Surveillance of trace metals in foods of animal origin - focus on the exploratory plan to test for methylmercury in fish

Rachida Chekri (1) (rachida.chekri@anses.fr), Jean-Cédric Reninger (2), Thierry Guérin (1), Laurent Noël (3)

(1) ANSES, Laboratory for Food Safety, Maisons-Alfort , France.
(2) ANSES, Risk Assessment Department, Maisons-Alfort, France
(3) French Directorate General for Food, Coordination Office for Chemical and Physical Contaminants, Paris, France

Abstract

The surveillance of trace metals such as arsenic, lead, cadmium, nickel and mercury in foodstuffs of animal origin is ensured by an operational plan aiming at risk identification and the quantification and characterisation of the hazards related to trace metals found in foods.

In 2014, several surveillance and control plans (targeted sampling) as well as an exploratory plan were implemented to monitor trace metals (lead, cadmium, mercury and methylmercury) in foodstuffs. These plans generated 6,908 analyses in various matrices (fish products, livestock products, milk, game, poultry, rabbits and honey). Processing of the results showed a completion rate of 99.3% and a rate of non-compliance (with the regulatory maximum levels or national alert thresholds) ranging from 0.7% to 16% across all sectors, excluding the equine industry. The identified non-compliances were managed based on the identified risk. They also helped to maintain or strengthen the surveillance of certain analyte/matrix pairs, such as lead in game meat and cadmium in equine liver.

In general, the surveillance system in place has contributed to estimating consumer exposure to trace metals as well as to populating databases (methylmercury exploratory plan) for enhanced risk assessment. The analysis of the monitoring system was an opportunity to present prospects for improvement including the need to define more suitable sample targeting criteria that are easier to implement. Another area for improvement would be the implementation of a tool for improving the quality of data generated by monitoring and control plans.

Keywords

Surveillance, Trace metals, Lead, Cadmium, Mercury, Methylmercury

Résumé

Surveillance des éléments traces métalliques dans les denrées alimentaires d'origine animale - focus sur le plan exploratoire de la recherche du méthylmercure dans les poissons

La surveillance officielle des éléments traces métalliques (ETM) tels que l'Arsenic, le Plomb, le Cadmium, le Nickel ou le Mercure dans les denrées alimentaires d'origine animale est assurée grâce à un dispositif qui permet de maîtriser le risque alimentaire par l'identification, la quantification et la caractérisation du danger lié à la présence de ces éléments dans les aliments.

En 2014, divers plans de surveillance et de contrôle (échantillonnage ciblé) ainsi qu'un plan exploratoire ont été mis en œuvre pour la surveillance des ETM (Plomb, Cadmium, Mercure et Méthylmercure) dans les denrées alimentaires. Ces plans ont engendré 6 908 analyses dans diverses matrices (produits de la pêche, animaux de boucherie, laits, gibiers, volailles, lapins et miels). L'exploitation des résultats obtenus, a indiqué un taux de réalisation de 99,3 % et un taux de non-conformités (au regard des teneurs maximales réglementaires ou des seuils d'alerte nationaux) variant de 0,7 à 16 %, toutes filières confondues, hors filière équidés. Les non-conformités mises en évidence ont fait l'objet de mesures de gestion adaptées en fonction du risque identifié. Elles ont également permis de maintenir ou de renforcer la surveillance de certains couples analyte/matrice tels que le Plomb dans le muscle de gibier ou le Cadmium dans le foie d'équidés. De manière générale, le système de surveillance mis en place a contribué à l'évaluation du niveau d'exposition du consommateur aux ETM ainsi qu'à l'alimentation des bases de données de contamination (plan exploratoire Méthylmercure), pour une meilleure évaluation du risque. L'analyse du dispositif a permis de présenter des perspectives d'amélioration, notamment la nécessité de définir des critères de ciblage des prélèvements, plus adaptés et plus simple à mettre en œuvre; ainsi que la mise en place d'un outil pour l'amélioration de la qualité des données générées par les plans de surveillance et de contrôle.

