AGENCE FRANÇAISE
DE SÉCURITÉ SANITAIRE
DES ALIMENTS

Maisons-Alfort,

LA DIRECTRICE GENERALE

OPINION

of the French Food Safety Agency (Afssa) on a risk assessment request concerning the presence of anisakidae in fishery products and the extension of the exemption from the freezing sanitary obligation of fishery products whose feeding is under control and for certain species of wild fish.

Context of the request:

On 21 November 2007, the Directorate General for Food (DGAI) requested the French Food Safety Agency (Afssa) to issue an opinion on the risk assessment concerning the presence of anisakidae in fishery products and the extension of the exemption from the freezing sanitary obligation for fishery products whose feeding is under control and for certain species of wild fish.

Questions raised:

The DGAI would like to have Afssa's opinion on the extension of the exemption from the freezing sanitary obligation regarding the parasitic risk, given that the European Commission has authorised this exemption for farmed salmon, under controlled feeding, since 6 November 2006.
The DGAI's request is to assess the "anisakidae" risk control when no freezing takes place (-20°C, for 24 hours right through) for fishery products, in the event of an exemption from the decontaminating process for:

- the main species of farmed fish (bass, bream, etc.) whose feeding is under control (pen-and sea-farmed);
- certain species of wild tuna that do not seem to be parasite-infested;
- marinated and/or salted fishery products under salting and marinating conditions.

The following two documents are attached to the request:

- a study report drafted by the Seafood Testing and Processing Centre (CEVPM, Boulogne-sur-Mer) concerning the conditions for destroying *Anisakis simplex* larvae in dry salted herring used to make traditional smoked herring fillets;
- a page from the website www.mapaq.gouv.qc.ca on the "management of parasitic risks associated with the consumption of raw or partially raw fish", in Quebec.

Context:

Regulation (EC) No 853/2004 lays down rules concerning the presence of parasites in fishery products and mentions the decontaminating process obligation by freezing in particular (-20°C, for 24 hours right through) for:

- all fishery products intended to be consumed raw or almost raw;
- fishery products coming from herring, mackerel, sprat or wild Atlantic or Pacific salmon which have to undergo a cold smoking process;
- marinated and/or salted fishery products if the processing is insufficient to destroy nematode larvae.

This regulation states that food business operators need not carry out this treatment "*if epidemiological data are available indicating that the fishing grounds of origin do not present a health hazard with regard to the presence of parasites*".

23, avenue du
Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE
FRANÇAISE

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

In accordance with the DGAI's request and recorded delivery letter for agreement on the expert assessment, sent to the latter on 27 December 2007, the assessment scope is limited:

- firstly to considering the presence of anisakidae in fishery products, whether this concern pen- or sea-farmed fish, whose feed is under control, or certain species of wild tuna;
- secondly, to assessing the effectiveness of salting and marinating processes to sterilise the fishery products, authorising non-application of the freezing process where applicable. In addition to the expected responses, it was deemed appropriate to provide responses to other types of alternative processes to freezing.

Assessment method:

Two experts from the "Animal Health" Scientific Panel and three from the "Microbiology" Scientific Panel met to draft a joint initial expert assessment report. A telephone meeting was organised on 9 January 2008 to define the limits of the expert assessment scope as defined above, and the contributions expected of each person. Accordingly, the "Animal Health" Scientific Panel's expert assessment focused particularly on the first two points of the DGAI's request (parasite-infested species) while that of the "Microbiology" Scientific Panel responded mainly to the third point (effectiveness of alternative processes to freezing). The former met on 12 March and 9 April 2008 and the latter on 12 March and 10 April 2008.

Argument:

1. Assessment of the probability of anisakidae larvae being present in fishery products (pen- or sea-farmed fish whose feeding is under control, wild tuna).

1.1 Brief reminder of anisakidae:

Human anisakidosis (or anisakiasis) is caused by parasites of the Anisakidae or Raphidascaridae families, the two main genera being Anisakis and Pseudoterranova. The definitive hosts of Anisakis are cetacae (dolphins, whales, porpoises, etc.) and of Pseudoterranova are pinnipedae (seals, sea lions, walruses, etc.). The intermediary hosts harbouring infesting larvae (L 3) are crustaceans (decapods, copepods, amphipods), particularly Euphausiidae ("krill"). Fish and cephalopods are the paratenic hosts in which a very large number of larvae can accumulate (case for large piscivorous fish). The overall distribution of the two parasite families is global (cold, warm and tropical seas) but the different species of Anisakis and Pseudoterranova have different distribution areas with zones where geographical areas overlap, however (Chai et al., 2005; McPherson, 2005; Doupé et al., 2003). There are also definitive host preferences according to parasite species, despite overlapping. According to Abollo et al. (2001), the list of anisakidae paratenic hosts comprises 200 species of fish and 25 species of cephalopods. There consequently seems to be little specificity of anisakidae larvae for their paratenic hosts, although preferences appear to exist. Frequency differences according to species would result from ecological factors (Chai et al., 2005).

