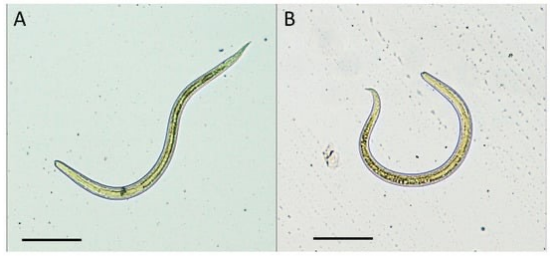


# OPINION ON THE PRESENCE OF *TOXOCARA* SPP. PARASITES IN WILD BOAR MEAT

Collective expertise

Opinion (2023-SA-0055)

I Vallée, French NRL



# Context of the opinion

- ✓ official searches for *Trichinella* larvae on wild boar carcasses in French wild game processing facilities have revealed the presence of ***Toxocara spp*** larvae.

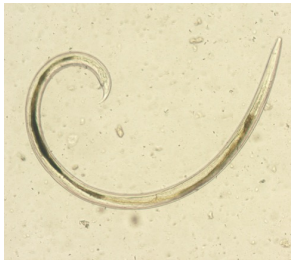


EU 2015/1375

Method: ISO18743



**Toxocara spp**



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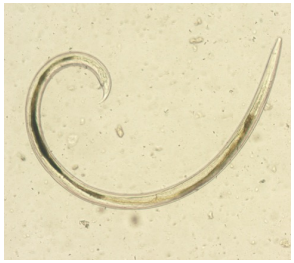


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**Toxocara spp**



✓ *Toxocara spp* is zoonotic: Humans can become infected by

- **ingestion of embryonated eggs** from the environment (soil, water)
- **consuming raw or undercooked meat** of infested paratenic hosts

✓ Regulation EU 2019/627: Meats that show **parasitic infestation** are considered **unfit** for human consumption → systematic sanitary seizure.

# Context of the opinion




- **6% of wild boars** killed by hunting in France are subject to *Trichinella* analysis (among 800,000 total hunted)
- During two hunting seasons (2021-2022 and 2022-2023): **40 batches contained at least one contaminated wild boar with *Toxocara***

  (➔ 366 wild boars)
- Positive cases have been reported by only **one** analytical laboratory (but from several hunting areas) (Network = 58 labs).

**Challenges for risk manager:**

- What is the risk of toxocariasis for consumers of wild boar meat?
- Should specific recommendations be made to hunters regarding the preservation and cooking of the meat?
- What should be done with detected batches?
- What control measures are proposed for these batches?