Mots-clés

Dispositif de surveillance, éléments traces métalliques, Plomb, Cadmium, Mercure, Méthylmercure

Every year, various surveillance and control plans (SCPs) are implemented to monitor contamination of primary plant and animal production, foodstuffs of animal origin, and animal feed. These plans are also a way of collecting data on contamination with a view to assessing the risks related to food.

Trace metals (TMs) in foodstuffs of animal origin are a group of contaminants that are monitored through this programme. The main elements under monitoring are lead (Pb), cadmium (Cd), and mercury (Hg). The sources of TMs are either natural or anthropic, i.e. related to human activities such as industry and agriculture. Through the various transformation processes that they undergo (physico-chemical, oxidation-reduction, biological activity, absorption-desorption, etc.), TMs are found in different chemical forms, whether organic or inorganic, with a variable lifespan, and are more or less toxic depending on the element of interest. They are adsorbed in soil, sediments, and in aquatic environments, and can also be found in the air. This is how these substances enter the food chain (water-phytoplankton/plant-fish/animal) where they undergo biomagnification and/or bioaccumulation. Ingestion of these TMs *via* food is associated with disruptions of essential metabolic functions in humans. Toxicity related to lead and mercury cause kidney, neurotoxic, and cardiovascular lesions, and cadmium is classified

as "carcinogenic in humans"; it affects renal function and causes reproductive disorders.

In this article, we will present the objectives of the surveillance programme for TMs implemented in 2014, its operational aspects as highlighted by surveillance scheduling and the surveillance protocol (choice of analyte/matrix pairs to monitor, sampling strategy and plan, analytical methods, etc.), as well as the results and areas for improvement. We will specifically focus on the methylmercury (MeHg) plan concerning fish. Mercury, a regulated substance, accumulates in fish mainly in the form of methylmercury, which is not regulated, and this form carries a toxic risk for the consumer. However, the surveillance plans implemented concern mainly mercury. As a result, in 2014, an exploratory plan was initiated to collect contamination data specifically on the most toxic species (MeHg) in fish consumed in France.

Objectives of the surveillance programme

The objectives are to: i) monitor the compliance of animal foodstuffs placed on the market in France on a pro rata basis of the quantities produced, and ii) provide data for assessing the risk to consumers related to contamination of animal foodstuffs by TMs. In addition, possible European alerts (RASFF[1]) are taken into account for implementation of the programme to enable further vigilance or to set up targeted plans regarding specific analyte/matrix pairs.

The SCPs implemented in 2014 concerned foodstuffs of animal origin at the stage of primary production or primary processing: meat, offal, milk and honey (for land animals), fish meat for farmed fish, as well as seafood and freshwater products. The plans were organised as follows:

- control plan for lead and cadmium in animals for slaughter, poultry, rabbits, game, farmed fish, and honey,
- control plan for lead in milk, beef, mutton/lamb, and goat meat,
- surveillance plan for lead, cadmium, and mercury in fishery products (fish, shellfish, cephalopods and bivalve molluscs),
- exploratory plan for methylmercury in fish.

Most of the programmed plans meet the regulatory objectives fixed by the European Union to monitor contamination levels by various contaminants in food, and to harmonise food safety monitoring for European production regarding certain health hazards. This is the case for TMs in primary animal production.

Other specific plans are aimed at national monitoring and involve analyte/matrix pairs that are not regulated but that are of interest. Examples include lead and cadmium in honey and in rabbits, and cadmium in game meat (farmed and wild) to which detection of lead was added in 2014.

Aside from these plans, implemented to monitor compliance of products, an exploratory plan for the detection of MeHg in fish was organised. Its aim was to collect data on MeHg and total mercury (HgT) concentrations observed in fish placed on the market. Currently, European regulations establish only the HgT concentration in foodstuffs, with a regulatory maximum limit (ML) of 1 mg/kg for predator fish and 0.5 mg/kg for other fish. However, mercury toxicity depends on its speciation (different chemical species of an element, i.e. chemical entity: atom or group of related atoms that can be an ion, a molecule, or a radical) and on the amount of these different species ingested, which can be different from the HgT concentration. Organomercury species are far more toxic than inorganic species. This is the case for MeHg, the most hazardous form to humans, which is neurotoxic and teratogenic.