1.2 Human anisakidosis:

Human anisakidosis is characterised by allergic, skin or articular manifestations (invasive stage), pseudo-ulcerous manifestations (acute stage) or subocclusive syndromes and pain (sub-acute stage). It has global reach with outbreaks concentrated in Asia and Western Europe. 90% of global cases are reported in Japan (2,000 cases annually) and the rest are reported in Germany, the Netherlands, Spain and France (500 cases in Europe to date according to Audicana et al., 2000). There were 50 cases recorded in the US between the 1950s and '80s (Deardoff et al., 1987 in: Deardorff et Kent, 1989) and 50 annual cases have been observed at present (Audicana et al., 2002). Human cases are associated with the consumption of raw, undercooked or marinated fish containing infesting larvae (L3): sushi, sashimi, Dutch salted or smoked herring, Scandinavian gravlax salmon, etc. The seafood most commonly behind human cases are mackerel (*Scomber japonicus*) and octopus

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

(*Todarodes pacificus*) in Japan and herring (Clupea harengus) in Europe. The increase in anisakidosis cases over the last 30 years worldwide could be linked to several factors:

- ✓ improved diagnosis;
- ✓ increased consumption of raw or undercooked fish;
- ✓ regulations on the exploitation of marine mammals, which has led to an increase in these animal populations.

In France, 5 cases were reported in 1986 with the identification of larvae by endoscopy (one case) or in the tissues by histology (4 cases) (Mudry et al, 1986). Fifty-five cases have been listed up to 1995 in France (Bourée et al., 1995) and one report from the French Institute of Public Health Surveillance indicated an estimated annual incidence of 8 cases at the end of the 1980s[1].

Moreover, cases of allergy to *Anisakis simplex* are regularly reported, particularly in Spain, with signs of variable severity, but requiring emergency treatment in 50% of cases (Audicana et al., 2002). In Spain, 12.4% of the population in Madrid have A.simplex specific IgEs (consumption of boquerones – fresh anchovies in vinegar – in Madrid) (Puente et al., 2008).

1.3 Infestation of wild fish:

The distribution of Anisakis and Pseudoterranova parasites in North Atlantic fish varies depending on several elements (Angot, 1993; Angot et Brasseur, 1993; CEVPM, 2005):

- fish species:
  - ✓ for Anisakis: 75 species of fish and 4 species of cephalopods are known to be parasite hosts. The fish are mainly pelagic, mesopelagic and bathypelagic species, particularly gadidae and clupeidae (whiting, blue whiting, herring, mackerel, hake, cod, coalfish, ling, angler fish, etc.);
  - ✓ for Pseudoterranova: 63 species have been listed, mainly piscivorous, demersal fish: monkfish, sculpin, cod and similar fish, as well as flat fish, searobin, smelt.

  The degree of infestation in fish also varies between species:
  - ✓ heavily parasite-infested fish: blue ling, ling, coalfish, pollock, hake and cod;
  - ✓ fish with average levels of parasite infestation: rockfish, haddock, North Sea herring, North Atlantic cod, red searobin, halibut, Atlantic seabass and other gadidae from the North Atlantic;
  - ✓ fish with low levels of parasite infestation: pout, plaice, flounder, angler fish, mackerel, horse mackerel, bass, East-Channel whiting, East-Channel, Baltic, Kattegat and Skagerrak cod;

- geographical location: Infestation varies considerably from one zone to the next for the same fish. The most infested zones are those with pinnipedae and cetacae present (rich in planktonic Euphausiidae): North Sea, Channel, Atlantic (very irregular for the Mediterranean). Coastal species seem to be less infested with parasites (bream, some types of cod, small-scale fished whiting);

- depending on the fish size and fishing season: the intensity of infestation increases with the size/age of the fish and also seems to depend on the fishing season (in the Baltic sea: herring fished between June and October is not infested, but highly infested between November and May).

The prevalence of anisakidosis in North Atlantic fish seems to be on the rise since the 1960s (Abollo et al., 2001).

1.4 Tuna infestation:

Only three publications report anisakidae larvae in tuna. Jones (1991) reports the presence of *Anisakis simplex* in albacore tuna (*Thunnus alalunga*) fished in the south-west Pacific: infestation levels vary from 0 to 50% depending on the size of the fish and its fishing ground.

