Anisakis spp., *Pseudoterranova* spp.

Anisakis, *Pseudoterranova*
Helminths, class of Nematodes (roundworm)

Parasites

anses
French agency for food, environmental and occupational health & safety

Characteristics and sources of *Anisakis* spp. and *Pseudoterranova* spp.

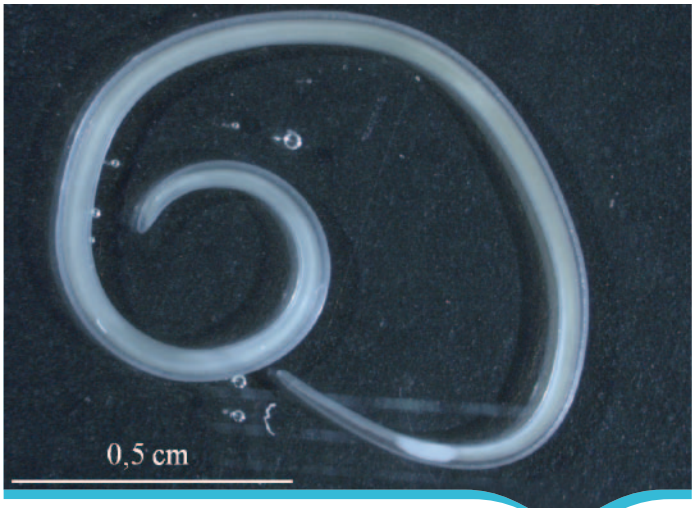
Main microbial characteristics

The family of Anisakidae comprises several genera, including *Anisakis* (including *A. simplex*) and *Pseudoterranova*, which are frequently implicated in anisakiasis infection in humans. *Anisakis* can also trigger allergies. Nine species of the genera *Anisakis* and six species of *Pseudoterranova* have been described to date.

The parasite's life cycle is summarised in Figure 1.

In general, the larvae are found in the abdominal cavity of fish, coiled and surrounded by a capsule; they are either free, or more often stuck to the surface of the mesentery, and are more rarely found in muscle tissue.

To date, nine allergens from *Anisakis* larvae have been described. Some have known functions or homologies (tropomyosin, paramyosin, protease inhibitors, etc.), and some are resistant to heat and pepsin. All are resistant to freezing. No data are available on the production of allergens from other Anisakidae genera, however.



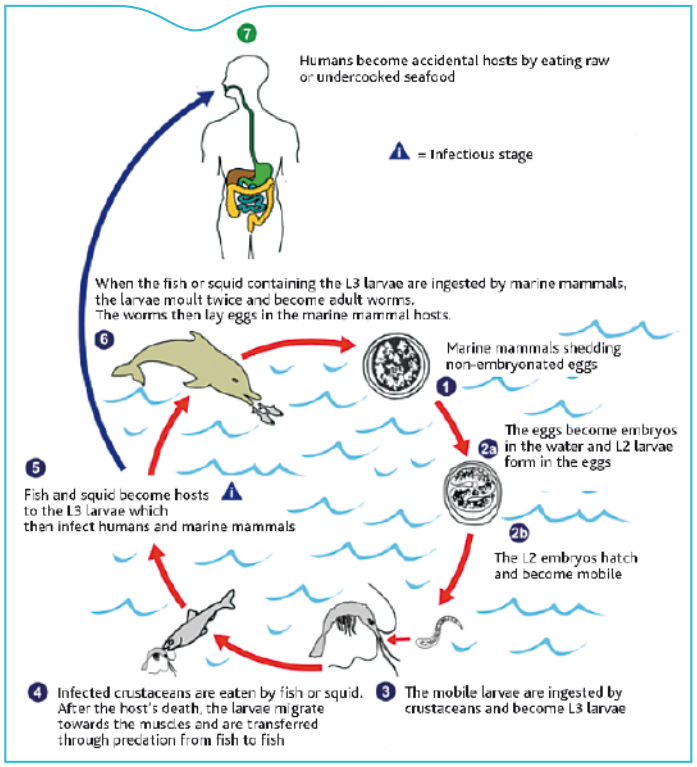


Figure 1. **Life cycle of Anisakidae (adapted from a diagram presented by the CDC).**

Sources of the hazard

Anisakiasis is a cosmopolitan zoonosis, with Anisakidae being found in all the world's seas and oceans. All warm-blooded piscivorous vertebrates can be parasitised by Anisakidae larvae. Depending on the species and capture sites, between 15 and 100% of marine fish have been found to be infested with Anisakidae larvae, sometimes in very large quantities. Cephalopods have lower infestation rates (20-35%).

The lack of data on levels of infestation and the dynamic nature of host populations make it impossible to define a geographic area within which fishery products will always be free of Anisakidae larvae.

The parasitosis can also affect migratory fish which swim in both seawater and freshwater (eel, smelt, salmon), and edible cephalopods (squid and cuttlefish).

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The probability of Anisakidae infesting farmed fish (salmon in particular), when their diet is controlled, is considered as zero to near-zero.

