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SCIENTIFIC REPORT OF EFSA

Technical specifications on harmonised epidemiological indicators for biological hazards to be covered by meat inspection of domestic solipeds[1]

European Food Safety Authority[2,3]

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ABSTRACT

In this report, harmonised epidemiological indicators are proposed for food-borne biological hazards to public health that are related to domestic solipeds and meat thereof and that can be addressed within meat inspection. These hazards include only *Trichinella*. An epidemiological indicator is defined as the prevalence or concentration of the hazard at a certain stage of the food chain or an indirect measure of the hazard that correlates with the human health risk caused by the hazard. The indicators can be used by the European Commission and the Member States to consider when adaptations to meat inspection methods may be relevant and to carry out risk analysis to support such decisions. It is foreseen that the indicators are used in a risk-based system for domestic soliped meat as proposed in the EFSA Scientific Opinion on the public health hazards to be covered by inspection of meat from domestic solipeds, particularly to help categorise countries/regions and animals according to the risk related to *Trichinella*. Depending on the purpose and the epidemiological situation, risk managers should decide on the most appropriate indicator(s) to use, either alone or in combination, at national, regional or slaughterhouse level. It is recommended that risk managers should define legal requirements for improving traceability of horses, recording information on all animal movements. Member States are invited to report data generated by the implementation of the indicators in accordance with Directive 2003/99/EC. The proposed indicators should be regularly reviewed in the light of new information and the data generated by their implementation.

KEY WORDS

Meat inspection, biological hazard, epidemiological indicators, domestic solipeds, *Trichinella*

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SUMMARY

The European Commission has requested that the European Food Safety Authority provides technical assistance on harmonised epidemiological criteria (harmonised epidemiological indicators) for specific public health hazards in food and animals to be used by risk managers when they consider that the current methods of meat inspection do not adequately address the relevant risks. It is related to the mandate from the Commission for a Scientific Opinion on the public health hazards to be covered by inspection of meat. The present report and the related Opinion under this mandate concern the meat inspection of domestic solipeds.

In this report, harmonised epidemiological indicators are proposed for food-borne biological hazards to public health that are related to domestic solipeds and meat thereof and that can be addressed within meat inspection and that have been indicated as relevant by the ranking methodology applied in the Scientific Opinion of the EFSA's Panel on Biological Hazards. These hazards include only *Trichinella*. An epidemiological indicator is understood to mean the prevalence or concentration of the hazard at a certain stage of the food chain or an indirect measure of the hazard (such as audit or evaluation of process hygiene) that correlates with the human health risk caused by the hazard. The epidemiological indicators can be used by the European Commission and the Member States to consider when adaptations to meat inspection methods may be relevant, and to enable the Member States to carry out risk analysis to support any such decisions. It is foreseen that the epidemiological indicators could be used to categorise countries/regions or animals according to the risks related to particular hazards.

Risk managers should decide on the most appropriate use of the epidemiological indicators at the European Union and national levels. Depending on the purpose and the epidemiological situation of the country, the indicators may be applied at national, regional, or slaughterhouse level. The indicators can be used alone or in combination. They may be applied to classify countries, regions or animals according to the infection status related to the hazards. The accumulated historical data from implementation of the epidemiological indicators will be particularly useful for the categorisation of countries and regions.

All epidemiological indicators are proposed for domestic soliped populations at the slaughterhouse level. One indicator includes the provision of food chain information with respect to the country or region of origin of the animals.

Comparable data from the European Union Member States are available for *Trichinella* prevalence at the animal level.

For each epidemiological indicator addressed, the key elements of minimum monitoring or inspection requirements are defined. These include the animal population to be targeted, the stage of the food chain at which the sampling should take place, sampling strategy, type and details of the specimen to be taken, diagnostic or analytical method to be used, and a case definition.

It is recommended that the European Commission and the Member States define legal requirements for improving traceability of horses, recording information on all animal movements.

The implementation of the proposed epidemiological indicators will generate additional data that will provide a more precise picture of the epidemiological situation in the European Union and these data may be used to update the indicators, when appropriate. It is recommended that the Member States report the data generated from the implementation of these indicators in accordance with the framework prescribed in Directive 2003/99/EC. The proposed indicators should be reviewed regularly in the light of new information and the data generated by their implementation.

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BACKGROUND AS PROVIDED BY THE COMMISSION

Requests for technical assistance defining harmonised human health epidemiological criteria to carry out risk analysis within the scope of meat inspection

During their meeting on 6 November 2008, Chief Veterinary Officers (CVO) of the Member States agreed on conclusions on modernisation of sanitary inspection in slaughterhouses based on the recommendations issued during a seminar organised by the French Presidency from 7 to 11 July 2008. Inter alia, it was concluded that "*EFSA and the European Centre for Disease Prevention and Control (ECDC) should define animal and human health epidemiological criteria required for the Member States to carry out their own risk analysis to be able, if appropriate, to adapt the general inspection methods within the framework provided by the legislation*". The CVO conclusions have been considered in the Commission Report on the experience gained from the application of the Hygiene Regulations, adopted on 28 July 2009. Council Conclusions on the Commission report were adopted on 20 November 2009 inviting the Commission to prepare concrete proposals allowing the effective implementation of modernised sanitary inspection in slaughterhouses while making full use of the principle of the 'risk-based approach'.

In accordance with Article 9(2) of Directive 2003/99/EC[4] of the European Parliament and of the Council of 17 November 2003 on the monitoring of zoonoses and zoonotic agents, amending Council Decision 90/424/EC and repealing Council Directive 92/117/EEC, EFSA shall examine and publish a summary report on the trends and sources of zoonoses, zoonotic agents and microbiological resistance in the European Union based on reports transmitted by the Member States. In addition, EFSA has prepared several scientific reports on (harmonised) monitoring of food-borne infections. Prevalence data from the zoonoses monitoring are considered as relevant epidemiological criteria to carry out a risk analysis, however, such data may be limited in certain Member States or not sufficiently harmonised to compare the situation between Member States. It is, therefore, appropriate to lay down harmonised human health epidemiological criteria and their minimum requirements. Such criteria should provide a tool to be used by risk managers in case they consider the current methods for meat inspection disproportionate to the risk.

In accordance with Article 20 of Regulation (EC) No 854/2004 of the European Parliament and of the Council laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption,[5] the Commission shall consult EFSA on certain matters falling within the scope of the Regulation whenever necessary.

[4] Directive 2003/99/EC of the European Parliament and of the Council of 17 November 2003 on the monitoring of zoonoses and zoonotic agents, amending Council Decision 90/424/EEC and repealing Council Directive 92/117/EEC. OJ L 325, 12.12.2003, p. 31–40.

[5] Regulation (EC) No 854/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption. OJ L 139, 30.4.2004, p. 206–320.

TERMS OF REFERENCE AS PROVIDED BY THE COMMISSION

The scope of this mandate is to request technical assistance on harmonised epidemiological criteria for specific public health hazards in food and animals to be used by risk managers in case they consider the current methods for meat inspection address the relevant risk not adequate.

Where possible, such epidemiological criteria should be based on monitoring activities already laid down in European Union provisions, in particular in Regulation (EC) No 882/2004,[6] Regulation (EC) No 2160/2003,[7] Regulation (EC) No 852/2004,[8] Regulation (EC) No 853/2004,[9] Regulation (EC) No 854/2004 and their implementing acts.

The following species or groups of species should be considered, taking into account the following order of priority identified in consultation of the Member States: domestic swine, poultry, bovine animals over six weeks old, bovine animals under six weeks old, domestic sheep and goats, farmed game and domestic solipeds.

In particular, EFSA is requested within the scope described above to:

1. Define harmonised epidemiological criteria for specific hazards already covered by current meat inspection (trichinellosis, tuberculosis, cysticercosis, …) and for possible additional hazards identified in a scientific opinion on the hazards to be covered by inspection of meat, which can be used to consider adaptations of meat inspection methodology (e.g. prevalence, status of infection).
2. Provide a summary of comparable data from Member States based on the above defined harmonised epidemiological criteria, if existing, e.g. from ongoing monitoring in humans, food or animals.
3. Recommend methodologies and minimum monitoring/inspection requirements to provide comparable data on such harmonised epidemiological criteria, in particular if comparable data are missing. These criteria should also be achievable in small Member States.

[6] Regulation (EC) No 882/2004 of the European Parliament and of the Council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules. OJ L 165, 30.4.2004, p. 1–141.

[7] Regulation (EC) No 2160/2003 of the European Parliament and of the Council of 17 November 2003 on the control of salmonella and other specified food-borne zoonotic agents. OJ L 325, 12.12.2003, p. 1–15.

[8] Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs. OJ L 139, 30.4.0224, p. 1–54.

[9] Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for on the hygiene of foodstuffs. OJ L 139, 30.4.0224, p. 55–205.