## Requests reviewed as part of this expert assessment

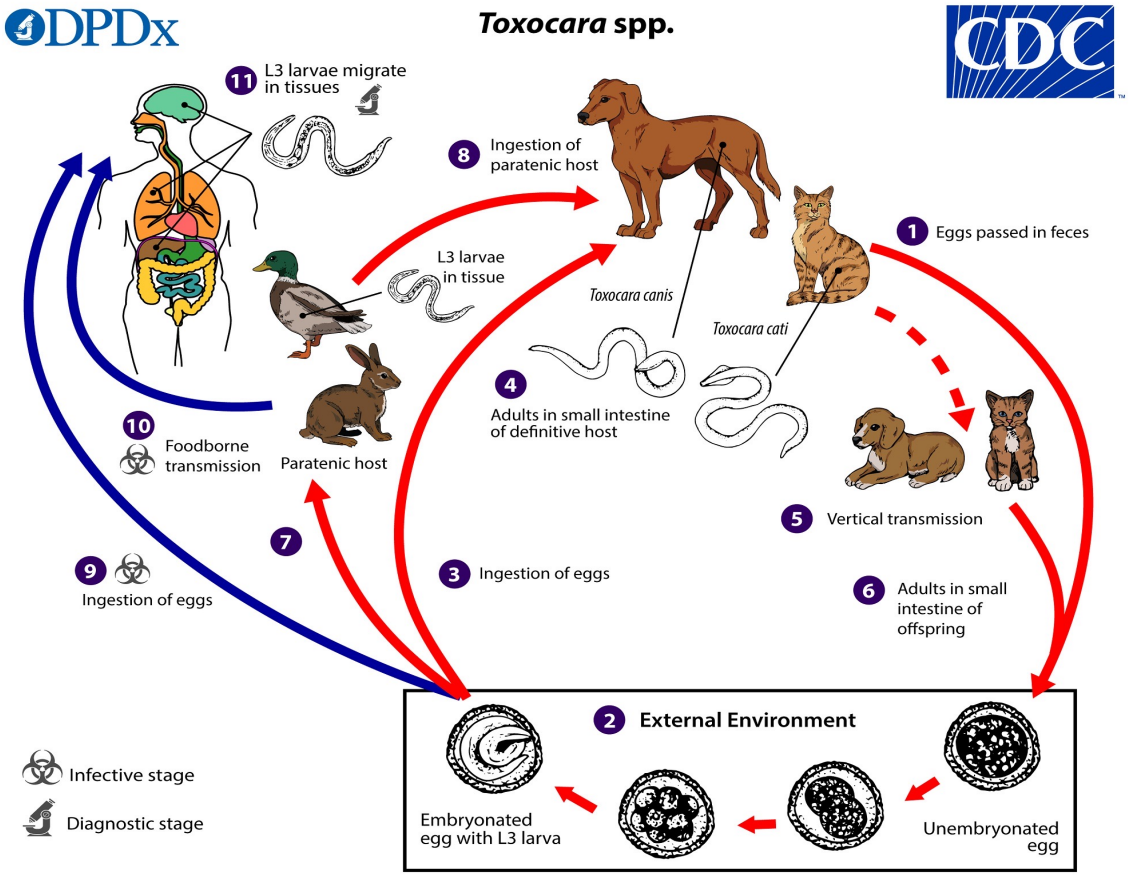
**Question 1:** To establish a risk profile for *Toxocara* spp in wild boar meat.

**Question 2:** To evaluate the effectiveness of carcass sanitation treatments—specifically freezing and cooking—on the viability of *Toxocara* spp, particularly when these treatments are performed either by food-handling establishments or directly by consumers.

# Parasite Description

*Toxocara* spp. :

- ✓ Nematode, Ascarididae family
- ✓ Definitive Host: dogs (*T. canis*) and cats (*T. cati*)
- ✓ Paratenic Hosts : broad host range including wild boars and human