The main source of exposure of humans to MeHg is consumption of fishery products. Moreover, the calculation of population exposure to MeHg is generally carried out on the basis of a hypothesis in which the mean proportion of mercury present in the form of MeHg in fish meat varies from 80% to 100% of HgT. To assess this exposure as precisely as possible, knowledge of the MeHg levels, in addition to the HgT levels, would enable the European authorities to issue new toxicity reference values and more specific food recommendations (committee of the *Codex Alimentarius*).

1. RASFF: rapid alert system for food and feed – European Commission.

Box.

Objectives

Surveillance plan: monitor contamination levels of regulated trace metals in foodstuffs of animal origin: lead (Pb), cadmium (Cd), and mercury (Hg) in primary production.

Exploratory plan for the detection of methylmercury (MeHg) in fish: provide additional data for assessing the risk related to consumption of fish.

Programming framework

Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products.

Decision 97/747/EC fixing the levels and frequencies of sampling provided for by Council Directive 96/23/EC for the monitoring of certain substances and residues thereof in certain animal products.

Decision 98/179/EC laying down detailed rules on official sampling for the monitoring of certain substances and residues thereof in live animals and animal products.

Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.

Commission Regulation (EC) No 333/2007 of 28 March 2007 laying down the methods of sampling and analysis for the official control of the levels of lead, cadmium, mercury, inorganic tin, 3-MCPD and benzo(a)pyrene in foodstuffs.

Protocol

The plans for the detection of TMs in foodstuffs of animal origin implemented in 2014 include: a control plan for lead and cadmium in animals for slaughter, poultry, rabbits, honey and game; a control plan for lead in milk; a surveillance plan for lead, cadmium, and mercury in fishery products; and an exploratory plan for MeHg in fish.

Production areas of interest: animals for slaughter (cattle, sheep, goats, and horses), poultry, rabbits, game, farmed fish, eggs, honey, milk, beef, mutton/lamb, goat meat, and fishery products (fish, shellfish, cephalopods, and bivalve molluscs).

Food chain stage: primary production or first processing. All distribution channels for fishery products (hyper- and supermarkets, fishmongers, itinerant markets, etc.).

Non-compliant samples: as a general rule, a result is considered non-compliant when the maximum levels of a contaminant present in a product are exceeded, taking into account the expanded measurement uncertainty (k = 2) associated with the result.

The surveillance programme for TMs implemented in 2014 involved 3140 samples, and 59 samples were analysed as part of the MeHg exploratory plan.

Sampling strategy: for control plans, sampling targeted at foodstuffs from areas that are likely to be contaminated, and for the surveillance and exploratory plans, random samples at the distribution stage.

Analytical methods: official methods for the determination of TME levels (Pb, Cd, Hg) in foodstuffs of animal origin by atomic absorption (AA) spectrometry or by inductively coupled plasma mass spectrometry (ICP-MS) and the method of determination of the MeHg content in fishery products by isotopic dilution.

How the surveillance programme operates

The programme calls on various players to perform different activities in specific areas of competence: management and scheduling (sampling strategy, choice of suitable analyte/matrix pairs, etc.), implementation (sampling, development of appropriate analytical methods, analysis, demonstration of non-compliance, etc.), and exploitation of results from the programme (measures implemented following cases of non-compliance or identified emerging risks, conclusions, and proposals for improving the programme)[2].

Management and scheduling framework

Management and scheduling are taken care of by the Directorate General for Food (DGAL). Control plans are developed and implemented in accordance with the provisions of Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products, and Commission Decisions 97/747/EC (fixing the levels and frequencies of sampling provided for by Council Directive 96/23/EC for the monitoring of certain substances and residues thereof in certain animal products) and 98/179/EC (laying down detailed rules on official sampling for the monitoring of certain substances and residues thereof in live animals and animal products).

The regulatory limits for TMs in animal foodstuffs are defined in Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels (MLs) for certain contaminants in foodstuffs.