TECHNICAL SPECIFICATIONS

1. Introduction

There are a number of food-borne diseases affecting humans that can be potentially related to consumption of meat from domestic solipeds and traced back to live solipeds. These hazards include parasites, bacteria and viruses. Horse meat was identified as source of human trichinellosis in more than 3 000 people in France and Italy in the period 1975–2005 (Liciardi et al., 2009). This food has also been suspected as the vehicle in human diseases caused by *Salmonella* and *Toxoplasma* (Weill et al., 2004; Elbez-Rubinstein et al., 2009; Pomares et al., 2011; Jourdan-Da Silva and Le Hello, 2012).

Meat inspection offers an opportunity to control some of these food-borne hazards, and in fact *Trichinella* is directly targeted through the current meat inspection procedures for solipeds (Regulation (EC) No 854/2004). However, most of the other biological hazards related to domestic solipeds and related meat are not specifically addressed by the meat inspection system in place in the European Union (EU).

It is possible to use the data on the prevalence and concentration of the biological hazards in animals, meat and humans as one aspect of the criteria when determining and ranking the human health importance of the hazards to be covered by meat inspection. These epidemiological indicators may be used by the risk managers when considering adaptations of current meat inspection methods for domestic solipeds.

In the case of domestic solipeds, data on the occurrence of zoonotic agents in animals and meat thereof are available from Member States (MSs) within the framework of the annual reporting in accordance with Directive 2003/99/EC on the monitoring of zoonoses. Harmonised EU statutory monitoring is in place in the EU MSs (i.e. *Trichinella*). Data on the incidence of food-borne diseases in humans are collected by the European Centre for Disease Prevention and Control (ECDC) based on Decision 2119/98/EC[10] on setting up a network for the epidemiological surveillance and control of communicable diseases in the EU.

The Scientific Opinion of the EFSA Panel on Biological Hazards (BIOHAZ) (later referred to as the 'EFSA BIOHAZ Scientific Opinion' or 'Scientific Opinion') on the public health hazards to be covered by inspection of meat from solipeds (EFSA BIOHAZ Panel, 2013) concluded that, in a risk-based system, carcases from domestic solipeds could be separated and undergo different inspection procedures according to the risk for *Trichinella*. It is foreseen that the harmonised epidemiological indicators (HEIs) will be used as part of this system. Therefore, this report should be read in parallel with that Scientific Opinion.

As the EU regulations do not include different inspection requirements for the different soliped species, and because only limited or no data are available for 'minor' species, all soliped species are considered together in this report. The general description of risk factors, available data and epidemiological indicators focuses on the main species (horses, donkeys), but any important differences concerning other species (mules and hinnies) were considered when necessary.

2. Soliped industry in the EU

Horses can be employed in leisure or sport activities, utilised in the agricultural industry or reared specifically for meat production. These different utilisations explain the diversities in the organisation and structure of the horse industry between countries in the EU. This becomes evident when discussing the use of solipeds as a source of food for humans.

[10] Decision No 2119/98/EC of the European Parliament and of the Council of 24 September 1998 setting up a network for the epidemiological surveillance and control od communicable diseases in the community. OJ L 268, 03.10.1998, p. 1–7.

Holdings rearing solipeds for meat production are often small/medium-size holdings, sometimes farming more species on the same premises. Production is generally concentrated in some regions within some countries. In Europe, Poland and France are by tradition involved in rearing horses for the production of meat, while Italy and Spain are specialised in the fattening of foals (EFSA, 2012).

Horses are slaughtered both in the country where they are reared and in other EU MSs, whereas they are not usually imported for slaughter from non-EU countries. The age of animals slaughtered is variable, from 1 to 30 years (EFSA, 2012). Based on the last available data provided by MSs within the framework of Directive 96/23/EC,[11] the countries which slaughter the majority of equidae for meat consumption in the EU are Italy, Poland, Spain, Romania and France (EFSA, 2013) (Appendix A).

Horse meat is eaten in many EU countries, although there is a clear cultural difference in using horse for meat consumption between and even within the countries (e.g. in Italy, horse meat is consumed mainly in three regions). Great Britain and Ireland have no market for horse meat according to statistics. Italy, on the other hand, is the leading horse meat consumer within the EU, where the yearly consumption is about one kilogram per capita, followed by the Netherlands, Luxembourg, France and Belgium (Appendix B). Additional data on soliped meat consumption have been included in the EFSA BIOHAZ Scientific Opinion (EFSA BIOHAZ Panel, 2013), as derived from consumer surveys carried out in some EU MSs (source: EFSA Consumption Database).

Horse meat is usually consumed as cooked fresh cuts, and in some areas is also consumed as raw minced meat. A small proportion of the meat reaches consumers in the form of meat preparations and cured meat. Offal from horses is usually not consumed (EFSA, 2012).

3. Legislation for solipeds

3.1. Identification of solipeds

According to Regulation (EC) No 504/2008,[12] from 2009 all equidae in the EU are required to be identified by means of a single lifetime identification document (also called a 'passport') unequivocally linked to the animal. Such an identification document, issued by relevant national bodies for both solipeds born in the EU and imported animals, shall in principle accompany the animals during all movements, with some derogations. In particular, the passport shall accompany all solipeds when they are transported to the slaughterhouse. An exception to this provision is allowed for solipeds less than 12 months old when they are sent directly from the holding of birth to the slaughterhouse within the same MS and provided that some additional conditions are ensured, such as an uninterrupted traceability from the holding of birth to the slaughterhouse and an individual identification during the transport, which should be specified in the food chain information (FCI) (in accordance with Section III of Annex II to Regulation (EC) No 853/2004).

Information to be included in the passport mainly relates to the origin and identification of the horse, and its health status, including vaccinations and laboratory health tests performed. In addition, information related to certain medical treatments which require a withdrawal period before the animal is submitted to slaughter have to be reported in the passport for all animals that may be intended for slaughter for human consumption. Those treatments do not need to be reported in cases where the owner/keeper of the animal irreversibly decides that the animal is not intended for slaughter. In this case the decision has to be clearly reported in the passport and the animal would never be allowed to enter the food chain. However, no specific requirements for the full traceability of animal movements are foreseen.

[11] Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directives 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC. OJ L 125, 23.5.1996, p. 10-32.

[12] Commission Regulation (EC) No 504/2008 of 6 June 2008 implementing Council Directives 90/426/EEC and 90/427/EEC as regards methods for the identification of equidae. OJ L 149, 7.6.2008, p. 3-32.

3.2. Meat inspection control

According to Commission Regulation (EC) No 2075/2005,[13] carcases of horses, as well as carcases of other *Trichinella*-susceptible animals intended for human consumption, are systematically sampled at slaughter as part of meat inspection and tested for *Trichinella*. Animals (both domestic and wild) slaughtered for own consumption are outside the scope of Commission Regulation (EC) No 2075/2005, but subject to national rules.

4. Definitions

For the purpose of this report, the following definitions will apply:

Audit: a systematic and independent examination to determine whether arrangements, activities and related results comply with the requirements set for controlled husbandry conditions, transport, lairage and slaughter methods and whether these arrangements and activities are implemented effectively and are suitable to achieve the desired objectives.

Carcase: the body of an animal after slaughter and dressing (Regulation (EC) No 853/2004).

Controlled husbandry conditions: a type of husbandry where animals are kept at all times and for their whole life under conditions controlled by the food business operator with regard to feeding and biosecurity of the holding.

Domestic solipeds: for the purpose of this document 'domestic solipeds' are animals belonging to the species *Equus caballus* (horses), *Equus asinus* (donkeys) and their cross-breeds (i.e. mules and hinnies).

Donkey: domestic animal of the species *Equus asinus*.

Equidae: wild or domesticated soliped mammals of all species within the genus *Equus* of the family *Equidae*, and their crosses (Regulation (EC) No 504/2008).

Farm: place where solipeds sent to slaughter are raised and/or kept during their lifetime, including units where solipeds are raised for meat production as well as units where solipeds are kept for other purposes (e.g. leisure activities). In the context of this report, the concept of farm covers all the different places where horses are kept during their lifetime, even when there are only few animals (one or two).

Food chain information: detailed information on the origin, history and management of animals intended for food production.

Harmonised epidemiological indicator (HEI): prevalence or concentration of the hazard at a certain stage of food chain or an indirect indicator of the hazards (such as audits of farms or evaluation of process hygiene) that correlates with the human health risk caused by the hazard.

Hinny: domestic equine hybrid that is the offspring of a female donkey and a male horse, typically sterile.

[13] Commission Regulation (EC) No 2075/2005 of 5 December 2005 laying down specific rules on official controls for *Trichinella* in meat. OJ L 338, 22.12.2005, p. 60–82.