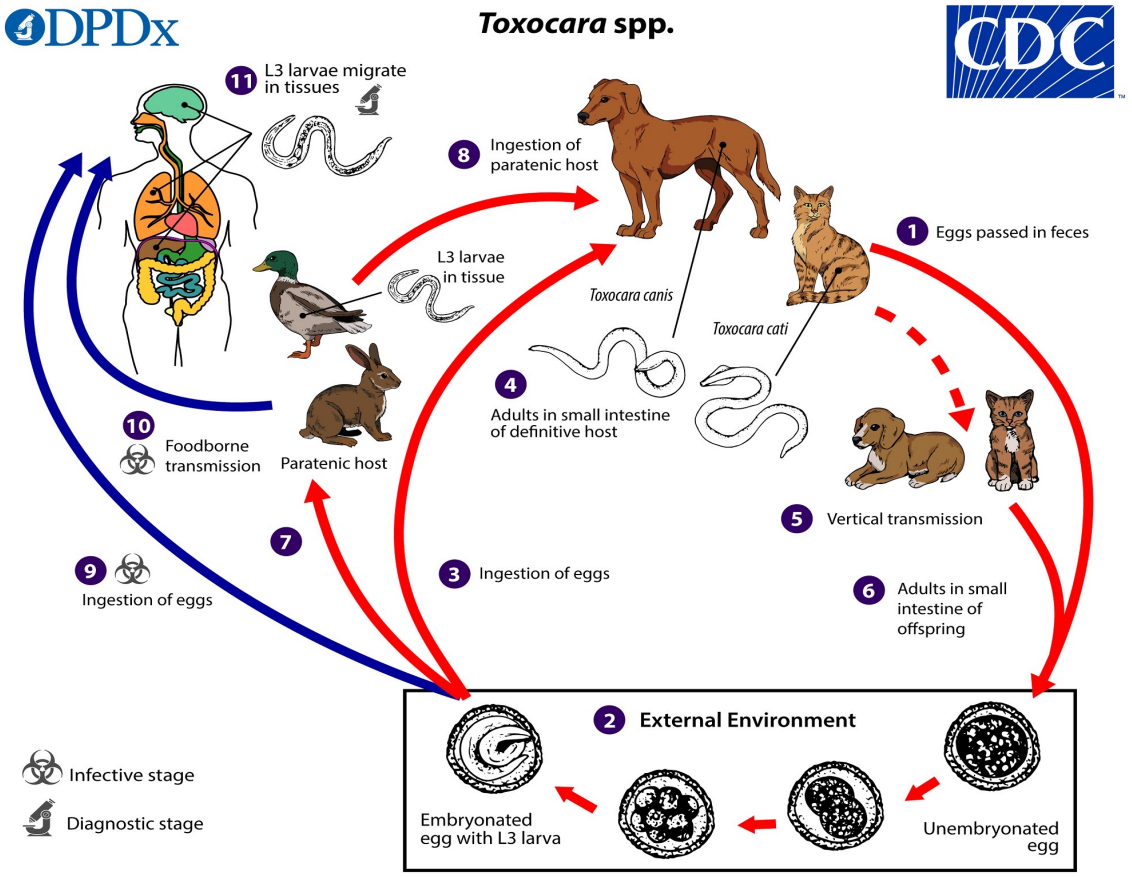


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**Zoonotic parasite**



# Toxocariasis & seroprevalence

**Toxocariasis** is generally **benign** and asymptomatic

Clinical forms of human toxocariasis :

- **Visceral Larva Migrans (VLM)**: Symptoms in various organs, especially in young children.
- **Ocular Larva Migrans (OLM)**: Eye infections leading to visual impairment.
- **Neurological and Covert Toxocariasis**: Severe and common forms, detailing symptoms like headaches, abdominal pain, and behavioral changes.

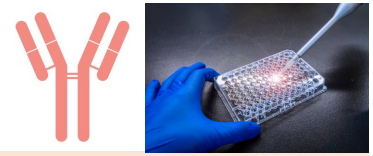
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**Antibodies** that result can persist for several years



A meta-analysis showed that **seroprevalence** is **6.2%** in Europe (Strube et al. 2020)

In France, health insurance data indicate that around 15,000 screening tests for anti-*Toxocara* antibodies and **3,000 confirmation tests in 2014-2015** (HAS 2017).

No possibility to estimate the number of cases of toxocariasis (clinical forms)

# Transmission routes of *Toxocara* spp

## *Toxocara* is a Foodborne Parasite

Transmission Routes via food

- Consumption of Embryonated Eggs: Found particularly on fresh produces eaten raw or undercooked.
- Consumption of Larva migrans: Present in the tissues of paratenic hosts such as muscles and viscera, consumed raw or undercooked.

Key Studies and Reports

- FAO and WHO (2014): Identified fresh produce as a significant vector for Toxocara transmission.
- Healy et al. (2022): Systematic analysis indicating the **majority of human cases linked to the consumption of mammalian meat** and gastropods.

**Table 1.** Reported food-borne human toxocariasis cases in the literature

| Country | Food type | No. of patients | Patient age/s (years) | Clinical presentation | Year | Reference |
|---|---|---|---|---|---|---|
| | *Meat products* | | | | | |
| Turkey | Unspecified raw meat | 1 | 36 | Unilateral neuroretinitis | 2016 | Karaca *et al.* (2018) |
| Japan | Chicken meat and bovine liver | 1 | 60 | Myelitis | 2015 | Hiramatsu *et al.* (2017) |
| Korea | Meat, liver, blood | 5 | 30–60 | Optic neuropathy | 2014 | Yang *et al.* (2014) |
| Korea | Bovine liver | 1 | 46 | Optic disc cyst | 2013 | Kim *et al.* (2013) |
| Korea | Cow meat, omasum, liver | 1 | 51 | OLM and VLM | 2012 | Park *et al.* (2012) |
| Korea | Bovine liver | 1 | 35 | Lung and liver abscesses, urticaria | 2010 | Kim *et al.* (2010) |
| Chile | Goat meat | 1 | 51 | Neurotoxocariasis and hepatopathy | 2010 | Finsterer *et al.* (2010) |
| Korea | Ostrich liver | 1 | 17 | Meningitis, lung and liver pathology | 2010 | Noh *et al.* (2012) |
| Japan | Deer meat | 1 | 19 | Myocarditis | 2009 | Enko *et al.* (2009) |

