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Horizon scanning for management of emerging parasitic infections in fishery products

María Llarena-Reino [a,*,1], Elvira Abollo [b], Marcos Regueira [a], Helena Rodríguez [b], Santiago Pascual [a]

[a] Ecobiomar, Instituto de Investigaciones Marinas de Vigo, CSIC, Eduardo Cabello 6, 36208 Vigo, Spain
[b] Centro Tecnológico Del Mar (Fundación CETMAR), Eduardo Cabello s/n, 36208 Vigo, Spain

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ABSTRACT

Public organizations operating in health and food-safety sectors are increasingly realizing the advantages of the long-term view of risk uncertainties associated to biological hazards, served-up in the short-term to anticipate the problem and its handling. Thus, the horizon scanning is becoming a major strand in proactive risk management and patient-consumer protection continuity. This approach was recently explained in the scientific opinion on risk assessment of parasites in fishery products by the European Food Safety Authority, EFSA (2010), followed by the launching of a funding scheme for a specific EU Framework Program Project under the Knowledge Based Bio-Economy concept, KBBE (FP7-KBBE-2012-6), which drives the new EU 2020 strategy. The aim of this paper is to examine horizon scanning issues in relation to public health and industrial concern on the presence of parasites in fishery products recorded in the Rapid Alert System for Food and Feed (RASFF) System. We focus on specific threats, targets, methods and challenges as a means of acquiring management goals and future objectives. The proposed horizon scanning identifies emerging ideas/technologies for an early handling of parasitized fish stocks/products for priority setting to inform strategic planning of stakeholders, policy-makers and health services. In order to accomplish this, a set of risk GIS maps illustrating the state of art about the presence of the zoonotic *Anisakis* spp. on commercial fish stocks of the last 65 years was firstly developed. Secondly, a program of 108 surveys among fish sellers of Galicia (NW Spain) were carried out with the main objective of getting information about hazard recognition, fish product management practices, quality self-controls and corrective and preventive measures in use. Additionally, during the "I International Symposium on strategies for management of parasitized seafood products" (Vigo, Spain), groups of researchers, technologists, official inspectors and industries participated in round tables with 3 different perspectives: market-industry, inspection and academia. All scanners agreed that the *status quo* to manage fish parasites in the production-to-consumption food pathway is unsatisfactory. The central message proposed a stable network performance based on collaborative software to provide multi-level information for industrial management of parasite contaminants in fish products. The discussion group also proposed to invigorate collaborative translational research and professional training as key drivers to fuel technological innovations and tech transfer, which may help to minimize/eliminate the risk of parasites that have public health and economic impacts in fish products.

1. Introduction

Marine parasites constitute an important health and quality threat in fishery products (Sabater & Sabater, 2000). Since the middle 20th century, scientific evidences have confirmed the presence of a high and raising prevalence of a "dirty dozen" of parasites in wild stocks of fishery products of commercial interest around the world (Adams, Murrell, & Ross, 1997; Abollo, Gestal, & Pascual, 2001; Køie, 1993; McClelland, Misra, & Martell, 1985; Mladineo, 2001; Quijada, Lima dos Santos, & Avdalov, 2005; Rello,

* Corresponding author. Ecobiomar, Instituto de Investigaciones Marinas de Vigo, CSIC, Eduardo Cabello 6, 36208 Vigo, Spain. Tel.: +34 986 231 930 (182); fax: +34 986 292 762.
E-mail addresses: mariallarena@iim.csic.es, mllreino@yahoo.es (M. Llarena-Reino).
[1] Present address: CESAM & Dep. Biologia, Universidade de Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal

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Adroher, Benítez, & Valero, 2009; Smith & Wootten, 1979; Valero, López-Cuello, Benítez, & Adroher, 2006; Wharton, Hassall, & Aalders, 1999). Reasons for these emerging fish diseases in fishery products are diverse. Primarily, outbreaks depend on the nature and life-cycle strategy of the parasites, but mostly on an uncontrolled ecosystem management and on new consumers feeding habits. Well-know examples of ecosystem-based implications for parasites are the outbreak spreading of *Giardia* and *Cryptosporidum* protozoans around shellfish harvesting areas due to fecal contamination by river and waste waters (Freire-Santos et al., 2000; Gómez-Couso, Mendez-Hermida, Castro-Hermida, & Ares-Mazas, 2005), or protectionist policies for marine mammals followed by several fishing practices that may increase the recruitment of zoonotic, allergenic anisakid nematodes at fishing grounds (Abollo et al., 2001; McClelland, Misra, & Martell, 1990; Rodriguez et al., 2009). Furthermore, the new wave of increasingly eating raw or undercooked fishery products has also epidemiological implications in industrialized countries. Specifically, *Giardia*, *Cryptosporidium*, some species of anisakids and more recently *Kudoa* have been recognized as human health hazards responsible for emergent zoonoses, that causes from gastro-allergic disorders in consumers (Audicana, Ansotegui, Fernández de Corres, & Kennedy, 2002; Chen et al., 2008; Dick, Dixon, & Choudhury, 1991; Kawai et al., 2012; Smith & Wootten, 1978; Vidacek, de las Heras, & Tejada, 2009) to occupathional-asma in fish-farming workers (Nieuwenhuizen et al., 2006; Plessis, Lopata, & Steinman, 2004). Besides these detrimental effects on public health, the presence of parasites in fishery products may also hamper the commercial value of products reducing thus its marketability (Arthur, Margolis, Whitaker, & McDonald, 1982; Crowden & Boom, 1980; Brassard, Rau, & Curtis, 1982; Lom & Dyková, 1992, 315 pp.; Williams & Jones, 1994, 593 pp.; Kumaraguru, Beamish, & Woo, 1995;Woo, 1995, 808 pp.). As an example, the economic losses among fish processing industries caused by anisakid larvae in fish flesh have been estimated to reach several millions of dollars (Bonnell, 1994, 208 pp.).