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE

[1] 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* (consulted on 12 March 2008)

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

Mattiucci et al. (2002), during a study on *Anisakis typica*, identify this parasite in *Thunnus thynnus* from the East coast of Brazil (larva: type I *Anisakis*). Williams and Bunkley-Williams report the presence of these nematodes in *T. alalunga, T. albacares* and *T. orientalis* (Munday et al., 2003). There is no data available in the literature to support the absence of anisakidae in tuna, despite the lists published for numerous species of fish (including with negative results).
Nevertheless, in Canada, the Centre québécois d'inspection des aliments et de santé animale (CQIASA, document 2007) states that the following species of wild tuna are known to be parasite-free (*Thunnus alalunga*, *T. albacares*, *T. atlanticus*, *T. maccoyii*, *T. obesus*, *T. thynnus*) and therefore require no freezing, which the Quebec Ministry for Agriculture, Fisheries and Nutrition (MAPAQ, 2007) regulations applied.

It is very difficult to conclude on the probability of anisakidae infestation of the six tuna species stated above without data to support the prevalence in the populations fished. With no demonstrations issued from Canadian experts, the French experts are adopting a more prudent position. As a result, the "Animal Health" Scientific Panel rapporteurs do not consider it to be appropriate, in the light of current available data, to make proposals for extending the exemption from subjecting these species of fish to a sterilising process.

1.5 Infestation of farmed fish:
Some studies have been carried out on the level of infestation of farmed fish by anisakidae larvae:
- ✓237 farmed salmon (3 different species) in the US (Deardorff and Kent, 1989);
- ✓3,700 fillets of farmed salmon (*Salmo salar*) from Scotland and Norway (Angot and Brasseur, 1993);
- ✓300 farmed salmon (2 species) in Japan (Inoue et al, 2000);
- ✓farmed salmon imported to Japan (number and species not given, Niizuma et al., 1996 in Inoue et al., 2000);
- ✓1,180 farmed salmon from different Norwegian regions (Lunestad, 2003);

2,000 farmed salmon in Norway (Bristow and Berland, 1991 in: Lunestad, 2003).

All of these studies, conducted on sea-farmed salmon in nets, show an absence of anisakidae larvae. The explanation given by the various authors mainly concerns the feeding method practised, i.e. the use of commercial feed in the form of granules (partly fish-based) and distributed until the fish have eaten their fill. This is confirmed by the examination of 560 digestive tracts of farmed salmon in Japan by Inoue et al. (2000) which do not reveal any crustacean, cephalopod or fish. Moreover, this salmon leads none of its life in the wild since it is farmed from the hatching stage. However, Deardorff and Overstrett (1990 in: Angot, 1993) considers that the possible passage of small herring, together with the presence of cetacae or pinnipedae on the edges of farmed zones, could form potential contamination sources.
When feed is based on fresh fish, the risk of infestation by anisakidae larvae is nevertheless possible. Accordingly, the feeding of farmed green turtles with fresh sardines from Australia is suspected to be the cause of anisakidosis cases in these animals (Burke and Rodgers, 1982). Likewise, the feeding of common farmed octopus in Galicia with wild fish led to anisakidae infestations (Abollo et al., 2001). Some observations made by Deardorff and Kent in 1989 in the US report farmers feeding salmon with fresh herring and studies on the stomach contents of farmed salmon revealing herring and crustaceans.
Data on farmed bass is limited to the study by the National Committee of Maritime Fisheries and Marine Farming (Suivi et amélioration de la qualité et des performances du bar en élevage de poissons marins, 2006, 4 p) which reports a negative search for anisakidae in 945 bass of French or Greek origin over four years.
In addition, a recent FAO document (Cage aquaculture FAO, technical paper 498, 2007) does not list anisakidae in the pathogens encountered in marine aquaculture.

All of this information points to a probability of anisakidae infestation of farmed fish that can be considered to be "*nil to negligible*" insofar as farming is practised under strictly controlled feeding conditions (raw materials register, supporting documents, etc.). This information is

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

required by the MAPAQ to allow for an exemption from the decontaminating treatment of farmed fish (CQIASA).

2. Assessment of the effectiveness of certain alternative processes to freezing, particularly salting and marinating

In order to rule on the possibility of extending the exemption from the freezing sanitary obligation for marinated and/or salted fishery products, according to the salting and marinating conditions, it seemed appropriate to conduct a more general review of the performances[2]:

2.1. processes of recognised effectiveness: freezing, cooking;
2.2. transformation processes featuring within the request: salting, marinating, smoking;
2.3. processes that could replace freezing: ionisation and high pressure.