Lesions and diseases in fish vary depending on the intensity of the infestation and on the species (host and parasite). The main manifestations are overloading of the abdominal cavity, localised mechanical compression of tissues and the formation of granulomas around the parasite (sometimes causing its death). *Anisakis* larvae are mainly located in the abdominal cavity, whereas those of *Pseudoterranova* tend to be found in muscles.

Transmission routes

Transmission to humans is almost exclusively *via* food. Consumption of raw or undercooked fish is responsible for infestation. Some rare cases of non-food allergies, from direct contact with infected animals, have also been observed.

Recommendations for primary production

- **All wild marine fish species should be considered as potentially contaminated, since due to a lack of information, no geographical area is known to be free of parasites.**
- **In marine and inland aquaculture, diet should be controlled (only use feed made from compound feedingstuffs) throughout the life cycle, beginning from the egg stage, to maintain a near-zero risk of infestation.**

Human foodborne illness

Nature of the disease

The clinical symptoms induced by different Anisakidae genera are broadly similar. The Table 1 below includes all the symptoms, but they may appear differently depending on the patient and location of the parasite.

Susceptible population groups(1): people with an inherited predisposition, in whom the repeated ingestion of Anisakidae larvae, including dead ones, can cause allergy and may even result in anaphylactic shock. Conversely, sensitisation of "naive" subjects to Anisakidae allergens only results in the presence of specific IgE antibodies. It is likely that sensitivity to *Anisakis* allergens is initiated by infection with a live larva. However, once this sensitivity has been acquired, allergic episodes may be triggered by a live larva or by the allergens alone (from dead larvae).

Dose-effect(2) relationships

The presence of one larva is sufficient to cause the syndromes described in the Table 1.

Epidemiology

There are over 2500 cases of anisakiasis per year in Japan, the most affected industrialised country. In the United States, the incidence is 10 cases per year. In Europe, the countries where anisakiasis is most commonly reported are Spain, Norway, the Netherlands and the United Kingdom. The exact incidence is difficult to establish, but seems to average fewer than 20 cases per country per year. However in 2005, a total of over 30 cases was reported in Italy. In France, a report by the InVS in 2003 estimated the incidence at eight cases per year, using data from a study conducted in 1985-1987.

The phenomena of allergic anisakiasis and sensitisation to *Anisakis* allergens have been a growing concern since they were first described in the 1990s. Indeed, a prevalence of around 12.4% of patients with IgE antibodies specific to *A. simplex* has been observed in the Madrid area. A Spanish study has implicated *Anisakis* in 10% of anaphylactic shocks resulting from allergic reactions. Moreover, *Anisakis* is responsible for the majority of allergic reactions due to hidden allergens (allergens to date unidentified as major allergens by the regulations stipulating labelling provisions, or not declared on the product label).

Role of food

Main foods to consider

Humans become infected by eating contaminated fish or cephalopods that are raw, undercooked or preserved in preparations low in salt or acetic acid. In infested fish, it has been shown that the number of larvae generally increases with age, and therefore in proportion to the size of the fish.

In France, various surveys (1988, 1993, 1994) on infestation rates in the most frequently consumed commercial fish species have led to the discovery of infestation rates of around 80% for anchovies, 30% for mackerel, 70% for whiting, 90% for hake and 60% for horse mackerel.

The various culinary preparations that may lead to contamination include sushi (raw fish), bottarga (made from dried or smoked fish eggs), rollmops (herrings marinated in white wine or vinegar), kippers (smoked fish), Tahitian fish or "ceviche" (fish marinated in lemon) and marinated anchovies.

(1) Susceptible population group: people with a higher than average probability of developing symptoms of the disease, or severe forms of the disease, after exposure to a foodborne hazard [definition used for the ANSES data sheets].

(2) The relationship between the dose (the amount of microbial cells ingested during a meal) and the effect on an individual

Table 1. **Disease characteristics**

Mean incubation period	Main symptoms	Duration of symptoms	Duration of infectious period (shedding)	Complications	Asymptomatic forms
From 1 to 12 hours	Gastric (abdominal pain, nausea, vomiting and/or diarrhoea, pseudo-ulcerous manifestations) **and/or***	Several days to several weeks in chronic cases	Not applicable	Bowel obstruction	Yes, No data available on proportions
From 12 h to more than 5 days	Intestinal (nausea, vomiting and/or diarrhoea, appendicular or peritoneal syndromes, rare colitis or ileitis forms)	Several days to several weeks in chronic cases	Not applicable	Bowel obstruction	Yes, No data available on proportions
From a few hours to 24 h	• Gastro-allergic anisakiasis (e.g. digestive allergies, hives) caused by live larvae • Skin allergies (hives (20%), angioedema) caused by live or dead larvae.	1 day	Not applicable	20 to 60% of cases are severe (angioedema, anaphylactic shock which can be fatal).	Yes, No data available on proportions

* The symptoms are related to penetration by the larvae of the gastric and/or intestinal mucosa.