Holding: an agricultural or training establishment, a stable or, generally speaking, any premises or facilities in which equidae are habitually kept or bred, for whatever use (Council Directive 90/426/EEC).[14]

Horse: domestic animal of the species *Equus caballus*.

Meat from solipeds: edible parts of the animal species mentioned above, including blood (Regulation (EC) No 853/2004).

Mule: domestic equine hybrid that the offspring of a male donkey and a female horse, typically sterile.

Risk factor: a variable associated with an increased risk of disease or infection.

Slaughterhouse: establishment used for slaughtering and dressing animals, the meat of which is intended for human consumption (Regulation (EC) No 853/2004). The establishment has to be approved by the competent authorities in accordance with Article 4 of Regulation (EC) No 853/2004 and Article 3 of Regulation (EC) No 854/2004.

5. Approach applied to select the epidemiological indicators

5.1. Harmonised epidemiological indicators

In this report, the term 'epidemiological indicator' is used instead of 'epidemiological criterion' for the sake of clarity. An HEI is, in this context, understood to mean the prevalence or concentration of the hazard at a certain stage of the food chain that correlates with a human health risk caused by the hazard. Indirect indicators of the hazards, such as audit of farms or evaluation of process hygiene, are also covered.

The purpose of the HEIs proposed in this report is to enable the European Commission (EC) and the MSs to consider whether adaptations to meat inspection methods may be made at the MS level and to enable the MSs to carry out a risk analysis (or components thereof) to support decisions on any such adaptations to meat inspection methods. The hazards addressed in this report were those identified in the complementary EFSA BIOHAZ Scientific Opinion (EFSA BIOHAZ Panel, 2013) as the most relevant in the context of meat inspection of domestic solipeds. The epidemiological indicators provide information to be used in a risk-based system as suggested in the Scientific Opinion. This applies particularly in the process of classification of the countries, regions and animals according to risk related to a particular hazard as well as the setting of related targets. The indicators, either alone or in combination, may be used by risk managers at the national, regional or slaughterhouse level depending on the purpose.

The principles applied in the identification of the appropriate indicators in this report are as follows:

- For each biological hazard, the prevalence of the agent at key points in the food chain, broken down by risk factors that may be used for risk-based sampling (e.g. type of production system, age of animals), is considered. The key points are those at which risk is first created, primarily on farm, but also possibly points at which the hazard can enter the food chain (e.g. during transport and slaughter) and where the hazard reservoir occurs.
- The key epidemiological indicator for a given hazard will almost always be the prevalence of the hazard in the animal population or in the food.
- The identification of a range of risk factors is not, in itself, adequate. The estimation of the impact of these risk factors on public health is required in order to consider the need to amend

[14] Council Directive 90/426/EEC of 26 June 1990 on animal health conditions governing the movement and import from third countries of equidae. OJ L 224, 18.8.1990, p. 42–54.

the meat inspection methods. This is most easily measured by estimating the prevalence of the agent in the populations subject to different levels of exposure to the risk factor.

In this report the following approach is applied to select the HEIs (the first Terms of Reference (ToR)):

- The hazard and, when appropriate, its life cycle is described. The current epidemiological situation within the EU, as regards to both animals and humans, is evaluated and the role of domestic solipeds as the source of human infections is discussed for each hazard.
- For each hazard, the main food chain related to domestic solipeds and the risk and risk-reducing factors along the chain, as well as the meat inspection and other risk mitigation strategies, are presented. This description includes an identification of possible epidemiological indicators.
- The possible epidemiological indicators are evaluated against selected criteria (i.e. their quality, appropriateness, data availability and feasibility) using a scoring system. The epidemiological indicators that received the highest scores are selected.

Following the selection of the HEI, the available data from the annual reporting in accordance with Directive 2003/99/EC were reviewed for comparable data from the MSs. These comparable data are presented in chapter 7 (the second ToR).

In the cases where no comparable data are available, harmonised monitoring requirements are proposed for each selected epidemiological indicator (the third ToR). These include the definition of the animal population to be targeted, the stage of the food chain where the sampling should take place, the type and details of the specimen to be taken, the diagnostic or analytical method to be used and a case definition. A general description of how to choose the sampling strategy for each case has been presented in the EFSA's scientific report on HEIs for swine meat inspection (EFSA, 2011).

5.2. The biological hazards addressed

The first ToR of the mandate for technical assistance from the EC asks for HEIs to be defined for specific hazards already covered by current meat inspection (such as trichinellosis, tuberculosis, cysticercosis, etc.). In the case of meat inspection of domestic solipeds, these hazards include only *Trichinella* (Regulation (EC) 2075/2005).

In addition, according to the first ToR, the epidemiological indicators for possible additional hazards identified in a Scientific Opinion on the hazards to be covered by inspection of meat from solipeds (EFSA BIOHAZ Panel, 2013), which can be used to consider adaptations to meat inspection methodology, should be addressed as well. The EFSA BIOHAZ Scientific Opinion identifies only *Trichinella* as such hazard. No additional hazards were considered of relevance for these animal species.

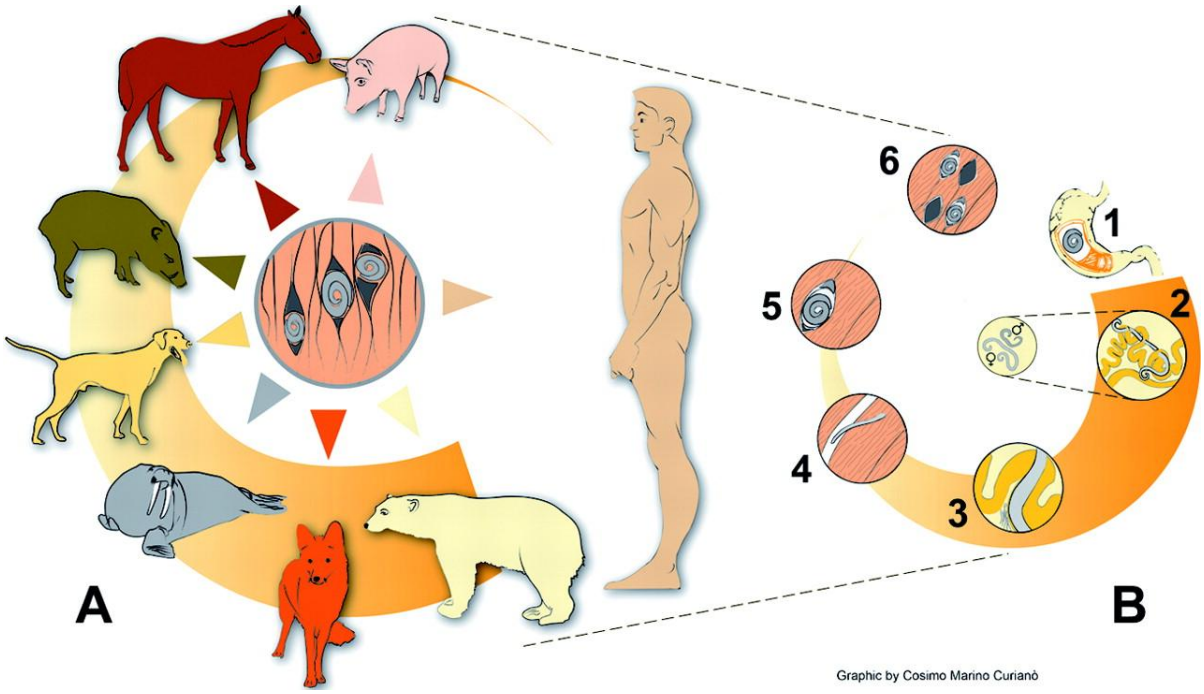
6. Epidemiological indicators for the biological hazards

6.1. *Trichinella*

6.1.1. Biology and epidemiology

Trichinellosis (also known as trichinosis) is caused in humans by nematodes (round worms) of the genus *Trichinella.* In addition to the classical agent, *Trichinella spiralis* (*T. spiralis*), three other species of *Trichinella* circulate in Europe. *T. spiralis* is distributed in temperate regions worldwide and is commonly associated with domestic pigs. It is highly infective for domestic and sylvatic swine, mice and rats, but it can also be detected in other mammalian carnivores (e.g. raccoon dogs) and horses. This species has been detected in 17 EU MSs. *T. nativa* occurs in mammalian carnivores of the Arctic and sub-Arctic regions of North America, Asia and Europe, including Nordic MSs. *T. britovi* is found predominantly in wild animals and pigs, and occasionally in horses. It occurs in temperate regions of Europe, Asia and in northern and western Africa, and it has been detected in most of the MSs. *T. pseudospiralis* is the only species infecting both mammals and birds; it is cosmopolitan in distribution and has been detected in 13 MSs (Pozio and Murrell, 2006; Merialdi et al., 2011; OIE, 2012). Both *T. spiralis* and *T. britovi* have been detected in horses reared in Europe. Another species, *T. murrelli*, which is mainly found in mammalian carnivores of North America, was introduced to France through an infected horse imported from the USA in 1985 (Pozio and La Rosa, 2000; Pozio and Murrell, 2006; Liciardi et al., 2009). Other species within the genus *Trichinella* have been identified, but they have not been detected in Europe (Pozio et al., 2009; Krivokapich et al., 2012).

