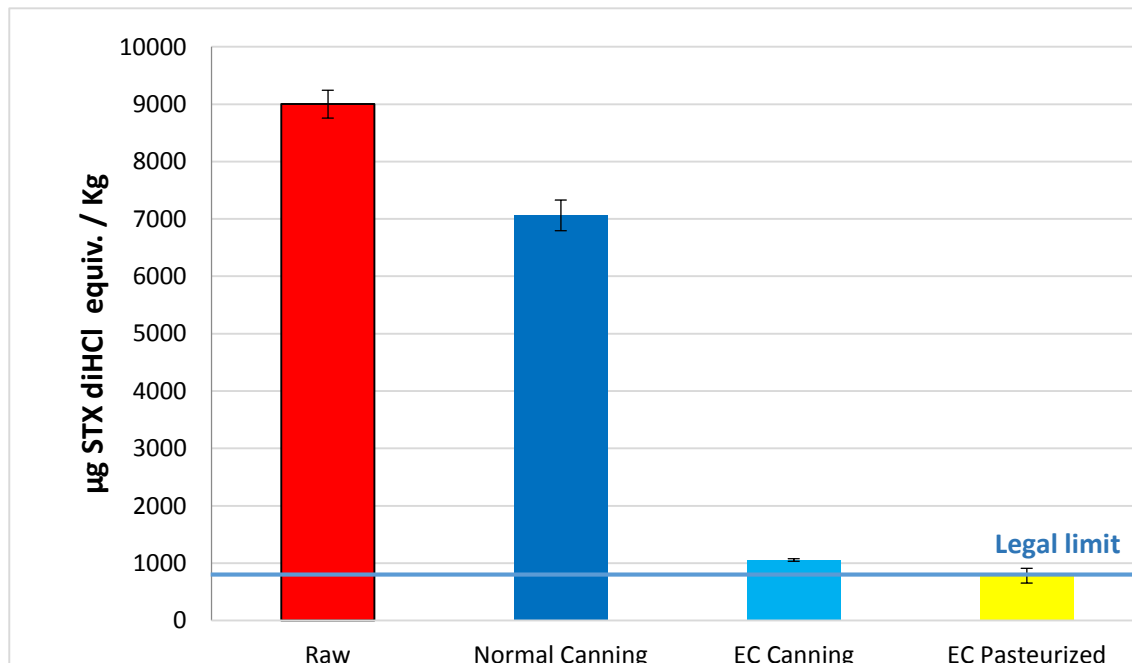


# Average of PSP toxins

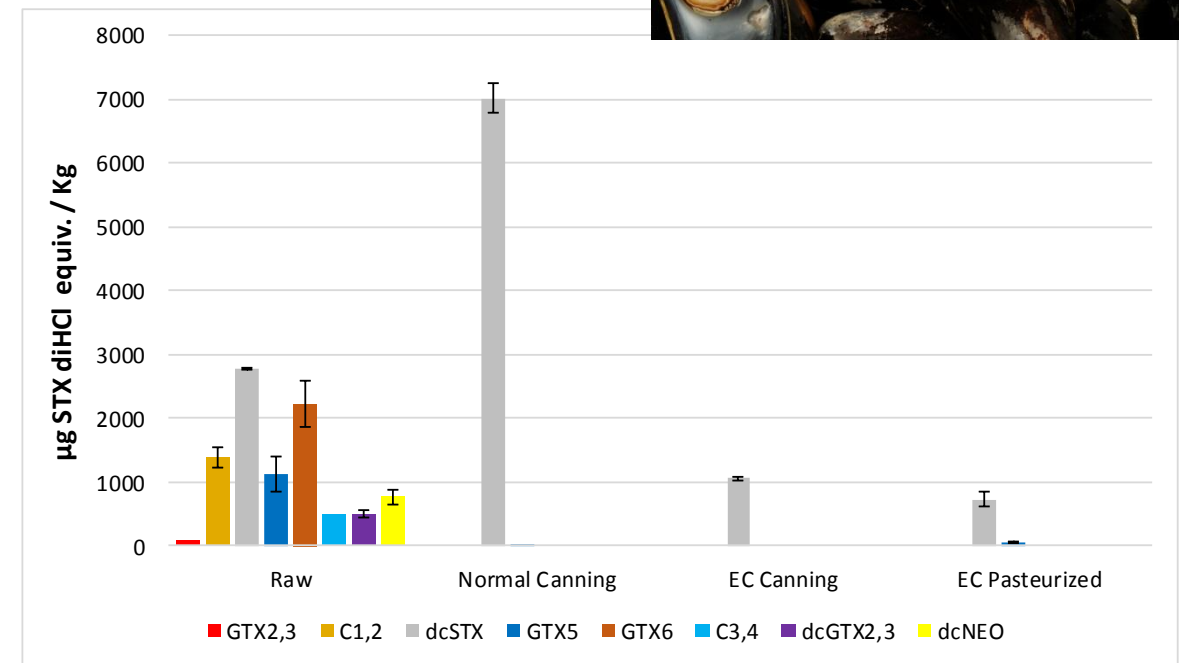
Naturally contaminated mussels Lisbon



