

Risk Assessment of Parasites in Fishery Products





Santiago Pascual del Hierro Vigo, 1st June 2018





EU fish production value chains ("Fish dependence")

□ EU fishing industry the fourth largest in the world (6.4 million tons/year; 13 million tons consumed)

□ Processing industry 4000 companies (SMEs) and 350,000 people

Galicia World-class fish consumer (22.3 kg; up to 40 kg) 25.5 kg person/year in Spain; 32 kg Galicia

Benefits

EAT FISH about three times a week as a part of a HEALTHY diet:

It has medicinal, grounding and strengthening properties:

- ✓ Filled with Omega-3 fatty acids
- ✓ Vitamins (D, B2)
- ✓ Rich in calcium, phosphorous, minerals



Why are we focused on <u>PARASITES</u>?

Emergent or Re-emergent risk in fishery products



The status quo? unsatisfactory

- Many knowledge gaps
- Many gaps between discovery and market up-take!!

What are our EVIDENCES on POTENTIAL RISKS?

I. Consumer AT RISK: Health impact





ZOONOTIC DISEASE Anisakiasis/Anisakidosis Gastric, intestinal, gastro-allergic

Severe gastrointestinal pain, fever, vomiting, diarrhoea, dispepsia, abdominal distensión, acute intestinal obstruction,...



ALLERGY

urticaria, rhinitis, conjunctivitis, asthma, angioedema, ANAPHYLACTIC shock

Allergen	Type of antigen	(kDa)	(PI)	Others	
Ani s 1	ES	24	7.0	Heat-resistant	
Ani s 2	Somatic	97	5.21	Paramyosin	
Ani s 3	Somatic	41	4.62	Tropomyosin Heat-resistant	
Ani s 4	ES	9	5.57	Heat and pepsin-resistant	
Ani s 5	ES	15	4.94	Heat-resistant	
Ani s 6	ES	9.7	9.68	Heat-resistant	
Ani s 7	ES	139	8.46		
Ani s 8	ES	15	4.51	Heat-resistant	
Ani s 9	ES	14	9.06	Heat-resistant	
Ani s 10	Somatic	21	4.20	Heat-resistan	
Ani s 11		27	\cup	\sim	
Ani s 12		31			
Ani s 13		37	Hemoglobin		
Ani s 14		24			

OTHERS

Colitis, rheumatological disease, oral mucosa disease, strangulated hernia, sepsis, cancer,...

OCCUPATIONAL ALLERGY

(fishmongers, fishermen, fishery and aquaculture workers, cooks)



II. Fish quality AT RISK: *Economic impact*

(EC) Reglament 178/2002: unfit for human consumption



Wellcome to the real life!

RASFF (only Spain; 2015-2018): 6 official notifications AECOSAN (PNCOCA; 2016): 1,028 official inspections (1.7%) SUPERMARKETS (2016): 85,000 internal complaints



III. Market AT RISK: are Anisakis scaring many people away from eating fish?

25% of consumers avoided purchasing/consuming fishery products due to the presence of *Anisakis* spp

31% would always avoid, if there were a high chance of *Anisakis* ssp. in their fish, purchasing/consuming fishery products due to this parasite



Consumers' attitudes and willingness to pay for *Anisakis*-free fish in Spain Miguel Bao^{a,b,c,*}, Graham J. Pierce^{a,d}, Norval J.C. Strachan^{b,c}, Cristina Martínez^e, Rosa Fernández^e. Ioannis Theodossiou^f





Claire Louise Barley
Morrisons
I hr near Chesterfield

So this has given me and possibly the husband the D&V - it's an anikasis worm from Monk fish bought from your Stavely store yesterday. My husband has tweeted it and you want to compensate us with points on ur card! Are you joking! This could make us ill for up to three weeks! I don't think that's nearly enough! Absolutely disgusted! Fresh fish it may have been, expensive too! Did not expect this or the illness to come from it though! Disgusted!





If consumer, product and market are at risk, What we can do?

the EC launched a **SPECIFIC CALL (<u>First Time</u>!!)** for a better managing of this <u>EMERGENT HAZARD</u>

THEME **KBBE**.2012.2.4-02

(Food safety and <u>quality issues</u> related to parasites in seafood) Funding scheme: <u>Collaborative Project</u> targeted to <u>SMEs</u> (30%)

Key performance topics (needs on EFSA)

Surveillance and monitoring in Fish species/Fishing areas/Production systems Diagnostic awareness of allergic reactions and epidemiological studies Interventions in the food web to inactivate parasites











DELIVERABLES (34: 50% PU):

- □ Risk Assessment (56%): evidence-based (high quality results)
- □ Integrated Tools (20%) marketed aligned (technology push vs. market pull)
- □ Exploitation Plan (24%): IPR valorization instruments

OTHER DISSEMINATION PRODUCTS

- Catalogue of technological results
- Training workshops (diagnostic tools and operating strategies)
- Short-term stages (industry, administration staff)
- Work with media professionals (discussion panels)
- Specific events (e.g., 9 ISFP 2015; ComNet;...)
- ✤ WEBSITE...



