

The Prevalence of *Toxoplasma* Antibodies in Swine Sera in Finland

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Hirvelä-Koski, V.: The prevalence of *Toxoplasma* antibodies in swine sera in Finland. Acta vet. scand. 1992, 33, 21-25. – A total of 1847 swine sera obtained from the 10 largest abattoirs slaughtering swine in Finland were examined by ELISA for toxoplasma antibodies. The sample represented 0.64 % of the total number of swine slaughtered in these abattoirs over a period of 2 months. The prevalence of toxoplasma antibodies in swine sera was 2.5 %.

Toxoplasmosis; sero prevalence.

Introduction

Toxoplasma gondii is a parasitic zoonosis recognized throughout the world. The infection can be transmitted to humans by ingestion of cysts in edible tissues or by oocysts shed in cat faeces. The foetus can be infected congenitally through trophozoites if the mother develops parasitaemia during the acute phase of infection.

Raw or inadequately cooked pork is considered an important source of toxoplasma infection (Boch 1973, Dubey et al. 1986). Although toxoplasmosis may occur in cattle too, cysts have rarely been isolated from beef (Jacobs et al. 1963, Boch et al. 1965, Hellmann & Tauscher 1967, Work 1967).

Carcases harbouring toxoplasma tissue cysts cannot be identified by conventional meat inspection methods. Since parasitological methods for the isolation of cysts are highly laborious, the diagnosis is usually based on serology.

It is very common in Finland to use a mixture of minced pork and beef for cooking and the raw meat is often tasted to check the

flavour before frying or roasting. The purpose of this research was to collect basic data mainly with a view to obtain a crude estimate of the risk of ingesting toxoplasma tissue cysts with raw or inadequately cooked pork.

Material and Methods

A total of 1847 swine sera were examined for toxoplasma antibodies. The blood samples were collected during October and November in 1984 from the 10 largest abattoirs slaughtering swine in Finland (Fig. 1). The number of sera collected was in proportion to the number of swine slaughtered in each abattoir (Table 1). For practical reasons, the staff at the abattoirs were allowed to make their own choice with respect to the system and timing used for sampling, provided that the samples were sent to the laboratory at intervals of 1 week. The abattoirs were asked to send sera from both fattened pigs and sows. The blood samples were centrifuged and the sera stored at -20°C until examined. Antibodies to *Toxoplasma gondii* were determined by ELISA as described previously

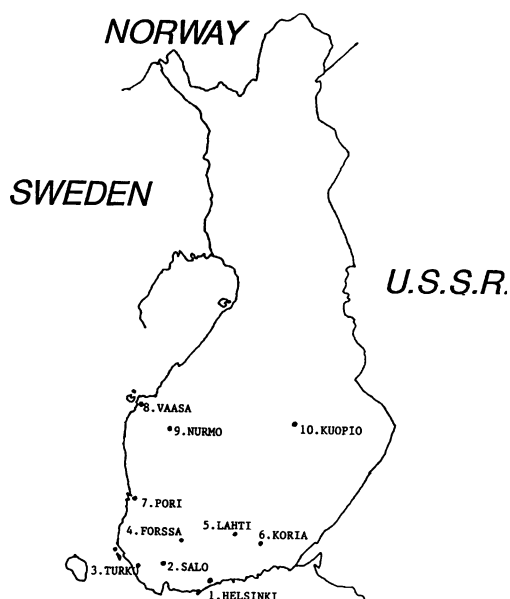


Figure 1. Location of the 10 abattoirs participating in the survey.

(Hirvelä-Koski 1990). Microtitre plates coated with sonicated soluble toxoplasma antigen were prepared by Labsystems Oy (Helsinki, Finland). The sera were diluted 1 : 200. Alkaline phosphatase conjugated sheep antibodies to swine IgG (Orion Diagnostica, Helsinki, Finland) were diluted 1 : 200. Paranitrophenyl phosphate 20 mg/ml in diethanolamine buffer was used as the substrate. The reaction was stopped with 1 M NaOH. Incubation times were 90 min for the sera, 60 min for the conjugate and 30 min for the substrate, the incubation temperature being 37°C. Phosphate-buffered saline (Labsystems Oy) was used as a diluent, and the wells were washed with 0.9 % NaCl containing 0.2 % Tween 20. The intensity of the colour reaction was measured at 405 nm with a Titertek Multiskan spectrophotometer (Eflab). Positive and negative control sera were included in each microtitre plate, and all the sera were tested in duplicate. The absorbance values of the parallel wells were averaged and the result converted to "enzyme immunoassay units" (EIU) using the following formula:

Table 1. Number of samples examined in relation to the number of swine slaughtered in the abattoirs during the period concerned.