*PSP total levels*



*PSP analogues*

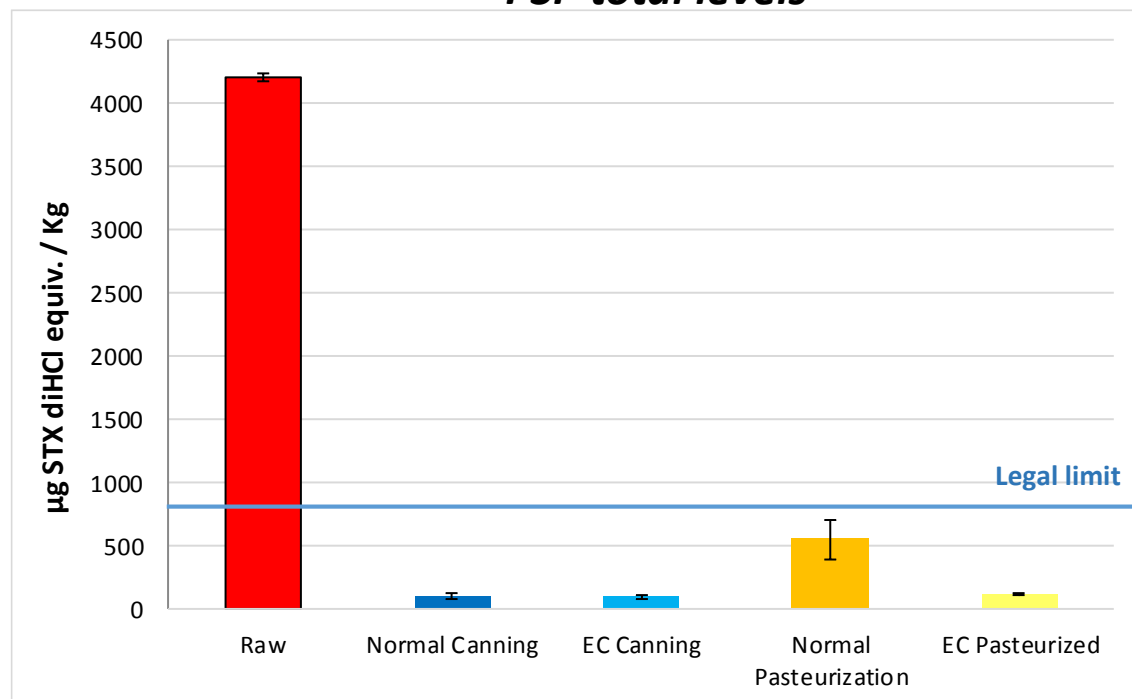


# Average of PSP toxins