The life cycle of *Trichinella* spp. principally comprises two generations in the same host (Figure 1) and includes a very broad range of host species (mammals, birds, and reptiles) (Pozio, 2005), although only humans become clinically affected. Following ingestion of infected meat, the first-stage larvae are released upon gastric digestion in the new host, subsequently reach the duodenum and, embedded in the intestinal mucosa, undergo four moults, thus developing into the adult stage within a very short time of two days. Males and females copulate and the females start to deliver a new generation of newborn larvae (NBL), which migrate via lymphatic venules into the general circulation. NBL are distributed throughout the body, where they invade striated muscles, showing predilection for specific muscle groups (highly oxygenated muscles). In horses, the tongue usually contains the highest concentration of larvae, followed by masseter, diaphragm and neck muscles. In muscle nurse cells, NBL develop to the infective larvae and can survive for at least one year (in horses) to several years (over 20 years, e.g. in polar bears; up to 40 years in humans) (Fröscher et al., 1988; Kumar et al., 1990; Hill et al., 2007b). After a period of time (that depends on the host species, its immune response, and the *Trichinella* species or genotype) calcification of the collagen capsule first and of the nurse cell and larva can occur.



Note: (A) Main sources of *Trichinella* spp. infections for humans. (B) *Trichinella* spp. cycle in the host body.
Source: International *Trichinella* Reference Centre (ISS, online).

Figure 1: Life cycle of *Trichinella* spp.

Human trichinellosis can be a debilitating disease and may result in death. The short-lived adult worms in the intestine can cause transient gastroenteritis, but the most severe symptoms result from the migration and presence of larvae in voluntary muscles. The clinical signs of acute trichinellosis in humans are characterised by two phases. The first phase of trichinellosis symptoms may include nausea, diarrhoea, vomiting, fatigue, fever and abdominal discomfort. However, this phase is often asymptomatic. Thereafter, a second phase of symptoms may follow, including muscle pains, headaches, fevers, eye swelling, aching joints, chills, cough, itchy skin and diarrhoea or constipation. In more severe cases, difficulties with coordinating movements as well as heart and breathing problems may occur. A small proportion of individuals die from trichinellosis infection. Systematic clinical signs usually appear about 8–15 days after the consumption of contaminated meat (Dupouy-Camet and Bruschi, 2007). Animals do not show any clinical signs of the infection.

Herbivorous animals are not expected to contract *Trichinella* infection in nature because their diet does not normally include meat. However, natural *Trichinella* infection in herbivores has been reported. Among wild herbivores, *Trichinella* infection has been detected in a reindeer (*Rangifer tarandus*) in Russia and in two roe deer (*Capreolus capreolus*) in Croatia (Pozio, 2001), suggesting that, in a particular epidemiological situation, this parasite can infect not only carnivores and omnivores but also herbivores. However, infections among wild herbivores can be considered more as an occasional event than as a veterinary problem (Pozio, 2001). Although mutton was considered the source of human trichinellosis in China (Takahashi et al., 2000), there is no a scientific evidence of natural infections with *Trichinella* in sheep and goats (Pozio, 2001). There is also a report of a trichinellosis outbreak caused by the consumption of beef in China (Murrell, 1994), but the source of infection was not scientifically confirmed.

The routes of *Trichinella* transmission to horses are still unclear, although different pathways have been suggested. The main hypothesis is related to the ingestion of infected flesh from pigs and wild animals. This hypothesis is supported by the illegal practice of feeding horses with potentially infected meat or meat products, such as scraps from domestic pigs and hunted wild boars or carcases of

carnivores bred or hunted for their fur. This is a short-term tactic to rapidly increase horse weight and improve condition prior to sale (Pozio, 2001; Murrell et al., 2004).

Another possible transmission route is the ingestion of pasture contaminated with infected rodent carcases or pork scraps (Pozio, 2001) or ingestion of feed contaminated with small parasitised carnivorous animals accidentally ground into fodder (Ancelle et al., 1998). However, no evidence to support this route as a means of natural infection is available (Pozio, 2001; Pozio and Murrell, 2006).

Further research is needed to clarify the relevance of the different pathways for domestic solipeds to acquire *Trichinella* infections.

6.1.2. Current situation and trends in the EU

Nematodes of the genus *Trichinella* circulate in wild animals in most EU MSs. The epidemiological situation is summarised in the Community Summary Reports and EU Summary Reports on zoonoses and food-borne outbreaks as well as by Alban et al. (EFSA, 2005c, 2006, 2007, 2009, 2010; EFSA and ECDC, 2011, 2012; Alban et al., 2011). In 2011, there were 363 reported cases of trichinellosis in humans in the EU, of which 73.8 % (268 cases) were reported as confirmed. The number of human trichinellosis cases increased by 20.2 % in the EU in 2011 compared with 2010 but is still at much lower levels than in 2007–2009. The EU notification rate was 0.05 cases per 100 000 population. Latvia, Lithuania, Romania, Bulgaria and Slovakia accounted for 84.3 % of all confirmed cases reported in 2011. There were major fluctuations in the number of cases reported by country over the years (EFSA and ECDC, 2013).

Trichinella is very rarely detected from domestic solipeds in the EU. In 2011, 22 MSs and three non-MSs reported data on solipeds. Overall, 176 251 solipeds were tested for *Trichinella* in 2011, and none of them was found positive. Most of these data were from horses (only 87 donkeys were tested in Italy). Monitoring data as reported in the period 2006–2010 by the EU MSs in the framework of the Directive 2003/99/EC included a total of 728 257 tested samples, with three positive results (0.0004 %), one for *T. spiralis* and two for *Trichinella* spp. The comparable data on *Trichinella* in domestic solipeds for the period 2006–2011 have been summarised in Table 3 (Chapter 7).

Trichinella is also rarely detected in pigs. *Trichinella* has been rare in slaughtered pigs for many years and has decreased since 2008. In 2011, the overall EU prevalence of *Trichinella*-positive pigs was 0.00017 %. Romania was responsible for the vast majority of *Trichinella* findings in pigs in 2011 (86.3 % of all *Trichinella*-positive findings) (EFSA and ECDC, 2013).

Trichinella is often reported from wildlife species by some eastern and northern European MSs in which the parasite is circulating in wildlife populations (Pozio et al., 2009). In 2011, 12 MSs reported positive findings in hunted wild boars, giving an overall EU animal-level prevalence of 0.1 % (EFSA and ECDC, 2013).

The prevalence in wildlife other than wild boars was noticeably high during 2011 in some northern European MSs, where positive findings were found in foxes, bears, raccoon dogs, lynx and other species. The prevalence of infection in wild animals is highly variable from one country to another depending on the environmental conditions, breeding practices, hunters' behaviour and host species composition. But, unlike pigs, there is no sign of a decreasing trend in *Trichinella* in wildlife (EFSA and ECDC, 2013). The increasing number of wild boars and red foxes and the spread of the raccoon dogs from eastern to western Europe may increase the biomass of parasites of the genus *Trichinella* circulating among wild animals (Alban et al., 2011).

6.1.3. Horse meat as a source of infection in humans

Trichinella infections in horses were documented as long ago as the late 19th century in experimentally infected horses in Austria and Germany and in a naturally infected horse in Ohio, USA (Pozio and Murrel, 2006). However, the potential role of horses in the transmission of *Trichinella* to

humans was ignored until 1975, when horse meat was identified as the source of infection in a human outbreak of trichinellosis in Italy (Mantovani et al., 1980).

Horse meat outbreaks have been recognised having public health relevance because of the large number of humans that can be infected by consuming meat from a single horse. Epidemiological data have shown that one *Trichinella*-infected horse can be the source of more than 600 infections in humans (Liciardi et al., 2009).

Worldwide, from 1975 to 2011, only 34 horses either tested positive for *Trichinella* at the slaughterhouse (19 horses) or were the source of infection in humans (15 horses). The 34 *Trichinella*-infected horses were the source of infection in 3 334 people, 2 296 in France and 1 038 in Italy (Table 1). In 1985, five persons with trichinellosis died in France. All human infections have occurred in France or Italy, despite the fact that other countries such as Belgium have a high average per capita consumption of horse meat. This fact is mainly attributed to food habits, i.e. the consumption of raw or undercooked meat (Boireau et al., 2000).