Inactivation treatments in industrial environments

The conditions described in ~~the~~ Table 2 kill the *Anisakis* larvae, although this does not completely eliminate the risk of allergy in humans (persistence of allergens).

Table 2. Inactivation treatments

Effects of temperature		
Thorough cooking: >60°C core temperature, 1 minute; the FDA recommends reaching at least 70°C, if cooking in the microwave. For fillets 3 cm thick: 60°C, 10 min. Freezing: –20°C, 24h* (or) –35°C, 15h** (or) –15°C, 96h**.		
Chemical treatments* **		
Treatment	**Parameters**	**Product**
Salting, salting, cold smoking	NaCl at 8-9%, 6 weeks, dry salt, 20 days	Herring
Marinating	NaCl at 12% + acetic acid at 10%, 5 days. NaCl at 12% + acetic acid at 6%, 13 days at 4°C NaCl at 6% + acetic acid at 2.4%, 35 days	Anchovy
	NaCl at 10% + acetic acid at 6%, 24h then 4°C, 13 days	Sardine
	NaCl at 6.3% + acetic acid at 3.7%, 28 days	Herring

* Regulation (EC) no. 853/2004 as amended.

** American standards.

*** These conditions, though effective, are not those typically used in current industrial processes but rather represent traditional and small-scale production.

Monitoring in food

In fishery products, the reference method for detecting larvae is a visual inspection of pieces, such as fillets, using transillumination. However, the efficacy of this method varies (7-75% of parasites detected) depending on the species of fish (darkness and density of the flesh) and the species of parasite (size and colour of larvae). The only existing document that describes a method for detecting parasites is a *Codex Alimentarius* standard on salted Atlantic herring and salted sprats (Codex Standard 244-2004).

Recommendations to operators

- **Freezing and cooking are the most effective treatments for killing larvae of *Anisakis* and *Pseudoterranova*, under specific conditions. However, there is no control measure currently available to combat the risk of allergy.**
- **Only certain traditional marinating or salting methods are sufficient to kill these larvae.**
- **The efficacy of new combinations of inactivation treatments warrants evaluation.**
- **Collective prophylaxis of anisakiasis is based on the principles laid down in Regulation EC No. 853/2004 of the European Parliament and of the Council of 29 April 2004: rapid refrigeration or processing (cutting, freezing) of fishery products, maintenance of the cold chain, visual inspection on site and/or in the laboratory of products released for consumption, prior freezing (–20°C, 24h at all points) of products intended to be consumed raw or inadequately processed (cold smoking, salting, marinating, etc.).**
- **Any migration of larvae towards surrounding tissue (fillets) should be avoided by refrigerating and eviscerating the freshly caught fish as rapidly as possible (this reduces but does not eliminate the risk because larvae are also found encapsulated in the muscle of live fish).**
- **In addition, although Anisakidae allergens are not among the major allergens identified by the regulations[3], operators are nevertheless encouraged to consider labelling information.**

Domestic hygiene

Recommendations to consumers

- **Individual prophylaxis of parasitism by Anisakidae larvae is based on thorough cooking of fresh sea fish. For raw fish eaters, freezing for 7 days in a home freezer is recommended. The rapid evisceration of fresh-caught fish is also recommended. Cutting fish into thin slices (carpaccio) rather than thick slices or cubes can help to detect possible parasites, but it should be noted that if an *Anisakis* larva is cut in two, the front half is still capable of penetrating the wall of the gastrointestinal tract.**
- **There is no known measure for avoiding the risk of allergies, only refraining from consumption is recommended in cases of allergy.**

References and links

- Center for Disease Control, Division of Parasitic Diseases - *Anisakis* Infection (USA) http://www.cdc.gov/ncidod/dpd/parasites/anisakis/default.htm
- EFSA Panel on Biological Hazards (BIOHAZ); Scientific Opinion on risk assessment of parasites in fishery products. EFSA Journal 2010; 8(4):1543. [91 pp.]. doi:10.2903/j.efsa.2010.1543. www.efsa.europa.eu
- European Union Reference Laboratory for Parasites (in particular *Trichinella*, *Echinococcus* and *Anisakis*), Istituto Superiore di Sanità (ISS), Viale Regina Elena 299, I-00161 Roma, Italy.
- FAO - Assessment and Management of Seafood Safety and Quality: ftp://ftp.fao.org/docrep/fao/006/y4743e/y4743e00.pdf
- InVS - Morbidité et mortalité dues aux maladies infectieuses d'origine alimentaire en France: http://www.invs.sante.fr/publications/2004/inf_origine_alimentaire/inf_origine_alimentaire.pdf
- National Reference Laboratory for foodborne parasites, Maisons-Alfort laboratory for animal health, UMR BIPAR, ANSES, 23 avenue du général de Gaulle, 94706 Maisons-Alfort cedex.

(3) French Consumer Code, Chapter II of Title I of Book I Article Annex IV, Modified by Ministerial Decree no. 2008-1153 of 7 November 2008 - art.