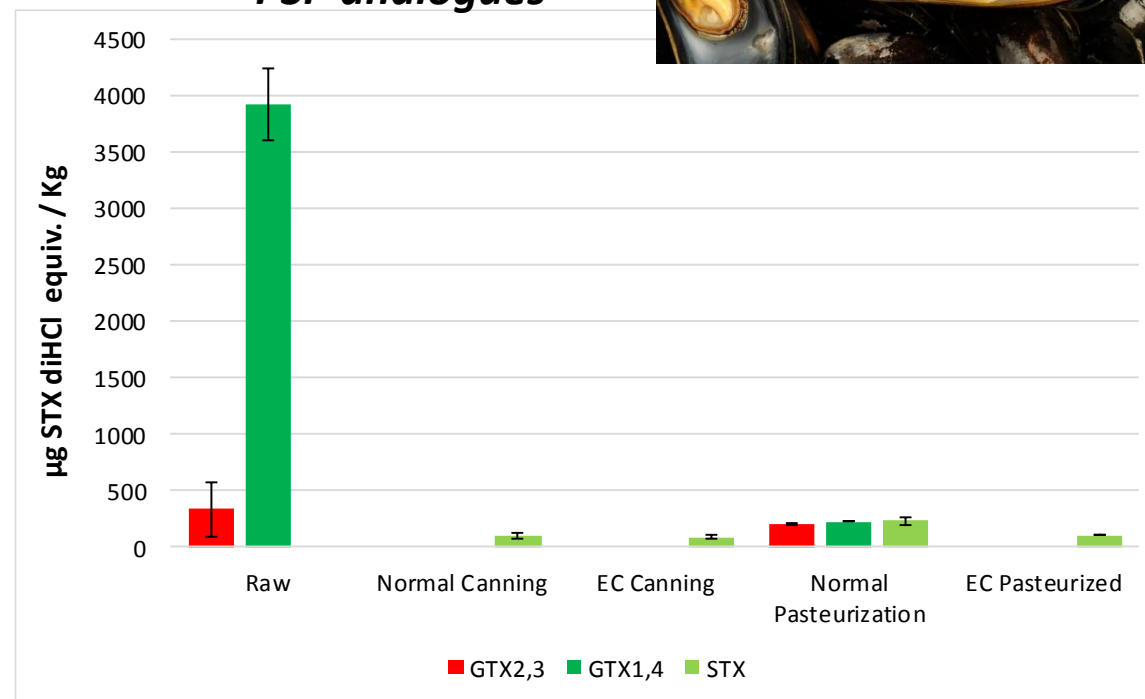
Inmersed mussels: Catalonia



*PSP total levels*



*PSP analogues*



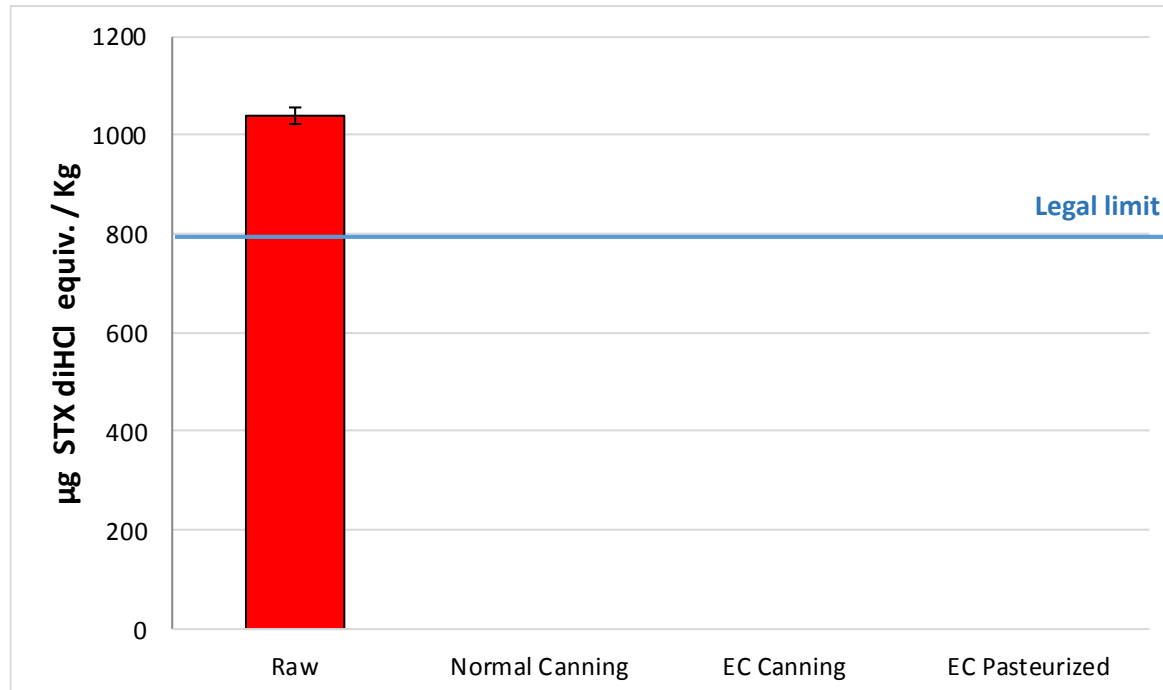


