

Current trends in monitoring *Trichinella* in slaughtered pigs

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Abstract

Trichinellosis is a zoonotic disease caused by parasitic nematodes of the genus *Trichinella*. In recent decades, trichinellosis has been classified as an emerging or re-emerging infectious disease. According to the European Commission Regulation 2075/2005, which stipulates special provisions for official inspections of *Trichinella* in meat, samples are taken from carcasses of domestic pigs at slaughterhouses on a systematic basis and examined for the presence of *Trichinella* using the digestion method. More than 200 million pig carcasses are inspected every year in Europe in this way, which represents considerable economic costs. The occurrence of *Trichinella* in pig carcasses has been rare for many years in Europe, and the risk of trichinellosis is considered extremely small for consumers of pork meat. A monitoring programme focusing on high-risk groups of pigs and employing highly sensitive diagnostic tests could be applied in place of the routine use of the digestion method in the examination of the meat of all pig carcasses. This paper maps out current activities relating to trichinellosis on the European and international level, and may contribute to the creation of an effective monitoring programme and a new approach to monitoring *Trichinella* in pigs in the Czech Republic.

Trichinellosis, pork meat

Introduction

Infectious diseases that may be transmitted from animals to man are generally known as zoonoses. People may be infected during contact with infected animals, though a more frequent path of infection is via foodstuffs of animal origin. Trichinellosis is one of the longest known zoonoses linked to foodstuffs. In recent decades, trichinellosis has been classified as an emerging or re-emerging infectious disease. The first group (emerging infectious diseases) consists of new diseases the occurrence of which has been on the increase in recent times and which may become a significant medical problem in the near future. Re-emerging infectious diseases are diseases that are already familiar to us and their increased occurrence is associated with a change in the process of transmission of infection.

Causative agents of trichinellosis and their biology

Trichinellosis is a parasitic disease in humans and animals connected with the consumption of raw or undercooked meat. The causative agents of trichinellosis are parasitic nematodes of the genus *Trichinella*. Twelve species and genotypes of *Trichinella* have been described; nine of the described species and genotypes form cysts around the larvae in muscle fibres. Only three species do not become encapsulated. Three species of *Trichinella* have been confirmed in wild boars in the Czech Republic over the last decade. *Trichinella spiralis* and *T. britovi* are cyst-forming species, while *T. pseudospiralis* is a species that does not form cysts.

Trichinella development is direct. The new host is infected by ingesting the muscle tissue of an infected host containing *Trichinella* larvae. Muscle fibres with *Trichinella* larvae are digested in the stomach of the new host, and the released larvae penetrate the mucous membrane in the small intestine. The larvae continue to develop over four larval stages during the course of thirty hours after ingestion and then become adults. The adult female

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Trichinella take hold of the intestinal mucous membrane and produce live larvae five days after being fertilised by males. One fertilised female will release an average of 1000 to 1500 larvae into the intestine over the course of a lifetime of a month and a half. The new larvae penetrate the intestinal mucous membrane and work their way through the lymphatic system into the blood circulation. They then migrate in the blood for two or three days before penetrating into muscle fibres, where they remain infectious for the entire lifespan of the host (Gottstein et al. 2009).

Human trichinellosis

Man is an extremely sensitive host, and serious medical changes occur after ingestion of uncooked meat containing *Trichinella* larvae. The clinical picture of human trichinellosis depends on the pathogenicity of the individual species and the number of larvae ingested. Moderate trichinellosis without significant clinical symptoms occurs following the ingestion of 10 to 50 larvae. Clinical symptoms may be observed if 50 to 500 larvae of the most pathogenic species *T. spiralis* are ingested, while the ingestion of more than 1 000 larvae is directly life endangering. Long-term statistics show that trichinellosis mortality ranges from 3 to 5%. Pathological changes are caused both by adult parasites during the intestinal phase and, primarily, by migrating larvae during the muscular stage. The first clinical symptoms of the nature of unspecific intestinal symptoms in the form of diarrhoeal illness appear during the first week after infection. The muscular stage of the disease, characterised by fever and by the general symptoms reminiscent of the onset of a bad case of influenza, begins in the second week after infection. Swelling of the face, and of the eyelids in particular, appears later. Minor haemorrhages appear in the limbs, while haemorrhages beneath the nails are described in around a quarter of those affected. Intense muscle pain and laboured breathing appear. Muscular pain continues after the larvae have become encapsulated, and the overall clinical state is similar to chronic fatigue syndrome (Murrell and Pozio 2011)