The “dirty dozen” genera that affect the quality and/or safety of fishery products comprise micro and macroparasites. Concerning microparasites (apart from waterborne *Giardia* and *Cryptosporidium*), the mixosporidians (*Kudoa* spp.) and the microsporidians (*Pleistophora* spp. and *Spraguea* spp.) are highly prevalent in the flesh of gadoid fish, mostly merluccidae and anglerfishes (Casal et al., 2012; Freeman, Yokoyama, & Ogawa, 2004; Leiro, Ortega, Iglesias, Estévez, & Sanmartín, 1996; Pascual & Abollo, 2008; Whipps & Diggles, 2006). Among the macroparasites, didymozoid trematodes occurring in scombrids (Pascual, Abollo, & Azevedo, 2006), cestodes (*Gymnorhynchus* spp., *Molicola* spp.) present in pomfret fish and swordfish, the cosmopolitan anisakid nematodes (*Anisakis* spp, *Pseudoterranova* spp., *Contracaecum* spp.) and crustaceans of *Pennella* spp. in the swordfish, represent the relevant target parasites during veterinary inspections of fresh and frozen products in the European fish industry.

The nematode *Anisakis* is a good candidate to be eligible as a sentinel model for targeting a horizon scanning for managing emerging parasites in fishery products. The reasons are:

i) it is by far the most prevalent macroparasite in fish products from major stocks around the world, with significant demographic infection values regardless of the host species and fishing area. Especially of concern is the fact that during fish inspections anisakids are usually found in high amount on the gut cavity (Vidacek et al., 2009), in a lower quantity on the belly flaps (Abollo et al., 2001), and sometimes in the flesh (Llarena-Reino, González, Vello, Outeiriño, & Pascual, 2012; Smith, 1984; Valero et al., 2006; Wharton et al., 1999);
ii) in the last 20 years anisakids have been a trending topic within the scientific community, fish consumers and the industry dealing with biological risks in seafood products. This results from many social alarms in most southern European countries (León, de Meacham, & Cláudio, 2006; Poli, 2005) linked with the trending record of available medical literature concerning the public health implications of anisakids in general, and the genus *Anisakis* in particular;
iii) besides the repercussion they have on seafood safety, quality aspects in parasitized fish decrease its commercial value by affecting the aesthetic of products (Fig. 1). This fact is hampering marketability of seafood products within a fair international trade and European consumer preferences which demand products with high standard quality (Pascual, Antonio, Cabo, & Piñeiro, 2010; Vidacek et al., 2009);
iv) because the parasite recruitment is successfully adapted to the marine trophic webs, alterations in the ecosystem reflect changes in the epidemiological status of this hazard in fish stocks and products (Deardorff, 1991; Marcogliese, 2001; Pascual, González, & Guerra, 2007; Slifko, Smith, & Rose, 2000; Wood, Lafferty, & Micheli, 2010). This reinforces the idea of a management strategy enlarged from the net to the plates which also should include a study of viability of parasites in unprocessed marine fish waste used for feeding aquaculture fish, as juvenile wild fish on-grown in captivity;
v) the risk assessment of this hazard demands a management strategy as the base of a fair international trade for products of different origin and production methods. In most cases neither the strategy is implemented nor available tools are integrated in the industry.

In relation to the discussion paper on the guide interpretation of Regulation (EC) 853/2004, recently the European Commission considered necessary to carry out a consultation to seafood industries' operators regarding the regulation of consumer information on such legislation. The present work aimed to propose the elaboration of a detailed and complete horizon scanning of the situation resulting from the impact of the most relevant parasites on the value chain of commercial fishery products. To this end and following the mentioned example of the European Commission, authors decided to arrange a meticulous analysis and discussion by using the same “consultation” method with fisheries stakeholders. Thus a triple strategy was put in practice:

(1) As a previous step it was considered the elaboration of risk GIS maps illustrating the state of the art concerning the condition of commercial fish stocks during the last 65 years, regarding the effect of the zoonotic parasite: *Anisakis* spp. Nowadays, there is an increasing interest on the use of GIS as an innovative technology to combine epidemiology, statistics and geographic information, due to the assist it provides by facilitating decision making, processing and analysis of information on several multidisciplinary areas.
(2) Secondly, it was planned a program of surveys to fishmongers. The consultative and anonymous character of this methodology, the potential amount of information available that it offers, the “consumer representation” made by fish sellers, and the “intermediary” role played by them within the fishing guild (exerts great influence on the extractive sector and on consumers), were important enough reasons to choose this tool.
(3) Finally, it was carried out the organization of three round tables framed within an international symposium. Panel discussions had the objective of agglutinating separately scientists, health inspectors and representatives of fishing