2.1 Processes of recognised effectiveness:

- **Freezing**

Since this is the process of reference, lots of studies have assessed the resistance of anisakidae larvae to freezing. Time/temperature couples have been established (Deardorff et al. 1984, Deardorff & Throm 1988, Karl & Priebe 1991, Wharton & Aalders 2002, Adams et al. 2005). The time needed to reach the desired temperature right through the product depends on the fillet thickness, the product mass, the species of fish and its fat content.
Accordingly, the FDA (2001a) has recommended that products be frozen for at least seven days at -20°C or for 15 hours at -35°C, while European Regulation No 853/2004 indicates that the product must be frozen at a temperature of at least -20°C in all parts of the product for at least 24 hours. The time difference between these two texts is partly due to the fact that the FDA takes the total storage time into account, while the European Regulation indicates the time during which the product must be kept once the temperature is reached at the product core.
Freezing does not destroy the allergens resulting from the presence of anisakidae.

- **Cooking**

Anisakidae larvae are destroyed by cooking. The European Regulation states that a core temperature of 60°C for 1 minute is sufficient to kill any larvae present. However, total cooking time depends on the product thickness and texture. For example, it is estimated that a 3cm thick fillet should be cooked at 60°C for 10 minutes to ensure all larvae are destroyed (Wooten and Cann, 2001).
The heat processes indicated above do not destroy all of the allergens resulting from the presence of anisakidae.

2.2 Transformation processes featuring within the request:

Transformed fishery products in the context of the request are grouped in the annex at the end of this document.

- **Salting**

Two techniques are used to salt food products: either dry salt, or by immersing in brine (Sainclivier, 1985). The former, more expensive option, generally concerned high added value products (salmon, trout, caviar, etc.) and some traditional products (herring fillets). Brine requires less handling and is therefore less expensive.

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE

[2] Note that the methods for assessing the viability and/or infectious potential of larvae are diverse, ranging from observing the mobility of larvae to experimental infection animal models. The vast majority of the studies mentioned in the text below assessed the performance of treatments and processes by observing the movements of larvae with or without stimuli.

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

Anisakidae are sensitive to salt under certain conditions. From 1969, Khalil showed that isolated Anisakis larvae die after 10 minutes in direct contact with dry salt and after 24 hours in contact with saturated brine. In other studies, living larvae have nevertheless been rediscovered after 24 hours of contact with saturated brine (Arcangeli et al., 1996). Studies by Karl have showed that, when the salt level reaches 20% in the aqueous phase of fish tissue, the storage time must be 21 days to destroy the parasites (Möller, 1989). This must be extended to 28 days if the salt level is only 15%.
In 2005, the CEVPM conducted a study on the conditions for destroying *Anisakis* larvae in dry salted herring (CEVPM, 2005). Professionals consider that whole or filleted herring is salted through after 11 days of dry salting (30 to 50 kg of salt for 100 kg of herring). The main results of this study, conducted under industrial production conditions, reveal a necessary timeframe of 2 to 6 days in contact with dry salt to reach full saturation of the fish, and then a further 5 to 14 days for all the parasites to be killed, no matter where they are situated in the fish (muscle or entrails). These results are consistent with the salting conditions (21 days in saturated brine, or with a salt concentration exceeding 264 g per kg of saturated brine) presented in standard NF V 45-067 of 1996 on the preparation of smoked herring fillets.

It is therefore estimated that the following conditions kill the parasites:
* either 21 days in contact with dry salt or saturated brine,
* or:
  - 21 days of storage in brine, once the 20% salt level in the aqueous phase of the fish tissue is reached,
  - or 28 days of storage in brine if the level reached is 15%.

These types of treatment are only practised for traditional transformation, i.e. for low production volumes. They could be eligible for an exemption from the freezing obligation.

- **Marinating**

Marinating involves acidifying sea products through contact with light (unsaturated) brine, possibly seasoned or sweetened and acidified by vinegar or an organic acid authorised for food use. Acetic acid is included in the list of substances given in annex III-A of the order of 2 October 1997, and can therefore be added to any foodstuff on the basis of the “quantum satis” principle[3].

Marinated products do not undergo any heat treatment. Anisakidae are generally resistant to the traditional conditions of marinating, mainly due to the short timeframes, adopted for economic and organoleptic reasons.
In 1995, Karl et al. determined the salt and acetic acid concentrations and timeframes required for the anisakidae larvae present in herring fillets to be killed. They propose two marinating methods:

- the German method: parasites are killed after 5 weeks at 3°C in a marinade comprising 14% salt, 7% acetic acid and hydrogen peroxide (fish/brine ratio = 1.5/1);
- the Danish method: parasites are killed after 17 hours at 12°C in an initial marinade comprising 10% salt (fish/bath = 2/1) followed by six weeks at 3°C in a marinade comprising 10% salt and 5% acetic acid (fish/bath ratio = 1.8/1).