Sampling methods and the performance criteria of analytical methods are defined in Commission Regulation (EC) No 333/2007 of 28 March 2007 laying down the methods of sampling and analysis for the official control of the levels of lead, cadmium, mercury, inorganic tin, 3-MCPD and benzo(a)pyrene in foodstuffs.

Sampling strategy

The sampling strategy is managed by the DGAL in conjunction with other managing bodies of the programme with support from ANSES and the National Reference Laboratory (NRL) for trace metals in foodstuffs of animal origin.

The sampling methods (number of samples, representativeness of the sample lots and sublots, or units, packages, labelling, and transmission) are those specified in Commission Regulation (EC) No 333/2007.

The sampling strategy depends on the type of plan and is carried out as follows.

Surveillance plans

Sampling is carried out randomly. The choice of lots to sample is made at random, irrespective of the date, place, origin (farmed or wild), or species concerned, depending on the human population of each region. The samples are taken at the distribution level. Concerning the surveillance plan in fishery products, regardless of the species, samples are taken at the point of transfer to the final consumer in all distribution channels (hyper- and supermarkets, fishmongers, itinerant markets, etc.).

Control plans

All of the samples are collected in a targeted manner. The criteria used are for example the location of agricultural production sites near polluted or potentially polluted areas. Databases that provide information on risk areas – IREP[3] and BASOL[4] – are used to distribute the samples at the departmental level.

All livestock rearing or production methods, whether intensive, organic, or certified, are included. Samples to detect lead and cadmium in the equine sector are taken from muscle and liver in the same animal (addition of this matrix in 2014). Since there is a lack of recent data on contamination of offal from horses over two years of age, reinforced monitoring of lead and cadmium in the liver was planned for 2014 in order to assess the level of contamination in this matrix, and if necessary, revise current management methods (systematic collection of livers from animals over two years). For milk, samples are taken from production sites where the animals have access to the outside, with priority given to polluted or potentially polluted areas.

Exploratory plan for MeHg in fish

Samples are taken at the distribution stage, in a randomised manner. A total of 54 samples were planned and attributed to all regions in mainland France, as well as the five Overseas *départements*.

Since predatory species are highly bioaccumulative compared to other species, it was decided to take one sample of predator fish and one non-predator by region in mainland France, and two samples of different fish (predator or not) in the five Overseas *départements*.

Implementation methods

The programme is implemented jointly by the decentralised services that carry out sampling, accredited laboratories, and the National Reference Laboratory (NRL) responsible for analyses, and by all the stakeholders for the management of non-compliance.

Analytical methods

The analyses are carried out by laboratories accredited by the Ministry of Agriculture, Food and Forestry to perform analyses, and by the NRL for certain specific plans. All of the laboratories are accredited by the French Accreditation Committee (Cofrac) to carry out analyses in accordance with the provisions of Standard NF EN ISO/CEI 17025 "General requirements for the competence of testing and calibration laboratories", and according to the 99-3 accreditation programme "Analysis of chemical contaminants in animals and products thereof and in foodstuffs intended for humans or animals: metals". The methods used for the regulatory analyses are the official methods (DGAL guidance note No. DGAL/SDPPST/N2011-8081 "Official methods for the determination of TME levels (Pb, Cd, and Hg) in foodstuffs of animal origin").

Two main techniques are used depending on the availability of equipment in the laboratories, i.e. atomic absorption (AA) spectrometry, and inductively coupled plasma mass spectrometry (ICP-MS). These methods are developed and validated by the NRL, in accordance with applicable standards, in order to evaluate performance parameters such as limits of detection (LODs) and quantification (LOQs), trueness and intermediate precision. They are then transferred to accredited laboratories. In line with European regulations, these performance criteria must meet the predefined requirements, especially in terms of LOQ and measurement uncertainty of the result. The method must be sufficiently sensitive to quantify low concentrations at and below (1/5 to 2/5) maximum levels, and must have a measurement uncertainty in agreement with a maximum regulatory value (calculated based on the concentration of interest). As the statement of conformity of a sample is based on the analytical result, minus its uncertainty, a maximum limit for the uncertainty value has been established to prevent any overestimation of uncertainty that would affect the conclusion.