# Average of PSP toxins

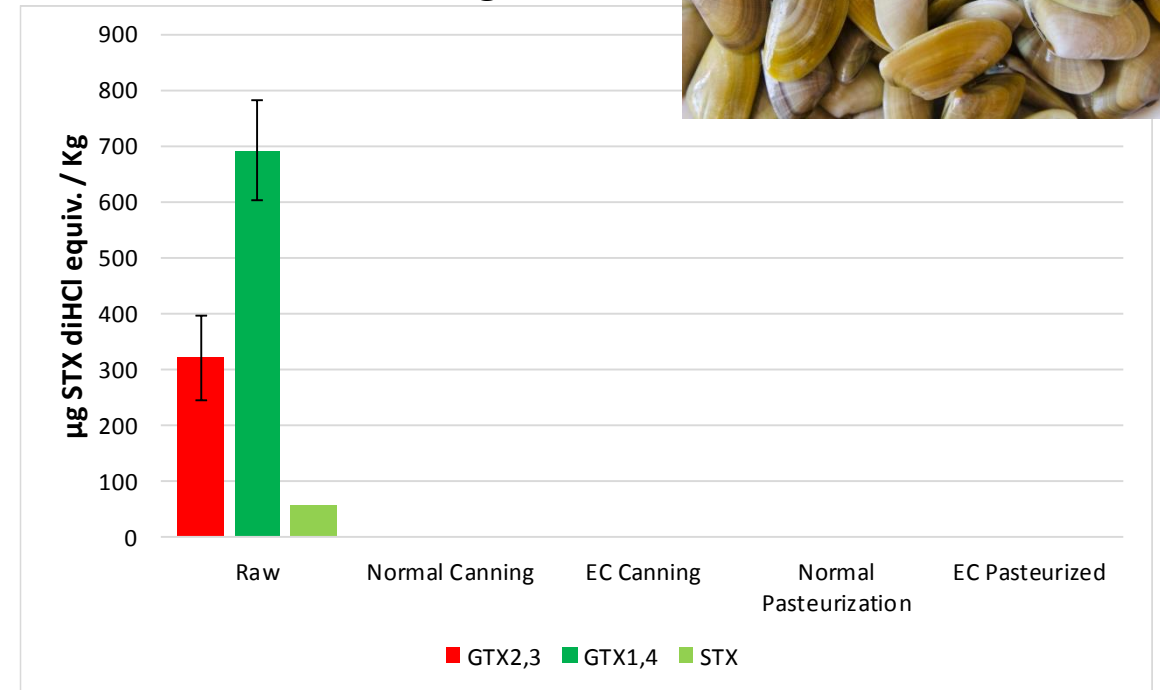
Naturally contaminated clams: Pontevedra