http://parasite-project.eu





This project is supported by the European Commission under the Environment (including climate change). Theme of the 7th Framework Programme for Research and Technological Development









• Parasite

Full length article

A survey of zoonotic nematodes of commercial key fish species from major European fishing grounds-Introducing the FP7 PARASITE exposure assessment study

Surveillance Plan: 17760 fish; 16 species at the PARASITE BIOBANK



- We identified and characterised species and populations of zoonotic nematode parasites infecting fish lots from different EU areas 1.
- We developed new genetic markers for genotyping Anisakis species 2.
- We established genes and designed primers/probes to be used as "DNA barcodes". 3.
- We gathered genetic variability data of parasites populations to be correlated to their infestation levels in order to establish scientific bases for 4. molecular epidemiological studies of each parasite species and their populations in different geographical areas.



Parasite



QRA model for anisakiasis

www.nature.com/scientificreport

SCIENTIFIC REPORTS

OPEN Assessing the risk of an emerging zoonosis of worldwide concern: anisakiasis

Received: 10 October 2016 Accepted: 26 January 2017 Published: 13 March 2017 Miguel Bao^{1,2}, Graham J. Pierce^{1,3}, Santiago Pascual⁴, Miguel González-Muñoz⁵, Simonetta Mattiucci⁶, Ivona Mladineo⁷, Paolo Cipriani^{6,8}, Ivana **Bušel**ić⁷ & Norval J. C. Strachan^{2,9}

Anisakiasis is an emerging zoonosis caused by the fish parasitic nematode *Anisakis*. Spain appears to have the highest reported incidence in Europe and marinated anchovies are recognised as the main food vehicle. Using data on fishery landings, fish infection rates and consumption habits of the Spanish population from questionnaires, we developed a quantitative risk assessment (QRA) model for the anchovy value chain. Spaniards were estimated to consume on average 0.66 *Anisakis* per untreated (non-frozen) raw or marinated anchovy meal. A dose-response relationship was generated and the probability of anisakiasis was calculated to be 9.56×10^{-5} per meal, and the number of annual anisakiasis cases requiring medical attention was predicted between 7,700 and 8,320. Monte Carlo simulations estimated *post-mortem* migration of *Anisakis* from viscera to flesh increases the disease burden by >1000% whilst an education campaign to freeze anchovy before consumption may reduce cases by 80%. However, most of the questionnaire respondents who ate untreated meals knew how to prevent *Anisakis* infection. The QRA suggests that previously reported figures of 500 anisakiasis per year in Europe is a considerable underestimate. The QRA tool can be used by policy makers and informs industry, health professionals and consumers about this underdiagnosed zoonosis.

QRA model for raw/marinated (anchovies) in Spain: 8,000 cases/year QRA model for undercooked (hake, cod): *in preparation*







What about ALLERGY?

Research Article SCI Noted 19 Resary TM Betel 39 Rep 74 Accord utile petitives 3 Jaco 274 Nether entries 07 Rep Coler Litery 25 Jaco 274 Accord 19 Resary Coler 20 Rep 74 Accord 19 Rep 74 Acco	Janum of Food Protection, Vol. 77, No. 4, 2014, Paper 405, 409 4653MJ ISING DECEMPT 12.79 Copying D, International Amountain to Food Printeria	() () () () () () () () () () () () ()	Poteonie: 2014, 14, 15/07-1588 DDI 10.1002/preic 20150/02/0 1
Antigenicity of <i>Anisakis simplex</i> s.s. L3 in parasitized fish after heating conditions used in the canning processing	Identification of Autoclave-Resistant Anisakis simplex Allergens Norla carballeda-sanciad; fabrola olivares; and leodrigtez mailleda, mercedes carcene;	Concernent and a second and as second and a	Proteomic profiling and characterization of differential allergens in the nematodes Anisakis simplex sensu stricto and A. pegreffii
Margarita Tejada, * Fabiola Olivares,* Cristina de las Heras,* Mercedes Careche,* María Teresa Solas,* María Luisa García, ^ Agustín Fernandez, Angel Mendizábal,* Alfonso Navas,* Ana Isabel Rodríguez-Mahillo ^f and Miguel González-Muñoz ^o	MARGARTA TEJADA" (COACED 000/002/07 - on MICCEE OCXALEZ-MINOZ ¹⁶ Venderin pur la leuriqueira Bundles del Hapitel Carlen III, Servin Delpado H. 2029, Habida Lyace "Portner de Coacie y Terrologie de Alternary Norvice (PCTA-CC), Inte Marcine Vonallo 2000, Marcine J. Bargardo Hamendeg, Hapitel Carles RJ, Sineira Delpado TI, 2019, Madrid, Spar. Mis 13 728. Rostruel 4 Jole 201 (Vacented 5 Presenter 2013)	Changes over Time in IgE Sensitization to Allergens of the Fish Parasite Anisotokis spp. Nada chandendamie, Ivan Halpan Mallik, Waradan Canada, Alliano Narao, Ipacio Mono, Ngal Consecution III (2014) Publicati Jaj. 27. 2016. + Tapa Statesurg 10. 2137 (parametapatel 2006)	Susana C. Arcos ¹ , Sergio Ciordia ² , Lee Roberston ¹ , Inés Zapico ² , Yolanda Jiménez-Ruiz ¹ , Miguel Conzalez-Muñoz ² , Ignacio Moneo ² , Noelia Carballeda-Sangiao ³ , Ana Rodriguez-Mahillo ² , Juan P. Albar ^{2,} and Alfonso Navas ¹

