

Risk-based Meat inspection: “Meat Juice Multiserology” for improving the food chain information

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Abstract

The new European food safety strategy has three main goals: increasing the food safety, optimizing animal health and improving animal welfare. To achieve all three goals by means of a process control, the intensity of the official control is based on a risk assessment by analyzing the so-called “relevant food chain information” from pig herds. This food chain information consists of seven criteria, which are listed in the EU-Regulation No. 853/2004. One of them is taking into consideration existing bacteriological and serological laboratory results. So far, except of the serological salmonella monitoring in some European countries, there is no systematic serological monitoring for any other pathogen from pig herds. The presented paper describes the concepts of a meat juice based “multi-serology” and shows its usefulness as part of the food-chain information.

Introduction

The traditional meat inspection procedures at slaughter, focussing at removing health risks for humans by condemning carcasses and organs that show pathological signs, has resulted in the eradication and/or control of most “classical” food-borne threats to human health such as tuberculosis, brucellosis and tape worms. The high number of food-borne diseases in humans such as salmonellosis, yersinioses and the health risks due to pharmaceutical residues, which do not cause any pathological lesions in pigs, proves that the traditional post-mortem inspection of single carcasses as end product inspection is not able to prevent and control the risks of today.

The new EU legislation is not any longer prescribing exactly the inspection procedure, but defines the common food safety goals. Thus, each EU-Member State has to develop its own and specific risk profiles and the ways of controlling and managing the risks in question to reach these goals. The paper describes the general concept and first results of a meat juice based “multi-serological” monitoring system by continuously testing random samples of meat juice from different pig herds for antibodies against zoonotic as well as production disease pathogens (Blaha et al., 2010).

Material and Methods

Taking into consideration the needs for a meaningful serological monitoring using random samples per pig herd for identifying serological herd profiles, a set of ELISA tests was selected, which provides results with relevance for human health (measuring antibodies of zoonotic pathogens) as well as for pig herd health (measuring antibodies of infectious pathogens for pigs). For the presented study, it was decided to start with detecting antibodies against the infectious agents that are of interest for following stakeholders:

- 1) For the food business operators and the official veterinarians: Salmonella, Trichinella, Toxoplasma and Yersinia,
- 2) For the pig producers and their veterinary practitioners: Mycoplasma hyopneumoniae as well as Influenza A (subtype H1N1 and H3N2).

Altogether, from 291 pigs a blood serum sample (taken at the point of bleeding the animals after stunning) and a meat sample from the diaphragm pillar of exactly the same pigs/carcasses (taken at the point of meat inspection) were collected. It was assured by additional tattooing of the pigs at bleeding that there were 291 specimen pairs (serum and meat juice) that both samples were unmistakably from the same animal.

After freezing and thawing of the meat pieces for producing the meat juice, all samples were tested with seven different ELISA-tests. In several test runs, a ten times lower dilution of meat juice than of blood serum for the ELISA tests turned out to

produce the most comparable results. This dilution ratio was finally used for the presented study.

After twelve months, meat juice random samples from pigs of the same six herds were tested again with the same tests under the same laboratory conditions to look into potential changes of the serological herd profiles over time.

Results

As for the test results (Tab. 1), the tested herds had highly heterogeneous serological profiles that allow for targeted herd health and food safety improvement measures. The repeated testing (Tab. 2) showed that several serological profiles change over time, which proves that the monitoring needs to be permanent, and that such a serological monitoring allows for an early detection of changes in the bacterial and viral burden of pig herds.

Tab. 1: ELISA test results from blood serum and meat juice of 291 slaughter pigs in 2009 and the 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>Salmonella</i> spp.	13% (38/291)	12% (36/291)	87%	99%
	<i>Yersinia enterocolitica</i>	69% (202/291)	72% (210/291)	100%	91%
	<i>Toxoplasma gondii</i> *	2% (6/291)	2% (6/291)	100%	100%
	<i>Trichinella</i> spp.*	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"

Tab. 2: Comparison of the proportion of positive meat juices per herd in 2009 and 2010

Herd	Year	<i>Salmonella</i> (n/N) [0-88%]	<i>Yersinia</i> (n/N) [0-100%]	<i>Toxopl.</i> (n/N) [0-28%]	<i>Trichinella</i> (n/N) [0%]	<i>M. hyo</i> (n/N) [0-99%]	SIV H1N1 (n/N) [0-37%]	SIV H3N2 (n/N) [0-99%]
A	2009	11% (12/108)	67% (75/108)	3% (3/108)	0% (0/108)	45% (49/108)	26% (29/108)	10% (11/108)
	2010	10% (8/89)	61% (49/80)	9% (7/80)	0% (0/80)	45% (36/80)	24% (19/80)	0% (0/80)
B	2009	8% (2/31)	58% (18/31)	3% (1/31)	0% (0/31)	39% (12/31)	26% (8/31)	3% (1/31)
	2010	0% (0/10)	100% (10/10)	0% (0/10)	0% (0/10)	30% (3/10)	30% (3/10)	0% (0/10)
C	2009	10% (2/20)	20% (4/20)	10% (2/20)	0% (0/20)	90% (18/20)	0% (0/20)	0% (0/20)
	2010	80% (8/10)	0% (0/10)	20% (2/10)	0% (0/10)	60% (6/10)	10% (1/10)	90% (9/10)
D	2009	0% (0/28)	86% (24/28)	0% (0/28)	0% (0/28)	32% (9/28)	25% (7/28)	25% (7/28)
	2010	5% (1/20)	35% (7/20)	0% (0/20)	0% (0/20)	0% (0/20)	25% (5/20)	5% (1/20)
E	2009	14% (9/63)	82% (52/63)	0% (0/63)	0% (0/63)	51% (32/63)	0% (0/63)	0% (0/63)
	2010	5% (1/20)	25% (5/20)	0% (0/20)	0% (0/20)	0% (0/20)	10% (2/20)	0% (0/20)
F	2009	27% (11/41)	90% (37/41)	0% (0/41)	0% (0/41)	51% (21/41)	37% (15/41)	0% (0/41)
	2010	50% (10/20)	60% (12/20)	5% (1/20)	0% (0/20)	60% (12/20)	20% (4/20)	0% (0/20)
Total	2009	12% (36/291)	72% (210/291)	2% (6/291)	0% (0/291)	48% (141/291)	20% (59/291)	7% (19/291)
	2010	18% (28/160)	52% (83/160)	6% (10/160)	0% (0/160)	36% (57/160)	21% (34/160)	6% (10/160)

Discussion

The results suggest that the closeness of agreement between the measured serum and meat juice antibody concentrations is sufficient for further pursuing the development of a multi-diagnostic "meat juice serology" for pig herds. Creating a flexible system of serological herd profiles for the most important infections (any pathogen can be added to the test panel) provides the opportunity for introducing benchmarking systems. Such systems are the basis for targeted decisions on a) risk-based meat inspection procedures, and b) on herd health and food safety improvement measures along the food chain. Apart from these opportunities, a major advantage of the suggested approach is that this kind of multi-diagnostic monitoring addresses three groups of stakeholders: the food business operators, the veterinary authorities, and the pig producers. Offering all three groups continuous information that serves their specific interests will provide the benefit to share the costs of such monitoring systems.

Conclusions

The tested serological meat juice monitoring of multiple zoonotic and pig health pathogens is highly valuable in terms of improving the meaningfulness of the food chain information, and is very cost effective, if added to an existing salmonella monitoring programme.

The proposed "meat juice multi-serology concept" provides a useful tool for improving food safety and animal health if implemented as part of the risk-based meat inspection.

References

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