*PSP total levels*



*PSP analogues*

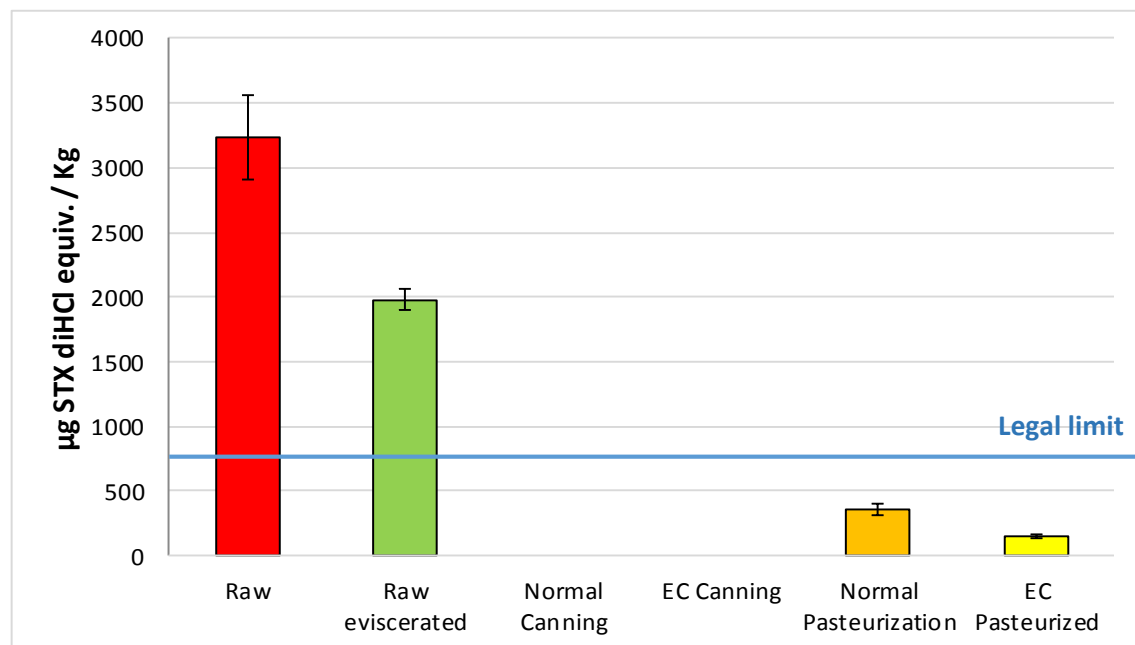


# Average of PSP toxins

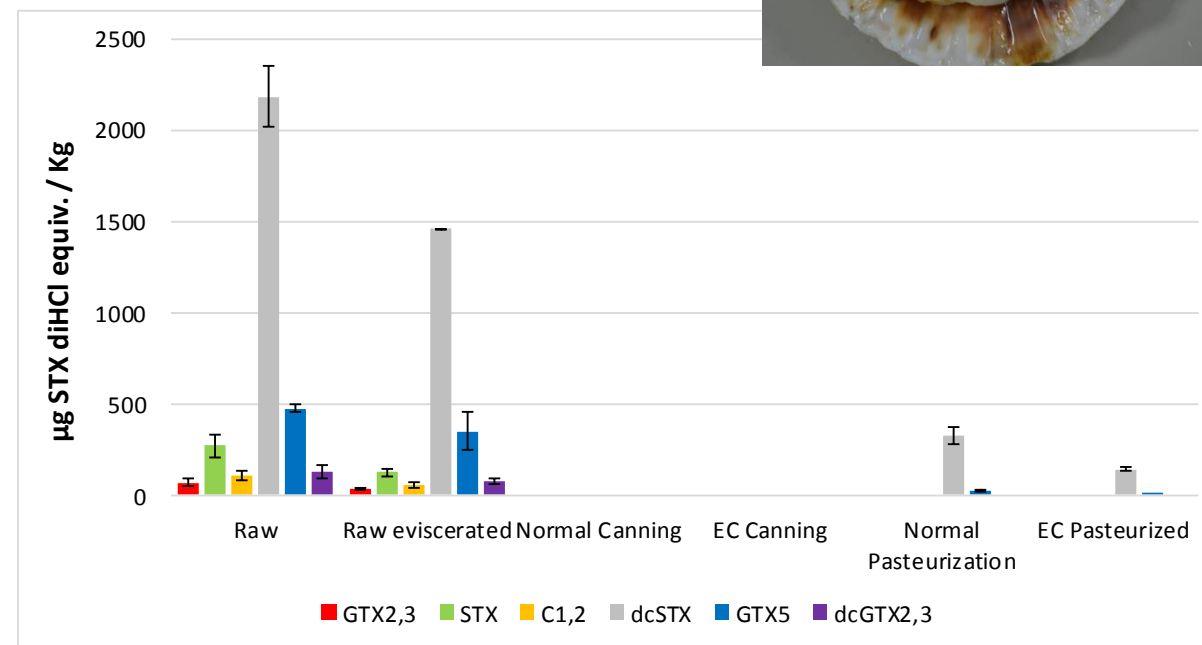
## Naturally contaminated scallops: Andalusia