Since 1975, all horses identified as the source of infection in human outbreaks or which were detected as *Trichinella* positive at the slaughterhouse have originated from countries with a high prevalence of *Trichinella* infection in pigs (Serbia, Poland, Romania and Mexico) and/or wildlife (USA and Canada) (Liciardi et al., 2009), suggesting that there could be a relationship between the infection in these animals and the horse infection (Pozio, 2001).

Meat from solipeds was not traditionally one of the main sources of trichinellosis infections in humans, according to the data reported by EU MSs on food-borne outbreaks caused by *Trichinella*. Overall, 186 *Trichinella* outbreaks were reported by MSs during the years 2004–2011 in accordance with Directive 2003/99/EC. Most of these outbreaks were caused by consumption of pork or wild boar meat, whereas none of them was reported to be caused by meat from solipeds (EFSA, 2005c, 2006, 2007, 2009, 2010; EFSA and ECDC, 2011, 2012, 2013).

Trichinella in horses shows a low frequency of infection (< 1/100 000) with potential high human risk, suggesting that all horses should be tested at the slaughterhouse. However, as reported above, all *Trichinella*-infected horses detected so far originated from eastern European countries or North America. But, according to the current legislation, information available for horses at slaughterhouse is not always able to fully trace the movements of the animals during their life.

Table 1: Origin of *Trichinella*-infected horses which were the sources of infection in humans or which were identified as *Trichinella*-positive at the slaughterhouse (modified from Liciardi et al., 2009).

Year	Locality (country)	No of *Trichinella* positive horses	No of human infections	Country of origin of horse
1975	Bagnolo in Piano (Italy)	1	89	Former Yugoslavia
1975	Chatenary-Malabry (France)	1	125	East Europe
1984	Varese (Italy)	1	13	Former Yugoslavia
1985	Paris and Melun (France)	1	431[(a)]	Connecticut (USA)
1985	Paris and 10 other foci (France)	1	642[(b)]	Poland
1986	Salsomaggiore (Italy)	1	300	Former Yugoslavia
1988	Brescia (Italy)	1	–	Poland
1989	Brescia (Italy)	1	–	Former Yugoslavia
1990	Barletta (Italy)	1	500	East Europe
1991	Clermont-Ferrand (France)	1	21	USA
1993	Paris and 3 other foci (France)	1	538	Canada
1994	State of Mexico (Mexico)	4	–	Mexico
1994	Seine de Marne (France)	1	7	Mexico
1996	Bordeaux (France)	2	–	Poland
1996	Barletta (Italy)	1	–	Romania
1998	Haute Garonne (France)	1	128	Serbia
1998	Brescia and Piacenza (Italy)[(a)]	1	93	Poland
1998	Toulouse (France)	1	404	Serbia
1998	Poggio Imperiale (Italy)	1	–	Serbia
1998	France	2	–	Serbia
1999	France	1	–	Poland
2000	Bitonto (Italy)	1	36	Romania or Poland
2001	France	1	–	Serbia
2001	Turin (Italy)	1	–	Romania
2002	Serbia	1	–	Serbia
2003	Turin (Italy)	1	–	Serbia
2005	Mantua (Italy)	1	7	Eastern Europe
2008	Cagliari (Italy)	1	–	Poland
2010[(c)]	Poland	1	–	Poland
	Total	34	3 334	

(a): Two deaths.
(b): Three deaths.
(c): Data for 2010 derive from the International *Trichinella* Reference Center (www.iss.it/site/Trichinella/index.asp).

6.1.4. Risk and protective factors

Risk and risk-reducing factors related to *Trichinella* infections are summarised by Pozio and Murrell (2006) and by relevant Scientific Opinions of the Panel on Biological Hazards (EFSA, 2005a, b). The fact that most of the infected horses originated from countries with a high prevalence of *Trichinella* spp. infection in pigs and/or wildlife suggests that there is a close relationship between infection in these animals and the horse infection (Pozio, 2001; Murrell et al., 2004; Pozio and Murrell, 2006).

The probability of horses coming into contact with reservoirs is increased when there are poor husbandry conditions. These may include, for example, feeding horses on food waste that potentially contains scraps of domestic pigs or hunted wild boars, or meat scraps from carnivore carcases from both wild and farmed animals. Investigations on equine *Trichinella* infection carried out by Murrell et al. (2004) demonstrated that the feeding practices of horse owners and the eating behaviour of many horses may create a high risk for *Trichinella* transmission. Specifically, the results of this study

revealed that in Serbia, at least, the feeding of meat or food waste is a common practice among horse owners and dealers and that the often poor condition of horses intended for sale may yield animals more willing to consume meat. Because of the high *Trichinella* prevalence in pigs in Serbia, the potential that pork used for feeding horses will be infected seems to be relatively high. Murrel et al. (2004) showed a relationship between *Trichinella* spp. infection in horses, the local prevalence of *Trichinella* infections in pigs and the feeding of animal with meat scraps to improve horse condition prior to sale. However, the extent to which feeding solipeds with pork scraps, which remains an illegal practice in the EU, is applied is unknown.

The presence of thin capsules around the larvae in muscle tissues of the horses slaughtered in January and the presence of thick capsules in the larvae from horses slaughtered in April and October seem to support the hypothesis that horses acquire this infection in late autumn or winter, i.e. when most of the backyard pigs are slaughtered at home, which in Europe may occur without any veterinary control if pork is for own consumption (Pozio and Murrell, 2006).

The incidental ingestion of pieces of infected carcases of rodents or small carnivorous animals in fodder may also potentially occur if feed storage conditions are poor.

In addition, outdoor access could also be considered as a potential risk factor for *Trichinella*, due to the potential exposure to feed accidentally contaminated with infected rodent carcases or wildlife scraps when grazing in pasture. *Trichinella* transmission from wildlife to horses has been demonstrated by the detection in horses of *T. murrelli*, a species not circulating in pigs (Pozio and Murrell, 2006). However, at least in EU, the role of wildlife in *Trichinella* transmission to horses is considered secondary to the role of infected pigs (Murrell et al., 2004). According to EU monitoring data reported under Directive 2003/99/EC, no positive horses are reported in countries with *Trichinella* circulating in wildlife but not in pigs (e.g. some Nordic countries) (EFSA and ECDC, 2013). Moreover, based on experts' opinion, the main factors involved in the transmission of *Trichinella* to horses are the presence of *Trichinella* in pigs and the practice of feeding animals with pork scraps.

As for the persistence of viable *Trichinella* larvae in the musculature of horses, no conclusive data are available. Although some studies suggest that muscle larvae do not survive in horses for more than 8–10 months (Soulé et al., 1989), more recent data confirm that viable larvae can be recovered from horse muscles 12 months post infection and the number of larvae can be stable over this time period (Hill et al., 2007b). This supports the hypothesis that *Trichinella* infection can persist for extended periods of time in the musculature and that the host immune response does not reduce the larval burden. Consequently, the permanence in countries with circulation of *Trichinella* spp. in pigs and wildlife occurring at any time during the animal's life should be considered a risk factor for *Trichinella* infection.

No specific risk or risk-reducing factor can be identified in relation to animal age. In fact, unlike most natural *Trichinella* hosts, in which there is a cumulative infection level related to the host age, this cumulative effect was documented in only one horse in which two *Trichinella* species (*T. britovi* and *T. spiralis*) were detected (Liciardi et al., 2009). Moreover, even though horses younger than six months of age (foals) are mainly fed with milk, they are bred in fields with their mother since their birth and therefore they can be exposed to pastures contaminated with infected rodent carcases or pork scraps.

At consumer level, *Trichinella* infections are mainly related to cultural food practices, which include dishes based on raw or undercooked meat of different animal origin, including domestic solipeds (Pozio and Murrell, 2006; Gottstein et al., 2009). The reason why most human cases were reported in France and Italy is related to the habit in some areas of these countries of eating raw horse meat. The demonstrated higher tolerance of *T. spiralis* for freezing in horse meat than in pork meat (EFSA, 2005a; Hill et al., 2007a) could also potentially influence the risk posed by the consumption of raw or undercooked horse meat.

6.1.5. Proposed harmonised epidemiological indicators (HEIs)

The following epidemiological indicators have been selected for *Trichinella* in domestic solipeds (Table 2 and Figure 2).