Abattoir	Total number of swine slaughtered	Number of samples	%	Number of samples in weekly lots
1	16937	120	0.71	75/23/22
2	56986	301	0.53	8/50/49/50/49/50/45
3	33238	200	0.60	50/50/50/50
4	45750	313	0.68	40/37/39/40/38/40/40/39
5	11500	76	0.66	25/26/25
6	11657	97	0.83	23/25/25/24
7	32103	190	0.59	49/36/24/44/37
8	13591	83	0.61	25/25/25/8
9	55724	368	0.66	30/46/50/46/48/50/48/50
10	13191	99	0.75	24/25/25/25
Total	290677	1847	0.64	

Table 2. Distribution of toxoplasma ELISA results for 1847 swine sera.

Abattoir	ELISA result (EIU)								Total n
	< 10.0		10.1-30.0		30.1-70.0		> 70.0		
	n	%	n	%	n	%	n	%	
1	109	90.8	10	8.3	1	0.8	0	0	120
2	295	98.0	3	1.0	2	0.7	1	0.3	301
3	183	91.5	15	7.5	0	0	2	1	200
4	303	96.8	6	1.9	3	1.0	1	0.3	313
5	59	77.6	10	13.2	2	2.6	5	6.6	76
6	92	96.9	5	5.2	0	0	0	0	97
7	167	87.9	17	8.9	3	1.6	3	1.6	190
8	79	95.2	3	3.6	1	1.2	0	0	83
9	317	86.1	28	7.6	11	3.0	12	3.3	368
10	93	93.9	6	6.1	0	0	0	0	99
Total	1697	91.9	103	5.6	23	1.2	24	1.3	1847

EIU =

$$\frac{\text{abs. (sample)} - \text{abs. (neg. control)}}{\text{abs. (pos. control)} - \text{abs. (neg. control)}} \times 100$$

Because an ELISA cut-off of 30.0 EIU produced the highest agreement between ELISA and IFAT (Hirvelä-Koski 1990), it was chosen as the cut-off point.

Results

The ELISA results are shown in Table 2. A total of 47 sera (2.5 %) were positive for toxoplasma antibodies (EIU >30.0).

The negative sera (1800 = 97.5 %) gave mostly very low ELISA values (91.9 % < 10.0 EIU), only 5.0 % of the sera were in the range 10.1-30.0 EIU.

Discussion

The prevalence of toxoplasma antibodies in swine sera in Finland is fairly low. The seroprevalence of toxoplasmosis is often difficult to compare between countries because of

variation in the tests used. The percentage of seropositive swine in different parts of Sweden varied between 2.5 % and 37 % (Uggla & Hjort 1984), while the prevalence of antibodies in Norway was 10.1 % (Hellesnes *et al.* 1978), in the Netherlands 0% in fattening pigs and 11 % in sows (van Knapen *et al.* 1982), in southern Germany 16.2 % in fattening pigs and 31.6 % in breeding pigs (Boch & Neurohr 1982) and in California 29 % with the prevalence figures for the 20 individual counties examined ranging from 0 % to 62 % (Garcia *et al.* 1979). On the other hand, the prevalence of toxoplasma antibodies obtained here is somewhat higher than that reported by Oksanen *et al.* (1990), who examined 307 swine from 4 Finnish abattoirs with an ELISA and an indirect fluorescent antibody test and found toxoplasma antibodies in 1 pig (0.3 %). The difference in the results are probably attributable to differences in the material used, since Oksanen examined a smaller number of sera and all from young animals, while in the present study the abattoirs were asked to send sera

from both fattening pigs and sows. The prevalence of toxoplasma antibodies usually increases with age (*Work 1967*).

The probability of isolating toxoplasma increases with the titre of the animal in question, but even pigs with low titres may have toxoplasma in their flesh (*Work 1967, Katsube et al. 1972, Boch et Neurohr 1982*). Seronegative swine seldom have latent toxoplasma infections (*Work 1967, Hellesnes et al. 1978*). The percentage of parasitologically positive swine changed from 0.7 % to 75 % in the material of *Boch & Neurohr (1982)*, and from 39% to 100% in that of *Hellesnes et al. (1978)* when the toxoplasma antibody titre rose from low to moderate values.