The current occurrence of trichinellosis in humans and domestic pigs in Europe

Zoonoses and agents of zoonoses are monitored at all stages of the food chain in which zoonoses or agents of zoonoses may occur. A system for monitoring the occurrence of zoonoses operates within the EU with the aim of obtaining comparable data. The rules governing monitoring at the European level are covered by EC Directive 99/2003 on the monitoring of zoonoses and zoonotic agents. The European Food Safety Authority (EFSA) is responsible for the collection and evaluation of data. The most recent report on the occurrence of zoonoses in the territory of the EU was published at the beginning of March 2012, and includes the occurrence of zoonotic agents in EU countries in 2010.

This report states that 394 cases of human trichinellosis were reported in 2010, of which 56.6% (223 cases) were confirmed in the laboratory. The difference in the number of reported and confirmed cases is normal, and is the result of the fact that not all cases are confirmed in the laboratory during an epidemic, as additional clinical cases tend rather to be considered as cases associated in epidemiological terms with cases already confirmed.

The number of confirmed cases of human trichinellosis in 2010 was 70.2% lower than in 2009. The largest declines in the number of cases of human trichinellosis were recorded in Bulgaria and Romania, where the number of confirmed cases fell by 96.6% and 69.1%, respectively. In spite of the sharp decline in the number of confirmed cases in Romania (a total of 265 cases in 2009 as compared with a total of 503 cases in 2008), Romania remained the EU country with the largest number of cases of human trichinellosis in 2010. The greatest increase in cases of human trichinellosis was recorded in Lithuania, where the number of confirmed cases in 2010 (77 cases) increased by 285% over 2009 (20 cases). Lithuania and Romania accounted for 71.3% of all cases of human trichinellosis in EU countries in 2010.

In 2010, the commonest proven agent of human trichinellosis was the species *T. spiralis* (58.5%). In contrast, no cases of human trichinellosis caused by the species *T. nativa* or *T. pseudospiralis* were proven. In 90% of cases of human trichinellosis, the source of infection was the meat of domestic pigs, while only 10% were caused by consumption of the undercooked meat of wild animals.

Findings of *Trichinella* in domestic pigs were reported in eight EU member states, though the total number of positive pigs fell significantly. While *Trichinella* was found in 430 domestic pigs out of 201 899 089 examined (0.0002%) in 2009, 199 positive pigs out of 211 378 305 (0.00009%) tested were confirmed in 2010. The majority of these positive domestic pigs (140) were found in Romania, which represents more than 70% of all confirmed positive pigs in EU countries. All the positive Romanian pigs came from small farms and had access to an outdoor environment, as was the case for the sporadic positive pigs found in Bulgaria, Finland and France. In all other countries in which trichinellosis was found in pigs, the occurrence of positive pigs in 2010 was lower than in 2009, with the single exception of Lithuania, where 8 positive pigs were found in 2010 as compared with ofMté

on infection in animals in its Terrestrial Animal Health Code and stipulates appropriate demands on the performance of laboratory tests in its Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. An *ad hoc* expert group is generally appointed for the purpose of updating. In the case of trichinellosis, an *ad hoc* group for zoonotic parasites last sat at the end of August and beginning of September 2011. The principal result of this sitting is a proposal for changes to both the Terrestrial Animal Health Code and the Manual of Diagnostic Tests and Vaccines for Terrestrial Animals in the chapters devoted to trichinellosis, reacting to the low occurrence of trichinellosis in domestic pigs in a number of countries around the world (OIE 2012). The proposed changes are to be discussed at the 81st General Session of the OIE in May 2013.