The use of hydrogen peroxide is currently banned in France for fishery product marinades[4]. According to certain conditions that must be specified, hydrogen peroxide may be an alternative treatment to freezing, subject to an authorisation for specific use for the products concerned by the request being obtained.
The traditional preparation of anchovies in Spain does not destroy anisakidae larvae and the freezing of these products modifies their texture and taste due to their high fat content. Sanchez-Monsalvez et al. (2005) determined the marinade conditions destroying anisakidae larvae by testing different combinations of salt and acetic acid. They propose five days at 4°C in a marinade containing 10% acetic acid and 12% salt to kill all parasites. The authors also tested a marinade containing 12% salt and 6% acetic acid, which they believe corresponds

[3] Order of 2 October 1997 amended on additives that may be used in the manufacture of food for human consumption.
[4] Order of 19 October 2006, on the use of processing aids in the manufacture of certain foodstuffs.

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

to the acetic acid content in the vinegar used for marinades. In these conditions, the death of all parasites present in the anchovy fillets was observed after 13 days at 4°C.
Regarding vinegar (production by natural fermentation), there is no data available to conclude on the possibility of exemption. Regarding acetic acid, the manufacturing parameters (acetic acid level, salt level, contact time) destroying the larvae still need defining for products made in France.

- **Smoking**

Smoking techniques can be split into two categories (Sainclivier, 1985; FDA.CFSAN, 2001b):

- hot smoking: the products are kept for a few hours at temperatures of around 70-80°C. Anisakidae larvae cannot withstand such conditions;
- cold smoking: the most common in France, this lasts from a few hours to a few days. The temperature depends on the product and species, but does not exceed 40°C. These temperatures do not kill the anisakidae larvae present (Khalil, 1969 ; Szostakowska et al., 2005). The products must therefore undergo a preliminary sterilising treatment.

Regarding the different transformation processes (salting, marinating, smoking), it is important to stress the difficulty in guaranteeing their equivalence given the diversity of products processed and the impact of geographical and cultural contexts.

2.3 Processes that could replace freezing

- **Ionisation (irradiation)**

The FDA (2001b) indicates that the necessary irradiation doses for killing *Anisakis simplex* exceed 6-10 kGy. Little is known of the impact of such doses on the organoleptic quality of the fish, and the studies conducted give contradicting results (Farkas, 1998). However, Venugopal et al. (1999) indicates that doses of around 6-10 kGy alter the appearance, smell and taste of fishery products. It can therefore be considered that ionisation is not an admissible sterilising process, since the **dose required is not compatible with acceptable organoleptic qualities**.
The reason why anisakidae larvae need higher doses of irradiation than other parasites is because anisakiasis is caused by infestation by young larva. The irradiation doses therefore have to be high enough to kill the larva, while for other parasites, the irradiation blocks the development of larvae nearing the “adult” stage which provokes the symptoms (FDA/CFSAN, 2001b).
The ionisation of fish and shellfish is currently banned in France.

- **High pressure**

The pressure required to kill anisakidae larvae seems to alter the flesh of fishery products (Molina-Garcia and Sanz, 2002; Dong et al., 2003). Moreover, Molian-Garcia and Sanz (2002) believe that the pressure required to kill parasites may be less if used in combination with other partially fatal processes. These authors also consider that high pressure may be used on transformed products (smoked and marinated) as the pressure would not alter the flesh in this case. To our knowledge, no study combining several processes has been published. **Current knowledge does not allow high pressure to be adopted as a decontaminating process**.

<u>Conclusions and recommendations</u>:

Concerning the assessment of the probability of anisakidae larvae being present in fishery products (pen- or sea-farmed fish whose feeding is under control, wild tuna):

- In view of the specific features of the parasitic cycle (numerous parasite species, large number of parasite-infested fish species, high risk in large carnivorous fish, geographical and time variability of infestations);
- In view of the lack of published epidemiological data backing up the prevalence of anisakidae in fished tuna populations according to fishing ground and therefore the

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

impossibility of reaching a conclusion on the probability of anisakidae infestation of these fish;

- In view of the absence of anisakidae larvae recorded in the studies carried out, particularly on sea-farmed salmon in nets, and in view of the feeding methods of farmed fish;

Afssa considers that:

- an extension of the exemption from decontaminating treatment (freezing at -20°C for 24 hours, right through) for certain species of wild tuna cannot be recommended given the current epidemiological knowledge available;
- This extension of the exemption from decontaminating treatment can be recommended for farmed fish given a probability of infestation by anisakidae that animal health experts consider to be "nil to negligible" as soon as feeding is strictly under control (raw material register, supporting documents, etc.).

