

Toxoplasma gondii prevalence in confinement pig herds measured by meat juice serology at slaughter

Blaha, Th.*

Meemken, D.

Field Station for Epidemiology, University of Veterinary Medicine Hannover, Germany

*Buescheler Str. 9, 49456 Bakum, Germany

e-mail: thomas.blaha@tiho-bakum.de; fax: +49 4446 9599112

Abstract

The new European food safety legislative demands a risk-based improvement of the processes of meat production from farm to fork instead of just inspecting the carcasses of each slaughtered pig. One major tool to include the pre-harvest stage of meat production is profiling herds serologically especially for latent zoonotic infections. The paper describes the inclusion of continuously serological testing for *Toxoplasma gondii* antibodies using meat juice samples. This concept was applied at two abattoirs in the Northwest of Germany using meat juice according to the sampling for the German Salmonella monitoring programme. The results of testing 39 pig herds demonstrated an unexpected high frequency of *Toxoplasma gondii* antibody positive pigs (> 90% herd prevalence, up to 80% intra-herd-prevalence) although only confinement herds were included into the study.

Introduction

Human cases of Toxoplasmosis are caused by contact to *Toxoplasma* shedding cats, resp. to their excretions, transmission from pregnant women to their fetuses or by eating *Toxoplasma* burdened raw or undercooked meat. The latter is the major reason, why *Toxoplasma gondii* infections of pigs are of public health relevance, especially in countries like Germany with a high proportion of raw pork consumption.

Toxoplasma burdened carcasses cannot be detected by the tools of the traditional meat inspection (visual inspection, palpation, incision) and they enter the food chain, which potentially pose a risk to pregnant women and immune-deficient persons.

In contrast to the traditional meat inspection, a core element of the risk-based meat inspection is process control and process optimization on the basis of the so-called "food chain information" (mortality, morbidity, drug-use in the herd of origin) as required by the Reg. (EC) 853/2004. To add data on subclinical zoonotic infections of pig herds to this food chain information, it is necessary to detect subclinical diseases like Salmonellosis, Yersiniosis, and Toxoplasmosis by means of targeted, specific diagnostic tests (e.g. by serology). Serological monitoring results are valuable for deciding on the appropriate inspection method and selecting carcasses for e.g. the production of minced meat. The paper gives an overview on ways to integrate the *Toxoplasma* seroprevalence of pig herds into meat juice multi-serology programmes for implementing the risk-based meat inspection.

Material and Methods

Testing the comparability of blood serum and meat juice: For assessing the reliability of meat juice instead of blood serum as samples for the detection of antibodies against *Toxoplasma gondii*, 291 paired samples from pigs (i.e. 291 times serum and meat juice from exactly the same pig) out of six herds supplying slaughter pigs to one abattoir were tested together with six different ELISA-tests for detecting antibodies against Salmonella, Yersinia, Trichinella, Mycoplasma hyopneumoniae, Influenza A H1N1 and H3N2.

For detecting *Toxoplasma gondii* antibodies, the ANIMALTYPE *Toxoplasma* Ab ELISA (LDL, Leipzig, Germany) was used. This test is based on a recombinant antigen and contains a multispecies conjugate, which has been developed and validated for the use of blood serum and meat juice.

Since a relatively low seroprevalence for *Toxoplasma gondii* was expected, several assuredly positive *Toxoplasma* control sera and meat juices (produced via experimental infections) were provided by the Institute for Parasitology of the University of Veterinary Medicine Hannover, Foundation, Germany, were simultaneously tested with the field sera and meat juices.

To look into potential changes over time in the intra-herd prevalence of *Toxoplasma* antibodies, 160 meat juice samples from the same six herds were taken and tested in 2010.

Assessing a regional herd and intra-herd prevalence using meat juice: After confirming that this test produces highly comparable results for *Toxoplasma gondii* antibodies in blood serum and meat juice of the same animals, the ANIMALTYPE *Toxoplasma* Ab ELISA (LDL, Leipzig, Germany) was used also for a second study, this time using only meat juice, for estimating the seroprevalence of *Toxoplasma gondii* in 33 pig herds supplying also to only one abattoir, situated in the Northwest of Germany with a very high pig herd density in the region – all herds were completely confined without any outdoor facilities. Per herd 60 to 80 randomly collected meat juice samples were tested (n = 2359).

The epidemiological investigation of the farm characteristics for identifying risk factors is still going on, but 11 low-prevalence and 9 high-prevalence herds have been already visited and scrutinized for known and other possible risk factors.

Results

Testing the comparability of blood serum and meat juice:

The result of testing the paired pig samples (blood serum and meat juice) for *Toxoplasma gondii* antibodies in the framework of the meat juice multi-serology concept are shown in Tab. 1. In both the serum and the meat juice samples, the same six pigs were seropositive for *Toxoplasma gondii*.