Table 2: Harmonised epidemiological indicators for *Trichinella* in domestic solipeds

Indicators (animal/ food category/other)	Food chain stage	Analytical/diagnostic method	Specimen
HEI 1: Information on the country where the domestic soliped has been kept during its life	Slaughterhouse	Food chain information	Not applicable
HEI 2: *Trichinella* in domestic solipeds originating from countries with *Trichinella* findings in pigs and wildlife	Slaughterhouse	Digestion	Meat
HEI 3: *Trichinella* in all domestic solipeds	Slaughterhouse	Digestion	Meat

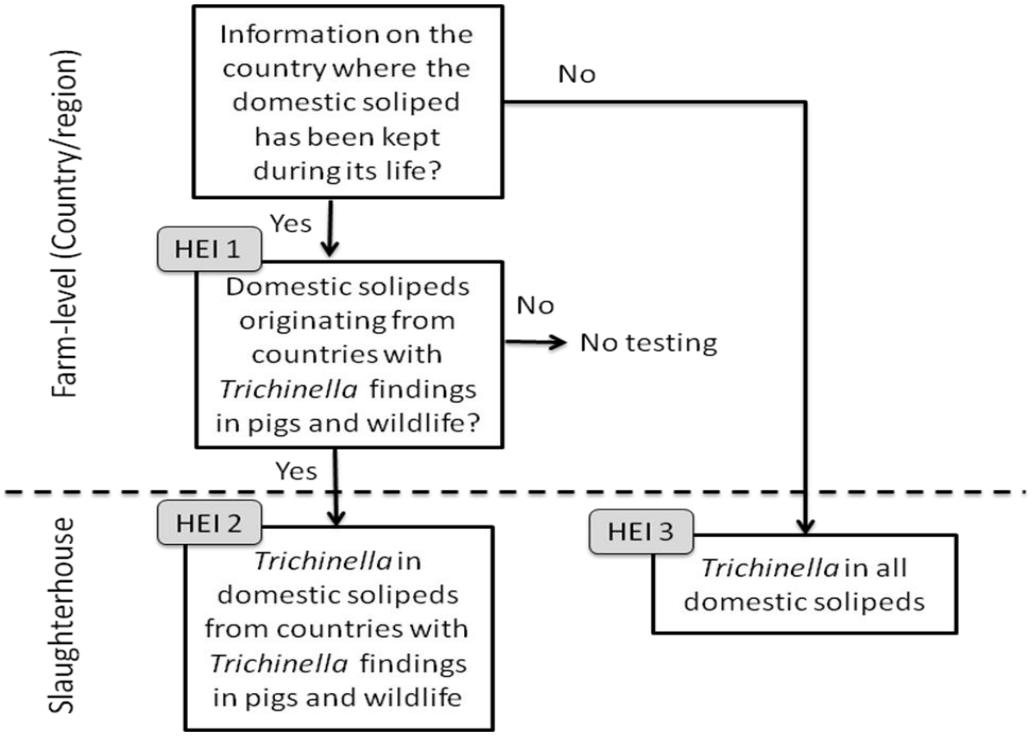


Figure 2: Schematic diagram illustrating the harmonised epidemiological indicators for *Trichinella* in domestic solipeds

The scheme describing the food chain and related risk and risk-reducing factors as well as the evaluation of possible epidemiological indicators is presented in Appendix C.

HEI 1 targets the availability of FCI. This indicator is closely related to the identification of the animals and the declaration of the place(s) where they were kept during their life, which are prerequisites for a traceability system. The horse origin is an important epidemiological indicator of

risk for consumers of raw horse meat to acquire trichinellosis. It follows that the identification document and horse traceability are very important to reduce the *Trichinella* risk. Taking into account the fact that no conclusive data are available on the persistence of viable *Trichinella* larvae in the musculature of horses, HEI 1 requires information on the countries or regions where the solipeds have been kept during their entire life. However, at present, there is no legal requirement for the reporting of detailed information on the places where the horses for human consumption have been kept before slaughter. The recent EU regulation on the methods for the identification of equidae (Regulation (EC) No 504/2008) does not lay down any specific indications on the traceability of horse movements. Consequently, the available information related to animal traceability varies across the EU and it is currently difficult to gather reliable information on the countries or regions from which the horses originate.

HEI 2 targets slaughtered domestic solipeds originating from countries with *Trichinella* findings in pigs and wildlife and which are considered to be at higher risk of *Trichinella* infection. Since, at least in EU, the role of wildlife in the transmission of *Trichinella* to horses is considered secondary to the role of infected pigs, this indicator is proposed not to target domestic solipeds originating from countries or regions with *Trichinella* occurring only in wildlife. The proposal of HEI 2 is linked to the availability of reliable information on the countries or regions where the horses have been kept during their life. The risk managers should decide upon the level of *Trichinella* in pigs and wildlife to classify the country or region at high risk of *Trichinella* transmission to horses.

For HEI 2 the sampling should take place at slaughterhouse using one of the digestion methods specified in Chapter I or II of Annex I of the EU regulation on official control for *Trichinella* in meat (Regulation (EC) No 2075/2005). Specific indications on sampling and testing of horse meat are provided in Annex III of the above-mentioned EU regulation. Testing the horses by serology is not proposed for detecting or monitoring this infection, since five to six months after infection anti-*Trichinella* antibodies disappear in sera, although infective larvae are still present in the muscles (Soulé et al., 1989; Pozio et al., 1997, 2002; Hill et al., 2007b). This approach could be considered in the future, if more reliable methods become available.

HEI 3 is proposed for situations where no reliable FCI is available regarding the countries where the solipeds lived. This indicator targets all domestic solipeds slaughtered for human consumption and sampling of solipeds takes place at slaughterhouse using the digestion method, in accordance with Regulation (EC) No 2075/2005. The same considerations on sampling and *Trichinella* testing made for HEI 2 also apply to HEI 3.

The above-mentioned HEIs can be used alone or in different combinations depending on the risk managers' decision and the epidemiological situation.

An additional indicator for 'controlled husbandry conditions' was initially also considered, but not finally retained in Table 2. Unlike pigs, for which 'controlled housing conditions' are proposed in the Annex IV of Regulation (EC) No 2075/2005, for horses most of requirements to be met by food business operators to obtain official recognition of holdings as free from *Trichinella* are not applicable as the horse farming system always includes outdoor access or free ranging. This means that potential exposure of domestic solipeds to pastures contaminated with infected rodent carcases or pork or wildlife scraps can occur. Therefore, it is not possible to assess the impact of outdoor access as potential risk factor. Moreover, in the case of domestic solipeds, it is very difficult to monitor other factors related to husbandry conditions. In particular, the use of meat to feed livestock is forbidden by the EU legislation; consequently, reliable information on this illegal action is very difficult to gather through auditing. For these reasons, auditing of controlled housing conditions was not proposed as an indicator.

6.1.6. Harmonised monitoring requirements

Animal population

- HEI 1: domestic solipeds
- HEI 2: domestic solipeds originating from countries with *Trichinella* findings in pigs and wildlife
- HEI 3: all domestic solipeds

Stage of the food chain

- HEI 1: the slaughterhouse for FCI
- HEI 2 and 3: the slaughterhouse for:
    - domestic solipeds originating from countries with *Trichinella* findings in pigs and wildlife
    - all domestic solipeds

Sampling

- HEI 1
    - target population: all domestic solipeds slaughtered for human consumption
    - epidemiological unit: animal
    - sampling strategy: census
- HEI 2
    - target population: domestic solipeds slaughtered for human consumption originating from countries with *Trichinella* findings in pigs and wildlife
    - epidemiological unit: animal
    - sampling strategy: census
- HEI 3
    - target population: all domestic solipeds slaughtered for human consumption
    - epidemiological unit: animal
    - sampling strategy: census

Type and details of sample

- HEI 2 and 3: muscle samples according to Regulation (EC) No 2075/2005.

Diagnostic/ analytical methods

Concerning the diagnosis of *Trichinella* infection in horses, the only available method is the artificial muscle digestion carried out according to one of the methods reported in Regulation (EC) No 2075/2005:

- Horse meat must be examined in accordance with one of the digestion methods specified in Chapter I or II of Annex I of the Commission Regulation (EC) No 2075/2005 with the changes specified in Annex III of the same regulation.

Case definition

- HEI 1: Solipeds originating from countries with *Trichinella* findings in pigs and wildlife.
- HEI 2 and 3: Finding of *Trichinella* spp. larvae from a meat sample.

7. Comparable data on the harmonised epidemiological indicators

Most of the data reported to EFSA in the context of the Directive 2003/99/EC derive from meat inspection and can be considered harmonised and comparable across the EU MSs as they are gathered in the framework of the *Trichinella* control programmes (Regulation (EC) No 2075/2005).

Table 3 includes the monitoring data on *Trichinella* in domestic solipeds at slaughterhouse that have been reported by the MSs in accordance with Directive 2003/99/EC in the period 2006–2011.