Concerning the assessment of the effectiveness of certain alternative processes to freezing, particularly salting and marinating:

- In view of the fact that freezing and cooking remain the reference processes guaranteeing the destruction of larvae, under conditions that are well defined in the regulations (time/temperature couples). It should nevertheless be recalled that freezing does not address the problem of allergens and that cooking does not destroy all allergens;
- In view of the fact that the conditions for using dry salt or brine leading to the destruction of larvae do not generally correspond to those actually practised for marketed salted or salted/smoked products, except for dried salted cod fillets and some traditionally transformed herring products;
- In view of the fact that only hot smoking decontaminates products and that the consumption of smoked fish mostly concerns cold smoked fish (herring, salmon, halibut, haddock, etc.);
- In view of the fact that marinating is only effective under very specific conditions of acetic acid use that are not usually practised;
- In view of the fact that hydrogen peroxide use is currently banned in France for marinades;
- In view of the fact that the variability of salting, marinating and smoking conditions (variability linked to local specific features and products) must be taken into account when assessing the performances of these processes;
- In view of the fact that ionisation and high pressure are not effective at killing anisakidae larvae under conditions that preserve the products' organoleptic qualities;

Afssa considers that it is not appropriate to recommend an extension of the exemption from the freezing sanitary obligation, for salted and/or marinated and/or cold smoked fishery products, except for;

- whole or filleted smoked herring that has been salted in dry salt for at least 21 days (NF V 45-067[5]);
- dried salted cod fillets.

Afssa also recommends:

- conducting surveys to more effectively assess the infestation of fish (particularly concerning wild tuna), including the infestation of anadromous fish;
- that clear, practical information be provided to caterers and the general public for conducting decontaminating treatments;
- conducting human health studies to improve the assessment of the annual incidence of anisakioases.

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

[5] NF V 45-067 Poissons transformés, Filets de hareng fumé, Spécifications, Septembre 1996.

These are the analytical responses that Afssa is able to provide for the Directorate General for Food's (DGAI) request of 21 November 2007 on the risk assessment concerning the presence of anisakidae in fishery products and the extension of the exemption from the freezing sanitary obligation for fishery products whose feeding is under control and for certain species of wild fish.

Director General for the French Food Safety Agency

Pascale BRIAND

LE DIRECTEUR GÉNÉRAL

2 [redacted] e
C c
B P 1 9 , 9 4 7 0 1
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
w w w . a f s s a . f r

R E P U B L I Q U E
F R A N Ç A I S E

LE DIRECTEUR GÉNÉRAL

Key words: *Anisakis*, parasitology, hygiene package, freezing, salting, marinating, seafood.

Main bibliographical references:

(2004) Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin.

Abollo, E., Gestal, C., Pascual, S. *Anisakis (*2001). infestation in marine fish and cephalopods from Galician waters: An updated perspective. Parasitology Research Volume 87, Issue 6, 492-499.

Adams AM, Ton MN, Wekell MM, MacKenzie AP, Dong FM (2005). Survival of *Anisakis simplex* in arrowtooth flounder (*Atheresthes stomia*) during frozen storage. Journal of Food Protection 68:1441-1446.

Angot V. Infestation de 7 poissons de consommation courante par des larves de nématodes anisakidés ; efficacité des méthodes de filetage. Conséquences sanitaires et prophylactiques. Thèse d'Université, Faculté de Médecine et de Pharmacie de Rouen, 1993.

Angot V. Brasseur P. (1993]. European farmed Atlantic salmon (Salmo salar L.) are safe from anisakid larvae. Aquaculture Volume 118, Issues 3-4, 15 December, 339-344.

Arcangeli G, Galuppi A, Bicchieri M, Gamberini R, Presicce M (1996). Experimental trials on the vitality of *Anisakis* larvae in brine solutions. Industria Conserve 71:502-507.

Audicana M.T . et al. (2002) *Anisakis simplex* : dangerous —dead and alive? Trends in Parasitology Vol.18 No. 1 January, 20-25.

Bourée, P., A. Paugam, and J. C. Petithory (1995). Anisakidosis: report of 25 cases and review of the literature. Comparative Immunology, Microbiology and Infectious Diseases 18:75-84.

Bristow, G.A., Berland, B (1991). A report on some metazoan parasites of wild marine salmon (*Salmo salar L.*) from the west coast of Norway with comments on their interactions with farmed salmon. Aquaculture Volume 98, Issue 1-3, 311-318.