- 1. other anisakid apart from *Anisakis* spp. have zoonotic and allergenic capacity
- 2. Anisakis spp. allergens were found in aquaculture and canned products
- 3. IgE sensitization to Anisakis allergens maintains over time



EMERGING:

- 1. New countries with reported cases of anisakiasis (Croatia, Portugal)
- 2. UNDIAGNOSED, UNREPORTED: Allergy to *Anisakis* spp. has been reported to be the most important hidden food allergen in the adult population suffering acute urticaria and anaphylaxis (Añíbarro, Seoane, & Múgica, 2007; M. Teresa Audicana & Kennedy, 2008; Del Pozo et al., 1997).

SUBCLINICAL SENSITIZATION (0.4-22% Spain): REAL CONCERN!!!!!!

thousands to millions of healthy individuals may have IgE sensitization to Anisakis spp. This finding suggests previous SUBCLINICAL or UNDIAGNOSED ANISAKIASIS



• Parasite



Improvement of <u>detection methods</u> for the industry



Improvement of the visual inspection scheme for detection by the UV press-method (**spectral** computing)



Implementation of molecular methodology based on <u>Real</u> <u>Time-PCR</u> to detect parasites and/or their traces in fishery products.

DNA



Ring Trial involving at least five experienced laboratories to evaluate reproducibility of the test/s and reliability of data produced by each laboratory

Beta-testing of validated detection methods at industrial level



Microbiology of the food chain — Methods for the detection of Anisakidae L3 larvae in fish and fishery products — Part 1: UV-

NP stage

press method





• Parasite Interventions in the food web to inactivate parasites



Device to kill zoonotic nematodes in offals onboard.

technological solution for management of parasite contaminants in residues under the Reglaments 1069/2009 and 142/2011 (Animal by-products Regulations).



Inactivation under novel freezing systems (*PSF, CAS*), and other treatments like high hydrostatic pressure, low voltage current, modified atmosphere packaging, electrolyzed-oxidizing water, radiofrequency, ultrasonic waves.

Optimization of the conditions in terms of quality of the product will be evaluate by Vibrational spectroscopy (Fourier Transform (FT)-infrared and FT-Raman) and Low Field Nuclear Magnetic Resonance (LF-NMR)



Application of specific treatments to reduce or inactivate the allergenic capacity.

strategies to eliminate the allergens (e.g. selective precipitations) or reduce their activity (e.g. by crosslinking to other proteins present such as in industrial processes used to elaborate *surimi* gels). Efficiency of the selected treatments will be assessed by immunoblotting using sensitized-patient's sera.



Dissemination, Tech transfer, Consulting (2015-18...)







"The dirty list" for PARASITES in seafood

Food safety and quality issues, and market perception



Last issue on RISK COMMUNICATION:

In Spain, <u>a WORKING GROUP for managing the risk</u> posed by parasites has been created, leaded by the Ministry. This group includes policy-makers, the National Authority, and the Fishing/Food sector (tech centers in subcontracting). <u>Scientists</u> <u>have not been invited</u> for advice in risk management.

our questions for EFSA are:

- □ Who is responsible for risk communication in a member state?
- □ Is it desiderable to communicate to consumers the risk assessment results before they have been managed?
- As scientists, if we accept the invitation send by mass media to participate in risk communication is it IMPERATIVE to agree the message with the Authority/Administration/Sector before being communicated?

Thank you!

RISEGAL Rede Galega de Riscos Erne en Seguridade Alimentaria

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Annex

The PARASITE project focused mainly on anisakid nematodes. We have placed less emphasis on trematodes and cestodes because, although zoonotic flatworms infect freshwater fish in many parts of the world, consumption of freshwater fish in the EU is relatively low and localised.

The CRLP has reported that, in the EU, the only parasites transmitted to humans through consumption of freshwater fish are the trematode *Opisthorchis felineus* (responsible for around 180 infections due to consumption of marinated tench fillets, mainly in Italy, since 2003) and the cestode *Diphyllobotrium latum* (the etiological agent of about 80-90 infections per year in the EU due to the consumption of raw or undercooked fillets of several perch and salmon species, mainly in Estonia, Finland, France, Italy, Lithuania, Poland and Romania).