Table 3: Summary table illustrating the monitoring data[(a)] on *Trichinella* in domestic solipeds[(b)] at slaughterhouse[(c)] in EU, 2006–2011

Country	2011		2010		2009		2008		2007		2006	
	No tested	No positive	No tested	No positive	No tested	No positive	No tested	No positive	No tested	No positive	No tested	No positive
Austria	1 003	0	520	0	978	0	903	0	781	0	–	–
Belgium	9 669	0	8 970	0	8 711	0	9 173	0	10 064	0	8 205	0
Bulgaria(d)[(d)]	39	0	5 321	1	5 519	0	1 126	0	1	–	–	–
Czech Republic	432	0	285	0	332	0	267	0	230	0	–	–
Denmark	2 022	0	1 431	0	3 444	0	2 520	0	–	–	1 272	0
Estonia	11	0	8	0	12	0	13	0	12	0	14	0
Finland	1 813	0	201	0	1 049	0	1 150	0	975	0	1 052	0
France	16 623	0	10 405	0	12 588	0	15 036	0	12 609	0	18 267	0
Germany	–	–	9 540	0	1 156	0	1 334	0	1 026	0	1 796	0
Hungary	486	0	394	0	121	0	-	-	28	0	17	0
Ireland	7 436	0	9 043	0	4 319	0	1 586	0	1 461	0	63	0
Italy[(e)]	37 672	0	28 336	0	15 006	0	23 769	1	13 355	0	26 648	0
Latvia	519	0	445	0	400	0	430	0	424	0	429	0
Lithuania	2 023	0	2 250	0	2 441	0	1 923	0	–	–	1 314	0
Luxembourg	41	0	38	0	36	0	–	–	20	0	36	0
Malta	76	0	161	0	–	–	–	–	111	0	–	–
Netherlands	5 063	0	3 434	0	2 193	0	0	0	1 808	0	2 023	0
Poland	–	–	–	–	–	–	35 612	0	72 261	0	32 648	0
Portugal	–	–	–	–	–	–	–	–	–	–	–	–
Romania[(f)]	25 876	0	24 770	1	29 471	0	22 337	0	15 682	0	–	–
Slovakia	–	–	4	0	–	–	13	0	11	0	12	0
Slovenia	1 773	0	1 722	0	1 426	0	1 477	0	1 504	0	1 497	0
Spain	49 672	0	33 069	0	30 918	0	25 820	0	24 314	0	27 251	0
Sweden	4 330	0	3 281	0	3 810	0	3 414	0	2 987	0	3 009	0
United Kingdom	8 614	0	9 018	0	5 136	0	4 008	0	3 748	0	4 955	0
EU Total	176 251	0	153 330	2	129 096	0	151 911	1	163 412	0	130 508	0
Iceland	3 105	0	–	–	–	–	–	–	–	–	–	–
Norway	1 600	0	1 500	0	1 300	0	1 331	0	1 400	0	1 600	0
Switzerland	2 622	0	2 845	0	–	–	–	–	1 730	0	13	0

(a): Data from control and eradication programmes, monitoring, surveillance, and unspecified sampling context were included. Data from "survey" and "national survey" were excluded.
(b): Data on domestic solipeds derived mainly from horses. Only Italy reported data on donkeys. Specifically, Italy reported 87 and 25 donkeys tested for *Trichinella* in 2011 and 2008, respectively, with no positive findings.
(c): Since most of the sampling for *Trichinella* testing is carried out at slaughterhouse, it was made the assumption that samples were collected at slaughterhouse even when information on the sampling stage was not reported or was reported as 'unspecified'.
(d): In 2010, Bulgaria reported one horse positive for *T. spiralis*.
(e): In 2008, Italy reported one horse positive for *Trichinella* spp.
(f): In 2010, Romania reported one horse positive for *Trichinella* spp.

CONCLUSIONS AND RECOMMENDATIONS

ToR 1: Define harmonised epidemiological criteria for specific hazards already covered by current meat inspection (trichinellosis, tuberculosis, cysticercosis, ...) and for possible additional hazards identified in the Scientific Opinion on the hazards to be covered by inspection of meat (see Annex 1 of the mandate), which can be used to consider adaptations of meat inspection methodology (e.g. prevalence, status of infection.

Conclusions

- In this report harmonised epidemiological indicators (HEIs) are proposed for food-borne biological hazards related to domestic solipeds and meat thereof in the context of the Scientific Opinion on meat inspection of domestic solipeds (EFSA BIOHAZ Panel, 2013). Specifically, HEIs were proposed for *Trichinella*, which is already covered by meat inspection of solipeds as well as being identified as the only relevant hazard by the Scientific Opinion itself. An epidemiological indicator is understood to mean the prevalence or concentration of the hazard at a certain stage of the food chain or an indirect indicator of the hazards, such as audit of farms or evaluation of process hygiene that correlates with a human health risk caused by the hazard.

- The epidemiological indicators proposed in this report will provide relevant information to risk managers (i.e. the European Commission (EC) and the Member States (MSs)), to enable them to consider whether adaptations to meat inspection methods may be relevant, and to enable the MSs to carry out a risk analysis to support such decisions. The epidemiological indicators could be also used in future to help categorise countries/regions and animals according to the risk related to a particular hazard. Thus, the indicators could facilitate the implementation of risk-based meat inspection.

- Risk managers should decide the most appropriate use of the epidemiological indicators. Depending on the purpose and the epidemiological situation of the country, the indicators may be applied at national, regional or slaughterhouse level and they can be used alone or in different combinations. The epidemiological indicators may be used in the classification of countries, regions or animals according to the infection status related to the hazards.

- The data accumulated from the implementation of the HEIs will provide historical information over time regarding the infection status of the animals. This information will be useful for the categorisation of countries and regions regarding their status. Where there is a history of negative test results, the information can also be used to reduce the testing frequency applied for HEIs.

- Most epidemiological indicators are suggested for domestic solipeds on the slaughterline using the digestion method. One indicator refers to food chain information (FCI) regarding the traceability of animal movements during their life. The proposed HEIs are listed in Table 4.

Recommendations

- It is recommended that the Commission and MSs define legal requirements for improving traceability of horses, recording information on all animal movements during their life. It is recommended that such data are included in the FCI.

- It is recommended that risk managers define the level of *Trichinella* infection in pigs and wildlife to be considered as the threshold for classifying countries based on the risk of *Trichinella* transmission to horses.

- The proposed epidemiological indicators will generate data that will provide information on the epidemiological situation in the EU and these data can be used to update the epidemiological

indicators, when appropriate. It is recommended that the MSs report the data generated from implementation and monitoring of the indicators within the framework of annual reporting in accordance with Directive 2003/99/EC.

- The HEIs proposed by this report should be reviewed regularly in the light of new information and the data generated from monitoring of them.

ToR 2: Provide a summary of comparable data from MSs based on the above-defined harmonised epidemiological criteria, if they exist (e.g. from ongoing monitoring in humans, food or animals).

Conclusions

- Comparable data from the EU MSs are available for the proposed epidemiological indicators. Specifically, meat inspection data provided through the annual reporting on zoonotic agents under Directive 2003/99/EC can be considered harmonised and comparable across the EU MSs as gathered in the framework of the *Trichinella* control programmes (Regulation (EC) No 2075/2005). These data are summarised in chapter 7 of this report.

ToR 3: Recommend methodologies and minimum monitoring/inspection requirements to provide comparable data on such harmonised epidemiological criteria, in particular if comparable data are missing. These criteria should also be achievable in small Member States.

Conclusions

- For each epidemiological indicator the key elements of minimum monitoring or inspection requirements are defined. These include the animal population to be targeted, the stage of the food chain where the sampling should take place, type and details of the specimen to be taken, diagnostic or analytical method to be used, and a case definition.

The proposed HEIs are summarised in the following table (Table 4).

Table 4: Proposed harmonised epidemiological indicators (HEIs) for *Trichinella* in domestic solipeds

Indicators (animal/ food category/other)	Food chain stage	Analytical/ diagnostic method	Specimen
HEI 1: Information on the countries where the domestic soliped has been kept during its life	Slaughterhouse	Food chain information	Not applicable
HEI 2: *Trichinella* in domestic solipeds originating from countries with *Trichinella* findings in pigs and wildlife	Slaughterhouse	Digestion	Meat
HEI 3: *Trichinella* in all domestic solipeds	Slaughterhouse	Digestion	Meat

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APPENDICES

Appendix A. Data on horse slaughtered for meat consumption

Table 5: Horses slaughtered in EU Member States in 2010[(a)] (EFSA, 2013)

Country	Production	Country	Production
Austria	947	Latvia	400
Belgium	12 000	Lithuania	2 250
Bulgaria	214	Luxembourg	0
Cyprus	6 800	Malta	173
Czech Republic	336	Netherlands	2 083
Denmark	1 872	Poland	45 152
Estonia	0	Portugal	907
Finland	1 179	Romania	27 520
France	15 468	Slovakia	0
Germany	8 937	Slovenia	1 578
Greece	0	Spain	29 638
Hungary	394	Sweden	3 940
Ireland	7 449	United Kingdom	5 062
Italy	84 063	**Total EU-27**	**258 362**

(a): Data provided by MSs within the framework of Directive 96/23/EC.