In this study 2.5% of the sera gave more than 30.0 EIU. These animals can be expected to include some which are free of toxoplasmosis, i.e. false positives, and some which are carrying tissue cysts. Consequently, the prevalence of carriers of toxoplasma tissue cysts, and thus of potential sources of infective meat, was probably somewhat lower than 2.5% in this material. It is possible, too, that some of the negative sera with ELISA values ranging from 10.1 to 30.0 EIU represent an early stage of infection when ELISA antibodies are beginning to rise.

Although serological tests cannot be reliably employed to assess the suitability of an individual carcass for human consumption, serological screening methods could be used to discriminate between seropositive and seronegative groups of animals, as suggested by *van Knapen et al. (1982)*. If the cut-off value between positive and negative results is set low enough, seronegative swine could be considered free of toxoplasma tissue cysts.

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References

- Boch J, Neurohr B*: Vorkommen latenter Toxoplasma-Infektionen bei Schweinen in Süddeutschland und deren Nachweis mit IFAT und IHA. (Latent Toxoplasma infection in pigs in southern Germany and diagnosis using the indirect fluorescent antibody test and the indirect haemagglutination test) Tierärztl. Umschau 1982, 37, 820-826.
- Boch J, Janitschke K, Rommel M, Sommer R*: Untersuchungen über das Vorkommen von Toxoplasmainfektionen bei Schlachtrindern. (Studies on the occurrence of Toxoplasma infection in beef) Wien. tierärztl. Mschr. 1965, 52, 1029-1036.
- Boch J*: Toxoplasma- und Sarcocystis-Infektionen der Haustiere (Toxoplasma and Sarcocystis infection in domestic animals) Wien. tierärztl. Mschr. 1973, 60, 337-341.
- Dubey JP, Murrell KD, Fayer R, Schad GA*: Distribution of *Toxoplasma gondii* tissue cysts in commercial cuts of pork. J. Amer. vet. med. Ass. 1986, 188, 1035-1037.
- Garcia Z, Ruppanner R, Behymer D*: *Toxoplasma gondii* antibodies in California swine. J. Amer. vet. med. Ass. 1979, 174, 610-612.
- Hellesnes I, Mohn SF, Melhuus B*: *Toxoplasma gondii* in swine in south-eastern Norway. Acta vet. scand. 1978, 19, 574-587.
- Hellmann E, Tauscher L*: Untersuchungen zum Vorkommen von Toxoplasmen in frischem Rind- und Schweinefleisch. (Survey of the occurrence of toxoplasma in fresh beef and pork) Berl. Münch. tierärztl. Wochenschr. 1967, 80, 209-212.
- Hirvelä-koski V*: Evaluation of ELISA for the detection of toxoplasma antibodies in swine sera. Acta vet. scand. 1990, 31, 413-422.
- Jacobs L, Moyle GG, Ris RR*: The prevalence of toxoplasmosis in New Zealand sheep and cattle. Amer. J. vet. Res. 1963, 24, 673-675.
- Katsube Y, Hagiwara T, Imaizumi K, Hanaki T*,

- Nobuto K*: Reliability of the dye and modified hemagglutination tests for the latent infection of *Toxoplasma*. Jap. J. vet. Sci. 1972, 34, 123-133.
- Oksanen A, Uggla A, Nikander S*: Förekomst av antikroppar mot *Toxoplasma gondii* hos slaktsvin i Finland. (Occurrence of antibodies against *Toxoplasma gondii* in pigs in Finland). NKJ (Nordisk Kontaktorgan för Jordbruksforskning) project no. 59: "Parasitära infektioner hos svin", Rapport 1990, Copenhagen.
- Uggla A, Hjort M*: A serological study on the prevalence of *Toxoplasma gondii* in meat-producing animals in Sweden. Acta vet. scand. 1984, 25, 567-576.
- van Knapen F, Franchimont JH, van der Lugt G*: Prevalence of antibodies to toxoplasma in farm animals in the Netherlands and its implication for meat inspection. Vet. Quart. 1982, 4, 101-105.
- Work K*: Isolation of *Toxoplasma gondii* from the flesh of sheep, swine and cattle. Acta path. microbiol. scand. 1967, 71, 296-306.

Sammandrag

Prevalensen av Toxoplasma-antikroppar i svinserum i Finland.

Seroprevalensen av *Toxoplasma gondii* hos finska svin undersöktes. Materialet bestod av 1847 svin från 10 slakterier. Blodprov analyserades för antikroppar mot *T.gondii* med ELISA. Prevalensen av *T.gondii* antikroppar var 2.5 %.

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