The European Food Safety Authority (EFSA) is an important institution focusing on food safety in Europe. The EFSA is responsible, first and foremost, for assuring independent scientific reports on issues of food safety, for collecting and analysing data on potential or emergent risks, and for maintaining a permanent dialogue with the public. In 2007, the EFSA announced a project aiming to develop a new harmonised programme for monitoring the occurrence of *Trichinella* in animals and foodstuffs in EU countries. The main result of this project is a draft conception in which only certain species or categories of animals would be inspected in individual EU countries on the basis of their classification into three areas depending on the occurrence of trichinellosis in domestic pigs. The first category of area (region or entire EU member state) is designated as endemic, the second category as an area of low risk of occurrence, and the third as an area with negligible risk (Alban et al. 2011; Pozio et al. 2012).

The main European institution devoted to the issue of protecting end consumers within the framework of the European Commission is the Directorate General for Health and Consumers, also known as DG SANCO. DG SANCO's principal missions include implementing an effective system for monitoring food safety in the member states of the EU, monitoring the conformity of legislation in the area of food safety throughout the EU, and supervising the implementation of veterinary, phytopathologic and food legislation. DG SANCO representatives have recently been devoting increased attention to the issue of trichinellosis. A conference focusing on the revision of meat inspection was held in the middle of December 2011 with the participation of prominent representatives of DG SANCO and the EFSA (Third Round Table Conference on Revision of Meat Inspection). The following recommendations relating to trichinellosis are formulated in the conference conclusions: (i) restrict inspections into the presence of *Trichinella* larvae to pigs from uninspected farms and outdoor pigs, (ii) examine sows and boars from inspected farms for *Trichinella* by the digestion method, (iii) draw up a system for verification of the standard of inspected farms, and (iv) focus on monitoring trichinellosis in wild animals (web site).

The results of the conference were further elaborated in February 2012 at a conference in Copenhagen organised by Denmark during its presidency of the EU and devoted to the modernisation of meat inspection (web site).

European Commission Regulation 2075/2005, which stipulates special directives for the official control of *Trichinella* in meat, came into effect at the beginning of 2006. The regulation states, in relation to domestic pigs, that samples are to be taken during slaughter from the carcasses of domestic pigs at the slaughterhouse on a systematic basis, and that these samples are to be examined for the presence of *Trichinella* at a laboratory stipulated by the pertinent body. Article 3 of the European Commission Regulation 2075/2005 states two exceptions allowing the carcasses and meat of domestic pigs to be exempted from obligatory inspections for the presence of *Trichinella*. The meat of domestic pigs that has undergone freezing in accordance with the stipulated conditions under the supervision of the pertinent body may be exempted

from inspections for the presence of *Trichinella* larvae. The given conditions are demanding of the technological freezer facilities and, according to the latest official information, no EU country has taken advantage of this exception. In the case of the second exception, pigs are not inspected for the presence of *Trichinella* larvae in their meat if they are reared for fattening only and if they come either from a farm that

the use of a serological method as a supplementary monitoring tool. The European Commission reference laboratory (the European Union Reference Laboratory for Parasites based in Rome, EURLP) recently validated the ELISA test for monitoring antibodies against *Trichinella* in serum or tissue fluid, and preparations for the use of serological tests in the monitoring programme in Germany are extremely advanced. Evidence for this is the fact that the first inter-laboratory comparative test of a total of 21 German laboratories that are to conduct studies using ELISA tests has already been performed (Knoop et al. 2011).

Conclusions

This paper provides a summary of basic information about the biology of agents of trichinellosis and the development of human trichinellosis, and considers the current occurrence of trichinellosis in domestic pigs in Europe. Findings of *Trichinella* in domestic pigs slaughtered in Europe are sporadic, and positive findings in domestic pigs have been made in just a few EU countries in recent years. It is, then, clear that large numbers of domestic pigs in which there is a small probability of the occurrence of *Trichinella* are currently examined. This fact, and the associated financial costs, raises the need for the creation of a new conception for monitoring *Trichinella*. This paper maps out current trends in trichinellosis in the European and international context with the aim of contributing towards the creation of an effective monitoring programme and a new approach to monitoring trichinellosis in the Czech Republic.

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