Appendix B. Consumption data

Current data on meat consumption are limited and not harmonised between MSs. In this appendix, Eurostat data on the consumption of meat from domestic solipeds in the EU MSs (2001–2007) have been included. However, it should be noted that the collection of meat consumption data has been discontinued and MSs no longer transmit these data to Eurostat.

Table 6: Eurostat annual data on the consumption of meat from domestic solipeds per capita (kg/head) in EU Member States, 2001–2007[(a),(b)]

Country	Year						
	2001	2002	2003	2004	2005	2006	2007
Austria	0.087	0.074	0.074	0.086	0.098	0.073	0.072
Belgium	1.341	1.024	1.076	0.950	1.100	:	:
Bulgaria	:	:	:	:	:	0.000	0.029
Cyprus	:	:	:	0.000	0.000	0.000	0.000
Czech Republic	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Denmark	0.000	0.186	0.186	0.185	0.185	0.184	:
Estonia	:	:	:	:	0.000	0.000	0.000
Finland	0.193	0.096	0.134	0.172	0.248	:	:
France	0.594	0.490	0.437	0.413	0.388	0.370	0.353
Germany	0.090	0.068	0.051	0.040	0.040	0.038	0.040
Greece	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hungary	:	:	:	0.056	0.050	0.045	0.066
Ireland	0.000	0.000	0	0	0	0	0
Italy	1.492	1.192	1.133	1.226	0.942	1.089	1
Latvia	:	:	:	:	0.046	0.057	0.074
Lithuania	:	0.115	:	:	:	:	:
Luxembourg	0.538	0.723	0.397	0.374	0.427	0.399	0.678
Malta	:	0.253	0.252	:	:	:	:
Netherlands	0.626	0.621	0.618	1	1	1	1
Poland	:	:	0.000	:	:	:	:
Portugal	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Romania	:	:		0.000	0.028	0.028	0.153
Slovakia	:	:	:	:	:	0.000	0.019
Slovenia	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spain	0.212	0.139	0.115	0.116	:	:	:
Sweden	0.208	0.180	0.186	:	:	:	:
United Kingdom		0.000	0.000	0.000	0.000	0.000	0.000

(a): Data on the gross human apparent consumption of meat from equidae per capita (extraction date 01.03.2013). Eurostat data for the years 2008–2012 were not included in the table as they are either very scarcely reported (2008–2009) or not available (2010–2012). Please note that this data collection has been discontinued and MSs no longer transmit these data to Eurostat (data no longer available from the Eurostat website).

(b): 0 = less than half the final digit shown and greater than real zero; ':'= data not available.

Table 7: Eurostat annual data on the consumption of meat from domestic solipeds (unit=1 000 tonnes) in EU Member States, 2001–2007[(a),(b)]

Country	Year						
	2001	2002	2003	2004	2005	2006	2007
Austria	0.700	0.600	0.600	0.700	0.800	0.600	0.600
Belgium	13.770	10.559	11.140	9.883	11.498	:	:
Bulgaria	:	:	:	:	:	0.001	0.226
Cyprus	:	:	:	0.000	0.000	0.000	0.000
Czech Republic	:	:	:	:	:	:	:
Denmark	0.000	1.000	1.000	1.000	1.000	1.000	:
Estonia	:	:	:	:	0.000	0.000	0.000
Finland	1.000	0.500	0.700	0.900	1.300	:	:
France	36.200	30.100	27.000	25.700	24.300	23.300	22.400
Germany	7.435	5.583	4.217	3.310	3.271	3.125	3.280
Greece	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hungary	:	:	:	0.570	0.500	0.450	0.660
Ireland	0.000	0.000	0	0	0	0	0
Italy	85.000	68.000	65.000	71.000	55.000	64.000	49
Latvia	:	:	:	:	0.105	0.130	0.170
Lithuania	:	0.400	:	:	:	:	:
Luxembourg	0.236	0.321	0.178	0.170	0.196	0.186	0.323
Malta	:	0.100	0.100	:	:	:	:
Netherlands	10.000	10.000	10.000	10	10	9	9
Poland	:	:	0.000	:	:	:	:
Portugal	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Romania	:	:		0.000	0.600	0.600	3.300
Slovakia	:	:	:	:	:	0.000	0.100
Slovenia	:	:	0	0	0	0	0
Spain	8.600	5.700	4.800	4.900	:	:	:
Sweden	1.846	1.604	1.667	:	:	:	:
United Kingdom		0.000	0.000	0.000	0.000	0.000	0.000

(a): Data on the gross human apparent consumption of meat from equidae (extraction date 01.03.2013). Eurostat data for the years 2008–2012 were not included in the table as they are either very scarcely reported (2008–2010) or not available (2011–2012). Please note that this data collection has been discontinued and Member States no longer transmit these data to Eurostat (data no longer available from the Eurostat website).

(b): 0 = less than half the final digit shown and greater than real zero; ':'= data not available.

Appendix C. Food Chain, risk and risk-reducing factors, possible human health epidemiological indicators and their evaluation

Trichinella

1. Identification of potential epidemiological indicators

Table 8: Potential epidemiological indicators for *Trichinella* in domestic solipeds

	Availability of prevalence data	Data availability to divide population into groups between which the risk varies	Suggested epidemiological indicator (HEI)
Farm (including contribution from wildlife)			
Risk factor 1 Origin from countries with *Trichinella* findings in pigs and wildlife	Reliable data currently not available	Reliable data currently not available	Domestic solipeds originating from countries with *Trichinella* findings in pigs and wildlife *Trichinella* in domestic solipeds from countries with *Trichinella* findings in pigs and wildlife *Trichinella* in all domestic solipeds
Risk factor 2 Outdoor access/free ranging		No data available	Controlled husbandry conditions
Risk factor 3 Poor husbandry conditions (not controlled), including: o Feeding horses intentionally with meat o Presence of waste of animal origin o Storage of feed in non controlled conditions o Pest control	No data available	No data available	Controlled husbandry conditions

Table continued overleaf.

Table 8 (continued). Potential epidemiological indicators for *Trichinella* in domestic solipeds

	Availability of prevalence data	Data availability to divide population into groups between which the risk varies	Suggested epidemiological indicator (HEI)
Transport to slaughterhouse			
Risk factor 1	–	–	–
Slaughterhouse			
Risk factor 1	–	–	–
Processing of meat and products thereof			
Risk factor 1	–	–	–
Retail			
Risk factor 1	–	–	–
Consumer			
Risk factor 1 Consumption of raw or undercooked horse meat	In most of the EU countries incidence data on human trichinellosis are available	Data available (Boireau et al., 2000; Pozio, 2001; Pozio and Murrell, 2006; Liciardi et al., 2009)	–

2. Evaluation of suggested indicators

Table 9: Suggested epidemiological indicators for *Trichinella*

Weighting factor				**30 %**	**40 %**	**15 %**	**15 %**	
Indicators (animal/ food category/ other)	**Food chain stage**	**Analytical/ diagnostic method**	**Specimen**	**Quality of indicator[(a)] (0, 1, 2)[(e)]**	**Appropriateness of indicator[(b)] (0, 1, 2)[(e)]**	**Data availability[(c)] (0, 1, 2)[(e)]**	**Feasibility[(d)] (0, 1, 2)[(e)]**	**Total points**
Domestic solipeds originating from countries with *Trichinella* findings in pigs and wildlife	Slaughterhouse	Food chain information	Not applicable	2	1	2[(f)]	2	1.6
Trichinella in domestic solipeds from countries with *Trichinella* findings in pigs and wildlife	Slaughterhouse	Digestion	Meat	2	2	2[(f)]	2	2.0
Trichinella in all domestic solipeds	Slaughterhouse	Digestion	Meat	2	2	2	2	2.0
Controlled husbandry conditions	Farm	Auditing	Not applicable	1	1	0	1	0.85

(a): Quality of indicator = how reliable the data for the indicator would be (e.g. test sensitivity).
(b): Appropriateness of indicator = how well the indicator correlates with the human health risk caused by the hazard and the possibility/need to amend the meat inspection method.
(c): Data availability = are there already data available or is it easy to get the data needed?
(d): Feasibility = how laborious is the sampling and testing procedure?
(e): 0 = bad, 1 = moderate, 2 = good.
(f): This scoring is based on the possibility of gathering reliable information in future (see also section 6.1.5).

ABBREVIATIONS

BIOHAZ	Biological Hazards
CVO	Chief Veterinary Officer
EC	European Commission
ECDC	European Centre for Disease Prevention and Control
EFSA	European Food Safety Authority
EU	European Union
FCI	food chain information
HEI	harmonised epidemiological indicator
MS	Member State
NBL	newborn larvae
ToR	Term of Reference