

Status of *Trichinella spiralis* in Domestic Swine and Wild Boar in Canada

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ABSTRACT

Evidence of the status of trichinellosis in Canada's national swine herd is provided from data acquired through national surveillance programs and from a prevalence study of *Trichinella* in wild boar and domestic swine. More than 500 000 swine tested at abattoirs in ongoing animal health surveys since 1980 and 2 national swine serological surveys (1985 and 1990) showed no evidence of *Trichinella* infection, except for 3 occurrences in a small infected zone in Nova Scotia. The prevalence study of domestic swine and wild boar was conducted for the prevalence of *Trichinella* after an epidemiological investigation of a 1993 outbreak of human trichinellosis in Ontario showed that the disease was linked to the consumption of wild boar meat originating from 2 farms in the province. Sera and tissues were collected from 391 wild boar and 216 domestic swine originating from 228 farms in Quebec, Ontario, Manitoba and Saskatchewan. The survey examined approximately 37% of the wild boar slaughtered in Canada in 1994. A pepsin-HCl digestion test of the tissues and an ELISA performed on the sera did not yield any positive results. These findings and the lack of human cases of *Trichinella* from the consumption of Canadian pork for nearly 2 decades suggest that the parasite has been rare in domestic swine and wild boar raised in Canada. *Trichinella spiralis* has only been found sporadically in swine in a small region within Nova Scotia.

RÉSUMÉ

Le statut du cheptel porcin canadien en regard à la trichinellose est présenté à partir des données acquises par l'intermédiaire de programmes nationaux de surveillance et suite à une étude de la prévalence de *Trichinella* chez le sanglier ainsi que chez le porc domestique. À partir des analyses effectuées chez plus de 500 000 porcs abattus depuis 1980 ainsi que de deux études sérologiques pan-canadiennes (1985 et 1990), aucune évidence d'infection à *Trichinella* ne fut notée, sauf pour trois épisodes rencontrés dans une zone circonscrite de la Nouvelle-Écosse. Une étude sur la prévalence de *Trichinella* chez le porc domestique et chez le sanglier fut effectuée après qu'une enquête épidémiologique eut reliée un épisode de trichinellose humaine en Ontario avec la consommation de viande de sanglier provenant de deux fermes de cette province. Des tissus et du sérum furent prélevés de 391 sangliers et 216 porcs domestiques provenant de 228 fermes au Québec, en Ontario, au Manitoba et en Saskatchewan. Au cours de cette enquête, environ 37% des sangliers abattus au Canada en 1994 ont été examinés. Les épreuves de digestion par la pepsine sur les tissus et d'ELISA sur les sérums n'ont pas permis de mettre en évidence de résultat positif. Ces informations et l'absence de cas humain d'infection par *Trichinella* associé à la consommation de viande porcine d'origine canadienne au cours des deux dernières décennies indiquent que ce parasite est rare chez le porc domestique et les sangliers élevés au

Canada. *Trichinella spiralis* n'a été retrouvé que sporadiquement dans une petite région en Nouvelle-Écosse.

(Traduit par docteur Serge Messier)

INTRODUCTION

Trichinella is an intracellular nematode parasite found in the muscle of a variety of animals throughout the world. It is transmitted to humans by the consumption of raw or undercooked meat. The prevalence of the parasite in swine in some regions of the world is a public health concern. However, in most industrialized regions, human trichinellosis is rare and the prevalence of *Trichinella* in swine has been reduced to a low level (1). A domestic cycle can be maintained in rodent populations and high levels of the infection occur in certain carnivorous wildlife species.

Although there has been no evidence of trichinellosis in the swine population of several countries for decades, the disease continues to be a major obstacle in the international trading of pork. For example, some countries require that all imported pork be frozen in order to destroy any *Trichinella* present, while others demand the testing of each carcass. Both of these requirements are costly and impede further development of the swine industry. Despite the lack of human trichinellosis from the consumption of Canadian domestic swine, there is no report of scientific data to demonstrate the current status of trichinellosis in the country's swine population.