Tab. 1: ELISA test results from blood serum and meat juice of 291 slaughter pigs in 2009 and the degree of agreement of the results

relevant for:	ELISA test for:	blood serum: proportion of positive samples (n/N)	meat juice: proportion of positive samples (n/N)	Sensitivity meat juice vs. serum	Specificity meat juice vs. serum
food safety (zoonotic diseases)	<i>Toxoplasma gondii</i> *	2% (6/291)	2% (6/291)	100%	100%
	<i>Salmonella spp.</i>	13% (38/291)	12% (36/291)	87%	99%
	<i>Yersinia enterocolitica</i>	69% (202/291)	72% (210/291)	100%	91%
	<i>Trichinella spp.*</i>	0% (0/291)	0% (0/291)	100%	100%
animal health (production diseases)	<i>Mycoplasma hyopneumoniae</i>	51% (149/291)	48% (141/291)	91%	96%
	Influenza A (H1N1)	32% (93/291)	20% (59/291)	61%	99%
	Influenza A (H3N2)	11% (31/291)	7% (19/291)	55%	99%

*all confirmed *Trichinella* and *Toxoplasma* positive control sera and meat juices were clearly identified as "positive"

The results of the repeated testing for *Toxoplasma* antibodies of the six herds in 2010 compared to the results 12 months earlier are demonstrated in Tab. 2.

Tab. 2: Changes in the *Toxoplasma* seroprevalence of six herds from 2009 to 2010

Herds	A	B	C	D	E	F	Total
Seroprevalence 2009	3% (3/108)	3% (1/31)	10% (2/20)	0% (0/28)	0% (0/63)	0% (0/41)	2% (6/291)
Seroprevalence 2010	9% (7/80)	0% (0/10)	20% (2/10)	0% (0/20)	0% (0/20)	5% (1/20)	6% (10/160)

Assessing a regional herd and intra-herd prevalence using meat juice: Out of the 2359 pigs slaughtered from 33 herds of the area of Germany with the highest pig density, 229 (9.7%) were seropositive for *Toxoplasma gondii* at the animal level.

From 33 herds, 31 turned out to be *Toxoplasma* seropositive (1 and more positive sample per herd = positive herd), which results in a herd prevalence of 94%. However, the intra-herd prevalence was highly variable ranging from 0% to 84%, with the majority of herds showing intra-herd prevalence values below 10%. Except of the herd with 59 positive samples out of 70 (84%) the following intra-herd prevalence values above 10% were detected: 12%, 13%, 14%, 15%, 2 x 16%, and 41%.

The 20 herds that so far were visited (eleven low prevalence herds including the two seronegative herds, and nine high prevalence herds including the two herds with the 84% and the 41% prevalence) did not show any plausible differences. Especially the presence of cats on the farms with and without access to the barns was evenly distributed in both groups.

Discussion

The results show that the use of meat juice instead of blood serum of pigs for detecting antibodies against *Toxoplasma gondii* as already done in other studies (McKean et al., 2009) is, especially for producing continuous serological herd profiles is highly justified. With this, the ANIMALTYPE *Toxoplasma* Ab ELISA (LDL, Leipzig, Germany) may be included into any meat juice multi-serology concept.

The results also show that the prevalence at pig level (9.7%) and at herd level (94%) of *Toxoplasma* antibodies in the tested herds of the German region with a very high pig density is remarkably higher than shown for Ontario (Canada) with 1.6% and 13.7%, respectively (Poljak et al., 2008).

The results of McKean et al. (2009) demonstrate a remarkably lower prevalence of *Toxoplasma* meat juice antibodies in large production systems compared to smaller production systems, which points to the role of biosecurity for the *Toxoplasma* prevalence of pig herds. The preliminary conclusions that can be drawn from the own study into the prevalence of completely confined pig herds support this assumption. The importance of the presence or absence of cats and of outdoor access for the pigs on a farm may be overestimated. General biosecurity deficiencies seem to determine the *Toxoplasma* prevalence of pig herds beyond cats, outdoor areas and rodents.

Conclusion

If *Toxoplasma* testing is included in a national zoonosis control programme which uses continuous testing of random samples of meat juice from all slaughter pig supplying herds, a tool for a) estimating the national *Toxoplasma* prevalence, b) recognising herds with and without *Toxoplasma* infestation for epidemiological analyses and for intervention measures at farm level, c) providing food business operators and veterinary authorities with valuable information in the framework of the risk-oriented meat inspection.

It could be shown, that there are more *Toxoplasma* seropositive confinement herds in the Northwest of Germany than expected, and that including *Toxoplasma* serology into any multi-serological herd profiling is meaningful in terms of continuously improving the safety of pork.

References

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