Burke, J.B., Rodgers, L.J. (1982). Gastric ulceration associated with larval nematodes (*Anisakis* sp. type I) in pen reared green turtles (*Chelonia mydas*) from Torres Strait. Journal of wildlife diseases Volume 18, Issue 1, January, 41-46.

Centre d'expérimentation et de valorisation des produits de la mer. Etude des conditions de destruction des larves d'*Anisakis simplex* dans le hareng salé au sel sec destiné à la fabrication de filets de harengs saurs traditionnels. CEVPM, OFIMER, Boulogne, Mai 2005, 71 p.

Chai, J. Y., K. Darwin Murrell, and A. J. Lymbery. (2005). Fish-borne parasitic zoonoses: Status and issues. International Journal for Parasitology 35:1233-1254.

CQIASA (Québec) Gestion des risques parasitaires associés à la consommation de poissons crus ou partiellement cuits. Agriculture, Pêcheries et Alimentation. Québec (Canada).
http://www.mapaq.gouv.qc.ca/cgi-bin/MsmGo.exe?grab_id=69&page_id=2622464&query=poissons+crus&hiword=CRUST+POISSANT+POISSON+crus+poissons+

Deardorff TL, Raybourne RB, Desowitz RS (1984). Behavior and viability of third-stage larvae of *Terranova* sp (type HA) and *Anisakis simplex* (type I) under coolant conditions. Journal of Food Protection 47:49-52.

Deardorff TL, Throm R (1988). Commercial blast-freezing of third-stage *Anisakis simplex* larvae encapsulated in salmon and rockfish. Journal of Parasitology 74:600-603.

Deardorff TL, Kent ML (1989). Prevalence of larval *Anisakis simplex* in pen-reared and wild-caught salmon (Salmonidae) from Puget Sound, Washington. J Wildl Dis. Jul;25(3):416-9.

Dong FM, Cook AR, Herwig RP (2003). High hydrostatic pressure treatment of finfish to inactivate *Anisakis simplex*. Journal of Food Protection 66:1924-1926.

Doupé, R.G., Lymbery, A.J., Wong, S., Hobbs, R.P. (2003). Larval anisakid infections of some tropical fish species from north-west Australia. Journal of Helminthology Volume 77, Issue 4, December, 363-365.

Farkas J (1998). Irradiation as a method for decontaminating food. A review. International Journal of Food Microbiology 44:189-204.

FDA/CFSAN US (2001a). Fish and fishery products hazards and controls guidance, 3rd Edition.

FDA/CFSAN US (2001b). Processing Parameters Needed to Control Pathogens in Cold Smoked Fish. In: Administration USFaD, Nutrition CfFSaA (eds.).

Inoue, K., Oshima, S.-I., Hirata, T., Kimura, I. (2000). Possibility of anisakid larvae infection in farmed salmon. Fisheries Science Volume 66, Issue 6, 1049-1052.

Jones, J.B. (1991). Movements of albacore tuna (*Thunnus alalunga*) in the South Pacific: Evidence from parasites Marine Biology Volume 111, Issue 1, October, 1-9.

Karl H, Priebe K (1991). Inactivation of larval nematodes (*Anisakis* sp.) in seafish by carbon-dioxide shock frosting at - 60 degrees C. Archiv für Lebensmittelhygiene 42:46-48.

Karl H, Roepstorff A, Huss HH, Bloemsma B (1995). Survival of *Anisakis* larvae in marinated herring fillets. International Journal of Food Science and Technology 29:661-670.

Khalil LF (1969). Larval nematodes in the herring (*Clupea harengus*) from British coastal waters and adjacent territories. Journal of the Marine Biological Association of the United Kingdom 49:641-659.

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

Lunestad, B.T. (2003). Absence of nematodes in farmed atlantic salmon (*Salmo salar L.*) in Norway. Journal of Food Protection, Volume 66, Issue 1, January, 122-124.

Mattiucci S, Abaunza P, Damiano S, Garcia A, Santos MN, Nascetti G. (2007). Distribution of *Anisakis* larvae, identified by genetic markers, and their use for stock characterization of demersal and pelagic fish from European waters: an update. J Helminthol. 81(2):117-27.

Mattiucci, S., Paggi, L., Nascetti, G., Portes Santos, C., Costa, G., Di Beneditto, A.P., Ramos, R., Argyrou, M., Cianchi, R., Bullini, L. (2002) Genetic markers in the study of *Anisakis typica* (Diesing, 1860): Larval identification and genetic relationships with other species of *Anisakis* Dujardin, 1845 (Nematoda: *Anisakidae*). Systematic Parasitology Volume 51, Issue 3, 159-170.