Recent growth in wild boar farming and a 1993 outbreak of human

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trichinellosis resulting from the consumption of wild boar meat in Ontario have raised concerns about an increased risk of trichinellosis to consumers. In Canada, most domestic swine are raised in confinement indoors, whereas farmed wild boar are raised on fenced farmland. This latter practice could allow wild boar to come in contact with wild animals and acquire *Trichinella* infection from them and may therefore have an increased risk of *Trichinella* infection. We conducted a survey to determine whether there were differences in the prevalence of *Trichinella* in wild boar and domestic swine populations in Canada that could be attributed to farm-management practices.

MATERIALS AND METHODS

NATIONAL SURVEYS

National swine health surveys for *Trichinella* infection were performed at abattoirs according to Office International des Epizooties guidelines (2). Briefly, this consists of placing 14 pieces of diaphragm (approx. 2 mm × 10 mm × 10 mm), in a compressorium and examination under a stereo-microscope or trichinoscope. Animals to be tested were chosen by random selection at slaughter.

A national swine serological survey was performed in 1990 as previously described (3). Blood samples were collected over a 5 mo period from across Canada in a manner proportional to the number of swine slaughtered in each region. Serum samples were analysed by indirect ELISA using *Trichinella spiralis* excretory-secretory antigens.

WILD BOAR AND DOMESTIC PIG SURVEY

Samples were collected from 391 wild boar and 216 domestic pigs from 27 federally registered abattoirs in Ontario, Quebec, Manitoba and Saskatchewan (Table I) from November, 1993 to June, 1994. From each animal 10 mL of blood was collected from the severed jugular vein at slaughter, and 50 g of diaphragm and 50 g of tongue were removed and labelled with the animal's identification number which could be used to determine the farm of origin. Sera were separated from the blood, and

TABLE I. Establishments from which samples were collected for *Trichinella* survey

Region	Location	Wild boar	Domestic pigs	Farms of origin
Quebec	St-Agapit	6		1
	Cte Papireau	23		6
	St-Perpetue		12	12
	St-Blaise		12	12
	St-Herari		12	12
	St-Alexandre		12	12
	Yamachiche		12	12
	St-Helene		12	12
	St-Jacques de Montcalm		12	12
Ontario	Kitchener	4	12	13
	Proton Station	110	0	9
	Burlington		12	7
	Toronto		12	12
Manitoba	Roblin	10		3
	Russell	11		3
	Winnipeg	141	24	34
	Dauphin	44		4
	St-Laurent		12	12
	Neepawa		24	15
	Winkler		12	5
Saskatchewan	Swift Current	11	12	13
	Drake	9		2
	Wadena	16		3
	Watson	06		2
	Saskatoon		12	12
TOTAL		391	216	228

with the diaphragms and tongues were stored at 4°C. Within 72 h of collection, samples were delivered to the Centre for Animal Parasitology, Saskatoon.

Following removal of fat and fascia, 25 g of tongue and 25 g of diaphragm were cut into 1 cm³ pieces and ground in a commercial meat grinder. The 50 g of ground meat were placed in 500 mL of digestive solution (1% HCl, 1% pepsin) and incubated in a shaking water bath (37°C, 190 rpm) for 4.0 h. Undigested non-muscle tissues were removed from the digested tissue by filtration through a sieve (180 µm). The filtrate was concentrated by several sediment-decant cycles in a Pilsner flask until the suspension was clear. The final 25 mL of sediment was poured into a petri-dish and examined under a stereo-microscope for the presence of *Trichinella* larvae. For use as positive controls, samples of 50 g of tongue and diaphragm obtained from a carcass that tested negative for *Trichinella* by the above method were each spiked with 0.1 g of rat muscle experimentally infected with 5 × 10³ larvae of *Trichinella spiralis*. One of these control samples was processed at approximately the end of every 100 digestions.

Sera were lyophilized and stored at -20°C until they were ready for use.

As needed, the lyophilized samples were returned to the original volume of sera by hydration in an appropriate volume of phosphate-buffered saline. An indirect ELISA using crude excretory-secretory antigen of 1st stage *Trichinella* larvae was employed to test the sera for antibodies to *Trichinella* infection as previously described (4,5). An optical density reading ≥ 5x the mean of 3 negative control sera was considered positive.

RESULTS

In Canada 25 000 to 30 000 swine were tested annually at slaughter for *Trichinella* infection by trichinoscopy. Between 1980 and 1995, 553 574 animals were tested by Agriculture and Agri-Food Canada meat inspectors and 3 occurrences of *Trichinella* infection were found in Nova Scotia, one each in 1990, 1993 and 1996.