*PSP total levels*



*PSP analogues*



# Sensorial analyses: business-as-usual scenario

## Mussels

### Pasteurized

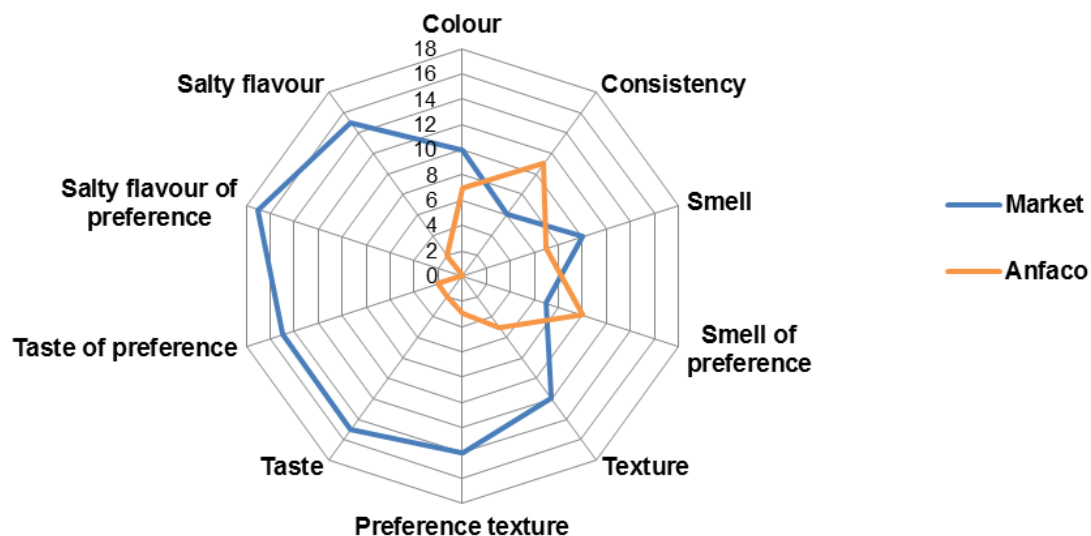


### Canned

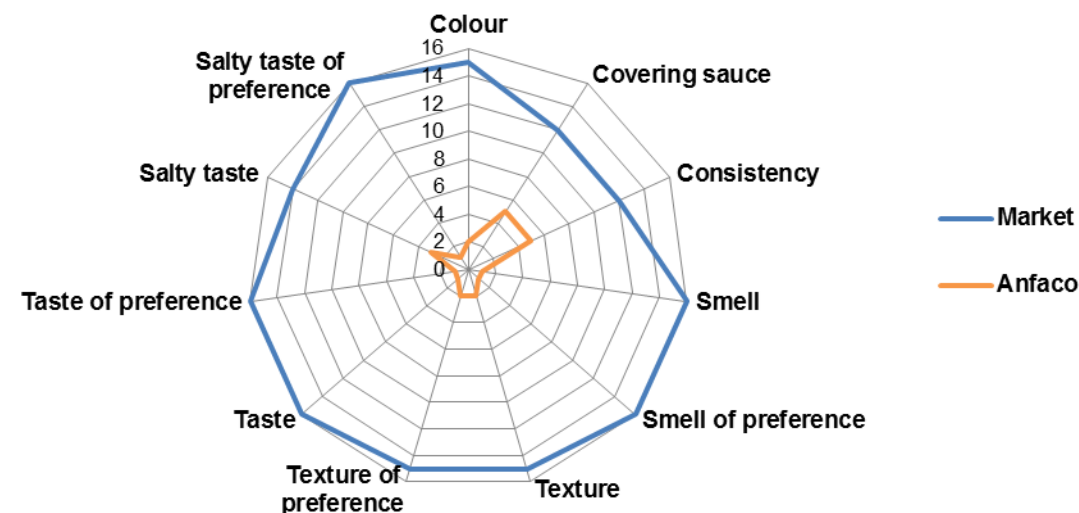


# Results of sensory analyses

## Pasteurized mussels



## Canned mussels



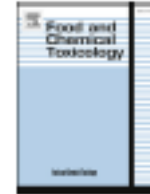




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## Detoxification of paralytic shellfish poisoning toxins in naturally contaminated mussels, clams and scallops by an industrial procedure

Ana G. Cabado<sup>a,\*</sup>, Jorge Lago<sup>a</sup>, Virginia González<sup>a</sup>, Lucía Blanco<sup>a</sup>, Beatriz Paz<sup>a</sup>, Jorge Diogène<sup>b</sup>, Laura Ferreres<sup>b</sup>, María Rambla-Alegre<sup>b</sup>