# Transmission routes of *Toxocara* spp

**Other transmission routes of *Toxocara* spp.**

- Untreated Water : exposure to untreated water is a significant risk for toxocariasis (Magnaval et al. 1994).
- Soil contamination by hosts (dogs>cats>foxes) (Bowman et al 2021)

Risk factors identified: Farmers/Veterinarians/Slaughterhouse Staff/Hunters

Conclusion on evaluation of toxocariasis incidence in France :

> **It is not currently possible to estimate the incidence of toxocariasis in France. Although epidemiological studies have identified certain risk factors, the relative contributions of the various routes of human exposure to *Toxocara* spp. have not been quantified.**



# *Toxocara* spp in wild boar meat



**Pigs are identified as paratenic hosts for *Toxocara* spp. harboring Larva migrans (Strube et al. 2013).**

**Tissue distribution with experimental studies:**

- Helwigh et al.(1999): **High initial larvae count in mesenteric lymph nodes and lungs**, with a **significant reduction over 28 days**.
- Sommerfelt et al. (2004): Similar initial findings with **no larvae observed in key organs 126 days post-infestation**.
- Cardillo et al. (2014): experimental infection in piglets with *T. cati* eggs. **Large numbers of larvae found in lungs and lymph nodes up to 14 days post-infection, with decreased levels thereafter**.

**Experimental studies show that the meat may contain live larvae of *Toxocara* spp. but inconsistently and always in low concentrations**

# Effects of control measures

## Freezing



- After 12 h at -25°C, larvae showed reduced mobility; no mobile larvae observed after 24 hours (Taira et al. 2012).
- Complete inactivation of T. canis after 10 days at -20°C (Dutra et al. 2013).

**General freezing recommendations:** some values are proposed for other parasites. *Toxocara* larvae are *a priori* not more resistant than *Trichinella spiralis.*

## Cooking

**Microwave Inactivation**: *T. canis* larvae completely inactivated in mouse livers at temperatures above 70°C (Cetinkaya, Gargili, and Altaş 2006).

**General cooking recommendations**: Ensuring an internal temperature of 60-75°C for 15-30 minutes effectively inactivates all parasites (Franssen et al., 2019).



## Salting



**Impact on *Toxocara***: Not specifically mentioned in literature.

**General effectiveness**: Parasites are sensitive to 2-5% NaCl; reaching a 2% NaCl threshold in dry-cured hams can take up to 40 days (Harkouss et al. 2018).

# Conclusion

**To the Question 1:** To establish a risk profile for *Toxocara* spp in wild boar meat.

- Risk assessment is not feasible.
- Toxocara spp. infects a wide range of animals, including domestic, companion, and wild species, serving as definitive or paratenic hosts.
- The pathogen is spread through various transmission routes, with long-lived larvae in hosts and eggs that are resistant to environmental conditions.
- Toxocariasis risk from consumption of wild boar meat is not considered the primary route of exposure.

**A global approach to assessing the risk of toxocariasis is recommended, considering all potential transmission routes.**

# Conclusion

**To the Question 2:** To evaluate the effectiveness of carcass sanitation treatments—specifically freezing and cooking—on the viability of *Toxocara* spp, particularly when these treatments are performed either by food-handling establishments or directly by consumers.

- Compared with other parasites (in particular *Trichinella* spp. and *Toxoplasma gondii*), *Toxocara* spp. does not appear to have significant intrinsic resistance to treatments aimed at eliminating parasites from wild boar meat.

- The following practices are a priori effective in eliminating Toxocara spp. larvae present in this meat:
  - cooking : target **60-75°C for 15-30 minutes**;
  - freezing : **at least 106 hours at -17.8°C** or equivalent combinations (Noeckler et al. 2019);
  - Salting process guaranteeing a salt concentration of **at least 2% at any point**. Only control under industrial conditions can guarantee that this target is reached. Curing in a **domestic setting does not ensure that this value is achieved**.