The national swine serological survey conducted in 1990 on 15 328 swine found 11 positive reactors though none could be substantiated through trace-back procedures and examination of other pigs from the farms of origin (6).

Trichinella larvae were not recovered from any of the tissues of 391 wild boar or 216 domestic pigs

examined. Corresponding serum samples from each of the 391 wild boar were also negative by the indirect ELISA for the detection of anti-*Trichinella* antibodies. The digestion method recovered numerous motile *Trichinella* larvae from each of the 5 spiked control meat samples. Similarly, the positive and negative control serum samples yielded the appropriate positive and negative results.

DISCUSSION

The national swine serological survey performed in 1990 found no substantial evidence of *Trichinella* infection. A similar survey performed in 1985 reported that 4 positive reactors were identified but no evidence of infection could be found in other pigs on the same farm during trace-back investigations (3). Annual testing of 25 000 to 30 000 swine across Canada have yielded 3 cases of *Trichinella* infection in swine since 1980, all in the same region of Nova Scotia. Except for a small population of swine in a defined 36 km² region of Nova Scotia, Canada's national herd of domestic swine has been free of *Trichinella* (7).

A review of the cases of human trichinellosis in Canada suggests that Canadian domestic pork as a source of *Trichinella* has declined over the last several decades. Since 1971, cases of human trichinellosis attributed to the consumption of infected pork have occurred in 1972, 1976, 1979 and 1980 (8). All remaining cases of human trichinellosis in Canada in the past decade have been linked to the consumption of infected meat from game animals or wild boar (9).

To our knowledge, *Trichinella*-infected wild boar has been found only once in Canada. In January, 1993, clinical trichinellosis was diagnosed in 28 people in Toronto and the surrounding area (10). An epidemiological investigation determined that all of the affected persons had consumed wild boar meat originating from 2 wild boar farms in Dufferin, Ontario. Live *Trichinella* larvae were recovered from raw meat and sausages obtained during the investigation. A total of 105 wild boar on the 2 incriminated farms were destroyed and the carcasses rendered.

This present survey examined approximately 37% of the 1057 wild boar slaughtered in 1994 in Canadian federal establishments, and originating from 45 farms in 4 provinces where the majority of the wild boar farming occur. Since 60–75% of all wild boar slaughtered in Canada are inspected in federal establishments, the results of this survey may be a good indication of the absence of *Trichinella* in wild boar in Canada.

The negative serological results suggest that the wild boar tested were not previously infected with *Trichinella*. Also, the negative digestion results of tongue and diaphragm, the highest predilection muscles in swine, demonstrate that these animals did not harbour infective *Trichinella* larvae. The digestion assay was sensitive enough to detect at least 0.02 larva per g of tissue and it is generally recognized that a minimum intensity of 1 larva per gram of ingested meat is usually required to cause clinical illness in humans (11), consequently there was no risk of acquiring trichinellosis from wild boar sampled in this survey.

The negative results obtained from this wild boar survey differ from results of similar surveys in other parts of the world. This appears to be due to the difference in the way wild boar are raised (12) and the fact that Canada, unlike many other countries, do not have feral or truly wild swine. Wild boar in Canada are confined to fenced areas, whereas elsewhere they are free-roaming in the wild. Nevertheless, the potential for acquiring *Trichinella* infection in any outdoor management system should be considered. Resident wild and feral animals in the USA have been studied to determine their role in transmitting the parasite to swine raised outdoors (13). Deer mice and shrews were found to be uninfected, while skunks, raccoons and feral domestic cats harboured high levels of *Trichinella*. However, there was no evidence that *Trichinella spiralis* was transmitted from any of these animals to swine. It was concluded that transmission may have been occurring only from swine and rats of the domestic cycle to wild animals.

In Canada, safeguards have been established to mitigate the possibility of the public becoming infected with

Trichinella from consuming wild boar meat regardless of its origin in the country. Farmers and veterinarians are alerted to the dangers of cohabitation of swine and wild carnivores, and the use of uncooked garbage for feed is illegal. Furthermore, all wild boar processed at federally inspected abattoirs are routinely tested for *Trichinella*, and consumers are encouraged to adequately cook all meat from swine. The results of these studies confirm the perception that *Trichinella* is not a problem in the Canadian domestic or wild boar pork industry.

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