2. See the article by Marion Bordier, The surveillance system for food-chain contaminants managed by the DGAL: report on the 2014 surveillance and control plan campaign, in this edition.

3. IREP: French register of pollutant emissions. *http://www.irep. ecologie.gouv.fr/IREP/index.php*

4. Basol: Database on polluted sites or contaminated land. *http://basol.developpement- durable.gouv.fr/*

For non-regulated analyses in the MeHg exploratory plan in fish, the method used was the determination of MeHg levels in fishery products by isotope dilution: solid/liquid extraction and quantification by isotope dilution - gas chromatography coupled with inductively coupled plasma mass spectrometry (ID-GC/ICP-MS).

Regulatory compliance

For monitoring purposes, the analytical results are compared to the maximum levels or to the nationally determined thresholds that apply to the analyte/matrix pair under consideration. The sample is compliant if the result subtracted from expanded measurement uncertainty (coverage factor fixed at 2, for a confidence level of 95%) is less than or equal to this maximum level.

Since there are no regulatory thresholds for some analyte/matrix pairs under monitoring, alert thresholds determined nationally have been defined by the DGAL on the basis of previous data from SCPs and/or bibliographic data, or on the basis of MLs for similar matrices or species (e.g. game birds associated with poultry).

This is, in particular, the case for lead and cadmium in game, rabbits, and honey, and lead in horses. For example, concerning honey, the retained thresholds are 0.10 mg/kg for lead and 0.05 mg/kg for cadmium, with these thresholds representing compliance thresholds above which an investigation is triggered to identify a possible source of contamination in the environment. Since 2015, an ML has been set for lead in honey at 0.10 mg/kg (Commission Regulation (EC) No 2015/1005 of 25 June 2015).

When a non-compliant result is found, the laboratories inform the decentralised service that obtained the sample, and this service then informs the Public Health Emergency Unit (MUS) at the DGAL. The MUS provides technical support to decentralised services in conjunction with the relevant sector office to assess reports. It ensures execution of a possible batch withdrawal or recall procedure and, if there is no immediate risk, where necessary transmits case management to the DGAL sector office and the directorate generals that may be concerned.

Results and Discussion

The surveillance programme for TMs implemented in 2014 involved 3,140 samples, with a completion rate of 99.3%. This rate ranged from 73% to 114% depending on the analyte/matrix pair, except for lead in sheep's milk (40%) and lead and cadmium in small farmed game (32%). These low rates are related either to samples not being collected due to difficulties in the field or to a lack of communication of results in Sigal (non-transmission of results or unusable transmitted results). The surveillance programme involved 23 different analyte/matrix pairs, which is a high number given the quantity of samples. Nonetheless, the number of samples meets the minimum requirements in European regulations and forms part of overall surveillance of health risks on the basis of priority setting by sector or by contaminant group, taking account of budget restrictions.

The total number of analyses was 6790. Generally speaking, the quantified results (24.9%) are far below authorised maximum levels. The identified non-compliances concerned HgT in fish (2.6%), cadmium in shellfish (6.5%, 31 samples), lead in horse liver (0.6%), cadmium in horse muscle (0.6%), cadmium in poultry liver and game muscle (0.7%), and cadmium in cattle liver (9%, 22 samples). These cases of non-compliance triggered an epidemiological investigation that led to stock seizure or batch withdrawal when contamination was confirmed. For example, following a non-compliant result for cadmium in cattle liver from a production site located in an area where the ground is contaminated with lead and cadmium, systematic seizure of offal from animals in this area was implemented.

Moreover, a high, though expected, level of non-compliance (78%) was found for analyses of cadmium in horse liver. This plan was implemented to confirm continued systematic seizure of liver from horses over two years of age at the slaughterhouse, in line with specific French legislation concerning offal of animals that are "slaughtered late" and may bioaccumulate cadmium in their livers in amounts higher than the maximum level of 0.5 mg/kg, and that would therefore be unfit for human consumption.