# Recommandations

**To game processing facilities:**

- ✓ Write a **Guide to Good Hygiene Practices** including animal management at sampling sites, cold chain management

**To hunters:**

- ✓ Inform them of the **potential presence of Toxocara** in wild boars;
- ✓ **Strengthen hunter's training** by providing them knowledge related to managing relevant biological hazards

**To wild game consumers:**

- ✓ Adopt best pratices for food preparation, storage and recipe preparation (cooking well done)

➡ Helpful to avoid contamination with foodborne pathogens in game meat

# Recommandations

**For research:**

- ✓ **Determine the effectiveness of various freezing methods** in inactivating the parasite
- ✓ Provide **better characterization of human epidemiological data** on toxocariasis
- ✓ Collect data on **Toxocara prevalence from the various sources** (soil, pets, wild life, livestock, recreational waters, vegetable, …)

➡ Helpful for future risk assessment studies related to *Toxocara* spp

# What was unique about the laboratory that regularly identified *Toxocara* larvae?

**Not part of the opinion**



EU 2015/1375

Method: ISO18743

Microscope magnitude x10, x20



Microscope magnitude **x40**



Lenght around 400um



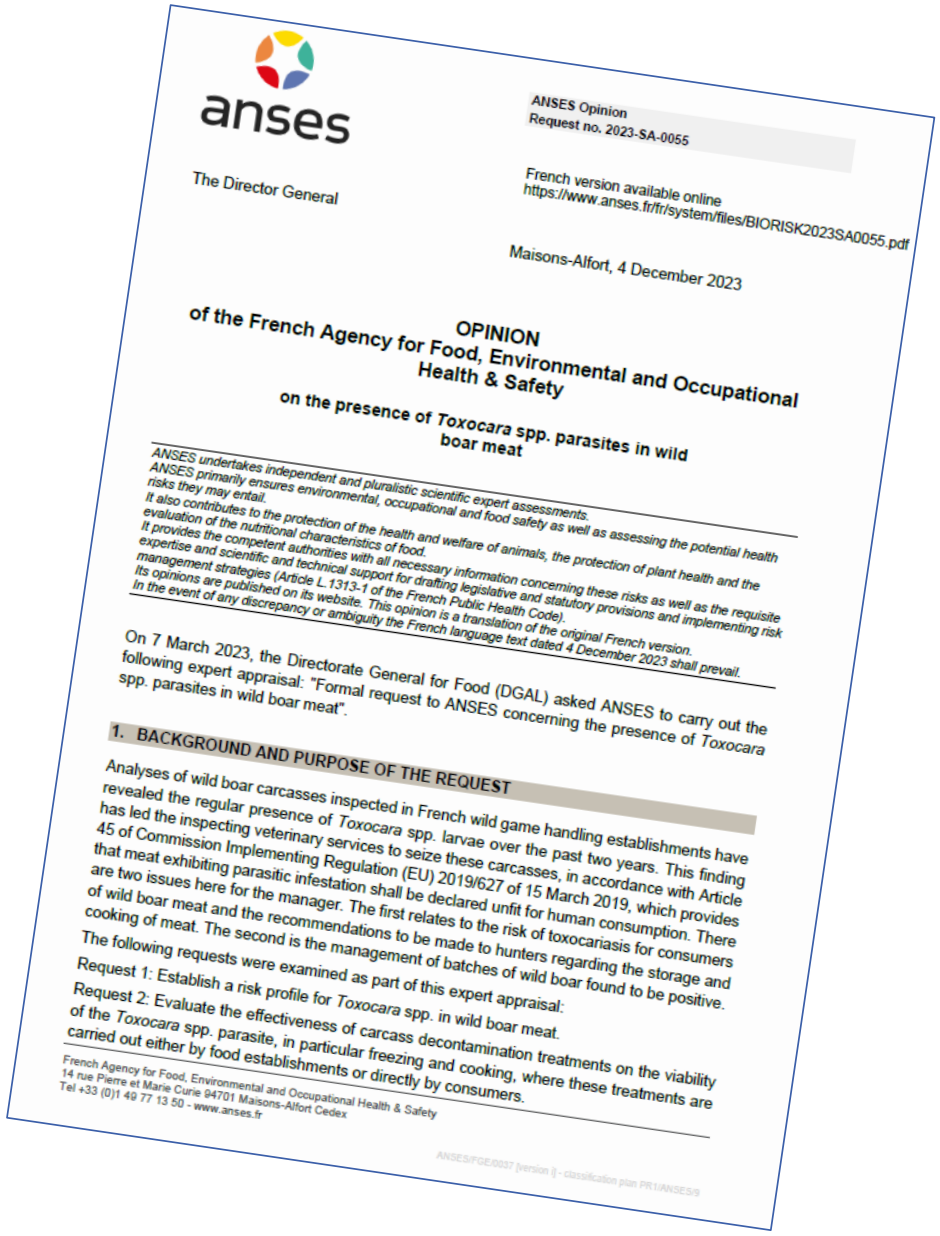
- ISO 18743 : not suitable for *Toxocara* larvae detection
  - Could lead to many false negatives (due to *larva migrans*)
- Routine labs need to respect strictly ISO 18743 for *Trichinella* detection
- To date, no reliable technique for *Toxocara* larvae detection in meat