<sup>a</sup> ANFACO-CROONESCA, Campus Univ. 16, 36310, Vigo, PG, Spain

<sup>b</sup> IRTA, Programa d'Algües Marines i Continentals, Ctra. De Poble Nou km 5,5, 43540, Sant Carles de la Ràpita, Tarragona, Spain

### ARTICLE INFO

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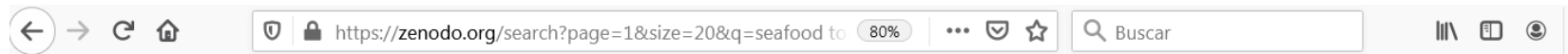
### ABSTRACT

Paralytic shellfish poisoning (PSP) episodes cause important economic impacts due to closure of shellfish production areas in order to protect human health. These closures, if are frequent and persistent, can seriously affect shellfish producers and the seafood industry, among others. In this study, we have developed an alternative processing method for bivalves with PSP content above the legal limit, which allows reducing toxicity to acceptable levels. A modification of the PSP detoxifying procedure established by Decision 96/77/EC of the European Union in *Acanthocardia murex*, was developed and implemented for PSP elimination in other bivalves species. The procedure was applied to 6 batches of mussels, 2 batches of clams and 2 batches of scallops, achieving detoxification rates of around 85%. A viable industrial protocol which allows the transformation of a product at risk into a safe product was developed. Although a significant reduction was obtained, in a sample circa 9000 µg STX diHCl equiv/kg, the final toxin level in these highly toxic mussels did not fall below the European limit. The processing protocol described may be applied efficiently to mussels, clams and scallops and it may be a major solution to counteract the closure of shellfish harvesting areas, especially if persistent.



- <https://doi.org/10.1016/j.fct.2020.111386>





Johan Robbins; Sofie Derycke;

Seafood is an important component of the human diet. With depleting fish stocks and increasing prices, seafood is prone to fraudulent substitution. DNA barcoding has illustrated fraudulent substitution of fishes in retail and restaurants. Whether substitution also occurs in other steps of the supply

Uploaded on June 10, 2020

Published in Food And Chemical Toxicology, vol. 141, issue May, p. 11.

April 30, 2020 (v1) Proposal Open Access

View

## Legislative proposal to harvest and detoxify PSP contaminated molluscs

Cabado, Ana G.; Lago, Jorge; González, Virginia; Blanco, Lucia; Paz, Beatriz; Diogène, Jorge; Ferreres, Laura; Rambla-Alegre, Maria;

In the frame of the SEAFOODTOMORROW project, a methodology for PSP elimination from bivalve molluscs (mussels, clams and scallops) in processing industries has been developed, based on an already approved protocol at European Union (Decision 96/77/EC) intended to eliminate these toxins

Uploaded on August 7, 2020

May 4, 2020 (v1) Journal article Open Access

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## Detoxification of paralytic shellfish poisoning toxins in naturally contaminated mussels, clams and scallops by an industrial procedure

Cabado, Ana G.; Lago, Jorge; González, Virginia; Blanco, Lucia; Paz, Beatriz; Diogène, Jorge; Ferreres, Laura; Rambla-Alegre, Maria;

Paralytic shellfish poisoning (PSP) episodes cause important economic impacts due to closure of shellfish production areas in order to protect human health. These closures, if are frequent and persistent, can seriously affect shellfish producers and the seafood industry, among others. In this study,

Uploaded on July 29, 2020



<https://zenodo.org/record/3975767#.X8oRhLd7nGI>

<https://zenodo.org/record/3965479#.X8oUBrd7nGJ>

<https://zenodo.org/record/3974510#.X8oSZLd7nGI>

# Conclusions



- Implementation of a detoxification procedure able to reduce PSP toxins in contaminated mussels, clams and scallops below the legal limit.
- An 85 % detoxification is attained in all samples.
- There are transformations among analogues after the thermal process.
- A change in current legislation would be needed. We are working on that.



# Disclaimer



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 773400 (SEAFOODTOMORROW). This output reflects the views only of the author(s), and the European Union cannot be held responsible for any use which may be made of the information contained therein.







# Thank You

## Contact Details:

Jorge Lago Alvarado ANFACO-CECOPECA

[jlago@anfaco.es](mailto:jlago@anfaco.es)

 @SEAFOOD\_TMRW