With regard to game, the detection of lead was added to the detection of cadmium in 2014 to assess possible lead contamination that consumers may be exposed to. In all, 16.6% non-compliance for lead in muscle and 5.5% in liver was found in game meat, as well as 12% for cadmium in liver and 0.7% in muscle.

The liver is usually more highly contaminated than muscle and this was confirmed for cadmium but not for lead. This increased level of non-compliance for lead in muscle is probably due to the use of lead-containing bullets used in hunting, with resulting contamination of samples, despite recommendations concerning sampling away from the bullet trajectory.

Since game meat is consumed only occasionally, it does not constitute a major source of exposure to cadmium or to lead. However, the possibility that consumers with a specific diet (for example those consuming large quantities of game meat) may be exposed to a greater extent, cannot be ruled out. It would be interesting to better characterise this situation in order to issue consumption recommendations, if necessary. Sources of contamination can be natural or possibly artificial (human activities such as industry) with logical accumulation in game given the diet of certain animals and their age.

Moreover, the number of samples collected in 2013 was slightly lower in comparison with the SCPs implemented in 2014 (2,273 *versus* 3,140), with an equivalent completion rate. We also observed small quantities of TMs in the analysed matrices and several non-compliances that involved two samples of horse and cattle muscle, and one sample of swordfish (Indian Ocean) for cadmium, and two samples of ling (NE Atlantic) for mercury. Alert thresholds were also exceeded for 22 game liver and muscle samples for cadmium and lead, and one sample of sea urchin (NE Atlantic), and two samples of honey for lead (including one case related to the presence of lead in the material).

Focus on the exploratory plan for MeHg in fish

A total of 59 samples were analysed and the results for mean levels of HgT and MeHg according to the various species (23 predator fish and 36 non-predator fish) are shown in Figure 1.

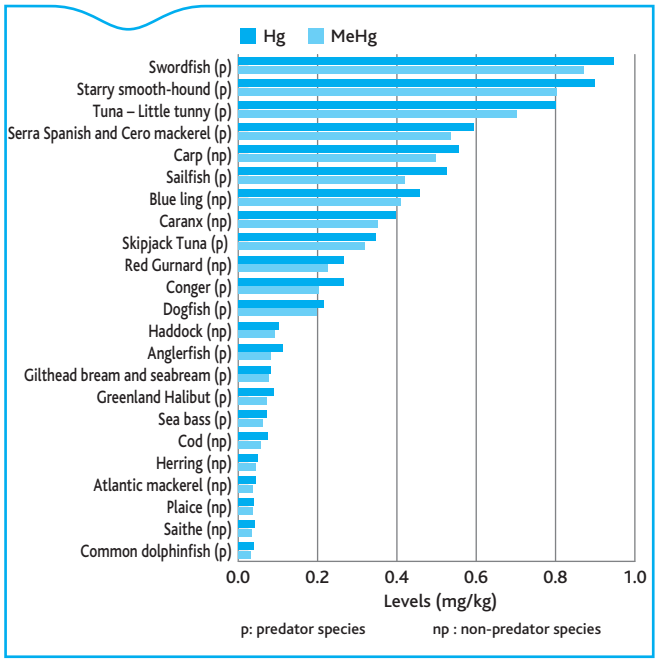

Figure 1. Distribution of HgT and MeHg levels according to fish species

Table 1. Mean data for HgT and MeHg contamination in fish

	Mean contamination values (mg/kg)			
	All fish (n = 59)	Non-predator fish (n = 23)	Predator fish (n = 36)	Predator fish, excluding swordfish and sharks (n = 19)
MeHg (mg/kg)	0.33	0.12	0.46	0.21
HgT (mg/kg)	0.37	0.14	0.51	0.24

The completion rate was 109%, with five additional samples of swordfish (*Xiphias gladius*) from Réunion Island analysed in addition with the scheduled sampling. All samples were quantified in HgT and in MeHg.