# Acknowledgments

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**ANSES CES BIORISK experts:** Philippe Fravalo, Frédéric Auvray, Mickaël Boni, Frédéric Borges, Gilles Bornert, Catherine Chubilleau, Monika Coton, Noémie Desriac, Florence Dubois-Brissonnet, Michel Gautier, Michèle Gourmelon, Sandrine Guillou, Stéphane Guyot, Didier Hilaire, Nathalie Jourdan-Da Silva, Claire Le Henaff-Le Marrec, Sandra Martin-Latil, Jeanne-Marie Membré, Eric Oswald, Nadia Oulahal, Pascal Piveteau, Sabine Schorr-Galindo, Régine Talon

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anses

ANSES Opinion
Request no. 2023-SA-0055

The Director General

French version available online
https://www.anses.fr/fr/system/files/BIORISK2023SA0055.pdf

Maisons-Alfort, 4 December 2023

**OPINION**
**of the French Agency for Food, Environmental and Occupational Health & Safety**

**on the presence of *Toxocara* spp. parasites in wild boar meat**

ANSES undertakes independent and pluralistic scientific expert assessments.
ANSES primarily ensures environmental, occupational and food safety as well as assessing the potential health risks they may entail.
It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.
It provides the competent authorities with all necessary information concerning these risks as well as the requisite expertise and scientific and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).
Its opinions are published on its website. This opinion is a translation of the original French version.
In the event of any discrepancy or ambiguity the French language text dated 4 December 2023 shall prevail.

On 7 March 2023, the Directorate General for Food (DGAL) asked ANSES to carry out the following expert appraisal: "Formal request to ANSES concerning the presence of *Toxocara* spp. parasites in wild boar meat".

**1. BACKGROUND AND PURPOSE OF THE REQUEST**

Analyses of wild boar carcasses inspected in French wild game handling establishments have revealed the regular presence of *Toxocara* spp. larvae over the past two years. This finding has led the inspecting veterinary services to seize these carcasses, in accordance with Article 45 of Commission Implementing Regulation (EU) 2019/627 of 15 March 2019, which provides that meat exhibiting parasitic infestation shall be declared unfit for human consumption. There are two issues here for the manager. The first relates to the risk of toxocariasis for consumers of wild boar meat and the recommendations to be made to hunters regarding the storage and cooking of meat. The second is the management of batches of wild boar found to be positive.

The following requests were examined as part of this expert appraisal:

Request 1: Establish a risk profile for *Toxocara* spp. in wild boar meat.

Request 2: Evaluate the effectiveness of carcass decontamination treatments on the viability of the *Toxocara* spp. parasite, in particular freezing and cooking, where these treatments are carried out either by food establishments or directly by consumers.

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ANSES/FGE/0037 [version 1] - classification plan PR1/ANSES/9