Molina-Garcia AD, Sanz PD (2002). *Anisakis simplex* larva killed by high-hydrostatic-pressure processing. Journal of Food Protection 65:383-388.

Möller H (1989). Nematode problems in North Atlantic fish. International Council for the Exploration of the Sea, Kiel.

Mudry J, Lefebvre P, Dei-Cas E, Vernes A, Poirriez J, Debat M, Marti R, Binot P, Cortot A. (1986). Anisakiase humaine: 5 cas dans le Nord de la France. Gastroenterologie Clinique Biologique 10(1): 83-87.

Munday, B. L., Y. Sawada, et al. (2003). Diseases of tunas, *Thunnus* spp. J Fish Dis 26(4): 187-206.

Puente P. et al. (2008). Anisakis simplex: the high prevalence in Madrid (Spain) and its relation with fish consumption. Exp Parasitol. 118(2):271-4.

Sainclivier M (1985). L'industrie alimentaire halieutique, Vol 2, Des techniques ancestrales à leurs réalisations contemporaines salage, séchage, fumage, marinage, hydrolysats.

Sanchez-Monsalvez I, de Armas-Serra C, Martinez J, Dorado M, Sanchez A, Rodriguez-Caabeiro F (2005). A new procedure for marinating fresh anchovies and ensuring the rapid destruction of *Anisakis* larvae. Journal of Food Protection 68:1066-1072.

Szostakowska B, Myjak P, Wyszynski M, Pietkiewicz H, Rokicki J (2005). Prevalence of *Anisakis* nematodes in fish from southern Baltic sea. Polish Journal of Microbiology 54:41-45.

Venugopal V, Doke SN, Thomas P (1999). Radiation processing to improve the quality of fishery products. Critical Reviews in Food Science and Nutrition 39:391-440.

Wharton DA, Aalders O (2002). The response of *Anisakis* larvae to freezing. Journal of Helminthology 76:363-368.

Wootten R, Cann DC (2001). Torry Advisory Note No. 80 : Round Worms in Fish Ministry Of Agriculture, Fisheries And Food.

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE

afssa
AGENCE FRANÇAISE DE SECURITE SANITAIRE DES ALIMENTS

LE DIRECTEUR GÉNÉRAL

Annex: List of main salted, smoked and/or marinated fishery products

High-tonnage and/or economically influential fishery products are introduced with the sign ➢, while low-tonnage products are introduced with the sign •. The products printed in italics do not pose an *Anisakis* risk as either their transformation kills the larvae or they are consumed after cooking.

Salted fishery products

- ➢ *Cod fillet that is dry salted and dried (as product is very salted)*
- ➢ Dry salted or brine-immersed fish eggs and gonads, sometimes dried, smoked, etc.
- • Dry salted herring fillet
- • Bloater stock: whole salted
- • Dry salted whole sardine (imported from Spain)
- • Cod: dry salted fillet

Salted and smoked fishery products

- ➢ Herring:
  - ➢ Sweet fillet: filleted, salted in brine, cold smoked
  - ➢ Traditional fillet: salted in dry salt, cold smoked, filleted
  - ➢ Smoked herring: salted whole in dry salt, cold smoked
  - • Bloater: whole, not gutted, salted in brine, cold smoked
  - • Kippers: gutted down the back, salted in brine, cold smoked
  - • Roe/Soft roe: salted gonads in dry salt or saturated brine, cold smoked
- ➢ Salmon and trout: salted fillet in dry salt or brine, cold smoked
- ➢ *Salmon: salted steak in brine, hot smoked*
- ➢ *Eel: gutted, salted in dry salt or sometimes in brine, hot smoked*
- ➢ Halibut: salted fillet in dry salt or brine, cold smoked
- ➢ Haddock: filleted, salted in brine, cold smoked
- ➢ Sprat: salted in dry salt or brine, cold smoked
- • Tuna, Marlin, Swordfish: steak or fillet salted in brine, cold smoked
- • *Mackerel: fillet, salted in brine, hot smoked*
- • Coalfish: salted fillet in dry salt and kept in brine, cold smoked

Marinated fishery products

- ➢ Rollmops: gutted, headed and filleted herring, marinated in a mixture of vinegar, water and herbs
- ➢ Anchovies: fillet marinated in a mixture of vinegar, water and herbs

Smoked fishery products

- • *Trout: whole, small, gutted, hot smoked*
- • Sardine: whole, cold smoked

23, avenue du Général de Gaulle
BP 19, 94701
Maisons-Alfort cedex
Tel 01 49 77 13 50
Fax 01 49 77 90 05
www.afssa.fr

REPUBLIQUE FRANÇAISE