We can note six cases in which the maximum levels were exceeded for HgT given the individual levels measured in the species fished in unknown areas, except for Serra Spanish mackerel (*Scomberomorus brasiliensis*) caught in the Atlantic Ocean (1.6 mg/kg > 1.0 mg/kg (maximum level for predator fish)), carp (*Cyprinus carpio)* (0.82 mg/kg > 0.50 mg/kg (maximum level for non-predator fish)), swordfish (*Xiphias gladius*) (respectively 1.3 – 1.8 – 3.1 mg/kg > 1.0 mg/kg (maximum level for predator fish)), and the Little tunny (*Euthynnus alletteratus*) (1.3 mg/kg > 1.0 mg/kg (maximum level for predator fish)). This corresponds to a proportion of non-compliant samples of 10%, but this should be interpreted with caution given the sampling level in this plan (59 samples for 25 different species from various fishing locations). Targeted sampling and a higher number of samples would provide a better assessment of MeHg contamination in fish. Furthermore, MeHg content represents on average 87% of HgT (74% to 97% depending on the species), which is consistent with data from the literature (AFSSA request 2003, EFSA Opinion 2012).

As expected, HgT and MeHg levels are higher in predator species, which accumulate HgT and MeHg more readily (Table 1).

This exploratory plan provided data concerning MeHg and HgT in fish placed on the market in France. High consumers of predator species are likely to be more exposed to HgT and MeHg.

In addition, the European committee of experts on environmental contaminants is currently discussing the proposed revision of maximum levels for mercury in fishery products, on the basis of Commission Regulation (EC) No 1881/2006 of 19 December 2006. In this area, a new classification of MLs is under consideration: four levels are proposed: 0.30 – 0.50 – 1.0 and 2.0 mg/kg, established on the basis of a review of available contamination data showing that, depending on the species, mean contamination levels for mercury are either far below or far above current MLs. As an example, the fish with the highest levels of mercury are the oldest predator fish at the end of the food chain (tuna, swordfish, etc.), but also smaller predators that have slow growth. The current ML fixed for swordfish and sharks does not reflect commonly recorded contamination levels. Therefore, the MLs for these species should be fixed in Hg, applying the principle generally used to set maximum levels for contaminants (ALARA[5] principle resulting from the comparison of theoretical exposure deduced from available contamination data and the toxicity reference value (TRV) of the contaminant).

5. ALARA: As low as reasonably achievable

Analysis and areas for improvement of the surveillance programme

Overall, the 2014 surveillance programme of TMs in foodstuffs of animal origin contributed to consumer protection by managing contaminations considered non-compliant.

Specific national plans such as the detection of cadmium in horse liver and lead, and cadmium in honey enabled continued surveillance and suitable provisions according to the associated characteristic risks (confirmation of the need for systematic seizure of liver from horses over two years of age, contamination surveillance for lead and cadmium in honey and game, outside European requirements).

Moreover, data from the exploratory plan for the detection of MeHg/HgT were used to populate contamination databases, which are used by the scientific community to better assess risk.

In view of the high level of non-compliance for lead in game muscle, a joint project was launched by the DGAL, decentralised services, analysis laboratories, and the NRL. This project should be continued to identify whether the source of contamination is environmental or essentially related to hunting practices (lead bullets) and to implement measures that are in line with the identified risks. The aim is to ensure higher traceability of the programme, in accordance with applicable rules and recommendations (sampling outside the bullet trajectory by decentralised services and then by the laboratories. Inconsistent analytical results, related to dispersed lead bullets invisible to the naked eye in the matrix, should be reported by the laboratories), and reporting of any anomalies by all of the stakeholders involved. In addition, the DGAL has sent a request to ANSES concerning the health risks related to consumption of game meat due to environmental chemical contaminants (dioxins, polychlorinated biphenyls (PCBs), cadmium and lead).

Other actions could be implemented to optimise the system more generally, in particular by examining the sample targeting criteria for control plans. Those criteria are difficult to take into consideration due to the lack of instructions, precise indications, and difficulties associated with implementation in the field.

The quality of data is also an area for improvement in order to optimise the use of data from SCPs. The development of a computer-based tool for the qualitative follow-up of SCP data using indicators has also been initiated by ANSES through an agreement between the DGAL and the ANSES.